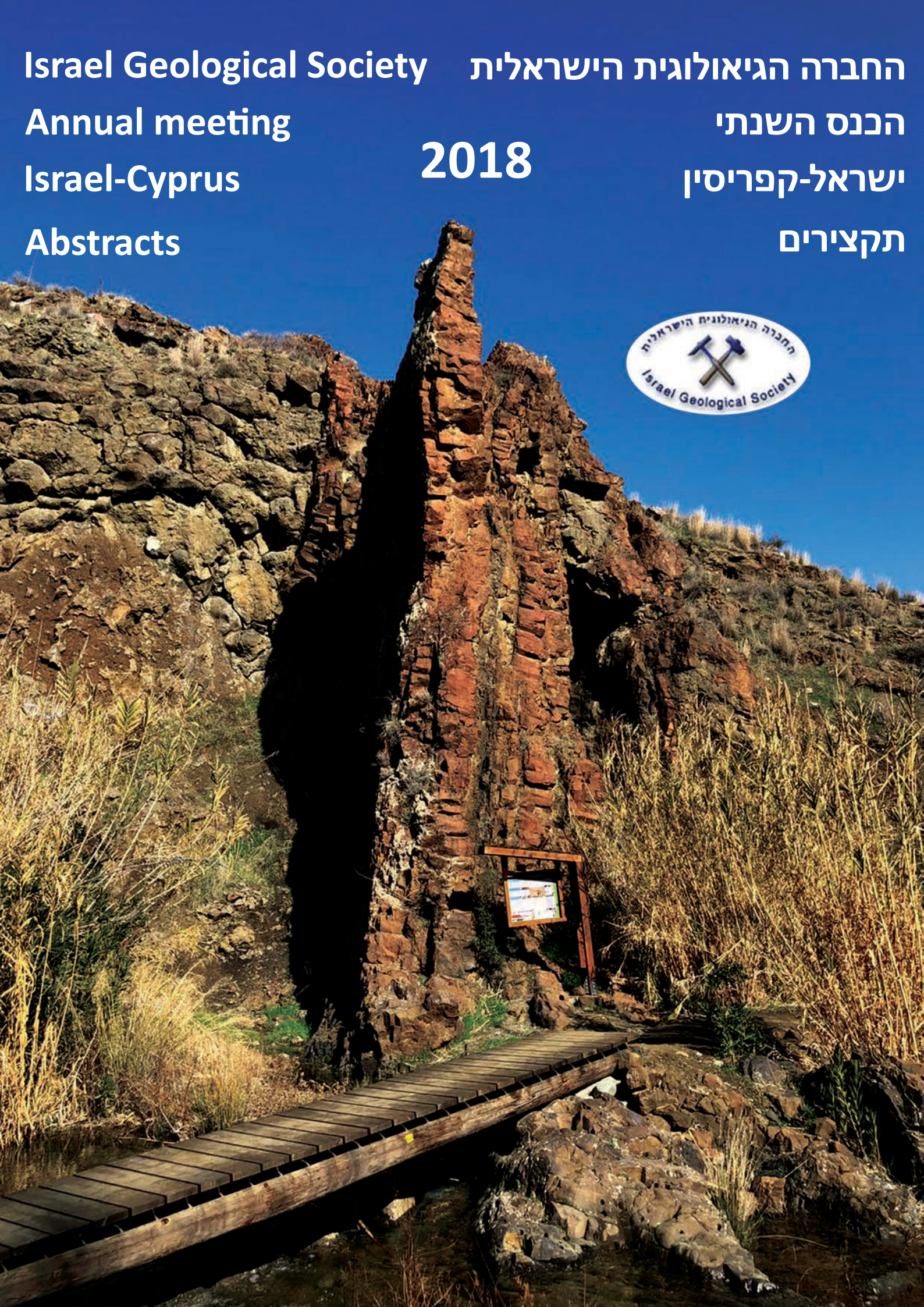
Israel Geological Society
Annual meeting
Israel-Cyprus
Abstracts

החברה הגיאולוגית הישראלית
הכנס השנתי
ישראל-קפריסין
תקצירים

2018



כנס החברה הגיאולוגית 2018

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ישראל-קפריסין
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חוברת תקצירים
Abstracts

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אביהו גינצבורג 1926-2017

צבי בן אברהם ומשה רשף

פרופסור אביהו גינצבורג נולד בישראל בשנת 1926. למד גיאולוגיה באוניברסיטה של מערב אוסטרליה, שם סיים את לימודיו בשנת 1952. כשחזר לארץ, הצטרף לפרוייקט ניסיוני בגיאופיזיקה שימושית בהובלת פרופסור פקריס ממכון וויצמן. מטרת פרוייקט ראשוני זה היתה לבחון ולהכין את הכלים הדרושים לחיפושי נפט במדינה הצעירה. במסגרת פעילותו בקבוצה, היה אביהו אחראי על המיפוי הגרבימטרי של ישראל אותו סיים בשנת 1957. במקביל, היה מעורב בבדיקות הראשוניות של טכנולוגיות סיסמיות שונות בתחום הרפלקציה והרפרקציה. בשנת 1959 הופרד הפרוייקט ממכון וויצמן ועבר למסגרת חדשה – המכון הגיאופיזי, בו שימש אביהו כמנהל המקצועי. בתקופה זו המשיך לעסוק במחקר אותו השלים במסגרת עבודת הדוקטורט בהדרכתם של הפרופסורים פיקארד ופקריס. את תואר הדוקטור קיבל אביהו במשותף מהאוניברסיטה העברית וממכון וויצמן בשנת 1961.

במסגרת עבודתו במכון הגיאופיזי עסק אביהו בחיפושי מים, מינרלים ונפט בארץ ובחו"ל, כאשר הוא משלב פעילות אקספלורציה זו בפעילות מחקרית בתחומים אלו. בשנות השישים של המאה שעברה, היה אביהו אחראי לקליטתן של מערכות מודרניות לאיסוף ועיבוד נתונים סיסמיים שהוו את הבסיס לפעילותו הענפה של מה שהפך להיות המכון למחקרי נפט וגיאופיזיקה (IPRG). בתקופת פעילותו במכון שמר על קשריו עם הקהיליה האקדמית בארץ ואף לימד קורסים בתחום הגיאופיזיקה בטכניון, באוניברסיטה העברית ובאוניברסיטת תל-אביב. בשנת 1971 סיים אביהו את תפקידו כמנהל המכון הגיאופיזי והצטרף לסגל האקדמי של המחלקה לגאופיזיקה באוניברסיטת תל-אביב.

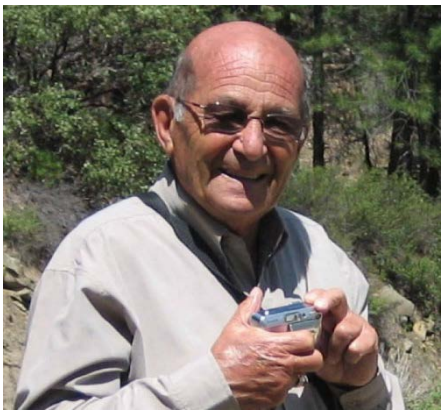
כאיש סגל באוניברסיטה, הקים פרופסור גינצבורג קבוצת מחקר חזקה בתחום הגיאופיזיקה השימושית. עיקר מחקריו בתקופה זו עסקו בהגדרת ומפוי קרום כדוה"א. במסגרת מחקרים אלו הוא יזם וביצע מספר סקרי רפרקציה בכל שטחי הארץ, סיני והאגן המזרחי של הים התיכון. אביהו שרת מספר שנים כראש החוג לגיאופיזיקה וכראש המרכז לחקר ים המלח באוניברסיטת תל-אביב. בנוסף להיותו יועץ לחברות נפט בארץ ובעולם, התארח אביהו במספר מכוני מחקר בינלאומיים

ביניהם המכון האוקינוגרפי הבריטי והמכון הגיאולוגי האמריקאי, בהם עסק במחקרי הקרום היבשתי והאוקינוס האטלנטי. בין קשריו האקדמיים ראוי לציין את היותו פרופסור אורח באוניברסיטת המבורג, שם הוביל מחקרים רבים במזרח האוקיינוס האטלנטי, הים התיכון ויבשת אירופה.

לאחר פרישתו לגימלאות בשנת 1995 המשיך אביהו לשמש כיועץ לחברות נפט מקומיות ובינלאומיות. כהמשך לפעילותו האקדמית כתב ספר לימוד בסיסי בגיאופיזיקה בשפה העברית. הספר '*מבוא לגיאופיזיקה*', יצא לאור בהוצאת האוניברסיטה הפתוחה.

אליעזר קשאי 1922-2018

אורי וולף, חיים שולמן ולוריאן פליישר



דר' אליעזר קשאי נולד בבודפשט, הונגריה, ושרד את מחנות העבודה הגרמניים באוסטריה בתקופת השואה. עם תום המלחמה החל את לימודי הגיאולוגיה ועם סיומם עלה לישראל בשנת 1949. סמוך לעלייתו החל לעבוד במכון הגאולוגי ובמחלקה לגיאולוגיה של האוניברסיטה העברית בראשותו של פרופ' י. ל. פיקרד. במסגרת עבודתו זו מיפה את פרוזדור ירושלים וזוכה בתואר מוסמך. שירת בחיל המודיעין כגאולוגי ועסק במיפוי אזורים שונים בנגב.

בשנת 1953 החל את פעילותו בתחום חיפושי הנפט בחברה קנדית, ישראל-קונטיננטל, במיפוי אזורים בהר הכרמל ובמספר קידוחים. בשנת 1959 עבר לעבוד בחברת לפידות כסגן גיאולוג ראשי ועסק בפיתוח שדה חלץ ושדה כוכב. במהלך עבודתו השלים את מלאכת מיפוי הכרמל ובגינה קיבל תואר דוקטור בשנת 1966.

בשנת 1968 ניהל את תנופת חיפושי הנפט שהחלה בעקבות מלחמת ששת הימים כגיאולוג ראשי, ובשנת 1970 נבחר לנשיא החברה הגיאולוגית. במסגרת חיפושים אלו נערכו אלפי קילומטרים של קווים סייסמיים במרחבי צפון סיני, רצועת עזה ומדף היבשת. במסגרת הקידוחים הרבים נמצא שדה הגז 'שדות' בצפון סיני, וכן מספר שדות נפט וגז קטנים בקרבת אשדוד, צוק תמרור ושיקמה. עבודה נרחבת זו שימשה ומשמשת עוד כעת כבסיס נתונים עצום להבנה מעמיקה של הגיאולוגיה של ישראל וסביבותיה בתת הקרקע.

את שנות עבודתו האחרונות במסגרת הממשלתית הקדיש לקידום חלומו הגדול – מציאת נפט בים המלח. עבודה זו הביאה לקידוח סדום עמוק 1, אך לא הניבה את הממצאים המצופים. לאחר פרישתו מחברת הנפט הלאומית החל לעבוד בחברת 'שדות נפט' ולאחר מכן בחברת 'ציון' בחיפושי נפט באזור הכרמל ובית שאן, שם עבד עד לפרישתו בהגיעו לגיל 91.

אליעזר הותיר אחריו דור גדול של גיאולוגים ומאגר ידע מקיף שיכול להמשיך ולסייע למאמץ חיפושי הנפט ולניהול משק המים. עם מותו בגיל 96 הגיע לסיומו פרק מפואר בתולדות המעש הגיאולוגי בישראל. יהי זכרו ברוך!

תומכי החברה הגיאולוגית בשנת 2018

חקר ימים ואגמים לישראל
Israel Oceanographic & Limnological Research

מחצבי אבן בע"מ

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Contents

Mapping Israel's LGM Coastline and Active Faults from 3D Offshore Seismics

Algon R. (1), Medvedev R. (2), Agnon A. (1)

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2. Schlumberger Petroleum Services, Parkstraat 83 Den Haag, the Netherlands.

The location of Israel's coastline during the last glacial has been inferred by fitting the global sea-level curve to Mediterranean bathymetry, assuming it has not changed. Thus, the coastline was set on the eustatic depth of the last glacial maximum. Accounting for sediments deposited since then, the coastline is actually buried; direct evidence for its location have never been produced. Global glaciation resulted in a global sea level drop of ~120 m, and westward migration of Israel's western coastline. The sea level changed little for millennia, until deglaciation caused an abrupt rise.

Interpretation of high resolution 3D seismic surveys (time-depth migrated) allows identification of the ancient coastlines, horizons and faults in the Eastern Mediterranean. Interpretation was facilitated by Schlumberger's PetrelTM and its unique attributes. The coastlines traverse pinch-out points per the stratigraphic sequence. A coastline likely from the last glacial peak is buried under tens of meters of sediment, and up to 100 m water depth. An epicenter closely coincides with a number of faults displacing both the ancient and the current seafloor, indicates activity on some faults. Reconstructing ancient coastlines constrains a reliable model, predicting conditions and processes that occurred during sea level lowstands.

Integrated geophysical and engineering-seismological investigations for solving geotechnical problems

Aksinenko T., Ronen A., Gatenio B., Ezersky M., Tahan S., Beck A.

Geotec, Engineering & Environmental Geophysics LTD, Rishon Lezion, 7502501

In most cases, to solve engineering and geological problems one geophysical method is performed. The possibilities for integrated geophysical and engineering-seismological investigations have been demonstrated on the site planned for the establishment of the Eilat Golf Neighbourhood. The complex geophysical methods included: MASW (Multichannel Analysis of Surface Waves), seismic refraction of S-wave and P-wave, seismic reflection and ambient noise measurements. Measurements of the MASW, seismic refraction and ambient noise near boreholes were carried out. These three surveys together, provided a correct thickness and shear-wave velocity values of the layers in the top 30m. The ambient noise measurements allowed to obtain the subsurface 1-D models to the depth of the main reflector. Along the seismic reflection lines, measurement of ambient noise was also carried out at four sites. For each site investigation the 1-D model was obtained. These subsurface 1-D models were used to create a 2D-velocity model that was used for data processing (stacking, migration and time-depth conversion). Geological interpretation of seismic reflection data was carried out. Stratigraphic boundary and faults were identified. The subsurface models were used as input for computing of Uniform Hazard Site-Specific Acceleration Response Spectra at the investigated sites. The calculation was made in accordance with the Israeli Standard code 413.

Imaging and Modeling of Authigenic Carbonate Precipitation at Seafloor Methane Seepage Sites, Offshore Israel

Alter Y. (1), Makovsky Y. (1), Katsman R. (1), Foubert A. (2)

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2. University of Fribourg, Department of Geosciences – Earth Sciences section, Chemin du Musée 6, 1700 Fribourg, Switzerland

Authigenic carbonate precipitation is a by-product of hydrocarbon seepage, where Anaerobic Oxidation of Methane occurs. Past studies show that there is a link between cold seeps and disturbed sediment surfaces. However, authigenic carbonate precipitation has not yet been fully resolved in offshore Israel. The selected study area, the Palmahim Disturbance and its surrounding, is characterized by several unique features including: Pockmarks, Deep sea corals, Chemosynthetic communities, Carbonate mounds, Nile Fan ridges and the Levant Turbidite Channel. The objective in this study is to investigate the subsurface precipitation process of authigenic carbonates observed in the western part of Palmahim Disturbance, during the 2016 SEMSEEP cruise. We want to characterize the subsurface morphology of bioturbated and bioirrigated sediment associated with methane seepage area, and to correlate between extensive burrowing and seepage areas using indirect analysis of the seafloor sediments. The study will be carried out by 12 sediment box cores; about half sampled from methane gas seepage areas. CT scans were performed on at least one sub-core taken from each box core, allowing characterization of burrow morphology in each core and the comparison between seepage and non-seepage related sediments. Following will be image processing, including artifact removal and segmentation to distinguish between voids and solid phase. This segmented image, combined with geochemical parameters, measured during the cruise, will be used in a numerical model that will investigate the sensitivity of authigenic carbonate precipitation in seepage related sediments to various physical parameters. Thus, understanding processes contributing to Anaerobic Methane Oxidation and its consequences around cold seeps is a very significant environmental issue.

Ground Penetrating Radar (GPR) used in engineering practice of Israel - case histories

Beck A., Ezersky M., Ronen A., Aksinenko T., Gatenio B., Tahan S.

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Ground-penetrating radar (GPR) is a geophysical method that uses radar pulses to image the subsurface. This nondestructive method uses electromagnetic radiation in the microwave band (UHF/VHF frequencies) of the radio spectrum, and detects the reflected signals from subsurface structures. GPR can have application in a variety of media, including rock, soil, ice, fresh water, pavements etc. Among all the high resolution geophysical methods, GPR has been proven as the most suitable method for detection of underground cavities preceding to surface collapse and sinkholes formation, in a wide range of soil and rock conditions GPR uses high frequency (usually polarized) radio waves. Usually in the range of 10 MHz to 2.6 GHz. GPR transmitter emits electromagnetic energy into the ground. When the energy encounters a buried objects or boundary between materials having different permittivity or dielectric constants (e), it may be reflected or refracted or scattered back to surface. A receiving antenna (that can be placed in the same unit as transmitter) can then record the variations in the return signal. Main formulas are: Propagation speed: $V = c/\sqrt{e}$, Reflection coefficient: $K = (\sqrt{e2} - \sqrt{e1})/(\sqrt{e2} + \sqrt{e1}$, Interface depth: $s = v * t/2$, where c = speed of light in vacuum; e = dielectric constant; t = propagation time. One can see parameters of GPR methods depends mainly from dielectric constant *e* and its difference in layers divided by studied boundary. In this paper we present case histories GPR application in Israel for resolving different problems such as search of karstic caves, buried graves, prediction of sinkhole hazard along the Dead Sea shore, investigation of engineering tunnels. 2-D and 3-D techniques are described.

Influence of water load on earthquake recurrence interval at strike-slip faults, and the role of hydromechanical fault properties

Belferman M. (1), Katsman R. (1), Agnon A. (2), Ben-Avraham Z. (1)

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2. Institute of Earth Sciences, The Hebrew University, Jerusalem, 91904

Tectonic motion is addressed as a primary cause of the earthquakes. Can water level fluctuations of order of hundred meters affect local fault systems in a way that modify the behavior of the seismic cycle? Our novel theoretical modelling can explain variability in the paleoseismic rates of large earthquakes at strike-slip faults, by large-scale water level fluctuations at basins overlying the faults. We demonstrate that water level increase can significantly affect fault stability, generate the immediate and delayed seismic responses, and accelerate seismic events. Fault stability and the decrease in seismic recurrence interval due to the large-scale water level fluctuations, predicted by our study, are significantly affected by interplay between hydro-mechanical properties of the rocks composing the fault. Considering the water level fluctuations of pre-historic lakes at the Dead Sea basin, our simulations show a promising agreement with paleo-seismic rates identified in the field at the Dead Sea fault.

Nuclear explosion monitoring at the Israel National Data Center

Ben Horin Y., Bregman Y., Radzyner Y., Tikochinsky G., Shemesh Z., Bettan M.

Israel NDC, Soreq Nuclear Research Center, Yavne 81800, Israel

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an international treaty that imposes a prohibition on nuclear explosion testing. Enforcement of the treaty is ensured by means of global monitoring networks based on four technologies (seismology, infrasound, hydroacoustics, and radionuclide) and onsite inspection mechanisms.

The Israel National Data Center (NDC), which operates within framework of the CTBT, was established at the Soreq Nuclear Research Center in 1994. The Israel NDC serves as a national scientific center of expertise for CTBT issues and it represents the State of Israel in the international institutions of the CTBT Organization (CTBTO). As part of its mission, the NDC is responsible for the operation of two CTBTO seismic stations (MMAI and EIL) and radionuclide laboratory.

During its years of operation the NDC concentrated on seismic and infrasound monitoring including network and station design, location algorithms, event characterization and waveforms analysis. Examples of the research done at the NDC: design of Mount Meron seismic and infrasound arrays, seismic events discrimination using machine learning methods, magnitude recalibration, interferometric synthetic aperture radar application for seismic event characterization, infrasound and seismic data fusion. Many of those works were carried together with the Geological Survey of Israel, Tel Aviv University, the Geophysical Institute of Israel and other institutions. We shall present the cooperation possibilities between the NDC and the Israel Geophysical research community including research funding.

Miocene Normal Faulting in the Bet Shean Area as Indicated by the Megiddo-Jezreel 1 Well

Buch-Leviatan, O. (1), Roter-Shindler L. (1), Politi M. (1,2)

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2. Institute of Earth Sciences, The Hebrew University, Jerusalem 91904, Israel

The Megiddo-Jezreel 1 exploration well, drilled by Zion Oil & Gas, Inc., and spud on 5 June 2017, is located near Kibbutz Sde Eliyahu, in the Bet Shean Valley. During the drilling operation, consecutive lithological and paleontological samples were collected and interpreted. In addition, a check shot survey and logs were run. Using these data, the stratigraphy of the well was reestablished. Furthermore, a synthetic seismogram was calculated, which enabled to tie and correlate the stratigraphy of the well with local seismic data. In its shallow portion, this well penetrated a few hundred meters of Recent to Miocene sediments. The Miocene Hordos Formation was found to directly overly the lower part of the Judea Group. This indicates a stratigraphic gap of the entire Avedat and Mount Scopus Groups, and much of the Judea Group. There are two different explanations of the stratigraphic gap, one posits that the stratigraphic gap results from an extensive erosional surface and/or a combination of faulting and erosion. The second explanation is that the stratigraphic gap results from a fault with hundreds of meters of magnitude. We suggest that this stratigraphic gap is a result of Miocene outfaulting and downthrowing to the east by a few hundred meters. The Gesher, Bira and Hordos Formations change their thickness on either side of the fault, thereby showing that they were deposited syn-tectonically to the fault. This interpretation supports the assumption that the fault is probably the most western fault of the Dead Sea Transform in the Beit Shean area and located slightly more west than previously assumed.

CO2 balance in the unsaturated zone of Nizzanim: input (roots), outputs diffusion (to the atmosphere) and dissolution (into the soil water)

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The major input of CO_2 in the unsaturated zone (USZ) is exhalation from plants roots, which varies annually between seasons. For a given month (m), there are three processes in the USZ that define the quantity of CO_2 remaining there: input from root exhalation, dissolution in the soil water to form dissolved inorganic carbon (DIC) and diffusion out to the atmosphere above. In March 21, 2013 a sediment core was collected in Nizzanim to 4 m depth. From this core the DIC was measured. On the same site soil gas was collected at 7 levels (0.3, 0.6, 0.9, 1.2, 4, 6 and 10m) between September 2013 and June 2014. CO_2 in the soil gas was measured and seasonal variations were detected, and 2 major sources were found at 4 and 10 m depths. From the gradient between 0.3m and the surface, the diffusion of CO_2 out from the USZ was calculated. For the date of the drilling the results of diffusion, soil gas and DIC were:

Diffusion between the beginning March to the date of the drilling, frrom 1 m^2 surface, 8 g (DF_m). Soil gas from the 1 m^2 surface to 4 m depth at the date of the drilling, 8 g (SG_m). Soil gas remains from the previous period in the 1 m^2 surface to 4 m depth at the date of the drilling from (SG_{m-1}). Soil gas production in the USZ in the present period at the time of the drilling (SGP_m).

Total DIC in the soil water at the time of the drilling between the1 m^2 surface and 4 m depth, 22 g (DIC_m). SG_m is the balance between the production SGP_m + the remains of soil gas from the previous month SG_{m-1}, and diffusion DF_m and dissolution (DIC_m) Thus $SG_m = SGP_m + SG_{m-1} - DF_m - DIC_m$ $8 = SGP_m + SG_{m-1} - 8 - 22$ so that $SGP_m + SG_{m-1} = 38$ on March 21, 2013. Assuming that the remains are the same in neighboring periods the production the production is 30 g.

Deciphering falling groundwater levels and uplift phases of the western shoulder of Dead Sea transform using U-Pb geochronology of speleothems

Chaldekas O. (1), Vaks A. (2), Haviv I. (1), Nuriel P. (2).

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Carbonate speleothems (chemical cave deposits) can form under phreatic or vadose conditions. Phreatic speleothems form below the groundwater level and incrust the walls, floor and ceiling of the cave by uniform calcite overgrowth whereas vadose speleothems form above the groundwater level and precipitate as dripstone and flowstone. A cave that contains both types of speleothems records a temporal transition from phreatic to vadose conditions. The timing of such a transition indicates a drop in the groundwater level in the vicinity of the cave - potentially driven by key triggers such as climatic or hydrologic shifts, uplift and incision. In this study we utilize novel LA-ICP-MS U-Pb geochronology of speleothems to date this transition in seven caves systems stretching along a 150 km north-to south transect along the western margin of the Dead Sea Transform (DST) plate boundary. Our initial results include 42 speleothems samples from which 110 thin sections were prepared. Preliminary U-Pb ages from the central Negev (Ma'ale Ha-Meyshar) indicate that the earliest precipitation of phreatic speleothems at 450-510 m asl took place in the late Miocene (~8-9 Ma) whereas the earliest precipitation of vadose speleothems occurred around ~4 Ma and continued intermittently until the late Pleistocene. Phreatic speleothems from Shimshon and Hartuv Caves, located in central Israel (Judean Mt.) at elevations of 400-430 m asl, yield U-Pb ages of Middle to Late Miocene (~12-13 Ma), marking the earliest phreatic precipitation in this region. The deposition record of the speleothems dated so far constitutes one of the longest records we are aware of in the eastern Mediterranean and opens the door to exciting paleo studies of the Neogene period. The implications of this record in terms of uplift of the Dead Sea western margin will be explored soon as more ages become available.

Redistribution of coarse gravel following shelf exposure and cross-shelf fluvial incision: Field observations from the Dead Sea

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Global sea level lowstands can expose vast areas of the continental shelf and occasionally trigger exposure of the shelf edge and continental slope. Although the limited connectivity of the fluvial system to the regressing shore influences the fluvial evolution of the newly emerged landscape, studies which focus on real-time natural processes are rare. Here we examine channel response to the Dead Sea lake level fall using a time-series of LiDAR-derived high-resolution elevation models, aerial imagery, field mapping and grain size analysis. The response we document include cross-shelf channel incision, sediment redistribution and alluvial fan progradation. We determine the timing and the critical slope for the onset of transport of coarse gravel that traverses the shelf and record an intensification of the coarse sediment flux with increasing fluvial gradients at the evolving knickpoint. The critical Shield's stress for incipient motion of coarse gravel on mud can be constrained using the unique field conditions at our sites. The calculated values appear to be similar or higher than the critical shield's stress over gravel bed. This may suggest that mud cohesion increases the shear stress required for gravel incipient motion. The settings and the processes we observe, and record are an analogue to fluvial processes during sea level lowstands, which coincide with glacial maxima or unique episodes such as the Mediterranean Sea level fall during the Messinian. In view of our observations, we suggest that continental margins worldwide should be characterized by high spatial and temporal variability of sediment routing patterns, depending on continental margins geometry and the local hydrological conditions.

Evaluation and mapping of Dead Sea coastal aquifers salinity using Transient Electromagnetic (TEM) resistivity measurements

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Evaporite karst has intensively developed recently along the Dead Sea (DS) coastal area in Israel and Jordan. It takes place in very saline groundwater dissolving buried salt layers and causing collapse of the surface. In this paper, groundwater salinity throughout the DS coastal area is investigated using Transient Electromagnetic (TEM) method. Twenty-eight TEM soundings along the DS coastal area were carried out close to observation boreholes to calibrate resistivity – salinity relationships. Groundwater electrical conductivity was measured in these boreholes, and its salinity was analyzed at the laboratory by the Geological Survey of Israel (GSI). Quantitative relationships between bulk resistivity ( ), water resistivity ( ) and chloride concentration ( ) were derived in the resistivity range less than 1.0 that enabled to evaluate the salinity of aquifer in situ conditions. Average effective porosity of sandy sediments =0.32 and silty ones = 0.44 were used to generate corresponding Archie's equations. The study has shown that DS aquifer with bulk resistivity of 0.55-1.0 contains in pores brine with 50 – 110g/l chloride (22 – 50% of saturated conditions, respectively), i.e. it keeps the potential to dissolve up to 114– 174 g/l salt. The study was carried out in framework of the USAID project.

Negev Precariously Balanced Rocks – stability analysis of in-situ rock pillars and initial implications for seismic hazard studies

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Precariously Balanced Rocks cannot withstand strong ground motion. When a strong earthquake occurs in their vicinity they are likely to break or topple. By evaluating the stability of PBRs and determining their age, it is possible to constrain the maximum PGA that has occurred at PBR sites during their life time. This methodology has been proven as effective in determining the maximal earthquake magnitude of faults around the world and has been applied to improve both deterministic and probabilistic seismic hazard analysis. In the Negev, slender, in situ rock pillars constitute a particularly important subset of PPRs as their seismically induced motion may be amplified. This amplification occurs in pillars with a natural frequency of 1-10 Hz, corresponding to seismic wave frequency which is predominant away from the source rupture of earthquakes. The motion of such pillars may be complex with an initial stage of resonance swaying motion followed by toppling or failure of a weak layer or crack. In case of base failure, the pillar may initiate rocking motion before toppling or failing or regaining its stability. An analysis of plausible pillar motion based on its dimensions and structural characteristics indicates that certain slender pillars are likely to experience resonance motion leading to toppling or failure. Non-slender pillars have a high natural frequency and therefore are not likely to experience resonance motion, and on the other hand, extremely slender pillars are more likely to topple before experiencing resonance motion. In the Negev, two pillars that were found to be ~10,000 years old, were used to explore potential implications for constraining the maximum magnitude of earthquakes along the Negev-Sinai Sear Zone faults and the Arava Fault. We show that assuming a plausible amplification of motion,

the pillar analysis may yield strong constraints on fault seismicity parameters and may indicate a need to re-evaluate ground acceleration maps. Ongoing dating and stability analysis of PBR and pillars may therefore provide important new insights for regional seismic hazard studies.

Validating the Tsunami Propagation Model Geoclaw, Based on the 1995, Mw7.2 Nuweiba Earthquake

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The tsunami reported after the strong Mw7.2 1995 Nuweiba earthquake, together with prehistoric tsunami deposits (tsunamites) found along the head of the Gulf of Elat-Aqaba (GOA) and the adjacent Red Sea, emphasize the natural hazard there. The Gulf is located along the southern part of the Dead Sea Transform, which is an active system that generates frequent strong and destructive earthquakes. The presence of a water body inside the Gulf increases tsunami potential by submarine earthquakes and landslides. Here we investigate the 1995 Nuweiba tsunami and validate our numerical model, as part of the preliminary evaluation of tsunami hazard along the Head of the Gulf. First, we constructed the bathymetry and topography grid for the Gulf. Next, we adopted the GeoClaw tsunami modeling program, which can solve 2D depth-averaged shallow water equations, simulate wave propagation and compute tsunami wave heights and inundation. We then simulated the 1995 Nuweiba tsunami and produced time series of the expected wave height in several artificial gauges along the northern part of the Gulf. Based on various models of the source parameters of the 1995 Nuweiba earthquake, four different scenarios were simulated. The results were then compared with field evidence, eyewitness reports and the recorded mareogram, as well as with the numerical model. Overall, the results show relatively small waves, in the order of and in accordance with field observations, the recorded mareogram and the numerical model. The findings provide profound validation of the GeoClaw model. The methodology and outcomes of this work lay down the foundation for a thorough and systematic evaluation of the tsunami hazard in this area.

The LDPM Micro-Parameters for Mechanical Analysis of Brittle Materials

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The mechanical response of brittle materials, such as rock and concrete, is complex and as other composite materials, multiscale modelling has the potential for modeling its macroscopic behavior. In this presentation an upscaling methodology for the modelling of the concrete/rock mechanical properties, the Lattice Discrete Particle Model (LDPM) will be presented. The suggested formulation starts from a known chemical and mechanical set of parameters of the cement paste, which are used to evaluate the mechanical properties of the LDPM concrete mechanical parameters. The parameters are divided to groups, which are related to different damage modes such as: pore collapse and material compaction, cohesive behavior, and shear behavior. For each group of parameters, a set of microscopic simulations are performed to complete the up-scaling methodology.

Negev Precariously Balanced Rocks – Online data base and interactive analysis tools for long-term fault activity and seismic hazard studies

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Precariously Balanced Rocks (PBRs) cannot withstand strong ground motion. If a strong earthquake occurs in their vicinity they are likely to break or topple. By evaluating the stability of PBRs and determining their age, it is possible to constrain the maximum peak ground acceleration (PGA) that has occurred at PBR sites during their life time. This methodology has been proven as effective in evaluating the maximal magnitude on faults and fault systems around the world, and has been applied to improve both deterministic and probabilistic seismic hazard analysis. In the Negev, slender, in situ rock pillars may constitute a particularly important subset of PBRs as their seismically induced motion may be amplified. Amplification occurs in pillars with a natural frequency of 1-10 Hz, corresponding to seismic wave frequency which is predominantly away from the source rupture of earthquakes. We introduce an interactive online tool being designed to enable effective access and contribution to the growing Negev PBRs database, and to perform stability analysis and initial evaluation of the natural frequency of rock pillars. The online interface will enable any collaborator or scientist, interested in the methodology and its implications regarding Negev faults, to explore and derive seismic implications based on various constraints and focused on any site or fault in the Negev. For example, researchers will be able to search and analyse specific PBRs and rock pillars by different criteria such as lithology, age and location, or to add new data and automatically get output of the impact of this data on peak ground acceleration map or as a constrain on a fault's maximal magnitude. Hence, as more scientist will use, promote this tool and add knowledge to its database, better understanding will be gained regarding seismic hazards in southern Israel. The methodology and web infrastructure are easily adjustable to include other localities in Israel and abroad.

Earth Sciences in the Hevel Eilot Regional Council: An Account from the Mayor's Journal

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The Hevel Eilot Regional Council covers an area of 2630 km^2, 13% of the territory of the State of Israel. This area includes a very diverse range of rocks and landscapes because the Dead Sea rift is located in the eastern part of the council, and because the area is hyper-arid, therefore, the rocks are completely exposed. Twelve settlements are found within the regional council, and local economic endeavors are primarily based on agriculture, tourism and renewable energy. The Council's actions in the following areas are related to Earth Sciences: A. Intelligent exploitation of natural resources in the area such as allocating land for agriculture and mining B. Intelligent management of floodwater and groundwater C. Earthquake preparedness D. Long-term planning: masterplans for agriculture, tourism and open spaces E. Promotion of renewable energy in an area with high solar radiation F. Innovation in education G. Cooperation with regional research institutes that promote Earth Sciences research On a personal note: Since June 2016, I have been serving as Mayor of the Council and chairman of the Arava Drainage Authority. In these positions, I often encounter the field of Earth Sciences, and my professional background in geology, hydrology and education, as well as my familiarity with the region and the processes occurring within it help me to manage these processes and make intelligent decisions. These decisions are very important for the positive development of the Eilot region.

Event identification and source parameter evaluation based on phenomena of linear superposition and interference effect in seismic and acoustic waves from explosions

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In some cases of man-made explosions, the event identification analysis and evaluation of source parameters are based on linear superposition and interference of induced seismic and acoustic waves from multiple sources in time and space and spectral analysis of seismic records. Coherent spectral minima and maxima in seismic signals from ripple-fired quarry blasts, observed at local network stations at different azimuths and distances, were explained and analyzed using the principle of linear superposition and interference theory. A similar spectral modulation for seismic records from underwater explosions was revealed and interpreted as an interference effect caused by gas bubble pulsations. This approach has an evident application in discriminating between earthquakes and explosions. The Low-Frequency Spectral Modulation (LFSM) method for discriminating quarry blasts and underwater explosions from local earthquakes was developed based on the spectral semblance statistic for smoothed amplitude spectra of seismic waves at different stations. Due to the interference modulation effect, the spectra are coherent, providing high semblance values, in distinction from earthquake spectra. An interesting and poorly known phenomenon in air-blast waves was observed at seismic and acoustic sensors during the Sayarim large-scale calibration surface explosions: superposition of Main Shock and Secondary Shock (SS), where the arrival time difference was dependent on charge weight, distance and type of explosives. The new shock wave parameter – the SS delay – was introduced, and a novel empirical relationship was developed, providing a simple and cost-effective method of the TNT yield estimation. One of the main advantages of this method is that it does not require an expensive high-pressure gauge system placed at near-source distances, that should be protected from the blast impact; the SS delay is easily measured by any simple low-cost sensor, deployed at remote location. The method is used for forensic studies of explosion accidents. One

more application of the interference effect was utilized for identification and source parameter estimation of underground nuclear tests. Teleseismic P-wave records from recent North Korean tests were analyzed and clear coherent spectral minima at 1.2-1.3 Hz were found in observations at ISN stations. It was shown that this is a clear source and not site-effect, by using the records in a broad azimuthal range: similar minima with about the same frequency were revealed in this data. A previous analysis of ISN data for nuclear tests in China, Russia, India and Pakistan showed quite different minima frequencies (~1.7 Hz). Therefore, this effect was interpreted as the well-known phenomenon of destructive interference between down-going P-wave energy and the pP-wave reflected from the Earth's surface. This approach was applied for accurate source depth estimation of North Korean tests. This seismic spectral feature can be used for reliable discrimination of shallow nuclear explosions from deeper earthquake sources.

Permian to Quaternary magmatism beneath the Mt. Carmel area, Israel: Zircons from volcanic rocks and associated alluvial deposits

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Zircon is an excellent tracer of the timing and nature of magmatic activity; this also applies when magmas remain in the upper mantle or deep crust, where they can be sampled by later eruptive magmas. Lam-ICPMS U-Pb dating of xenocrystic zircons from Cretaceous pyroclastic vents on Mt Carmel, N. Israel, documents two major periods of earlier mafic magmatism: Permo-Triassic (285-220 Ma) and Jurassic (200-160 Ma). Related alluvial deposits contain these zircon populations, but most alluvial zircons are Cretaceous (118-80 Ma) or younger. Permo-Triassic-Jurassic zircons are typically large and glassy, with irregular shapes and a variety of internal zoning patterns. They appear to have grown in the interstitially in coarse-grained rocks (cumulates, peridotites); many show evidence of recrystallization, including brecciation and rehealing by chemically similar zircon. Igneous-looking grains have mantle-like $d^{18}O$ (5.5±1 ‰; SIMS analysis), but brecciation leads to lower values (mean 4.8‰, down to 3.1‰). Hf-isotope compositions (*in situ* LA-MC-ICPMS) lie between the CHUR and Depleted Mantle (DM) reservoirs; Hf model ages suggest that the source region separated from DM in Neoproterozoic time (1000-500 Ma). Most Cretaceous zircons have $^{176}Hf/^{177}Hf$ values like those of the older zircons, suggesting recrystallization in the Cretaceous thermal event. Trace-element patterns (LA-ICPMS) of Permo-Jurassic zircons are consistent with crystallization from a range of alkaline rocks; they resemble zircons that crystallized from plume-related magmas (Iceland, Hawaii). Calculated melts in equilibrium with Permian to Cretaceous zircons show strong depletion in LREE and P, large positive Ce anomalies, variable Ti anomalies, and high and variable Nb, Ta, Th and U, consistent with the fractionation of monazite, zircon, apatite and Ti-bearing phases. We suggest that these zircons crystallized from

differentiates of mafic magmas, ponded near the crust-mantle boundary (*ca* 30 km depth), and were reworked by younger igneous/metasomatic fluids.

The zircon data support a published model which locates a fossil Neoproterozoic plume head beneath much of the Arabia-Levant region, that has been intermittently melted to generate the volcanic rocks of the region. The Cretaceous magmas carry mantle xenoliths derived from depths up to 90 km, providing a minimum depth for the magma source. Post-Cretaceous magmatism, as recorded in detrital zircons From the Kishon River, shows distinct peaks at 30 Ma, 13 Ma, 11.4±0.1 Ma (a major peak; n=15), 9-10 Ma and 4 Ma, representing the Lower and Cover Basalts in the area. Some of these magmas tapped the same mantle source as the Permian-Jurassic magmatism, but many young zircons also have Hf-isotope compositions extending up to DM values, suggesting derivation of magmas from deeper, more juvenile sources. The zircon data clarify the evolution of drainage patterns in the Lower Galilee and help to refine the source-to-sink exploration model for the gemstone placer deposits of the Kishon River Mid-Reach.

Intra-Messinian truncation surface in the Levant Basin explained by subaqueous dissolution

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The Messinian salinity crisis (MSC) is an extreme event in Earth history during which a salt giant accumulated on the Mediterranean seafloor within ~640 k.y. Erosional unconformities extending from the continental margins into the deep basins are key features for reconstructing the MSC; however, the nature of the erosional processes and their subaerial versus subaqueous origin are highly controversial. This study focuses on the top erosion surface (TES) in the deep Levant Basin, which is notably flat, truncating a basinward-tilted Messinian evaporitic succession. Based on high-resolution seismic surveys and wireline logs, we show that (1) the TES is actually an intra-Messinian truncation surface (IMTS) located ~100 m below the Messinian-Zanclean boundary; (2) the topmost, post-truncation Messinian unit is very different from the underlying salt deposits and consists mostly of shale, sand, and anhydrite; and (3) the flat IMTS is a dissolution surface related to significant dilution and stratification of the water column during the transition from stage 2 to stage 3 of the MSC. Dissolution occurred upslope where salt rocks at the seabed were exposed to the upper diluted brine, while downslope, submerged in the deeper halite-saturated layer, the salt rocks were preserved. The model, which requires a stratified water column, is inconsistent with a complete desiccation of the eastern Mediterranean Sea.

Israel Oceanographic and Limnological Research– Goals and Activities Overview

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Israel Oceanographic and Limnological Research (IOLR) is a national research institution (non-profit governmental corporation for the benefit of the public) that was established in 1967 by the Israeli Government with the mission of generating knowledge for sustainable use and protection of Israel's marine, coastal and freshwater resources. IOLR staff conduct scientific research in the fields of oceanography, limnology, mariculture and marine biotechnology. IOLR aims to play a major role in the long-term planning and sustainable development and preparation for natural and anthropogenic hazards in the marine and lakes environment. Increasing use of marine resources in recent years, such as development of energy resources and infrastructure, freshwater production and security, maritime commerce, conservation and more, highlight the urgency of meeting these objectives and their importance. IOLR researchers provide scientifically based recommendations to governmental offices on issues such as conflicting uses of the marine environment; ecological deterioration of Kinneret and marine waters and ecosystems stability in response to climate change, decreased fresh water supply, declining lake level, increased residence time, salination, toxic blue-green algae blooms, increasing demand for drinking water in Israel and Jordan; increased environmental pressure caused by the rapid development of various types and spatial scales along the shores of the Israeli Mediterranean, Gulf of Eilat and neighboring countries as well as its exclusive economic zone.

Currently, the two northern units of IOLR, the National Institute of Oceanography in Haifa and the Kinneret Limnological Laboratory have a total staff of 119 employees. Of these, there are 34 PhDs, 22 of which are principle investigators. Each year approximately 60 graduate students (MSc and PhD) from different Israeli Universities are supervised by IOLR researchers. In addition, approximately 6400 school children (elementary to high-school level) are instructed within the IOLR youth outreach programs every year. Over the past years IOLR scientists have published a multiannual average of 70 pier reviewed scientific papers per year and have been conducting over

60 research projects that are funded by competitive grants from Israel and abroad as well governmental institutions with a total funding of 18 million NIS/year. In addition to other research activities, IOLR researchers are focusing on the following main activities:

- The Israeli National monitoring program of Mediterranean waters – This program has been expanded during the last year to include the entire exclusive economic zone as well as meeting the new requirements for Good Environmental Status in the Ecosystem Approach adopted by the Barcelona Convention.
- The Kinneret monitoring network – state of the ecosystem assessment and its water quality; impact assessments of extreme conditions' scenarios, climate change, and implications of the import and export of water from the lake.
- Completion of the baseline survey and revision of the strategic environmental survey in the exclusive economic zone of Israel in the Mediterranean Sea in the context of gas and oil prospecting and development.
- Expansion of Glider missions and operation of continuous data logging stations in the lakes and sea – at the end of the coal loading piers of Ashqelon and Hadera; Current meters and sea level gauges deployed at different locations and depths along the Mediterranean coast of Israel; operation of Kinneret and Dead sea meteo-marine eco-rafts; deployment and operation of the first Deep-Sea mooring in the Eastern Levantine basin at 1500 m bottom depth.
- Operation and access improvements of the National Data Oceanographic and Marine Biology (barcoding and species diversity) Data Center.
- Running operational models to predict sea state and oil slick trajectories during spill events; Running of diagnostic hydrodynamic, ecological and sediment transport models of the Israeli Mediterranean shelf waters.
- Further expansion of the R/V Bat-Galim's activities as part of this strategically important national research and monitoring infrastructure. Operation of state of the art research equipment; increased collaboration with the Israeli ministries of Environmental Protection – oil spill response vessel;

Transportation – Search and rescue; Defense – Navy; Academia – within the framework of the Mediterranean Research Center.

From paper to the net: New technologies for publishing maps as web applications

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Web maps are now part of everyday life, from Google Earth to Waze we all rely on them. As far as using geological maps go there are still traditionalists who prefer paper, but more and more geologists are going into the field with maps they have saved on their laptop or tablet. New technologies allow much more than the ability to glance over a digital image on a computer. Web applications now allow identification of features, processing and filtering of data, image enhancement and the ability to edit the master files on a server from the field via the web. These new features are destined to become the normal way of working with maps in the field and the ability to update maps instantaneously via the source files on a server has uses in data management whose potential has yet to be realized. Our poster graphically depicts how data is stored on a server as a web map which is then published via the web as a web application with multiple functions enabling remote processing and editing using a standard web browser from any place where the internet is accessible.

Seventy Years of Natural Hazards in Israel, 1948-2018: A Temporal and Spatial Analysis

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The impact of natural hazards on earth's population has increased several folds in recent decades. The aim of this study is to review the natural hazards- earthquakes, floods, landslides, droughts and forest fires that occurred in Israel since the establishment of the State in 1948 until 2018, a period of 70 years. The total risk (R), or the expected number of injuries and lives lost and property damage, is a function of the number of victims and affected elements (E), the hazard magnitude (H), and the human and physical environment vulnerability (V): R= f (E,H,V). The consequences of a disaster event may be defined as the product of the physical hazard and the society's vulnerability. Social scientists emphasize vulnerability as the basic component of the equation. The long term cost of natural disasters in the world rose sharply in the last decade, amounting to 100 billion US$ yearly, as against U$S 5 billion 50 years ago. The highest economic losses that occur in developed countries as a result of extreme natural disasters rarely exceed 1% of their early Gross national product, but in weaker economies the losses may amount to 50% or more of the Gross national product, causing considerable damage to the country's growth and development. In Israel the total number of victims by natural disasters was about 200 deaths for the 70 year period including 44 victims in the 2010 Carmel forest fire. Forest fires and drought are the major events causing economic losses that reached several hundreds of millions of shekels every year in the last decade.

Site characterization at stations of earthquake early warning system for Israel and based on geological and seismological data

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The Geophysical Institute of Israel has conducted seismic a survey for establishing the Earthquake Early Warning System (EEWS) for Israel. Background seismic noise was measured at numerous candidate sites providing data for site-effect evaluation. The detailed spectral-statistical characteristics of the seismic noise were obtained. In addition, geological characterization of the selected sites was provided. The geological features of each site present important information for estimating the seismic response to strong earthquakes. The detailed geological characterization at each EEWS site, in comparison with background seismic noise measurements, allows to elaborate geological models and to evaluate possible site-effect for adjusting the EEWS system work parameters. We analyzed the detailed spectral-statistical characteristics of the background seismic noise and geological parameters related to seismic features of each site. During the analysis we revealed several sites where a clear site-effect is observed. The obtained results should be accounted for improvement of the EEWS warning capability.

Fracture-driven methane bubble ascent within shallow fine-grained clay-bearing aquatic sediments: dynamics and controlling factors

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Mature methane gas bubbles in the fine-grained, clay-bearing (cohesive) aquatic sediments, are much larger than characteristic pore size. When gas pressure within the bubble is high enough to overcome compression, friction, and cohesion at grain contacts, gas migrates upward driven by buoyancy, by pushing grains apart and fracturing sediment. This may destabilize sediment and result in slope failure. Migrating methane bubbles may bypass processes of oxidation in the upper sediment layers due to their fast rise velocity, may release to the water column and eventually to the atmosphere. In this study we use coupled macroscopic single-bubble mechanical/reaction-transport numerical model to explore bubble ascent under various ambient conditions. It is demonstrated that bubble migration scenario is controlled dominantly by the internal bubble pressure that manages solute exchange with adjacent porewater. For shallow water depths two sequential bubble propagation patterns were observed: (1) Stable fracturing, followed by (2) Dynamic fracturing, leading to an ultimate release of the bubble to the water column. However, for a higher water depth, bubble propagation pattern is characterized by stable fracturing only. In this pattern the bubble becomes more sensitive to the ambient field of methane concentrations and may stop below sediment-water interface due solute release, as observed in the nature.

The role of submarine ground water discharge as a source of total alkalinity to the SE Mediterranean Sea (Levantine Basin)

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The total alkalinity (TA) of the Levantine Basin (LB), eastern Mediterranean Sea (MS) surface layer is 10% higher than Atlantic Ocean water that enters this basin through the Gibraltar and Sicily straits. Previous studies have demonstrated that this excess is primarily a result of high TA inputs from major rivers in the region that flow into the LB as well as the net TA flux resulting from water exchange with the connected Black Sea. Recently, it has been demonstrated that submarine groundwater discharge (SGD) is an important source of nutrients to the MS. This source, which usually has a higher TA than seawater, may also be an important source of TA to the LB. During 2015-2016 water from a shoreline groundwater spring flowing into the LB near Tel-Shikmona, northern Israel, was sampled 46 times and analyzed for TA and dissolved inorganic nutrients. Adjusted TA varied annually between a low of 6600 during the summer and a high of 7200 µmol kg^{-1} during the winter. According to a mass balance calculation for the entire LB, the TA flux from the fresh SGD in this region is 32% and 13% of the riverine and Black Sea TA fluxes to the MS, respectively. Total SGD could have an even greater impact on the TA budget of the LB, considering that the volume flux of recycled SGD significantly exceeds fresh water SGD. The input of TA to the oceans from SGD with respect to the global oceanic TA budgets has received little attention so far. The SGD alkalinity flux to the oceans and its potential role in controlling their buffering capacity could be an important and previously overlooked feedback mechanism for the current increasing trend in atmospheric CO_2, which merits further investigation.

Release of Particulate Iron Sulfide during Shale-Fluid Interaction

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During hydraulic fracturing, a technique often used to extract hydrocarbons from shales, large volumes of water are injected into the subsurface. Although the injected fluid typically contains various reagents, it can become further contaminated by interaction with minerals present in the rocks. Pyrite, which is common in organic-rich shales, is a potential source of toxic elements, including arsenic and lead, and it is generally thought that for these elements to become mobilized, pyrite must first dissolve. Here, we use atomic force microscopy and environmental scanning electron microscopy to show that during fluid-rock interaction, the dissolution of carbonate minerals in Eagle Ford shale leads to the physical detachment, and mobilization, of embedded pyrite grains. In experiments carried out over a range of pH, salinity, and temperature, we found that in all cases pyrite particles became detached from the shale surfaces. On average, the amount of pyrite detached was equivalent to 6.5 × 10–11 mol m–2 s–1, which is over an order of magnitude greater than the rate of pyrite oxidation expected under similar conditions. This result suggests that mechanical detachment of pyrite grains could be an important pathway for the mobilization of arsenic in hydraulic fracturing operations and in groundwater systems containing shales.

Evaluation of the environmental Impact of Phosphogypsum Storage

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The mildly radioactive (~140 ppm uranium) Israeli phosphorites are used to produce phosphate-fertilizer by combining it with sulfuric acid. A large volume of gypsum sludge is formed as a by-product, called phosphogypsum (PG). The parent ore is sufficiently old as to allow the uranium to have achieved secular equilibrium with its radioactive daughters (e.g., 230Th, 226Ra, 222Rn, 210Pb and 210 Po). Not only are these nuclides radioactive but most are biologically deleterious. They tend to concentrate in the acidic PG phase. The radioactivity of the PG exceeds the EPA limits for use in agriculture (370 Bq/kg for 226Ra) for soil amelioration or for industrial applications. It is forbidden to dump the waste into the ocean. Thus, this presents a problem of disposal. At present, the most economical means of handling this waste is to store it on land in large stacks, each of approximately 1.5 million tons. The storage is at either in the Negev at Mishor Rotem or at Haifa Bay. The gamma-radiation that we have measured is highly variable both between sites and among the stacks at a site, and over time, ranging between 500 Bq/kg and 4300 Bq/kg for 226Ra. 40K is likewise highly variable, ranging from 1 to 1500 Bq/kg. The large volumes of acidic material (pH=2-5), containing elevated radio-elements may present environmental problems. We considered this. We conclude that these do not present an environmental risk at present and can be sufficiently mitigated for the future. For example, the average measured radon released from the stacks varies from <0.004 to > 3 Bq/m2, averaging 1 Bq/m2. The US EPA limit is 0.74 Bq/m2. This can be readily achieved by plant or soil cover. The gamma-ray exposure to workers would increase the annual radiological dose rate to works by not more than 0.45-0.85 mSv over background. Most importantly, the chemistry of the fluids in the stacks prevents potential release of the radium, and its daughters, before they can migrate away or reach the groundwater. Probably the best solution for the future would be the extraction of the uranium from the ore, which is technically feasible, and keep this energy source in the country or sell it.

Submesoscale Turbulence over a Topographic Slope

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Regions of the ocean near continental slopes are linked to significant vertical velocities caused by advection over a sloping bottom, frictional processes and diffusion. Oceanic motions at submesoscales are also characterized by enhanced vertical velocities, as compared to mesoscale motions, due to greater contributions from ageostrophic flows. These enhanced vertical velocities can make an important contribution to turbulent fluxes. Sloping topography may also induce large-scale potential vorticity gradients by modifying the slope of interior isopycnal surfaces. Potential vorticity gradients, in turn, may feed back on mesoscale stirring and the generation of submesoscale features. In this study, we explore the impact of sloping topography on the characteristics of submesoscale motions. We use the MITgcm to conduct high-resolution (1 km x 1 km) simulations of a wind-driven frontal current over an idealized continental shelf and slope. We explore changes in the magnitude, skewness and spectra of surface vorticity and vertical velocity across different configurations of the topographic slope and wind-forcing orientations. All of these properties are strongly modulated by the background topography. Furthermore, submesoscale characteristics exhibit spatial variability across the continental shelf and slope. We find that changes in the statistical properties of submesoscale motions are linked to mesoscale stirring responding to differences in the interior potential vorticity distributions, which are set by frictional processes at the ocean surface and over the sloping bottom. Improved parameterizations of submesoscale motions over topography may be needed to simulate the spatial variability of these features in coarser-resolution models, and are likely to be important to represent vertical nutrient fluxes in coastal waters.

Limnological and geochemical processes in the late Quaternary Dead Sea from pore-fluid composition in the ICDP deep drilled core

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Major ion and isotope compositions of pore fluids extracted from marine or lacustrine sediments and are commonly used for reconstructing the composition of water from the sediment-water interface of the past. Here the major ion and isotope compositions of pore fluids from an ICDP sedimentary core drilled at the bottom of the Dead Sea were used to piece together a picture of limnological and geochemical processes in the lake over ca. 200 ka. Conservative ion concentrations from the pore fluids (Mg^{2+} and Br^{-}) were diluted and concentrated over glacial and interglacial periods, respectively, and were inherently linked to the degree of addition and removal of H_2O in the deep-lake over time. Halite precipitation and dissolution was a dominant process on the lake salinity. During the last interglacial (ca. 132 to 117 ka) Dead Sea levels dropped and the brine precipitated massive halite layers accompanied by a decrease in the Na/Cl ratio and in $\delta^{37}Cl$ in the pore fluids as a result of halite precipitation. Conversely, during the last glacial enlarged 'Lake Lisan' the Na/Cl ratio and the $\delta^{37}Cl$ in the pore fluids increased suggesting that the contribution of Cl- in the lake was via dissolution of halite, mostly from the adjacent salt diapir of Mt. Sedom. The array of major ion and isotope compositions from pore fluids unlocked geochemical processes of the glacial and interglacial Dead Sea and were ultimately used to reconstruct paleo-limnological conditions.

$\delta^{37}Cl$ and chemical composition of pore fluids reveal salt precipitation and dissolution mechanism in the Late Quaternary Dead Sea

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During 2010-11 a Dead Sea Deep Drilling Project (DSDDP) under the umbrella of the ICDP drilled at the abyssal floor of the Dead Sea and exposed a sedimentary core spanning ca. 200 ka. Pore fluids and salt (halite) sampled from the ICDP core, as well as salt from units that are exposed at the adjacent Mount Sedom salt diapir, were used to understand the long term dynamics of salt precipitation and dissolution in the Dead Sea over the last interglacial and glacial periods. During the last interglacial (ca. 132 to 117 ka) Dead Sea levels dropped and the brine precipitated massive halite layers. The changes in the brine composition during this period is reflected in the pore fluids: conservative ion concentrations increased (Mg2+ and Br−) accompanied by a decrease in the Na/Cl ratio and in $\delta^{37}Cl$ as a result of halite precipitation. The $\delta^{37}Cl$ fits a Rayleigh distillation curve, inferring that external sources of Cl− into the lake were negligible over this period. Conversely, during the last glacial (ca. 116 to 14 ka) lake level rose to form the Late Pleistocene 'Lake Lisan', which is reflected in the dilution of the pore fluids conservative ion concentrations. Concurrently the Na/Cl ratio and the $\delta^{37}Cl$ in the pore fluids increased as a result of recharge of the Na+ and Cl− reservoir as a result of halite dissolution. Chemical and $\delta^{37}Cl$ isotope mass balance calculations suggest that the contribution of Cl- in the lake was via dissolution of halite, mostly from the adjacent salt diapir of Mt. Sedom.

Effect of water surface salinity on evaporation: The case of a diluted buoyant plume over the Dead Sea

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Evaporation from water bodies strongly depends on surface water salinity. Spatial variation of surface salinity of saline water bodies commonly occurs across diluted buoyant plumes fed by freshwater inflows. Although mainly studied at the pan evaporation scale, the effect of surface water salinity on evaporation has not yet been investigated by means of direct measurement at the scale of natural water bodies. The Dead Sea, a large hypersaline lake, is fed by onshore freshwater springs that form local diluted buoyant plumes, offering a unique opportunity to explore this effect. Surface heat fluxes, micrometeorological variables and water temperature and salinity profiles were measured simultaneously and directly over the salty lake and over a region of diluted buoyant plume. Relatively close meteorological conditions prevailed in the two regions; however, surface water salinity was significantly different. Evaporation rate from the diluted plume was occasionally three times larger than that of the main salty lake. In the open lake, where salinity was uniform with depth, increased wind speed resulted in increased evaporation rate, as expected. However, in the buoyant plume where diluted brine floats over the hypersaline brine, wind speed above a threshold value (~4 $m \cdot s^{-1}$) caused a sharp decrease in evaporation probably due to mixing of the stratified plume and a consequent increase in the surface water salinity.

3D Quantitative Seismic Fault Analysis, a case study offshore Israel

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The variation of displacements on fault surfaces allow to distinguish between buried and fault growth. Quantitatively analyzing the "Gabriella" 3D seismic data, we define the relation displacement patterns to reconstruct fault evolution under shelf settings. Displacement patterns diagnostic of buried faults, where both tips close gradually, characterize the normal faults of a N-S trending system in the northern part of Gabriella license. However, a syn-sedimentary fault pattern is also observed, where displacements in the fault's surface upper part sharply diminishes. We speculate that the underlying chaotic zone, at the eastern part of ISC, controls the displacement patterns. Expansion indices for both blind and syn-sedimentary faults are compared to these patterns, suggesting a criterion for distinguishing between blind and growth faults in this fault system.

Information gleaned by displacement contour diagrams is useful for interpreting seismic data, both for quality control of interpretation and quantitative extrapolation of limited data. Also, they can improve prediction of fault geometries in areas of limited resolution. The ISC is considered one of the larger slump complexes in the world, and therefore the present approach holds a considerable promise for improving the understanding of faults in the continental shelf.

Palaeocological reconstructions of the Albian–Cenomanian in Northwestern Israel (Mount Carmel) on basis of quantitative analysis of calcareous nannofossils

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The characterization of seismogenic zones and an updated database of active faults are important for seismic hazard analysis. We suggest a method to define and characterize seismogenic zones, based on earthquakes that were recorded by the Geophysical Institute of Israel from 1983 to 2017, and were relocated. We characterize seismicity by the following parameters: earthquake density, seismic moment density, and by earthquake average depth. The parameters are calculated in a 1-km interval grid. Their spatial distribution allows us to suggest a new seismic zonation. We further calculate the seismicity parameters of the frequency – magnitude relation in each zone, any by that estimate the frequency of large earthquakes. Another part of this study is to create an updated database of faults that show evidence of activity during Quaternary times, primarily based on 1:50,000 geological maps of the Geological Survey of Israel, and also on other sources. We present the fault map and its criteria, which is partially based on the seismicity part of the study. The integration of active fault analysis and of seismicity-based study is a new suggested approach, which can be implemented for seismic hazard analysis.

Preliminary Tsunami Hazard Evaluation to Elat

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The Gulf of Elat is located along the southern part of the Dead Sea Transform and is subject to strong and destructive earthquakes. Thus, there is a potential of tsunami hazard due to co-seismic deformation and submarine landslides. The city of Elat at the Head of the Gulf hosts many tourist and commercial activities and there are plans for large projects in the future. Yet tsunami hazard evaluation has not been done to this area and it is not clear how severe it is. The tsunami that followed the 1995 Nuweiba, Mw7.2 earthquake, its associated mareogram (curtesy of the Survey of Israel), and eyewitnesses and field evidences emphasize this hazard.
To evaluate the hazard we first characterized the potential tsunamigenic earthquakes and submarine landslides, map its areal distribution, and estimate its source parameters, geometrical dimensions and return periods. In parallel we adopted at the GeoClaw tsunami modelling software and built a grid of the bathymetry and topography of the investigated area. We then examined the 1995 tsunami field evidences and the mareogram as our benchmark, found a good agreement and thus validated the suitability of the GeoClaw for our purposes. The main effort was the running of conceptual scenarios that represent the most severe tsunamigenic earthquakes in the Gulf. It appears that the rupture of the marginal faults along the Elat Basin pose the worst-case scenarios for Elat. We thus examined the Elat Fault in two ways: the GeoClaw and the Ward (2011) approaches. Both the ways suggest about 5 m wave height along the coast of Elat. Moreover, this scenario imposes co-seismic subsidence that may worsen the tsunami inundation, and can also trigger a tsunamigenic submarine landslide, not to mention a severe shaking in the city. To complement the evaluation, we simulated a generic tsunamigenic submarine slump offshore Elat and received about 5 m wave in there.

Overall, we recommend adopting a tsunami wave height of 5 meters as the leading parameter for tsunami preparedness in Elat. We also applied the 'Attenuation Model' and produced a preliminary inundation hazard map. The return period of a significant tsunami event in Elat is estimated at about 500 years. The warning time is a few minutes only and thus the earthquake shaking should be considered the tsunami warning, although false alarms are inevitable.
Our simulations suggest that the other cities nearby Elat are also exposed to this hazard. To raise the public awareness, we prepared a draft of education program that includes supporting presentation in Hebrew and English, outlines for discussion and a questionnaire that evaluates the level of awareness of the public-at-risk from a tsunami, to be implemented in local schools, public institutions and tourist centers and hotels.

New approach for seismic zonation and Quaternary fault database in Israel and adjacent areas

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The characterization of seismogenic zones and an updated database of active faults are important for seismic hazard analysis. We suggest a method to define and characterize seismogenic zones, based on earthquakes that were recorded by the Geophysical Institute of Israel from 1983 to 2017, and were relocated. We characterize seismicity by the following parameters: earthquake density, seismic moment density, and by earthquake average depth. The parameters are calculated in a 1-km interval grid. Their spatial distribution allows us to suggest a new seismic zonation. We further calculate the seismicity parameters of the frequency – magnitude relation in each zone, any by that estimate the frequency of large earthquakes. Another part of this study is to create an updated database of faults that show evidence of activity during Quaternary times, primarily based on 1:50,000 geological maps of the Geological Survey of Israel, and also on other sources. We present the fault map and its criteria, which is partially based on the seismicity part of the study. The integration of active fault analysis and of seismicity-based study is a new suggested approach, which can be implemented for seismic hazard analysis.

Strontium retention in Ordinary Portland Cement, low pH cement and model compounds

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Within the framework of geological disposal for radioactive waste, structural concretes must be adapted to withstand underground chemical conditions. CEMI cement-based materials are characterized by high pH that may produce an alkaline plume in the near-field of the repository. To avoid this phenomenon, low-pH cements have been regarded as possible containment and structural materials. Since these materials serve as a boundary between waste packages and the environment, high retention for radionuclides will be favorable. The objective of this work is to examine the microstructure and the Sr (Strontium) retention properties of CEMI cement pastes and low pH cementitious systems, together with model compounds of tri-calcium silicate (C3S). This approach is useful to discriminate the impact of individual phases, such as portlandite, ettringite and C-S-H, on the whole set of the Portland cement retention properties. Four paste formulations were chosen: a CEMI paste (w/c=0.47), low pH CEMI paste (50%wt silica fume, 2.2%wt superplasticizer, w/b=0.6), C3S paste (w/c=0.47) and low pH C3S paste (40%wt colloidal silica, 6.6%wt superplasticizer, w/b=0.65). During casting all the samples were spiked with non-radioactive Sr ions (simulating the immobilized waste ions) introduced as a solution of SrCl2, to reach a concentration of 3.6 mg Sr/g binder. The samples were demolded after 2 days and cured for four months under N2 atmosphere to prevent carbonation. Calorimetry of the fresh pastes was measured using a TAM air isothermal calorimeter. The cured samples were analyzed by XRD, TGA and X-ray micro-tomography. 1D monolith

leaching experiment was performed according to EPA method 1315 using deionized water as the leachant. pH-dependent leaching was performed according to EPA method 1313, providing liquid-solid partitioning curves as a function of pH for different elements, as well as pH behavior and buffer capacity of the cementitious matrices. Major ion concentration as well as Sr content of the leachates were measured using ICP-OES for both leaching experiments. XRD and TGA analysis of the two low pH systems revealed the absence of portlandite, indicating a full pozzolanic reaction occurred. On the other hand, in the C3S paste, portlandite content was high and strongly increased the buffer capacity of the system, measured in the pH-dependent leaching experiments. Preliminary results from the 1D monolith leaching tests showed that Sr leachability in the C3S system was 2.5 times higher than the level measured for the CEMI system, whereas both low pH systems showed lower leachabilities (on the order of 30-20%) of the CEMI system. The effect of micro-structure variation vs. pH decrease on the leaching behavior is yet to be determined. Geochemical modelling will be used to bridge the gap between the leaching experiment results and the chemical and mineralogical characterizations.

Rain and runoff balance of strong storm, and effective rain from different rock and soil units in Timna Valley

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On 26.10.2015, a strong storm hit the southern Arava and in a short time, 30-60 mm of rain fell in Nehushtan Wadi at the southern part of Timna Valley. Of this,20 mm fell in 20 minutes. Such an extreme rain event hasn't been recorded for the last 30 years. Rain gauges installed in the basin showed the rain dispersion. The Nehushtan watershed is 16 km^2 and contains various types of rocks and sediments such as igneous rocks, sandstones, marine sediments, colluvium slopes, ancient terraces and alluvium. Using high resolution geological maps, we calculated the specific area of rock and soil cover. The outlet of the wadi is closed with a high dam, so the water of the flashflood accumulates before the dam and its volume calculated. Eleven runoff plots on the various rock and soil types enabled the precise measurement of runoff volume from each rock type, and calculation of the P value. The water balance shows that the total amount of rain that precipitated on the watershed was 680,000 m^3. The quantity of runoff at the "lake" near the dam was 69,000 m^3, which is 11 of the total rain. All the runoff plots yield 25-85%. In 40% of the watershed, the percent of the runoff was lower than 30% and in another 40%, the percent of the runoff was 60-85%. 47% of the rain infiltrated into the slopes and 42% to the alluvium. Conclusions: 1. The character of the rain is the most important factor in desert flash floods and stating an average runoff coefficient is very problematic because the standard deviation is bigger than the average. 2. To state an average coefficient for a type of rock or soil is problematic because of the different hydrologic parameters in the watershed. 3. In this storm, almost 2/3 of the runoff filtrated in the alluvium and more than 1/3 filtrated on the slopes. 4. Even in a high intensity storm with a large volume of water, in a hyper-arid climate with bare rocks and without vegetation cover, the runoff rate did not reach 12%.

Halite focusing and amplifying salt accretion in deep hypersaline basins

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The worldwide stratigraphic record presents thick halite layers accreted in deep hypersaline basins under dry climate conditions. The thickness and distribution of these halite units are used in basin analyses and paleoenvironmental reconstructions. Recent studies raised doubts regarding the assumption, according to which, a given thickness of halite layer is directly related to evaporation of a given water thickness, where the areas of both water surface and deposited halite are similar. Here we present the mechanism of halite focusing using a limno-sedimentological model for halite accumulation, based on observations from the Dead Sea, the only modern analog for such environments. The model accounts for a halite-saturated hypersaline basin under negative water balance and a stratified water column with a warmer, halite-undersaturated upper layer. Under such stratification, double-diffusive flux transfers dissolved salt from the epilimnion down to the hypolimnion, resulting in continuous halite focusing and a significant amplification of halite accretion in the depocenter, at the expense of dissolution from the shallow basin margins. Halite focusing can almost triple the thickness calculated by uniform precipitation, meaning that a given halite unit may have accumulated faster, during shorter, less arid intervals than previously interpreted from halite deposits. Halite focusing explains (a) extremely high deposition rates, (b) accretion of exceptionally thick halite sequences in deep basins (e.g., the Messinian salt giant), and (c) a marginal basin that is fully or partially devoid of halite, with coeval thick sequences in the deep basin.

The last 3000 yrs. sea level curve of Israel presents centennial sea-level variations

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Archaeological remains are valuable sea-level indicators in Israel, a tectonically stable coast with minor (< 0.2 mm/yr over the last 6 ka) isostatic inputs. Previous research has used these indicators, with various uncertainties, to argue for centennial sea-level fluctuations. Lately, we place archaeological indicators in a quality-controlled database format and subject them to statistical analysis. The database now consists of 100 index points (including bio-construction index points) and 12 limiting points from the last 3,000 yrs. that have accurate dating and functional heights (the term used for the original relationship of archaeological indicators to sea-level). An error-in-variables Integrated Gaussian process (EIV-IGP) has been applied on the index points to model the evolution of relative sea level (RSL) for the last three thousand years in Israel. Unlike the Early-Holocene observations that derive from fully submerged Pre-Pottery Neolithic–Chalcolithic sites off the Carmel coast of Israel, the last 2,500 years of archaeological index points are mainly coastal. Sea levels rose from ~ 0.8m ± 0.4 at 2850 yrs. BP (Iron Age) at up to 1.2 mm/yr to near-present levels ±0.1 m by around 1850 yrs. BP (Roman period) and continued rising to 0.1 m ±0.1 above present at 1600 yrs. BP (Byzantine Period). It then fell to about -0.3 m ± 0.1 below present by up to 0.7 mm/yr ±0.2 at 650 yrs. BP (Late Arab period), before rebounding to present levels by 0.5 mm/yr. The re-assessed Israeli record serves as a reference for comparisons with other records from the East Mediterranean.

Microbial iron reduction in lacustrine and marine methanogenic sediments

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In many aquatic sediments significant microbial iron reduction has been observed not only in its expected traditional depth but also in the deep methanogenic zone, often accompanied by methane decrease. Using geochemical isotopic approach, we have investigated the coupling of this microbial iron reduction to methane cycling in sediment diffusive profiles of Lake Kinneret (Israel) and the Eastern Mediterranean continental shelf. The results show that in Lake Kinneret iron and methane cycles are linked mainly by iron reduction via anaerobic oxidation of methane (AOM). Surprisingly, the less reactive iron minerals such as magnetite and hematite are more accessible to this process. The iron coupled AOM process involves complex community that is able to sustain life under highly-reducing low energy conditions using novel strategies. Sediments collected from the Eastern Mediterranean continental shelf show also active microbial iron reduction in the methanogenic zone and reactivation of iron minerals as magnetite, however, it seems that AOM does not have a significant role there.

U-Th ages of calcitic corals from the Gulf of Aqaba indicate wetter climate conditions during past interglacials in the currently hyper-arid region

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Fossil coral reefs provide geological records of late Quaternary sea level changes, tectonic movements and paleoclimatic information. Most studies on fossil reefs were done on pristine corals that preserve the original aragonite composition. Yet, many fossil corals are affected by various degrees of diagenesis, e.g. recrystallization of aragonite to calcite (termed here: calcification) due to interaction of the coral's aragonite with meteoric waters in the phreatic zone. A surprising example for an extensive calcification of coral reefs are the uplifted late Pleistocene reef terraces along the NE shores of the Gulf of Aqaba (GOA), a region that is currently one of the most hyper-arid climatic zones on Earth. The elevated reef terraces in the NE GOA constrain the history of tectonic uplift and local relative sea level changes during the last interglacial period. These relative sea level changes were inferred from measured elevations coupled with U-Th ages of aragonite precipitation and recrystallization to calcite. The corals comprising the coral reef terraces were recrystallized from aragonite to calcite, when sea level was at or close its stable MIS5e elevation a few meters above the modern GOA level. The terraces comprise fringing reefs, some with clear reef structure that includes a reef flat and a shallow back lagoon accurately marking sea levels. Terrace R2, comprising a wide and developed reef flat, formed during the stable sea level of peak MIS5e at ~129-121 ka and was recrystallized to calcite at 104±6 ka. Terrace R1 formed during a short still-stand at 117±3 ka. The recrystallization age of Terrace R2 implies that at around 104±6 ka (MIS5c) sea level was close to its MIS5e elevation. The elevation and ages of the reef flats indicate a slow average uplift, 0.12±0.05 m/kyr, similar to rates inferred for other last interglacial

reef terraces along GOA and the Red Sea. This is consistent with an overall long-term slow uplift of the Arabian lithosphere during the late Quaternary.

It appears, that enhanced freshwater activity occurred along the shores of the GOA during the last interglacial, indicating wetter climatic conditions in the region during peak MIS5. Other lines of evidence corroborate the existence of wetter conditions in the vicinity of the GOA during past interglacials. These wetter climate conditions and availability of freshwater along the shores could assist the Homo-Sapience upon his move “Out of Africa” during peak MIS5.

Subducting buoyant ridges: effects of density and rheology in 3D models of free subduction

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Plate rheology and geometry had been shown before to affect the final shape and behavior of subduction zones. Moreover, the presence of buoyant ridge on the subducting plate had been correlated with unique phenomena such as flat subduction and lack of magmatic activity. In this ongoing study we introduce a coupled finite element and boundary element 3D numerical model to investigate the controls of different plate and ridge properties on subduction development. We focus our work on density difference between the buoyant ridge and the surrounding plate and the viscosity difference between the slab and the mantle. Initial results based on previous versions of the model indicate that subduction and trench retreat velocities increase with increasing plate strength. Subduction velocity depends on buoyancy of the subducting ridge and is not independently sensitive to ridge size and density. However, the evolution of trench shape is strongly affected by ridge geometry. In addition, trench velocity and slab shape depend on the viscosity ratio between the slab and mantle. Comparison of our preliminary modelled slab geometries and trench evolutions with those observed in subduction zones around the world suggests that subducting plates are relatively weak and many subduction zones, e.g., those in the western Pacific, may be shaped by the subduction of buoyant features.

Leachability characteristics of cementitious mixtures containing fly ash

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Fly ash is commonly used as a substitute material in cementitious mixtures, which when used in infrastructure applications may come into contact with runoff, infiltration and groundwater. Leaching of constituents of potential concern (COPCs) from cementitious mixtures containing high content of fly ash that were cured for different time periods was examined. Two types of cementitious mixtures, controlled low strength material (CLSM) and grout that are commonly used in Israel were examined .

Cubic blocks of cement mixtures containing fly ash and control mixtures with no ash were manufactured and cured for periods of 7, 28 and 90 days, chosen for engineering reasons. After the curing, the cubes were tested according to procedure EA NEN 7375:2004 ("tank test"; equivalent to US-EPA test method 1315) for determination of the leaching rate and extent of inorganic components. The Colombian fly ash CMC-CerD was chosen for its high concentration of contaminants and its low pozzolanic activity as a bounding case .

The initial stages of leaching, especially for the short 7 days of curing, show substantial variation in pH and conductivity values. The contents of 20 trace elements, mainly COPCs, were measured in the eluates from the monolith and the cumulative releases for the entire monolith test were determined. These values can be used to evaluate environmental safety of cementitious mixtures containing fly ash following a scenario-based approach. The US-EPA pH dependence leaching test method 1313 and total content analysis were applied for characterization of the materials (the fly ash and both cementitious mixtures with and without fly ash).

The fly ash composition is considerably different than the CLSM and grout reference mixtures and strongly affected the chemical composition of the fly ash containing blends, more than the difference in the type of blends .

Two patterns were observed for COPCs leaching from the grout and CLSM during the monolith leach testing: (1) an initial high flux from the grout followed by similar or slightly lower values than the CLSM and (2) considerably lower fluxes of the grout compared with the CLSM. Interestingly, COPCs typically originating from the fly ash were leached in lower concentrations from the high FA–high cement grout mixture compared with the lower FA–lower cement content CLSM concrete. This observation points to importance of the cement in stabilizing COPCs within a cement mixture.

Anoxic atmosphere underground – origins and hazard mitigation

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Dangerous atmosphere with high CO2 concentrations and low concentrations of O2 (blackdamp) is known from coal mines and volcanic areas. Concentrations of >6% of CO2 or/and <10% of O2 are considered lethal. It is less known that blackdamp also forms in natural caves, non-coal mines and other poorly ventilated underground spaces. In this study we explore an atmosphere of eight vertical caves and abandoned montmorillonite mine where severe respiration problems were reported. The caves located on Dalton Plateau, Galilee, in Cenomanian carbonate rock. The mine is near Mitzpe-Ramon, Negev Desert, and built of multiple horizontal passages of several km along a 2m thick montmorillonite layer sandwiched between Cenomanian carbonate strata. The mine is abandoned and haven't been ventilated since 1980-s, except having one opening 0.5 m2 wide.

More than 100 gas samples were analyzed. Six Galilee caves are characterized by lethal CO2 levels of 7-11%, and 9.5-13% of O2, whereas in other 4-5% of CO2 and 16-17% of O2 were found, with atmosphere-caves-air mixing lines with a slope of 1±0.11. The CO2 accumulates in lowest parts of the caves and can increase abruptly from safe to deadly level along <2 m of vertical descent. The CO2 d13C value in the caves is -23.2±1.0‰, typical to CO2 originated from oxidation of organic material, as follows:

(1) CH2O + O2 >>> CO2 + H2O

In the mine O2 decreases and CO2 increases with the distance from the entrance. At depth of 300 m the O2 levels drop to 11-12%, with CO2 concentrations reach 3.5-4%, defining an atmosphere-mine-air mixing line with the slope of 2.7±0.3. At depth of 500-600 m the O2 drops to the lethal level of 6.6%. The CO2 d13C value is -3.4±0.3‰,

showing its inorganic origin. SEM analyses of multiple iron-oxide concretions in the montmorillonite show extensive pyrite oxidation and its replacement with limonite in the following CO_2 emitting reaction:

(2) $2FeS_2$ (pyrite) + $7.5O_2$ + $4CaCO_3$ + $5H_2O$ >>> $Fe_2O_3*H_2O$ (limonite) + $4CO_2$ + $4CaSO_4*H_2O$.

Presence of blackdamp in Israeli caves and mines is more common than previously thought. Mitigation of this hazard requires use of O_2-CO_2 sensors and self-contained breathing apparatus (where possible) while entering an unknown underground space.

The circulation of the Dead Sea brine in the adjacent regional aquifer

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Throughout the history of the Dead Sea, brines discharge into the lake and recharge from it to the adjacent aquifers. The Ein-Qedem (EQ) hydrothermal saline springs system discharging at the western shore of the modern Dead Sea comprises the most significant source of brine that discharges currently to the lake. The chemical composition of EQ brine has remained virtually uniform during the past 40 years, indicating derivation from a large groundwater reservoir. The history of the brine traces to ancient lakes that filled the tectonic depression of the Dead Sea Basin during the Quaternary times. During this period, the brine circulated between the lakes and the adjacent aquifers. The discharge of the EQ brine is the modern manifestation of this essential and continuous process in the hydrological-limnological history of the Dead Sea system. Based on chronological and geochemical data, we argue that the modern EQ brine originated from the last glacial Lake Lisan. Radiocarbon and krypton-81 dating indicates 16-35.5 kyr residence time of the EQ brine in the aquifer. These ages coincide with the highest stand period of Lake Lisan. Thus, the circulation of the brine involves penetration to the groundwater during high stands and discharging back to the lake during low stands. This circulation characterized the Dead Sea lacustrine system during the ~3 Ma of lakes' history. The suggested mechanism for circulation of brines may explain circulation in other basin environments worldwide and in particular the relation of circulation to the regional hydrology and climate regime.

Rate of seawater intrusion determined with radioactive noble gas isotopes of ^{81}Kr and ^{39}Ar

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This study presents for the first time direct estimation of the rate of seawater intrusion into coastal aquifers with radioactive noble gases isotopes. Dating of deep saline groundwater in Israel, near the Mediterranean Sea, was conducted in order to estimate the rate of seawater intrusion and the connectivity of the aquifer with the sea. Several dating tools were used for old seawater, including ^{81}Kr, ^{39}Ar, ^{85}Kr, together with the more commonly used tools of ^{14}C and tritium. ^{81}Kr-dating indicates that the saline water age is less than 26,500 years, in contradiction with previous estimates of much older ages of up to several million years which were based on hydrogeological consideration. The results imply a stronger connection between the sea and the aquifer than previously understood, which means that a reduction of the fresh water level due to over pumping would induce seawater intrusion on relatively short timescales. Moreover, this study demonstrates the suitability of radioactive noble gases for the examination of hydrogeological systems in general and of saline water intrusion specifically.

Northern Hemispheric trigger for The Mid-Pleistocene Transition

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The earth's climate changed fundamentally during the Mid-Pleistocene Transition (MPT), when glacial-interglacial periodicity shifted from ~41- to ~100 kyr, and glacial periods became more intense, with no substantial change in the orbital Milankovitch forcing. Here we present new evidence showing that the onset of the MPT initiated in the northern hemisphere (as opposed to the southern hemisphere). Using Nd isotopes as water mass tracers, from deep sea cores along a meridional section of the Atlantic Ocean, we have reconstructed the changes to the Atlantic Meridional Overturning Circulation (AMOC) through the MPT, and the changes to the North Atlantic end-member. Our results show that glacial perturbations to the southward transport of North Atlantic source waters (NASW) started at Marine Isotopic Stage (MIS) 38 (~1250 ka), and culminated during MIS 26 (~960 ka) with anomalously high inputs of detrital discharge from surrounding Archean shield regions into the North Atlantic. This was followed by a major basin-wide disruption of the AMOC between 950-850 ka leading to recurring 100 kyr glacial-interglacial periodicity. This new view of the AMOC throughout the MPT interval points to a northern hemispheric sourced initiation, possibly through regolith loss which would have facilitated the growing and thickening of northern hemispheric ice-sheets, leading to changes in the ice-sheet and forcing feedbacks.