ABSTRACTS

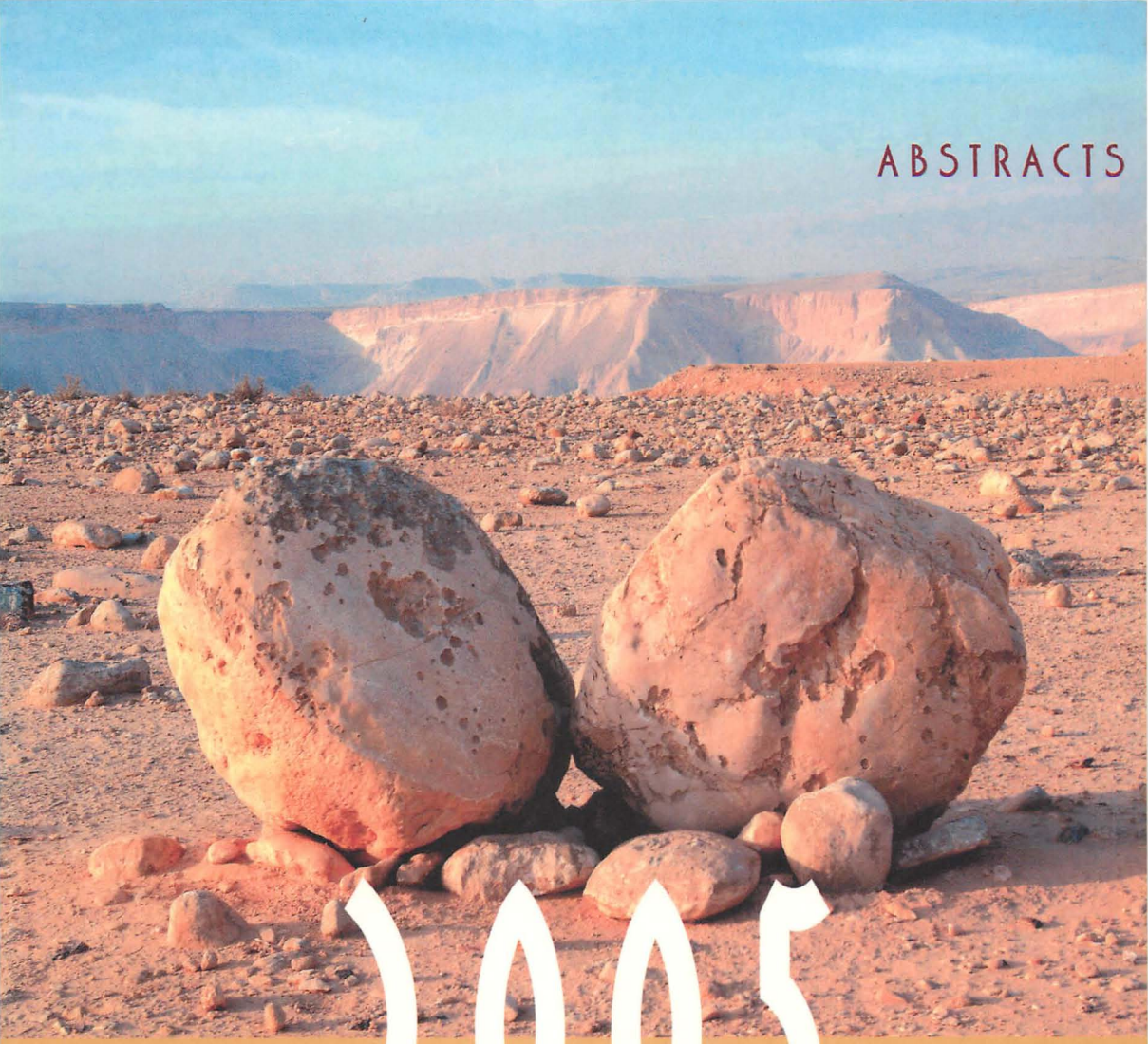

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TABLE OF CONTENT

DID HOT WATER CAUSE THE LARGEST BLOCK-SLIDE ON EARTH?

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The Heart Mountain Detachment of southwestern Montana and northwestern Wyoming is the largest surficial landslide known to have occurred in Earth's history. This Early Eocene landslide presently covers an area of over 3,400 km2 and moved a minimum of 45 km across open terrain. The initial 2 to 4 km thick Heart Mountain detachment moved on a slope of about 2° detaching for half it length on a nondescript bedding plane in the Ordovician Big Horn Dolomite. Given our current understanding of fundamental mechanics, a mass of rock this great should not have slid for such a significant distance on a gentle slope without some special condition. Here we suggest that a special condition existed during the interval between extensive upper plate dike injections and the initial movement phase. The dike injections created elevated fluid pressure of water trapped within the Big Horn Dolomite. In our model, the dike injections caused overpressuring due to thermal expansion of the trapped water in proximity of the dikes. As we will discuss, overpressuring is a mechanism that can overcome the mechanical problem of initiating movement on a low-angle surface as well as explaining the observed fluidized features along the basal contact of the detachment and the observed lack of deformation of the lower plate Big Horn Dolomite.

USE OF AMBIENT MEASUREMENTS FOR ASSESSING DEPTH OF REFLECTOR: MEASUREMENTS AND COMPARISON

Aksinenko T., Zaslavsky Y., Mikenberg M., Ataev G., Gorstein M., Ezersky M., Kalmanovich M., Giller V., Perelman N., Livshits I., Giller D.,Dan I., Shvartsburg A.

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During the last decade, site effect is known to be responsible for the widespread destruction during several earthquakes. Some of these destructions might have been avoided if more information regarding resonant frequencies of the ground had been available.

Areas of high seismisity present opportunities for determining amplification and resonant frequencies through analysis of strong motion data. In Israel, where seismisity is relatively low, other methods must be employed to estimate resonance characteristics of site effect. Site response in Ha-Shefela region was estimated by implementing the H/V spectral ratio of ambient vibration.

We have used observed resonance frequencies and their amplification to add information and constraints for the development of a subsurface model. The microtremor measurements in the town of Kfar-Sava and in the area between the towns of Hod-ha-Sharon and Lod allowed us to interpret complicated geological structure formed by system of anticlines and synclines on the west side of the fault crossing the study area. Comparison of the reflector map derived from H/V measurements with the structural map of the Top Judea Group shows significant difference in the structural elements. For instance, we have observed a deep trough that may be followed by a fault in the southern part of the Kfar Sava area, where an anticline is located according to the structural map. In reality, the anticline is shifted one kilometer to the north. The flexure mapped on the structural map in the Petah Tiqva area has no effect on the H/V measurements and is not traced by us.

Analytical models of site effect allow evaluating local parameters of vibration of the soft soil during future earthquakes. In case of lack of detailed subsurface information, analytical models may be calibrated by low-cost microtremor measurements.

THE ACTIVE TECTONIC-REEF-SEDIMENT SYSTEM IN THE HEAD OF EILAT GULF.

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Our research is aimed to study the recent evolution of the seafloor at the head of the Gulf of Elat. We report here our up-to-date results based on detailed processing and interpretation of a grid of high resolution Chirp sub-bottom profiles acquired offshore Elat in 2002.

A submerged band of reefs characterized by their distinctive seafloor reflectivity are mapped by us sub-parallel to Elat north beach at a depth range of 15 to 35 m. This band of reefs and similar sub bottom reflectivity patches to the east of it seem to belong to one stratigraphic level. We therefore suggest that they represent rejuvenated fossil reefs that evolved when the water level was 15 to 20 m lower than today. Sediments that flowed into the gulf subsequently where blocked by this band of reefs, flowed around it in the western part, and buried its eastern part where sediment supply is greater. Thus the sub-bottom profiles provide insight to the life cycle of a reef, and its causal relations with the eustatic sea-level, sediment supply, and tectonics. Correlation of discontinuities in the sedimentary section and seafloor lineaments reveal two recently-active fracture systems striking north-east, semi-parallel to the western coastline. The first is characterized bellow about 15 m depth by about 10 m down to the west offsets in the sedimentary sequence and a set of elongated mounds at the seafloor. A set of fractures are truncating the shallower sedimentary levels, close to the eastern marina of Elat, indicating recent activity along this system. The other fracture system is characterized by a minor bathymetric step; a set of diffractions suggesting open cracks at the seafloor; and a discontinuity in the sedimentary sequence. This system truncates and offsets the northern reef, and intersects with the northern coast of Elat west of the western marina. Both fracture systems project to areas of localized damage in the hotels area of Elat following the 1995 Dahab earthquake.

PRACTICAL ASPECTS OF SITE-EFFECT ESTIMATION

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The earthquake site effect, due to local geologic and/or topographic conditions, is in many sites an important engineering parameter, often with a surprising magnitude. Without measurement of vibrations at the site, site-effect estimation is only derived from calculation for an assumed model of the site based on measured or estimated geological, geophysical and topographic data. Such simulation may result in large errors, mainly due to the following limitations:

Even in intensively explored sites, with a high concentration of borings and geophysical surveys (refraction, uphole etc.) there may remain a significant uncertainty concerning the true spatial distribution of density and shear velocity values. The latter may vary widely from point to point within the same geologically-defined material and anisotropy, possibly large, may be a further complication. Such uncertainties can introduce large errors in the analytically derived frequencies and amplification (including de-amplification) factors of the site effect. For many sites with common geological complexity, even if we had somehow obtained comprehensive, three-dimensional density and velocity field data, the limitations of existing calculation codes would have degraded the results. For the topographic effect, existing codes appear to be unreliable even for relatively simple terrain features, while special effects such as wave interference at deep underground facilities are still more problematic.

Actual measurements of vibrations at the site provide inherently the most direct approach for site-effect determination, although such empirical studies have their own limitations, which include the following:

Empirical studies rarely have an opportunity to sample the strong-motion non-linear domain. Typically, results include considerable scatter, especially in amplification factors. At sites of low-to-moderate seismicity and high ambient noise, studies are practically limited to ambient vibrations, typically yielding only partial results related to the first resonant mode. Special site limitations may include difficulties in placing and maintaining a seismographic array with related communications, lack of desirable reference locations etc.

Hence, currently the best approach for site-effect determination includes, as much as possible, both an empirical study of actual seismic motions at the site as well as collection of data for a geological-geophysical-topographic model.

A model is then constructed such as to be consistent with the latter data with their reasonable range of uncertainty, while also yielding a theoretically calculated site response consistent with the measured values with their range of scatter. A model thus obtained is better constrained, by geology, geophysics, topography and seismometry, and it is therefore more immune to gross errors in any particular discipline or calculation procedure. To such a model, obtained in the linear domain, appropriate anelastic properties may be later added for calculation of the strong-motion site effect in the nonlinear domain.

EFFECTS OF URBANIZATION AND AGRICULTURAL ACTIVITIES IN THE COSTAL PLAIN OF ISRAEL ON THE CHEMICAL AND ISOTOPIC COMPOSITIONS IN THE VADOSE ZONE AND GROUNDWATER

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Over the past few years, the Coastal Plain of Israel has undergone intensive urbanization. Many rural and open areas have become urban residential, industrial and commercial. Urbanization of rural and cultivated areas can be harmful to groundwater resources due to the potential reduction in recharge volumes and contamination of the percolating water. In the present study, this problem was investigated in the city of Ashdod, located in the Coastal Plain of Israel, where extensive urbanization of cultivated and undeveloped areas has taken place over the past 15 years.

The assessment was based on a large chemical, isotopic and mineralogical data set including rainwater (64 rain samples from 46 rain events), sediment and pore water from the vadose zone (115 samples from six boreholes), and groundwater (28 samples from observation and groundwater supply wells) collected under different land uses within the city, and in the surrounding cultivated and undeveloped sand dunes.

In residential areas, salts are added primarily to the upper part of the vadose zone, mainly as a result of calcite dissolution and near-surface evaporation of the percolating water.

Below the cultivated areas, salt buildup was observed across the entire vadose zone down to the water table, following the application of fertilizers and the use of treated wstewater for irrigation.

Industrial activities were found to contribute trace metals and organic compounds mainly to the upper shallow aquifer. Atmospheric-borne contaminants (e.g. potassium and sulfur) could be detected at significant concentrations in the groundwater, close to the contributing source areas.

In the residential areas, the local aquifer was affected by leaky sewers and water-supply lines, resulting in higher salinity and NO_3 contamination. Urbanization's impact was found to have a lag time of 10 to 25 years due to the long residence time of salts in the unsaturated zone below the city. Whereas the urbanization of undeveloped areas appears to result in the deterioration of groundwater quality, the shift from cultivated to residential areas has the (surprising and unexpected) potential of improving groundwater quality due to the decreased salt load on land surface.

LIFE ON THE EDGE: VARIATIONS IN SEA FLOOR VENTILATION OF MISHAH FM, CAMPANIAN, UPPER CRETACEOUS, ISRAEL USING BENTHIC FORAMINIFERA

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At the time of deposition of the Mishash Formation in the late Campanian, present-day Israel lay beneath a wide belt of oceanic upwelling along the southern margin of the Tethys. The upwelling system was characterized by high productivity, but also by temporal and spatial heterogeneity in bottom water condition and consequently in sediment character. Variations are expressed in organic matter content and benthic foraminifera assemblages, both affected by degree of sea floor aeration. We examined organic rich carbonates (ORC), carbonate-porcelanites, phosphate-rich carbonates and shell beds from the carbonate-phosphate unit of the Phosphate Member, Mishash Formation, in order to reconstruct the bottom-water conditions and especially the degree of top-sediment ventilation. A total of 74 samples from four different sections were examined. The Saraf borehole in the Zin basin represents the most restricted environment. The Qazra-Omer basin, studied from the Nahal Omer section on the basin flanks and the Nahal Ashosh section from the central part of the basin, was somewhat less restricted. The Wadi-Kelt section was a more aerated basin closer to the open sea. The abundance of benthic foraminifera is highly variable, varying from nearly barren stratum to floods of foraminifera (up to 146,000 specimens/ g dry sediment). Samples most impoverished in microfauna were the porcelanites, some of the ORC and phosphate-rich carbonates. Extremely high numbers occur only in the ORC. Generally, the dominant forms are buliminids, comprising 90-100% of the entire benthic foraminiferal assemblage. There is a general decrease in the buliminid abundance from the most restricted environment of the Zin basin, to the more aerated Wadi Kelt basin, indicating an increase in sea floor aeration. Species richness is generally very low, usually of 5-6 species/sample in the Zin basin, to a more diverse 10 - 17 species/sample in the other basins. Praebulimina prolixa is the most abundant buliminid, accompanied by other buliminid species that usually occur in significantly lower numbers. Further evidence from the benthic foraminifera characteristics allows us to assign the ORC rocks to several aeration levels, ranging from dysoxic to anoxic. In this way, benthic foraminifera are used for the first time to characterize the variety of oxygen-depleted environments, and in higher resolution than has been possible to date.

CALIBRATION OF H/V RATIO BY REFRACTION LINE AND CONSTRUCTION SUBSURFACE STRUCTURE: CASES OF DIMONA AND ARAD

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Site effects are widely recognized as an important factor of seismic hazard. The local geology significantly modifies strong ground motion and controls the irregular distribution of damage observed during large earthquakes. Seismic hazard studies often make recourse to predictions of ground motion, which take into account site effect by theoretical response functions. But these functions should be validated empirically through a regional seismic monitoring and analysis program. Three hundred nineteen measurements of ambient vibration were registered to produce maps of distribution of the fundamental resonance frequency and maximum amplification over the towns of Dimona and Arad.

We used seismic refraction survey carried out in the towns of Dimona and Arad for calibration experimental transfer function at points located along refraction lines. Analytical transfer functions calculated with direct use of thickness and velocity given in the shear-wave refraction surveys yield agreement with corresponding experimental spectral ratios. The distribution of fundamental frequency and amplification level were used to estimate layer thicknesses under all measurement points. These unknown parameters have been estimated by fitting analytical transfer function to the experimental spectral ratio. In the corresponding optimization procedure values of shear wave velocity were fixed and taken from refraction lines. The practical relevance of the investigation is illustrated by means of cross sections, constructed from results of ambient vibration analysis, which provide a convincing image of the subsurface structure of the areas investigated.

The site response analysis shows that Dimona and Arad can be subdivided into six and three zones, respectively. For each zone we adjusted typical soil column model for calculation of the response spectrum throughout the whole zone. The shape of the spectra obtained for all zones are significantly different in the frequency range 2.0-5.0 Hz from the ones prescribed in the design provision for earthquake resistance of structures in Israel.

THE GEOLOGICAL HISTORY OF THE ISRAELI CONTINENTAL SHELF BASED ON LATE QUATERNARY SUCCESSIONS

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The shallow Israeli continental shelf is a unique area which records in great detail the history of past climate and sea level change. The transition zone between the land and the deep sea is a key area for paleoclimate reconstruction because of the interfingering marine and continental records. Late Pleistocene - Holocene carbonate-rich sands interbedded with silt and clay horizons were encountered in two boreholes, 0.5 and 2.5 km off Ashqelon, at 9.5 and 25 m water depths. Data collected consists of sedimentological, and quantitative foraminiferal studies for correlation and reconstruction of the marine environments. The cores were dated using (AMS) ^{14}C, U-Th (TIMS) and luminescence, enabling correlation to the marine isotope stage (MIS) chronostratigraphy. Above a basal unconformity at about 80 m depth lays a carbonate-rich siliciclastic unit dated at ~330-225 kyBP, which records the interglacial MIS 9 and 7.5-7.3, and the intervening glacial MIS 8. Rapid climate and sea level fluctuations are represented by heterogeneous rocky substrate and lateral facies variants shallowing to the east. Following is silty-sandy marine sediments, deposited between 225-172 kyBP, representing major increases in Nilotic input and near-shore marine productivity. Sea level fell towards the end of the penultimate glacial, MIS 6.4-6.3, with the shoreline migrating westwards as demonstrated by intertidal beachrocks in the eastern core. Continuation of sea level fall is evidenced by the overlying paleosol, known onshore as the Poleg Hamra. During the last interglacial MIS 5, between 128-70 ka BP, resumption of Nile River activity is indicated by the accumulation of marine sands. A break in the marine sedimentation occurred during MIS 5.4, when sand dunes formed 2 km west of the present coastline under arid conditions and sea level fall. During the early part of the last glacial, ~70-~55 ka BP, marine sands and indurated sandstones accumulated in the west at a low rate, reflecting reduced Nile River contribution. Between ~40 and ~10 kyBP, sea level gradually fell, the entire shelf became exposed and a paleosol corresponding to the onshore Netanya Hamra developed. As the early Holocene sea level rose, rates of sedimentation increased rapidly, and sands and silty sands covered the entire pre-Holocene exposed shelf. Towards the east silty clays of a brackish/fresh water origin accumulated. This unit seems to be intimately linked to the rapid sea level rise, high rate of deposition, and humid climate conditions prevailing in the early part of the Holocene

THE ROLE OF CLIMATIC CHANGE IN THE BYZANTINE- EARLY ISLAMIC TRANSITION: THE CASE OF THE NEGEV HIGHLAND

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Archeological and geological research conducted in the Negev Highlands during the past 25 years consistently indicated that the transition between the Byzantine and the Early Islamic periods (6^{th} - 8^{th} centuries CE) was characterized by the continuity of the environmental conditions, with no indication of a climatic change.

The archaeological record includes hundreds of farms and agricultural installations, which together with the main Byzantine towns of the Negev Highlands – Halusa, Avdat, Mamshit, Shivta, Nessana, and Rehovot in the Negev, formed an intensive settlement pattern which combined agriculture, herding and commerce as an economical basis for the Negev population. This intensive pattern continued to function during Early Islamic period and was gradually abandoned only during the 9^{th} century CE as a result of complex political and social processes.

During the Early Islamic period the agricultural settlements penetrated even to the remote southern regions of the Negev Highlands, in which the environmental conditions are much degraded and the amount of rain is smaller relative to the central and northern regions of the Negev Highlands. This may serve as an indication that the environmental conditions during this period were not degraded as a result of a climatic change, as claimed in several recent studies. The existence of widespread anthropogenic activity during these periods was a result of a wise utilization of the natural desert conditions including the optimized use of desert floods resulting from the precipitation regime which in its general characteristics seems to fit the present one.

Therefore, this new data indicates that the climatic component was not a significant factor in the dramatic historical and cultural shift resulting from the collapse of the Byzantine regime in the Near East, which was replaced by the Early Islamic dynasties.

As almost 100 years have passed since Elsworth Huntington published his theory which highlight the importance of dramatic climatic changes as a trigger to major historical and cultural shifts, the archaeological and geomorphological research done in the Negev indicates that the human factor is much more significant than the climatic factor.

MULTI-PHASE TECTONICS AROUND BEER SHEVA - AN INTRODUCTION TO FIELD TRIP

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More than twenty sets that represent distinct fracture events of joints and faults have been identified in the Beer Sheva and Shephela Eocene synclines around Beer Sheva. They provide the basic information for two fracture groupings. First, a 'joint classification' into five categories: Burial, syntectonic, uplift, post-uplift and surface joints. Second, a 'fault-joint classification' (FJR), which consists of eight temporal relationships (types) between faults and their associated joints (two more are predicted). These include: Pre-fault burial joints, post-fault burial joints, syn-fault syntectonic joints, post-fault early uplift joints, pre-fault late uplift joints, and other FJR types. Representatives of these two groupings will be shown in six stops during the trip.

The joint classification predicts for hydrologists and engineers what should be the distinct physical properties (like dimensions and spacing) of joints that belong to the five categories. The fault-joint classification may help geologists to trace different stages in the evolution of basins. From the eight FJR types observed in the Beer Sheva syncline (Bahat et al. 2004, Table 6.3), this abstract concentrates on types 5 and 6 in Wadi Naim.

Type 5 joints formed at a fault termination zone cutting a Middle Eocene chalk layer during the uplift stage. The termination zone consists of a primary fault, three secondary faults, and a joint set. The primary is a vertical right-lateral strike-slip fault, striking 318°. A set of three partly curved secondary faults initiates at the tip of the primary fault, and a joint set striking 344° curves sympathetically with the primary and secondary faults in a close proximity to the faults. The 344° striking joints are exclusively associated with the faults, and they are termed syntectonic joints. Another joint set, the 028° one, is ubiquitous in Wadi Naim. Where the latter joints approach the termination zone they arrest or interact (hooking style) with the 344° striking joint set, but they never penetrate to the termination zone. Therefore, the 028° set postdated the termination zone in the same chalk layer, i.e., they are younger than type 5 FJR joints. Thus, sets 344° and 028° belong to two separate fracture events: An early and an advanced one during the uplift process (Bahat 1999).

Type 6 joints are cut by the Naim normal fault A, which occurs above the fracture termination zone. Type 6 joints belong with set 028° to the same ubiquitous fracture system in Wadi Naim. Thus, three distinct fracture stages are recorded from the uplift(s) process at this location: The fault termination zone was followed by a system of joint sets (like 028°), which was partly cut by the young, normal fault A.

'EARLY JOINTS' IN SEDIMENTARY AND GRANITIC ROCKS.

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There are indications that the classification into 'late joints': Syntectonic, uplift and post-uplift joint categories in sedimentary rocks has been also useful for grouping joints in granitic rocks. However, quite a different situation is encountered when 'early joints' are concerned. It seems unlikely that early, 'cooling joints' that form during the cooling and consolidation of the granite would form resembling features to the early, 'burial joints' in sedimentary rocks, simply, because their fracture mechanisms are expected to be drastically different. Surprisingly however, 'cooling joints' from the North Bohemian Massif and the South Bohemian Pluton in central Europe, and from the Sierra Nevada Batholith in California show similarities to fracture patterns from both, the 'Cloos's 1921 model' for granitic rocks and the 'Steams's 1968 model' for sedimentary folds. This resemblance implies that, within their extremely different setups, these two rocks respond similarly to regional stresses and strains, in terms of extensile fracture. Although the actual fracture in these granites is induced by pore pressure, the orientation of the joints is controlled by remote stresses.

It is generally accepted that shortening parallel to the general SW-NE compression direction has been exerted by the underthrusting Pacific plate on the various components of the North American Cordillera. This strain has been associated with an elongation along the general NW-SE direction in these regions. As expected, these stress and strain modes have resulted in extensive jointing. In the Sierra Nevada Batholith strikes of orthogonal sets were measured in the NE and NW directions and in the N-NW and E-NE directions (e. g. Segall et al. 1990 and references therein). It was suggested that the NE to E-NE oriented joint sets correspond to the Q-joints, and their orthogonal sets fit the S-joint pattern from the 'Cloos's 1921 model' (Bahat et al. 2004, p.354).

Differences are also important. Possibly, the association of conjugate extension fractures (CEF) with the axial extension fractures (AEF) in sedimentary rocks and the absence of the former in granitic rocks relates to the high strength of granites. This results in the decrease of the dihedral angle (formed by the CEF) in the tensile part of the Mohr diagram, compared with the dihedral angle increase with stresses within the Coulomb fracture criterion regime, in the positive side of the Mohr diagram (Bahat et al. 2004, see discussion on the reliability of the results in sub-section 2.2.13.3). Therefore, even if CEF do occur in association with their corresponding AEF with Q and S-joints, their angular deviation from the axial direction would be small, possibly undetected in the field.

GEOMORPHIC SURFACES AS INDICATORS FOR TECTONIC UPLIFT OF THE MOUNTAIN BACKBONE OF CENTRAL ISRAEL

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This study traces uplift stages during the Neogene of the western slopes of the Judea and Samaria mountains, part of a comprehensive analysis exploring tectonic causes of uplift of the mountain backbone in central Israel, and its possible connection to the development of the eastern Mediterranean basin.

Geomorphic surfaces (GS) are remnants of ancient low-relief landscapes developed by subaerial erosion or marine abrasion during long periods of stability. Relicts of GS are best preserved along watersheds, where they can be recognized in topographic profiles. Only widely distributed GS remnants discordant with geologic structure were considered useful in this study. We used the GIS program ArcView for identification and correlation of GS. Phases of geomorphic surface (GS) stabilization were identified as follows:

(1) The uppermost GS (UGS) is of regional extent, and is represented by the highest summits of the Hebron ridge and Ba'al-Hatzor Mt. The age of this surface was assumed (Picard, 1943, 1951) to be Oligocene to Early Miocene.
(2) A series of younger, narrow, less mature surfaces incised into the UGS.
(3) A lower, more widespread surface, covering large areas around Jerusalem and named here the "Jerusalem surface". This surface incised into the earlier GS phases, and represents remnants of wide and shallow valleys of the precursors of the Soreq and Shilo valleys, superposed across the present watershed of Israel.
(4) A renewed phase of intensive incision, forming terraces instrumental in initial shaping of the present narrow Soreq and Shilo valleys. These terrace systems gradually merge into an abrasional marine terrace along the western slope of the mountain backbone, overhanging the Higher Shefela surface.
(5) The Higher Shefela surface of Sneh and Buchbinder (1984), extending along the western margins of the mountain backbone, beneath the surface of phase 4. This is an abraded marine terrace capped by Middle Miocene sediments. North of Park Canada, it cuts into hard Judea Group rocks, forming a narrow geomorphic step.
(6) The Lower Shefela surface of Sneh and Buchbinder (1984) is significantly wider and more continuous, and is covered by rocks ranging in age from Middle Miocene to Late Pliocene, and was formed under multiple abrasion and denudation events.

The UGS, the Jerusalem surface and the Lower Shefela surface represent long periods of tectonic stability, while the geomorphic steps in between may represent shorter phases of stability during tectonic uplift. Our data indicate that a significant part of the central Israel mountain backbone uplift took place during the Lower to Middle Miocene.

BIQAT SAYYARIM EXPERIMENT- AN EXAMPLE FOR SUGGESTED MEASURES TO IMPROVE GEOPHYSICAL TECHNIQES WITHIN THE FRAMEWORK OF THE CTBT

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According to the Comprehensive Test Ban Treaty (CTBT), a variety of geophysical techniques have been included within the activities of the On Site Inspection (OSI). Being of an intrusive nature, costly and complicated to operate, the geophysical techniques should be carefully tailored to the specific scenario, the nature of the inspected area, its size and geological realm.

In order to enable the appropriate operation of the geophysical techniques in the field during an OSI, State Signatories that have relevant information concerning the specific nuclear test signatures, are encouraged to provide a wide scope of this phenomenology, or to initiate a research plan, which might enable well-considered technology selection in the field in case of an OSI. This research would also rely on public domain sources.

As part of the proposed research plan, the various geophysical techniques included in the treaty could be tested in either former nuclear tests sites (taking into account the time factor), or in recent chemical explosions test-beds.

The Israeli Biqat Sayyarim experiment is presented as an example of such a research plan, which was initiated by the IAEA . Seismic reflection, seismic refraction and CVES surveys were performed at a site, where another seismic calibration experiment, performed by the Geophysical Institute of Israel took part.

Changes in rock mechanical properties, as well as subsurface structures, were identified in these surveys at moderate depth, below relatively small, partly contained events.

The recognition of sub-surface structures is usually dependent on the pre-event existing information. Geological considerations might reduce the absolute dependence.

The geophysical techniques described herein bear out the potential capabilities as OSI technologies. The seismic reflection and refraction methods are proven to be a strong tool in detecting sub-surface anomalies. The CVES method is not a stand-alone one, but might be considered as complementary.

This project is an example for future experiments, simulating underground nuclear tests, to help in pointing out the appropriate geophysical methods, as well as in their parameters selection.

THE ORIGIN OF NEOPROTEROZOIC PERALKALINE GRANITES IN THE NORTHERN ARABIAN-NUBIAN SHIELD (SINAI): NEW INSIGHTS FROM OXYGEN ISOTOPE RATIOS IN ZIRCON

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The Arabian-Nubian Shield (ANS) comprises Neoproterozoic juvenile crust formed during the East African Orogeny (EAO). Exposed ANS rocks are found in western Arabia, the northeastern parts of Africa, the Sinai Peninsula and in minor exposures in southern Israel and Jordan. Per-Alkaline granites in the ANS are attributed to the last tectono-magmatic phase affecting the shield between 600-530 Ma and are considered A-type post-orogenic granites.

The two main reservoirs for magma-generation, the crust and the mantle, have distinct oxygen isotope signatures, making $\delta^{18}O$ a valuable tracer for the origin of magmas. While mantle $\delta^{18}O$ is thought to be homogeneous, the crust may be affected by either low temperature isotope fractionations during surface processes resulting in higher $\delta^{18}O$, or by hydrothermal alteration resulting in lowering of its $\delta^{18}O$ values. As zircon (Zrn) has been shown to preserve igneous oxygen isotope ratios through post magmatic cooling, alteration and metamorphism, the relative contributions of mantle and crustal sources to a chosen pluton can be estimated by the $\delta^{18}O$ values of its zircons.

We present here preliminary $\delta^{18}O$ (Zrn) results from peralkaline A-type granites of the Sinai Peninsula. The Sahara pluton of southern Sinai, and the Um-I-Fai pluton of eastern Sinai have $\delta^{18}O$ (Zrn) values of 5.14±0.1‰ and 5.49±0.1‰ respectively, corresponding to $\delta^{18}O$ values of mantle zircon (5.3±0.3‰). These results are consistent with a mantle source for these granites and are in agreement with tectonic models for A-type granites. The Sharm pluton of southernmost Sinai shows $\delta^{18}O$ (Zrn) of 4.8±0.1‰ slightly lower than the expected $\delta^{18}O$ mantle range. This ^{18}O-depletion suggests a contribution of hydrothermally altered crust to a mantle-derived magma. This interpretation is also supported by the occurrence of a large amount of xenoliths in the Sharm pluton, while the Sahara and Um-I-Fai plutons are xenolith – poor.

10Be AND 14C IN THE HYDROLOGICAL- LIMNOLOGYCAL SYSTEM OF THE MODERN DEAD SEA-IMPLICATIONS FOR PALEOHYDROLOGY

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The cosmogenic isotopes $^{14}C(t_{1/2}=5.73x10^3 year)$ and $^{10}Be(t_{1/2}=1.52x10^6 year)$ have similar production modes but differ significantly in their geochemical behavior. After their production in the upper atmosphere ^{14}C is oxidized to CO_2 and enters the global carbon cycle whereas ^{10}Be quickly absorbs to aerosols and after a mean residence time of 1-2 years it is washed out of the atmosphere by dry and wet precipitation.

In fluvial and lacustarine environments the pathways in the geochemical cycles of ^{10}Be and ^{14}C multipart: ^{10}Be, after its deposition on the drainage basin terrain is washed within the fluvial system, hence, during the Quarternary its concentration in lake sediments was most probably dependant upon the hydrological regime within the drainage basin. ^{14}C on the other hand was affected by equilibration between the atmosphere and the runoff, the "reservoir effect", addition of "dead carbon" from the surrounding lithology and by radioactive decay. The similarities in the production mode and the differences in the geochemical behavior between these two cosmogenic isotopes open the way to use them as combined hydrological-limnological tracers. The aim of our research is to understand the behavior of ^{14}C and ^{10}Be in the hydrological-limnological system of the Dead Sea.

We analyzed the ^{14}C and ^{10}Be concentrations in the various water components of the Dead Sea hydrological cycle (Dead Sea, saline springs and various freshwater inputs). ^{14}C values range from 50-60 pmc in the fresh water springs; 85 pmc in Dead Sea water and up to 100 pmc in floodwaters. ^{10}Be concentrations decreased along a flood evolution profile: $1.5x10^4 atoms \cdot gr^{-1}$ in rain, $0.8x10^4 atoms \cdot gr^{-1}$ in runoff and $0.4x10^4$ $atoms \cdot gr^{-1}$ in floods. ^{10}Be concentrations of modern dust and loess ($2.4x10^8$ $atoms \cdot gr^{-1}$ and $3.1x10^8$ $atoms \cdot gr^{-1}$ respectively) are similar to those in detritus material from Lake Lisan($2x10^8$ $atoms \cdot gr^{-1}$) and are order of magnitude higher than in the Lisan authigenic aragonite($0.17x10^8$ $atoms \cdot gr^{-1}$).

Our data suggests that the main source of ^{10}Be to the Dead Sea drainage basin is atmospheric dust, which part of is transported with the floods into the Dead Sea basin and part settles directly upon the lake. From this conclusion we propose that the ^{10}Be and ^{14}C geochemical cycles in the Dead Sea could be described in two simple box models. This will be varified by further investigating the behavior and fate of ^{10}Be in the hypersaline lacustrine environment of the Dead Sea.

STRATIGRAPHY AND PALEOECOLOGY OF THE AVNUN/TAMAR CYCLE, NORTHERN NEGEV,ISRAEL

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A new study of the Avnon-Tamar depositional cycle of the northern Negev is placed in a revised depositional and sequence stratigraphic context. Two main sections (Nahal Gov, Ef'e) and eight subordinate reference sections have been sampled. Three subregions were determined: Dimona, Yeruham and Ma'ale Aqrabim. Along with detailed sampling of rocks for laboratory observation under the microscope, field tracing and mapping has been done in order to track and image the main paleoecological elements of the Cenomanian (~95 million years ago). The Avnon Mbr begins with a bioturbated, nodular packstone facies rich in echinoderms including pelagic crinoids, thin-walled mollusks, rare oysters, oligosteginids and benthic foraminifera, and sporadic planktonic foraminifera, signifying an aerobic, subphotic outer-ramp to basinal environment. This sedimentary package at the base of Avnon/Tamar cycle represents a TST (Transgressive Systems Tract). A thin laminated horizon with planktic foraminifera indicates an episode of oxygen depletion and includes the MFS (Maximum Flooding Surface). This facies aggrades upwards to more proximal packstones, occasionally with winnowed accumulations of Orbitolina, indicating the preliminary phase of the HST (Highstand Systems Tract). The mid-ramp packstones are abruptly terminated by prograding cross-bedded coarse bioclastic rudist buildups of the Mid-HST phase. A DLS (downlap surface) is located either at this transition or somewhat lower, at the first accumulations of bioclastic packstones-depending on variation in local properties of sections. Lateral to these buildups are patches of larger foraminiferal grainstones and packstones representing passage to the inner ramp/lagoonal facies of the top of the Avnon Mbr. At this stage of the cycle the prolonged aggradational upper HST first appears. Fenestral microbialitic dolomites of the overlying Tamar Mbr have been explained as indicative of slow subsidence under supratidal conditions.

On closer examination, however, Tamar Mbr cycles may not be dominantly supratidal. Curiously absent or at least very uncommon are peritidal features such as flat-pebble conglomerates (storm rip-ups have been found), desiccation cracks, karst, or pedogenesis. Cycles consist of bioturbated mudstones topped by a small mollusk packstone. Attempted colonization of cycle tops by a variety of organisms fail to develop 'keep-up' buildups. Inevitably, cycles terminate in fenestral microbialitic mats and 'give-up' features, such as bored surfaces or iron crusts, which could well be subtidal. These features can be explained by mesotrophic conditions, inhibiting development of carbonate buildups.

Recently Buchbinder et al (2000) showed the Ce-Tu transition in Israel was underlain by the a type III drowning sequence boundary (following Schlager, e.g., 1999). This drowning surface is at the position of ultimate disappearance of these Tamar cycles. Continued subsidence, coupled with gradual, long-term deterioration of 'keep-up' buildups, symptomatic of ecosystem inhibition by nutrient stress, apparently led to widespread 'basinal' type sedimentation across the shelf, as the Ce-Tu boundary is approached.

MODEL FOR PREDICTING THE REACTION OF ALLUVIAL RIVER CHANNELS TO CHANGES IN THE DEAD SEA WATER LEVEL

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The reaction of alluvial rivers to changes in baselevel's altitude was studied by many researchers and by different methods (empirical, quantitative, physical, etc). The Dead Sea region is a unique field laboratory to examine the reaction of a fluvial system to baselevel change, because of its drastic level changes during history, especially during the last century, the fast reaction of the rivers that flow into it, and the availability of detailed data. Most of the works done so far in this region have presented a situation report, and didn't deal with the predicted continued changes. By combining empirical and quantitative approaches, we have managed to build a model predicting the reaction of the longitudinal profile of different rivers to changes in baselevel, which is based on a sediment diffusion equation. By using diffusion as an analog to the processes occurring in the river, where material is being transported downstream from steep segments to moderate ones, we have bypassed the complexity of the system and the dependence of the different parameters on each other and on external factors.

The research was carried out on 8 wadi channels along the northern basin of the Dead Sea, in the segments between the shore and the Dead Sea road. The road reacts as a nickpoint and a local baselevel, and prevents the upstream influence of the baselevel change. The channels chosen have minimal human interference, have fill-cut terraces record and represent different morphological characters. For the calibration and validation of the model we reconstructed longitudinal profiles of the channels from various years, by mapping and surveying of old terraces. The terraces' ages were determined by the altitude of the shoreline that they join, it's matching with the Dead Sea level curve, and by aerial photos.

The parameters that were supplied to the model were the Dead Sea levels curve, the location of the shoreline every year (as determined from aerial photos), and the reconstructed profiles. In the calibration stage, the diffusion coefficients and sediment fluxes were found, by running the model between longitudinal profiles of different years. In the validation stage, the same coefficients were used in runs between other years, and the matching of the predicted profile to the measured profile of the target year was checked.

We have shown that most systems along the Dead Sea behave in a diffusional pattern, and this analog can represent the aggradation and degradation processes, as a reaction to baselevel lowering. This tool can be used for future planning of infrastructure in the Dead Sea region. The analysis of diffusion coefficients in rivers with different hydrological parameters can help to assess the influence of those parameters on the reaction of rivers to baselevel changes.

THE INTENSITY OF THE GEOMAGNETIC FIELD DURING THE LAST 6 MILLENNIA – RECORDED IN SLAG DEPOSIS FROM ARCHAEOLOGICAL SITES IN THE SOUTHERN LEVANT

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We have tested a novel medium with an improved experimental protocol for the reconstruction of the geomagnetic field intensity during the last six millennia. The novel medium, namely copper slag, is distributed in many archaeological sites throughout the Old World and especially in the large production centers of the southern Levant. Slag deposits are the archaeological analog of volcanic glass that has proven to be exceptionally reliable for absolute paleointensity measurements of the geomagnetic field.

Our experiment is based on the classic Thellier-Thellier method and combines the advantages of common Thellier-Thellier protocols; it also uses sever criteria for testing and filtering the results, in order to establish a well accepted data base that can be viewed as a reference within the enormous amount of inhomogeneous and often questionable paleointensity data.

27 sites, mainly from the regions of Feinan and Timna, have been sampled. The results of the paleomagnetic measurements has shown that slag-deposits are the best recorder for geomagnetic paleointensity studied so far, especially in comparison to other archaeomagnetic material that consist of burned clay. The new data creates a reliable and high-quality paleointensity variations curve. This curve is a key for studying the behavior of the earth magnetic field and its triggers; moreover, it is a tool for understanding phenomena that relates to the geomagnetic intensity such as shielding of cosmic radiation and creation of cosmogenic isotopes, climatic changes and variations in the biosphere.

The curve can also be used as a dating tool for archaeological sites that has problematic age determination. It is suitable mainly for some of the earliest periods (Chalcolithic – Bronze) and for the sites of the desert regions, where the accepted scheme of ceramic typology is problematic.

In general, we have found low geomagnetic field intensity during the 5^{th} and 4^{th} millennia B.C, a peak in the first half of the 1^{st} millennium B.C. and some smaller scale fluctuations in between. Our curve agrees with some other studies, and is consistent with the interpretation that the directly measured recent decay of the geomagnetic field intensity is a fluctuation of a magnitude common in the field and not a drastic change that leads towards reversal.

SPATIAL ANALYSIS OF THE DEAD SEA DRAINAGE AREA AS A TOOL FOR ASSESSMENT OF SURFACE FLOW VOLUMS INTO THE DEAD SEA

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Due to high utilization of fresh water around the Dead Sea by all surrounding countries (Israel, Jordan, Syria, and Lebanon) the amount of surface flow volume into the Dead Sea is almost insignificant. The aim of this current study is to give an assessment of the surface flow and to reduce the uncertainties in the Dead Sea water balance (inflow-outflow-evaporation-sea level). The study is part of the Dead Sea limenological calibrated model study, currently conducted in the Geological Survey of Israel.

The surface flow into the Dead Sea, which is measured by standard hydrometric station, is mainly restricted to the northern parts of the Dead Sea drainage areas (the Jordan River). The flow from all seasonal streams, which are more abundant around the Dead Sea, will by assesed according to the statistical model of frequency, discharge and flow volume calculated by the Hydrological Service of Israel. This model is based on the relationship between frequency, volume, average annual rain distribution and basin size. Relationship also exists with the lithological distribution in the basin.

The aim of this study is to consolidate a formula connecting the physiographic (elevation, slope, basin size), geologic (lithology), and meteorological (average annual rain) with the measured flows. The formula will be based on all hydrometric station, and will be used for the Dead Sea basin.

"ArcInfo GIS" software, along with "ArcHydro", and "Spatial Analysis" extensions were used. The software allows hydrological modeling, stream network building and watershed border deliniation, based on a digital elevation model (DEM).

Current achievements:

1. The drainage area to the Dead Sea was delineated. It is 43,471 sq Km.
2. A lithological map of the Dead Sea drainage area is completed.
3. The drainage area is subdivided into four main watersheds (Jordan River, Nahal HaArava, eastern areas, and western areas). The physiographic, geologic, and meteorological nature of all sub watersheds was study.
4. The physiographic, geologic, and meteorological nature of all hydrometric stations drainage area where prepared for the formula establishment.

THE CARBON DIOXIDE CONCENTRATION AND ITS ISOTOPIC SIGNATURE IN THE AIR OF THE SOREQ CAVE

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We report preliminary results of the concentrations of CO_2 and its isotopic signature in the air of the Soreq cave. Air samples have been collected from several sites in the cave, from the visitor hall entrance (adaptation hall) and from outside the cave. Factors that control the CO_2 concentrations and its isotopic signature in the cave are breath exhalations of visitors in the cave, out gassing from water drops falling from stalactites and exchange with the outside atmosphere.

The CO_2 concentrations measured in the Soreq Cave are up to 4 times higher than in the outside air. Inside the cave, the air contains ~1400 ppm CO_2 with $d^{13}C$ = -19‰ and $d^{18}O$ ~ - 5.5‰. In the absence of visitors in the cave clear gradients in CO_2 and in $d^{13}C$ are observed from the cave to the adaptation hall, to the free air. When the entrance door to the cave is held open for 5 minutes (which is the average entrance time for a group of visitors), CO_2 leaks from the cave outwards and raises the concentration and isotopic signature in the adaptation hall to become equal to that of the cave. Another path of CO_2 outflow only from the cave to the free air is through cracks in the roof.

The two sources of CO_2 in the cave (exhalations and drippings) are different in their CO_2 and $d^{13}C$, and both are very different from atmospheric $^{13}CO_2$. The 190,000 annual visitors in the cave contribute ~ 2000 m^3 of CO_2 which are ~60 times the volume of CO_2 in the cave. However, if this was the only contribution of CO_2 to the cave we would expect the cave atmosphere to have $d^{13}C$ ~ -24‰, which is the value of human exhalation. But, the measured value in cave air is $d^{13}C$ = -19‰ and therefore contributions of CO_2 with heavier ^{13}C, such as from stalactite dripping and exchange with outside atmosphere are expected. We present tentative models for the balance of CO_2 and $d^{13}C$ in the cave air.

GIS-BASED SOIL DATABASE INCORPORATED WITH REMOTELY-SENSED DATA: PRELIMINARY RESULTS

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This study presents the first stage of the project "Integrated Forecasting of Desert Terrain Conditions for Military Operations", held by researchers from the Desert Research Institute, University of Washington, The Hebrew University of Jerusalem, and The Geological Survey of Israel. The aim of this study is to develop an integrated, predictive tool for forecasting desert terrain conditions. To achieve this goal we established a GIS-based soil database incorporated with remotely-sensed data, on two main arid areas: the Negev desert, in southern Israel, and the Southwestern deserts of the USA.

The soil database consists of two linked tables – a) the main table, in which each record represents one soil profile, with general soil profile fields (location, climate parameters, topography parameters, etc.), and b) the horizons table, in which each record represents one soil horizon, with horizon characteristics fields (color, granolometry, chemistry, etc.). The database includes about 300 soil records through out the Negev desert and will include in the near future remotely-sensed data, such as mineralogy, roughness, and clast coverage percentage.

A test for such incorporation was done at the Yotvata playa, southern Negev desert, Israel. In this case study few soil pits were sampled and analyzed while the area was photographed by various sensors. We were able to relate data achieved from reflective and thermal sensors to several soil properties. These relations will help in future modelling and forecasting of soil parameters.

THE ONSET AND EVOLUTION OF THE PALMAHIM DISTURBANCE

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The Palmahim Disturbance, located offshore central Israel, is one of the major bathymetric anomalies along the continental margin; it is assumed to be the result of a gravity slide caused by evaporitic flow within the channel that underlain this area. The objective of this study was to determine relative and absolute time markers for analysis of the onset and evolution of the Palmahim Disturbance based on the reconstruction of its geological model.

The proposed geological model for reconstruction resulted from reprocessing of the 1983 Horizon 2D multi-channel seismic lines, which derived high-resolution depth sections across the disturbance. Line EM-83-40 was selected for reconstruction as it crosses the Palmahim Disturbance along the direction of material transport, thus, it can be assumed that all the observed phenomena are perpendicular to the section plane and there is no material movement or transport in and out of the section.

The chosen section was divided into three areas: 1.The eastern part, which is characterized by complex structures caused by gliding of the massive Yafo Formation sediments along synthetic and antithetic growth faults. 2. The middle part, characterized by undisturbed continuous horizons. 3. The Western part, characterized by compressional faults; however, the apparent continuity of the horizons in this part allow reliable correlation.

Geological reconstruction of the western part of line EM-83-40 enabled identifying three main tectonic phases: small-scale normal faulting, intense reverse faulting and folding, all postdating the "M" reflector, top of the Messinian evaporitic sequence. Tying a reflector near the top Pliocene at the YAM WEST 02 borehole into the disturbance enabled to determine an absolute time marker, which indicates, together with the present day sea-bottom, that the last phase, the folding, is much younger than 1.7 ma. The reconstructed section further indicates that the faulting started at an earlier stage, and that the folded structures developed on top of the concurrent reverse faults.

RECENT ADVANCES IN DISCRETE FRACTURE NETWORK MODELING

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Discrete Fracture Network modeling (DFN) is a simulation approach that has been in practice for about 20 years. The basic DFN method addresses rock mechanics and hydrogeology by realistically modeling the most significant fractures, their geometries, and their mechanical and hydraulic properties. DFN began as a combination of statistical descriptions of fracture geometry and finite-element flow solvers. The techniques of DFN simulation have advanced through applications in radioactive waste research laboratories, such as the Stripa Mine and the Äspö Hard Rock Laboratory. Petroleum reservoir applications have also provided a means of testing modeling approaches.

Although fractures can be described by probability density functions with reasonable levels of statistical confidence, natural fractures are the result of rock deformation and chemical processes that may either enhance or heal the transmissivities of the fractures. Among the alternative approaches for generating geologically realistic fractures are (1) fracture growth based on fracture mechanics principles, (2) palinspastic reconstruction methods from structural geology, and (3) forward modeling using finite-strain simulation methods. These approaches have been incorporated into DFN fracture generators. The paper will present example applications of each of these methods. Future trends in geological generation of fractures will likely include chemical processes as well.

FLINT EXPLOITATION BY THE PREHISTORIC INHABITANTS OF NAHAL ME'AROT CAVES, MOUNT CARMEL, ISRAEL

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Reconstruction of exploitation patterns of flints, technology and typology, provides insights into changes and developments in material culture and ways of life during prehistory. The long prehistoric sequence of the Nahal Me'arot sites, which extends from the Lower Paleolithic to the Natufian and even the Neolithic, enables the examination of the cultures represented in it, while isolating the factor of site location and distance from flint sources. The examined assemblages were derived from the Acheulian, Acheulo-Yabrudian, Yabrudian, and the Early and Late Mousterian cultures (from Tabun Cave), and the Aurignacian and Natufian cultures (from el-Wad Cave and Terrace).

The research aims at:

1. Reconstructing patterns of raw material procurement through tracking the potential flint sources used by the inhabitants of the Nahal Me'arot sites from the Lower Paleolithic to the Epi-Paleolithic.
2. Establishing the connections between these patterns and the ways people exploited their environment during these periods.
3. Evaluating the potential contribution of flint exploitation to the understanding of cultural changes throughout this unique prehistoric sequence such as various technological inventions (e.g., the use of the Levallois method, flake vs. blade industries, microlithic industries; and the transition from nomadic hunter-gatherer groups to sedentary complex societies).

A geological survey of the various Mount Carmel geological formations was conducted in order to identify possible flint exposures which might have been used as sources of raw material by the inhabitants of Nahal Me'arot in the periods discussed. The findings of the survey were marked on a geological map to create a "flint library". The various flint types were differentiated on the basis of their color with a number of paleontological, morphological and textural criteria. The archeological samples were then sorted according to the geological flint types. A geochemical test, intended to distinguish between the various types of flints, showed that, while it is possible to distinguish between Eocene and Cenomanian flints, further subdivision into secondary sub-types is not possible.

When the various archaeological samples are analyzed against the background of the geological "flint library", it becomes clearly apparent that local flint sources were available to, and used by, the inhabitants of Tabun and el-Wad Caves throughout the prehistoric sequence. Two main local flint sources, from the Khureibe and Shamir formations, high-quality flints for knapping, were utilized by all cultural groups.

For a better understanding of the modes of raw material procurement, and in order to further characterize certain cultural entities or tool-kits, future research should deal separately with specific technological traditions or tool-types. This will help elucidate some of the observed changes in raw-material procurement models, such as the greater emphasis on the use of the Shamir Formation flints during the Middle Paleolithic and Upper Paleolithic.

GROUNDWATER FLOW COMPLEX AT THE KISHON GRABEN

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N.R.D. - Natural Resources Development Ltd.

Young sedimentary deposits of Neogene to Quaternary age were accumulated in a deep and narrow erosional channel over older relief of down faulted blocks in the Kishon Graben. This sedimentary sequence is very thick (over 1,000m) in the coastal zone close to the Mediterranean Sea, thins to about 350-400m in the central part of the graben (Haifa Refineries investigation borehole) and wedges out further to the East at the foothills of Tivon syncline. The stratigtaphic section at the graben central area could be divided into three major units (from bottom): (1) Impermeable Anhydrite layer (Mavkiim formation). (2) Sandy marl, clay and fine sand. (3) Littoral and marine calcareous sandstone, sand (the lower section of which, includes the Kurdani formation).

Groundwater salinity in the bottom unit is very high and close to seawater. Salinity in the middle section decreases but still high, reaching 8,000ppm chlorides. Groundwater in the upper unit is brackish and salinity varies between 600ppm chlorides to 3,000ppm chlorides. This unit is the main and principal aquiferic complex in the graben area, which is divided locally into two or three sub aquifers.

The Kishon graben aquifer is a receptor and collector of underground inflows and surface infiltrations into the downfaulted graben valley. Groundwater inflow from Judea Group aquifers in Mt. Carmel and Naaman uplift enter through the faulted graben boundaries in the south and north. Groundwater inflow from Mt. Scopus aquifer enters from the Eastern area of Usha – Kefar Hasidim-Tivon. Groundwater overflow enters the graben aquifer from the north (Afek horst). Surface infiltrations reach the aquifer along streambeds, irrigated areas and fishponds.

Throughout the past several years, few studies took place, including 3D model simulation for the Kurdani aquifer. During model calibration, detailed flow directions and chlorides transport were obtained, as well as determination of permeabilities and transmesivities along the graben northern boundary (Ramat Yohanan fault).

New hydrogeological significant data was obtained as a result of the detailed investigations carried out by Haifa refineries and the surrounding industrial plants aimed towards brackish groundwater exploitation and desalination for industrial purposes. New observation boreholes and production wells to the upper unit were drilled and hydrological monitoring took place in the past three years. The accumulated data interpretation discovered different flow orientations and salinity resources at different levels of the upper unit. Further and more comprehensive monitoring observations will take place at the next few years.

DOES MANTLE DIAPIR PRODUCE HEBRON MAGNETIC ANOMALY?

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Hebron magnetic anomaly is the greatest magnetic anomaly located at the Israeli territory. Folkman & Bein (1978) and Rybakov et al. (1995) assiociated this anomaly with magnetic source at comparatively small depths (5-7 km). Quantitative analysis indicates that the upper edge of the magnetic source ocurrs at a depth of 25-26 km. A rough estimation of the lower edge occurrence is estimated at a depth of about 40 km. Calculated magnetization of this body is about 3000 mA/m. Maps of Moho and Curie discontinuites suggest that the corresponding surfaces in the region are located at the depths of 29-30 and 40-40.5 km, respectively (Eppelbaum & Ben-Avraham, 2002). Thus, the upper edge of this body is located 4-5 km above the Moho boundary. At the same time the depth of the lower edge of this body and the maximum possible depth of magnetic source occurrence are practically coincided.

In the area of the Hebron magnetic anomaly a few deep (^{3} 5-6 km) boreholes (Meged-2, Ramalla-1, David-1A, Helez-Deep, Pleshet, Moza-1, etc.) were drilled. All the boreholes contain detailed stratigraphical sequences of the Mezosoic and Cenozoic strata. Within this area is located a collision zone between the terranes of Judea-Samaria and Negev (described by Ben-Avraham and Ginzburg (1990)). Sequence formation maps show that the Judea-Samaria terrane was subducted under the Negev terrane. It is known that collision zones are characterized by geodynamic crust-mantle instability. In collision zones of the eastern Mediterranean the occurrence of mantle sequence rocks at earth's surface is explained by uplift of mantle diapirs (Borradaile & Lagroix, 2001). Thus, we suggest that the Hebron magnetic anomaly is caused by an upper mantle diapir with roots located at a depth at least of 40 km.

BRITTLE ASPECTS OF EARLY TERTIARY EXTENSION IN THE CANADIAN CORDILLERA

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We document a change in footwall rheology of a core complex in the Okanagan area from ductile to brittle as it was exhumed and progressively incorporated into the hanging wall. This record includes, an initial WNW-ESE extension followed by the subsequent northeast-southwest compression. Three deformational styles, shallow ductile shear, shallow brittle shear, and steep jointing and faulting, were involved progressively through time as the structure was exhumed both tectonically and erosionally.

We measured the attitude of fault planes and their striations and use a combination of striae and other displacement indicators such as displaced contacts, and/or recrystallization, mainly of calcite, in small pull-aparts to determine the sense of movement on faults. The relative timing of the shallow brittle deformation resulting in shallow dipping fault planes and the steep joints and faults is based on cross-cutting relationships. The pattern of the most significant group of faults, in most stations, is identical to that of a systematic joint set. The trend of these joint sets is parallel to both major extensional faults and early Tertiary dykes of the Okanagan area. This indicates that the early Tertiary deformation was dominated by WNW to ESE extension resulting in a pervasive and intense fracture set (joints), striking NNE. A later NE-SW to N-S compressional deformation resulted in reactivation of these joints as normal, reverse or strike-slip faults, and in small and major folds. Good exposures of the major faults planes in the area are rare, and their trace is often inferred from the prominent morphology formed by displacement along them. The consistency between the small structures and the map-scale structures, mainly faults, suggests a similar structural history for both.

THE POTENTIOAL OF GEOPHYSICAL METHODS FOR SINKHOLE HAZARD ESTIMATION AT THE DEAD SEA SHORE-FIRST STAGE OF STUDY

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Two geophysical studies were carried out, addressing the sinkhole hazard estimation: One of them is the official study leaded by the Geological Survey and the other one is presented hereby, suggesting some new and different results. The second study was performed by scientists of the GII as inter-disciplinary studies, including the Seismic refraction, reflection and diffraction, Ground Penetrating Radar (GPR), Continuous Vertical Electric Sounding (CVES), and Microgravity methods (Bruner et al., 2003, Ezersky, 2003a,b, Rybakov, 2003). In the present paper we will consider the conception of the sinkhole hazard estimate using the combined geophysical technology. We will present the results of pilot study at the Newe Zohar site: compare the Microgravity and CVES results performed at the same sinkhole development area, and re-estimate the potential of electromagnetic methods. In 2003 we have proposed the compressional wave velocity of 2900-3000m/s as lower limit for compact salt (located under water table) indicator. We proposed the "salt edge dissolution" as the mechanism of sinkhole formation at the Ein Gedi area, based on seismic refraction data available. We shown that at the Nahal Hever south area the sinkholes developed in some different mechanism, but there is no sufficient seismic refraction data for mechanism specification. In 2004 we have mapped the western edge of the salt at the limited area of Newe Zohar south site, where ground water table is located at elevation of –392m because of the water pumping into Dead Sea plant pools (whereas –415m is the water table level of the Dead Sea). It was obtained that the sinkhole groups develop along the compression wave velocity of 2900-3000m/s, which is accepted as the salt border – i.e. the "salt edge dissolution". There are resistivity anomalies of 1000-4000 Ohm-m at the sinkhole development site (whereas 200-900 Ohm-m are background resistivities). Using GPR method the characteristic anomalies shaped like hyperbolas, were obtained at the microgravity anomaly locations. These anomalies with high probability are small voids and fractures located at the depth of 4.5-5m and connected with the general decompaction of the soil in shallow subsurface at the sinkhole development sites. Microgravity map is presently in processing. The study at other sites will be continued in framework the NATO Science for Piece Program.

THE RELATIONSHIPS BETWEEN SALINITY, GROUNDWATER DISCHARGE, AND SURFACE FLOW AS CONSTRAINTS FOR FUTURE MANAGEMENT SCENARIOS IN THE LOWER JORDAN RIVER

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A study of the Lower Jordan River, between the Sea of Galilee and the Dead Sea, reveals that groundwater discharge into the river water is a major process that controls the river water salinity. Integration of the geochemical (e.g., Br/Cl) and isotopic ($d^{34}S$, $^{87}Sr/^{86}Sr$) variations enabled us to quantify the groundwater flux in different sections of the river. We show that the initial base flow of the river at Alumot Dam, just south of the dammed Lake Kinneret (Sea of Galilee), is a mixture of saline springs diverted to the river and sewage effluents. In the northern section of the river, sulfate-rich groundwater discharges into the river and modifies the river water composition. During the winter months, the groundwater contribution can reach up to 80% of the total solute budget of the river. In the southern section of the river, we use the high salinity, and SO_4/Cl, and Br/Cl ratios of the different groundwater bodies as fingerprints to identify and quantify the groundwater flow to the river during different times of the year. The current relationships between groundwater discharge and surface flow are used for the prediction future scenarios. Using water quality data, mass-balance calculations and actual flow-rate measurements, we investigate possible management scenarios for the Lower Jordan River and their potential effects on its salinity. The predicted scenarios reveal that implementation of some elements of the Israel-Jordan peace treaty will have negative impact on Jordan River water salinity.

THE FATE OF CHROMIUM IN THE VADOSE ZONE, RAMAT HASHARON AREA.

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High concentrations of chromium in soils and groundwater pose a significant environmental problem. Over the last 40 years, an industrial plant located above the coastal plain aquifer of Israel has produced large amounts Cr(VI)-rich wastewater. High concentrations of chromium, to 700 ppb, have been detected in several drinking-water wells located around the industrial zone. The vadose zone in the area is 30-50 m deep and composed of alternating sand, silt, and clay layers.

This study focuses on the exploration of the fate of chromium and other metals in the vadose zone below the potential sources within the industrial plant. Low (0.5 – 5 m) and high (10 cm) resolution soil profiles were sampled, from the surface down to the water table and in the upper two meters of the soil, respectively. The soil samples were extracted and analyzed for concentrations of trace elements. In specific locations, the concentrations of Cr(VI) were analyzed independently. The relationships between metal concentrations, soil mineralogical composition, surface area of the soil, organic compound content and other parameters were also studied.

Despite the historical data suggesting that high concentrations of chromium leached into the soil, and the high concentrations of chromium found in the surrounding groundwater, preliminary results indicate that surprisingly low concentrations of Cr were accumulated along the soil profile. The significant concentrations of calcite in the loam, sandy-loam and clay layers and the consequently high buffer capacity of the soil suggest that the infiltrating solution should reach pH values greater than 6.5 fast regardless of the initial pH of the penetrating effluent. Therefore, it is likely that the Cr(VI) was mobile along the unsaturated profile. If so, most of the Cr(VI) has already migrated through the unsaturated zone and only a small amount is still left in the vadose zone. Even in high resolution profiles taken below storage ponds where high-Cr solutions were stored, relatively low concentrations of Cr(VI) were found in the soil profiles. In addition, most of the Cr found in the profile was Cr(III), suggesting that the more mobile Cr(VI) has already leached down and probably found its way to the water table.

Several possibilities could explain the low concentrations of Cr found in the soil profile, even under potential "hot spots": (1) most of the Cr has already been flushed out from the vadose zone to the groundwater as Cr(VI) and the unsaturated zone profile is therefore relatively clean; (2) the low resolution sampling in the deep boreholes "missed" spots of high Cr concentration that still exist in the vadose zone; (3) the information provided by the industry about the location of the "hot spots" was inaccurate and therefore the vertical profiles of high concentrations have not yet been located.

COLLOID TRANSPORT IN SATURATED POROUS MEDIA- COMPARING NATURAL AND ARTIFICIAL SAND

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Soil column experiments were conducted to explore the influence of purity degree of sandy soil on the transport and fate of fluorescent colloid particles.

Negatively charged fluorescent microspheres of three sizes (0.02, 0.1 and 1 micron) together with a conservative tracer (LiBr) in artificial rainwater solution were applied to the surface of a vertical column (20.5 cm length and 5.7 cm inner diameter). The porous media consisted of natural dune sand and of the same sand, cleaned with nitric acid (50%) and sonicated with sodiumdiphosphate decahydrate. During the experiments effluent samples were taken at the column outlet, using a fraction collector. Additionally, the columns were dissected and samples were collected at different depths at the end of the experiments. Breakthrough (BT) colloid concentration curves and the final spatial distribution of colloids retained by the porous media were found to be dependent on the colloid size and to a great extent on the purity of the porous media. Overall BT of colloids was found to be less in natural sand compared to washed sand. Especially the small colloids (0.02 micron) were retained almost completely (~97%) in natural sand. BT for the medium colloids (0.2 micron) was highest (~30% retained), while the largest colloids (1 micron) were retained to ~60%. Despite the low recovery, breakthrough occurred for the colloids and for bromide almost simultaneously at one pore volume (PV). Lithium was retarded (BT at 1.5 PV), with a maximum relative concentration of 0.2 and extended tailing.

In washed sand colloid BT was much higher (90, 80, 70% for, 1, 0.2, 0.02 micron, respectively). The solute tracer had 90 and 100% recovery for lithium and bromide, respectively. In an up scaled experiment at saturated conditions and with the same natural sand (column length: 250 cm, diameter: 23.7 cm), colloids were retained completely, while the solute tracer showed similar behavior to that observed in the small column with natural sand.

The significant differences in BT of colloids and solute tracer between the natural and the washed sand can be attributed to the changes in physical and chemical properties, as a result of the cleaning procedure and thereby changes in both surface properties of the sand grains and the actual pores size and shape. Though being an accepted modus operandi in colloidal transport studies, simplification of the system often leads to an eventual change of the system to such an extend, that concluding from one onto the other seems a rather doubtful procedure. Especially when keeping in mind that most applications of these studies focus on a practical use in contamination control and prevention. Therefore, more efforts should be made in dealing with natural soils in order to approach colloidal transport phenomena of the "real" world.

INTRASHELF-BASIN OR TETHYAN BASIN-MARGINS? PRELIMINARY RESULTS OF A SEDIMENTARY STUDY IN THE CENOMANIAN-TURONIAN OF THE WEST-CENTRAL GALILEE

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The Ce-Tu stratigraphy in the Yirka – Yanuch region of the west-central Galilee is significantly different from other parts of the Galilee. The Yanuch Fm, Yirka Fm and Kishk Fm were constrained by Freund (1958, 1965) to the elongate, narrow, NE-SW trending intrashelf Yirka basin, transecting the western Galilee from the subsurface of the Haifa bay via Carmel to the Beka'a in Lebanon. According to Freund (1965) the Yanuch and Yirka Fms pass laterally into dolomitic lithology of the Sakhnin Fm both to the SE and NW, representing the shallow-water margins of the intrashelf basin. Preliminary results of a new facies study in this region questions the validity of the intrashelf basin concept for this region.

A reexamination of this succession shows that it is underlain by aggradational basinal deposits of the upper Deir-Hanna Fm. Highly bioturbated, mildly progradational rudist thickets and bioclasts characteristic of homoclinal ramp conditions occur at the base of both the Sakhnin and Yanuch Fms. Progradation is indicated by meter-scale upward-shallowing cycles in the inner ramp position, and by the development of rudist thickets further out on the mid-ramp. These mid-ramp biostromes ultimately form an arcuate rudist-debris apron of upward-steepening clinoforms (up to 25°) composed of calcarenites and calcirudites of ~80m thick. Their base forms a downlap surface. These clinoforms reflect a transformation of the western side of the mid-ramp region into a distally-steepened ramp (DSR) which is no longer homoclinal.

Two main features characterize the distal settings outside the accurate structure: (1) occasional colonization by rudists together with bioturbation of distal, originally laminar deposits; (2) mass-transport of proximal bioclastic calcarenites via channels, into a deep-water settings. Two episodes of onlap of basinal sediments occurred within this DSR phase. These two episodes are expressed in the mid and outer ramp, but have not yet been identified in the inner platform. They reflect two incomplete drowning episodes in the DSR prior to the Late Cenomanian major drowning phase, known to correlate with widespread shut-down of carbonate production in the entire Tethyan region.

The Late Cenomanian drowning episode was followed by deposition of the transgressive and early highstand tract of the Yirka Fm. This tract begins with distal decimeter-scale marl-limestone cycles with planktic foraminifera, followed by hemipelagic wackestones which interfinger with distal calciturbidites. Some of these distal turbidites near the village of Yanuch went through complete dolomitization and mapped as Sakhnin Fm. As such, they were erroneously considered as shallow-water facies bordering the Yirka Basin in the North West.

USING SEISMIC REFLECTION TO IDENTIFYSUSPECTED ACTIVE FAULTS IN THE SUBSURFACE

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Updating of the Israel Building Standard 413, which refer the map of potential active faults, necessitated further mapping of such faults utilizing geophysical methods. The seismic reflection method enables to identify faults in the near subsurface, which may be considered as active faults.

This activity is complementary to the geological mapping of young faults, and will be followed by paleoseismological dating of activity. This procedure will be also followed in designing new buildings, infrastructures and sensitive structures. Several surveys, which were conducted in various parts of the country, revealed some suspected active faults which are clearly shown in seismic sections, with no surface expression. In the Kiryat Shemona area a young fault, suspected as active was identified, running from Givat Shehumit southward. In the Zevulun Valley various areas were surveyed in order to map such features. In some cases young faults were located and in other areas no indication for young activity was found.. A seismic survey had been performed in the Arava area as part of the initial feasibility study for building an alternative airport for the city of Elat, eliminating suspected active faults.

THE SILOAM TUNNEL, JERUSALEM, WAS INDEED EXCAVATED DURING KING HEZEKIAH PERIOD: RADIOMETRIC DATING EVIDENCE

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The historical credibility of Biblical texts is often debated when compared with Iron Age archaeological finds. Modern scientific methods may, in principle, be used to independently date structures that seem to be mentioned in the biblical text, in order to evaluate its historical authenticity. In reality, however, this approach is extremely difficult because of poor archaeological preservation, identification uncertainty, scarcity of datable materials, and restricted scientific access into well-identified worship sites. Due to these problems, no well-identified biblical structure has been radiometrically dated prior to the present study. Here we report radiocarbon and U-Th dating of the Siloam Tunnel, proving its Iron Age II date; we conclude that the biblical text presents an accurate historic record of the Siloam Tunnel construction. Being one of the longest ancient water tunnels lacking intermediate shafts, dating the Siloam Tunnel is a key in determining where and when this technological breakthrough took place. The Siloam Tunnel dating also confirms the common palaeographic dating of the Siloam Inscription, and refutes a claim that it belongs to the 2nd century BCE.

OXYGEN ISOTOPE PERSPECTIVE ON POST OROGENIC ALKALINE MAGMATISM IN THE ARABIAN-NUBIAN SHIELD OF SOUTHERN ISRAEL

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The origin of anorogenic alkaline granites (A-type granites) is a long-standing geological problem. In the Arabian-Nubian Shield (ANS) A-type magmatism occurred in a post-orogenic setting at the latest Precambrian, postdating the formation of a vast calc-alkaline granitic batholith. A-type magmas form only 10% of the exposed ANS, but are geographically scattered and well represented in the outcrops in south Israel, including both plutonic and volcanic rocks. Previous petrogenetic and geochemical studies suggest that A-type rocks of south Israel originated by the differentiation of mantle-derived magmas without any notable contribution of crustal sources. Radiogenic isotope ratios cannot constrain the involvement of crustal sources in magma-generation since the ANS is juvenile and had not developed the indicative isotope signature of mature crustal terrains. Notwithstanding, oxygen isotope ratio is a sensitive tracer of addition of supra-crustal material to magma, since rocks that have dwelled close to the Earth's surface often have a distinctive signature due to exchange of oxygen with the hydrosphere. The ability of Zircon (Zrn) to attain and retain magmatic $d^{18}O$ values, avoids the problematic effects of post-magmatic alteration and re-equilibration, common in slowly cooled plutonic rocks.

Oxygen isotope ratios of Zircon of Timna alkali granite and Quartz-syenite are 5.55‰ and 5.82‰, respectively. These values lie within the range of mantle zircon, suggesting derivation of the felsic alkaline rocks of Timna from mafic, mantle-derived material. The lack of inherited Zircon is suggested by similarity in isotope ratios of different size fractions. $\delta^{18}O$ (Qtz) values of Timna alkali-granite, 8.17 to 8.40‰, are also consistent with mantle-derived origin. In contrast to the mantle values of the alkaline rocks of Timna, the Zircon separated from the Timna calc-alkaline porphyry granite has slightly higher values of 6.06 to 6.38‰ indicating a small, but significant input of supra-crustal material to the magma. $\delta^{18}O$ (Qtz) of Timna porphyry-granite is heterogeneous (6.91 to 8.31‰) and lower than the expected equilibrium values with Zircon, indicating post-magmatic hydrothermal alteration. This process might be related to the intrusion of the later alkaline Timna suite. The oxygen isotope ratios of Zircon from the Timna monzodiorite, 5.68 to 5.93 ‰, might suggest genetic relations with the Timna alkaline suite as argued by previous geochemical and geochronological studies. The higher (~1‰) oxygen isotope ratios of Zircon and Quartz of the Yehoshafat granite, 6.52-6.76‰ and 9.13 to 9.27‰, respectively, suggest input of either previously altered low-temperature or sedimentary component. A possible scenario is assimilation or re-melting and mixing of the adjacent Yotam rhyolites ($\delta^{18}O$ (Qtz) = 9.81 to 11.40‰).

INFLUENCE OF MANTLE ON THE OIL GAS BEARING OF EARTH CRUST

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Independent Researcher

At present time extracted oil reserves are estimated about 1* 10 barrel, which concentrated in Earth Crust. However, Earth crust occupies only 0.5 % 0f mantle mass. It is known, that in rift class oil gas bearing basins are concentrated about 80 % of oil and gas reserves. These structures by themselves are being channels between mantle and Earth Crust. Here arises the question – in which way influences mantle on the generation and placing of hydrocarbons?

For solution of this question:

1. Had been studied a fluids of Kura rift basalts (Alpine geosynclinals system).
2. Had been summed up a huge geological, geochemical and geophysical data over the world.

1. The range of basalt fluids classificated as a:

H_2O> CO>H_2>CO_2>CO_4, with content of components accordingly (sum of medium/ml/gram of rocks): 22.12; 8.08; 0.62; 0.29; 0.006.

Revealing of high temperature chrysene, pyrene can show about it depth fluid flow from the top of the mantle.

2. a) Research of the connection between partial melting degree of mantle and duration of rift development revealed the tendency of decreasing of partial melting degree of rift while decreasing of rift age.

b) Research of the connection between partial melting degree of mantle and the depth of mantle's roof shows that under giant oil gas bearing basins (South Caspian, West Siberia, Pannon etc.) mantle's roof are lying down on the big depths.

c) Research of the connection between depth of mantle's roof and degree of rift development shows decreasing of mantle's roof depth while decreasing of the rift age.

The conclusions:

1. The influence of partial melting degree on oil gas bearing forming of basins defines indirectly on the depth of mantle drainage.
2. The depth of mantle drainage plays important role in forming of reduction regime of fluids. Moreover, these deep fluids are being migrating, and give a certain budget into sediments of Earth Crust.

THE DEAD SEA RIFT/TRANSFORM DEBATE – CONTRIBUTION FROM INTERPRETATION OF OLD SEISMIC DATA

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The subsurface structure and stratigraphy of the southern Dead Sea basin were interpreted and mapped in the framework of a recent hydrocarbon exploration campaign in the area. The studied data set included sixty seven 2D, multi-channel seismic reflection lines acquired between 1975 and 1996, in an area extending from Ein Gedi in the north to Hazeva in the south; and from the international border in the east to the western boundary faults in the west. Reprocessing of the old seismic lines resulted with improved resolution and continuity of seismic events within the sedimentary fill of the basin,

Correlation of the seismic data to wells allowed identifying the three main stratigraphic units composing the basin-fill: the Hazeva, Sedom and Amora-Lisan sequences. Each of these units is characterized by a unique seismic signature. The Hazeva sequence is generally composed of discontinuous, high- and low-amplitude reflections associated with sand/shale intercalations. The Sedom sequence is characterized by chaotic and reflection-free zones associated with salt flow and occasionally by continuous reflections that probably reflect a more clastic rich facies. The Amora-Lisan sequence is composed of well layered, continuous high- and low-amplitude reflections associated with fine-grained lacustrine deposits; that are in places highly deformed due to underlying salt movement.

The three units were found to extend throughout the basin from the northern Arava in the south to the Ein Gedi area in the north. The main depocenter is located between the Sedom and Lisan Diapirs where the base of the Hazeva sequence is estimated to be found at depth of 9 km. Early subsidence in the basin took place on relatively short segments of normal to oblique faults oriented in NE-SW and NW-SE directions and was later transformed to several dominant marginal faults.

No indication was found in the study for northward propagation of depocenters with time and to the existence of a master strike-slip fault on the southwestern part of the Dead Sea basin. These findings indicate to complex relations between lateral and vertical motions that are not adequately described by a simple pull-apart model.

THE TECTONIC EVOLUTION OF THE LEVANTINE BASIN: FROM INTRA-CONTINENTAL RIFTING TO INVERSION AND CONVERGENCE

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In this study we identified and mapped the main structural elements and stratigraphic units of the Levantine basin in the southeastern Mediterranean sea; between the area of the Eratosthenes seamount on the northwest and the coast of Israel in the east.

The study is based on interpretation of 4,000 kilometers of 2D, multi-channel, deep seismic reflection data and 16 boreholes, located onshore and offshore Israel.

Six seismic packages were mapped above the crystalline basement. Their boundaries are extensive reflectors in the central part of the Levantine basin that are correlated to regional unconformities penetrated by wells in the eastern margin. These units are interpreted as low-order depositional sequences that accumulated within the basin and on its margin during the Mesozoic and Cenozoic.

Two main styles of deformation are recognized. Normal faults affect the older stratigraphic units, forming extensive graben and horst system in the central and western part of the basin. Reverse, thrust faults and folds affect most of the stratigraphic units and are found predominantly in the eastern margin of the basin.

Our analysis supply evidence for two major tectonic phases: (a) Large-scale rifting and extension in a NW-SE direction between the Eratosthenes Seamount and the Levant margin during Anisian to Middle Jurassic, associated with opening of the Neotethyan Ocean (b) Inversion of the older extentional structures, thrusting and folding in several pulses during Senonian to Late Miocene, associated with closing of the Neotethys.

The seismic data show no evidence for sea-floor spreading and emplacement of oceanic crust, therefore we assume that the deep-seated extensional structures were formed in an intra-continental rift system at an early magmatic phase.

The elevated and upthrusted fold belt extend along the entire Levant margin, where it forms the offshore continuation of the Syrian Arc fold system exposed onshore. The western edge of the fold belt, located some 50-70 km west of the coastline appear to coincide with an area of discontinuity in the crust previously hypothesized by other geophysical data. We therefore assume that the distribution of contractional deformation is partly controlled by variation in crustal properties.

MAPPING AGRICULTURAL SOIL PARAMETERS USING GEOELECTRIC METHOD

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Portable Frequency Domain Electromagnetic (FDEM) systems provide cost-effective mapping tools for various purposes, e.g. agriculture, soil salinity and contamination, shallow geology, shallow water table detection, archaeology and more. The measurements are frequently used to produce a conductivity map on which anomalies are outlined to track subsurface feature. Here we demonstrate that tangible soil parameters can be extracted from the measured conductivity in a combined procedure of processing and calibration. We aim to identify the effects of agricultural cultivation on the soil characteristics by delineating their signature on the measured conductivity.

Conductivity measurements in the eastern Roman hippodrome of Caesarea, currently buried beneath a seasonal wheat field, portray sharp linear parallel anomalies superimposed on broader archaeological and basal anomalies. The linear parallel anomalies are spaced by about 3.5 m with amplitudes 2-5% higher than the field's background conductivity. Based on their spacing, orientation, and distribution, we suggest that the anomalies in Ceasarea are related to the cultivation of banana trees, which were removed over 10 years ago from the field. Filtering the measured conductivity map we isolated the agricultural signature from the background conductivity. The conductivity anomaly produced by the hippodrome *Spina* (central wall) provides a control on our identification and separation of the agricultural signature.

By Comparing measurements of dry (summer) to wet (winter) soil, we learned about the moisture impact on conductivity signature in the area (winter: +50%), and used it for more accurate mapping of the soil features.

Analyses of the soil physical and chemical properties identify the ions governing its electrical conductivity. Our intention is to identify the soil characteristics associated with the agricultural linear anomalies, and calibrate our conductivity results.

Using the methodology we developed in Ceasarea we managed to image the Middle Bronze palace of Tel Kabri, presently buried under avocado plantations by removing high conductivity anomalies (about +25%) caused by the trees.

LITHOLOGICAL AND PETROPHYSICAL STUDY OF THE ISRAELI AQUIFERS

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Geophysical Institute of Israel has at its disposal data from a large number of oil/gas and water wells drilled from 1954 to 2004. Various companies in Israel have recently expressed interest in geological and geophysical information from these wells in order to define in detail the lithological composition, capacity-filtration properties and formation water salinity of groundwater reservoir.

Available composite logs for oil and water wells constructed on the basis of drilling data contain mainly lithological information from small cuttings along with resistivity curves from wire line logs. At the same time, in a significant number of wells, there are hundreds of meters of sediments not covered by lithological description due to no-return drilling (LOC intervals). Quite commonly these "blind" intervals correspond to the aquifers (Judea and Kurnub Gr.). Lack of reliable geological information in these intervals complicates the geological and stratigraphic correlations considerably.

Exploration of oil wells in these formations has yielded abundance of well log data, which can compensate for missing information and, thus, replenish data to fill in these gaps. Moreover, digitized well log data may serve as a source for continuous computation (throughout the entire depth interval) of the aquifer's petrophysical properties (lithology, porosity, water salinity).

We have developed a new "Extended Composite Log" format of digital well log, which combines petrophysical well log information with mud logs, stratigraphic and lithological markers. These "Extended Composite Logs" will be used in particular to fill in lacking data in the LOC intervals.

The accurate porosity and lithology determination is based on a combination of available "porosity" logs. Porosity is calculated taking into account lithological variations (sandstone, limestone, dolomite, shale). The results of lithology-porosity calculations are later used for formation fluid analysis of the aquifer (water salinity), construction of the lithology display, and for correlation purposes.

The groundwater salinity is usually obtained from well logs using the Rwa method, which is based on resistivity-porosity information. Rwa is the apparent resistivity of the groundwater obtained using the Archie equation, which assumes a clean water-bearing formation. The set of statistical relationships between log data and water well parameters was established in order to provide quantitative interpretation of aquifers from well logs.

The proposed petrophysical approach combined with other geological and geophysical information can form a quantitative aid to groundwater exploration and will facilitate more reliable solution of the following problems: mapping of subsurface structures, subdivision of the aquifers into sub-aquifers, mapping aquifers and aquicludes and estimating their lateral extent, tracing of lithofacies heterogeneity of aquifers, estimation of groundwater salinity, determination of the fresh/saline water interface, estimation of fresh groundwater reserves.

SITE EFFECT INVESTIGATION IN URBAN AREAS: THE INFLUENCE DUE TO THE PROXIMITY OF A STRUCTURE

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Good sites for settlements and dense urbanization are often not good as to seismic response: they are often located along the coast, or within flat sedimentary basins. As a consequence, the seismic risk is increasing in urban areas, as repeatedly illustrated in almost all recent destructive earthquakes.

Estimating site effects in urban areas using earthquake data is hampered by the high-noise level, especially in regions where the seismic activity is relatively low, as in Israel. The results of our investigation show that horizontal-to-vertical spectral ratio obtained from microtremors (Nakamura's technique) gives a good estimate of the resonance and amplification factor. Microtremor measurements in urban areas may be significantly modified by dense urbanization in some specific conditions. The basic phenomenon leading to such modifications is a combination of wave radiation from building due to soil-structure interaction, and wave trapping due to shallow impedance contrast.

Six buildings of three and four stories in Dimona were temporarily instrumented with two horizontal component stations for various periods of time. The fundamental frequencies of the translational motions in the NS and EW directions and the frequency of first torsional mode were determined using ambient excitation. The vibration tests show that for three-storey-buildings the fundamental translational modal frequencies for either orthogonal axis is 6.5-7.5 Hz while for four-storey-buildings the first mode motion is 4.3-5.3 Hz.

We observed that the resonance of the soil is strongly influenced by the proximity of structures on distance roughly proportional to their heights. The influence vanishes only at distance greater than twice the high of the structure.

SAYYARIM SEISMIC CALIBRATION EXPERIMENT

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A series of experimental explosions 0.3, 2 and 32.5 ton were successfully conducted recently by the Geophysical Institute of Israel (GII) in Sayyarim Valley (Massif Eilat Nature Reserve), near Eilat, Israel, in boreholes of large diameter (0.6-0.7 m) with depth of 18-21 m.

The largest shot of 32.5 tons designed as a large-scale in-land seismic calibration explosion, which aimed at improving regional velocity models for calculating travel times of seismic waves to seismic stations in Jordan and Israel and calibration of IMS stations. Two smaller explosions 0.3 ton and 2 tons were conducted at the same site, in single boreholes, thus providing (together with the calibration shot) a source scaling experiment for the yield-dependent analysis of regional waveforms.

A seismic refraction survey was conducted on the site by the GII before the experiment – to estimate thickness of near-surface soft sediments for evaluation drilling feasibility, and estimate a velocity model in the near-source zone.

The 300-kg explosion was fully contained, whereas two larger shots showed rock outbursts and energy losses into the atmosphere. The 2-ton explosion created a round symmetrical crater of radius ~13-14 m, a number of different non-symmetrical craters were created by the large explosion.

High quality waveform records were obtained for the explosion series in the near-source region by accelerometers at distances 100-500 m, and numerous portable and network seismic SP and BB stations in Israel and Jordan. In the largest shot clear Pn and Pg wave groups are observed at remote IMS station AS56 (ASF) at 323 km and IMS array AS49 at Mt. Meron at distance ~350 km. Using first Pn, Pg arrivals we updated an existing velocity model. The new model provided better accuracy and reduced the RMS error for observed data. Coda-derived moment-rate spectra technique was applied to BB records for determination of stable regional magnitude.

Significant seismic strength was achieved (M_L~2 for 2 ton and M_L~3 for 32.5 ton) in spite of accommodation of the explosives in dry alluvium and shallow burial depth, commonly considered as low-coupling factors.

This experiment will also contribute to study of explosion source phenomenology in specific geological settings and understanding main features of seismic energy generation from point-like sources.

SEISMIC AMPLIFICATION IN THE ISRAELI BUILDING CODE

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The understanding of ground motion amplification during earthquakes and its relations to the subsurface structure has significantly improved in Israel in recent years. However, the newly acquired information cannot be implemented in the building code that doesn't consider lithological variations deeper than 30 m. This paper highlights two problems. First, the Israeli as well as the US and international building codes, are based on the concept of upper 30 m and, thus, may not cover the strong amplification expected when soft sediments overlying the hard Judea Group start to resonate. Second, the Israeli building code is not updated compared to the US and International codes.

In the Israeli code the spectral acceleration (SA) for rock sites is determined by a single parameter, PGA (Pick Ground Acceleration), whereas in the US code it is determined by two values – the accelerations at 0.3 sec and at 1 sec. In the Israeli code the maximal soil amplification factor is 2.5, whereas in the US code it may reach 3.5. In the Israeli code there is no difference between rock and soil sites at periods shorter than 0.35 sec, whereas in the US code they may differ by a factor of 2.

The approach that only requires shear wave velocity at the upper 30 m of the ground was proven to work quite well in California. Its practical advantage is that it is based on a single parameter easily obtained by private initiators. Its weakness is that it doesn't treat well situations of resonance. One famous example of severe damage caused by resonance is the Mexico City EQ in 1985. In that case, buildings with a natural period close to the natural period of a soft mud layer upon which they were build, collapsed.

Such geological conditions are not common in California. Nevertheless, in suspicious cases (Site Class F) the US code requires site specific surveys. The relevant question for Israel is whether the same approach can be adopted here. On one hand, strong resonance of soft surfacial layers may be much more common in Israel, because the impedance ration between the Judea Group and its overlying sediments is much larger than most cases in California (5-10). On the other hand, the non linear characteristics of soils that reduce ground vibrations at high levels of acceleration still haven't been fully considered. This is, therefore, the focus of future research that will determine whether the Israeli building code will simply adopt the US code or implement significant changes suitable to Israel's geological structure.

MAPPING SEAWATER INTRUSION INTO THE COASTAL AQUIFER USING SUPPLEMENTARY TDEM/CVES MEASUREMENTS

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During the last two decades, the time domain electromagnetic (TDEM) method became the leading geophysical technique for detecting and monitoring seawater intrusion into coastal aquifers all around the world. The method has replaced traditional resistivity soundings (VES) due to its superior accuracy and reliability of the interpretation. However, the successful application of TDEM is very limited in urban areas due to its high sensitivity to ambient EM noise and due to the necessity of using relatively large infrastructures free areas to lay down the transmitting antenna. Contrary to TDEM, resistivity soundings are carried out along straight lines (e.g. streets or roads) and are practically insensitive to most kinds of EM noise. Moreover, during the last decade, a new sophisticated multi-dimensional modification of traditional resistivity soundings, named continuous vertical electrical soundings (CVES) has been developed and gained increasing popularity in solving various geoexploration problems.

In order to overcome the above mentioned limitations of TDEM, an attempt has been made to supplement TDEM measurements by CVES in those areas, where the application of TDEM alone is impossible.

To calibrate CVES measurements, several lines have been run first near existing observation wells. All calibration measurements detected the very low resistivity layer in the bottom of the interpreted resistivity cross-section, which was identified with seawater intrusion. However, in most cases the intrusion was located significantly deeper than that detected in the well and by TDEM. Analysis shows that this problem was caused by a non-uniqueness of the inversion known in traditional resistivity soundings as the equivalence problem. The specific smoothness constraint algorithm used in the inversion possibly further complicated the problem.

Another severe problem encountered during the CVES measurements was instability of the measurements in dry sand dunes. The instability remained even after significant amount of saline water or blue vitriol has been added to each electrode thus reducing the contact resistance below the allowed threshold value of 20 Kohm.

The only promising CVES results were obtained not far from the seashore, where the depth to fresh-seawater interface did not exceed some 25-30 meters. As far as significantly deeper interface is concerned, it is not obvious that CVES should replace even traditional VES due to the lack of the appropriate inversion software, which is based on a sharp boundary constraint algorithm, and, in addition, can detect and analyze the equivalence problem.

At all locations, where TDEM can be deployed and can provide a reasonable signal-to-noise ratio, the use of neither traditional VES nor CVES is recommended.

SITE EFFECT MEASUREMENTS ALONGE THREE PROFILES LOCATED IN HAIFA BAY AREA : PRELIMINARY RESULTS

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In order to estimate site response, ambient vibration measurements were carried out along three lines. Two profiles crossed Qrayot-Haifa bay area from northwest to southeast and additional from southwest to northeast close to coastline. The horizontal-to-vertical spectral method was applied to approximate the fundamental resonance frequencies of the subsurface and their associated amplitudes.

It was established that the soil sites exhibit H/V peak amplitudes ranging from 3 to 7 in the frequency range 0.4 to 7.0 Hz. In particular, we found that along the profile which passes through the Qishon graben from the southeast to the coast line, reflector changes from limestones of the Top Judea Group to chalk of Eocene age, to limestone of Miocene age and finally to calcareous sandstone of the Kurkar Group. Influence of two reflectors simultaneously is revealed by presence of two peaks on the spectral ratio curves. We also concluded that shear-wave velocity of the Kurkar Group increases significantly toward the coastline.

Site response functions along the second profile located within the Afek horst reveal two reflectors. The shallow reflector which is associated with high-frequency response is limestone and sandstone of the Kurdane Fm. The deeper reflector which correlates with lower frequency peak is limestone of the Top Judea Group. However, in the west part of this profile we observe divergence between depth of reflector estimated by measurements and depth of the Top Judea Group.

Two important points must be emphasized:

1. Available borehole information and seismic surveys data do not allow establishing exact verification of the experimental response function by 1-D model.
2. Thickness of sediments above reflector, the presence of different reflectors and local changes of shear wave velocities of soil and underlying reflector, could be evaluated by dense grid measurement of ambient vibration. This is the only way for establishing the correct 1-D model of site effect for different points.

THE FINE GRAIN DETRITAL SEDIMENTS OF THE DEAD SEA GROUP.

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The Petrography, Grain size, Mineralogy, Chemical and Isotopic composition of fine – grain detrital sediments that were deposited in the lacustrine environment of the Dead Sea basin during the late Pleistocene and the Holocene period, are used to reconstruct the sources, means of transportation and deposition of the detrital sediments and to combine these data with the information on the climatic conditions in the region.

Samples were collected in several exposures of the late Pleistocene Samra, Lisan and the Holocene Ze'elim Formation and from some possible –sediments suppliers flood from the western side of the Dead sea, aeolian loess deposits from Netivot osa SoilR arreT dna puorg aeduJ morf kcor etanobrac ,(northern Negev)section .(common in the drainage basin)

Petrographic examination of the detrital sediments, reveals microstructure of graded bedding and well-sorted, silt size bedded sediment. These microstructures indicate two settling mechanisms of the fine sediments, by flood and by dust-fall.

The mineral assemblage, as defined by XRD, chemical and electron microprobe analysis, is dominated by calcite + dolomite and quartz, and minor feldspar, clay, soluble salt, and iron minerals. The Dead Sea group sediments share similar composition with the flood load (calcite+dolomite>quartz) and differ from the loess deposit and Terra Rosa soils (calcite+dolomite<quartz).

The detrital sediment consist mostly of silt size with some clay and a few sand grains. The size distribution (determine by Mastersizer), for all samples, shows that the mode size of the Lisan samples is close to the loess deposits (7-10m) and bigger than in Ze'elim Samples and the flood load (~ 4m).

$^{87}Sr/^{86}Sr$ Isotopic composition was measured in acetic acid soluble fraction (carbonate) and in the residual fraction (silicate) of the sediment. The soluble fraction is dominated by the presence of autigenic minerals (soluble salts or calcite). The insoluble fraction, on the other hand, shows similarity between the Lisan and Samra $^{87}Sr/^{86}Sr$ ratio and these of loess deposits, while the flood load and Ze'elim formation has higher $^{87}Sr/^{86}Sr$ ratios.

The results of this study indicate that there is a strong connection between Quaternary climatic changes and the characteristic of the fine detrital sediments in the Dead Sea group. During wet climatic condition, when lake levels are high, the fine detrital sediment is mainly dominated by aeolian sediment transported to the basin from a long distance and settled both over the drainage basin and over the lake, while during dry periods the fine sediments is dominated by the local land cover. This scenario is consisted with data of present airborne and settling dust.

NEW ISOTOPIC EVIDENCES FOR THE ORIGIN GROUNDWATER FROM THE NUBIAN SANDSTONE AQUIFER (KURNUB GROUP) IN THE NEGEV

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A multiple isotopic (oxygen, hydrogen, sulfur and oxygen in sulfate, strontium, boron, carbon) investigation of groundwater from the Nubian sandstone aquifer (Kurnob Group) in the Negev and Arava Valley challenges previous models for the origin and flow paths of groundwater in this aquifer. We found that groundwater in the confined area of the aquifer in northeastern Negev has high deuterium excess (~16‰) relative to groundwater from Sinai Peninsula (~10‰), thus indicating local recharge sources in the Negev but not lateral flow originating in the Sinai Peninsula as previously suggested. We found that modern recharge (^{14}C=67 pmc) is associated with oxidation of pyrite and carbonate dissolution, resulting in depleted sulfur isotopes (-13‰) and relatively high $^{87}Sr/^{86}Sr$ ratios. As groundwater flows into the confined parts of the aquifer, sulfate is reduced and hydrogen sulfide is generated as detected by the enrichment of sulfur and oxygen isotopes in sulfate coupled with significant reduction of sulfate content. The generation of dissolved bicarbonate by sulfate reduction process affects also the ^{14}C budget and thus age calculation. Consequently, the traditional link between deuterium excess and ^{14}C proxies for groundwater-age determination in the aquifer is not sufficient given the possible effect of sulfate reduction process. We show that the solute composition of groundwater in the aquifer is controlled also by mixing with sulfate-rich underlying groundwater. In the northeastern Negev we suggest that a large fraction of the groundwater is mixed with groundwater from the underlying Jurassic aquifer that was interacted with Triassic marine anhydrite, characterized by high $\delta^{34}S$ (+15‰) and low $^{87}Sr/^{86}Sr$ (0.70764) values. In the central and southern Arava Valley we suggest that the groundwater is mixed with brines from the underlying Paleozoic aquifers having low $^{87}Sr/^{86}Sr$ (0.7073), high Br/Cl (3x10-3), and high $\delta^{34}S$ (11‰) values. In both areas, the idea of contribution of a large volume of underlying groundwater is new and require a major changes in the hydrological concepts that consider only lateral flow within the aquifer from presumably recharge in outcrops in southern Sinai Peninsula.

MAPPING SITE EFFECTS IN DIMONA AND ARAD

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The towns of Dimona and Arad are located in earthquake prone area, in the vicinity to the Dead Sea Transform, where several destructive earthquakes have been occurred in the past. They are recently developed towns and might be the place for future, heavily damaging events, due to the combination of site effects and urban development.

In order to estimate site response functions empirically 275 and 110 sites were instrumented in the towns of Dimona and Arad respectively. We used the H/V spectral ratio from ambient vibration technique to estimate site response. Additionally, weak ground motion amplifications were determined using H/V spectral ratio for S-waves generated by explosions at three sites. Similar response functions obtained from two source facilitated extrapolation of ambient vibration measurements for site response estimation. Distributions of the resonance frequency and corresponding maximum amplification factor are depicted in the maps.

The site response investigation in Dimona revealed fundamental frequencies in the range of 1.0-9.0 Hz associated with amplification factors of 2.0-7.0. The asymmetrical shape of syncline is distinctly visible in the contours map of resonant frequency. The belt of lower (1.0-2.0 Hz) fundamental frequency values directed northwest-southeast may be interpreted as a channel of erosion of paleorelief as confirmed by geological information. The significant variations in the amplification level could be related with the variation of the impedance between the bedrock

In Arad, the distribution of the resonance frequency and maximum amplification exhibits amplification factor of 2.0-4.0 over the frequency range 2.0-7.0 Hz. The higher fundamental frequencies occur in the western part of the study area. The lower resonance frequencies are attained in the southern part of Arad. The amplification factor 2.0-3.0 we observed at majority of sites. Only in the eastern part of the area are distinguished a few spots with amplification factor up to 3.5.

LANDSLIDES IN VIBRATION SAND-BOX; PRELIMINARY RESULTS REPORTING TYPES OF SLOPE-FAILUERE AND APPARENT FREQUENCY MAGNITUDE (AREA) POWER LOW RELATIONS

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It is commonly thought that different types of landslides merely reflect different mechanical characteristics of slopes (i.e. rockslide and slumps develop in layered sequences of solid rock and in earth-like geological material, respectively). We present experimental evidence for a new and unexpected control on types of landslides: Using a vibrating 28 cubic cm box filled with wet (1%wt) sand, we observe that different types of slides form on a single slope subjected to different acceleration directions. Initial slope angle was about 50°, vibrating frequency 10Hz and individual test duration lasted a few minutes. Three different accelerations directions were tested: vertical, slope perpendicular, and normal horizontal accelerations. Acceleration magnitudes ranged from 0.1 to 1.2g. Slope-performances were continuously recorded using a 30 frames/second digital camera.

We observed that vertical vibrations larger than 1.0g, induced mainly a few cm wide block-slides and toppling from a step like scarp that migrated up the slope. Block sliding rate was approximately one every few seconds. Lower accelerations or lower initial slope angles yielded only surface grain flow. Horizontal shaking yielded different behavior: Above a threshold acceleration (0.6g and 0.8g for shaking parallel and normal to slope dip direction, respectively), surface flow occurred initially. It was followed by a box-wide slump, which first remained coherent and then progressively disintegrated. Lower accelerations or initial slope angle yield only surface grain flow. These results point to a previously unknown control on style of slope failure: the acceleration direction and amplitude. We speculate that different vibrations activate failure on weak planes with different orientations, followed by gravity induced down-hill displacement. Finally, the upper surface areas of tens of block-slides induced in the above described vertical vibration tests were analyzed. The blocks cumulative area distribution shows power law relation with slope of about 1. We hypothesize that the power of the frequency-magnitude relations in landslide populations is determined by material heterogeneity such as pre-sliding cracks.

G.I.S BASED EVATUATION OF EARTHQUAKE- INDUCED LANDSLIDES HAZARD AND SLOPE-FAILURE STYLE IN NORTHERN MT. CARMEL AND THE CITY OF HAIFA EREA

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Landslides are rapid down-slope movement of rocks and earth often triggered by moderate to strong earthquakes. Landslides in populated regions may cause extensive life and property losses. Identifying areas susceptible to landslides promotes proper urban planning and engineering design that lead to hazard reduction and increased safety for life and property. Here we present a preliminary evaluation of earthquake-induced landslide (EILS) hazard in the region of Haifa city and northern Mt. Carmel (based on the Haifa 1:50,000 map-quadrangle).

We applied a G.I.S based EILS hazard analysis using, a digital terrain model, a geological map and a structural map of top Judea Group (25m2 grid cell). We first calculated the topographical and structural dip and dip direction (aspect) and converted the geological map to a lithology-based geotechnical map. The high strength dolomite and limestone formations were designated "geotechnical unit I" (GT-I), while GT-II to GT-IV comprise formations with decreasing rock strength. We then used these data to construct a map showing the most likely failure style (landslide type) of each slope in the studied area. Slopes susceptible to rock-falls are found where the topographic dip exceeds 40°. Where the topographic dip is smaller than 5° we found lateral spreads or no-failure to be most likely (for GT-III,IV and GT-I,II respectively). For a topographic dip of 5°-40°, where the exposed rocks are weak (GT-III,IV) slumps are most likely, and where the exposed rocks are strong (GT-I,II) the area is susceptible to rockslides, if two kinematic conditions are met: (1) the structural aspect is within 45° to the topographic aspect and (2) the apparent structural dip in the direction of the topographic aspect is smaller than the topographic dip. If one of these conditions fails the area is not assigned a likely failure style.

We then assigned mechanical properties to each geotechnical unit and calculated the critical acceleration for slopes where slumps and lateral spreads are the likely failure styles, and for slopes where the failure style was not determined. Critical acceleration for rockslides and rockfalls was calculated using the mechanical properties of clay-filled bedding planes. Low critical acceleration (relatively high EILS hazard) was found in the north and northeastern fronts of Mt. Carmel and in the gorges descending towards the Mediterranean and the Zevulun valley.

Finally, we used the Newmark analysis to calculate scenario maps depicting slope performances for some theoretical earthquakes (i.e. M=6.5 on Carmel-Tirtza fault system and 7.5 in the Dead Sea rift).

CLASSIFICATION OF KURKAR UNITS FOR ENGINEERING PURPOSES, THE "RED LINE" PROJECT, MASS TRANSIT SYSTEM FOR TEL-AVIV METROPOLITAN

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The lecture presents a classification method for Kurkar layers for engineering purposes. The need of a classification method was arising during the geotechnical investigation of the underground section of the "Red Line", the first line of Tel-Aviv metropolitan mass transit system.

The total length of the line is 18 km and it is extended from Petah Tikva through Zabotinsky rd, Menahem Begin rd, Manshia, Jerusalem bl. To Bat-Yam. The underground section extends from Geha junction to Manshia. The line crosses the Kurkar ridges which are extended parallel to the line of the cost.

As can be seen in exposures the Kurkar is a very non-homogeneous media, with a varying structure: hard cemented layers, with thickness of 0.5 to 5 cm, with layers of sand in between. Fingers of cemented sand, cross-bedded layers. Massive and hard rock. Etc. the quality of Kurkar samples, which can be obtained with regular core drilling is very poor. Triple core barrel was used to improve the sampling, with minor success.

A classification method of the Kurkar layers were proposed, in which the Kurkar is classified to 4 groups: K1, K2, K3 and K4, mainly due to the content of the cemented layers. A trial was made to correlate the Kurkar group to the carbonate content. Box "Un-disturbed" samples were obtained for shear strength tests.

THE EFFECT OF THE RECESSION OF THE DEAD SEA ON GROUNDWATER IN ITS VICINITY

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Since the 1960's, there has been a decrease in the Dead Sea level. In recent years this decrease has reached a rate of one meter per year. The recession of the Dead Sea is much more rapid than natural processes and it affects the groundwater system in the Dead Sea area. Previous studies show a hydraulic connection between the Dead Sea and the groundwater system dynamics. Geophysical studies also show evidence of an interface between salt water and fresh water in the Dead Sea area. The present study aims to determine the rate of hydrological processes in this extremely dynamic system. For that purpose, the interface between the salt and fresh water and groundwater level are monitored at boreholes in the alluvial fan of Nahal Arugot. In the last two years, a significant groundwater level drop has been observed at the boreholes near the Dead Sea coast, following the Dead Sea level drop. Groundwater level drop has also been observed at boreholes around 700 meters away from the coast. Beside changes in water levels, an interface movement has been observed at the boreholes near the coast, whereby the location of the interface has been decreased in about 0.3 m following the Dead Sea level drop in the past two years. This change in the location of the interface, in an area that was covered by the Dead Sea until recently, indicates a very fast rate of flushing of the original brine. On the contrary, the interface at the boreholes far from the coast doesn't show the same trends of movement.

Preliminary simulations were run with the SUTRA model (a finite element model for saturated-unsaturated density-driven flow) in order to evaluate hydrological parameters of the aquifer in the Nahal Arugot area, by comparing the results to field data. Preliminary results show good correlation between measurements in the boreholes and the results of the numerical model.

LESSONS LEARNET FROM DISCRETE FRACTURE NETWORK (DFN) MODELING OF MULTI-BOREHOLE PUMPING AND TRACER TESTS IN FRACTURED CHALK

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Multi-borehole pumping and tracer tests on the 10- to 100-m scale were conducted in the fractured-chalk-aquitard site in the Ramat Hovav area. Prior to these tests, extensive fracture surveys in outcrops and cores, as well as slug tests in packed-off intervals, were carried out at this site. These investigations were intended to form the foundation for DFN models, designed to simulate the multi-borehole tests. Stochastic DFN modeling turned out to be inadequate for modeling flow and transport on the multi-borehole scale because of (1) unclear hydrological meaning of the fracture-length distribution revealed from fracture surveys, (2) computational-capacity problems which led to a connectivity problem (although the connectivity problem may have existed without the computational problem), and (3) inefficient model calibration of the inter-borehole response through adjustment of the fractures' transmissivity probability density function (PDF). Instead, two equivalent deterministic DFN models representing two conceptual models of the dominant water conduits at the site were used. The first was the vertical-fractures (VF) model, consisting of only vertical fractures. The second, based on a channel-network conceptualization obtained by a macroscopic interpretation of the multi-borehole tests, was the fractures' intersections (INT) model, consisting of vertical and horizontal fractures with enhanced transmissivity at their intersections. Both models were calibrated against the multi-borehole response of one pumping test and validated against three other independent pumping tests. The average accuracies of all transient drawdown predictions of the VF and INT models were 65% and 66%, respectively. Considering the similar drawdown predictions and times needed for calibration, the VF model exhibited higher drawdown-prediction efficiency. Particle-tracking simulations of two tracers injected at different boreholes were run through the aforementioned models, and simulation results were compared with the tracer-test experimental BTCs. The strong influence of the tracer-dilution rate at the injection boreholes was handled by (1) predicting the tracer concentrations at the injection boreholes with the flow model, and (2) calculating the BTCs in the pumping borehole by superposing sequential pulse injections with decreasing concentrations. The INT model better captured the fast first arrival, peak recovery time and long tail than the VF model, demonstrating the improvement in transport prediction gained by the more complex conceptualization. Based on our experience with these fracture surveys, hydraulic testing and modeling campaigns, we conclude that efficient DFN modeling of multi-borehole tests should be aimed at constructing equivalent deterministic DFN models prior to stochastic modeling.

TIDAL EFFECTS ON THE LOCATION AND MOTION OF THE SALINE-FRESH WATER INTERFACE IN COASTAL AQUIFERS

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While the influence of oceanic tides on groundwater levels in coastal aquifers has long been recognized, little is known of the effect of tidal fluctuations on the location of the saltwater-freshwater interface. In this work we present field exploration of the influence of tides on saline-fresh water interface as seen in the coastal aquifer of Israel. Using a set of electrical conductivity sensors we document the fluctuations of the freshwater-saltwater interface on the short term/tidal period time scale and the longer-term time scale of several weeks. We find that the freshwater-saltwater interface fluctuates with tidal periodicity as well as responding to longer-term effects (weeks, rainy period). Subsequently, the location of the freshwater-saltwater interface varies depending on the time of day and part of the moon cycle in which it was measured. It is assumed that parts of these fluctuations in the location of the interface are artificial due to the effect of the borehole in which the measurements are done. An artificial effect means that the fluctuations in the aquifer itself are much smaller than those observed in the borehole. Nevertheless, this effect should be recognized because the monitoring of saltwater intrusion by the hydrological service is done by EC measurements in similar boreholes to those of the present research. It is, important, therefore that such monitoring will take into account the actual time of day due to the tidal effect.

THE CARBONATE SYSTEM OF AKHZIV SEDIMENTOLOGICAL AND FAUNAL ANALYSIS

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The Akhziv (northern Israel) sedimentary system is different from the main sedimentary regime of the Israeli Mediterranean offshore. Along the Israeli coast, siliciclastics decrease and carbonate content increases to the north, but north of Haifa there is a sharp fall-off of remaining siliciclastics and carbonate becomes dominant.
We report here on an initial study of sedimentological and faunal elements of the carbonate system of the Akhziv submarine reservation, part of a research project on the comparison between the recent carbonate platform off Akhziv and the late Pleistocene carbonate ramp found in boreholes off Ashqelon. The profile presented here was constructed from data gathered from three parallel scuba diving sampling transects near the small islands of Tekhelet, Shahaf and Nahli'eli, from 30 meters water depth to the shoreline. Distribution of components is categorized by statistical analysis of foraminiferal assemblages and sedimentary components from thin sections. Carbonate content and granulometry were also assessed.

From the preliminary results, 5 facies zones were distinguished along this profile; (1) An 0-5 m depth nearshore environment consisting of calcareous medium sand-size eroded skeletal fragments; (2) A 5-12 m depth sheltered zone between the shore line and the Kurkar ridge, containing of coarse carbonate sand and spherical rhodoliths, which become larger and more tabular toward the deeper parts of the sheltered area; (3) The small islands, between 0-5 meter depth, which separate the sheltered zone from the open sea. They consist of a Kurkar base covered by a thick carbonate crusts of encrusting red algae, with "cup ridge" shaped frameworks with prominent margins of vermetid gastropods forming at sea level; (4) A steep seaward slope to ~30 m, covered by algal crusts and patches of articulated red algae, and carbonate sand accumulations in sheltered crevices and holes. (5) The zone below 30 meter depth, sloping gently seaward, covered by loose silty-sandy sediments without carbonate encrustations or articulated algal growth. Large living *Conus sp.* (gastropods) occupies this zone.

These carbonate sediments fall into the category of the "Foramol" facies dominated by molluscs, bryozoans, benthic foraminifera, and coralline algae. The foramol facies characterizes oligotrophic, temperate-climate marine environments in the western Mediterranean but has rarely been reported in the southeast Mediterranean.

WATER, SALT AND ENERGY BALANCES OF THE DEAD SEA

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The Dead Sea is a hypersaline terminal lake experiencing water level drop of ~1 m/yr over the last decades. The existing estimations of water balance are widely variable, reflecting the unknown subsurface water inflows and rate of evaporation. To solve these we use energy and mass balance considerations. The heat of evaporation is calculated using the Bowen's approach. The calculated evaporation, along with measured hydrographical quantities, provides constraints on the subsurface inflows during the holomictic years (1996-2001). The calculations indicate that salt accumulates at the Sea floor at a rate of 0.1 m/yr. The average total annual inflows and evaporation rate do not exceed 325 MCM/yr and 1.21 m/yr, respectively. The subsurface inflows, deduced from the minimum estimate of surface inflows is less than 60 MCM/yr. Higher subsurface inflows require increased evaporation rate leading to cooling of the Dead Sea, which contradicts the hydrographic measurements.

TEMPORAL AND SPATIAL CHANGES IN CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN THE UNSATURATED AND SATURATED ZONES OF THE COASTAL PLAIN AQUIFER IN TEL AVIV

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Volatile organic compounds such as Trichloroethene (TCE), Tetrachloroethene (PCE) Dichlorethene (DCE) and Dichloroethane (DCA) have been in use for the past 7 decades, for example as solvents in the metal industry. Due to improper disposal techniques and lack of environmental regulations, these compounds are presently a major cause of contamination of the unsaturated and saturated zones in industrial sites.

We report on high concentrations and temporal and spatial changes in VOCs below the water table region and in the unsaturated zone of the Magen area, a former metallurgic industrial complex in Nahalat Yitzhak, Tel Aviv. The study was conducted using a passive multi layer sampler (MLS) that was periodically deployed, during one year, into 4" monitoring wells. The MLS is essentially a chain of isolated, cylindrical stainless steel dialysis cells (150 ml) filled with distilled water and closed with membranes at both ends. The sampling principle is based on passive equilibration of the unsaturated zone gas phase and the saturated zone liquid phase with water in the cells. The minimal distance between two consecutive cells is 0.12 meters.

In the saturated zone, till a depth of 4 meters below the water table, VOC concentrations were as high as 68,000 mg TCE/L – water; 1,180 mg PCE/L–water; 1,290 mg *cis*-1,2- DCE/ L–water and 145 mg 1,1-DCA/L-water. In the unsaturated zone, 18 meters from land surface till the water table, VOC concentrations as high as 27,000 mg TCE/L–air; 840 mg PCE/ L–air; 285 mg *cis*-1,2-DCE/L–air and 50 mg 1,1-DCA/ L–air were detected. In this zone, all VOC concentrations in the gas phase increased with depth. For TCE, the maximum absolute vertical gradient was 37 mg/L-air cm^{-1} and the calculated upward TCE flux was $100x10^6$ mg $/m^2$ yr^{-1}. Temporal variability in the concentration of VOCs was detected between profiles of the same well, both in the unsaturated and saturated zones. For example, during a sampling period of 4.5 months, the concentration of TCE at an elevation of –0.1 m (just below the water table) decreased from 50,298 mg/L–water to 47,320 mg/L–water and then increased to 54,3000 mg/L–water. Spatial variability was also observed between profiles obtained simultaneously in two adjacent wells, 29 meters apart. For example, in the saturated zone, 6 cm below the water table, the difference in the concentration of TCE was 23,900 mg/L–water. The saturated/unsaturated interface region exhibited variable equilibrium conditions in the concentration of VOCs. While in some profiles, VOC fluxes evolved from the saturated into the unsaturated zone, in others the saturated zone was contaminated by VOC influx from the unsaturated zone.

RADIOCARBON AND U-Th DATIND OF MELANOPSIS SHELLS FROM THE KINNERET BASIN

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The establishment of the late Pleistocene and Holocene limnological history of Lake Kinneret requires the achievement of high-resolution and precise chronological framework. We report on the progress in testing the potential use of Melanopsis shells (= MS) as limnological choronometer using U-Th and radiocarbon dating methods. We collected live MS representing various environments: Lake Kinneret, Nahal Kibutzim and Jordan River (of the types: Costata Jordanica; Castata Costata; Buccinoidea, respectively), and analyzed the [$^{234}U/^{238}U$] activity and ^{14}C content of the relevant waters as well as other geochemical water tracers such as $^{87}Sr/^{86}Sr$ ratios.

We found a good agreement between the current water radiocarbon and the living shells and concluded that the aragonitic MS derives most of the radiocarbon from its contemporaneous water. Thus, defining the reservoir age for each water type (e.g. in Lake Kinneret ~ 800 years; Nahal Kibbuzim ~ 7000 years; Jordan River ~2500 years) provides age correction for fossil specimen from the same environments. Then, we analyzed fossil MS from various sites in the northern Jordan Valley and Lake Kinneret, where the calendar chronology was available or determined from contemporaneous organic matter. These include: historical sections in Beteiha valley (dated by organic radiocarbon to 680 – 1045 yr); the Galei Kinneret archeological site (~ 749 AD) and the Ohalo-II archeological site dated to 23 ka cal BP.

A series of U-Th measurements were performed on live and fossil MS. Ages were obtained by single sample ^{238}U -^{230}Th calculation as well as by $^{230}Th/^{232}Th$-$^{238}U/^{232}Th$ regression (the "isochron method", which eliminates detritus U-Th addition to the authigenic aragonite). The calculated U-Th ages of the Beteiha and Galie Kinneret MS show good agreement with the true (calendar) ages and organic ^{14}C ages. We continue to evaluate whether this correlation can be extended for older samples (e.g. the late Pleistocene Sheik Hossein and Hamadia sections).

MAPPING THE SALINE/FRESH GROUNDWATER INTERFACE BENEATH THE JUDEAN DESERT USING DEEP TDEM

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A deep TDEM (Time Domain Electro-Magnetic) survey was carried out at the Judean Desert to delineate the geometry of the interface between fresh, brackish and saline groundwater bodies up to the depth of approximately 1.5 km. The survey was conducted at 20 locations on the desert plateau, between Nebi Musa in the north and Nahal Hever in the south. At this area, fresh groundwater flows from the replenishment area at the eastern slopes of the Judea Mountains toward the Feshha, Kaneh, Samar and Ein-Gedi springs, whose total mean annual discharge is estimated to be 85 million m^3/y. At deeper aquifers, saline groundwater is found, which is mixed at specific locations with the shallow fresh groundwater; thus the salinity of some of these springs varies from fresh to saline.

Results of all TDEM soundings show that a low resistivity layer of 5-15 ohm-m exists below a relatively higher resistivity layer of 50-500 ohm-m. The low resistivity layer is found at a depth range between 500 and 1000 m below land surface. Comparison of these geoelectric results with stratigrafic data testifies to the existence of an interface most likely separating fresh and brackish groundwaters within the above mentioned depth range. Theoretical estimations using Archie's law as well as comparison of TDEM resistivities with groundwater salinities measured in oil and deep water wells in the southern Judea desert and central Israel verify this hypothesis. The expected resistivity of the Dead-Sea brine is about 1 ohm-m or less. Although not detected in most locations of this survey, yet at three sites located at the eastern edge of the plateau (adjacent to the rift faults), an additional interface probably separating the brackish groundwater (5-15 ohm-m) and the Dead-Sea brine (3-5 ohm-m) is detected at greater depth. These observations show that the upper Judea Group aquifer is usually saturated with fresh groundwater, while the lower Judea Group aquifer, as well as the underlying Kurnub Group aquifer, are saturated with brackish groundwater, the salinity of which does not exceed the normal seawater salinity. The underlying Jurassic formations are normally saturated with the Dead-Sea brine.

SOIL AND GROUNDWATER CONTAMINATION BY ORGANIC POLLUTANTS FROM MILITARY INDUSTRY

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Vadose zone and groundwater contamination by industrial organic pollutants is being investigated in the framework of a comprehensive environmental survey. The survey is conducted in and around a large military industrial complex where indication to groundwater contamination has been observed. This part of the survey and research study has focused on identifying the range of organic components that could have polluted the soil and possibly migrated through the vadose zone to the groundwater. A historic survey revealed that over the past 50 years untreated waste effluents containing explosive residues of RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) and TNT (2,4,6-trinitrotoluene) were released to streams, channels, and unlined storage ponds. As a result, a set of potentially polluted "hot spots" was selected for borehole drilling and high-resolution soil sampling. Soil samples collected from the vadose zone were extracted and analyzed for a range of explosives, as well as for VOC's and SVOC's.

Sorption experiments of several explosives on a variety of local sediment samples were conducted to assess the pollutants mobility properties and reconstruct their migration conditions. The sorption-desorption behavior and long-term fate of the explosives were examined in a set of batch experiments, covering a range of time scales and initial concentrations.

The experiments indicate low sorption of RDX and HMX to all soil types. However, sorption of TNT was very fast and extensive. These results were consistent in both short-term and long-term sorption-desorption experiments.

Analyses of sediments retrieved from the boreholes suggest that currently only residues of explosives as RDX and HMX remain in the vadose zone. Nevertheless, water samples from groundwater on site indicate that those compounds migrated through the vadose zone all the way to the groundwater over the past 50 years.

NEOTECTONICS AND RE-EVALUTION OF A SYRIAN ARC STRUCTURE BURIED IN THE LEVANT BASIN OFFSHORE ISRAEL

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Extensive research has been done on the Syrian arc structures on land, in Israel and adjacent countries, over the years. The research made in the sea focused on sedimentary structure or in solving tectonic problems of the Carmel structure and land-sea cross faults. The research area is on the continental margin off Nethanya some 20 Km off shore, in a 600Km^2 area. The "Delta" structure is the name if a buried structure, that is assumed to belong to the Syrian arc system. It was first studied and drilled by "BELPETCO" in 1970 for oil and gas exploration. It is buried under a wedge of Plio-Pleistocene, Neil derived, sediments, and added the Messinian evaporates (known as reflector M and N on seismic lines) on the western bank.

The aim of the study is to examine the deformation and on going tectonic activity in the study area, and its relation to the bulgy "Delta" structure. The work is based on some 450 Km of multi-channel reflection lines from "Horizon" and "Isramco-91" series. The seismic data is controlled by 3 oil drill-wells. A designated data re-processing will be done in selected lines to improve the resolution of the shallow part and improving the interpretation ability in the deeper part. Preliminary results of the main horizons interpretation in the study area and a isopach map of the Plio-Pleistocene will be shown. At this point no conclusive conclusion can be made on the nature of the Neo-tectonic. The study's contribution can be in assessing the seismic hazard and in designing submarine infrastructure.

ROCK MASS CLASSIFICATION FOR TUNNELS-PROJECTS IN ISRAEL AND FUTURE CHALLENGES

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GGS - Geological & Geotechnical Surveys

Classification of rock mass for tunnels is an essential element of comprehensive geo-engineering survey for tunnels design. The common methods, which are used in Israel, are the Q method (Barton, 1974) and the RMR method (Bieniawski, 1989), while recently the GSI method (Hoek et al 1995) is implemented. The advantages in these methods are the possibility to evaluate throughout numbers the behavior of rock mass in terms of stability and the required time for support. The disadvantages are mostly in limiting the engineering thinking, while sometimes the local geological conditions get less importance in confrontation with construction difficulties. The Austrian method for example emphasizes the behavior of rock mass and therefore extends the use of deformation and stress measurements during the construction. This is done in order to implement the best excavation and support method. The use of a flexible classification method (NATM for example) requires a flexible contract method with risk sharing and contractors with large experience and variable equipment, which for the time being seems too innovative in Israel.

Three projects of tunneling are described. The first is Hadid tunnels, 460 m long, excavated as part of the Cross Israel Highway. The second is Kedumim tunnels in Nazareth, 310 m long under construction. The third is Akko-Karmiel railway tunnels, 5 km, which are now at the design stage.

DYNAMIC BACK ANALYSIS OF BLOCK DISPLACEMENTS IN A VOUSSOIR ARCH AND ESTIMATION OF HORIZONTAL PGA THRESHOLDS IN ARCHEOLOGICAL SITES USING DDA

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Many archaeological sites in Israel were damaged by earthquakes, but only in few it is possible to make a precise quantitative mechanical analysis of the damage, and evaluate threshold horizontal Peak Ground Acceleration (PGA). In order to perform back analysis of historical earthquakes we chose archaeological sites that show damage but not total destruction. Furthermore, the observed damage must be measurable by comparing final and initial positions of elements in the structure such as displaced blocks within an otherwise intact structure.

A number of potential archeological sites for quantitative analysis were found. In this work we focus on examples from two sites: Masmshit in the Negev and Nimrod Fortress at the Golan Heights where single blocks were displaced from their original position.

A Voussoir is one of the most ancient and common structures in the world typically used in construction of vaults in masonry structures such as cathedrals, fortresses, and public facilities. However, there is no agreement over a complete analytical solution to the distribution of stresses in an arch since the problem is statically indeterminate. Therefore, numerical methods of the discrete element family such as DEM or DDA must be employed in order to solve the response of the Voussoir to both static and dynamic loads.

In this research, a two-dimensional model of an arch and the surrounding structure was simulated, and a synthetic earthquake record was used as input in the basement block in the form of time dependent displacements, simulating numerically the effect of a shaking table. The response of the structure was studied up to the point of incipient failure in a mechanism similar to the one observed in the field.

The analyses of the numerical output include the critical frequency and size of input displacements, thus allowing initial conclusions regarding threshold values of seismogenic ground displacements which caused the observed damage in historic earthquakes.

THE HYDROGEOLOGY AND GEOCHEMISTRY OF GROUNDWATER IN THE ALLUVIAL FAN OF WADI ARUGOT, THE DEAD SEA EREA

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The present study summarizes the geological, hydrological and geochemical data obtained from new observation boreholes in the area of Wadi Arugot. The main findings in the research were: A salt layer was found in boreholes that were drilled near sinkholes (at a depth of about 50 m). The thickness of this salt layer varies from 20 m to less than 2 m over a distance of 100 m. Two sub-aquifers were found in the area. The upper, lower pressure sub-aquifer and the lower, higher pressure sub-aquifer. The upper sub-aquifer is divided into top, low salinity water (molality of about 3.5 $mmol \cdot Kg^{-1}H_2O$) and bottom water having near Dead Sea salinity. The salinity of lower sub-aquifer is much lower than that of the Dead Sea (about 450 $mmol \cdot Kg^{-1}H_2O$). The characteristics of the lower sub-aquifer suggest that it may cause dissolution of the salt layer. Indeed, groundwater from the salt layer had Na/Cl=0.55 that is indicative of salt dissolution (comparing to the much lower Na/Cl=0.25 of the Dead Sea).

The very low value of the cosmogenic isotope ^{14}C in some of the groundwater (about 8 pmc) suggest that some of the brines are older than several thousands years and at present, fresh groundwater recharge is minute. This is because the ^{14}C of the groundwater is lower than the weighted mean of Dead Sea ^{14}C (the saline end member with ^{14}C of about 82 pmc) and the fresh springs waters (the freshwater end member with ^{14}C of about 60 pmc).

The ^{3}H content of the groundwater varied between 3 to 0 TU. This value is lower than the recent value of the Dead Sea ^{3}H (about 3.7 TU) the recent rain ^{3}H, indicating that some of groundwater are older than 40 years.

THE SIGNIFICANT GEOLOGICAL CONTRIBUTION TO THE RENOVATION OF THE SECOND TEMPLE BY KING HEROD

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The Zedekiah Cave is a subsurface quarry within an area of surface quarries of building stones for the city of Jerusalem. The cave has a small opening at the foot of a quarry escarpment below the northern wall of the old city about 70m northeast of the Damascus (Shekhem) Gate. The cave is about 200m long and 80-100m wide with quarrying structures characteristic of Roman times. A Babylonian winged bull found carved on a wall suggested that the cave existed in earlier periods, and that the quarried part may have followed a karstic system. The Zedekiah Cave follows a certain layer 2-3m thick within the Lower Turonian Detrital Limestone Member ("Meleke") of the Bina Formation. It consists of porous rudistid white limestone which in the cave is wet, friable and of a chalky appearance. The underground quarry of this friable stone must have had a significant benefit that justified the difficult and dangerous operation.

Among King Herod's great building activities was the renovation of the Second Temple (started about 20 B.C.E.). The Bible forbids using metal tools in the construction of the Temple, which complicated the final shaping of the stones on the holy site. The underground quarried layer consists of massive freestone, easily and rapidly cut and carved in various shapes. When the blocks are exposed and dried they harden from outside inward, forming with time hard building stones. During the first days of exposure the blocks can be further shaped by non-metallic tools (bone, ceramic, stone). The friable nature of this rock-type made it useless while quarrying in the open hard blocks for building. A similar detrital limestone that cements when exposed was underground quarried for building stones in southern England since Roman occupation. This phenomenon may have been known to the Roman engineers advising King Herod in the constructions. When such a stone was needed for the renovation of the Temple the local quarrymen pointed to the useless layer in the open quarries north of the city. The layer was traced by the geologists-engineers to the quarry-wall to the south. A single small opening was cut through the hard external hard crust of the layer to keep the internal humidity of the rock during underground operation. The cave did not exist earlier in any form and therefore was not the legendary escape route of King Zedekiah from the Babylonians in 586 B.C.E. as the Babylonian symbol should substantiate, and thus the latter is regarded a forgery.

ARTIFICIAL TRACERS AS MARKERS FOR GROUNDWATER MOVEMENT AND PARTICLE TRANSPORT IN THE DEAD SEA AREA

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Artificial tracers for marking groundwater movements are a widespread tool, for quantifying and realizing connections and directions in hydrological systems. The goal of the present work is to quantify the groundwater velocity and particle transport at different areas of the Dead Sea coast, as a response to the rapid dropdown of the Dead Sea level.

Some of the most common groundwater tracers are influenced by both the groundwater salinity and the sorption properties of the porous media. Therefore we primarily tested the tendency of some tracers to be absorbed onto sediments from the Dead Sea area at different water salinities, in order to establish a tracing tool for highly saline groundwater. Preliminary result shows that some of the tracers can be applicable in the Dead Sea area (sorption of less than 50%). These tracers will be used in a field test at the Einot Zokin national reserve and near the Ein Gedi shoreline.

Transport and removal of particles by groundwater was first suggested as a mechanism for formation of sinkholes at the Dead Sea area. Although there are many data that show that the main mechanism of sinkholes is salt dissolution by groundwater, the role of particles removal has not yet been ruled out as a secondary process. Particle suspension in groundwater is strongly influenced by the groundwater ionic strength, where the ionic strength is low the particles are suspended and beyond critical salt concentration they settle. Therefore, as a first stage, the transport of particles (microsphere- fluorescent polystyrene spheres) was studied at the laboratory in a series of columns filled with sediments and water of different salinities. Preliminary results show that, even in the most concentrated brines, such as the Dead Sea waters, some of the particles remain in suspension and are transported through the column.

IMPROVING FLUID FACTOR ESTIMATION USING SPECIAL TUNING OF MUD-ROCK LINE PARAMETERS

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The AVO (Amplitude Versus Offset) method has been widely used with great success over the past few years in the study of lithology and for direct detection of oil and gas in various parts of the world (including offshore Israel). One of the AVO attributes, the fluid factor, is an optimal hydrocarbon indicator for gas-bearing sands.

This work illustrates the importance of mud rock line parameters evaluation for improvement of the fluid factor definition. A new method for mud-rock line parameter calculation by examination models of water saturated sands is proposed. In water-saturated sands the fluid factor must be equal to zero and the seismically extracted AVO attributes (intercept and gradient) form a well-defined background trend. In this case mud-rock line parameters will be determined by the trial-and-error modeling. These calculated parameters are then introduced as for local geological conditions, allowing an AVO inversion for gas-saturated sand.

Gas sands may exhibit a variety of AVO behaviors. Class I sands has high impedance relative to the overlying shales. Class II has a small impedance contrast. Class III sands has lower impedance than the overlying shales (classical bright spots) and exhibit increasing reflection magnitude with offset. For Class IV sands, the introduction of gas causes a negative normal-incidence reflection coefficient and decrease in amplitude with increasing offset. For each class of gas-saturated sands, alternative models of water saturated sands were tested. Direct and inversion AVO computations were carried out and the fluid factor was estimated.

Tuning of mud-rock line parameters for better fluid factor estimation was performed on selected lines crossing the sand reservoir offshore Israel. Sand deposition appears to be confined to the Lower Pliocene, with a predominantly shaly section thereafter of Pliocene-Pleistocene times. The project results in the determination of mud-rock parameters for local geological conditions (sand reservoir offshore Israel).

THE INFLUENCE OF WADI EL QUILT – FLOODING ON THE SHALLOW AQUIFER SYSTEM IN JERICHO AREA

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Twenty ground water samples and 50 flood water samples were collected during the hydrologic years 2003/2004 and from 2001/2004 respectively. The water samples were analyzed for there chemical and isotopical Constituents.

To identify recharge area and the mixing zone we used two sources of fresh water (two end members) fresh water and brackish water with chloride content of "68.4" mg/L and "2.9"mg/L.

We identify three main recharge zones , the waste water area with more than 80% fresh water contribution and only 20% brackish water , the area which range between 40% and 70 % fresh water and the eastern area less than 40% fresh water .

USING A GIS TRANSFER MODEL (AVGWLF) FOR PLANNING WATERSHED BMPs: A CASE STUDY IN LAKE KINNERET WATERSHED, ISRAEL

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Lake Kinneret (Sea of Galilee) is the only large surface water body in Israel, encompassing an area of 167 km^2 and supplying some 30% of the country's fresh water. The lake has a watershed of 2730 km^2 in area, which is intensively used for agriculture and tourism purposes. Pollution from anthropogenic sources and water abstraction for domestic and agricultural use are threatening the water quality of the lake. Hence, an intensive monitoring program has been implemented since 1969. The monitoring was intensified in 1999, due to a deterioration of the lake water quality. Although there are more than 200,000 residents in the watershed, the main land use is agriculture (e.g., orchards, field crops, fishponds, cowsheds, and cattle-grazing areas). Pollution from point sources (PS) in the watershed has decreased drastically with the development of wastewater treatment. However, not much has been done to prevent non-point-source (NPS, diffuse) pollution from agricultural. Evaluating and managing diffuse pollution is difficult, due to the complex spatial behavior of pollutants. Therefore, a plan has been initiated to implement pollutant transport modeling using a GIS-based approach.

Monthly loads of phosphorus, nitrogen and sediment for a given set of weather conditions are evaluated using AVGWLF (a GIS-based watershed load model). The model has been implemented in Pennsylvania, Ontario, and Mexico; currently, it is being tested also in Sweden and several other states in the United States. In this paper we present an application of the model to the Lake Kinneret watershed, using local climate, soil, land use, and point source data. The new version of the model (KINWET – Kinneret Watershed Evaluation Tool) will enable simulation of current and future phosphorus, nitrogen and sediment loads entering the lake from the surrounding watershed. A decision support system (PRedICT – Pollution Reduction Impact Tool) will be linked to the model to evaluate different BMPs (Best Management Practices) and pollution mitigation strategies for the purpose of minimizing diffuse pollution flow to Lake Kinneret. Results from simulations will enable watershed managers to prioritize the most effective alternatives for protecting water quality in the lake.

THE TECTONIC LINK BETWEEN THE EASTERN MEDITERRANEAN AND THE NORTHERN RED SEA

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Structural experiments in analog modeling paved the way to suggest a new tectonic model of the eastern Mediterranean and the northern Red Sea. That region is constrained by two major tectonic elements – the Levant rift and the Hellenic subduction zone, and by two principal displacements – the northward motion of Arabia and the westward offset of Anatolia. GPS measurements show that the rate of Anatolian motion increases westwards considerably, whiles the difference between the displacements of the tectonic blocks of Arabia and Sinai-Israel is not large. The tectonic significance of these findings was tested in series of structural experiments in oblique rifting and in subduction. Centrifuge experiments in incipient subduction shows that the underthrusting of the oceanic lithosphere leads to the uplift and extension, which is most effective in the crust of the overlying continent, and rolls back the upper subduction zone. The edge of the extended continental crust tends to rift apart and form a back-arc basin. Split box experiments in oblique rifting led to the contemporaneous development of extensional axial basins that gradually merged to form an axial rift. The brittle layer of the rift thinned and enabled the ascent of ductile layer diapirs. Morphological resemblance of the models to tectonic features of the eastern Mediterranean suggests that the westward motion of Anatolia is derived from the Hellenic subduction and the roll-back of the subduction zone and the subsequent extension of the overlying slab. That motion occurs mostly along the North and the East Anatolian Faults, and partly through the Aegean extension. The oblique extension of the Levant Rift system seems evident in the series of axial basins that propagated gradually to form the active Jordan and El Gharb rifts, and the Lebanese fault splay in between. There is ground to presume that the extension along the Hatay Rift is a product of the transtensional motion along the East Anatolian Fault. Consequently doubt was cast on the validity of the occurrence of a transform fault along the Levant rift system, and of the escape tectonics of Anatolia derived from that transform offset.

EVIDENCE FOR NON-CONSTANT ENERGY/MOMENT SCALING FROM CODA-DERIVED SOURCE SPECTRA

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We present two lines of evidence showing the ratio of seismically radiated energy (E_R) to seismic moment (M_o) increases with increasing moment for crustal events spanning 5 orders in seismic moment. This ratio, often referred to as the scaled energy <!--[if !vml]-->e<!--[endif]--> ($=E_R/M_0$) has been elusive and the subject of recent debate within the seismological community. Because significant frequency-dependent corrections must be made to account for source and path heterogeneity, it is common that energy estimates of the same event by different researchers have significantly different values. To minimize some of the potential problems, we used the regional coda methodology outlined in Mayeda et al. [2003] on 4 large earthquake sequences; M_w 7.4 and 7.2 Izmit/Duzce, M_w 7.2 Gulf of Aqaba, M_w 7.3 Landers, and M_w 7.2 Hector Mine. This methodology has been shown to provide the lowest variance estimate of the source spectrum when compared against traditional direct wave estimates. In our first approach we made energy estimates from coda-derived spectra and observed that <!--[if !vml]-->e<!--[endif]--> increases with increasing moment for $3.7 < M_w < 7.4$. In our second approach we used the simple idea outlined by Prieto et al. [2004] to directly test for self-similarity. Under self-similarity, earthquake source spectra scaled by w^{-3} should have the same shape. To test this, one needs very stable spectra either through spectral stacking of direct wave spectra or by the use of stable coda-derived spectra. For all sequences we found that the mainshocks and larger aftershocks had significantly different spectral shapes than the smaller events. The scaled w^{-3} spectra of the larger events represented an upper bound, having larger amplitudes near the corner frequency. In fact, an $w^{-3.5}$ scaling moved the larger events closer to the mean of the spectral population, though the spectral shape differences persisted. These results strongly suggest that earthquakes are not scaling self-similarly and that complexities in the rupture process such as variable slip velocity exist between small and large events.

STABILITY OF CAVITIES AND FORMATION OF SINKHOLE ALONG THE DEAD SEA COAST

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We present a study of stability and collapse mechanisms of cavities with respect to the formation of the Dead Sea sinkholes. The influence of (1) cavity depth/width ratio, (2) shape of cavity, and (3) sediment mechanical properties, on the stress distribution and failure pattern around a sub-surface cavity are tested using numerical simulations. The process of cavity collapse is analyzed by two modes of failure.
Simulated stress distribution around cavity is calculated using linear elasticity. We evaluated Mode-I failure where pure tension developed. Results of 3D simulations demonstrate tension near the free surface, probably causing surface cracks and sudden collapse. Mode-II corresponds to yielding or plastic flow of the soil under shear and compaction. Stress simulation is done for an elasto-plastic material obeying the Coulomb-Mohr yield criterion.

The simulations results show that the salt layer is strong and stable. Failure in the salt layer will not occur due to the loading of the upper layers. Yet, shear stresses are amplified on the contacts due to the contrasting properties between the salt and other sediments. These enhanced shear stresses can produce cracks and can increase the water flow into the cavity. Dissolution at the roof of the salt layer will cause the unconsolidated sediments to flow to the open space. The week clastic sediments could not hold underground cavities. Therefore, it is more likely that the underground cavities develop from the bottom of the salt layer which holds the cavity until their collapse.

A plastic model simulates the development of faults for various sinkhole cavity depth/width and sediment strengths. In all cases failure develops along reverse faults. With the approach of these faults to the free surface a bell shape sinkhole forms. This sinkhole will grow to a funnel shape, and a new sinkhole can develop on the bottom of the primary sinkhole. A small bell shape sinkhole inside a large funnel sinkhole was observed in several sinkholes sites. For small cavity depth/width or high sediment strength, the maximum width of the parent sinkhole is too small for the development of new additional sinkholes.

It also appears that high cavity depth/width tends to stabilize cavities in clastic sediments. Tensile stresses develop perpendicular to the cavity roof and can produce a stable arch shape. The arch shape and stability of the clastic sediments depends on the ratio between the vertical and horizontal stresses and the material friction angle. However, a cavity in clastic sediments is unstable since the strength of the host rock is low and varying.

GEOLOGISTS KEY ROLES IN OUR COUNTRY'S PRESERVATION AND DEVELOPMENT

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Traditional geology dealt with exploration and exploitation of building materials, phosphorite, clays, metal ores or water supply, civil engineering consultation etc. The target was to answer all the market demands.
The leeway of the geologist's activity is considerably wider in the 21st century, in light of the general awareness that pristine landscapes have to be preserved for us and for the next generations. The scope of the geologist's functions is extended and we should participate in the setting of priorities and provision of the optimal solutions for modes of preservation as well as environment-friendly development. The following are a few examples of relevant topics:
* Israel has variegated geological landscapes - let us identify and preserve them.
* Planning is a typical geologist's activity - state-wide, urban, and environmental.
* Thematic surveys around residential complexes in order to anchor them at their surroundings, e.g. detecting special landscape units, springs, river beds, karstic features, rock exposures etc., and incorporating them in the public gardens, squares, scenic promenades and view points, as well as using local rock types in public buildings and stone fences, and giving the streets relevant thematic names.
* Geological - community - regions. A region of a marked geological structure can often be the base for the development of regional inter-communal ties, e.g. the ongoing crystallization of a community of the Makhteshim Country and the adjacent Great Rift Valley Segment or the coastal Kurkar Hills between Ness Zyona and Gedera.
* Geological raw material surveys will always cover the whole range of possible applications of the area, including kinds of non-destructive enterprises, nature tourism, and preservation.
* Mining plans should always minimize the destruction and address rehabilitation..
* Full utilization of a quarry's products in order to minimize waste and reduce the need to open new mines.
* Optimal utilization of emptied mine spaces to be planned ahead, e.g. for cemeteries, parks or waste sites.
* Geological aspects of restoration, e.g. of quarries, mines, road cuts, drainage basins, waste dumps etc.
* Involvement and cooperation with decision making bodies: e.g. state and municipal planning committees and committees of the Knesset, as well as the green organizations.
* Inclusion of these themes in the university teaching by courses and research.
* The IGS medal. It is warmly recommended the listed aspects are included.

GROUND MOTION SCALING IN ISRAEL

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The rate of seismic activity in Israel and its vicinity is relatively low, but historical descriptions show that strong earthquakes have occurred in this region. Some of these events have caused widespread damage to large areas. The evaluation of attenuation relationship is therefore of great practical importance to this region. Understanding regional variations in attenuation is important for predicting the amplitude of ground motion expected from future earthquakes. Describing the attenuation of the ground motion as a function of frequency can be used for engineering design and seismic hazard.

The overall aim of this project is to investigate the regional attenuation of the ground motion as function of the source-station distance and frequency of motion. The optimal relation is one based on data from large earthquakes, because such a data set contains large ground motions of interest from large earthquakes near the site of interest. The records of strong large earthquakes are rather scarce in Israel and for this reason we propose to use data from more frequent, smaller earthquakes to constrain the distance and frequency dependence of the ground motion. The sparse sets of strong motion recordings can thus be used to focus on scaling from small earthquake to large earthquake motion.

To obtain the distance scaling relationship we use the Yazd's method (1993) and following the approach described by Raoof et al. (1999) and Malagnini et al. (2000). In this approach we use a source model and a regional scaling law to predict spectral shape and amplitudes of ground motion at various source-receiver distances, instead of trying to reproduce the exact details of the ground acceleration in the time domain. We could obtain the scaling relationships using a large number of recordings of the background seismicity and then performing regressions on the parameters describing the ground motions.

In this research we use more than 1500 regional earthquakes recorded by Israel Seismograph Network (ISN) over period 1984-2004. About 600 events in the data set span a magnitude range from 3.0 to 4.0, about 100 events from 4 to 5 and about 10 events have magnitude range more that 5. The data set is analyzed in this study consists of waveforms from 40 stations.

CONSTRUCTION OF A VELOCITY MODEL OF THE SHALLOW SUBSURFACE FOR SITE EFFECT ESTIMATION USING SEISMIC METHODS

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In order to estimate the site (local) effect, we first had to perform seismic refraction or downhole measurements (seismic studies) in the field and to obtain ambient noise records using the Nakamura technique, (i.e. the horizontal-to-vertical spectral ratio of microtremors) or direct records of earthquakes or both together (seismological studies).

The seismic refraction and downhole methods are used for construction of the velocity model of the shallow subsurface in Israel. The main goals of seismic refraction surveys are (a) to estimate compression (Vp) and shear (Vs) wave velocities and (b) to map all interfaces available between the lithological units in the subsurface. As a rule considerable site effect occurs when a low velocity soil layer (with shear wave velocities of 100-600 m/s) overlies hard rocks (with a shear wave velocity of 700-2500 m/s and over). However, there are cases where the combination of rock layers alone can cause the site effect. Such is the case in northern Israel (Afula, Qiryat Shemona areas) where, strongly weathered Lower basalt unit with a shear wave velocity of 650-800m/s (Vs) is located on a high velocity basalt unit (Vs=1400-2000m/s).

The methodology of the data acquisition is considered. Methods for S-wave velocity measurements are analyzed. The compression and shear velocities of the soil and rock in Israel are analyzed. Case histories of the velocity structure of the subsurface composed of soil or rock uppermost layer underlain by the strong rock mass are described.

APPROXIMATION OF EXPERIMENTAL TRANSFER FUNCTION BY THE SHAKE ANALYTICAL MODEL

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Based on Nakamura method we obtain a spectral ratio H/V function, using ambient vibration measurements. This function can be used to estimate a first mode of the 1-D transfer function for the vertical incident S-waves. This 1-D model is characterized by a matrix of parameters (thickness, density, velocity and damping factor) of multilayer system, which can be estimated from the given H/V ratio function. For this purpose a known SHAKE algorithm is used. The procedure comprises following stages:

1. A small neighborhood of the frequency and amplitude of first mode is chosen.
2. For reference set of parameters matrix we choose transfer SHAKE functions with amplitude and frequency of first mode from given neighborhood.
3. From the given set of transfer functions we choose one that has minimum deviation from the given H/V ratio function in the given frequency interval.

In the cases when many parameters are searched, the problem may have more than a single solution.

BUILDING OF THE WESTERN ALPS AND EXHUMATION OF METAMORPHIC ROCKS: EVIDENCE FROM FORELAND BASINS OF SE FRANCE.

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In the Western Alps syn-orogenic sediments were deposited during the Tertiary in a series of foreland basins, formed on top of the European lower plate by its downward flexure under the advancing orogenic load. We have studied the mineralogy, geochemistry and geochronology of detrital sediments from those basins in order to identify possible provenance terrains and assess their relative contribution. This may enable us to reconstruct the paleo-structures and the geodynamic evolution of the western part of the Alpine orogen in the Tertiary.

Samples of sandstones were collected from the foreland basins of SE France whose ages of deposition are well constrained from Middle Eocene to Early Miocene. The Si content of detrital muscovite grains from sandstone samples of all different deposition ages ranged from 6.05-6.5 atoms p.f.u. In two samples colleacted from the Barrême Oligocene basin, the occurrence of single grains with Si>6.7 atoms p.f.u was detected. The Si content of white micas can serve as an approximation for the metamorphic pressure under which the mineral re-crystallized (according to Massonne and Schreyer, 1987). The 6.05-6.5 Si atoms p.f.u grains originated from low-grade metamorphic or magmatic terrain, such as the Hercynian basement of the European plate currently exposed in the external crystalline massifs of the western Alps. The Si>6.7 atoms p.f.u grains originated from high-pressure metamorphic terrain, such as the units from the inner part of the Alpine orogen.

Various pebble were collected from the conglomerate units of the Barrême Oligocene basin. This conglomerate unit is composed of over 90% carbonate pebbles sourced in the underlying Mesozoic cover of the European plate, the remaining 10% include inner orogenic material: flysch-type sediments, ophiolite derived lithologies and blueschists. Blueschist pebbles contain mineral assemblages indicating P-T metamorphic conditions of ~ 450°C and 11-12 kbar.

$^{40}Ar/^{39}Ar$ dating of white mica from bluschist pebble yielded Tertiary ages of 31-36 Ma, very close to the deposition age of their host conglomerate unit. This indicates rapid exhumation of HP-LT metamorphic rocks and their exposure at the surface of the Alps by early Oligocene time. K/Ar and $^{40}Ar/^{39}Ar$ dating of detrital muscovites from sandstone layers show the dominance of Pre-Alpine ages (200-300 Ma) within all the Tertiary sediments.

As a whole, our data indicate that internal Alpine units were not a significant provenance area for their adjacent foreland basins even though HP-LT units were exposed in the internal Alps by Early Oligocene time. This may imply that the present day structure of the Western Alpine chain, in which the internal high-pressure units are sealed by the more external units along SW dipping backthrusts and exposed mainly to the east of the main water-divide, already existed in the Early Oligocene.

HYDROCHEMICAL AND HYDROLOGICAL ASSESSMENT OF SOME SPRINGS IN HEBRON AREA

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More than 40 springs in Hebron Area were considered in this study. Most of these springs lie within the eastern aquifer basin of the mountain aquifer. They flow out of carbonate aquifers, which range in age between Albian to Turonian. The study aims at providing a data base about the spring and checking the suitability of their water for different purposes as well as finding out the possible sources of the contamination of these springs.

Calculations using the available data of the period 1970 - 2004 estimated the average annual runoff, recharge and precipitation to be 55.7 mm/y (11.4% of the precipitation), 141 mm/y (25% of the precipitation), and487 mm/y respectively. The hydrochemical and the isotopic study of the springs showed that rainwater is the main source of the groundwater recharge in the area. Mixing with wastewater from different sources as well as the leachates from washing the piles of animal dung by rainwater are possible sources of contamination of the shallow groundwater. The stable isotopic composition (δ2H and δ18O) of the water lies on the Mediterranean meteoric water line. This suggests the meteoric origin of the water. 3H analysis shows that the water of these springs contains between 5 – 6 TU which indicates the relative recent age of the water.

Although the water of some of these springs is not suitable for domestic purposes, most of the springs are suitable for irrigation without limitations.

PERMANENT SCATTERING InSAR – A NEW TECHNIQUE FOR DETECTING mm-SCALE GROUND MOVEMENTS, APPLIED TO THE AREA ADJACENT TO THE CARMEL FAULT SYSTEM

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We present the first application of high-resolution deformation detection in Israel by the Permanent Scattering Interferometric Synthetic Aperture Radar (PSInSAR) technique. Conventional InSAR carries the potential to detect sub-centimeter scale target displacements along the satellite's Line-Of-Sight (LOS) direction, with limitations resulting from temporal and geometrical decorrelation, atmospheric artifacts and cycle ambiguity.

The PSInSAR approach (see T.R.E web site: http://213.215.195.35/tresite_eng /tecnicaps/subtecnicaps/interferometria/index.htm) is based on two basic observations:

(1) Atmospheric artifacts show a strong spatial correlation, but they are uncorrelated in time. (2) Target motion is usually strongly correlated in time and can exhibit different degrees of spatial correlation depending on the phenomenon at hand. Therefore, atmospheric effects can be estimated and removed by combining data from long time series of SAR images. In order to exploit all the available images, and then improve the accuracy of the estimation, only scatterers slightly affected by both temporal and geometrical decorrelation are selected (hereafter called Permanent Scatterers). This allows pixel-by-pixel selection with no spatial averaging. Relative target LOS-velocity can be then estimated with unprecedented accuracy (often better than 0.1 mm/yr - depending on time span). The results are computed with respect to a ground control point of known location, elevation and motion.

The study area covers Mt. Carmel, between the city of Haifa and the Zevulun plane in the north and Menashe Hills in the south. The area is located adjacent to the Carmel Fault System (CFS), which is regarded as an active fault, with high seismic risk due to its proximity to large population centers and petrochemical industry. The current deformation in this area is presented with an unprecedented spatial resolution.

This study was carried out within the framework of the Terrafirma Pan-European service for ground motion hazards. We analyze measurements of deformation time series and average annual rates that were carried out by T.R.E, Milano using 47 ERS-1 and ERS-2 satellite images acquired between April 1992 and December 2001. At present, the observed deformation does not seem to correlate with other deformation indicators, such as water-level changes, catalog seismicity, and slope stability. However, there is apparent correlation between PSInSAR-detected ground movement and deformations observed in pavements and buildings in Lev-Hamifratz shopping center. In addition, an attempt is made to explain some of the observed deformations in the Yoqne'am-Jalame area by a fault model that assumes left-lateral strike-slip motion along the NW-striking Carmel Fault segments.

CONTRASTING SERPENTINIZATION SETTINGS IN THE TROODOS OPHIOLITE: AN ISOTOPE RECORD OF OCEANIC-SPREADING AND EMPLACEMENT-RELATED TECTONICS

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A highly serpentinized domain within the ultramafic complex of the Troodos ophiolite is considered based on gravimetric data to be the exposed part of a serpentine diapir formed above a Pleistocene subduction zone. However, field evidence favors serpentinization during Cretaceous seafloor spreading: the ultramafic complex forms part of an oceanic ridge-transform intersection (RTI) and its off-axis location resembles the geometry of oceanic core complexes.

In this study we use field, petrographic and stable isotope data to unveil the early, oceanic-spreading related tectonics and alteration of the Troodos RTI. Petrographic and isotopic tracers (δD, $\delta^{18}O$) of hydrothermal alteration were examined in three profiles across the Amiandos Fault, a major ridge-parallel normal fault, which juxtaposed serpentinized ultramafic rocks against gabbros. Along strike, the fault was described as a listric splay of a low-angle detachment. Petrographic and field observations indicate that the degree of alteration determined by the modal amounts of hydrated minerals in both gabbros and ultramafic rocks increases as the fault is approached.

Oxygen isotope ratios of serpentine (Srp) along a 2 km transect at the central part of the serpentinite exposure range from 10.5 to 12.5 ‰, among the highest $\delta^{18}O$ values measured in ophiolite serpentine, and in agreement with the pioneering work of Magaritz & Taylor (1974). Entirely different, much lower $\delta^{18}O$ (Srp) were measured in a detailed, 70 m long profile perpendicular to the Amiandos fault at the northern part of the serpentinite domain: 4.6 to 5.6‰. Hydrogen isotope ratios also vary: whereas the dD values in the central transect range from –73 to –91‰, those of the northern transect are significantly higher ranging from –57 to –70‰. The duality in isotope ratios in Troodos calls for two distinct serpentinization events: low-temperature hydration recorded in the central area and high-temperature interaction with seawater at the northern part. Superposition of the two serpentinization events is evident at the third, southernmost transect, where $\delta^{18}O$ (Srp) values decrease gradually from 10.3‰ 2 km away from the fault to 4.99‰ at the fault plane itself. It is thus suggested that exhumation and serpentinization of the Troodos peridotites first occurred at the footwall of an oceanic core complex. The tectono-hydrothermal oceanic history was later overprinted by low-temperature serpentinization either on the seafloor or at continental conditions during emplacement.

MANGANESE MOBILIZATION DURING "SOIL AQUIFER TREATMENT" OF EFFLUENTS (THE SHAFDAN PLANT)

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The geochemical behavior of Mn is controlled by the oxidation state of the environment. In aerobic environments Mn is immobilized in solid phases of Mn(III,IV)-oxides. When the conditions become suboxic, the Mn oxides are reduced to the soluble species Mn^{2+} and maybe mobilized by the water.

Organic matter presents in infiltration water is oxidized by a series of reduction reactions following a decreasing order of oxidation potentials: dissolved oxygen (DO)> NO_3> Mn(III,IV)> Fe(III)> SO_4 > CO_2. Hence, when oxygen and nitrate are depleted, Mn(III,IV) can serve as the electron acceptor and is reduced to Mn^{2+}. Accordingly, one of the methods of tertiary treatment of effluent water is the Soil Aquifer Treatment (SAT). This treatment includes recharging the aquifer with effluents containing large organic matter loads, which are oxidized in the unsaturated and/or saturated zone. Clearly, this system may reach the stage of Mn reduction and mobilization.

The present study examines the Mn mobilization in the unsaturated zone and within the aquifer in the SAT system of the Shafdan Plant. It was observed that 20 years after the onset of operation the Mn concentrations of the reclaimed water rose to values of 100-2000 ppb, much higher than the concentrations in the recharged effluents (ca. 30 ppb). This phenomenon is mainly found around one of the infiltration basins, Yavne 2, where this study is conducted. The increase in Mn was attributed to its mobilization from the country rocks but the mechanism and controls on its dynamics is not clear.

The work includes installation of ceramic cups at depth of 0.5-9m that collect water from the unsaturated soil during basin flooding events. Two observation wells were drilled in the center of Yavne 2 infiltration basin: one down to the water table, and the second reached 10m below. The preliminary results show low Mn concentrations (lower than 50 ppb) in waters from the unsaturated zone down the top of the aquifer. Therefore we suggest that the redox potential of the unsaturated zone has not decreased to the level of the manganese reduction as corroborated by the relatively high nitrate content (produced by ammonium nitrification in the effluents). Our results may imply that the main Mn reduction and dissolution occur along the flow path of the water within the aquifer, and not in the unsaturated zone, as has been suggested in the past.

SHEAR STRENGTH OF SILTY SANDS AND SILTY CLAYEY SANDS FROM THE SOUTHERN COSTAL PLAIN.

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We determine the mechanical properties and mechanical behavior of two soil types from the studied section by application of *in – situ* and laboratory tests.

In – situ tests were performed in 5 boreholes drilled to a maximum depth of 20 meters. The tests included three standard penetration tests (SPT), five pressuremeter tests (PMT) and cross hole and down hole surveys for determination of seismic wave velocities. In addition, two trenches were cut in the site to depths of 7 and 14 meters. Samples from bore holes were retrieved in 1 meter intervals for laboratory tests. In addition, blocks were quarried out of the trenches for direct shear tests. The experimental work included the following tests:

1. Determination of Index Properties, Atterberg Limits, and grain size distribution.
2. Drained shear tests performed on a hydraulic, servo-controlled, load frame
3. Determination of a shear strength criterion for the two soil types
4. Determination of the elastic modulus and maximum shear modulus

QUALITY ASSESSMENT OF STRONG-MOTION RECORDS IN ISRAEL

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The strong motion data are absolutely necessary for estimating seismic vulnerability as for separated important structures (power stations, dams, tail buildings and others) so for man-made structures in densely urbanized areas to improve public earthquake safety. Collection of the strong motion data in Israel is conducted by Seismology Division of Geophysical Institute of Israel (GII). The first analogue strong motion instruments (SMA-1) were installed in 1978. Since 1984 all strong motion instruments have been equipped with digital recorders. The number of strong motion accelerometer stations has been growing rapidly during the last three years and now there are 60 stations. The accelerograms database currently includes more than 50 accelerograms from 17 earthquakes with M_W magnitude ranging from 3.7 to 7.1. The geological characteristics of the sites where the accelerometers located differ and range from hard-rock to thick layers of sand, alluvium, clay and sift-grained sediments.

It is essential to make an assessment of quality of these records, since accelerograms may, occasionally, be affected by non-standard recording, which could limit their implementation in strong -motion studies. Since all strong-motion data are rare, it is important to know whether any useful information can be obtained from accelerograms that were affected by such problems. The following types of errors obtained from the accelerograms were analyzed: insufficient digitizer resolution, S-wave trigger, insufficient sampling rate, multiple baselines and spikes. We examined the effect of these errors on Fourier and response spectra and excluded those records, which cannot be used in strong-motion studies. After that, all accelerograms have been integrated with removing offset low-cut filtering in order to obtain velocity and displacement and define peak ground acceleration (PGA), peak ground velocity (PGV) and peak ground displacement (PGD). Fourier spectra, response spectra and also horizontal-to-vertical spectral ratio were computed.

NATURAL RADIOACTIVITY IN GROUNDWATER FROM THE NEGEV, ISRAEL

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As most of the groundwater basins in the Middle East are being diminished or contaminated, exploitation of the deep aquifers referred as the "Nubian Sandstone" from the Paleozoic and Lower Cretaceous sandstone units is increasing. Natural radioactivity is an important water quality factor of groundwater from this aquifers. Systematic analyses of radium isotopes (^{226}Ra, ^{228}Ra, ^{224}Ra, ^{223}Ra), using four analytical measurement methods, in over sixty groundwater samples from the Negev and Arava Valley, reveal that a large number of the pumping wells exceeds the International and Israeli drinking water regulations as regulated by European Community (EU) and the Israeli Ministry of Health. In the Lower Cretaceous Nubian sandstone (Kurnob Group) aquifer 19 out of the 27 (70%) investigated wells are having radium activity above the Israeli regulations while 96% exceed EU regulations.

In the overlying Upper Cretaceous carbonate (Judea Group) aquifer the numbers of wells with activity exceeding the Israeli regulations are 9 (38%) and 10 (42%) out of 23 exceed EU regulations. In the carbonate aquifer we observed a linear correlation between ^{226}Ra activity and salinity whereas in the sandstone aquifer the ^{228}Ra isotopes is predominated and no relationship with salinity was found. Our results clearly indicate that high activity of radium, even in low saline groundwater, play a key role in exploitation and water utilization for domestic and agriculture applications.

HIGH NATURAL RADIOACTIVITY IN THE NUBIAN SANDSTONE (KURNOB) AND JUDEA AQUIFERS IN THE NEGEV

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High radioactivity of water originating from naturaly high radium concentrations has been discovered in the past years in the Nubian sandstone aquifer (Kurnub group) and the Cenomenian carbonate aquifer (Judea group) of the Negev and Arava Valley. In order to characterize the radioactive phenomenon, over 60 wells were sampled from both the Kurnub group and the Judea group aquifers. The groundwater samples were analyzed for the major and trace elements combined with measurements of the four radium isotopes: ^{226}Ra ($t_{1/2}$ =1600 years), ^{228}Ra ($t_{1/2}$ =5.75 year), ^{224}Ra ($t_{1/2}$ =3.6 days) and ^{223}Ra ($t_{1/2}$ 11.44 =days).

Our results show that natural radioactivity is an important water quality factor of groundwater in the two investigated aquifers in the Negev. The activity data of the four radium isotopes show that a large number of the pumping wells in the Negev exceeds the international drinking water regulations as regulated by the USEPA and the European Community (EU). In the Lower Cretaceous Nubian sandstone (Kurnob Group) aquifer 26 out of the 29 (90%) investigated wells are having radium activity above the EU and the EPA regulations. Excluding the activity of the shorted-live ^{224}Ra isotopes (half life of 3.6 days) the fraction of wells with activity above the EU regulation reduces to 79%. In the Upper Cretaceous carbonate (Judea Group) aquifer the numbers of wells with activity exceeding the EU and EPA drinking regulations are 9 (39%) and 11 (48%) out of 23. In the carbonate aquifer we show that the ^{226}Ra isotope is predominant relative to the sandstone aquifer where the groundwater is enriched in ^{228}Ra and ^{224}Ra isotopes. We use the radium isotopes to distinguish between thorium (high $^{228}Ra/^{226}Ra$ and $^{224}Ra/^{223}Ra$ ratios) and uranium sources (low $^{228}Ra/^{226}Ra$ and $^{224}Ra/^{223}Ra$ ratios). Since the correlation of radium activity with salinity is weak, our results clearly indicate that high activity of radium, even low saline groundwater, can pose a serious problem for possible water utilization for domestic and agriculture (e.g., fish farming) applications.

ON THE POTENTIAL IMPACT OF CONVECTION ON EVAPORATION AND SUBSEQUENT SALT PRECIPITATION IN FRACTURED CHALK

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Diffusive fluxes limit the potential amount of evaporation from surface-exposed fractures and other discontinuities crossing the land surface. However, if density differences between the air above a fracture and the moist air within the fracture voids exist, convective flux might develop. If so, evaporation could increase by up to several orders of magnitude, depending on temperature differences and the size of the aperture. Theoretical calculations suggest that under typical desert conditions convection is likely to occur during the night while diffusion is likely to control evaporation from fractures during the day. Field experiments carried out in the Negev desert of Israel showed that the level of salts accumulated within a fracture over six months is much higher than could be explained by diffusion alone. This further supports the existence of additional mechanisms that enhance evaporation. The major objective of this work is to explore experimentally the existence of convective conditions in natural fractures in the field. A surface-exposed fracture in Eocene chalk in the Negev desert was instrumented to achieve constant monitoring of temperature and relative humidity within the 120 cm deep fracture. These parameters were also measured 20 cm above the land surface, just above the fracture surface. To explore the potential for convective flux of moist air in larger discontinuities (e.g., karst systems), a large diameter uncased borehole, 55 m in depth, was also instrumented with thermocouples and relative humidity probes. Preliminary results indicate that: (1) convective conditions exist, at least in the upper part of a fracture, from early evening to late morning (the existence of convection cells deeper in the fracture is still not certain); and (2) convective conditions prevail for almost 24 hours a day (excluding at noon for a short period) in the large borehole. These field measurements suggest that large amounts of salt could accumulate within surface-exposed fractures due to enhanced evaporation controlled by convection. Subsequently, these salts could find their way into the groundwater, bypassing the thick vadose zone.

NETWORK LOCATION BASED ON TIME DIFFERENCE PICKING

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A new bulletin based procedure is developed for absolute location of single events, which generally doesn't require any velocity or travel time model or preliminary ground truth information. Location is based on travel time differences (TTD), calculated for the pairs of stations under assumption of constant apparent velocity between them. This assumption can be considered usually valid for the pairs of stations belonging compact dense sub-networks, small arrays and almost equidistant teleseismic arrivals. Solution is obtained via grid-search in the parameter space of epicenter coordinates and apparent velocity by comparison of the observed arrival time differences and calculated TTD using exponential bell-shape measure of coincidence. The method was verified and showed high efficiency using bulletin first arrivals data for a set of accurately located events.

RIVER TERRACES IN THE CENTRAL NEGEV AND THEIR RELATION TO GLOBAL CLIMATIC FLUCTUATIONS

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Climatic changes during most of the Pleistocene are the major factor that determined the alternating processes of erosion and accumulation in the Negev desert. An extremely arid climate, manifested by a hot desert landscape, prevailed during the Holocene when erosion completely predominated. Though several phases of accumulation coincide with arid periods (terraces III and V); the degree of aridization was not as severe as during the Holocene and steppe and desert elements equally comprised the vegetation cover. Formation of terraces II, IV, VI and the deposition of loess units occurred during a relatively humid, semiarid climate with an annual precipitation above 200 mm. These periods were characterized by steppe landscapes and the formation of calcic paleosols on the terrace surfaces. Thus, accumulation occurred both during relatively humid semiarid periods and, probably, in the transition stages between semiarid and extremely arid climates. More humid periods were characterized by the deposition of large amounts of loess, whereas during more arid periods the accumulation of mainly coarse alluvium occurred. Periods of intensive erosion coincide with extremely arid conditions.

The major climatic fluctuations in southern Israel are related to the global climatic changes. The geomorphologic processes during both glacial and interglacial periods developed in the Mediterranean and central and southern Europe synchronously. Glacials and stadials were characterized by cool to cold climate; steppe landscapes were widespread over a vast territory, and accumulative processes predominated in the valleys. During interstadials and interglacials tree cover in Europe increased following the increasing of mean annual temperatures and rainfalls, whereas desert landscapes prevailed in the eastern Mediterranean because of decreasing annual precipitation and the change in of their regime. These quite different tendencies in the climate-related landscape formation had the same morphological effect: erosion of the valley floor.

However, the main factors that controlled these processes are quite different. During glacial periods periglacial areas of Europe were under drier and cooler climates, characterized mainly by winter storms. Under such conditions winter runoff from slopes increased, the amount of sediment delivered to the streams exceeded their transporting capacity, which induced active filling of the valley floors. In the eastern Mediterranean the climate was dominated by many storms that delivered enormous amounts of dust from North Africa. Mild rain events coupled with extensive loess cover resulted in the decrease in runoff and increase in sediment supply. This combination further resulted in gradual accumulation of alluvial sediments in the stream valleys, and formation of extensive floodplains. Under such "quiet" regimes of precipitation the rich steppe vegetation serves as a dust trap and protects sediments from erosion.

ROAD TUNNEL IN KURKAR RIDGE-PARAMETERS TO CHECK Road

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A shallow road tunnel was planed to cross the Kurkar ridge in Hertzelia municipality. The tunnel purpose was to supply a transportation solution to the Hertzelia municipality by connecting the east to the west side of the city.

According to the plan, the tunnel cross section was a 10 meter diameter circle. The tunnel length was 570 meter. The tunnel slope was approximately 6% from the portals to the tunnel center. The rock thickness above the tunnel changed from 6 to 32 meters due to topography and tunnel path. The path of the tunnel was right under or very close to residential flats and private houses.

Lithology, the Kurkar ridge is built of 40%-60% Quartz grains, 1% of heavy minerals, 2% of clay and the rest are bioclastics carbonate formed by crashed shells and skeletal fragments. Grain cement was made by Calcium which fills the space between the grains ununiformly. The rock strength and density are determined by amount of carbonate cement. Morphology, the Kurkar is built of laminas, which are hard compact to porous. There are uncement sand pockets between the laminas.

The use of ordinary tunneling methods to classify the rock mass is not possible at the Kurkar ridge. Practically, the Kurkar rock mass can not obtain self-support.

The tunnel probability Parameters are:

1. Soil settlement at the tunnel construction period.
2. Vibrations of the rock mass at the construction and operation period.
3. Noise at the construction period and mainly at the operation period.
4. Air pollution at the operation period.

Soil settlement above the tunnel is a widespread effect when the settlement profile, the amount of vertical settlement and the settlement area, depend on the soil type, tunnel depths, tunnel span, ground lost and tunneling method.

Settlement profile was calculated empirically according Peck (1969). The calculations show that the maximal settlement on the surface above the tunnel is 5.4 to 20.8 cm. The horizontal distance from the tunnel axis in which the settlement will be present is between 18 to 65 meters.

Such a soil settlement will dangerous the residential flats and even the private houses.

AUTOMATIC INTERPRETER OF SEISMIC TELEMETRY

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New Automated Interpreter of Seismic Telemetry (AIST) software for general network and array data analysis and bulletin production is now developing in the Geophysical Institute of Israel (GII). This JAVA based (all platform applicable) user friendly program comprises reading of seismic data in various formats, flexible waveform and geographical visualization in different scales; interactive and automatic picking P, S and other phases; source localization in local, regional and teleseismic scales using seismic network and array, linear and non-linear optimization algorithms; magnitude and moment estimation, source type discrimination and other parameters. The program is supplied by a variety of standard tools for the single and multiple seismogram traces analysis: band path filtering, spectral, cepstral, correlation analysis and several new algorithms, developed in GII, such as AUTOLOC and BULLOC procedures, based on non-linear grid search optimization.

The automatic location function of AIST is based on the AUTOLOC code realizing automatic picking P and S wave's first arrivals with further application of the bell-shaped weighting functions and the grid search maximization. This original program is now working on-line as a part of the Early Warning Automatic System established in the Seismological Department of the GII and sending on-line the trigger and location messages to the European Mediterranean Seismological Center, France.

The new BULLOC procedure is based on P first arrival differences and non-linear optimization of the simple partially constant velocity model valid for the tight arrays of stations.

A THICK LATE PLEISTOCENE TO HOLOCENE FLUVIAL SEQUENCE BURIED UNDER THE ACTIVE CHANNEL OF NAHAL ZIN

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A pit dug by Rotem Amfert Negev in the active channel of Nahal Zin south of Har Zin, aimed at exposing phosphate beds, revealed 25 m of coarse gravels and fluvial sands of the Nahal Zin alluvial fill. At this location the active channel of Nahal Zin is 200-300 m wide.

Four samples for luminescence dating were collected from the section. A sandy lens a few meters above the base is ~70 ka, the middle was dated to ~55 ka and a sandy bed 2 m below the top is ~10 ka. This time frame covers the entire glacial interval and part of the late Pleistocene interglacial phase. The luminescence ages indicate that during the last glacial phase, the depositional environment in the intermediate segment of the Zin Valley (Biqeat Zin) was aggradational. The unconformable position of the alluvium directly on top of a phosphate bed hints that at the end of the last interglacial phase the bedrock along Biqeat Zin was widely exposed. The present active channel of Nahal Zin is currently incising into this alluvial fill, however most of it is still preserved.

At the Zin headwater near Mizpe Ramon accumulation started also at around 70 ka and was roughly continuous until ~ 25 ka. Then erosion started, and it intensified during the late Pleistocene to Holocene post glacial phase. The present channels there incise into the 4-5 m section, forming several erosive terraces and exposing the bedrock along part of the upper valleys.

In the Makhteshim, which are part of the Nahal Zin drainage basin, two Late Pleistocene terraces were found by Plakht (2003): a 9-11m terrace dated by thermoluminescence to 66-54 ka, and a 5-6 m terrace dated to 36-33 ka. It appears that there deposition was interrupted by an erosional phase between 50-40 ka.

The variations between the timing and rates of accumulation and erosion between different segments of the same drainage basin indicate that the geomorphic response to climatic changes is highly dependant on the location of each segment along the drainage basin. At the time that erosion was initiated in the upper segments of Nahal Zin, accumulation continued in the intermediate segment of Biqeat Zin until well into the Holocene. Differences in the geomorphic response exist even between upper segments of the same drainage basin with different lithologies, as exemplified by the differences between the Makhteshim and the headwater near Mizpe Ramon.

GEOMORPHOLOGICAL EVIDENCES FOR NEOTECTONICS IN THE NAHAL RAHAM ALLUVIAL FAN-SOUTHERN ARAVA- DEAD SEA TRANSFORM

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The alluvial fan of Nahal Raham is located on a structural high, separating the Yotvata basin in the north from the Avrona basin in the south. In this area several faults meet: 1. the Thamad fault, a right lateral fault generally trending west – east, perpendicular to the Dead Sea Transform (DST) fault zone, changes here its strike to NE; 2. The western normal fault system of the DST striking north – south; and 3. The Avrona fault – one of the DST left lateral segments, trending north – northeast.
In order to determine the relationship between the structure of the Raham alluvial fan and the regional tectonic elements we mapped the alluvial surfaces of the fan, analyzed the alluvial fan sedimentary sequence and determined the paleoseismology of a NNE trending graben crossing the alluvial fan.

The mapping reveals that during the upper Pleistocene and the Holocene the location of the alluvial fan was the same in relation to the Yotvata and Avrona basins. However, detailed surface mapping shows a complex history of erosion and burial phases. The sedimentary sequence of the fan shows evidence of at least three phases of abandonment followed by soil development (paleosols). The ages of these paleosols, which represent the abandonment of the surface, are: 88 ka; 54 ka and 20 ka. We found that the northern – central part of the alluvial fan which is buried by eolian sand as a result of a tectonic elevation indicates ending of fluvially activity. The last elevation phase occurred about 5 ka ago. The paleoseismological analysis of the graben reveals that at least four earthquakes occurred during the upper Pleistocene and the Holocene at: 20 ka; 13 ka; 9.5 ka and one event in between the last two. The displacement for one event ranges between 30 to 50 cm in the Holocene, and 180 to 200 cm in the Pleistocene. The total amount of displacement along one of the graben's faults is between 2.2 and 2.8 m.

To summarize, the development of the Raham alluvial fan resulted from a combination of several young tectonic processes related to its location on a structural high, its location relative to the regional and local fault systems, and the degree of the tectonic activity of these faults. In addition, erosion and deposition processes related to climatic fluctuations may also have affected it.

WATER QUALITY STRATIFICATION IN THE SATURATED ZONE OF THE ISRAELI COASTAL AQUIFER

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Stratification of water layers in the upper part of the saturated zone in unconfined aquifers have been reconstructed by environmental isotope tracers in combination with traditional hydrogeology, hydrochemistry, and numerical modeling. In particular the relationship between modern and old recharged waters was evaluated. Numerical modelling and field studies conducted in Germany and Venezuela have demonstrated that more than 85 % of the groundwater recharge is turned over in aquifers close to the water table (i.e., active recharge zone) and less than 15 % reaches greater depths (passive recharge zone or deep groundwater). Here we investigate the water quality stratification in the saturated zone of the coastal aquifer of Israel. We use pumping wells with different screen depths to provide access for multiple depth analysis of the aquifer along several cross-sections perpendicular to the coast line. Statistical comparison of historical data shows the "shallow" wells became saline during an earlier stage of the salinization process than did the "deep" ones. Tritium data of deep wells (top end screen deeper than 75m below sea level) show low values (<0.9TU). In contrast, shallow wells (upper than 30m) reveal higher tritium levels (>3.0TU). A transition zone was identified at a depth range of 30-75m, showing a wider tritium range (0-4.2TU). Our data suggest water layering of different ages in the upper part of the saturated zone in spite of lack of physical separation by low-conductivity layers. We also observed that chloride and nitrate concentrations are lower at the "deep" wells, though for nitrate the variability is high. Stable isotopes show a narrow $d^{18}O$ and $d^{2}H$ range for the "deep" wells, while the "medium" ones show a wider variety with a slope lower than MWL.

COMBINED SEISMIC-GRAVITY GEOPHYSICAL INTERPRETATION AND ITS RELATION TO BOREHOLE DATA: A CASE HISTORY FROM THE EIN GEDI AREA

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The project was initiated in order to interpret a gravity data set in the Ein Gedi area, integrate it with new, high resolution, 2D seismic lines and place the overall interpretation in an exploration context.

After reprocessing the high resolution seismic lines it was concluded that a shallow complex-faulted, NW trending anticline structure exists in the investigated area. The location of this structure coincides well with a structural high inferred from the gravity analysis. Relative amplitude preserved data processing has resulted in detecting an amplitude anomaly, potentially correlated with gas-water contact. This seismic amplitude anomaly overlaps a low density zone obtained using the total normalized gravity gradient method.

These interpretation results have been recently verified. The Zerach-1 well was drilled after geophysical data interpretation. Sonic and density logs from the well were used for elastic modeling and seismic data calibration. A synthetic seismogram generated from the well logs indicates a waveform contrast and an amplitude amplification associated with a zone of gas shows reported whilst drilling. This zone is characterized by decreasing density and correlates with a low density zone obtained using the total normalized gravity gradient method.

GROUNDWATER RECHARGE OF THE COASTAL PLAIN AQUIFER UNDER DIFFERENT LAND USES

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This research was designed to examine the impact of different land uses on recharge rates in the Coastal Plain Aquifer, the most important aquifer in Israel. The determination of infiltration rates is crucial for proper aquifer management; specifically, it is essential for (1) estimating the annual water volumes available for pumping, and (2) evaluating the migration rate of various contaminants from land surface into the water table.

The study is being carried out in the city of Ashdod, where urbanization of the sand dunes has probably been the fastest in Israel. Infiltration rates under different urban land uses are being compared to those beneath nearby cultivated areas and the undeveloped sand dunes. Infiltration rate has been estimated at five sites, using a novel methodology based on time domain reflectometry (TDR). TDR sensors are installed in slanted boreholes, drilled throughout the entire unsaturated zone, and provide real-time, online information on temporal variations of water content at various depths.

The preliminary results shed light on the infiltration process and provide information about questions such as: (1) the amount of rain needed to activate percolation, (2) the impact of clay layers in moderating the percolation rates, (3) the travel time of an infiltration pulse across the entire vadose zone, (4) the possibility of distinguishing infiltration pulses from individual events at various depths, and (5) the impact (if any) of a single rain event on water-level fluctuations.

IDENTIFICATION OF THE ORIGIN OF NITRATE POLLUTION IN THE COASTAL AQUIFER BY ISOTOPIC TRACERS

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This study aims to identify the origin of nitrate contamination in the coastal aquifer of Israel. The study is based on systematic sampling of polluted groundwater from the major nitrate plumes in the coastal aquifer and measurement of the nitrogen, oxygen in nitrate molecule, boron, and tritium isotopes coupled with chemical analyses.

Overall, the chemical and isotopic data suggests two parallel contamination process; salinization derived from natural saline groundwater superimposed with anthropogenic nitrate pollution. In some cases, however, the isotopic data suggests that the salinity is also derived from direct anthropogenic sources (e.g., Migdal area). The isotopic composition of nitrogen and oxygen ($d^{15}N< 8‰$, $d^{18}O<12‰$) indicate that that most of the nitrate pollution is derived from nitrogen decomposition from organic material in the soil. This phenomenon is observed mainly in the northern part of the aquifer, and reflects a long-term process of nitrogen releasing from the unsaturated zone to the aquifer's saturated zone. These results confirm previous evaluation that suggested that the nitrate pollution is related to agriculture development and the virgin soil tilling since the thirties of the 20th century. This study reveals, however, that a large number of polluted groundwater sites, particularly in the southern part of the aquifer, are having high $d^{15}N$ values (> 8‰), reflecting contamination from sewage and/or animal waste effluents. In Ashqelon area Groundwater samples with an anthropogenic nitrogen signature (high $d^{15}N$) are associated with high tritium contents, inferring that the anthropogenic nitrate pollution is younger (recharge during the 1960's) relative to the natural nitrate pollution. In addition, we found a geographical pattern in the groundwater's age; groundwater with low tritium and low $d^{15}N$ values in the northern part relative to groundwater with high tritium (6-16 TU) and high $d^{15}N$ values in the southern part of the aquifer.

Our data show that the massive nitrate pollution in the Gaza Strip is associated with high $d^{15}N$ values indicating that sewage effluent is the major source of the pollution. In Migdal area we found that the nitrate contamination is associated with high $d^{15}N$ (>8‰) and low $d^{11}B$ (~10‰), suggesting that domestic sewage is the major source of the pollution. The combined use of isotopic tracers is shown to be a very powerful tool in investigating groundwater contamination.

FLOW AND DISSOLUTION OF THE MESSINIAN SALT AT THE DISTAL CONTINENTAL SLOPE OF THE LEVANT

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Extensive slumps overlie enigmatic structures of Messinian evaporites at the base of the continental slope of the Levant. These structures, commonly known as "The Pelusian Structures," had been attributed to some ingenious tectonic models, such as transcontinental megashear or incipient subduction. The Pelusian structures affect the Messinian evaporites and the overlying Plio-Quaternary sequence along ~20 km wide band that stretches along the distal continental slope of Israel and Lebanon. The deformation in the two sequences is not uniform, in the Plio-Quaternary series it comprises tilted blocks and detachment faults, where the stratification is readily discerned, while the deformation in the Messinian series occurs in the pinching-out zone, and displays a very rough sector of uneven surface and numerous diffractions, where the regularity of both reflectors M and N is drastically disrupted.

We suggest that while the initial deposition of the Messinian evaporitic sequence was rather regular and nearly horizontal, post-depositional subsidence tilted the Levant basin slightly to the NW. The tilt caused the salt to flow, as indicated by the small reverse faults in the basin, and consequently to withdraw from the edge of the Messinian hypersaline basin, where reflectors M and N merge. Indeed eastwards dipping reverse faults that affect only reflector M and the Plio-Quaternary series were discerned in the Levant basin, more than 50 km west of the Pelusian structures, suggesting westward flow of the evaporitic sequence. The withdrawal of the edge of the evaporite sequence caused geotechnical faulting and slumping in the Plio-Quaternary series, which, in turn, enabled flow of water that partly dissolved the evaporites and enhanced the slumping further. The Pelusian structures were traced off Lebanon and Israel, but seem not to cross the continental margin of northern Sinai, and thus seem not to underlie the extinct Pelusian arm of the Nile Delta.

The Pelusian structures are not the only type of slumps along the Levant margin, and the large Palmahim slump, which, like the Dor slump, transects the Israeli margin, offsets sinistrally the Pelusian structures. It seems that unlike the Pelusian structures, the Palmahim slump is constrained by a series of NW-trending faults.

SINKHOLE HAZARD ASSESSMENT USING THE GRAVITY AND MAGNETIC SIGNATURES OF THE SAELLOW SUBSURFACE MASS DEFICIENCY

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Problems associated with sinkhole development are causing serious concerns in land-use planning in the Dead Sea area. We studied the resolving power of gravity and magnetic surveys for the assessment of sinkhole hazard. Microgravity surveying has been used worldwide to detect karst caves in the dense carbonate rocks. However, the Dead Sea sinkholes are developing very rapidly in the young, thick, low-density sediments that fill the Dead Sea graben. The gravity effect of the entire graben reaches -130mGal with a horizontal gravity gradient up to 10mGal/km. To the best of our knowledge a micromagnetic surveying has never been used to delineate subsurface cavities.

Assuming that the collapse is caused by large voids in the shallow (a few tens of meters) depth, we defined our survey designs by 3-D gravity and magnetic forward modeling. A density contrast of such a target ranges from 0.9 to 2.0 gr/c^3 and numerous magnetic susceptibility measurements suggested an average magnetic contrast of $3*10^{-4}$ SI. The modeling showed that high resolution detailed gravity and magnetic surveys can reliably delineate the voids located at the shallow depth. The magnetic dipole anomaly with its positive part located north of the negative part is typical of anomalies of a concealed void.

We have been studying the feasibility of methods mapping the sites with sinkholes occurring in alluvial fans and mud flats along the Dead Sea shore since 1999. About 20 thousand gravity stations were measured at eleven sites and micromagnetic measurements were taken at five sites.

The results suggest:

- The microgravity and micromagnetic data indicate a subsurface mass deficit beneath some of the areas where open sinkholes are observed, suggesting that a mass deficit is presented and additional sinkhole development can be expected. Indeed, new sinkholes opened up at several anomalous locations.
- Moreover, the absence of negative residual gravity anomalies and typical magnetic dipole anomalies at the sites with open and/or filled sinkholes, suggests that the subsurface mass deficit was recently compensated and these sinkholes are not presently developing.
- The methods can be an effective tool for monitoring the subsurface mass redistribution that may signal impending collapse.
- The elongated anomalies observed in several sites indicate that most collapse is related to tectonic lineaments.

The possible wavelength and magnitude of the effects of structural variations could be similar to concealed hollows. This means that the microgravity and micromagnetic surveys should be accompanied by a seismic refraction study.

INTERNAL STRUCTURE OF THE DEAD SEA TRANSFORM AS REVEALED BY A HIGH-RESOLUTION AEROMAGNETIC SURVEY

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We present the high-resolution (scale 1:100,000) magnetic maps (the total field, their derivatives and detailed maps of several locations) of the southern, 120-km-long, section of the Dead Sea Transform. A high-resolution magnetic (HRAM) survey was carried out in October 2003 aboard a Jordanian helicopter flying at an altitude of 100m. The survey was part of a US-AID Middle Eastern Regional Cooperation project between Jordanian, Israeli, Palestinian and American scientists. Data were collected along rift-perpendicular lines spaced 300m apart, requiring frequent crossings between Israeli and Jordanian air spaces. The raw HRAM data (about half a million readings) were processed and incorporated into a GIS. Comparison between the HRAM and the land magnetic surveys along the selected profiles confirmed the high quality of the aeromagnetic data. The high quality allowed compilation of the magnetic anomaly maps with a contour interval of 5nT.Moreover, anomalies with magnitudes of only a few nanoTesla can be reliably delineated along the flight lines, providing an unprecedented detailed insight to the tectonic pattern of the shallow subsurface.

The main findings of the HRAM survey are the absence of magnetic anomalies crossing the entire rift valley and the presence of a rift-parallel regional lineament corresponding to the active trace of the Dead Sea Transform. The lineament extends NNE as an almost continuous trace from Elat to the eastern side of the Arava/Araba valley 5 km north of Rahmeh, Jordan. Another fault trace, located 2-3 km to the west, may overlap and continue NNE through Gebel A-Risha, and into the central Arava, where it is visible on the surface. Alternatively, the two traces may be connected. Traces of buried faults in the Arava are visible as abrupt terminations of short wavelength magnetic anomalies. Such anomalies are observed east of the Paran village and north of the city of Elat, suggesting shallow magmatic bedrock at these locations. The largest magnetic high (east of the Yahel village) is probably related to the concealed western part of Precambrian Qunai diorite massif. The eastern (Jordanian) part of this massif, shifted 105km north, presently outcrops east of the main road close to the Lot monastery.

Comparison between the HRAM and the sparser land-gravity data shows the same general azimuth of the magnetic and gravity lineaments associated with the segmented transform system and a surprisingly good coincidence between gravity and magnetic anomalies over the Timna pull-apart basin.

PROPOSED TECTONIC STRUCTURE OF THE NIKLAS AREA (EASTERN MEDITERRANEAN- SOUTHWEST OF CYPRUS)

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Last year we reported on the Niklas - a hitherto unknown deep magmatic massif in the eastern Mediterranean as suggested based on the gravity, magnetic and seismic refraction data in the area southwest of Cyprus and west of Eratosthenes Seamount. The geophysical signature of the Niklas is typical for the ophiolite massifs around the world and for the Troodos, Hatay, and Antalya massifs in particular. Based on this similarity, the Niklas was assumed as being composed of dense and magnetic ophiolites. This large (~100*75km) deep-seated (~7km) thick (~7km) massif is located south of the Cyprian arc. North of the arc up to southern coast of Turkey, the gravity and magnetic maps show a number of objects with the same pattern of the potential fields. This can be interpreted as an expression of the ophiolite bodies beneath the Mediterranean bottom.

In the present work we extrapolated the tectonic style observed in southeastern Turkey (Eastern Taurus) and northwestern Syria (Baer-Bassit and Hatay) to the study area. In the Cyprus-Niklas-Eratosthenes area as well as in southeastern Turkey, we propose a combination of the Upper Cretaceous large low-angle thrusts, high and moderate angle, probably Miocene (or Eocene-Miocene) north-dipping reverse faults, Miocene-Recent subvertical normal faults and strike-slip faults. Large sheets, bounded by large Upper Cretaceous thrusts, were dissected and displaced by younger Cenozoic faults. These faults restrict the inclined slices and tectonic blocks.

First, the collision zone is expressed by the Miocene reverse-faults zone. A displacement along the faults is supposedly the main reason for the considerably lower hypsometric level of the Niklas massif relative to the Troodos massif. This zone reflects the Miocene-Pliocene convergence between Eratosthenes and Cyprus and Plio-Pleistocene underthrusting of continental lithosphere beneath Cyprus.

It is conceivable that in the Niklas area we observe an isolated, southernmost fragment of the 'Peri-Arabian ophiolite belt'. In the past this was the southern part of the large thrust slab which includes the Troodos massif of Cyprus. In the large scale it is possible that this is the southern outpost of the large North-Eastern Mediterranean ophiolite allochthon. By this means on the mega-scale, the Niklas area could be considered as any outpost in the dynamic system of the Eastern Mediterranean that is characterized by association of the southward–facing thrusts and left-lateral strike-slip faults. This dynamic system possibly developed as a result of anticlockwise rotation of the a part of the Eastern Mediterranean.

PALEOMAGNETIC DATIND OF UBEIDIYA FORMATION

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Ubeidiya is a Lower Paleolithic site located in the central Jordan Valley, 3.5 km south of Lake Kinneret. The 150 m thick layers of this site occupy a major section within the 'Ubeidiya Formation that is limited to the Kinnarot Valley. Systematic geological and archaeological excavations (1960-1999) uncovered the site's stratigraphy in a series of trenches. The variable layers were deposited in lacustrine and fluvial environments. After deposition these layers were tectonically tilted. Lithics, cutmarks on the faunal remains and scant paleoanthropological finds attest to the presence of early hominids at the site. The 'Ubeidiya lithic assemblage is generally similar to that of Olduvai Upper Bed II (1.6-1.27 ma), Tanzania.

There are no radiometric ages for 'Ubeidiya Fm. and its age is, therefore, uncertain. The formation overlays the Cover Basalt (4.4–5 ma), and possibly also the Erk el Ahmar Fm. (1.96-1.78 ma), but without clear field relations, the stratigraphic assessment is dubious. The 'Ubeidiya Fm. Is overlain by the Naharayim Fm. (0.8 – 0.6 ma). Therefore, at best, the Ubeidiya Fm. was deposited sometimes between 1.78 - 1 ma. An estimated age of 1.4 ma was suggested by the late E. Tchernov (1987) on the basis of long -range biochronological correlations with Europe. The biogeographic location of 'Ubeidiya in the Levantine crossroads, and evidence for one of the earliest presence of hominids "out of Africa", emphasizes the role of obtaining precise dating of the archaeological bearing strata. Therefore, we have conducted detailed and systematic paleomagnetic study at 'Ubeidiya.

Paleomagnetic measurements were carried out at ~0.5m intervals. At each point we collected two samples for Alternating Field (AF) and usually a third sample for thermal demagnetization. The results from the AF samples could not be explained by a geomagnetic source, while the thermal demagnetization yielded better results. The sediments carry two ferromagnetic minerals: Maghemite, with J_s=38mT (Saturation Magnetization) and T_c= 300°-350°C (Curie Temperature), and Ti-magnetite, with J_s=48mT and T_c= 580°C. These minerals are indistinguishable using AF, but have a distinct thermal magnetization. We have identified a R-N-R-N-R polarity sequence in the section. According to the bounding ages of deposition, we assign these sediments to the Matuyama Reversal (2.58-0.78ma), and propose the two Normal polarity readings represent either the Gilsa and Cobb Mt. (1.55 and 1.2 ma, respectively), or Cobb Mt. and Jaramillo (1.2 and 0.99 ma, respectively). The current reanalysis of the faunal remains suggest that biochronological correlations are equally consistent with either interpretation. Thus, future paleomagnetic and biochronological research are needed in order to decide between the two chronological resolutions.

OPEN QUESTIONS IN SEISMIC HAZARD EVALUATION IN THE HAIFA BAY AREA

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Geological conditions in the Haifa Bay area increase its vulnerability to earthquake hazards. Moreover, the area is densely populated and heavily industrialized and therefore, in the event of a strong earthquake, the damage may be intensified considerably. Yet the present Israeli Building Code 413 does not fully cover all the hazard factors the area is exposed to. The structure of the Bay and the intense development in it complicates the hazard assessment and may pose dilemmas and open questions in determining the actual status of the investigated area. Some of these problems will be discussed here.

Within the framework of the national steering committee for earthquake readiness, a comprehensive survey has currently begun to define and map all the seismic hazards in the Bay area. The survey is carried out by the various earth sciences institutes of Israel: the Geological Survey, Geophysical Institute, National Building Research Institute - Technion, Atomic Energy Committee and the Survey of Israel. The main aspects that will be examined are:

Active faulting: Mapping the Carmel fault and the Zevulun Valley in search of paleoseismic records; Evaluation of geodetic data, InSAR and PSINSAR measurements for the detection of current deformations. The aim is to define the status of the potentially active faults according to the Israeli Building Code.

Amplification of seismic accelerations: Seismic zoning by site effect measurements; 1-D modeling of the amplification based on empirical measurements and subsurface structure; 2-D and 3-D deterministic modeling of the amplification factor caused by the basin effect induced by the Qishon graben.

Slope stability: Qualitative evaluation of the potential of slope failure in the area of the Haifa topographic sheet 1:50,000; Stability evaluation of the Carmel slopes in the Halisa neighborhood; Quantitative estimation of past seismic accelerations from existing landslides.

Liquefaction: Mapping the vulnerable areas according to the geological conditions.

Tsunami: Evaluation of the expected run-up waves and the area likely to be flooded.

The potential of each of these factors will be presented on vulnerability maps. In addition, a map integrating all the hazards will be constructed. The findings will allow various users, such as areal planners and engineers, to formulate planning regulations, guidelines and instructions necessary to evaluate and mitigate earthquake-related hazards.

WATER QUALITY OF SPRING DISCHARGE AND BOREHOLE EXTRACTION IN THE SOUTHERN WEST BANK .

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This paper presents chemical and biological analyses of water samples taken from more than 60 springs and 20 deep boreholes over the period 1998-2004. The aim of this research is to determine the suitability of the uses to which the water is put. All springs sampled are contaminated with coliform bacteria, most with colonies so prolific that they are too numerous to count. The analysed samples from springs in the southern West Bank, showed highest concentration of NO3 in those collected at the end of the dry season Nitrate values were particularly high in samples taken from some agricultural springs, probably due to an over application of fertilizer. About 5% of the samples are of doubtful water type, according to Todd (1980) with respect to their soluble sodium percentage (SSP), 55% of the springs sampled are classified as having good water the remaining 40% are classified as excellent. Lack of water from springs in villages dependent on them for drinking water also reduced the quality of the drinking water. This presented a serious health hazard, especially for the children. Significant incidence of amoebic dysentery among both children and adults were reported in most of the villages in this study. Treated wastewater could alleviate some of the water stress. The larger towns, in particular, the city of Hebron has an industrial base with huge demands on this diminishing resource, but, at the same time, produces a considerable amount of wastewater. This potential resource was lost. The tanning, dyeing, glass and ceramic industries were the main polluters but claimed that removal of hazardous waste material from the water was too expensive. Plans for a large wastewater treatment plant to the south of Hebron have been impossible of implementation because of the volatile situation from autumn 2000. The results of analyses of the water samples taken from boreholes in the Southern West Bank show that, from the biological and chemical aspects, the water is of good drinking quality. However, a few of the samples do have values that are slightly higher than the WHO guidelines. Thirteen samples exceed the calcium limit, two exceed the HCO3 limit and six exceed the PO4 limit. The biological evaluation revealed some faecal coliform in four samples taken during the period of study. All the samples are within the acceptable limits for hardness. According to the classification of Sawyer and McCarty (1967), 70.1% of the samples are hard and 29.1% of them are very hard. All the samples are of low sodium hazard and medium salinity hazard and classified as of excellent water quality with respect of soluble sodium percentage (SSP) according to Todd (1980).

EVIDENCE FOR PARALLEL RIFTING ACROSS THE ARABIAN PLATE

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New well data obtained on the continental shelf of the northern Levant margin revealed a unique sedimentary sequence (mid Oligocene-early Miocene), which is absent from the stratigraphic record of the entire eastern Mediterranean basin. Analysis of seismic profiles indicates that the sequence was deposited in a morphotectonic basin, "Haifa basin", which evolved along the present-day Carmel fault. This basin is interpreted as being part of a larger series of basins, comprising a failed rift along the Qishon-Sirhan trend. The Carmel fault would therefore seem to be related to processes occurring several million years earlier than previously thought. The failed rift evolved in parallel, both spatially and temporally, to the Red Sea-Suez rift. The development of a series of basins in parallel with a young spreading center is a known phenomenon in other regions worldwide; however this is the only known example from the eastern Mediterranean region.

VERTICAL MOTIONS AND THE ASYMMETRIC STRUCTURE ACROSS THE DEAD SEA TRANSFORM SINCE THE PLIOCENE

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A 3-D layered structure of the Levant and the southeastern Mediterranean lithospheric plates has been constructed using data of four interfaces: 1) elevation; 2) the top of the crystalline basement; 3) the Moho boundary; and 4) the base lithosphere. The local and flexure isostatic compensations since the Pliocene were calculated by setting up a dataset for the accumulated Pliocene-Recent sediments of the Nile cone and infilling of tectonic basins (loading), as well as for the contemporary amount of denuded rock units from the Arabian, Sinai and African continental parts (unloading). Variable density values for the different layers according to composition, compaction and temperature were used for these calculations. A gravity model for the 3-D lithosphere is compared with the Bouguer gravity and the resulting residual map served as an independent constraint for the 3-D structure.

The isostatic modeling demonstrates that most of the area studied is balanced (±200 m) only when the compensation level is placed at a depth of about 100 km, which is close to the base of the lithosphere, and significantly deeper than the Moho boundary. This enabled adopting thermal-dependent density variations in the mantle lithosphere of ±0.05 g/cm^3. The isostatic compensations, as well as the gravity calculations exhibit a similar pattern of anomalies. This provides important support for the newly established 3-D plate structure that preferred single flexure rigidity on the order of D=10^{23} Nm and as low as D=10^{16} Nm rigidity for the Dead Sea Transform (DST) plate boundary.

The most prominent positive anomaly of Lebanon and northern Israel (up to ±2500 m and ±100 mGal) clearly indicates intensive uplift of this region since the Pliocene. This uplift was most likely caused by a dynamic push-up mechanism of the DST where it changes direction north of the Hula basin along the Yammouneh fault (segment). The high negative anomalies associated with tectonic basins within the DST (<–1000 m) are the results of subsidence within dynamic pull-apart (sort of) basins. The loading of the Nile sedimentary cone yielded concentric oscillatory negative and positive anomalies, up to ~400 m high, or ±20 mGal. Such a negative anomaly offshore Israel may explain the rapid subsidence of this region in the Pliocene; and on the other hand, the positive anomalies of similar order of magnitude in central Israel, northern Sinai and Egypt may explain the arching of these regions. In the same way most of the vertical movements within the DST and the Gulf of Suez, and along their margins, such as the topographic asymmetry across parts of the DST, might be explained by the sedimentary loading within these tectonic basins.

THE CARMEL STRATIGRAPHY- A NEW OUTLOOK

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Following stratigraphic synthesis in Mount Carmel, new formations were defined, and four sedimentary cycles were recognized within the time interval of the Albian-Turonian. Each of these cycles accumulated under a specific interplay of environments, and the boundaries between them mark a sharp change in these environments. Cycle 1: Yagur Fm. This cycle accumulated under conditions of shallow carbonate platform in most of the Carmel area, which was rimmed by a barrier reef in its western part. This environmental regime is reflected in the predominance of dolomites in the sheltered platform, and in limestones in the slope and deeper open sea environments. The Yagur cycle was terminated by emergence, erosion, and renewed subsidence. Cycle 2: includes a volcanic tuff (V_1 – 97.1 Ma) at the base, and the Isfye chalky Fm and Bet Oren limestone in the central Mount Carmel. Toward the south, around Zikhron Yaakov, limestone layers, in places alternating with dolomites, become predominant. The beginning of this cycle in most of Mount Carmel points to conditions of outer, deeper platform, becoming shallower upwards. This is reflected in the upward transition from pelagic chalks to reefoidal-related limestones. Cycle 3: V_2 at the base, covered by the Zikhron Fm in the south, and Arqan Fm in the north. The Arqan Fm (known previously as the Khureibe and Junediya [or Shamir] formations) consists of chalks, commonly with chert nodules, and locally with another volcanic unit (V_3 – 96.7 Ma) in the middle part. This formation accumulated under conditions of outer platform, similar to those that prevailed in the second cycle. The Zikhron Fm, consisting of dolomites and limestones, represents shallow environments, of barrier reef complex and a sheltered platform. Cycle 4: contains a wide array of facies, which include various limestones and dolomites, marls and chalks, and locally a volcanic unit (V_4 – 95.4 Ma) at the base. This cycle, whose age is upper Cenomanian-Turonian, marks the transition into a highly complex set of platform environments, which is controlled by two elements, a basin and local reefs. The latter either fringe the basin or occur haphazardly over the platform. As a result, facies changes are abundant, and the existing stratigraphic schemes have merely local significance. The alternative stratigraphic framework is: a) in places, in particular in south-western Carmel, the indivisible stratigraphic succession, is ascribed to the Bina Formation; it comprises mainly limestones with some dolomites, and marls are minor; b) elsewhere, the Bina Fm is made up of two units, the Muhraqa Mbr at the lower part (consisting of reef-complex limestones and dolomites), and an overlying Sumaq Mbr - alternating limestones (reef-related and biomicrites), marls (previously Dalyya marl), and chalks (previously Ein Hod Chalk).

THE ACTIVE STRUCTURE OF THE DEAD SEA DEPRESSION- INSIGHTS FROM ACCURATE RELATIVE EPICENTER RELOCATION

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Earthquake catalog data from the Dead Sea Depression (DSD) show a diffuse epicenter distribution pattern, with no obvious clustering along distinct fault zones. Specifically, ongoing seismicity does not seem to delineate two major, left-stepping, ~N-S strike-slip faults along the eastern and western boundaries of the Dead Sea basin. One particular problem in resolving DSD seismicity is the heterogeneity of upper crustal lithological structure across it, making source-receiver ray paths for sources within the DSD highly heterogeneous. A single 1D velocity model, as used for routine epicenter determinations, cannot realistically represent the crustal velocity structure.

In order to overcome this difficulty and better resolve the DSD hypocenter distribution pattern, an accurate double-difference relative location algorithm was applied to 171 selected DSD earthquakes of that occurred between 1984 and 2005. In this approach, distances between hypocentral pairs are iteratively adjusted by minimizing the residuals between observed and calculated travel-time differences for each pair of earthquakes at common stations. These results in cancellation of common errors related to the source-receiver path.

Preliminary results for the DSD show an epicenter distribution pattern that is more clustered than suggested by catalog data. Particular earthquake clusters occur in the north-western Dead Sea basin, along the Lynch fault, east of the Lisan peninsula and in the northeastern Arava. Ongoing seismicity does not align along the margins of the DSD, and most earthquake mechanisms indicate faulting along NW and NE oriented planes.

THE JERICHO VALLY SEGMENT OF THE DEAD SEATRANSFORM: LOCALIZED VS. DISTRIBUTED SHEAR IN TRANSFORM PLATE BOUNDARY ZONES

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Continental transform plate boundaries are typically either localized along a single, usually segmented major fault, or distributed over a broad deformation zone. In the latter, shear is partitioned between major strike slip faults and intervening, often rotating, fault systems. Analog and numerical simulations suggest that such internal fault systems evolve and may be localized or delocalized depending on strain and fault zone strength. We discuss the degree and evolution of shear localization in the Jericho Valley section of the Dead Sea Transform (DST), where the current breadth of the transform valley and its penetrative strain field are difficult to reconcile with localized shear. We integrate newly acquired high-resolution reflection data, re-processed exploration reflection data (both focused to 2.5-3.5km depth), relocated earthquake epicenters and fault plane solutions based on P-wave first arrivals, and suggest re-interpretations for previously published structural and seismic data in the Jericho Valley and the northern Dead Sea basin. It is found that shear in this section of the DST evolved from an early, probably Mio-Pliocene stage of localized strike slip motion primarily along the Jericho fault, to a late stage (Pliocene-Recent) when shear has been distributed over internal fault sets that apparently lean against a major eastern DST segment. In the early stage, the Jericho fault formed the western boundary of a deep narrow, probably pull-apart basin filled by energetic fluvial clastics and by evaporites. This is overlain by the late stage broad basin, characterized by low-energy deposition of lacustrine and fluvial sediments. Pliocene rocksalt has apparently utilized the Jericho fault zone as a conduit for diapirism, causing the uplift, normal faulting and surface deformation of Late Pleistocene and Holocene sediments currently observed along the ~15km long Jericho Lineament. Based on the currently observed dextral-normal motion across internal NNE-NE trending faults, counterclockwise rotation is expected to have occurred within the transform zone. These tectonic and depositional changes were likely associated with onset of transtension across the DST, related to the previously postulated shift of the Africa/Arabia Euler pole of rotation in the Pliocene.

FLOODWATER PERCOLATION AND GROUNDWATER RECHARGE IN ARID LANDS

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The principal source of water in arid environments around the world is related to transmission loss of floodwater in ephemeral streams. Though floodwater is not considered a sustainable water source, both natural ecosystems and human societies exploit this scarce water source to maintain life. While natural ecosystems have adapted to the natural hydrologic regime, human requires development of efficient scientifically-based methods to exploit the ephemeral availability of water. The increasing demand for water by urban and agricultural communities challenges the scientific community stakeholders and planners to find identify and quantify sustainable sources of water. Flood water is usually exploited through two main practices: (1) pumping the local alluvial aquifers that are occasionally and infrequently replenished by flood water percolating, and (2) damming the stream channel to store large volumes of flood water for direct use in nearby agricultural fields, or to enhance percolation into the local alluvial aquifers.

This study focuses on the critical relations between floodwater and recharge processes of shallow alluvial aquifers from both natural undisturbed ephemeral streams and percolation/storage reservoirs. This research is an integrated study that simultaneously monitors and analyzes all three hydrological domains controlling the recharge process: (1) the flood hydrograph as the water source for the vadose zone, (2) the deep vadose cross section response to flood events and (3) the groundwater response to the flood hydrograph.

The study implements a new technique for the installation of Time Domain Reflectomtry probes (TDR), to monitor continuously the vadose zone moisture and temperature profiles. These probes were installed in specially drilled slanted boreholes. Water level and EC sensors were installed in piezometers that were drilled for this project and in special shelters on the stream channel.

Up to date three monitoring stations were constructed in the Arava valley, one on the Arava stream by Ein Yahav, and two other by the Tzukim reservoir. The flood events impact on groundwater recharge was recorded through three main natural floods, in December 2003, January 2004, October 2004, and in a controlled percolation experiments under ponded conditions that was carried out by May 2004.

Preliminary analysis of the data from both controlled experiment and natural floods shows quick response of the vadose zone and groundwater to the flood event in open stream channels. The measured percolation flux rates ranged between ~0.03 to ~0.2 m/h, suggesting 20,000 to 120,000 m^3 of recharging water through each kilometer of open stream on an average flood of 12 hours. On the other hand a significant decrees in percolation rates was observed under the reservoir due to sealing of the reservoir bottom by silt. Consequently a major portion of the water collected by the reservoir is lost to evaporation and never reach the groundwater.

THE INTERNATIONAL SEISMOLOGICAL CENTRE; SERVICE TO SEISMOLOGY

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The International Seismological Centre is a non-governmental, no-profit making organisation, charged with the final collection, analysis and publication of earthquake source information from all over the world. Earthquake readings are received annually from almost 3,000 seismograph stations through almost 200 seismological agencies representing every part of the globe. The Centre's main task is to re-determine earthquake locations and magnitudes, making use of all available information, search for new earthquakes, previously unidentified by individual agencies and distribute this information to the global seismological community.

The International Seismological Centre is widely recognized as the source of the most comprehensive reliable listing of global seismicity data. This information is made available by the ISC by producing an annual CD with all of the data (locations, magnitudes and phase readings) for earthquakes of each year and by providing Internet links from the on-line Bulletin to waveforms, regional catalogues, and other products required for in-depth studies

The ISC team, of only 7 people, is integrating the efforts of seismologists who run stations and networks around the world and provide readings of phase arrivals and amplitudes. The ISC build on those efforts to locate tens of thousands earthquakes each year with millions of associated readings.

SC bulletin is used in a wide spectrum of seismological research: Global seismic tomography (structure of the solid Earth), Earthquake hazard assessments, Tectonics, Physics of the Earthquake phenomenon, Earthquake prediction research among others. The ISC Bulletin serves as a reference to helps seismological centres evaluate their capabilities to monitor the seismicity in the region of their interest. Examples will be presented during the talk, along side with presenting current initiatives lead by the ISC to improve global seismic monitoring.

CLAY MINERALS AS INDICATORS OF THE PALEOENVIRONMENT AND PALOCLIMATE CONDITIONS DURING THE MIDDLE TRIASSIC TO THE LOWER ALBIAN, ISRAEL AREA

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The sedimentation along the southeastern Tethyan margin during the Middle Triassic to the Lower Albian took place on a wide and shallow shelf platform and was controlled by marine transgressive and regressive cycles of the Neo-Tethys Ocean upon the Arabian Craton. The marine cycles were separated by terrestrial periods. The clay minerals within the sediments deposited during these periods are used as indicators of the paleoenvironment and paleoclimate conditions during these cycles.

The marine periods: Diagenetic or converted clay minerals in the marine sediments should document conditions during the deposition. In the wide shallow sea, the temperature and salinity of the seawater were probably controlled by the climatic and the environment conditions. Interstratified illite/smectite (I/S) is the common clay mineral in the marine formations of the Middle Triassic to the Lower Albian periods. Converting the precursor smectite to I/S required warm water and higher salinity of the sea. It is assumed that such conditions were found on the shallow shelf platform along the southeastern Tethyan margin during these periods. By determining the ordering degree of the I/S along the stratigraphic section, such conditions and their changes during these periods are specified. For example, higher-ordered I/S in the claystone layers, interbedded with gypsum and dolomites of the Triassic Mohila Formation, reflect their deposition in a salty lagoon environment under warm and arid paleoclimate conditions.

The terrestrial periods: The type of clay minerals in palaeosols and terrestrial sediments should document climatic and landscape conditions. Kaolinite is the dominant clay mineral in lateritized palaeosols and claystones as well as in Nubian sandstones and conglomerates of the Jurassic to the Lower Albian periods. In soils, kaolinite is usually formed under warm and humid climate conditions with high leaching of parent rocks, accompanied by rich vegetation cover. It is assumed that similar climate conditions were found along the coastal plain of the southeastern Tethys during these periods. Indeed, mineral assemblage indicative of tropical paleoclimatic conditions characterizes the residual soils, laterite and flint-clay, of the Jurassic Mishhor Formation. Erosion of the lateritized soils by the Nubian fluvial system probably provided the detrital kaolinite deposited within the terrestrial sediments. For example, the kaolin lenses in the Nubian sandstones of the Jurassic Inmar Formation and the kaolinite that composed the matrix of the Lower Cretaceous Arod conglomerate reflect their deposition in local lakes and channels of the Nubian fluvial system under warm and humid paleoclimate conditions.

USE OF LOW TEMPERATURE SINTERING TECHNOLOGY IN THE MANUFACTURE OF DOMESTIC IRON AGE COOKING POTS

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Iron Age ceramic technology used in the manufacture of domestic cooking pots was studied. The pottery was excavated at Tel Hadar on the eastern shore of the Sea of Galilee. The results demonstrate that the cooking pots were manufactured using noncalcareous or slightly-calcareous raw material composed of smectitic (montmorillonitic) clay. The raw material came from basaltic soil or Terra Rossa soil. The firing was at about 750-850°C.

Cementation of the ceramic body by sintering of the clay usually occurs at firing above 900-1000°C. The firing temperature of the pots, at about 750-850°C, suggests that the cementation to ceramic was obtained by low temperature sintering of the clay. The use of soil raw material composed of smectitic clay enabled the low temperature sintering. The clay from soil is relatively poorly crystallized and rich in natural iron oxide, both of which induce earlier sintering. In very fine textured raw material (such as clayey soil), the sintering begins earlier than in coarse raw material. Moreover, very finely divided ferrous oxide (FeO) in a reduced state may act as flax at temperatures between 800 and 900°C. It seems that the high iron oxide content in the basaltic soil or in the Terra Rossa soil acts as an efficient flax material, which reduces the sintering temperature during the firing.

A higher quality noncalcareous or slightly-calcareous raw material was necessary for the manufacture of cooking pots in order to produce dense ceramic, impermeable and stable in cooking directly over fire and able to withstand repeated heating and cooling. Ceramic is a poor heat conductor, thus the walls of the vessel should be resistant to thermal shock, without damage.

USE OF LIME TECHNOLOGY IN THE MANUFACTURE OF DOMESTIC IRON AGE STORAGE JARS

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Iron Age ceramic technology used in the manufacture of a group of storage jars was studied. The pottery was excavated at Tel Hadar on the eastern shore of the Sea of Galilee. The results demonstrate that the storage jars were manufactured using calcareous raw material proceeds from alluvium. Firing was at about 650-750°C. The potters used calcareous raw material for the preparation of storage jars in order to enable low temperature firing. Lime is used as a flux, and vessels prepared from this clay are sintered at lower temperatures. However, the large amount of calcite in the ceramic (39-57%) indicates that instead of sintering the clay, the potters used lime technology in order to achieve consolidation of the vessels. Consolidation by cementation with calcite required lower firing temperatures than that necessary to complete the sintering of the clay.

Firing at about 650-750°C was sufficient for decomposition of the calcite in the calcareous material, forming quicklime (CaO). The consolidation of the storage jars was achieved by recrystallization of microcrystalline calcite during the recarbonation process. It seems that after the firing, the quicklime picks up moisture from the air, forming calcium hydroxide [$Ca(OH)_2$]. The recarbonated calcite is slowly formed by the reaction of the $Ca(OH)_2$ with atmospheric CO_2. Recarbonated calcite usually crystallizes with small crystal size and a low degree of crystallinity. Indeed, in these storage jars a micrographic texture of microcrystalline calcite (micrite) with a low degree of crystallinity is observed in the fired matrix. From the Neolithic period, lime technology was used for cementation of plasters and for preparation of Vaiselle Blanche ("Whiteware"), but these vessels were shaped after the firing of the carbonate. The Iron Age storage jars were produced from calcareous raw material and the quicklime was obtained in situ by the firing. It seems that after firing the storage jars were carefully stored for a period of time in order to complete the solidification by recrystallization of the recarbonated calcite.

GEODYNAMIC RADON SIGNALS AND SIGNATURES ALONG THE DEAD SEA TRANSFORM (ISRAEL) – RESULTS FOR 1994-2004

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Radon is being monitored at three arrays of stations located in a 200 km sector along the western boundary fault of the Dead Sea Transform (DST). Measurements are conducted in the geogas of the unsaturated zone of different rock units - Precambrian igneous and metamorphic basement rocks, Cretaceous syenite and sub-recent unconsolidated gravel. Alpha and gamma detectors, placed at depths of 1.5 to tens of meters, gather radon and ancillary information at a high time resolution (< 1 hour). Long time series (up to +10 years) display systematic and recurring signatures and signals, enabling to discern several variation patterns: 1) Multi-year (MY); 2) Seasonal; 3) Multi-day (MD), and 4) Diurnal Radon Signals (DRS).

Establishing the geodynamic nature of the signatures and signals is based on three approaches:

Negation of atmospheric influence - demonstrating that the variation of the radon in geogas is basically unrelated to variations in the local ambient atmospheric conditions. This is shown by searching for correlation and fit in the time and frequency domains.

Analyzing radon signatures in the geological, spatial, time and frequency domains. Systematic relations are observed among signals from different stations within an array at spatial scales of 0.1 to 20 km. Time series of radon exhibit temporal correlation, among stations in the local arrays. Several modes of correlation occur, based on the time scale of the radon signal – MY, MD, DRS.

Systematic time-offsets of the signals, confirmed by cross-correlation analysis, are observed among stations within an array. In the case of DRS different patterns of daily cyclic signals, derived by FFT analysis, are associated with geologic and tectonic elements.

Establishing correlation with geophysical phenomena, and specifically by correlation to seismic patterns. Using a 10 year long time series from a single monitoring site at the NW Dead Sea, statistically significant correlations with earthquakes in an associated tectonic segment of the DST is demonstrated independently for three different time scales of variation – MY, MD, and DRS.

Such relations imply subsurface geophysical driving processes, influencing the release of radon from its source rock and/or affecting the advection/conduit system transporting the radon from source at depth to the detector. Furthermore, the results determine radon as a sensitive proxy of subtle transients in the geodynamic activity in the upper crust. This sets radon as a leading tool for investigations in the field of geodynamic prediction research.

MASS BALANCE CONSTRAINTS ON GYPSUM DEPOSITION IN LAKE LISAN

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The Lisan Fm., deposited by the Late Pleistocene Lake Lisan (~70-14 kyr B.P.), is comprised of alternating laminae of aragonite and detritus, massive and laminar gypsum layers and clastic units. Typically, the thickness of the gypsum layers in the lower and middle members of the Formation is 10-20 cm. The upper member of the Lisan Fm. is capped by a thicker, ~2m gypsum layer, defined as the Upper Gypsum Unit (UGU).This layer precipitated at the end of the Last Glacial Maximum (LGM), at 17 Kyr BP.

The formation of the gypsum layers is explained by the continuous import of sulfate to the lake by runoff water and its accumulation in the lake water. This process continues until gypsum saturation is reached and gypsum starts to precipitate. This can occur after several thousand years of continuous sulfate concentration build up or due to evaporation and water column overturn. In the former case, minor quantities of gypsum sink in a continuous flux to the lake's anoxic hypolimnion where they are susceptible to dissolution. In the latter case, large quantities of gypsum precipitate during discrete events and form massive gypsum layers. However, the thickness of these layers is limited.

The amount of gypsum precipitate is constrained by the sulfate concentration in the epilimnetic waters and the thickness of the epilimnion. The sulfate concentration is limited by the Ca^{+2} concentration, ionic strength, and gypsum solubility constant (K_{sp}). Lake Lisan was ~2-3 -fold larger than the Dead Sea and therefore, the maximum sulfate concentrations in Lake Lisan (assuming 3-fold lower Ca^{+2} concentrations) were ~1,500-2,900 mg/l. This value is equivalent of up to ~20cm of gypsum, depending on the evaporation degree of the water and the gypsum density. Thus, the deposition of the UGU cannot be explained altogether by the accumulation of sulfate in the epilimnion, because the maximum mass of dissolved sulfate contained in it is much smaller than that found in the UGU.

Given the unique hydrological-limnological setting of Lake Lisan during the LGM, i.e., the lake level high-stand and long term water column stratification, we suggest that one or both of the following scenarios could explain the deposition of the UGU at the culmination of the LGM: 1. Sulfate accumulation over a large area of the lake during its high stand and its deposition as gypsum in a smaller area at a later stage; 2. An increase in the sulfate supply to the lake parallel to the deposition of the UGU. This concurrent supply might replenish sulfate concentrations and enable ongoing precipitation gypsum. The source of this sulfate is not known.

STRUCTURAL UNCERTAINTIES AND THE STABILITY OF CANTILEVERED CLIFFS IN A DISCONTINUOUS ROCK MASS .

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Instability of cantilevered cliffs depends mainly on structural discontinuities that transect the cliff and on tensile stresses that develop at the base of the slope at some distance from the toe. The uncertainty associated with modeling of discontinuities is a well known problem in rock slope engineering. This geometrical uncertainty is further enhanced when the rock mass structure is partially, or fully, concealed by urban development, or when the effects of past engineering activities are unknown. Given these uncertainties, a rigorous slope stability analysis should account for unknown geometrical variations in the modeling of the rock mass.

In this paper we present stability analysis of a 34m high over-hanging cliff. The rock is transected by closely spaced horizontal bedding planes and vertical joints. The upper third of the cliff is cantilevered and extrudes more than 11m beyond the toe of the slope, giving rise to eccentric loading at the base of the slope. Field observations suggest that the vertical joints which transect the entire cliff form "tension cracks" at the back of the cliff, but their distance from the face is uncertain. Yet, the nature of deformation and mode of failure depend upon the exact location of the vertical tensile crack at the back of the slope.

The stability of the cliff was studied using the 2-D Discontinuous Deformation Analysis (Shi, 1989). DDA forward modeling showed that for the case of a tension crack less than 5m away from toe, failure by forward rotation will ensue. The slope is found to be safe when the distance from the toe to the tension crack is greater than 5m. This result was also confirmed by Finite Element Analysis (STRAP) where the entire slope was modeled as a continuum.

Based on these findings rock bolt reinforcement wad added to the DDA model. Individual bolt length was adjusted such that the bolts were anchored beyond the plane of the potentially dangerous tension crack. Several models were analyzed with different bolt diameters. It was found that cliff stability was guaranteed with bolt diameter larger than 2". With such rock bolts the calculated displacements were similar to those without a tension crack at the back of the slope. Thus a known qualitative solution to the rock instability problem can be addresses quantitatively using the suggested modeling and analysis scheme.

WAS NORTHERN BOUNDARY OF THE SAHARO-ARABIAN DESERT STABLE DURING THE MID-LATE QUATERNARY? EVIDENCE FROM SPELEOTHEMS IN THE NEGEV DESERT, ISRAEL

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The Negev Desert is situated at the boundary between the south-eastern corner of the Eastern Mediterranean Sea and the northern border of Saharo-Arabian Desert. In the northern Negev, near the city of Beer-Sheva, average annual rainfall is 200mm/y. This value marks the transition between the semi-arid climate to the north and the subtropical arid climate to the south.

The isohyets in northern Israel run from north to south, parallel to the coastline. More to the south the isohyets change abruptly and run to the west, parallel to the coastline of the Sinai Peninsula. The rainfall gradient is sharpest in this region despite the absence of significant topographic forcing. Along the Mediterranean coast, annual rainfall drops from 600 to 400mm over 144km distance between Haifa (32°49'N) and Gaza (31°31'N). To the south of Gaza the annual rainfall drops more sharply, from 300 to 200mm along 25km distance. Back-trajectories show that the typical Cyprus cyclones are the major contributor of rainfall in Israel, and correspond to the majority of long fetch maritime air masses crossing the Mediterranean and the Levant region to the west of Israel. As a result, rainfall amount to the north of Be'er-Sheva is much higher than to the south.

Thus, the Negev Desert is an ideal region for paleoclimatic studies. The purpose of this study is to determine how the present-day location of the desert boundary changed with time.

Under present-day conditions, deposition of speleothems in the region requires more than 250-300mm annual rainfall. In the Negev Desert there are numerous karstic caves rich with speleothems, with no present-day deposition. Their presence indicates that wetter conditions prevailed in the past. Their growth periods provide direct evidence for when water reached the unsaturated zone. We collected speleothems from caves located in zones with different amounts of annual precipitation: from the most humid (280-300mm) in the north (31°25'N), to the most arid (40-50mm) in the south (~30°N). High resolution U-Th dating using MC-ICP-MS shows that during the last 200ky the southern boundary of speleothem deposition was located in three different positions: a) the most arid episodes occurred between 150-138ky, 117-96ky, 22.5-21ky, and 12.5-0ky, with desert boundary 5-10km north of Be'er-Sheva; b) wetter conditions prevailed mostly during glacial with some short interglacial episodes: at 190-150ky, 95-90ky, 80-23ky, 21-16ky and 14-13ky, with desert boundary located 5-10km south of Be'er-Sheva; c) during short humid events during the interglacials, at 205-190ky, ~136ky, 132-118ky and ~85ky, the desert boundary was located more than 100km south of Be'er-Sheva.

These results show that during most of the last 200ky the desert boundary shifted slightly around Be'er-Sheva apart from very short wet episodes when it shifted more than 100km southward.

RADIUM ISOTOPES QUARTET IN GROUNDWATER FROM THE NEGEV

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Here we report the results of a geochemical study that investigates the origin of radioactivity in brackish to saline groundwater from the Negev and Arava Valley, Israel. We measured the Ra isotopes quartet (226Ra-half life 1600 y, 228Ra - 5.6 y, 224Ra - 3.6 d, 223Ra – 11.4 d) in more than 60 water samples from the Negev and were able to discriminate between radioactivity derived from a thorium source (high 228Ra/226Ra and 224Ra/223Ra ratios) found in groundwater flowing in the Kurnob Group (Nubian Sandstone) aquifer and an uranium source (low 228Ra/226Ra and 224Ra/223Ra ratios) in groundwater flowing in the Judea Group (carbonate) aquifer. We show that the activity of 226Ra in groundwater from the two aquifers is positively correlated with temperature, inferring that radium leaching from the aquifer matrix increases with temperature. We also observed an inverse correlation between Ra activity and sulfate and a positive correlation with barium contents. We hypothesize that the chemical composition of the water also controls the radium content in the water, which is controlled by both leaching and retention into secondary minerals like barite. These findings indicate that high radioactivity can also be found even in relatively low-saline groundwater and that the isotopic ratios of radium are sensitive tracers for the water-rock interactions and thus reconstructing the flow paths in different aquifer matrix (i.e., carbonate versus sandstone).

LIQUEFACTION POTENTIAL OF THE SOUTHERN COASTAL PLAIN, ISRAEL

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The liquefaction potential of the Southern Coastal Plain, Israel was studied.
Most methods of estimating liquefaction potential are based on correlations with various field tests, mainly with the Standard Penetration Test (SPT). Alternative methods correlate liquefaction potential with various laboratory techniques, from which the triaxial cyclic shear tests being the most popular. Most of the predictions are based on the ratio between the shear stress developed during seismic loading and the vertical effective stress: the Seed and Idriss (1971) simplified procedure is widely used for this purpose.

A thorough site investigation was performed at the Kerem Shalom site. The investigation included: SPT, pressuremeter tests, and borehole seismic investigation. The borings were logged and index properties were determined. A two and three-dimensional model of the sub-surface was constructed. A similar model, based on previous investigations was constructed for the Rafah site.
Using the laboratory results and field investigation, a series of useful correlation between the index properties and mechanical properties was developed. In addition, the nonlinear shear mass participation factor r_d (Seed and Idriss, 1971) was determined using the numerical SHAKE code.

Assessment of liquefaction potential of the research area was based on different prediction methods, site properties, two different attenuation models (Boore et al., 1997 and Idriss, 1991) and a design earthquake of magnitude 7.5 with epicentral distance of 100 km for Kerem Shalom and 105 km for Rafah. According to Boore et al., (1997) under the specified conditions, the research area is not prone to liquefaction. However, according to Idriss (1991), liquefaction at different depths of the subsurface is expected.

The Boore et al. (1997) attenuation model was found to fit well with the geological setting of Israel (Leonov, 2002), and is used in the Israeli Building Code (IC 413, update 08/2002). Furthermore, it was found that most of the empirical methods correlate well with the Frydman et al. (1980) and the Seed and Idriss (1971) laboratory based methods for assessment of liquefaction potential.

Finally, a series of correlation charts was developed. In these charts, the liquefaction potential of the research area is determined, using SPT values or relative density and the epicentral distance. The charts are developed for different prediction methods, using the Boore et al. (1997) attenuation model. These charts can also be used for other areas of similar sub-surface structure with shorter epicentral distances.

$^{34}S/^{32}S$ WITHIN THE HYDROLOGICAL SYSTEM OF MOUNT HERMON AND THE GOLAN HEIGHTS, NORTH-EASTERN ISRAEL

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Mt. Hermon constitutes the south-eastern extension of the Anti Lebanon mountain chain and forms the main replenishment area of the Jordan River sources. The area is dominated by regional folding trend (the Palmyra system) dissected by younger deep faults. The exposed rock sequence ranges from Lower Jurassic to Eocene, where the younger Golan Volcanic Plateau, of Neogene-Pleistocene age, extends southward of the uplifted structure. The major aquifers are the highly karstified carbonates of Jurassic and Cenomanian-Turonian ages, as well as the Golan basalts and pyroclastics.

Isotopic values of $\delta^{34}S(SO_4)$ within the various sources of the considered region are forming the following isotopic clusters indicating the subsurface paths of groundwater and springs: (a) snow with the average value of +7‰; (b) rainwater (including dry deposition during winter time) yielding the average value of +5‰; (c) dissolution of sulfates from unexposed Triassic-Lower Jurassic evaporates dominating the isotopic characteristic of the Banias spring +16.5‰; (d) volatilization of sulfur compounds from flooded basaltic soil during the winter period, yielding residual heavy value of +12‰ among all water resources of volcanic origin (springs, shallow and deep groundwater); (e) surface runoff upon flood events over the Golan Heights with the average isotopic value of +7‰; (f) deep-sited brines in northern Israel penetrated by oil wells (two samples) with the average isotopic value of +17‰.

The present study indicates the importance of sulfur isotopes in delineating the hydrological regime of the Jordan River sources (Dan, Hatzbani and Banias) as well as the volcanic Golan Heights.

THE AVNON-TAMAR SEDIMENTARY CYCLE IN THE NORTHERN NEGEV

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The Avnon-Tamar depositional cycle of the Cenomanian of the northern Negev (Dimona-Yeruham-Ma'ale Aqrabim area) is placed in a revised depositional and sequence stratigraphic context.The Avnon Mbr overlies the drowned upper surface of the Zafit Mbr with a bioturbated, nodular packstone facies rich in echinoderms including pelagic crinoids, thin-walled mollusks, small hyaline benthic foraminifera, oligosteginids, signifying an aerated, subphotic outer-ramp to near-basinal environment. This sedimentary package at the base of Avnon/Tamar cycle represents a TST (Transgressive Systems Tract). A thin laminated horizon with planktic foraminifera and lacking benthos, akin to the Deir Yassini facies (Jerusalem area), indicates an episode of oxygen depletion and forms the MFS (Maximum Flooding Surface). This facies aggrades upwards to a mid-ramp facies, with reappearance of the nodular facies grading upwards to more proximal packstones, occasionally with winnowed accumulations of Orbitolina, indicating the preliminary phase of the HST (Highstand Systems Tract). The mid-ramp packstones are abruptly terminated by prograding cross-bedded coarse bioclastic rudist buildups of the Mid-HST phase. A DLS (downlap surface) is placed near this transition, at the first accumulations of bioclastic packstones. Lateral to the progradational buildups are patches of grainstones and packstones with larger foraminifera, representing passage to the inner ramp/lagoonal facies, at the top of the Avnon Mbr in this region. The prolonged aggradational upper HST of the Tamar Mbr overlies appearance of the inner ramp facies. At first glance, fenestral microbialitic dolomites of the Tamar Mbr would seem to be a continuation of the inner-ramp facies, under conditions of slow subsidence under supratidal conditions. On closer examination, however, Tamar Mbr cycles may not be dominantly supratidal. Curiously absent or at least very uncommon are peritidal features such as flat-pebble conglomerates (storm rip-ups have been found), desiccation cracks, karst, or pedogenesis. Cycles consist of bioturbated mudstones topped by a small mollusk packstone. The mudstones, where not dolomitized, contain planktonic foraminfera or oligosteginids, and ammonites have been reported. Attempted colonization of cycle tops fail to develop 'keep-up' buildups. Inevitably, cycles terminate in fenestral microbialitic mats and 'give-up' features, such as bored surfaces or iron crusts, which could well be subtidal. Continued subsidence, coupled with gradual, long-term deterioration of 'keep-up' buildups, led to widespread mimicking of 'basinal' type sedimentation across the shelf in the Tamar Mbr. Recently Buchbinder et al (2000) showed the Ce-Tu transition in Israel was underlain by a type III drowning-type sequence boundary (following Schlager, e.g., 1999). This drowning surface is at the position of ultimate disappearance of the Tamar cycles. Ecosystem inhibition by nutrient stress, invoked for the Ce-Tu boundary event in many places in the Tethys, can thus be applied to the observed ecological deterioration of the rudist-buildup facies at the top of the Avnon-Tamar cycle.

DESERT – AN INTERDISCIPLINARY STUDY OF THE DEAD SEA TRANSFORM

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To address one of the central questions of plate tectonics - How do large transform systems work and what are their typical features? - geophysical investigations across the Dead Sea Transform (DST), the boundary between the African and Arabian plates in the Middle East, were conducted for the first time and combined with 2.5 and 3D thermo-mechanical modelling. One major component of these investigations are seismic and magnetotelluric surveys across the Dead Sea Transform. Main results of this study indicate that the DST cuts through the entire crust, that strong lower crustal reflectors are imaged only on one side of the DST, that the seismic velocity sections show a steady increase in the depth of the crust Moho from ~26 km at the Mediterranean to ~39 km under the Jordan highlands, with only a small but visible, asymmetric topography of the Moho under the DST. These and several other observations can be linked to the left-lateral movement of 105 km of the two plates in the last 17 Ma, accompanied by strong deformation within a narrow zone cutting through the entire crust. Comparing the DST and the San Andreas Fault system indicates that lower crustal reflectors and deep deformation zones are possibly fundamental features of large transform plate boundaries.

EVIDENCE OF POST LISAN FAULTING AT THE EASTERN MARGIN OF THE KINNAROT BASIN

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Geological mapping and subsurface data show that Tel Katzir is a fault-bounded uplifted block inside the graben of the Kinnarot Basin, which is part of the Dead Sea Fault system in northern Israel. We aimed to explore the Holocene activity around Tel Katzir. Preliminary results from paleoseismic investigations in the vicinity of Tel-Katzir, at the eastern margins of the Kinnarot Basin, show evidence of young faulting apparent from displacements found in Lisan Formation layers, both inside the basin and at its margins.

Trenches were excavated in 4 sites around Tel-Katzir and an outcrop was mapped and measured. The first site was in close proximity to the shores of Lake Kinneret, between Haon and Maagan. Three parallel trenches showed displacements of several tens of centimeters, juxtaposing the Lisan laminae against soil and weathered Lisan material. The second site of trenching was adjacent to the south-eastern slopes of Tel-Katzir, where a sharp straight contact between soils of contrasting colors clearly visible in air-photos coincides with the inferred trace of the eastern Tel-Katzir fault. Again three trenches were excavated across the suspected fault line. The trenches exposed sections of massive soil with no stratification, but some evidence of deformation in the form of vertical sand-filled fractures was found. Due to the lack of stratification no displacement could be identified. The third and fourth sites were also near the eastern slopes of Tel-Katzir, north of the second site, along the eastern Tel-Katzir fault trace. In both sites only one trench was excavated, and in both we found vertical fractures where the fault was expected but no stratification, so again we couldn't measure the displacement. An outcrop along the road from Maagan Junction to Hamat Gader, south of Avner Hill, was also studied. These faults are the continuation of the eastern normal fault zone that bounds the Kinneret Basin, at the base of the Golan escarpment. In this outcrop layers of Lisan show normal faulting, the vertical component of the displacement totals about 2 meters.

The paleoseismic study shows that activity on the faults in Maagan and the road outcrop postdates the high stand of Lake Lisan at 26-24 ka. In Maagan that activity postdates the pedogenetic processes as well. C14 dating on the trenches in currently underway.

NEW EVIDENCE AND PATTERNS OF SUBMARINE GROUNDWATER DISCHARGE ALONGE THE MEDITERRANEAN COAST OF ISRAEL

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Submarine Groundwater Discharge (SGD) is now considered as having a major role in transporting fresh water and nutrients to the sea. SGD may be traced by salinity and nutrient measurements, as well as by monitoring the activities of ^{222}Rn and radium isotopes. In a survey during June 2004 through February 2005, we found low salinities and moderately high ^{222}Rn activities in several sites close to the shoreline along the northern coast (down to 37.4 ppt and up to 3.5 dpm/l, compared with 39.6-39.8 ppt and <0.5 dpm/l, respectively, in eastern Mediterranean water). The highest activities were observed at Haifa Bay, and in this case they are attributed to surface inflow from the Qishon and the Naaman Rivers (up to 74 and 290 dpm/l, respectively).

At several sites we identified discharge of groundwater (2-4 ppt) directly into the sea. These include the area of Dor, the northwestern side of Mt. Carmel (Shiqmona and Dado Beach), Shavei Zion, south of Akhziv, and south of Wadi Betzet. At Shiqmona, Betzet and Akhziv, discharge is from the Cretaceous aquifer, while at others it is from the Pleistocene aquifer, which veneers the Cretaceous one. At most sites, seepage was identified just during the wet season, while during the summer it was just traced by slightly lower salinities and moderate ^{222}Rn activities. However, at Shiqmona, seepage was also identified during the summer, with low tide Rn activities of 1,800 dpm/l (three times and more the activities of typical groundwater). At this site, ^{222}Rn activities as high as 8 dpm/l were found 1,100 meter away from shoreline, indicating that seepage is not restricted to the tidal flats. High radon activities were also found at a cave in Rosh Haniqra, with more than 12 dpm/l.

Temporal study at the Shiqmona site shows that radon activity decreases by a factor of 45 between low and high tide, significantly more than the variability in salinity, implying the existence of another low radon/low salinity component or that the flux of radon into groundwater is reduced during high tides.

Unlike the radon, ^{226}Ra activities were usually low (<30 dpm/l), suggesting that the discharge is mainly of fresh water.

High activities of ^{222}Rn were not found at any southern coastal site, and low salinities were documented just at two sites. This implies very limited SGD, which is probably the result of the effective confinement of the Cretaceous aquifer by Pliocene clays and of the reduced groundwater levels in the Pleistocene aquifer due to over-exploitation. On the other hand, at the north, confining layers do not always exist or that they are dissected by faults allowing discharge from the Cretaceous aquifer.

AEOLIAN SAND INCURSION INTO THE NORTH WESTERN NEGEV DURING THE UPPER QUATERNARY

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The sand dunes in the north western Negev are part of the northern Sinai dune field. These dunes, which were active in the past, are stabilized today by biogenic crusts and vegetation. According to the differences in sand color and in the morphology of the sand dunes, we assume that there where several incursions of sand into the area. Previous studies in this area have shown that the activity cycles of the sand dunes occurred during the Upper Quaternary. The different sand units were mapped according to their color, dune morphology and time of stabilization (TL dating). The mapping of the sand dunes in the north western Negev was made by remote sensing and GIS. The data was collocated from a Landsat TM image, digital aerial photographs and from sand samples collected in the field. The color was determined by the spectrometric signatures of the sand samples and from the spectrometric data that was extracted from the image and the aerial photos. Results show that there are at least three sand units according to their color. The different sand units have been deposited one on the other with areas of mixed sand units. TL dating will determine the time of the different sand incursions into the north western Negev.

SHORT-TERM NANOSEISMIC MONITORING OF AFTERSHOCKS AND RUPTURE DYNAMICS: THE Mb 5.1 NORTHERN DEAD SEA EARTHQUAKE OF 11 FEBRUARY 2004

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The February 11th 2004, Northern Dead Sea Earthquake (ML 5.1) was used to test the aftershock monitoring capacities of Seismic Navigation System (SNS). One single sparse, small-aperture tripartite array was deployed and started to record data less than five hours after the mainshock. Within 17 hours of continuous monitoring, a series of 61 micro- and nano-aftershocks ($2.4 > ML > -1.9$) were detected and subsequently analyzed by data processing techniques developed for nanoseismic monitoring. The results were further evaluated for robustness by independent data anchoring and instrument sensitivity analysis. The aftershocks cluster within an E-W trending and south-dipping discontinuity zone, which is consistent both with available fault plane solutions and with a latest tectonic model of the Northern Dead Sea Basin. The non-random statistic distribution of these events shows that eight aftershocks of larger magnitude ($ML > 1.5$) are each followed within several minutes by a series of micro- and nano-aftershocks of decaying magnitude, described here as aftershock pulses (AP). The spatial migration of micro- and nanoseismic events ($ML < 1.5$) associated with each AP provides insights into rupture dynamics within the first 24 hours of the mainshock.

CROSS-RIFT AND ALONG-RIFT WAVEFORM CHARACTERIZATION OF TEST-BLASTS

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Recent test-blasts (20-32 Tons) detonated at shallow depth (< 100 m) in Israel and in Jordan were recorded by several portable sparse arrays (Seismic Navigation Systems-SNS) and used to assess the effect of the Dead Sea Rift (DSR) substructure on waveforms. Two source-to-sensor configurations are compared: cross-rift and along-rift. Path- and site-effects are isolated by an initial SNR analysis. The distribution of broad-frequency range (1-75 Hz) signal energy as a function of frequency is evaluated by sonogram analysis for source-to-sensor distances, ranging between 0.5 and 232 km. This work investigates the influence of the tectonic substructure of the DSR on the location and characterization capabilities of non-natural seismic sources.

TEN YEARS OF SITE EFFECT INVESTIGATION IN ISRAEL: TECHNIQUES AND EXAMPLES

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It is now well known, that the effects of local surface geology and topography on seismic motion can be large. The damage from recent earthquakes (Mexico City, Mexico 1985, Spitak, Armenia 1988, Northridge, California 1994, Kobe, Japan 1995, Eilat, Israel 1995, Armenia, Columbia 1999, Izmit, Turkey 1999...) have brought additional evidence of the importance of site effects. This is particularly important for Israel since most urban areas include soft surface deposits and/or significant topography.

The presentation will therefore focus on three issues:

1. How to estimate the site effect?
2. How to cope with special site conditions, especially urban conditions and scarcity of data in remote sites?
3. What is the topographic site effect?

During the last decade, at the request of various clients, more than 70 sites proposed for new construction have been investigated by us in an attempt to estimate the possible amplification of the seismic ground motion. We used various empirical methods to determine the site response function, including reference and non-reference techniques and referring to different sources of excitation – earthquakes, explosion and ambient vibration. Amplifications factors of 3 to 8 were observed at various frequencies of 0.6 – 8.0 Hz. Available geological and geophysical data were employed to obtain subsurface models which were reasonably consistent with these data while producing calculated site effects consistent with the site effects which were determined empirically.

In 2001 a special team was formed in the Geophysical Institute to map site effects in different areas across Israel. Up to now, seismic microzonation studies in the towns of Lod and Ramla, Qiryat Shemona, Kefar Sava, Dimona, Arad and in the Coastal plane and Hashefela regions have been carried out by this team. For each town, two maps were prepared, showing the fundamental frequencies and maximum relative amplifications in the investigated area. Earthquake records are difficult to use for site effect assessment in urban areas due to the high noise level, especially in a moderate seismicity region. Our experimental studies confirm the fact that ambient vibration recording can be used to obtain reliable information about the fundamental frequency and amplification of a 1-D multi-layer medium.

Macroseismic observations have shown that the effects of local topography on ground motion may be of great importance. We have used earthquake, explosion and ambient vibrations records for estimating topographic site effects. The seismic response of steep slopes and mountain peaks showed prominent amplifications, up to factor 8, within the 0.8-3.0 Hz frequency range. Theoretical studies of the effect of topography are very sensitive to various parameters of analytical models. Empirical seismological site response evaluations are more reliable.

SITE EFFECT AND GROUND MOTION PREDICTION IN QIRYAT SHEMONA

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This study is focused on estimating the seismic hazard to Qiryat Shemona by implementing a three-step process: (1) detailed mapping of the characteristics of the H/V spectral ratios from ambient noise, (2) incorporating geological and geophysical information to construct subsurface models for different sites within the investigated area and (3) estimating the seismic hazard in terms of uniform hazard site-specific accelerations.

An investigation of the site effect by ambient vibration survey was carried out at 300 sites. Two methods were applied to estimate site effects: (1) horizontal-to-vertical spectral ratio of motion observed at the same site; and (2) and horizontal-to horizontal spectra ratios of motion at the investigated site and those at reference site. In some cases the shape of spectral ratios and level of spectral amplifications obtained from two methods are similar. However, in many other cases, the spectral ratio with respect to reference site was invalid because in urban areas even on very short distance spectrum of motions in investigated and reference sites is affected by different local sources.

The spectral ratios indicate site amplifications range from 2.0 to 8.0 within the frequency band 0.7-14 Hz. These results suggest that there is significant shear-wave velocity change and considerable variation of sediments thickness. The ambient vibration measurement data were used to constrain different 1-D subsurface models, that allowed us to determine the area of expansion of the Hazbani basalt, which is the reflector for the greater part of the study area. Maps of depth to reflector and shear-wave velocity of the second sediment layer were constructed using Vs obtained by refraction surveys and program for fitting the analytical transfer function to the empirical one. The part of Qiryat-Shemona-Jammunneh master fault located within the study area and not mapped previously by geological survey was detected by measurements. Amplification effects were revealed in the area where the Hazbani basalt crops out according to the geological map. The width of this area may reach 500 meters.

Based on the observed resonance frequencies, we divided the study area into eight zones. The Uniform hazard site-specific acceleration spectra for the all zones were computed for a probability of exceedence of 10% during an exposure time of 50 years and a damping ratio of 5%. The shape of the spectra obtained for all zones differ significantly from those prescribed by Israel Building Code (IS-413). IS-413 essential underestimates the accelerations in the period range from 2 sec. to 0.1 sec. These evaluations are very important for realistic assessment of the vulnerabilities of all types of existing and newly designed structures and for urban and land use planning.

טרנספורם ים המלח בקטע בקעת יריחו - גזירה ממוקדת או מפוזרת?

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3. אקולוג בע"מ, אופנהיימר 5, רחובות

אינטגרציה של נתונים סייסמיים, סייסמולוגיים וסטרוקטורליים מאזור טרנספורם ים המלח בבקעת יריחו מראה כי הגזירה המרוכזת לאורך שבר יריחו פסקה, כבראה בפליוקן, והתנועה הפכה למפוזרת על פני אזור טרנספורם נרחב, מכוסה בסדימנטים אגמיים ונחליים וחדור בגופי מלח.

חידור מי שיטפונות והעשרה של אקוויפרים אלוביאליים באיזורים צחיחים

שני י. [1], דהן ע. [1], אנזל י. [2], יחיאלי י. [3]

1. מכון צוקרברג לחקר המים, אוניברסיטת בן-גוריון בנגב
2. המכון למדעי כדור הארץ, האוניברסיטה העברית, גבעת רם, גבעת רם, ירושלים 91904
3. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501

המחקר עוסק בחידור מי שיטפונות ומילוי חוזר של מי תהום באזורים צחיחים ומתמקד ביחסי הגומלין בין מי שיטפונות, מי התווך הלא רווי ומי התהום, תחת ערוצי נחלים טבעיים לעומת מאגרי חלחול.

שימוש בטכנולוגית גיר בייצור קנקנים מקומיים בתקופת הברזל

שובאל ש. [1], בק פ (ז"ל). [2].

1. קבוצת הגיאולוגיה, המחלקה למדעי הטבע, האוניברסיטה הפתוחה, קמפוס דורותי דה רוטשילד, רח' רבוצקי 108 רעננה
2. המכון לארכיאולוגיה, אוניברסיטת תל-אביב, תל-אביב

נחקרה טכנולוגית קרמיקה ששימשה בתקופת הברזל בייצור קבוצה של קנקנים שנחפרו בתל הדר. חומר הגלם היה חרסית גירית שמקורה בסחף. התכולה הגבוהה של קלציט בקרמיקה (57-39%) מעידה כי הקדרים השתמשו בטכנולוגיה של גיר להקשיית הכלים.

עדויות לבקעים מקבילים בלוח הערבי

שטנר א.[1], בן-אברהם צ.[1], רשף מ.[1], בר-עם ג.[2], לזר מ.[1]

1. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד 39004 רמת אביב 69978
2. שדות נפט בע"מ, רח' האומן 18, ירושלים

בקידוח חדש, הממוקם על מדף היבשת של צפון ישראל, נתגלה רצף סדימנטרי נדיר בהרכבו המתוארך לאוליגוקן תיכון עד מיוקן תחתון. מביתוח של חתכים סייסמיים עולה כי רצף זה שקע באגן מורפוטקטוני, "אגן חיפה", לאורך התוואי הנוכחי של שבר הכרמל. אגן חיפה הוא אחד מבין סדרה של אגנים המהווים את הבקע הכושל קישון-סירחאן, שהתפתח עוד לפני הפעילות לאורך שבר ים המלח. בקע קישון-סירחאן התפתח במקביל במרחב ובזמן לביקוע בתוואי ים-סוף – סואץ.

המבנה הפעיל של שקע ים המלח על פי איכון יחסי מדויק של רעידות אדמה

שמיר ג.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

איכון יחסי של רעידות אדמה בשקע ים המלח בשיטת ההפרשים הכפולים מאשר כי אין פעיות ברורה לאורך שוליו, ועל צבירי רעידות בצפון אגן ים המלח, באזור שבר לינץ' ומזרח הליסאן וכן בערבה הצפונית.

תארוך פלאומגנטי של תצורת עובדיה

שגיא א. [1], בלמקר מ. [2], רון ח. [1], אנזל י.[1], עגנון א. [1], בר יוסף ע. [3]

1. המכון למדעי כדור הארץ, האוניברסיטה העברית, גבעת רם, גבעת רם, ירושלים 91904
2. המחלקה לאבולוציה, סיסטמטיקה ואקולוגיה, האוניברסיטה העברית, ירושלים.
3. המחלקה לאנטרופולוגיה, הרווארד, קיימברידג'.

תארוך פלאומגנטי שנעשה בתצורת עובדיה, בקעת כנרות, הניב חתך R-N-R-N-R. התצורה מתוארכת על ידי השוואת פאונה להיפוך ה Matuyama, ל 1.4 מ"ש, ולפי התוצאות הסקנו שגיל ההיפוכים הנורמלים שנמצאו, הינם גילסה והר קוב (1.55 ו1.21 מ"ש, בהתאמה), או הר קוב וחרמיו (1.2 ו1 מ"ש, בהתאמה). השוואת מאסף היונקים לאתרים באפריקה ובאירואסיה אינו מאפשר הבחנה בין שני האפשרויות.

מינרלי חרסית כאינדיקטורים לתנאי פליאו-סביבה ופליאו-אקלים מאמצע הטריאס עד תחילת האלביאן, אזור ישראל

שובאל ש.

קבוצת הגיאולוגיה, המחלקה למדעי הטבע, האוניברסיטה הפתוחה, קמפוס דורותי דה רוטשילד, רח' רבוצקי 108 רעננה

מינרלי החרסית משמשים כאינדיקטורים לתנאי סביבה ואקלים ששררו לאורך שולי דרום-מזרח התטיס מאמצע הטריאס עד תחילת האלביאן. היווצרות אילית/סמקטיט מעידה כי במדף היבשה היו מי הים חמים ומלוחים יותר ממי האוקיינוס הפתוח. היווצרות קאוליניט מעידה כי על היבשה התפתחו קרקעות בתנאים המאפיינים אקלים טרופי.

שימוש בטכנולוגית סינטור בטמפרטורה נמוכה בייצור סירי בישול מקומיים בתקופת הברזל

שובאל ש. [1], בק פ (ז"ל). [2].

1. קבוצת הגיאולוגיה, המחלקה למדעי הטבע, האוניברסיטה הפתוחה, קמפוס דורותי דה רוטשילד, רח' רבוצקי 108 רעננה
2. המכון לארכיאולוגיה, אוניברסיטת תל-אביב, תל-אביב

בחקרה טכנולוגית קרמיקה ששימשה בתקופת הברזל בייצור סירי בישול שנחפרו בתל הדר. חומר הגלם היה חרסית בלתי גירית שמקורה בקרקע בזלת או בקרקע טרה-רוסה. הקדרים השתמשו בטכנולוגית סינטור בטמפרטורה נמוכה להקשיית הכלים.

שיכוב באיכות המים של אקויפר החוף, ישראל

רענן ה. [1], ונגוש א. [1], זיילר ק.פ. [2], מלושבסקי פ. [2]

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105
2. GSF , נויהרברג, גרמניה

תקציר: מספר אזורים באקויפר החוף נדגמו כדי להציג תלות של איכות וגיל המים בעומק המסבנת. תוצאות ראשוניות מגלות שיכוב בגיל המים ובריכוזי הכלוריד, ובאופן פחות מובהק גם בריכוזי ניטרט. מטרת המחקר היא להציע מערכת התראה מוקדמת להגעת זיהום למי תהום עמוקים.

תנועות אנכיות והמבנה הא-סימטרי משני צידי טרנספורם ים המלח מהפליוקן ואילך

שגב ע. [1], ליחובסקי ו. [1], ריבקוב מ. [2], הופשטטר א. [2], טיבור ג. [3], בן-אברהם צ. [4], גולדשמידט ו. [2]

1. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501
2. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100
3. המכון לחקר ימים ואגמים בישראל, חיפה 31080
4. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד 39004 רמת אביב 69978

איזון איזוסטטי של הלבנט מראה שלבנון וצפון ישראל מורמים עקב תנועה טקטונית לאורך טרנספורם ים המלח. שקיעה באגן הלבנט ו-Arching במרכז ישראל גרמים ע"י מעמס קונוס הסדימנטים של הנילוס. מעמס סדימנטים באגני ים המלח ודומיו גורמים להתרוממויות בשוליהם, לעיתים א-סימטריות.

הסטרטיגרפיה של הכרמל – מבט חדש

שגב ע. [1], שש א. [2]

1. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501
2. המכון למדעי כדור הארץ, האוניברסיטה העברית בירושלים ירושלים 91904

במהלך מיפוי גיליון עתלית הוגדרו תצורות חדשות והוכרו ארבעה מחזורי סדימנטציה בתחום אלביאן-טורון : מחזור 1– תצורת יגור; מחזור 2 – קירטון עספיה, גיר בית אורן ואופק וולקני ($_1$V) בבסיס; מחזור 3 – תצורות זכרון בדרום הכרמל וערקן בצפון עם $_2$V בבסיס; מחזור 4 – תצורת בע'נה, מעל $_4$V, ללא חלוקה בדרום-מערב ועם חלוקה לפרט תחתון – מוחרקה, ופרט עליון – סומק, בצפון-מזרח.

פענוח סייסמי-גרבימטרי משולב והקשר שלו לנתוני קידוח:דוגמא מאזור עין גדי

רזניקוב מ., אט"ב ג.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

מטרת הפרויקט היתה לפענח נתונים גרבימטריים מאזור עין גדי, ולשלבם עם נתונים סייסמיים חדשים מסקרי רפלקציה בהפרדה גבוהה.
אחרי עיבוד חוזר של הקוים הסייסמיים הוסקה מסקנה כי באזור קיים מבנה אנטיקלינלי רדוד המאופיין בתבנית שבירה מורכב והנוטה לכוון צפון-מערב.
קימום המבנה חופף את המבנה שהתקבל מפענוח נתונים גרבימטרים. הנתונים הסייסמיים מראים אנומליה של אמפליטודה החופפת את אזור בעל צפיפות נמוכה שהתקבל מנתונים גרבימטריים. האנומליה הסייסמית פוענחה כאזור מגע של גז-מים. תוצאה זאת מצאה את אישורה בקידוח זרח-1 שבוצע מאוחר יותר.

שיפור בחישוב Fluid Factor בעזרת כוונון מיוחד של Mud rock line פרמטרים

רזניקוב מ. [1], בינקין י. [2]

1. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100
2. גיאומג', המכללה האקדמית יהודה ושומרון, ב.10, אריאל 44837

הפרמטר Fluid Factor משמש כמדד אופטימאלי לאיתור של נפט וגז בעזרת סייסמיקה בשיטת AVO . אנו מציעים לבחון מודלים חלופיים של חולות רוויי מים ולהעריך את הפרמטרים של Mud Rock Line. הפרמטרים הללו יאפשרו לבצע AVO מודליגג עבור סוגים שונים של החולות רוויי גז וזיהוי של Fluid Factor , לשפר את לימוד הליטולוגיה ואיתור של נפט וגז. השיטה המוצעת נבדקה באזור נבחר בישראל.

העשרת מי התהום של אקוויפר החוף תחת שימושי קרקע שונים

רימון י. [1], דהן ע. [2] נתיב ר. [1]

1. המחלקה לקרקע ומים, האוניברסיטה העברית בירושלים, ת.ד. 12 רחובות 76100
2. מכון המים ע"ש צוקרברג, אוניברסיטת בן גוריון בנגב, ת.ד 653 שדה בוקר 84990

מטרת המחקר הינה לבחון את השפעת שימושי קרקע שונים על קצב העשרת מי תהום באקוויפר החוף. קביעת קצבי החלחול הטבעי לאקוויפר חיונית לצורך אומדני המילוי החוזר השנתי ולהערכת קצב תנועת מזהמים שונים בתווך הבלתי רווי אל מי התהום. המחקר נערך בעיר אשדוד בחמישה אתרים המאפשרים השוואה של קצבי החלחול מתחת לשטחים אורבאניים לצד שטחים חקלאיים מעובדים ודיונה פתוחה.

ניתוח מרחבי של רכיבי תחום ההתנקזות אל ים המלח כאמצעי להערכת נפחי הזרימה העל קרקעית לים המלח

קלבו ר.

1. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501

הפוסטר מציג את המידע המרחבי שישמש להערכת הנגר העילי המגיע לים המלח. האומדן יתבסס על הרחבת מודל השרות ההידרולוגי, המציג קורלציה בין תדירות, עוצמה, משקעים, גודל אגן ניקוז וסוגי מסלע.
במחקר יגובש קשר בין מאפייני האגן (פיזיוגרפיה, גיאולוגיה ומטאורולוגיה) וזרימות מדודות של תחנות הידרומטריות, ויישום על תחום הניקוז לים המלח.

מיפוי תגובת אתר בערים דימונה וערד

קלמנוביץ' מ., זסלבסקי י., גורשטיין מ., אטייב ג., פרלמן נ., דן י., גילר ד., אקסיננקו ט.,גילר ו., ליבשיץ י., שוורצבורג א.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

להערכה ניסיונית של תגובת אתר בוצעו מדידות רעש רקע ב-375 נקודות בדימונה וערד.
יחסים ספקטראליים מציגים הגברה מ-2.0 עד 7.0 בפס תדרים מ-1.0 עד 9.0 הרץ בדימונה והערכים מ-2.0 עד 7.0 בפס תדרים מ-2.0 עד 7.0 בערד.
בהתבסס על תוצאות המדידות התגלו בדימונה קער אסימטרי וערוץ בלייה של תבליט קדום.

שימוש בסמנים איזוטופים לזיהוי מקורות ותהליכי זיהום חנקות באקוויפר החוף

רודד, ד.,[1] ונגוש, א.,[1] מאהייר, ב.[2]

1. המחלקה לגיאולוגיה ומדעי הסביבה, אוניברסיטת בן גוריון-בנגב, ת.ד. 653 באר-שבע 84105
2. Geophysics, University of Calgary, & Astronomy and Geology & Departments of Physics 2500 University Drive NW, Calgary, Alberta, Canada T2N 1N4

מחקר זה מתמודד עם זיהוי מקורות החנקה באקוויפר החוף. הוא מתבסס על דיגום של מוקדי זיהום החנקה אשר זוהו באקוויפר ומדידת איזוטופים של חנקן וחמצן במולקולת החנקה, איזוטופים של בורון, טריטיום וההרכב הכימי של המים.

סיווג קרקעות כורכר לצרכים הנדסיים – פרוייקט הקו האדום במטרופולין תל אביב

קיסר, י.

ג.י.א. הנדסת קרקע וביסוס בע"מ

ההרצאה עוסקת במיון סלעי כורכר לצרכים הנדסיים. הצורך במיון שכבות הכורכר התעורר תוך כדי החקירה הגיאוטכנית שבוצעה עבור החלק התת קרקעי של "הקו האדום", פרויקט הרכבת הקלה המבוצע כשלב הראשון של מערכת הסעת המונים של מטרופולין תל אביב.
אורך ה"קו האדום" הוא כ- 18 ק"מ והוא נמשך מפתח תקווה לאורך רח' ז'בוטינסקי, דרך רח' מנחם בגין, מנשיה ושדרות ירושלים עד לבת ים. הקטע התת קרקעי במשך מצומת גהה ועד למנשיה. הקו חוצה את רכסי הכורכר הבניים במקביל לקו החוף.
כפי שנראה במחשופי כורכר שפזורים בעיקר לאורך חוף הים, קרקעות כורכר הן תווך מאד לא הומוגני ובעל מבנה משתנה: שכבות מצומנטות קשות בעובי של 0.5 עד 5 ס"מ, עם שכבות ביניים של חול לא מצומנט. אצבעות של חול מצומנט, שכבות מצטלבות, סלע מסיבי קשה וכו'. איכות המדגם המתקבלת של שכבות כורכר התקבלת בקידוחי ניסיון המבוצעים בשיטות רגילות היא ירודה מאד. לשם קבלת מדגם טוב יותר בוצע הקידוח בהצלחה חלקית שיטת Triple Core Barrel.
הוצעה שיטה הממיינת את שכבות הכורכר ל-4 סוגים: K1, K2, K3, K4, בעיקר על פי הכמות של השכבות המצומנטות שבחתך. נעשה ניסיון למצוא קורלציה בין כמות הקרבונטים וסוג הכורכר. נלקחו מדגמים "בלתי מופרים" של כורכר בשיטת הקופסא, לשם בדיקות מעבדה לחוזק גזירה.

השפעת נסיגת ים המלח על מערכת מי התהום בסביבתו

קירו י.[1,2], יחיאלי י.[1], סטרינסקי, א.[2], לייחובסקי ו.[1], שלו א.[1]

1. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501
2. המכון למדעי כדור הארץ, האוניברסיטה העברית בירושלים, ירושלים 91904

החל משנות השישים חלה ירידה מהירה ומתמשכת במפלס ים המלח המשפיעה על מערכת מי התהום בסביבה. במסגרת המחקר בנחל ערוגות נצפו ירידות של מפלסי מי התהום ושל מיקום הפן הביני במספר קידוחים. נתונים אלו מתאימים בקרוב לתוצאות ראשוניות של סימולציות נומריות בעזרת תכנת SUTRA.

אי ודאות מבנית והשלכותיה על יציבות מצוקים שלוחים בסלע בלתי רציף

צסרסקי מ.[1,2], חצור י. ח.[1], יגודה, ג.[1], לויתן א.[3], זלצמן, ע.[4], סוקולובסקי מ.[5].

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653, באר שבע 84105
2. הפקולטה להנדסה אזרחית וסביבתית. הטכניון, חיפה.
3. לויתן מהנדסים. רח זכרון יעקב 8. תל אביב.
4. גיאולוגיה הנדסית והנדסת סלע, רח' המלאכה 8 א' רמת גן.
5. המשרד להנדסה גיאוטכנית וביסוס, מנהל תכנון והנדסה, משרד הבינוי והשיכון.

בעבודה זו נחקרה יציבותו של מצוק בגובה של 34 מ'; אשר בנוי ממסת סלע סדוקה. השליש העליון של המצוק שלוח כ – 11 מ'; מעבר לבסיסו, כך שהעמסה אקסצנטרית גורמת להתפתחות מאמצי מתיחה בבסיסו. יציבותו של המצוק נחקרה ע"י שילוב בין שיטות דטרמיניסטיות ושיטות ספרתיות. על סמך ממצאי האנליזה נבנתה תוכנית תמוך למצוק.

תובנות ממידול בשיטת רשת סדקים דיסקרטית, של הזרימה וההסעה במבחני שאיבה וסמנים מרובי בארות, בקרטון סדוק.

קורצמן ד. [1], נתיב ר. [1] אדר א. [2]

1 המחלקה לקרקע ומים, הפקולטה לחקלאות ומדעי איכות הסביבה, האוניברסיטה העברית , רחובות 76100
2. המכון לחקר המים, המכונים לחקר המדבר, שדה בוקר והמחלקה למדעי הגיאולוגיה והסביבה, הפקולטה למדעי הטבע, אוניברסיטת בן-גוריון שבנגב.

מבחני שאיבה וסמנים נערכו במספר בארות בו זמנית באתר ניסויים באקויטרד הקרטוני ברמת חובב. מודלים של רשתות סדקים דיסקרטיות בנו על סמך סקרי סדקים שנערכו באתר. שיטת המידול הסטוכסטית התגלתה כלא יעילה לחזוי תוצאות של מבחנים הידרוליים מרובי בארות. לעומתם מודלים דטרמיניסטים אקוויוולנטיים היו יעילים לחזוי התוצאות של מבחנים אלה.

זיהוי העתקים החשודים כפעילים בתת הקרקע בשיטת הרפלקציה הסייסמית

פריזלנדר א., מדבדייב ב., שגיא י.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

עדכונו של תקן הבניה ת"י 413 בהקשר לבנייה באזורים של שבירה פעילה העלה את הצורך במיפוי של העתקים החשודים כפעילים אשר אינם באים לידי ביטוי במחשופים על פני השטח והניתנים לאיתור באמצעות שיטת הרפלקציה הסייסמית.

הערכת איכות נתוני מדי תאוצה בארץ

פרלמן נ., זסלבסקי י., פלד א., שוורצבורג א.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

להערכת סיכון סיסמי הן למבנים בודדים והן לאזורים בעלי ריכוז אוכלוסיה גבוה דרושים נתוני מדי תאוצה. היום בידי המכון הגיאופיסי 50 אקסלרוגרמות מהרשת המורכבת מ-65 מדי תאוצה.
יש לבצע הערכת איכות נתונים וזה נובע מכך שנתונים עשויים להשתבש כתוצאת פגמי רישום מקורי (אקסלרוגרמות) אשר מגביל אפשרויות יישומם.

סטרטיגרפיה של אגן פנים יבשתי או סטרטיגרפיה של רמפה קרבונטית? תוצאות ראשוניות של ניתוח סדימנטרי של מרכז-מערב הגליל במהלך הקנומן והטורון

פרנק ר.[1], בנימיני ח.[1], בוכבינדר ב.[2]

1. המחלקה לגיאולוגיה ומדעי הסביבה, אוניברסיטת בן גוריון-בנגב, ת.ד 653 באר שבע 84105.
2. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501.

היחידות הליתוסטרטיגרפיות הקנומניות והטורוניות במרכז-מערב הגליל פורשו בעבר כמייצגות אגן פנים-יבשתי מוארך וצר. המחקר מראה שהיחידות הפציאליות מאפיינות רמפה הומוקלינלית המשתנה בזמן לרמפה תלולת קצה ושהליתופציאס הדולומיטי הרדוד של תצורת סחנין התוחם את האגן מצפון-מערב בנוי למעשה מרצף טורבידיטים המיפלגיים של ים פתוח השייכים לאזור המעבר יגוח-ירקא.

תנועת חלקיקים בתווך רווי – השוואה בין חול טבעי ומלאכותי

פישר ק. , ויסברוד נ. , יקירויץ א.

המחלקה להידרולוגיה ומיקרוביולוגיה סביבתית, מכון צוקרברג לחקר המים, המכונים לחקר המדבר ע"ש י. בלאושטיין, אוניברסיטת בן גוריון בנגב

לעיתים קרובות משתמשים בחול שעבר תהליכי שטיפה וניקוי לאריזת עמודות וניסויי הסעה של חלקיקים בתווך. מחקר זה בוחן את השפעת תהליך הניקוי על תנועת החלקיקים. תוצאות העבודה מראות כי תהליך ניקוי החול גורם לשינוי מובהק בתנועת החלקיקים וכמות החלקיקים המצטברת בעמודה. ההבדלים נמצאו מובהקים במיוחד בחלקיקים קטנים.

נקבת השילוח אכן נחצבה בתקופת חזקיהו: ראיה מתיארוך רדיומטרי

פרומקין ע. [1], שימרון א. [2], רוזנבאום ג'. [3]

1. המחלקה לגיאוגרפיה, האוניברסיטה העברית, ירושלים
2. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501
3. אוניברסיטת רדינג, בריטניה

נקבת השילוח תוארכה על ידינו בשתי שיטות: פחמן 14 של חומר אורגני בתוך הטיח הקדום המכסה את קרקעית הנקבה ודפנותיה, ואורניום-תוריום של ספלאותמים שהושקעו בתוכה לאחר שנחצבה. שתי השיטות מאשרות את הנתונים ההיסטוריים והפליאוגרפיים ששימשו בעבר לתיארוך עקיף.

ריכוזי ראדיואקטיביות גבוהים באקוויפר אבן החול הנובית ובאקוויפר חבורת יהודה בנגב.

פרי נ. [1], וונגוש א.[1], חקין ג. [2], אלחנני ש. [3], גזית יערי נ. [2], פנקרטוב א. [3], יונגרייס ז.[2], בבדגלי ה. [1]

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105
2. המרכז למחקר גרעיני שורק- יבנה 81800
3. נציבות המים המסגר 4 תל אביב ת.ד 20365
4. אונברסיטת סטנפורד המחלקה למדעי הגיאולוגיה והסביבה סטנפורד קליפורניה 2115-94305 ארה"ב.

ריכוזי אקטיביות של ראדיום וראדון נבדקו בכ- 60 קידוחים באקוויפר אבן החול הנובית ובאקוויפר חבורת יהודה. במים אלה נמצאו רמות החורגות מהתקן הישראלי והאירופי (בעשרות אחוזים).
ריכוז חריג זה מקורו טבעי ונובע מאינטראקציה מים-סלע. המחקר עוסק בזיהוי המנגנונים השונים והמאפיינים המעודדים ריכוזי ראדיום גבוהים במים אלה.

עדויות גיאומורפולוגיות לניאוטקטוניקה במניפת הסחף של נחל רחם – הערבה הדרומית – טרנספורם ים המלח.

פורת נ. [1], רפאפורט ע. [2], עמית ר. [1], זילברמן ע. [1], איל י. [2],

1. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים
2. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון, באר שבע 84105

במניפת הסחף של נחל רחם נמצאו עדויות לטקטוניקה צעירה. התפתחות מניפת הסחף של נחל רחם הושפעה משילוב של תהליכים טקטוניים הקשורים למיקומה על סף סטרוקטוראלי בין האגנים יוטבתה ועברונה, לבין שבר תמד ולמערכת השברים החוצים ומגבילים אותה. מהמחקר עולה שלמרות מיקומה היציב במרחב, המניפה נמצאת בתהליך של הרמה ושבירה. רוב אירועי השבירה אירעו בפליסטוקן העליון ותחילת ההולוקן בעוד שתהליך הרמת המניפה כנראה התרחש ברובו בהולוקן.

קונבקצית אויר בתוך סדקים בקרטון כגורם עיקרי לאידוי והשקעת מלחים

פילרסדורף מ. [1], וויסברוד נ. [1], דראגילה מ. [2]

1. אוניברסיטת בן גוריון בנגב, המכון לחקר המדבר ע"ש בלאונשטיין, מכון המים ע"ש צוקרברג, המחלקה להידרולוגיה ומיקרוביולוגיה של הסביבה, מדרשת שדה בוקר.
2. אוניברסיטת המדינה של ארגון, המחלקה למדעי הקרקע, קורבליס, אורגון, ארה"ב.

נחקרה תופעה של אידוי והשקעת מלחים מדפנות סדקים בקרטון כתוצאה מתחלופת האוויר שבסדק עם האוויר שבחוץ. לשם הניסוי נבנו שתי תחנות מדידה, באחת נמדדו תכונות האוויר בתוך סדק ובשנייה בתוך באר .

איכון סיסמי בהתבסס על הפרשי זמן

פינסקי ו.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

אנו מציגים בולטין חדש המתבסס על איכון מוחלט של אירועים בודדים אשר נערך בעזרת הפרשי זמן בלבד ואינו דורש מודל מהירויות.

תוכנה חדישה לעיבוד אוטומטי נתוני טלמטריה סיסמית

פולוזוב א., פינסקי ו., הופשטטר א.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

התוכנה מיועדת לניתוח כללי נתוני רשת וקבוצות תחנות סיסמיות להפקת בולטין אשר מפותח היום ע"י המכון הגיאופיסי לישראל .התוכנה, הידידותית לסביבה, מבצעת קריאת נתוני טלמטריה סיסמית במגוון פורמטים הקיימים ותצוגתם גמישה בצורות גראפיות שונות.

מנהרת תעבורה ברכס כורכר – מדדים לבדיקה

פולישוק צלי ב.

ד.א.י.י. מנהרות, החורשה 17 רעננה, 43613

ביצוע מנהרת תעבורה רדודה ברכס כורכר בשטח עירוני מחייב בדיקת היתכנות באמצעות המדדים הבאים: שקיעת הקרקע בתקופת הקמת המנהרה, רטט במסת הסלע בתקופת ההקמה והתפעול, רעש בתקופת ההקמה ובעיקר בתקופת ההפעלה, וזיהום אוויר בתקופת ההפעלה.

חתך פלוביאלי עבה מגיל פלייסטוקן עליון עד הולוקן קבור מתחת לערוץ הפעיל של נחל צין בבקעת צין

פורת נ. [1], אבני י. [1,2], אייל ע. [3]

1. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501
2. מרכז מדע רמון, ת.ד 194 מצפה רמון 80600
3. רותם-אמפרט נגב

בור שנחפר לכריית פוספט חשף חתך בעובי 25 מ' של קונגלומרט וחול. 4 דוגמאות שתוארכו בשיטות בלומינסנציה נתנו גילים בין 70,000 ל- 10,000 שנה. במעלה אגן הניקוז סדימנטים החלו לשקוע לפני 70,000 שנה אך החל מ- 25,000 שנה האיזור עובר אירוזיה, כך שקיימים הבדלים בתגובה של חלקים שונים של אגן הניקוז לאותם שינויי אקלים.

אינטרפרומטריה של מחזירים קבועים (PSInSAR) – יישום שיטה חדשה למדידת מעוות של פני השטח באזור חיפה והעתק הכרמל

נוביצקי ר.[1,2], בר ג. [2], אייל י.[1] , שמיר ג.[3]

1. המחלקה לגיאולוגיה ומדעי הסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר-שבע 84105
2. המכון הגיאולוגי לישראל, רח' מלכי ישראל 30, ירושלים 95501
3. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

המעוות באזור הסמוך להעתק הכרמל – מאזור יוקנעם בדרום ועד חיפה בצפון וכן עמק זבולון, נמדד תוך שימוש בשיטת אינטרפרומטריה של מחזירים קבועים (PSInSAR). נעשה ניסיון למצוא התאמה בין הדפורמציה הנמדדת לשינויי מפלס מי-תהום (עבור אזור נמל חיפה), פעילות סייסמית, יציבות מדרונות ומודל טקטוני.

אירועי סרפנטיניזציה עוקבים באופיוליט טרודוס: רקורד איזוטופי לתהליכי פתיחה אוקיאניים ותהליכי הצבה מאוחרים

נוריאל פ.[1], קציר י.[1] אבלסון מ.[2], ואלי ג'.וו, [3], מתיוס א.[4]

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105
2. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501
3. המחלקה לגיאולוגיה וגיאופיזיקה, אוניברסיטת וויסקונסין, מדיסון, ארה"ב
4. המכון למדעי כדור הארץ, האוניברסיטה העברית, ירושלים, 91904

מחשוף הסרפנטיניט, המהווה חלק מהקומפלקס האולטרה-מאפי של אופיוליט טרודוס, נחשב כראשו של דיאפיר שנוצר מעל אזור הפחתה שהתפתח מדרום לקפריסין בפלייסטוקן (Robertson, 2000).
ערכי $\delta^{18}O$ ו- δD שהתקבלו במחקר זה מראים כי הסרפניטיזציה התרחשה לפחות בשתי סביבות טקטוניות שונות הקשורות לתהליכי פתיחה אוקיאניים בקרטיקון ולתהליך ההצבה של האופיוליט בפלייסטוקן.

בעיות פתוחות בהערכת סיכוני רעידות אדמה במפרץ חיפה

סלמון ע.

המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים, 95501

המבנה הגיאולוגי של מפרץ חיפה והבינוי האינטנסיבי בסביבתו יוצרים תמונת סיכונים מורכבת ובעיות בהערכת הסיכון. גורמי הסיכון הם: העתקה פעילה, הגברת התאוצות, יציבות מדרונות, התנזלות וצונאמי. הסקר אשר נערך בימים אלה במסגרת ועדת ההיגוי להיערכות לרעידת אדמה יתייחס לבעיות אלה וממצאיו יוצגו במפות מסכמות עבור מגוון רחב של משתמשים.

יציבות חללים תת קרקעיים והתפתחותם בהקשר לבורות בים המלח.

מימון א. [1,2], לייחובסקי ו. [2], עגנון א. [1], אבלסון מ. [2]

1)המכון למדעי כדור הארץ, האוניברסיטה העברית, ירושלים.
2) המכון הגיאולוגי לישראל, ירושלים.

יציבות חללים תת קרקעיים נבחנה בעזרת מודל נומרי ביחס לשני אופני כניעה (אופן I ואופן II). צורת חלל, גודלו ועומקו, תכונות החומר הסובב אותו, ויחסי המאמצים הפועלים עליו נבחנו בעזרת המודל ועומתו מול תצפיות מהשדה. לרב, נוצר בור פעמוני בשכבת המלח המתפתח ונשען על מבנה קשתי בסדימנטים הקלאסטיים.

התאמת פונקצית תגובת אתר ניסיונית בעזרת אלגוריתם שייק

מיקנברג מ., זסלבסקי י.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

בעזרת שיטת נקמורה מקבלים פונקצית יחס ספקטראלי אופקי לאנכי ממדידות רעש רקע.
הפונקציה משמשת להערכת מוד ראשון של פונקצית תגובת אתר אנליטית חד-ממדית בעזרת אלגוריתם שייק. התוכנה המוצגת בוחרת את הפרמטרים של המודל אשר מספקים התאמה מרבית בין שתי הפונקציות ולא רק בערכי תדר והגברה אלא גם בצורתן.

השפעת אופי המגע בין גרגרים על התכונות המכניות של סלעים סדימנטרים

מנור ש., פלצ'יק ו., יוסף ח. חצור

המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105

במחקרים רבים במכניקת הסלע נמצא כי לאופי המגעים בין הגרגרים השפעה חזקה על התכונות המכניות של הסלע. במחקר זה בחנו את השפעת אורך ורציפות המגעים בין גרגרים על התכונות המכניות של סלעים סדימנטרים. לצורך כך נדחסו דוגמאות אבן חול וגיר בלחץ הידרוסטטי של 20 MPa ו-40 MPa, ונבחנו השינויים בתכונות המכניות ובמיקרוטקסטורה.

עוקבים כסמנים לתנועת מי תהום והסעת חלקיקים באזור ים המלח

מגל ע., ויסברוד נ., יחיאלי י.

1. המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501
2. המחלקה להידרולוגיה סביבתית ומיקרוביולוגיה, המכון למדעי וטכנולוגית מים, מכון בלאושטיין לחקר המדבר, אוניברסיטת בן גוריון בנגב

העבודה הנוכחית מנסה להעריך את מהירות זרימת מי התהום והסעת חלקיקים באזורים שונים לחוף ים המלח בעזרת עוקבים (tracers). לצורך כך נעשו ניסיונות ספיחה של מספר סוגי עוקבים והסעת חלקיקים בתמיסות שמליחותם נעה ממליחות מי ים המלח ועד למי ים המלח מהולים. תוצאות ראשוניות מראות על תנועת חלקיקים בעמודות במעבדה גם בתמלחות מרוכזות כגון מי ים המלח.

תפקידי המפתח של הגיאולוג בשימור הארץ ובפיתוח המושכל שלה

מזור ע.

מדעי הסביבה ומחקרי אנרגיה, מכון ויצמן למדע, ת.ד 26, רחובות 76100

במאה ה-21 התרחב מרחב הפעילות של הגיאולוג במידה ניכרת, וזאת לאור ההכרה הציבורית שיש לשמר תאי הנוף שהאדם טרם פגע בהם - להעלאת איכות החיים שלנו ולמילוי הצוו המוסרי של הורשת פלחי נוף בראשית לדורות הבאים. משרעת תפקידי הגיאולוג רחבת ידיים כיום ועליו להשתתף בקביעת העדיפויות ומתן הפתרון המיטבי לממשק השימור מול הפיתוח המושכל של תאי השטח השונים.

עדות ליחס לא קבוע בין אנרגיה ומומנט סייסמי בעזרת ספקטרה של גלי קודה

מיידה ק.[1], גוק ר.[1], וולטר ו.[1], הופשטטר ר.[2]

1. המעבדה הלאומית בליברמור, ליברמור, ארה"ב
2. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

אנו מציגים עדות לקיום יחס לא קבוע בין אנרגיה ומומנט סייסמי בעזרת ספקטרה של גלי קודה. השתמשנו בנתונים מארבע רעידות אדמה חזקות שהתרחשו במפרץ אילת, טורקיה וארה"ב. עדויות אלו מעידות כי יש הבדלים ביו רעידות חזקות וחלשות בשבירה ומהירות השבירה המאופיינים ביחסים שונים.

מאזני המים, מלח ואנרגיה של ים המלח

לנסקי נ.ג.[1], דבורקין י.[1], לייחובסקי ו.[1], גרטמן א.[2], גבריאלי א.[1]

1. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים 95501
2. חקר ימים ואגמים לישראל בע"מ, תל שיקמונה, חיפה 31080

מאזני המים, מלח ואנרגיה של ים המלח נחוצים כדי להעריך את המשך התנהגות הים, בפרט על רקע ירידת המפלס המהירה. על ידי הצבת המאזנים אנו מחשבים את קצב האידוי וספיקת המים מקרקעית הים. שני גדלים אלו אינם ברי מדידה ישירה, והם מהגורמים העיקריים שמשפיעים על התנהגות ים המלח.

יחסי תנודות קרקע בישראל

מאירוב ט.[2], הופשטטר ר.[1], בן אברהם צ.[2] ושטיינברג ד.[2]

1. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100
2. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד. 39004 רמת אביב 69978

רמת פעילות הסיסמית בישראל ובסביבתה יחסית נמוכה. תיעוד היסטורי מראה שרעידות אדמה חזקות מתרחשות באזור, ומספר רעידות גרמו לנזק והרג רב. לכן לקבלת יחסי ניחות של גלים סיסמיים בתת הקרקע יש חשיבות רבה. קביעה של ניחות תנודות קרקע בהתבסס על רעידת אדמה כפונקציה של תדירות חשובה לתכנון הנדסי וסיכונים סיסמיים.
המטרה העיקרית של הפרויקט לחקור תנודות קרקע באזור ישראל כפונקציה של מרחק בין מקור רעידה לתחנה ותדירות התנודות. נתונים מרעידות אדמה חזקות באזור ישראל נדירות. כדי לפתח יחסי תנודות קרקע אנו משתמשים בנתונים מרעידות אדמה חלשות יותר. השיטה מבוססת על זאת של Yazd (1993) ומתוארת ע"י Raoof et al., (1999) ו Malagnini et al., (2000). -בגישה זאת אנו נשתמש במודל המקור ובחוק דירוג לצורך חיזוי הספקטרום ומשרעת תנודת הקרקע במרחקים שונים. לחילופין אפשר לקבל את יחסי תנודות הקרקע על בסיס נתונים מרעידות אדמה חלשות ובעזרת פרמטרים אשר מתארים את תנודות הקרקע.
לביצוע האנליזה בבחרו כ-1500 רעידות אדמה לוקליות אשר נקלטו ע''י הרשת סיסמית ישראלית בין השנים 1984-2004. מתוכם 600 אירועים במגניטודה של-3.0 עד 4.0, 100 אירועים במגניטודה של-4.0 עד 5.0 ו10 אירועים במגניטודה גדולה מ-5.0 .

סווג מסת סלע למנהור – דוגמאות מעבודות בארץ ואתגרים לעתיד

לוין מ.

מ. לוין - סקרים גיאולוגים וגיאוטכניים

סווג מסת סלע למנהור היגו שלב הכרחי כחלק מעריכת סקר גיאוהנדסי לתכנון מנהרות. בארץ מבוצעים כיום מספר פרוייקטים של מנהור וכן נמצאים בתכנון מספר לא מבוטל של מנהרות רכבת העוברות בחתך סלע . עד כה היה מקובל להשתמש בשיטות הסווג המקובלות כדוגמת שיטת Q (Barton, 1974) ושיטת RMR (Bieniawski, 1989) כאשר לאחרונה נכנסת לשימוש גם שיטת GSI (Hoek et al 1995). היתרון בשימוש בשיטות מובנות היא באפשרות לקבל ערכים מספריים אשר מאפשרים למתכנן המנהרה להעריך את תגובת מסת הסלע מבחינת יציבות החלל וזמן התמוך הנדרש. החיסרון הוא בעיקר בתיעול החשיבה ההנדסית לתחום צר, כאשר לעיתים לא באים לידי ביטוי ההשפעות המקומיות של התנאים הגיאולוגים והדרכים להתמודדות עם תקלות וקשיים. שיטת הסווג האוסטרית לדוגמא מדגישה את חשיבות תגובת מסת הסלע ובהתאם מרחיבה את השימוש של מדידת תזוזות ומאמצים בזמן הכרייה תוך התאמה של שיטת הכרייה והתמוך בזמן הביצוע. שימוש בשיטה כזו מחייב שיטת התקשרות חוזית גמישה תוך חלוקת סיכונים וקבלנים בעלי ניסיון רב וציוד משתנה אשר כפי הנראה טרם הגיעה העת ליישמה באופן מלא בארץ.
שלושה פרוייקטים של מנהור נסקרים. הראשון מנהרות חדיד באורך 460 מ' שבוצעו כחלק מכביש חוצה ישראל באזור מחלף בן שמן. השני מנהרות קדומים בנצרת באורך של 310 מ' הנמצאות בביצוע. השלישי פרוייקט רכבת עכו כרמיאל הנמצא בשלב התכנון. ההרצאה תעסוק בקשיים של סווג מסת סלע, בחיזוי תגובת הסלע, בפתרונות האפשריים ואתגרים לעתיד.

המערכת הקרבונטית הימית באזור אכזיב : ניתוח סדימנטרי ופאוניסטי

לזר ש. [1,2], אלמוגי-לבין א. [2], בנימיני ח. [1], בוכבינדר ב. [2]

1. המחלקה לגיאולוגיה ומדעי הסביבה, אוניברסיטת בן גוריון-בנגב, ת.ד 653 באר שבע 84105
2. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים 95501

החתך הסדימנטרי של מערכת זו מתחלק לחמישה תתי אזורים בטווח העומקים 30 - 0 מטר על פי קריטריונים סדימנטולוגיים וביולוגיים: (1) סביבה חופית רדודה (2) סביבה לגונרית מוגנת חלקית עם רודוליתים (3) סביבת איי הכורכר (4) סביבת מדרון הכורכר התלול (5) סביבת המדרון הסילטי-חולי המתון.

הערכה מחדש של מבנה "דלתה" במדף היבשת של ישראל: בחינת תהליכים נאו-טקטוניים והקשרם לחתך העמוק.

לוין ד.[1], בן-אברהם צ.[1], רשף מ.[1], בן-גיא י.[2]

1. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד 39004 רמת אביב 69978
2. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

מחקרים רבים נעשו על מבני הקשת הסורית באזור היבשה בישראל ובמדינות שכנות במהלך השנים. המחקרים שנעשו בים עסקו בעיקר במבנה הסדימנטרי או בפיתרון בעיות טקטוניות של מבנה הכרמל והמשכי שברים מהיבשה לכיוון הים. איזור המחקר מצוי בשולי היבשת מול חופי נתניה, כ-20 ק"מ מקו החוף, והוא מכסה שטח של כ- X4030 ק"מ. מבנה "דלתה" הוא שמו של מבנה קבור, אשר הונח שהוא שייך למערכת מבני הקשת הסורית. המבנה הנ"ל נחקר ונקדח על ידי חברת "בלפטקו" באמצע שנת 1970 למטרת חיפושי גז ונפט. מבנה "דלתה" קבור תחת יתד סדימנטים פליו-פלייסטוקניים נילוטיים, ואליהם נוספים אוופוריטים מסיניים בצידו המערבי (ידועים בסימון M,N בחתכים סייסמיים).
מטרת העבודה היא לבדוק האם קיימת דפורמציה ופעילות טקטונית מתמשכת באזור המחקר, והאם היא קשורה למבנה הבולט של "דלתה". לצורך כך מתבססת העבודה על פענוח כ-450 ק"מ של קוים סייסמים, רב ערוציים, אשר נאספו בסדרות "Isramco-91", "horizon". המידע הסייסמי מכויל על ידי 3 קידוחים שנעשו באזור. יבוצע עיבוד נתונים ייעודי בחתכים נבחרים לצורך הגדלת כושר ההפרדה בחלק הרדוד ושיפור יכולת הפענוח בחתך העמוק. תוצאות ראשוניות הן אינטרפטציה של אופקים סייסמים עיקריים באזור המחקר, ומפת איזופח של החתך הפליאו-פלייסטוקני אולם בשלב זה לא ניתן לגבש מסקנה ברורה על אופי השבירה.
חשיבות המחקר באה לידי ביטוי בהערכת סיכונים סייסמים, וכן תשתית הנדסית בשולי היבשת של ישראל.

תיארוך קונכיות מלנופסידים על ידי אורניום-תוריום ו C^{14} מבקע הכינרת

לב ל.[1,2,4], בוארטו א.[2], מרקו ש.[1], הלר י.[3] שטיין מ.[4]

1. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד. 39004 רמת אביב 69978
2. מדעי הסביבה ומחקרי אנרגיה, מכון ויצמן למדע, רחובות 76100
3. הפקולטה למדעי החיים, האוניברסיטה העברית, קמפוס גבעת רם, ירושלים 91904
4. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501

תיארוך קונכיות מלנופסידים מאזור בקע הכינרת התבצע הן על מלנופסידים חיים, תוך השוואה לערכי המים בהם הם חיים והן על מלנופסידים מאובנים, עליהם קיים גיל מתיארוך בלתי תלוי. תוצאות ראשוניות מראות כי הפחמן בקונכיה הארגוניטית מקורו במים ועל כן ידיעת זמן המאגר של גוף המים בהם גדל המלנופסיד תאפשר הפחתה של זמן זה וקבלת גיל מדויק. תיארוך מלנופסידים מאובנים בשיטת אורניום-תוריום (הן על ידי גילאים בודדים על דוגמאות והן על ידי שימוש בשיטת הרגרסיה – גיל איזוכרון) הראה התאמה יפה לגילאים שהתקבלו על ידי תיארוך חומר אורגני מאותה שכבה.

מיפוי היחסים המרחביים בין מי תהום מתוקים, מליחים ומלוחים תחת מדבר יהודה באמצעות שיטת ה- TDEM העמוקה

לוי א.[1], גולדמן מ.[2], גבירצמן ח.[1]

1. המכון למדעי כדור הארץ, האוניברסיטה העברית, ירושלים 91904
2. המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

סקר גיאוחשמלי במדבר יהודה מלמד על קיומה של שכבה בעלת התנגדות חשמלית נמוכה (15-5 אוהם-מ) מתחת שכבה בעלת התנגדות חשמלית גבוהה (500-50 אוהם-מ) . המעבר בין השכבות משתנה ונע בין העומקים 1000-500 מ' מתחת פני השטח, והוא כנראה מלמד על מעבר בין מי תהום מתוקים למי תהום מליחים.

שימוש בשיטת DDA(Discontinuous Deformation Analysis) למציאת מנגנון הכשל של קשת בלוקים באתרים ארכיאולוגיים וחישוב תאוצות סף ברעידות אדמה היסטוריות.

לוי ר.[1], חצור י.[1], מרקו ש.[2]

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105
2. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד. 39004 רמת אביב 69978

המחקר מתמקד במקרה של החלקת בלוק בודד בקשת בלוקים (נצפה בממשית ומבצר נמרוד). מבנה קשת הוא אחד המבנים העתיקים והנפוצים ביותר, ולכן מעורר עניין בקרב חוקרים ברחבי העולם. יחד עם זאת, לא קיים עדיין פתרון אנליטי מדויק, ולכן שימוש בשיטות נומריות לאנליזה דינאמית כמו DDA שופך אור על התנהגות הקשת ברעידת אדמה.

ריכוז דו תחמוצת הפחמן והרכבו האיזוטופי באוויר של מערת שורק

כרמי י.[1], שטילר מ.[1], קרונפלד י.[1], יחיאלי י.[2], בר-מטיוס מ.[2], איילון א.[2], יקיר ד.[3]

1. אוניברסיטת תל-אביב, ת"ד 39040, תל-אביב 613690
2. המכון הגיאולוגי, 30 מלכי ישראל, ירושלים 95501
3. מכון וייצמן למדע, ת"ד 26, רחובות 76100

אנו מציגים תוצאות ראשונות של ריכוז דו תחמוצת הפחמן והרכבו האיזוטופי באוויר של מערת שורק. אס]נו דוגמאות אוויר ממספר אתרים במערה, באולם ההסתגלות, ומהרחבה לפני המערה. הגורמים הקובעים את ריכוז דו תחמוצת הפחמן והרכבו האיזוטופי באויר המערה הם נשימות המבקרים במערה וכן דליפה מטיפטופי הסטלקטיטים שהם על-רווים בדו תחמוצת הפחמן.
ריכוז דו תחמוצת הפחמן באוויר המערה הוא עד פי 4 מהאוויר שבחוץ. בתוך המערה הריכוז הוא 1400 כאשר אין מבקרים במערב רואים בברור גרדינט $\delta^{13}C$=-19‰ והפחמן-13 הוא ppm .ברכוז של דו תחמוצת הפחמן ושל תכולת ה C^{13} שלו בין המערה ואולם ההסתגלות, ובין אולם ההסתגלות והאויר החפשי. כאשר דלת המערה פתוחה משך 5 דקות (זה זמן כניסת מבקרים מהאולם אל המערה), נמדדת דליפה חזקה של אוויר המערה אל אוויר האולם. כמוכן דליפות יכולות להיות גם דרך הסדקים בגג המערה.
שני המקורות של דו תחמוצת הפחמן במערה (נשימות ודליפה מטיפות מים מסטלקטיטים) שונים מאד הן בריכוז דו תחמוצת הפחמן הן בהרכב האיזוטופי. 190,000 המבקרים בשנה תורמים כ 2000 ממ"ק דו תחמוצת הפחמן למערה שהם פי 60 מנפח דו תחמוצת הפחמן הנמצא במערה. אילו הנשימות היו המקור היחידי לדו תחמוצת הפחמן במערה הייתי מצפים להרכב איזוטופי של $\delta^{13}C$=-25‰. הערך הנמדד הוא $\delta^{13}C$=-19‰ ולכן תרומה של דו תחמוצת הפחמן כבדה יותר ב C^{13} מהטיפטופים נראית סבירה. אנו נציג מאזנים של דו תחמוצת הפחמן ושל C^{13} במערה.

תרכובות אורגניות נדיפות בתווך הרווי והלא רווי של אקוויפר החוף בתל אביב: שינויים בזמן ובמרחב

לב ח.[1,2], רונן ד.[2,3], ויסברוד נ.[2], דהן ע.[2], מילטאו ר.[4]

1. המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד 653 באר שבע 84105
2. המחלקה להידרולוגיה ומיקרוביולוגיה, מכון צוקרברג למדעי המים, המכון ללימודי מדבר ע"ש בלאושטיין, אוניברסיטת בן גוריון, באר שבע
3. נציבות המים, תל אביב
4. המחלקה למדעי הקרקע, המים והסביבה, מנהל המחקר החקלאי, מכון וולקני, בית דגן

באתר מגן בתל אביב, פעל מפעל של תע"ש עד השנים האחרונות. באתר נמצאו ריכוזים גבוהים של תרכובות אורגניות נדיפות הן בתווך הרווי והן בתווך הלא רווי של אקוויפר החוף. במהלך תקופת מדידות של שנה, נצפו שינויים בזמן בריכוזי התרכובות באותו הקידוח, ושינויים במרחב בין קידוחים הממוקמים כשלושים מטר אחד מהשני.

יישום של מכלול שיטות גיאופיסיות להערכת סיכון הבולענים באזור ים המלח – שלב ראשון של מחקר

יזרסקי מ.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

הגישה המערכתית המשלבת מספר שיטות גיאופיסיות (רפרקציה סייסמית, GPR, מיקרוגרביטי וכול'), המשלימות ומחזקות זו את זו; מאפשרת התמודדות יעילה יותר עם הסיכונים הנובעים מתופעת הבולעים בחוף ים המלח. המאמר מציג תוצאות חדשות ושונות במסגרת השלב הראשון של המחקר.

גלישות מדרון בקופסת חול מורעדת; תוצאות ראשוניות המפרטות טיפוסי כשל ויחס מעריכי של נפיצות וגודל (שטח)

כץ ע. [1], אהרונוב ע. [2]

1. המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501
2. מכון ויצמן למדע, זוסמן 209, רחובות 76100

הרעדנו (10 הרץ, 0.2-1.2g) קופסה עם ערימת חול רטוב (1% משקלי מים) בכיוון אנכי או אופקי מקביל או ניצב לכיוון המדרון. מצאנו גורם חדש הקובע את טיפוס הגלישה: כיוון ההרעדה. בנוסף מצאנו כי הרעדה אנכית יוצרת גלישות בלוקים עם יחס מעריכי של בקירוב 1 בין הנפיצות וגודל (שטח) הבלוק.

גלישות מדרון בצפון רכס הכרמל ובעיר חיפה בעת רעידת אדמה; הערכת הסכנה וטיפוס הכשל הצפוי בעזרת מערכת מידע גיאוגרפית

כץ ע., אלמוג ע., פנחסי ג.,

המכון הגיאולוגי, רחוב מלכי ישראל 30, ירושלים 95501

הסכנה לגלישות מדרון בצפון הכרמל ובחיפה בעת רעידת אדמה וטיפוס הכשל הצפוי נותחו בעזרת ממ"ג. רובדי הבסיס להערכה הם D.T.M, מפה גיאולוגית ומפה סטרוקטורלית של גג חבורת יהודה. התוצרים הם מפת טיפוס הכשל הצפוי, מפת רגישות (תאוצה קריטית לכשל) ומפות תרחיש לכשל מדרונות ברעידות צפויות (למשל, 6.5 על העתק הכרמל).

הערכת תגובת אתר ותנודות קרקע בקרית שמונה

זסלבסקי י., אטייב ג., מיקנברג מ., קלמנוביץ' מ., גורשטיין מ. , אקסיננקו ט., גילר ו., פרלמן נ., ליבשיץ י. , גילר ד., דן י., שוורצבורג א.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

נתוני התפלגות תדר תהודה והגברה שימשו לשחזור מבנה תת קרקע בעזרת 280 נקודות מדידה. התוצאות הוצגו בצורת חתכים גיאולוגיים ומפות.
במפת עומק שכבה מחזירה ניתן להבחין בשלושה מבנים המוגבלים בהעתקים בעלי שכבה מחזירה שונה. תוצאותינו הראו כי ערכי עובי השכבות משתנים באופן משמעותי (מ-10 עד 200 מ').

החומר הקלסטי דק הגרגר בחבורת ים המלח

חליוה - כהן, ע. [1,2], שטיין, מ. [2], סטרינסקי, א. [1].

1. המכון למדעי כדור הארץ, האוניברסיטה העברית, גבעת רם, ירושלים 91904
2. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים 95501

המינרלוגיה, הפטרוגרפיה ויחסי $^{87}Sr/^{86}Sr$ נמדדו בסדימנטים דטריטיים דקי גרגר מתצורות ים המלח השונות וממקורות אספקה אפשריים – שיטפונות ולס. נמצא כי הרכב הסדימנט בים המלח הוא תוצר ערבוב בין שני מרכיבי קצה, מרכיב איאולי המובל אל שטח אגן הניקוז ממרחק רב ומרכיב מקומי הכולל את קרקעות וסלעי אגן הניקוז. תרומת המרכיב האיאולי שולטת בפלייסטוקן ותרומת המרכיב המקומי בהולוקן, עד היום.

יישום שיטות סיסמיות למיפוי מבנה ותכונות תת הקרקע להערכת תגובת האתר

יזרסקי מ.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

סקירה וניתוח של סקרי רפקציה סיסמית ומדידת מהירויות בקידוחים - מיפוי ההתפלגות האנכית והאופקית של מהירויות גלי לחיצה (P) וגזירה (S) בשכבות השונות בתת הקרקע לשם הערכת פונקציית תגובת האתר בהתרחש רעידות אדמה (Site Specific Response).

עדויות לשבירה צעירה בשולי בקעת כנרות

וקסלר נ., מרקו ש.

1. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד. 39004 רמת אביב 69978

תוצאות של מחקר פלאוסייסמי שנערך בסביבת תל-קציר מראות על שבירה צעירה, מאוחרת לליסאן, בבקעת כנרות ובשוליה. תעלות נחפרו ומופו בארבעה אתרים סביב תל-קציר וליד חוף הכינרת, וכן מופה מחשוף של תצורת הליסאן על כביש מעגן - חמת גדר. נמצא כי השבירה מאוחרת לתקופת המפלס הגבוה של אגם הליסאן, לפני 26-24 אלף שנים.

יחסי $^{34}S/^{32}S$ במערכת ההידרולוגית של החרמון ורמת הגולן, צפון-מזרח ישראל

וקשל א.[1], נילסן ה.[2]

1. מרכז ליאו פיקרד לחקר מי תהום, האוניברסיטה העברית בירושלים, ת.ד. 12, רחובות 76100.
2. המכון הגיאוכימי של אוניברסיטת גטינגן, רחוב גולדשמידט 1, גטינגן, גרמניה.

יחסי איזוטופים של גפרית $^{34}S/^{32}S$ מאפשרים להגדיר טוב יותר את המערכות ההידרוגיאולוגיות של מקורות הירדן במבנה הקרבונטי-קרסטי של החרמון ובפלטו הוולקני של רמת הגולן. מובחנים כאן תהליכים משולבים של תרומת מי גשם ושלג, המסת אבפוריטים ותהליכי חיזור עונתיים של גפרית על פני הקרקעות הבזלתיות.

עשר שנות מחקר של תופעת תגובת אתר: שיטות ודוגמאות

זסלבסקי י.

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

בעשור החרון, במטרה להעריך שיעור הגברת תנודות קרקע נחקרו על ידינו מעל 70 אתרים המיועדים לבנייה חדשה וגם נערכו מחקרי חלוקה לאזורים סיסמיים של מספר ערים.
כתוצאה מכך פותחה שיטת יחס ספקטראלי ממדידות רעש רקע לביצוע הערכת סיכונים סיסמיים בשטחים עירוניים בעלי ריכוז אוכלוסיה גבוה.

מחזור ההשקעה של פרטי אבנון ותמר בצפון הנגב

ולד ר., בנימיני ח.

המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד. 653 באר שבע 84105

מחזור ההשקעה אבנון/תמר בצפון הנגב נבחן מחדש בהקשר פליאואקולוגי, תוך היעזרות בסטרטיגרפיית רצפים. במסגרת העבודה נדגמו עשרה חתכים עמודיים בשלושה תתי-איזורים בצפון הנגב: דימונה, ירוחם ומעלה עקרבים. מוצע שדיכוי הדרגתי וממושך של מבנים ביוגניים, כתוצאה מעקה נוטריינטית, הוביל בסופו של דבר לסדימנטציה מסוג "בסינלי" לרוחב המדף, בואכה גבול-רצף Ce/Tu.

חדירת חולות לנגב הצפון-מערבי במשך הרביעון העליון

ונקרט ר., צוער ח., ובלומברג ד.ג.,

המעבדה לחישה מרחוק והדמאות פלנטאריות (EPIF), המחלקה לגיאוגרפיה ופיתוח סביבתי אוניברסיטת בן-גוריון, באר שבע 84105

דיונות החול בנגב הצפון מערבי הן חלק משדה החול של צפון סיני. הדיונות, אשר היו פעילות באקלים שונה בעבר, מיוצבות היום על ידי קרומים ביוגניים וצומח. על פי הגוון המשתנה של החולות והמורפולוגיה השונה של הדיונות ניתן להניח שבאזור התרחשו בעבר מספר חדירות של חול איאולי. מחקרים שונים, אשר התבצעו באזור זה, מציינים מספר מחזורי פעילות של חולות איאולים שהתרחשו במהלך הרבעון העליון. בעבודה זו מבוצע מיפוי של יחידות החול על מנת להבחין בחדירות החול השונות באזור הנגב הצפון מערבי לפי צבעם של החולות, על פי צורתם המורפולוגית של הדיונות ועל פי גיל השקעתם (תיארוך TL). המיפוי של החולות באזור הנגב הצפון מערבי נעשה באמצעות חישה מרחוק והטמעה בממ"ג (GIS). הנתונים התקבלו מתוך הדמאת Landsat TM, אורטופוטו דיגיטאלי ומתוך דוגמאות חול שנאספו בשדה. בדיקת הגוון של החולות נעשתה באמצעות מדידת החותמת הספקטראלית של דוגמאות החול ומתוך המידע שהתקבל מהדמאת Landsat ומאורטופוטו דיגיטאלי. על מנת להבין את מחזורי הפעילות של הדיונות נבדקה מידת ההתאמה של תכונות החול השונות (צבע, ריכוז הברזל וגיל) אשר נמדדו במעבדה ומידת ההתאמה לנתוני החישה מרחוק של יחידות החול השונות. התוצאות מצביעות על לפחות 3 חדירות חול לנגב הצפון-מערבי בהתאם לגוון. יחידות החול השונות עברו עירוב ואף שיכוב אחת מעל לשנייה. תיארוך TL של יחידות החול השונות יוכל לקבוע את התזמון של חדירת החולות לנגב הצפון-מערבי במשך הרביעון המאוחר.

מודל לחיזוי תגובת ערוצי נחלים בתשתית אלוביאלית לשינויים במפלס ים המלח

בן-משה ל. [1], אנזל י. [1], זילברמן ע. [2]

1. המכון למדעי כדור הארץ, האוניברסיטה העברית, גבעת רם, ירושלים 91904
2. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים 95501

הבעיה של תגובת נחלים הזורמים על תשתית אלוביאלית לשינוי גובה בסיס הסחיפה נחקרה ע"י חוקרים רבים ובגישות שונות (אמפיריות, כמותיות, פיזיקליות, וכו'). אזור ים המלח מהווה מעבדת שדה יחודית לבחינת הבעיה, עקב שינויי המפלס הקיצוניים שארעו בו במהלך ההיסטוריה, ביחוד במאה האחרונה, תגובתם המהירה של הנחלים הנשפכים אליו, זמינות המידע, ועקומות מפלסים מפורטות. רוב העבודות שנעשו עד כה באזור הציגו תמונת מצב, ולא עסקו בחיזוי המשך תגובת הנחלים. ע"י שילוב של גישות אמפיריות וכמותיות, התאפשרה בנייתו של מודל לחיזוי תגובת פרופילי האורך של הנחלים השונים לשינויים בבסיס הסחיפה, המבוסס על משוואת הדיפוזיה של סדימנט. ע"י שימוש בדיפוזיה כאנלוג לתהליכים המתרחשים בנחל, בהם מועבר חומר במורד הנחל ממקטעים תלולים למקטעים מתונים, ניתן לפשט את מורכבותה הרבה של המערכת ההידרולוגית ותלותם של המשתנים בה זה בזה ובגורמים חיצוניים.

המחקר התבצע על 8 נחלים הנשפכים לחלקו הצפוני של ים המלח, במקטע שבין חוף ים המלח לכביש 90. כביש זה מהווה נקודת נקע ובסיס סחיפה מקומי, אשר מונע את מעבר השפעת השינוי בבסיס הסחיפה למעלה. נבחרו נחלים בהם הייתה מינימום התערבות אנושית, שנמצאו בהם טרסות שאריתיות, והמייצגים תכונות פיזיוגרפיות ומורפולוגיות שונות (שטח מניפות, אורך הנחל ממזרח למצוק העתקים, בטימטריה מול המניפה). לצורך כיול המודל ואימותו שוחזרו פרופילי האורך של נחלים אלו בשנים שונות. שחזור זה התבצע ע"י מיפוי טרסות הנחל הקדומות ומדידת פרופילי האורך שלהן. גיל הטרסות שוחזר ע"י מדידת גובה קו החוף אליו הן מתלכדות והתאמתו לעקום מפלס ים המלח, ובמידה ולא נשארו שרידים מקו חוף זה, ע"י תצלומי אויר. המיפוי והמדידה בשטח התבצעו ע"י מכשיר GPS דיפרנציאלי.

הפרמטרים שהוזנו למודל הם עקומת מפלס ים המלח, מיקום קו החוף בכל שנה (שוחזר ע"י תצלומי אויר), ופרופילי האורך המשוחזרים. בשלב הכיול נמצאו מקדמי הדיפוזיה ושטפי הסדימנט המגיעים אל מקטע הנחל שמתחת לכביש 90 ממעלהו, ע"י הרצתו בין פרופילי אורך משנים שונות. בשלב האימות הורץ המודל עם המקדמים הללו בין שנים אחרות ונבדקה התאמת הפרופיל החזוי לפרופיל המדוד או המשוחזר לשנת המטרה.

הראנו באמצעות מבחני האימות למודל, כי המערכות מתנהגות בקירוב טוב באופן דיפוזיבי, וכי אנלוג זה מייצג את תהליכי ההתחתרות וההשקעה כתגובה לשינוי גובה בסיס סחיפה בצורה לא רעה. ניתוח התגובה של נחלים בעלי מאפיינים גיאולוגיים, הידרולוגיים ומורפולוגיים שונים, מאפשר את בחינת השפעתם של המשתנים ההידרולוגיים השונים על תגובתם לשינוי בסיס סחיפה, ויתרום להבנת הרקורד הגיאולוגי כפי שהוא משתקף בטרסות נחלים קדומות ובמניפות דלתאיות. המודל יוכל לשמש לתכנון ארוך טווח של תשתיות וככלי נוסף בקביעת מדיניות השימור של אזור ים המלח.

C14 ו-Be10 בים המלח המודרני - אפליקציות פליאוהידרולוגיות

בלמקר ר.[1] לזר ב. [1] יחיאלי י. [2] שטיין מ. [2]

1. המכון למדעי כדור הארץ, האוניברסיטה העברית בירושלים, ירושלים 91904
2. המכון הגיאולוגי, רח' מלכי ישראל 30, ירושלים 95501

במחקר זה נבחנה ההתנהגות הגיאוכימית של האיזוטופים הקוסמוגנים Be^{10} ו- C^{14} במערכת ההידרולוגית של ים המלח המודרני מתוך המחשבה שמכיוון שלאיזוטופים אלו מנגנון יצירה דומה אך התנהגות גיאוכימית וקצב פירוק שונה הבנת הקשרים הגיאוכימיים ביניהם תאפשר את יצירתו של כלי פליאוהידרולוגי.

שינויים במידת אוורור קרקעית ים המישאש, קמפאן, קרטיקון עליון, על פי פורמניפרים בנתונים.

אשכנזי ש. [1,2], אדלמן-פורסטנברג י. [1], לוי ז. [1], בינימיני ח. [2], אלמוגי-לבין א. [1]

1 המכון הגיאולוגי, מלכי ישראל 30, ירושלים 95501
2 המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון-בנגב, ת.ד. 653 באר שבע 84105

במהלך הקמפאן, ישראל הייתה חלק מחגורת upwelling שהתקיימה בשוליים הדרום-מזרחיים של התטיס, מערכת זו מאופיינת ביצרנות ראשונית גבוהה עם ריכוזי חמצן נמוכים בקרקעית הים. ע"פ הפורמניפרים הבנתונים ניתן לקבוע מספר רמות אוורור, ברזולוציה גבוהה מהידוע כיום, בסלעי הקרבונט העשירים בחומר אורגני מפרט הפוספט של תצורת מישאש בטווח הדיסאוקסי עד אנאוקסי.

טקטוניקה רבת פזות בפורמציות האקון מסביב לבאר שבע

בהט ד.

המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד. 653 באר שבע 84105

יותר מעשרים אירועי שבירה נבדלים של סדוקים והעתקה זוהו במחשופים שבסינקלינות באר שבע והשפלה. תצפיות אלו מהוות בסיס לשתי קלסיפיקציות. הראשונה, לחמש קטגוריות של סידוק לפי המחזור הגיאולוגי: קבורה, טקטוניקה מקסימלית, הרמה ופוסט-הרמה. בנוסף, סדוק של השכבה העליונה בלבד - תהליך עכשווי. השניה דנה בעשרה סוגים של יחסי-שדה של העתקה-וסדוק.

'סדקים מוקדמים' בסלע משקע ובסלעים גרניטיים.

בהט ד.

המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן גוריון בנגב, ת.ד. 653,באר שבע 84105

עבודות שונות הראו 'סדקים מאוחרים' (בקטגוריות טקטוניקה מקסימלית, הרמה, ופוסט-הרמה) מתנהגים באופן דומה בסלעי משקע ובסלעים גרניטיים. אולם, סביר להניח ש'סדקים מוקדמים' יתנהגו באופן שונה לחלוטין, כיוון שאין זה הגיוני שסדקי קבורה בסלעי-משקע יתנהגו בדומה לסדקים הנוצרים בעת התקררות המגמה בתנאים שונים לחלוטין. למרות זאת, תצפיות מראות דמיון ניכר בין שתי קבוצות סדוק אלו.

יישום מדידות רעש רקע להערכת עומק שכבה מחזירה: מדידות והשוואה

אקסיננקו ט., זסלבסקי י., מיקנברג מ., ג. אטייב, מ. גורשטיין, מ. יזרסקי, מ. קלמנוביץ', נ. פרלמן, י. ליבשיץ, ו.גילר, י. דן, ד. גילר, א. שוורצבורג

המכון הגיאופיסי לישראל, ת.ד 182 לוד 71100

מדידות רעש רקע בשילוב עם שיטת חישוב יחס ספקטראלי אופקי לאנכי שימשו לשחזור מבנה תת-קרקע. השוואה בין מיפוי שיכבה מחזירה על בסיס מדידות עם מפה סטרוקטוראלית של גג חבורת יהודה בין כפר סבא ובין לוד גילתה הבדלים משמעותיים בנוגע להערכת עומקה של שכבה מחזירה.

היבטים מעשיים של הערכת תגובת האתר

ארז א. א.

יועץ גיאוטכני, רחוב קריניצי 80, רמת גן 52601

תגובת אתר המופקת רק מסימולציה סובלת מליקויים, הן של הנתונים למודל והן של הקודים הקיימים. הפקה מסיסמומטריה באתר היא ישירה יותר אם כי חסרה בדרך כלל דגימת רעידה חזקה, פיזור התוצאות ניכר וקיימות מגבלות אתר שונות. הערכה עדיפה מופקת ע"י מודל שמותאם גם למידע הגיאולוגי-גיאופיזי-טופוגרפי וגם לתוצאות סיסמומטריה באתר.

המערכת הפעילה של שבירה-שוניות-סדימנטים בראש מפרץ אילת.

אריאלי ר.[1], מקובסקי י.[1], עגנון א.[2], בן אברהם צ.[1], רשף מ.[1]

1. החוג לגיאופיסיקה ומדעים פלנטריים, אוניברסיטת תל אביב, ת.ד 39004 רמת אביב 69978
2. המכון למדעי כדור הארץ, האוניברסיטה העברית, גבעת רם, ירושלים 91904

מטרת עבודתנו היא לימוד התפתחות קרקעית הים באילת. אנו מציגים תוצאות עדכניות מניתוח נתוני החזרה אקוסטיים ברזולוציה גבוהה שנאספו לאורך חופי אילת ב-2002. אנו ממפים רצועת שוניות מאובנות שנוצרו כפי הנראה כאשר פני הים היו נמוכים בכ-15 מ. שתי מערכות שבירה עוברות בערך במקביל לקו החוף המערבי ונראות פעילות.

הערכה מחדש של מבנה "דלתה" במדף היבשת של ישראל: בחינת תהליכים נאו-טקטוניים והקשרם לחתך העמוק.
לוין ד., בן-אברהם צ., רשף מ., בן-גיא י. 17

סווג מסת סלע למנהור – דוגמאות מעבודות בארץ ואתגרים לעתיד
לוין מ. 18

המערכת הקרבונטית הימית באזור אכזיב : ניתוח סדימנטרי ופאוניסטי
לזר ש., אלמוגי-לבין א., בנימיני ח., בוכבינדר ב. 18

מאזני המים, מלח ואנרגיה של ים המלח
לנסקי נ.ג., דבורקין י., לייחובסקי ו., גרטמן א., גבריאלי א. 19

יחסי תנודות קרקע בישראל
מאירוב ט., הופשטטר ר. , בן אברהם צ., ושטיינברג ד. 19

עוקבים כסמנים לתנועת מי תהום והסעת חלקיקים באזור ים המלח
מגל ע., ויסברוד נ., יחיאלי י. 20

תפקידי המפתח של הגיאולוג בשימור הארץ ובפיתוח המושכל שלה
מזור ע. 20

עדות ליחס לא קבוע בין אנרגיה ומומנט סייסמי בעזרת ספקטרה של גלי קודה
מיידה ק., גוק ר., וולטר ו., הופשטטר ר. 20

יציבות חללים תת קרקעיים והתפתחותם בהקשר לבורות בים המלח
מימון א., לייחובסקי ו., עגנון א., אבלסון מ. 21

התאמת פונקצית תגובת אתר ניסיונית בעזרת אלגוריתם שייק
מיקנברג מ., זסלבסקי י. 21

השפעת אופי המגע בין גרגרים על התכונות המכניות של סלעים סדימנטרים
מנור ש., פלצ'יק ו., יוסף ח. חצור. 21

אינטרפרומטריה של מחזירים קבועים (PSInSAR) – יישום שיטה חדשה למדידת מעוות של פני השטח באזור חיפה והעתק הכרמל
נוביצקי ר., בר ג., אייל י., שמיר ג. 22

אירועי סרפנטיניזציה עוקבים באופיוליט טרודוס: רקורד איזוטופי לתהליכי פתיחה אוקיאניים ותהליכי הצבה מאוחרים
נוריאל פ., קציר י., אבלסון מ., ואלי ג'.וו, מתיוס א. 22

בעיות פתוחות בהערכת סיכוני רעידות אדמה במפרץ חיפה
סלמון ע. 22

תוכן עניינים

נחמן עמד בתחרות עם מרצים כריזמטיים, על לבם של התלמידים, ואלו נתנו בו את אמונם כשבחרו בו למדריך ומנחה בעבודות מתקדמות. כאן השקיע את רוב מרצו (גם כשלא היה מדריך פורמאלי) בעבודות בתחומים רבים ושונים, וזאת בלא לקבל "תמורה" של פרסום.

מפעל חייו הגיאולוגיים של נחמן היה המחקר בעמק הירדן. עבודת הגמר ב-1957, שהורחבה לעבודת ד"ר ב-1962, ואח"כ למספר רב של עבודות שהתבססו עליהן, והמשיכו אותן, ובהן הגיאולוגיה של בית שאן, טבריה, קריית שמונה ועוד. בהיותו בר סמכא מרכזי לידע הגיאולוגי של האזור היה שותף טבעי למחקרים אחרים: הקוורטר של עמק הירדן, חפירות תל עובדיה, וההידרולוגיה של עמק הירדן.

במהלך הקריירה שלו השתתף נחמן במפעלים ומיזמים שונים שהיו מרכז ההוויה הגיאולוגית של אותן שנים: מיפוי הנגב, חיפושי נפט ומים, המוביל הארצי, פרויקטים הנדסיים כדוגמת סכר נחל איילון, היתכנות להקמת תחנת כוח גרעינית בניצנים ובשבטה, וסיוע בין לאומי בחיפושי מים באקוודור. לאחר מלחמת ששת הימים היה ראשון למתעניינים ברמת הגולן בהיבטים הסטרוקטורליים, הסטרטיגרפיים והוולקניים. לפתע התברר כי נחמן מיפה את רמת הגולן במשך שנים רבות קודם לכיבושה, וכך גם היה לגבי שטחים נרחבים בגדה המערבית.

נחמן היה איש רעים בחיצוניות מאופקת, ובהופעה דקדקנית. אבל למי שרצה לקבל ממנו – הרבה לתת . הוא עמד במרכזן של כמה מחלוקות שהיוו ציר מרכזי לפעילות של תקופתו. רק אחת מהן, על טבעה של ההעתקה בגליל, נתגלגלה בצורה מסודרת לספרות. המחלוקת המרכזית, על אודות ההעתקה האופקית שבבקע הירדן, הייתה בעיקרה מחלוקת על פרטים, וחבל שלא תועדה. מחלוקת הזו הייתה קשה לו במיוחד, שכן שלט ברזי תורת תנועת הלוחות המתגבשת לכלל משנה סדורה, וטען שאכן התנועה האופקית בבקע מתחייבת מתורה זו. תלמידיו ומשתתפי סיורים שהדריך (כדוגמת הסיור בכנס הסדימנטולוגי בשנת 1978) זכו להרבצת תורה סיסטמטית וביקורתית, שאין בה שמץ של ניסיון לטיוח.

נחמן היה אנציקלופדיה מהלכת. היה בעל ידע ייחודי בענפים רבים ושונים של הגיאולוגיה, עליו שמר גם לאחר יציאתו לגמלאות. השיעור האחרון ששמעתי ממנו היה בסתיו 2002, על אודות הגיאולוגיה של צפון מזרח קזחסטן. לימים התברר כי המקום היה חשוב לו במיוחד, כשכן שארית משפחתו ניצלה מן השואה בגלות לאזור זה.

נחמן הצר על שלא השאיר אחריו הרבה ספרים וכתבים. זמן רב ניחם את עצמו שהנצחתו – בתלמידיו, אחריהם עקב באופן כמעט חשאי (במחתרת...).

תלמידיו ישאו את זכרו עמם לתמיד.

יוסי ברטוב

נחמן שולמן - דברים לזכרו

נחמן נולד בשנת 1919 בבסרביה, ועלה ארצה ב-1939 אחרי חברות בתנועת "ביתר" ופעילות ציונית, באוניית מעפילים. הוא החל בלימודי כימיה באוניברסיטה העברית, ובמקביל פעל בשורות הלח"י, עד לפרישתו בעקבות המשא ומתן עם הגרמנים בסוריה.

בשנת 1942, בעקבות אירוע שלא היה מעורב בו, הוקצב על ידי הבריטים פרס על ראשו אשר פורסם בעיתונות. הוא נתפס ע"י הבולשת, והוגלה לאריתראה ואח"כ לקניה, שם ישב במעצר עד 1948. לאחר הקמת המדינה שוחרר, חזר ארצה, והצטרף לפלמ"ח. לאחר פירוק הפלמ"ח שרת בגולני, והגיע לתפקיד מ"פ.

את ההכרות הראשונה שלו עם מקצוע הגיאולוגיה עשה בעת המעצר, שם למד בהתכתבות. לאחר שחרורו מצה"ל החל לעבוד בחברת תה"ל, אצל פרופ' בוריס אייזנשטיין, עוד בטרם חזר ללימודיו הפורמליים. עם שובו לאוניברסיטה, אל המחלקה לגיאולוגיה ההולכת ומוקמת, נקשר למוסד, תחילה כתלמיד, ואחר כך הצטרף לשורותיה ועבד בה כמורה וכחוקר, עד פרישתו לגימלאות ב-1989.

נחמן נחשב לתלמידו המובהק של פרופ' ליאו פיקרד ולעוזרו הנאמן. נחמן היה יד ימינו של פיקרד במישור המנהלי, וסייע לו סיוע לוגיסטי ומקצועי. עד מהרה היה למוציא ולמביא גם בנושאי ההוראה, שם עמדה לו למדנותו המופלגת והשכלתו רחבת האופקים. לאחר שסיים את לימוד הדוקטורט והיה למרצה ברשות עצמו, התבלט כמורה מתמיד, מעודכן יצירתי וחדשני. הוא הקפיד להביא לתלמידיו את חידושי המדע בסטרטיגרפיה, גיאולוגיה סטרוקטורלית, טקטוניקה וולקנולוגיה, וגיאולוגיה הנדסית, תוך שהוא מנחיל להם גם שפע של מיומנויות טכניות: שימוש בתצלומי אוויר, שליטה בטכניקות של מפות וחתכים, ומיפוי גיאולוגי בשדה. נחמן הקים מסגרות של מחנות לימוד, ובהם מחנה מיפוי למתקדמים בעזרת שולחנית, ו"מיפוי בודדים", והדריך בהם במשך שנים רבות.

דו"ח כספי לשנת 2004

הכנסות				
העברה משנת 2003				6,156.15
		מזומן (קופה קטנה)	1,050.00	
		עו"ש בבנק הפועלים	5,106.15	
השתתפות בכנס				159,260.97
		השתתפות בכנס 2004	158,810.97	
		חובות מכנס 2003	450.00	
דמי חבר				73,339.00
	10	חברי כבוד	0.00	
	95	סטודנטים/פנסיונרים	17,859.00	
	148	רגיל	55,480.00	
סה"כ	247	חברים		
תרומות				14,500.00
		אוניברסיטת תל-אביב	2,000.00	
		אוניברסיטת באר שבע	5,000.00	
		האוניברסיטה העברית בירושלים	5,000.00	
		מנהל מדעי האדמה, משרד התשתיות	2,500.00	
		ועדת לאור	0.00	
שונות				17,860.00
		מכירת חולצות בכנס הגושרים	3,860.00	
		תשלומים עבור החסעות	4,500.00	
		החזר מקרן פרץ גרדר ז"ל על תשלומי חברה עבור שנים קודמות	3,000.00	
		מקדמות לסיור סיני	6,500.00	
		סה"כ הכנסות		271,116.12

הוצאות

כנס				165,198.10
		אירוח במלון הגושרים	102,301.20	
		ביטוח סיורים	3,400.00	
		הסעות לכנס ולסיורים	12,800.00	
		הפקת חוברות תקצירים וסיורים	26,325.00	
		החזר עבור ביטולים	1,520.00	
		פרס פרץ גרדר ז"ל לשנת 04 וסיום תשלום עבור שנת 02	1,500.00	
		מתנות	8,442.00	
		הדפסת חולצות כנס הגושרים למכירה	3,976.00	
		שונות	4,933.90	
ימי עיון וסיורים				6,620.00
		פרחים ליום עיון - טקטוניקה	120.00	
		תשלום מקדמה לאקו טורס לסיור סיני	6,500.00	
עיתון מדעי האדמה				64,272.00
		דפי לייזר - שנת 2004	64,272.00	
		(לפי $65 * 250 חברים)		
אתר אינטרנט				22,452.89
		פיתוח, תפעול ותחזוק האתר	17,452.89	
		סגירת חוב - תחזוקת אתר אינטרנט 02-2001	5,000.00	
הוצאות תפעוליות				2,227.36
		עמלות בנק	255.66	
		רואה חשבון	0.00	
		הוצאות משרדיות	1,971.70	
		סה"כ הוצאות		260,770.35
העברה לשנת 2005				
		עו"ש בבנק הפועלים	10,345.77	
		מזומן (קופה קטנה)	0.00	
		סה"כ		259,692.12

חברי ועדת הביקורת

שמואל מרקו

רמי וינברגר

הנצחת פרופ' יעקב בן תור

החברה הגיאולוגית, החליטה להציע למועצה המקומית במצפה רמון להנציח את זכרו של פרופ' בן תור באמצעות קריאת הרחוב העולה למרכז המקרים במצפה רמון על שמו: "מעלה בן תור". המיקום המיוחד מהווה הנצחה הולמת לפועלו של בן תור אשר פעל במכתש רמון, ובנגב כולו, במחקר הגיאולוגי ובפעילות הגיאולוגית-כלכלית. טקס הסרת הלוט מעל אבן ההנצחה יתקיים בפארק הסמוך למרכז המבקרים במצפה רמון, בחסות החברה הגיאולוגית והמועצה המקומית מצפה רמון, ויחתום את הכנס השנתי של החברה הגיאולוגית לשנת תשס"ה.

העיתון הישראלי למדעי האדמה

בסוף שנת 2004 הגיעה לסופה תקופת הכהונה של העורכים הראשיים של העיתון, פרופ' אלן מטיוס ואהובה אלמוגי – לבין. החברה הגיאולוגית מביעה בזאת את תודתה העמוקה לפועלם של העורכים הראשיים במהלך שנות כהונתם. החברה הגיאולוגית מברכת את העורך הראשי החדש של העיתון, פרופ' יוסי מרט, בשנות כהונה פוריות.

פרס החברה הגיאולוגית ע"ש ד"ר פרץ גרדר ז"ל

הפרס יוענק השנה לשתי עבודות:

אורית סיון – על עבודת הדוקטור שלה בנושא: "התהליכים העוברים על פחמן 14 במי חללים ובמי תהום מלוחים: דיאגנזה, הסעה ודעיכה"

אדווה אביטל – על עבודת הגמר שלה בנושא: "שחזור ההיסטוריה הגיאולוגית של דרום מדף היבשת בפליוקן העליון, בפליסטוקן ובהולוקן עפ"י סדימנטים ופאונה מקידוחים ימיים באשקלון"

פרס החברה הגיאולוגית ע"ש פרופ' רפי פרוינד ז"ל

הפרס יוענק השנה לשלושה מחברים: גידי שטייניץ, בני בגין, נעמה גזית-יערי על עבודתם:

Statistically significant relation between radon flux and weak earthquakes in the Dead Sea rift valley, *Geology* V. 31, no. 6, p. 505-508, 2003.

מדלית החברה הגיאולוגית

ועדת המדליה החליטה להעניק את מדלית החברה הגיאולוגית לשנת 2005 לדר' אבי שפירא על עבודתו רבת השנים בהקמת הרשת הסיסמולוגית הארצית, המאפשרת היערכות ניאותה של מדינת ישראל בכל הקשור לסיכון הסיסמי באזורנו ומהווה בסיס למחקר עתידי.

פרסי החברה יוענקו במושב הפתיחה החגיגי של הכנס השנתי.

פעילות החברה הגיאולוגית לשנת תשס"ד – תשס"ה (2005 - 2004)

סיור סיני

השנה עמדה החברה לקיים סיור מקצועי למזרח סיני בהדרכת פרופ' משה איל בין התאריכים 10 – 14 לאוקטובר, 2004. תכנית הסיור הוכנה לפרטים כולל כל הלוגיסטיקה הקשורה בכך. לסיור נרשמו 30 חברים. בעקבות אתראה חמורה של מערכת הביטחון לגבי אפשרות לפיגוע טרור כנגד מטיילים ישראלים בסיני, הוחלט לבטל את הסיור.

יום עיון בנושא ההתפתחות הטקטונית של ישראל מהקרטיקון העליון ואילך, תמונת מצב ופערי מידע: יום עיון מיוחד של החברה הגיאולוגית לזכרו של דר' נחמן שולמן.

השנה הסתלק מאתנו מורנו היקר דר' נחמן שולמן. החברה החליטה לקיים יום עיון מיוחד לזכרו של נחמן בנושא טקטוניקה של ישראל והלבנט. עודד בר-פרגו ארגן את יום העיון. ביום העיון הרצו חוקרים מהאוניברסיטאות ומכוני המחקר בישראל. הכינוס התקיים באוניברסיטת בן-גוריון בתאריך 4 לנובמבר, 2004, ונכחו בו כ – 140 חברים מכל רחבי הארץ. במסגרת יום העיון הוצגו העבודות הבאות: צבי גרפונקל – ההתפתחות הטקטונית של ישראל; צבי בן-אברהם – מבנה תת הקרקע של ישראל; יוסי ברטוב – שברי הרוחב ובקע ים-המלח בדרום ישראל; עזרא זילברמן ורני קלבו – הפעילות הטקטונית בישראל בניאוגן; חגי רון – הפעילות הטקטונית בצפון ישראל; יואב אבני – הפעילות הטקטונית בנגב מסוף המיוקן ואילך; יהודה איל – התפתחות שדות המאמצים בישראל; אמוץ עגנון – רעידות אדמה עתיקות וטקטוניקה צעירה; עמוס סלומון - סיסמוטקטוניקה של ישראל וסביבותיה; יוסי מרט – בקע הלבנט: האנטומיה של אוקיינוס עוברי.

דברים לזכרו של דר' נחמן שולמן מופיעים בהמשך.

יום מדעי כדור – הארץ

בתאריך 12 לדצמבר, 2004 התקיים יום מדעי כדה"א הרביעי במספר במכון דוידסון לחינוך מדעי במכון ויצמן למדע ברחובות. כותרת היום הייתה: "מדעי כדור הארץ בשירות החברה – כשארכיאולוגיה פוגשת גיאולוגיה". בכינוס הוצגו ההרצאות הבאות: יואב אבני – סלע, נוף, ואדם בהר הנגב ב – 2 מיליון השנים האחרונות; סטיב רוזן – בחינת הקשר שבין שינויי אקלים והתמוטטות חברתית על רקע ממצאים מהארכיאולוגיה; נעמי פורת – מתי זה קרה – תיארוך אתרים ארכיאולוגיים ופרהיסטוריים; סטיב ווינר – ארכיאולוגיה באמצעות מינרלוגיה; אמוץ עגנון – עדויות גיאולוגיות לרעידות אדמה היסטוריות; דורית סיוון – התמורות בסובב בחוף הכרמל וזיקתם להתיישבות האדם ב – 10,000 השנה האחרונות; צביקה צוק – מפעלי מים עתיקים בסלע; יובל גורן - קביעת מוצאן של תעודות עתיקות מהמזרח הקרוב הכתובות על גבי חומר (חרסית); שמוליק מרקו – רעידות אדמה בעבר – לקח לעתיד; יואל רק – אבולוציית האדם ותפקיד השבר הסורי אפריקאי ביציאת אפריקה הראשונה.

כנס החברה הגיאולוגית הישראלית

הכנס יתקיים בכפר הנופש משאבים אשר בקיבוץ משאבי שדה בין התאריכים 5 – 7 לאפריל 2005. לכנס נרשמו 175 חברים והוגשו 131 תקצירים. בכנס יתקיימו 104 הרצאות בשלושה מושבים מקבילים, ובנוסף יהיו שני מושבי מליאה, אחד אשר יוקדש להרצאות חתני הפרסים והשני מושב הרצאות מוזמנות של אורחים מחו"ל. ביום השלישי של הכנס יתקיימו שישה סיורים מקבילים. הכנס ינעל בטקס הקדשת מעלה בן תור במצפה רמון.

חברי ועדת פרס החברה הגיאולוגית ע"ש ד"ר פרץ גרדר ז"ל לשנת 2005:

יוסי חצור, דב אביגד, עמוס ביין

חברי ועדת פרס החברה הגיאולוגית ע"ש פרופ' רפי פרוינד ז"ל לשנים 2004-2005:

יוסי חצור, אהובה אלמוגי- לבין, אמוץ עגנון, שמוליק מרקו, שמעון פיינשטיין

חברי ועדת המדליה של החברה הגיאולוגית לשנת 2005:

יוסי חצור, עודד נבון, רונית נתיב

מנהל הקרן ע"ש ד"ר פרץ גרדר ז"ל - רני קלבו

ועדת ביקורת - שמוליק מרקו ורמי וינברגר

החברה הגיאולוגית מודה לרבקה עיני, ארי מלכסון, שלומית יובל, ושחר כורם על עזרתם בארגון הכנס והכנת חוברות התקצירים והסיורים.

החברה הגיאולוגית הישראלית מודה למוסדות הבאים על השתתפותם ותרומתם לכנס החברה בכפר הנופש משאבים:

- מכון צוקרברג לחקר המים, אוניברסיטת בן גוריון בנגב
- הפקולטה למדעי הרוח, אוניברסיטת חיפה
- המכון למדעי כדור הארץ, האוניברסיטה העברית בירושלים
- המחלקה למדעי הגיאולוגיה והסביבה, אוניברסיטת בן-גוריון בנגב
- US-AID (Middle East Research Cooperation Project, MERC)
- רותם אמפרט נגב בע"מ
- משרד התשתיות הלאומיות
- האגף לקשרי ציבור, אוניברסיטת בן-גוריון בנגב
- הפקולטה למדעים והוראתם, אוניברסיטת חיפה
- המכון הגיאולוגי
- המכון הגיאופיסי לישראל
- מועצה אזורית רמת נגב

חברי ועד החברה הגיאולוגית לשנת 2004-2005:

- נשיא - יוסי חצור
- סגנית נשיא - מרים בר- מטיוס
- מזכירה - סיגל אברמוביץ
- מרכז פעולות - מיקי גרדוש
- גזברית - ענת ברנשטיין
- מנהל אתר אינטרנט - איליה וינשטיין
- חבר - מיכאל צסרסקי

הפקה: סטודיו אפרת 2000 (02-6522144)
עיצוב הגרפיקה: נאוה מוסקו

התמונה בגרפיקה: נחל צין
צילום: דני מיכליס

תקצירים

5-7.4.2005

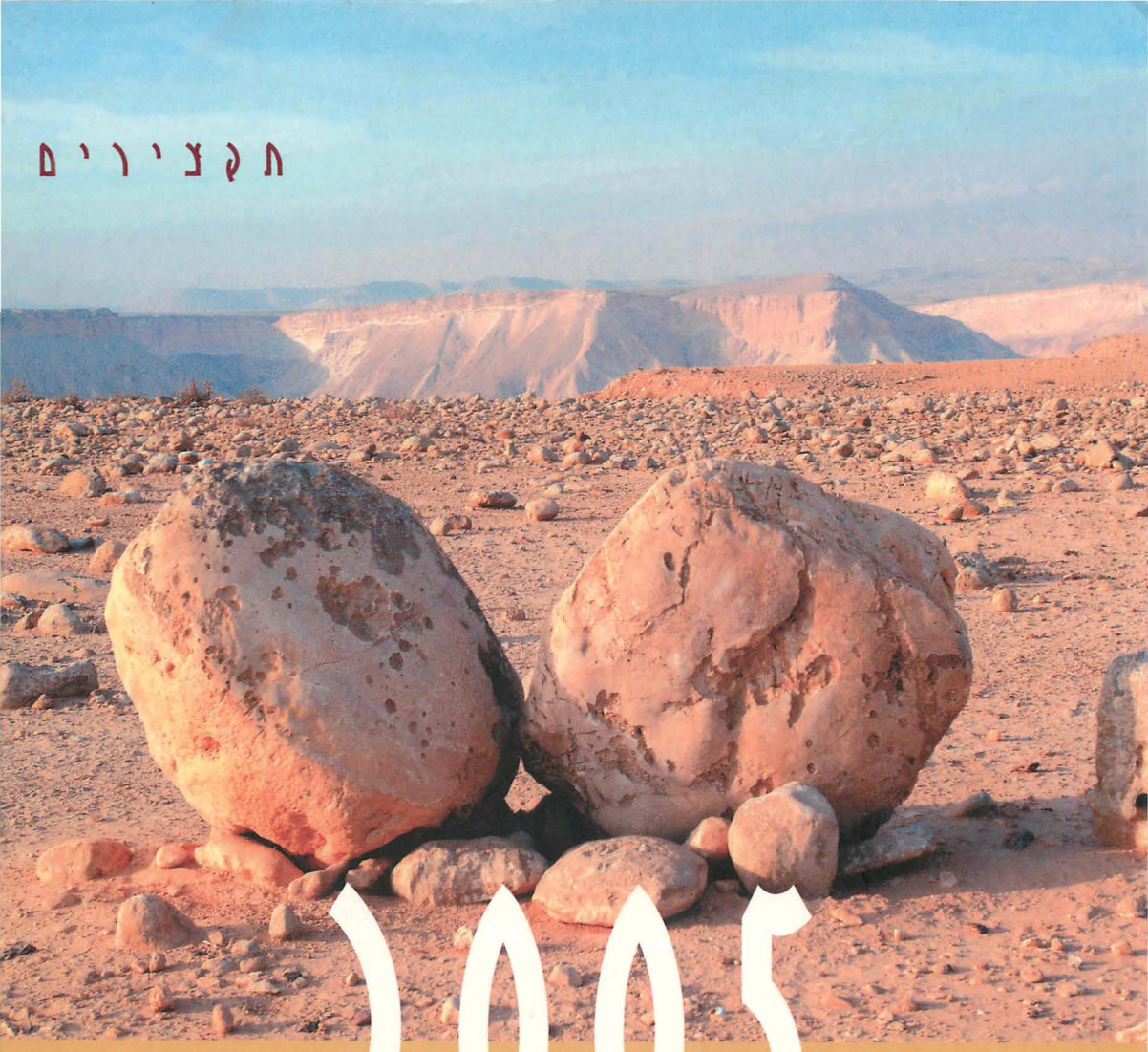
2005

החברה הגיאולוגית הישראלית
הכנס השנתי

עריכה: סיגל אברמוביץ

משאבים

תקצירים



2005

החברה הגיאולוגית הישראלית
הכנס השנתי

מטעמים