PROCEEDINGS OF MEETINGS OF THE ISRAEL GEOLOGICAL SOCIETY, 1967–1969*

LECTURES AND EVENTS

---

* Edited for the Society by E. Rosenthal and I. Perath.

** No abstract received.

** No abstract received.

** No abstract received.

ABSTRACTS OF LECTURES

Oil and gas prospects of the Kurnub Group (Lower Cretaceous) in southern Israel

E. AHARONI, *Lapidoth Oil Co.*

The combination of the facies, structure, and hydrodynamics of the Kurnub Group in the northern Negev and the south Hebron arch warrants the existence of potential hydrocarbon traps. Such traps would be stratigraphic in the south Hebron arch, stratigraphic and anticlinal in the northern Negev, and fault block traps on the west side of the Dead Sea graben.

Although drilling on some anticlines and on some fault blocks has shown the Kurnub Group to be water-bearing, the oil and gas shows which were found in these wells should encourage further exploration for oil and gas in Kurnub Group strata in this area.

The Jurassic outcrop at Hammam el Malih, east Shomron

E. AIZENBERG, *Naphtha Oil Co.*

Upper Jurassic carbonate rocks are exposed at the northern end of the Wadi Fari'a structure, near the springs of Hammam el Malih. Most of the outcrops occur along an elevated block, formed by two parallel faults that strike perpendicular to the structural axis. The total area of the outcrop is approximately 3 km^2. The section is known as the Malih Formation, and is divided into a Lower Malih and an Upper Malih Member.

A section of 200 m was measured and sampled. It appears to be equivalent to the Be'er Sheva' Formation. Most of the section consists of grain-supported calcareous clastics, cemented by sparry calcite. Fossils are abundant, including reef-building organisms, even though true reefs were not found. The petrography suggests deposition in a shallow, high-energy marine environment.

The Lower Malih Member, 67 m thick, forms a pronounced cliff and consists almost exclusively of bioclastic limestone. The Upper Malih Member, 124 m thick, has a softer, ledged morphology. This unit includes, apart from the dominant bioclastic sparites, also micritic layers.

The Naphtha Co. is interested in the region for two reasons: a) The Fari'a and Hammam el Malih areas have suitable localities for drilling pre-Jurassic strata. b) Information on the Jurassic stratigraphy and especially the Jurassic-Cretaceous unconformity is still incomplete, and more data are required on the pre-Cretaceous structures.

The geology of the Be'er Ora area

J. BARTOV, *Department of Geology, The Hebrew University of Jerusalem*

The Be'er Ora area is located at the western margin of the Rift Valley, 20 km north of Elat. The area was mapped, and eight lithostratigraphic units were distinguished, ranging in age from Late Cenomanian to Neogene. The rock sequence is predominantly of marine origin, and consists mainly of carbonates, shales and cherts, and some evaporites. Two new lithostratigraphic units are established: the 'Eteq Formation, a sequence of dolomites and organogenic limestones of Coniacian age, and the Raham Conglomerate, of Neogene age.

The area is strongly affected by faulting and folding. The Ora Shales, of Early Turonian age, and the lower part of the Gerofit Formation (alternations of shales and limestones of Late

Turonian age) act as disharmony planes: many faults disappear or become bedding-plane faults when reaching these rock units. The rock sequence is accordingly divided into two parts, each displaying a different structure.

The fault lines can be grouped into three major systems: the first trends E–W and continues far into the Sinai Peninsula. The second is directed N–S, parallel to the Rift Valley border faults. The third, oriented NW–SE, is observed in the vicinity of Nahal 'Eteq. The segments bordered by these fault systems have been folded into five major synclines.

The main E–W fault (Be'er Ora–Nahal Shani fault) is one of the oldest structural features observed in the region. Its eastern termination was rotated 30° counter-clockwise during the formation of the second and third fault systems, which were associated with the formation of the syncline.

There is a close correlation between tectonic events and erosion-depositional non-marine phases. A post-Middle Eocene faulting phase was followed by erosion of the Cretaceous to Middle Eocene strata, and the consequent accumulation of the Raham Conglomerate. Syncline formation and related faulting were followed by an erosional phase. The youngest tectonic occurrence recognized is an eastward flexure along the western border of the Rift Valley.

Determination of Al_2O_3, Fe_2O_3, MgO and SiO_2 in phosphate rocks

W. BODENHEIMER, S. EHRLICH, AND H. ELDAD, *Geological Survey of Israel*

The determination of the sesquioxides magnesium oxide and silica according to the classical analytical method is tedious and time-consuming, due to the presence of the phosphate and fluorine ions.

Using atomic absorption spectography, the interference of these ions can easily be overcome.

Geochemical prospection for lead and zinc in the Golan Heights

I.B. BRENNER AND R. BOGOCH, *Geological Survey of Israel*

An occurrence of galena in the Hermon area was reported by Dubertret in 1952 (the deposit was worked before June 1967). Mineralization is found in carbonate rocks of Jurassic (J_4) age. The area is located to the west of the Joubata ez-Zait graben and is apparently moderately faulted. A dolerite intrusion is exposed near the galena occurrence.

Soils, stream sediments and rocks of the area were sampled according to a grid system, and analysed for cold extractable heavy metal (dithizone test), and total Pb and Zn (by emission spectrography and atomic absorption).

Several significant anomalies, higher than 100 ppm lead and 300 ppm zinc, were discovered and mapped.

The high cold extractable heavy metal/Pb + Zn ratio implies an epigenetic cause of the major anomaly. The high variability of Zn/Pb ratios within the anomaly is usually characteristic of areas in the close vicinity of mineralization. Other smaller anomalies generally overlie veined and leached zones in the carbonate. Alteration is generally observed at the dolomite-limestone contact and is more pronounced in the zone of mineralization. The dolomites are apparently a preferential host for zinc (smithsonite was detected in the dolomite).

Sulphur isotope data of the galena, according to A. Nissenbaum, indicate a hydrothermal origin.

Young conglomerates in HaShefela area

B. BUCHBINDER, *Geological Survey of Israel, Oil Division, and the Institute for Petroleum Research and Geophysics*

Three conglomerate formations, occurring over wide areas, are distributed in the HaShefela region. Part of them were described by Avnimelech in 1936.

1. Bet Nir Conglomerate. Age: Upper Miocene-Pliocene? This conglomerate covers areas of lower HaShefela in the south and caps the higher hills of HaShefela in the Latrun-Yalu area. The Bet Nir Conglomerate is of fluviatile origin, and represents the regression which followed the transgression of the Late Miocene.

2. Ahuzzam Conglomerate. Age: Plio-Pleistocene.

In the subsurface of the eastern coastal plain, the Ahuzzam Conglomerate is underlain by the Plio-Pleistocene Pleshet Formation, and is overlain by the young (Tyrrhenian) formations of the "Kurkar" Group, which contain the foraminiferid *Marginopora*. The Ahuzzam Conglomerate occurs as the upper (20–50 m above the present river channels) of two distinct terrace levels flanking the stream channels of HaShefela. The Ahuzzam Conglomerate is predominantly distributed in the Ayyalon Valley, in Nahal Soreq, Nahal HaEla and Nahal Adorayim. Unlike the Bet Nir Conglomerate which caps the hills, the Ahuzzam Conglomerate is confined to the valleys only.

3. Nahshon Conglomerate. Age: Pleistocene.

The Nahshon Conglomerate forms the lowermost level (5–15 m above the stream channels). The level is cut into the Ahuzzam Conglomerate; it is predominantly distributed in the valleys of Nahal Ayyalon, Nahal Soreq and Nahal Haela.

Outcrops of Neogene formations in the central and southern Coastal Plain, HaShefela and Be'er Sheva' regions, Israel

B. BUCHBINDER AND G. GVIRTZMAN, *Geological Survey of Israel, Oil Division, and the Institute for Petroleum Research and Geophysics*

The Neogene formations named Ziqlag, Yafo, Bet Nir, Pleshet, Ahuzzam, Sheva' and Hazeva are distributed in the Coastal Plain, HaShefela and in the Be'er Sheva' regions. A marine transgression of Late Miocene times, advancing over a dissected topography, deposited the bioclastic limestone of the Ziqlag Formation. A rapid regression of Late Miocene to Pliocene times caused deposition of the fluvial Bet Nir Conglomerate. A new Pliocene transgression deposited the sandy Pleshet Formation, followed by the Ahuzzam Conglomerate during the subsequent regression. In the Be'er Sheva' morphotectonic embayment, the Late Miocene transgression deposited the Yafo Formation in the bottom of an ancient canyon. The marly Lower Member of the Sheva' Formation, of a brackish-marine facies, was deposited soon after. The bioclastic limestone of the Ziqlag Tongue that reached as far as the Yeroham Basin was deposited during the peak of the transgression. The new Pliocene transgression deposited the sandy Upper Member of the Sheva' Formation. In the Be'er Sheva' area, the continental Hazeva Formation and its top conglomerate interfingers with the Sheva' Formation. The Ziqlag Formation indicates shallow, warm water conditions, with deposition of coralline, algal and milleporid biolithites, mollusk banks and bank-talus, mollusk-algal-foraminiferal biosparites and biomicrites, and also biodolomicrites. The Ziqlag Formation is considered a potential oil reservoir in the subsurface of the Coastal Plain.

The hydrogeology of the 'Ein Fashkha springs

Y. ECKSTEIN, *Geological Survey of Israel, Hydrogeology Division*

The springs of 'Ein Fashkha are located along the northern shore of the Dead Sea, east of a fault escarpment of Cenomanian-Turonian dolomites and limestones. The recharge area of these springs is mainly on the anticlines of the Judean Mountains, in the west. The spring waters have characteristic hydrochemical features which are directly influenced by the fossil salts of the pre-existing Lake Lisan. Waters of this lake penetrated into the Cretaceous calcareous formations on the eastern slopes of the Judean anticlines, and left behind their salts. Cyclic ground waters which today penetrate these formations are quickly acquiring the geochemical pattern of the Dead Sea. The waters are characterized by a Mg^{++}/Ca^{++} ratio of up to 3.5.

A different group of springs in the 'Ein Fashkha area is characterized by higher water temperatures. These thermal anomalies usually occur together with a high concentration of H_2S. These waters have chemical features similar to those of the waters of the Dead Sea, with the ionic relations: $Mg^{++} > Na^{+} > Ca^{++}$.

Oil exploration in the Shefela Region, Israel

ISRAEL Z. ELIEZRI, *Consulting Geologist, Tel Aviv*

Exploration for oil was concentrated in the past in two regions:

a. The Coastal Plain region along the Heletz trend, from Nirim in the south to Petah Tiqwa in the north.

b. In the northern Negev, along the exposed anticlinal axes.

The area between the northern Negev and the Coastal Plain was left relatively unexplored except for several scattered wells drilled in selected localities. This area was considered structurally a low basin, a conclusion derived from the gravity map, and from the Senonian, Eocene and Miocene rocks on the surface. No distinct structures were observed in either surface or subsurface.

Lately, new ideas have been expressed, which as a result called the attention of the oil companies to this area.

a) The Hebron and Judea Mountains, probably formed during the early Tertiary, are believed to be separated from the Shefela by deep-seated faults. During Cretaceous times the Shefela was higher, structurally and geographically, than the Hebron and Judea Mountains.

b) In the centre of the Shefela a low-gravity area is found (Mivtahim). If oil was generated in this area it could have migrated to the structures along its edges, which are the Helez trend, to the west, and the Qeren-Revivim–Ziqlag chain to the east.

c) The Lower Cretaceous sands are pinched out or lap along a hinge line between the Coastal Plain and the northern Negev, which creates the possibility of finding oil traps.

d) Gravity interpretation suggested several structures along the foothills.

e) Stratigraphic studies indicate changes in thickness of Upper Cretaceous and Lower Tertiary formations which may point to pre-Senonian structures.

f) In the Shefela region the Lower Jurassic and Triassic are still within the capacity of normal drilling operations.

These concepts have led to concentration of oil exploration along the southern Coastal Plain, the Shefela and the northwestern Negev.

On the occurrence of coal and amber in the Lower Cretaceous of Qiryat Shemona, northern Israel

A. FLEXER, *Department of Geology, Hebrew University of Jerusalem*

Fossil wood is known from several outcrops of Lower Cretaceous (Neocomian?) age in Israel (Ramon, Naftali Mountains, etc.). It was recently also found in the Qiryat Shemona quarry, in the uppermost strata of the Nubian Sandstone, which consists here of clayey sandstones and silts.

Most of the plants are preserved as coal; a few of them are limonitized.

The fossil plant structures are crossed by numerous veins of sulfides (pyrite, arsenopyrite?) and sulfates (gypsum).

A transparent amber of cognac-like colour was found nearby.

The more detailed mineralogical, petrographical and paleobotanical aspects are now under investigation.

Stratigraphy and facies development of the Mount Scopus Group (Senonian-Paleocene) in Israel and adjacent countries

A. FLEXER, *Department of Geology, Hebrew University of Jerusalem*

Published in *Israel J. Earth-Sci.* (1968) 17, 85–113.

Is the present the key to the past?

A. FLEXER, *Department of Geology, Hebrew University of Jerusalem, (Presidential Address)*

Geikie's maxim "the present is the key to the past" (1905), cited in all geological textbooks, is considered to be a fundamental geological principle. It serves as an effective tool for geological research and in geological teaching. This metaphor is actually derived from Hutton's principle of uniformitarianism (1785), which postulates the uniformity of natural phenomena.

Nowadays, having almost two hundred years of geological research behind them, geologists ask themselves: Is this doctrine still valid? Is uniformitarianism necessary? Has Geikie's maxim much credit?

The basic claims of opponents to the doctrine are the following:

a) Post-glacial phenomena, presently prevailing over the surface of the earth, are geologically atypical as they comprise only about two per cent of Post-Cambrian history. b) At present, the earth has a remarkably polarized morphology (high continents, deep oceans), a feature which is also abnormal in comparison to the past. c) The late geological periods are characterized by a rearrangement of geosynclines. d) The existence of short periods of mass-extinction of animal groups.

It is the opponents' belief that uniformitarianism is a dangerous doctrine.

Among the advocates, there is a tendency to consider natural phenomena (ice ages, mountain-building, etc.) to be of a periodic character. For them, present processes are of considerable importance in investigating the past. Moreover, among the advocates there is not any intention of treating uniformitarianism in a formal manner, but to express the view that without using present observations one cannot decipher the history of the earth. The assumptions expressing invariance of natural laws in space and time and that former changes of the earth's surface may be explained by processes now in operation, are fundamental to geology or to any other empirical science. By discarding these assumptions, no past deciphering is possible.

The dictum that the present is the key to the past must be regarded as a philosophical concept which may be applied for the reconstruction and the better understanding of natural phenomena.

Strike slip faulting in Sistan, south-east Iran

R. FREUND, *Department of Geology, The Hebrew University of Jerusalem*

An area of about 2,500 km^2 in the Sistan District of south-east Iran has been mapped in order to study a complex pattern of strike slip faults. The discussed area belongs to the Cretaceous-Tertiary flysch province which surrounds the blocks of Dasht-i-Lut and Djaz-Murian. The exposures in this desert area are excellent, and the fact that mineralization occurs along the faults facilitates their mapping and study.

The area is riddled by north-trending dextral and east-trending sinistral faults which range in length between half a kilometre and more than 100 km, and along which the horizontal movement is about 10–15% of the fault length.

The angle between the sinistral and dextral sets of faults, when measured through the compressional direction, ranges from 45° in the smallest faults, to 145° in the largest ones. This indicates that the strike slip faults rotate from their original position, which deviate by about 25° from the compressional stress, to 70–75° from this direction. This rotation is demonstrated by a simple wet sand model, and it is concluded that all faults which are due to shear must rotate away from the compressional stress during the deformation. Still, faults which are due to direct shear, such as nappes and "transform" faults, do not rotate.

The stratigraphy of the Hashefela and Saqiye Groups in HaShefela region

G. GVIRTZMAN AND B. BUCHBINDER, *Geological Survey of Israel, Oil Division, and the Institute for Petroleum Research and Geophysics*

The sedimentary sequence in HaShefela (Senonian-Middle Eocene) includes chalk, bituminous marl, marly chalk, silicified chalk and flint. HaShefela Group, comprised of this sequence, fills the synclinorium situated between the Hebron and Helez anticlines. The group attains a thickness of approximately 700 m in the middle of the synclinorium, and thins to 40–20 m at the margins. HaShefela Group unconformably overlies the Judea Group. It is unconformably overlain by the Saqiye and "Kurkar" groups. Unconformities and changing thicknesses within HaShefela Group indicate folding which began at least in the Turonian and continued at varying rates up to the Middle Eocene.

Sediments of the Saqiye Group are also found in HaShefela region. Sparse outcrops of the Ziqlag and Bet Nir formations are found in Upper HaShefela. In addition, the following formations crop out in Lower HaShefela: Bet Guvrin, Lakhish, National Park Volcanics and Yafo. The Saqiye Group reaches its greatest thickness in the subsurface of the Coastal Plain. In HaShefela region only relict exposures are found in a marginal facies.

The Saqiye Group contains two major transgression-regression cycles which reached HaShefela area. In the first cycle (Late Eocene to Early Miocene), the Bet Guvrin and Lakhish formations were deposited. In the second cycle (Late Miocene-Pliocene?), the Yafo, Ziqlag and Bet Nir formations were deposited.

All the above-mentioned units were mapped on a series of outcrop and subcrop maps.

Some structural patterns younger than the sediments of HaShefela group may be distinguished in HaShefela region. Some of these patterns are shown by geophysical surveys only. It is essentially a fault pattern, formed during the Neogene and Pleistocene, in the course of tectonic events in the Coastal Plain.

The Thyrrhenian in Israel, Lebanon and Cyprus

A ISSAR, *Geological Survey of Israel, Hydrogeological Division*

The finding of *Strombus* cf. *bubonius* Lmk. in conglomeratic calcareous sandstone at Rosh Haniqra at about 2 m above M.S.L, and of *Marginopora* sp. in calcareous sandstone about 4 m above M.S.L. at the same site, confirm the assumption stated previously by Avnimelech, Reiss and Issar that the occurrence of *Marginopora* sp. (which is a warm-water foraminiferid) in the subsurface of the central Coastal Plain of Israel may indicate a Tyrrhenian age.

Marginopora sp. was also found lately in a sandstone located south of Ras Beyrouth, Lebanon, at an altitude of 55 m above M.S.L.

The same fossil was reported by S. Moshkovitz from the northern coast of Cyprus from altitudes of 2–20 m above M.S.L.

It is therefore suggested to regard *Marginopora* sp. as an index fossil for the middle part of the marine Pleistocene in Israel, Lebanon and Cyprus.

Strombus bubonius is believed to be restricted to the upper part of the Middle Pleistocene.

It is also suggested to name the entire sequence with the warm-water fauna as Thyrrhenian; the earlier part, containing only *Marginopora* sp. and which reached up to 35–60 m above present sea level, as Tyrrhenian I, and the later part, containing both *Marginopora* sp. and *Strombus bubonius*, and which reached 2–15 m above present sea level, as Tyrrhenian II.

Brines, thermal springs and mineralization phenomena along the eastern coast of Sinai as compared to those of the Hot Deeps of the Red Sea

A. ISSAR**, E. ROSENTHAL*, Y. ECKSTEIN* AND R. BOGOCH*

The chemical composition of the brines found as formation waters in oil wells and emerging at the thermal springs along the western coast of Sinai are shown to have equivalent ionic ratios similar to those of the hot brines found in the three deeps on the bottom of the Red Sea.

Along the cliff close to the thermal spring of Hammam el-Far'un, on the shore of the Suez Gulf, iron mineralization, dolomitization and enrichment in heavy metals were observed. This mineralization is shown to be similar to that found in the cores collected from the Atlantis II, Discovery and Chain deeps of the Red Sea.

The thermal regime in the investigated area is characterized by high gradient foci (10–15 m/1 °C) occurring within areas having lower thermal gradients (up to 50 m/1 °C).

Similar phenomena have been observed in the region of the Hot Deeps. The metals found in the waters are believed to be connected partly with hydrothermal activity and partly with the leaching of sedimentary formations.

It is suggested that the hot brines in the deeps of the Red Sea may be submarine thermal springs draining out mineralized formation waters trapped in the sediments underlying the Red Sea.

* Geological Survey of Israel

** Geological Survey of Israel and Centre for Ground Water Research, The Hebrew University of Jerusalem

Sample preparation for the quantitative determination of clay minerals by X-ray diffraction

NURIT KAUFHER AND YAACOV NATHAN, *Department of Geology, The Hebrew University of Jerusalem*

All X-ray methods for quantitative determination of minerals are based on a comparison between the intensity of a certain reflection and that of a standard. This procedure in the case of clay minerals is full of pitfalls, for in addition to the usual absorption effects there are other complications due to the different crystallite sizes, the different degrees of crystallinity, preferred orientation, segregation effects, and probably more.

Careful preparation of the sample is therefore critical. This problem has recently been investigated by Gibbs (1965; 1968) and Quakernaat (1968). The "pipette on glass" technique (considered unacceptable by Gibbs) is presently being re-appraised in our laboratory, and a controlled sample thickness (15–20 μ) would appear to solve the problem of segregation which was formerly objectionable.

This technique has much to recommend it: it is by far the easiest way of preparing a specimen, a potent consideration when thousands of samples are required, as in geological investigations. Furthermore, the "pipette on glass" technique gives to the specimen a very good preferred orientation, resulting in better intensity relative to the background than do the other techniques which have been recommended. Finally, the "pipette on glass" technique is completely free of operator bias.

Marine transgression in the Jordan - Dead Sea Rift Valley during the Middle Pleistocene

Y. LANGOZKI, *Geological Survey of Israel*

Geomorphological analysis of the drainage pattern in the Judean Desert indicates the existence of some nickpoints in most wadis at various levels. One of the most pronounced levels was found at the recent Mediterranean Sea level. Moreover, the bottom of some valleys west of the Jordan Valley were found to be at the same level (Yavne'el, Bet She'an, Wadi Fari'a).

The existence of an erosive surface at − 20 MSL at the margins of the Rift Valley was mentioned by Quennell in 1958. In several places along the western margins of the Dead Sea, near M.S.L. and lower, sediments were found composed of clays, chalks and gravel beds, with a faunal assemblage indicating marine-brackish environments and a Pliocene-Recent age (Z. Reiss, personal communication). These sediments are found in limited patches, from HaMakhtesh HaQatan in the south (Shahar et al., 1967) through several locations in the Judean Desert up to a location near Nebi Mussa (Y. Shahar, personal communication).

The continuity of the nickpoints in the drainage pattern at the elevation of recent sea level and the upper boundary of late marine sediments at that level might be the product of the same marine transgression.

It seems that such a transgression occurred after the main tectonic movements which shaped the recent morphology of the Rift Valley. The age of the transgression might therefore be Middle Pleistocene. Moreover, during Mio-Pleistocene times oceanic levels were occasionally higher than the recent oceanic level. Some of the evaporite sediments in the Rift Valley may have been deposited from this water body.

The faunal assemblages which were found in the outcrops resemble those which were found in the wells 'En Gedi 2, and Jordan Exploration Co. Nos. 7 & 9. The latter were either deposited by earlier Plio-Pleistocene transgressions, or were locally downfaulted.

Upper Campanian ammonites from the Negev, southern Israel

Z. LEWY, *The Hebrew University of Jerusalem*

Over thirty species of ammonites were recognized in the upper Mishash Formation. in the Negev (southern Israel). Some of these species have a regional biostratigraphic importance and enable correlation with neighbouring countries like Jordan and Egypt, as well as with more distant ones like Tunisia, Angola, western Europe, southwestern central U.S.A. and Colombia, all of which belong to the western part of the Upper Campanian Tethys. Correlation by means of ammonites with the eastern part of the Tethys (Madagascar, India, Japan and Western Australia) during the Campanian is, however, difficult.

The upper part of the Mishash Formation with *Hoplitoplacenticeras vari* (Schlüter) and *H. coesfeldiensis* (Schlüter) at its base (Judean Mts., Arad, SE Makhtesh Hazera), is attributed to the early Upper Campanian (France, Germany, Poland, Madagascar and U.S.A.). Wherever the main phosphate horizon is not well developed (mostly in the Upper Campanian of anticlinal areas), there exists only a single, narrow, upper ammonite zone in phosphoritic limestone. The most important ammonites found in this horizon are: *Didymoceras* cf. *D. navarroense* (Shumard), *D.* cf. *D. simplicicostatum* (Whitf.), *Nostoceras hyatti* Stephenson, *N. helicinum* (Shumard), *Exiteloceras* sp., *Solenoceras humei* (Douvillé), *S.* cf. *S. reesidei* Stephenson, *Hoploscaphites* sp., *Hauericeras* (*Gardeniceras*) sp. and *Libycoceras khargense* Blanck. In some areas there are found between these two ammonite horizons some species of *Baculites* (among which is *B. palestinensis* Picard) *Libycoceras* sp. (Judean Mts., SE Makhtesh Hazera, and Rekhes Menuha), and *Didymoceras* sp. (Judean Mts., SE Makhtesh Hazera).

In the Oron phosphate field and in the SE flanks of the Hazera anticline, where the phosphorite beds may attain a thickness of 8 m, another ammonite zone exists, with different genera and species, e.g., *Menuites* sp., *Pachydiscus* cf. *P. ootacodensis* (Stoliczka), *Libycoceras afikpoense* Reyment and *Nostoceras draconis* Stephenson. Species of *Baculites*, *Nostoceras* and *Exiteloceras*, found in the lowermost beds of these phosphorites, occur in the upper ammonite zone (regular upper zone) in other places, apparently due to stratigraphic condensation (the thickness of the reduced phosphorite horizon there attains not more than 5–20 cm).

Ten years of research in water chemistry in Israel

S. LOEWENGART

Information collected during the last decade makes it possible to explain in many cases the connection between specific waters and the geological and meteorological factors determining their composition. The amount of respective data now available is enormous, but few authors have tried to follow up this connection.

There are many possibilities for using chemical data in applied hydrological research.

In Israel the concentration of ground waters is dependent — other factors being equal — on the permeability of the surface and on the storage capacity of the aquifer. Significant chemical differences are found between groundwaters in porous and karstic aquifers. The influence of the stratigraphic position of individual aquifers seems, however, to have been exaggerated in the past. The connate water concept has, in the author's opinion, to be entirely abandoned.

Concerning the Rift Valley, there is no contradiction between the evidence for one or more intrusions of the Mediterranean during the late Tertiary and/or early Pleistocene on the one hand and the origin of the Dead Sea salts from airborne transport on the other.

The quantity of salt deposits in the Rift Valley is probably much larger than originally presumed. There are data suggesting that the residual brine extends not only throughout the subsurface of the Rift Valley, including Lake Kinneret, but reaches out under the Valley of Yizre'el to the Mediterranean. The brine beneath Lake Kinneret is of a very uniform composition. Local differences exist, however, between Ca and Mg — a fact which in itself points to additional conclusions.

Compositional changes in sea water in contact with rocks

E. MAZOR, *The Israel Atomic Energy Commission and Weizmann Institute of Science*

Marine sediments are not in chemical equilibrium with ocean water although they were formed in it. When sea water comes in contact with sedimentary or magmatic rocks it reacts with them and its composition is changed. This process starts already in the interstitial waters of the sediments in the bottom of the sea, it takes place in sea waters infiltrating rocks on land (e.g., our Coastal Plain) and it is most pronounced in connate waters. The reactions of sea water with the various common rocks have rather constant directions, e.g., losses of Na, gains of Ca, Sr, Li, Br and occasionally Ra, and either losses or gains of Mg, K and SO_4.

The mineral waters of the Tiberias-No'it water association show similar deviations from oceanic composition. However, various workers have suggested, in various models, that these waters had a marine origin, and we further assumed that their compositional deviations are caused solely by reactions with rocks. The feasibility of this process was checked in a series of laboratory experiments and the first results are the subject of the present note.

Ten various rock samples (limestone, dolomites, marl, clay, bituminous shales, phosphorites and basalt) were powdered and stirred for 30 days with equal weights of sea water at 70°C. The analysis of the water at the end of the experiment revealed significant changes towards the composition of the Tiberias-No'it waters and towards connate waters (compare with Chave, 1960; White, 1957, etc.).

This was true for Na, Ca, Mg, K, Sr, Li, Br, SO_4 and Ra. Br was exceptional. It was found to be deficient in all samples, contrary to determinations in the normal natural waters which are as a rule enriched in it. Marine formation-waters have commonly Cl/Br ratios of about 100 (a value which is also common in the Tiberias-No'it waters), whereas sea water has a ratio of 300. How the Br is enriched is not clear. The problem is even more severe in the Fashkha springs which have Cl/Br ratios of 60 to 20(!). The Br cannot come in this case from mixing with Dead Sea water because the Dead Sea has a Cl/Br ratio of about 40 (but not 20!), and because no enrichment in other typical Dead Sea elements is observed. Neither can intensive evaporation be the cause as we deal with changes of the Br content in adjacent springs at Fashkha, and, furthermore, evaporation could not explain the general Br anomaly observed in sea water that comes in contact with rocks all over the world.

The future experiments will be directed mainly to this problem.

Hydrology, chemical and isotopical composition of the 'Ein Fashkha springs, Dead Sea Basin

E. MAZOR, *The Israel Atomic Energy Commission and the Weizmann Institute of Science* and M. MOLCHO, *The Israel Atomic Energy Commission*

The 'Ein Fashkha springs, on the western shores of the Dead Sea, have a discharge of thousands m^3/h and vary much in salt concentrations.

(a) Over 99% of the discharged waters belong to the previously defined (in the Rift Valley) Tiberias-No'it (T-N) water association. Their Cl content varies from 1700 to 3900 mg/l and the accompanying concentrations of SO_4, Br, I, Ca, Mg, Na, K, Sr and Li vary with it in good

correlation. These waters are rich in Rn and their temperatures are from 27° to 30°C. It is suggested that these T-N waters are a mixture of trapped ocean waters, diluted by both ancient and recent fresh waters. The relative Br content is remarkably high, the Cl/Br ratio being 23/65.
(b) Several small springs which discharge waters belong to the previously defined (in the Dead Sea basin) Zohar-Yesha (Z-Y) water group, which is compositionally a mixture of T-N and Dead Sea waters.

The D and O^{18} data fit well with this classification and may serve to identify the recent and ancient fresh waters involved. The tritium content is very low.

The Neogene sequence of the Tubas area

Y. MIMRAN, *Geological Survey of Israel, Mapping Division*

The Neogene sequence in the Tubas area overlies the Cretaceous units at an angular unconformity. The distinguished lithostratigraphic units are the probable equivalents of the Herod Formation and the Umm Sabune Conglomerate in the Poriyya area, and of the Hazeva Formation in the Negev.

The Neogene sequence is divided into three lithological units: 1) Lower Conglomerate; 2) "Red Beds"; 3) Upper Conglomerate.

The Conglomerates. The two conglomerates are very similar. They are nearly always covered by thick nari and soil, which makes their recognition difficult. Their most characteristic qualities are:
a) polymict components;
b) poor sorting (pebbles-boulders);
c) variable roundness and sphericity;
d) strong carbonatic to clayey cement, with reddish colouring;
e) no fossils of any kind;
f) smooth morphology.

The "Red Beds". This is a sequence of fine clastic rocks which include several kinds of evaporitic components. The two sediment types appear together. In the chalky marls and silts we find gypsum (in veins and disseminated crystals), dolomite rhombs and salt. The absence of fossils is also characteristic here.

The Fari'a anticline, on whose flanks the Neogene outcrops occur, is faulted by a system of SE-NW faults forming a set of horsts and grabens perpendicular to the anticlinal axis. The most prominent are the Fari'a, Buqei'a and Tayasir grabens.

These structural features have a direct influence on the Neogene sequence. There is a pronounced thickening towards the east (down the SE flank of the anticline), mainly of the middle unit (the fine clastic "Red Beds"). On the other hand, the Upper Conglomerate reaches further westward along the above-mentioned grabens. Moreover, the Upper Conglomerate may be also associated with other, less prominent faulting phenomena.

The stratigraphy of the Lower Cretaceous of Wadi Malih

Y. MIMRAN, *Geological Survey of Israel*

The Wadi Malih area is located at the structural axis of the Fari'a anticline. This intensively faulted structure displays the deepest stratigraphic exposure in central and northern Israel (excluding Mt. Hermon). About 200 m of the Jurassic section are exposed beneath the Lower Cretaceous sequence.

The total thickness of the Lower Cretaceous sequence is about 900 m. The following units were distinguished (from base to top): volcanic unit, sandy unit and carbonate unit.

I. *The volcanic unit.* The total thickness of this unit is approx 200 m and it is divided into 3 subunits: a. Lower flow of olivine basalt, 0–30 m thick; b. Tuffs, with a maximal thickness of about 130 m; c. Upper flow of trachyandesite, 0–58 m thick.

II. *The sandy unit.* This unit is divided into the pre-Aptian hematitic sandstones, and the calcareous to sandy oolitic limestones of the Lower Aptian. The total thickness is 200 m.

III. *The carbonate unit.* This is an approx 500 m thick unit, of Aptian-Albian age. It includes a cliff of biomicritic limestone at its base, several thin beds of calcareous sand, thick marls (sometimes including iron ovulites) with intercalations of biomicritic and biosparitic limestones, banks of sublithographic limestones, and dolomites, including several thin marly beds.

There is a good correlation between the upper part of the carbonate unit and the equivalent sequence exposed in the Jerusalem-Bet Shemesh area (Bentor, 1945; Arkin et al., 1965). The lower part of the sedimentary sequence is divided into the same lithostratigraphic units as those suggested by Heybroeck (1942) in S. Lebanon, and as used by Rosenberg (1957) in the Manara area.

The clays of the Ghareb-Taqiya formations in the Shefela

Y. NATHAN, *Department of Geology, The Hebrew University of Jerusalem.*

The range in clay mineral composition of the non-carbonate fraction of the Ghareb-Taqiya formations in the Shefela is as follows:

Montmorillonite	60 – 90 %
Kaolinite	0 – 20 %
Palygorskite	0 – 20 %
Illite	0 – 10 %
Sepiolite	0 – 5 %

The other minerals found in the insoluble residue are quartz, opal and clinoptilolite.

This mineralogical composition is very similar to that found in the same formations in the Negev, apart from two significant differences: a) palygorskite occurs much lower in the section; b) kaolinite persists to the very top.

The palygorskite occurrence in the Shefela may indicate a transition in facies between the Galilee and the Negev; the persistence of kaolinite indicates the existence of a small terrigeneous component at least up to the Landenian, which was perhaps derived from the Judea anticlinorium.

The definite identification of clinoptilolite, which also occurs in the Negev and the Galilee Taqiya Formation, is further evidence for the neoform nature of some of the sediments.

The electrolysis of molten basalt, its geochemistry and possible applications

M.J. OPPENHEIM, *Department of Geology, The Hebrew University of Jerusalem*

On electrolysis, a basalt melt undergoes marked geochemical differentiation towards each electrode. The metallic ions of low valency, namely Na, K, Fe^{2+}, Ca, Mn and Mg, become concentrated at the cathode. Towards the anode, there is a concentration of the metallic ions of higher valency — Fe^{3+}, P, Ti, Si, and Al; oxygen gas is released.

In terms of rock composition, the cathodic product would be alkaline and femic, containing an acid plagioclase and nepheline. The corresponding anodic rock is sialic, quartz-bearing, and contains a basic plagioclase.

Oxygen constitutes roughly one half the weight of common igneous rocks. It is assumed that the moon's surface is, for a large part, composed of silicate rock similar to those known on earth. It would accordingly be possible to supply the oxygen requirements of men working on the moon by electrolyzing lunar rocks. Mirrors could supply the necessary heat, utilizing the sun's rays, and the electricity could be generated by solar cells.

Note on Santonian chert beds in the Judean Desert

Z. REISS, *Department of Geology, The Hebrew University of Jerusalem*

Planktonic foraminiferid assemblages occurring in limestones and chalks intercalated by chert beds in the Wadi Qelt region (Judean Desert) indicate that the lowest post-Turonian chert beds in this region are of Late Santonian (*Globotruncana concavata* Zone) age. Phosphatic chalks separate Santonian from Early Campanian chalks, limestones and cherts in this region; these phosphatic strata correspond to the so-called "lower phosphorite" of the Negev. Environment-controlled benthonic foraminiferid assemblages rich in Buliminidae occur in central and southern Israel in Middle-Upper Campanian strata, but are present in the Judean Desert already in Upper Santonian chalks.

On the geochemical evolution of the ocean

E. SASS, *Department of Geology, The Hebrew University of Jerusalem (Presidential Address)*

It is postulated by many geologists that the chemical composition of the ocean (and atmosphere) has remained practically constant since the beginning of the Cambrian. This postulate is based on the Uniformitarian doctrine, on geochemical considerations concerning the time the various elements resided in the ocean, and on the persistence of life on earth.

In order to explain the assumed chemical consistency, various mechanisms were proposed. Some of the mechanisms utilize chemical mass balances, while others are based on thermodynamic equilibria.

A critical appraisal of the various evidence and mechanisms points toward probable and real changes in the chemical composition of the ocean. Furthermore, it is shown that the composition of the ocean is not, and cannot be, a result of a thermodynamic equilibrium.

An alternative concept is therefore proposed, according to which the chemical state of the ocean is regarded as one varying between certain limits. Weyl called the mechanism which can explain the consistency within certain boundaries a "negative feedback mechanism".

This concept is strengthened by many indications, which are, among others, based on changes in the intensity of orogenesis, changes in the volcanic activity, global occurrence of certain rock types at certain times, chemical and isotopical changes within particular rock types, and paleo-climatological changes.

This approach makes it possible to explain certain phenomena which are otherwise poorly understood, or to invoke mechanisms which have to be rejected if one adheres to the assumption of chemical constancy of the ocean. Among the examples are the Permian evaporites, the burial of organic carbon, and the great accumulation of Upper Cretaceous carbonates.

Neogene and Quaternary of the Marma Feiyad area, south of Bet She'an

N. SCHULMAN, *Department of Geology, The Hebrew University of Jerusalem*, and E. ROSENTHAL, *Geological Survey of Israel, Hydrogeology Division*

Published in *Israel J. Earth-Sci.* (1968) 17, 54–62

Lower Cretaceous stratigraphy of the Bet El (Ramallah) Mountains

E. SHACHNAI, *Geological Survey of Israel*

Lower Cretaceous rocks crop out along the structural high of the Ramallah anticline at several locations. They are (starting from the south): 1) South of 'Ein 'Arik, to the north of the Ramallah-Latrun highway; 2) 'Ein 'Arik; 3) 'Ein Qinya vicinity. In this location we have the lowest section. Lower Cretaceous outcrops are at their most frequent in this region; 4) El Mazra'a-El Qibliya-Abu Shukheidim-Kaubar region. Extensive exposures of the upper part of the section. A relatively deep section is found only near Mazra'a. This region is linked by outcrops with the 'Ein Qinya region. 5) Ajjul (Wadi el-Ish). The deep wadi cuts through the northern plunge of the Ramallah anticline, exposing Lower Cretaceous rocks.

If the lower part of the Kefira Formation (Itzhaki et al.) is of Albian age, the distribution of Lower Cretaceous rocks increases and we obtain nearly continuous outcrops from the south end to the north end of the Ramallah (1:50,000) map, along the anticline axis.

According to a measured section in the 'Ein Qinya region there are 180 m of exposed Lower Cretaceous formations, not including the Kefira Formation. The Lower Cretaceous sequence includes four formations:

1) Orbitolina series. This sequence is known from Manara (Rosenberg, 1956; Reiss, 1961), Rami (Nevo, 1956), Maghar (Golani, 1957) and Beit Jann (Eliezri, 1959). The exposed thickness of the formation is 875 m. Three members can be distinguished: a) The lower, hard member (14.5 m), b) The middle, weathered member (43.5 m), and c) The limestone and marl member (29.5 m), which contains *Engonoceras* sp.

2) 'Ein Qinya Formation — 57 m. This name is proposed for a continuous sequence of massive or pseudoconcretional, mainly detritic limestones, well bedded, with well-defined recognizable bottom and top, but otherwise indivisible in the field. The sequence is very rich in microfauna and macrofauna, including *Engonoceras* sp. and a rudistid reef. The lower 17.5 m are identical, petrographically and microfacially, with the Zumoffen cliff "A" (Reiss, 1961) of Manara. There is some cross-bedding in the sequence. At one locality a 30° inclination (disappearing laterally) is observed between two horizontal strata. This phenomenon led Blake (1932) to suggest an unconformity between the Aptian and Albian strata near 'Ein Qinya.

3) Qatana Formation — 40 m. This formation includes 40 m of limestones and marls, with a rich microfauna and macrofauna, including *Knemiceras* sp. The limestones are mainly of the biomicrite type, pseudoconcretional, with marl, heavily encrusted with nari. The marls appear in the field in the form of nari. The formation changes thickness laterally and in Wadi el-Ish (near Ajjul) it reaches 52.5 m.

4) Kefira Formation — 171 m. A thick, highly cavernous, well-bedded sequence, with some interlayered marl and chert. The limestones are of the micrite and biomicrite type, containing layers rich in rudistids, *Strombus incertus* (d'Orb.) and echinoids. The Albian-Cenomanian contact occurs in this formation, approximately 100 m above the base.

Marine Pliocene (?) strata in the Nebi Musa region

Y. SHAHAR, *Geological Survey of Israel, Mineral Resources Division*

A 3 m layer of grey chalk was found in the vicinity of Nebi Musa (18855/13230) near Jericho, on the eastern flanks of the Mar Saba anticline. The chalk overlies a bed of conglomerate up to 2 m thick which, in turn, overlies the Ghareb chalk. The conglomerate is composed of well-sorted pebbles of limestone, chert and chalk in a marly matrix. Several horizons of grit were encountered. The bed of chalk passes horizontally and vertically into the conglomerate. Elsewhere it is truncated to half its thickness. The upper part of the conglomerate is composed of unsorted pebbles of chert and limestone. The chalk bed dips 15° N whereas the Ghareb chalk dips 5° SE. The chalk contains Pliocene marine ostracods and foraminifera.

Another outcrop with a similar lithological composition and faunal assemblage was found at the eastern entrance of HaMakhtesh HaQatan. Micropaleontological determinations (Z. Reiss) indicated a Neogene (Pliocene ?) age and a shallow marine-brackish environmemt of deposition. Both outcrops are reminiscent of the Bira Marl (Schulman, 1959). Similar occurrences were reported by Langozky along the western margins of the Dea Sea Graben (oral communication).

It is noteworthy that the two outcrops are located exactly at MSL, a fact which may have paleogeographic implications.

Structural and metamorphic history of the Elat Massif

ARYEH E. SHIMRON (SMAJOVIC), *Department of Geology, The Hebrew University of Jerusalem*

A study of the structural geology and metamorphic petrology of the Elat Massif has revealed at least four generations of folding and their relationship to the metamorphic history. The first and second phases of folding, F_1 and F_2, are the most widespread and are mainly responsible for the high-grade regional metamorphism of the area. The first phase (earliest) produced an axial-plane slaty cleavage (S_1) having associated micro- and mesoscopic intrafolial folds. Most first-phase structures have been destroyed or obscured by subsequent folding and extensive regional recrystallization. The second phase produced conspicuous E-W flexurial slip folds by folding of the first-phase cleavage planes. Major E-W lineations (L_2) and certain new axial planar schistosities (S_2) were produced. Tight, steeply plunging N-S cross folds form the third phase (F_3). The fourth generation of folding (F_4), appearing only in the southern portion of the massif, comprises meso- and macroscopic open recumbent folds and associated crenulations and crenulation cleavages.

Recrystallization accompanied deformation but was completed before the beginning of the fourth phase. The fourth and younger generations of folding are manifested by deformed polygonal arcs of micas.

Garnet and staurolite porphyroblasts began to grow during the interkinematic (IK_1) of the first and second phases, the growth of staurolite ending after the end of the second phase with garnet continuing to grow until after the third phase. Andalusite began to grow towards the end of the second phase and is mostly interkinematic between the second and third phases. Cordierite is synkinematic with the second phase but its growth continued until after the third phase. Fibrolite can be attributed to metasomatism by late granite intrusions and is postkinematic. Plagioclase augen and microcline occur mainly in a narrow contact aureole and are related to the emplacement of the early synkinematic granites.

Amphibolites are synkinematic with the first phase but their emplacement probably continued until after the second phase and remained gabbroic. Dolerites have been injected preferentially into axial-plane zones of second-period isoclinal or tight folds and are synkinematic with this phase.

The Elat granite was injected preferentially into probably reactivated cores of macroscopic F_2 folds during and after the third interkinematic (IK_3) phase. It has locally participated in fourth phase (F_4) folding movements and is therefore late syntectonic.

The plurifacial metamorphism is of the low-pressure amphibolite facies series type, closely resembling that of the Hercynians in the Eastern Pyrénées.

Geochemical methods for identification of potential source rocks for oil

R. SHORESH, *Institute for Petroleum Research and Geophysics, Azor*

The Institute for Petroleum Research and Geophysics has been conducting a geochemical research project for several years with the aim of identifying potential source rocks for oil in Israel.

Samples collected in various wells were analyzed for organic carbon content and for gaseous hydrocarbons in the methane-hexane (C_1 to C_6) range, and their variations in the lithological columns of various formations were correlated and interpreted.

Gaseous hydrocarbons were determined by gas chromatography; organic carbon was determined by burning the sample in an oxygen atmosphere. A relatively high content of both these constituents may point to potential oil-bearing formations. Up to now several such formations have been determined and some of them have been linked to present hydrocarbon production (‘Arqov, Kidod, Gevar‘am and Saqiye formations).

Habitat of phosphate in Senonian and Maastrichtian chalks in Galilee

A. STARINSKI AND A. FLEXER, *Department of Geology, The Hebrew University of Jerusalem*

The nature of the deposition basins of the Negev differed markedly during Senonian and Maastrichtian times from the nature of those of Galilee. This is evident from the nature of the sediments deposited during these periods. Large quantities of phosphate and chert are encountered in the Negev Basin, whereas only small amounts, or none at all, occur in Galilee.

The phosphate plus clay content, and various other parameters (lithology, thickness, benthos/plankton ratio), were employed as indicators of depositional conditions.

The average phosphate content in Galilee sections of Santonian, Campanian and Maastrichtian ages is 0.07%, 1.10% and 0.25% respectively (on the basis of 300 samples). The composition of the phosphate content of any given time-rock unit in Galilee and in the Negev revealed, as anticipated, a marked enrichment of phosphate in the latter region. However, since the Galilee sections are thicker than those of the Negev, the absolute quantities of phosphate deposited during the same period in these basins were approximately the same. Thus, the 7.5 m-thick phosphate horizon in the Oron area, having an average P_2O_5 content of 20%, is approximately equivalent to four m of pure phosphorite. The 100 m-thick Campanian section at Zefat, with an average P_2O_5 content of 1.13%, is equivalent to three m of pure phosphorite.

The rate of phosphate deposition varies for different periods and was highest during the Campanian. However, the rate of deposition of clay during this and subsequent periods (including Paleocene) was constant (see Table I).

TABLE I

Period	*Duration of period in millions of years*	*Average thickness in metres*	*Average %*		*Rate of deposition, cm/million years*	
			P_2O_5	*clay*	*P_2O_5*	*clay*
Santonian	6	30	0.07	2	0.35	10
Campanian	6	45	1.10	8	8.2	60
Maastrichtian	6	30	0.25	11	1.2	55
Paleocene	12	15	0.50	45	0.6	55

A definite relationship exists between the contents of foraminifera (benthos/plankton ratio), phosphate and clays. The benthos/plankton ratio, believed to serve as an indicator of bathymetry and also, indirectly, of distance from the continent, increases with increasing value of the P_2O_5/clay ratio.

The En Zeitim Formation in Galilee is devoid of chert and the problem posed is to identify the sections of the Mishash and Menuha formations in the Negev which were deposited synchronously with it. One of the aims of this investigation is to establish reliable means for the lithostratigraphical correlation between the Negev sections and those of Galilee. The benthos/plankton ratio and phosphate content may be of help.

Chert "dikes" — diagenetic deformation structures in the Senonian of the southern Negev

GIDEON STEINITZ, *Department of Geology, The Hebrew University of Jerusalem*

Small, dike-like, elongate structures, having a common parallel trend, have been found protruding from the chert beds of three stratigraphic zones in the Senonian of the southern Negev. These "dikes" are sedimentary structures which intrude and deform the layers overlying and underlying them. Their height varies from $^1/_2$ mm to 4 m, and the distance between adjacent "dikes" varies from a few millimetres to a few tens of centimetres.

The trend of the structures has been traced and mapped from the Har Shani — Nahal 'Eteq Be'er Ora region to the vicinity of Nahal Taba. In the whole area the trend of the structures is uniform, generally N5OE, somewhat more northerly (N2OE) in the vicinity of the 'Arava Graben.

The cherts composing the "dikes" are similar to all other Senonian cherts in the surveyed area and also to the cherts of the Mishash Formation (Campanian) of the Central and Northern Negev (Kolodny, 1967, 1968). The mineralogy is the same, and there are indications that the chert is a diagenetic replacement of unconsolidated calcareous sediment.

"Dike" cherts exhibit deformational features of a plastic and non-plastic nature. Plastic deformation is shown by the intrusive nature of the structures into adjacent strata and by the deformed primary (sedimentary) lamination within the "dike" chert. Non-plastic deformation is responsible for the heterogeneous ("breccoidal") structures in the chert. Similar heterogeneous structures are well known in other Senonian cherts of the Southern Negev and in the Mishash Formation. Petrographic examination and structural field evidence show that both plastic and non-plastic deformations are diagenetic. The following stages in the diagenetic development of the chert "dikes" are indicated:

1) Deposition of a calcareous sediment.
2) Initial silicification of the unconsolidated calcareous mud.
3) Plastic deformation.
4) Partial lithification of the deformed siliceous mud.
5) Non-plastic deformation ("brecciation") of lithified areas.
6) Continuation of carbonate growth in the cement of heterogeneous structures.
7) Silicification of the cement.
8) Final lithification.

Concerning the genesis of the "dike" structures, it is concluded that:

a) Siliceous sediments are liable to remain unlithified for rather long spans of time.
b) The process which caused deformation of the chert beds, forming the "dikes", originated within the beds themselves.
c) A considerable hydrostatic (confining) pressure existed, indicating in turn a considerable column of sediments overlying the chert bed at the time of deformation.

The suggested mechanism for the formation of the "dikes" is an intralayer diagenetic volume growth which results in an evenly distributed expansion (lengthening) of the siliceous layer, This in turn accounts for the evenly distributed and symmetrical deformation of the chert bed. The local and regional parallel orientation of the structures is due to a force acting within, and parallel to, the bedding plane, in a direction perpendicular to the trend of the structures. The development of this force can be explained only if a regional tectonic influence during the diagenetic deformation is assumed. The orientation of the structures may thus reflect the influence of configuration of the sedimentation basin.

The geological development and the dissolved salts in the Upper and Central Jordan Basin

E. WAKSHAL, *TAHAL Water Planning Ltd. and the Groundwater Research Centre, The Hebrew University of Jerusalem*

The accumulation of Upper Jurassic-Eocene strata within the described region follows to a great extent a system of highs and lows trending NE to NNE.

Concerning the vertical and lateral changes which are known to take place in the concentrations, occurrence and chemical composition of the dissolved salts in aquifers and hydrodynamic surfaces, the following controlling regime is proposed:

1) Fresh bicarbonate waters result from direct precipitation upon Jurassic (Mt. Hermon), Cenomanian-Turonian and Eocene replenishment areas, as well as on Neogene-Pleistocene basalts.

2) Sodium chloride waters (up to 24,000 mg/cl/1) with r Mg > r Ca. Such waters were found only in wells in the Jordan Rift Valley, south of the Korazim high, and penetrating clastics and basalts underlying horizontal marls of the Lisan Formation.

3) Sodium chloride waters with r Ca > r Mg, reaching concentrations up to 22,000 mg/cl/1, are found in varying lithologies of both Jurassic and younger ages, within the Rift Valley and outside it, suggesting issuance through fault and shear zones.

4) Calcium chloride waters (up to 60,000 mg/cl/1) were encountered in the calcareous Basal Jurassic-Top Triassic section of the Rosh Pinna 1 well.

5) Waters of varying qualities and salt concentrations resulting from the mixing of fresh waters (1) with the various waters described.

It is assumed that the source of types 3 and 4 is within Jurassic formation waters or evaporites of Triassic age whereas waters of type 2 were trapped at the end of the aquatic cycle of the Ubeidiya Formation (Lower? Middle Pleistocene).

The driving head of the present hydrologic system is explained by the hydrodynamic regime prevailing since the formation of the Jordan Rift Valley as a regional base level.

Some remarks on the Cretaceous-Eocene stratigraphy of the Judean-Samarian Mountains

Y. WEILER, R. FREUND AND A. FLEXER, *Department of Geology, The Hebrew University of Jerusalem*

Several excursions recently made to the Judean and Samarian Mountains shed light on our knowledge of the stratigraphy and facies of the Cretaceous-Eocene rocks of the country. Several factors were noted:

a) Upon examination, Blake's (1936, p. 64) unconformity between Aptian and Albian strata, exposed near 'Ein Qinya (4 km west of Ramallah), turned out to be a mega cross-bedding phenomenon only. Strata underlying and overlying the inclined bioclastic beds are horizontal. The cross-bedding, repeated twice in the section, may be a reef talus feature.

b) Turonian strata exposed in the eastern parts of the Judean and Samarian Mountains resemble the Derorim, Shivta and Netzer formations of the Negev. Lower Turonian ammonites were found in limestone beds exposed along the eastern flanks of the Ramallah and the Buqe'a anticlines.

c) Additional quartz sand deposits were recorded in cavities within the Bi'na Limestone at localities near Rockefeller Museum, south of Talpiot, near Bethlehem, north of Teqo'a and near Bani Na'im, where the sand is quarried for use in the local ceramics industry. The occurrences are mainly of the Talpiot type (Weiler, 1966).

d) The Eocene strata of the Nablus basin are built of nummulitic, detrital, reefal limestones and foraminiferal chalks which intertongue laterally with each other.

Flint beds alternate with both lithofacies types. It appears that the ratio of interfingering lithology bulks is indicative of the ancient bathymetry of the Nablus basin.

The lower part of the Eocene section is characterized by the occurrence of intraformational conglomerates, sliding and slumping phenomena. This can be explained by earthquakes or slight tectonic movements acting during Eocene time.

Several field sections were made; laboratory examinations of the samples and a photolithological map are now under preparation.

TABLE I

CORRELATION TABLE OF CRETACEOUS-EOCENE FORMATIONS OF THE JUDEAN MOUNTAINS

	Itzhaki et al., 1964		*Rofe and Raffety*, 1965	
Time units	*Group*	*Formation*	*Formation*	*Group*
Eocene		Zor'a	Jenin subseries	
Paleocene		Taqiye		Belqa
Maastrichtian	HaShefela	Ghareb	Unnamed subseries	
Senonian		Mishash		
		Menuha		
Turonian		Bi'na	Jerusalem	
Late Cenomanian		Weradim		
		Kefar Sha'ul	Bethlehem	Ajlun
	Judea	'Amminadav	Hebron	
		Moza	Yatta	
		Bet Me'ir		
		Kesalon	Upper Beit Kahil	
Early Cenomanian		Soreq		
		Giv'at Ye'arim	Lower Beit Kahil	
L. Cretaceous		Kefira		
		Qatana	Kobar	Kurnub

The stratigraphy of the Nubian sandstone in the Elat area

T. WEISSBROD, *Geological Survey of Israel*

Outcrops of Paleo-Mesozoic Nubian Sandstone appear in the Elat area (southern Israel) and extend from Yotvata southward to 'En Netafim. Similar sediments, an extension of those of southern Israel, are exposed in the adjacent countries, Jordan, Saudi Arabia and Sinai.

The stratigraphy of the Nubian Sandstone sequence in southern Israel is discussed in several papers and reports. The first comprehensive study of this sequence was carried out by Bentor and Vroman (1955). Lately, different parts of this sequence were studied in detail by Bartura (1966), Karcz and Key (1966) and Weissbrod (1966–1968).

The thickness of the exposed clastic series in southern Israel ranges between 250 and 500 m. It consists mainly of variegated sandstones which are arkosic in the lower part and feldspar-free in the upper part. Minor siltstone and clay layers appear in several parts of the section.

In the lower part of the clastic series some dolomite, dolomitic limestone and shale intercalations are present.

Fossils are rare. Trilobites indicating Lower Cambrian age were found in the shaly intercalations of the lower part of the sequence, whereas fossil plants and tree-trunks, probably of Lower Cretaceous age, were found in sandstones of the upper part. Besides these, only unidentified tracks and markings were found.

Criteria for the subdivision are mainly the lithology, mineral composition, colour, appearance in the landscape and the fossil content.

Due to lack of fossils in most of the formations, their age cannot be defined accurately. The stratigraphy is partly based on outcrops of southern Israel, partly on correlation with those of Sinai and southern Jordan. In the latter localities the exposed sequence is much thicker and more complete, and contains many more fossils throughout. Thus in southwestern Sinai the sequence contains, besides the units represented in southern Israel, also well-defined Carboniferous strata. In Jordan it contains also fossiliferous Ordovician and Silurian sediments.

The ages of the Netafim and Amir formations are uncertain. The Netafim Formation can be of any age from Upper Cambrian to Upper Devonian, and the Amir Formation can be from Upper Carboniferous to Lower Cretaceous. These problems are now under study.

Sulphides and Oxides in Igneous Rocks of the Timna Massif

U. S. WURZBURGER

The investigation was concerned with the study of the opaque minerals contained in some of the rock types previously described (Zlatkine and Würzburger, 1957; Bentor, 1961). The Cu-S system minerals occur in two rock types of the Timna igneous complex:

1) In a granite, termed the porphyroid granite by Zlatkine and Würzburger (1957). The sulphides occur in veinlets varying in width from 0.5 mm to 3 mm.

2) In a dike rock of quartz porphyry which is younger than the granite. The sulphides in this rock are more or less randomly distributed, or occur along minor cracks.

Three minerals of the Cu-S system were identified: chalcocite (Cu_2S), digenite ($Cu_{1.8}S$) and covellite (CuS). In the porphyroid granite, the assemblage of chalcopyrite, digenite, chalcocite and covellite was found. The younger quartz porphyry dike rock contains only chalcocite and covellite. The alteration products were green minerals, mainly paratacamite, malachite and chrysocolla.

At a wave length of 589 nm, the reflectivity of chalcocite varies between 25 and 32.5%, of digenite between 22 and 24%, and covellite, with its very strong pleochroism, yields maximal values between 15 and 20% and minimal values between 4.6 and 5.4%.

In the ultrabasic rock termed olivine gabbro an association of pyrrhotite-pentlandite-chalcopyrite occurs as grain aggregates, varying in size from 0.02 to 0.3 mm.

The olivine gabbro contains two types of magnetite: 1) Chromian magnetite, a primary anhedral chrome-bearing magnetite varying in grain size from 0.01 mm to 0.1 mm. This magnetite is dispersed throughout the rock without any preferred orientation relative to the silicate crystals. The electron probe microanalyses indicated a composition of about 64.2% Fe and 8% Cr. No traces of Ti were noted. The reflectivity is about 17% at 589 mm; 2) A second type of magnetite in the same rock appears within the altered olivine crystals in the form of small veinlets. Their length varies from 0.01 to 0.5 mm and their width from 0.02 to 0.01 mm. No traces of Cr were detected in this magnetite.

Magnetite and titanomagnetite crystals in rocks of intermediate composition (diorite, monzonite, etc.) are partially oxidized to hematite or titanohematite. Titanomagnetite contains ilmenite exsolution lamellae elongated parallel to their 0001 direction and oriented in the 111 planes of the magnetite.

Pyrite and its oxidation product hematite are found in a dike of quartz porphyry.

The copper sulphides are considered to be of hydrothermal origin. However, the chalcocite and covellite of the quartz porphyry may be of a later stage and lower temperature than the sulphides in the porphyroid granite which includes also chalcopyrite and digenite.

The genesis proposed for the Ni-Fe-Cu sulphides in the olivine gabbro is an early magmatic liquid sulphide segregation and relatively late sulphide crystallization. The chromian magnetite seems to have crystallized at an early stage, before the silicates, and the second generation of magnetite formed at low temperatures as a result of the alteration of olivine.

Sulphide ore bodies of early magmatic or hydrothermal origin may be found in depth.

Sequence of evaporation in Mount Sedom halite, according to the Cl/Br ratio

I. ZAK, *Department of Geology, The Hebrew University of Jerusalem*

The Cl/Br ratio has been determined in composite beds of rock salt from Mount Sedom. Most of the beds are composed of layers in each of which the Cl/Br ratio decreases upwards or remains uniform. No regularity in the Cl/Br ratio has been found between successive layers in the same bed. The top and bottom relationships in the section were verified through an investigation of sedimentary structures. It is assumed that each layer was deposited during a single season. Each layer seems to correspond to one influx phase followed by varying degrees of evaporation.

MEMBERS OF THE ISRAEL GEOLOGICAL SOCIETY, 1969

Name	Address	Position	Place of work
Ailon, Avner	The Hebrew Univ. of Jlm.	Student	
Aizin, Binyamin*	3 Shilo St., Tel Aviv	Geologist	
Aizenberg, Bezalel	38 Frug St., Tel Aviv		
Aizenberg, Eitan	19 Balfur St., Bat Yam	Geologist	Netivei Neft, Tel Aviv
Aisenstein, Boris	10 Arlosoroff St., Jerusalem	Mining Engineer	Tahal, (5)
Almagor, Gidon	74 Tchernichovski St., Jlm.	Geologist	G.S.I. (3)
Amiran, David	9 Alfasi St., Jerusalem	Prof. of Geography	The Hebrew Univ. of Jlm.
Amit, Ora*		Geologist	
Arad, Arnon*		Geologist	G.S.I. (3)
Arkin, Yaakov*	54 Harlap St., Jerusalem	Geologist	G.S.I. (3)
Atzmon, Emanuel	9 Ben Yehuda St., Be'er Sheva	Prof. of Geology	Univ. of Negev, Be'er Sheva
Avnimelech, Moshe	6 Ahad Ha'am St., Jerusalem	Prof. of Geology (Honorary Member)	The Hebrew Univ. of Jlm.
Axelrod, Shimshon	60 Horev St., Ahuza, Haifa	Geologist	Chemicals & Phosphates Co., Haifa
Baida, Uri*		Geologist	Tahal (5)
Beit Gordon	Degania A		
Bakler, Nathan	5 Yitzhak Sadeh St., Qiryat Ono	Geologist	G.S.I. (3)
Bar-Deroma, H.	P.O.B. 802, Jerusalem		
Bar-Ilan, Haim	137 Haro'eh St., Ramat Gan	Mud Engineer	Israel Nat. Oil Co., T.A.
Bar-Yosef, Yosef*		Geologist	Tahal (5)
Barner, Uri	6 Rosh Pinna St., Herzlia	Hydrogeologist	Tahal (5)
Bartov, Josef	2 Neve Granot, Jerusalem	Geologist	The Hebrew Univ. of Jlm.
Bartura, Ya'akov	7 Shikun Qiryat Moshe, Jlm.	Geologist	Timna' Copper mines, Timna'
Bashan, Amos	Nirim		
Bear, Reuven	2 Ahdut Haavoda St., Giv'ataim	Geologist	Tahal (5)
Begin, Binyamin	2 Gedeira St., Jerusalem	Geologist	G.S.I. (3)
Bein, Amos	72 Anilevich St., Jerusalem	Geologist	I.P.R.G. (1)
Beyth, Michael*	3 San Martin, Jerusalem	Geologist	G.S.I. (3)
Ben-Avraham, Zvi	Hebrew University, Jerusalem	Student	
Bentor Yaakov, K.	6 Benei Berith St., Jerusalem	Prof. of Geology	Hebrew Univ. of Jerusalem
Benvenisti, David	11 Balfur St., Jerusalem	Teacher	Beit Hakerem Teachers Seminary, Jerusalem
Ben-Yair, Moshe	114 Rothschild St., Petah Tiqva	Chemist	The Israel Bureau of Standards
Biran, Dov	P.O. Box 21098, Tel Aviv	Documentation exec.	I.P.R.G. (1)
Blumenfeld, Dov	11 Alkalai St., Jerusalem	Geologist, Cartographer	G.S.I. (3)
Bodenheimer, Wolf	9 Jonathan St., Jerusalem	Prof. of Chemistry	G.S.I. (3)
Bogoch, Ron	113/62 Brazil St., Jerusalem	Geologist	G.S.I. (3)
Bowman, Dan	23 Bayit Vegan St., Jerusalem	Geomorphologist	Hebrew Univ. of Jerusalem
Braun, Moshe	2 Hisachon Levinyan, Jerusalem	Geologist	G.S.I. (3)
Brenner, Isaac	9/16 Meir Avner St., Jerusalem	Geologist	G.S.I. (3)
Buchbinder, Binyamin*	P.O. Box 2281, Jerusalem	Geologist	I.P.R.G. (1)
Buri, Moshe	Hebrew University, Jerusalem	Student	
Bejarano, Isaac	Sa'sa', D.N. Upper Galilee		
Carmi, Pinchas	605/2 Eilat	Geologist	Timna' Copper Mines, Timna'
Coates, Joseph	Wildflower House, Shodbon Leominster Herefordshire, Eng.	Geologist (Honorary Member)	
Cohen, Frits	7 Golomb St., Qiryat Ono	Geologist	Belco Petroleum, Tel Aviv
Cook, Philip		Geologist	G.S.I. (3)
Dan, Joel	28 Spinoza St., Rehovoth	Pedologist	Volcani Inst., Rehovoth

* Temporarily abroad

Name	Address	Position	Place of work
Davis, Barry K.		Geophysicist	Lapidoth (2)
Debenedetti, A.*		Geologist	
Derin, Baruch	6 Habe'er St., Ramat Gan	Micropaleontologist	Israel Inst. of Petroleum (4)
Deutsch, Joets	2 Ben Zion St., Jerusalem	Chemist	G.S.I. (3)
Druckman, Yechezkel	7 Sharon St., Jerusalem	Geologist	I.P.R.G. (1)
Ecker, Amos	35 Harav Berlin St., Jerusalem	Hydrogeologist	G.S.I. (3)
Eliash, Moshe	Hukok, D.N. Korazim	Teacher	
Eliezri, Israel Z.	9 Shivtei Israel St., Ramat Hasharon	Geologist; Business Administrator	Israel National Oil Co., Ltd.
Erez, Jonathan	36 Nehemia St., Haifa		
Eyal, Moshe	Sa'ad, D.N. Hanegev	Geologist	Hebrew Univ. of Jerusalem
Eyal, Yehuda		Geologist	Univ. of the Negev, Be'er Sheva
Feldman, Uri	105a Iris St., Qir'on	Geographer	
Fink, Moshe	51 Zahal St., Qir'on	Geologist	Tahal (5)
Fisher, Yoel	7 Balaban St., Holon	Geologist	Israel Nat. Oil Co., Tel Aviv
Fleischer, Ezra	4 Ben Yefune St., Jerusalem	Hydrogeologist	G.S.I. (3)
Fleischer, L.	25 Mesilat Ha'olim St., Holon	Geologist	Lapidoth (2)
Flexer, Akiva	10 Aluf Simhoni St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Fo'a, Pamela Esther	4 Sa'adya Gaon St., Jerusalem	Hydrologist	Hydrological Service, Jlm.
Folkman, Yehoshua		Geologist	I.P.R.G. (1)
Foner, Henry	14 Bolivar St., Jerusalem		
Frankel, Jack Joseph	Univ. of New South Wales, P.O. Box 1, Kensington, N.S.W. 2033 Australia		
Frenkel, Elias K.	4 Bayit Vegan, Jerusalem	Physician	Hebrew Univ. of Jerusalem
Friedman, Gerald M.	32 34th. St., Troy, N.Y. 12180, U.S.A.	Prof. of Geology	Rensselaer Polytechnic Inst.
Ganor, Eliahu		Climatologist	Hebrew Univ. of Jerusalem
Gaon, Moshe	29 Alfasi St., Jerusalem	Chemist	
Garfunkel, Zvi	24 Yehoshua Bin Nun St., Jlm.	Geologist	Hebrew Univ. of Jerusalem
Gavish, Eliezer	2 Bustanai St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Gavish, Uri			Inst. For Negev Research, Be'er Sheva
Gerry, Ephraim	P.O. Box 17221, Tel Aviv	Micropaleontologist	Israel Inst. of Petrol., T.A.
Gilad, Dror	12 Hirschenberg St., Jlm.	Hydrogeologist	Hydrogeological Service, Jlm.
Gilboa, Yaakov*	28 Hatsalbanim St., Haifa	Geologist	Tahal (5)
Gill, Gavriel*		Geologist	
Gill, Dan*		Geologist	
Ginzburg, Avihu	17 Chaim Cohen St., Petah Tiqva	Geophysicist	I.P.R.G. (1)
Ginzburg, Dov	1a Hapalmach St., Jerusalem	Geologist	G.S.I. (3)
Glick, Alexander	7 Ramban St., Jerusalem	Engineer	
Golani, Uri		Geologist	
Goldberg, A.	Ein Harod, Ihud	Teacher	
Goldberg, Moshe	Beit Zayit 63, D.N. Harei Yehuda	Geologist-Stratigrapher	G.S.I. (3)
Goldberger, Mordechai*	4 Lieberman St., Tel Aviv		
Goldschmidt, Martin J.	34 Habannai St., Jerusalem	Hydrogeologist	Retired
Gottlieb, Martin	4 Shimon Hatarsi St., T.A.	Geologist	Tahal (5)
Golik, Avraham	19 Heasif St., Haifa	Geologist-Oceanographer	The Inst. for Oceanogr. & Lim. Research, 120 Ha'atzmauth St.
Gratch, Eitan			Israel National Oil Co., T.A.
Greenberg, Menachem	12/18 Ramat Dania, Jlm.	Geologist	G.S.I. (3)
Greitzer, Yeshayahu	35 Hasharsheret St., Afeqa, T.A.	Geologist	Tahal (5)
Gross, Shulamit	14 Herzog St., Giv'atayim	Geologist - Mineralogist	G.S.I. (3)
Grusovitch, Yoram	36 Hapalmach St., Jerusalem	Geologist	Hydrological Service, Jlm.
Hanreck, Ron G.S.	5 'Amminadav St., Jerusalem	Geologist	Ministry of Development, Jlm.

Name	Address	Position	Place of work
Harash, Arnon	20 Kaplan St., Rishon Lezion	Geologist	Tahal, Tel Aviv (5)
Hayati, Gideon	8 Hashofetim Ave., Qirat Motzkin, Haifa	Geologist	Technion Inst., Haifa
Herzog, Amos	9 Hamelech Koresh St., T.A.	Student	
Hildebrand, Nurit	Hebrew Univ. of Jerusalem	Student - Micropaleontologist	
Hirsch, Francis	CH-1200 Geneva		
Horowitz, Aharon	173 Hebron Road, Jerusalem	Palynologist	G.S.I. (3)
Inbar (Nisselbaum) Moshe	Ne'ot Mordechai, Upper Galilee	Teacher	Huleh Valley Regional High School
Issar, Arie	13 Rabinovitz St., Jerusalem	Hydrogeologist	G.S.I. (3)
Itzhaki, Yehoshua	1 Yiftah St., Jerusalem	Geologist	G.S.I. (3)
Jedidyah, Joash	Ramat Hashofet	Teacher	"Oranim" Teachers Seminary Qiryat Tiv'on
Kafri, Uri	12 Ramat Dania, Jerusalem	Geologist	G.S.I. (3)
Kanfi, Yaakov	7 Meir Avner St., Jerusalem	Student	
Karcz, Yaakov	92 Sderot Herzl, Jerusalem	Geologist	G.S.I. (3)
Kashai, Eliezer	48 Ha'atzmauth St., Bat Yam	Geologist	Lapidoth (2)
Kastner, Miriam*			
Katz, Amitai	77 Herzog St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Katz, Avraham		Mining Geologist	Oron Phosphates
Kimchi, D.	10 Carlebach St., Tel Aviv		Magal Co.
Klang, Alexander	18 Szold St., Petah Tiqwa	Geophysicist	I.P.R.G. (1)
Klein, Cippora M.	10 King George St., Jerusalem	Geographer	Hydrological Service, Jerusalem
Kolodny, Yehoshua	12 Bialik St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Kolton, Yaakov*		Geologist	Tahal (5)
Landes, Kenneth K.	2078 Natural Science Bldg., Univ. of Michigan, Ann Arbor, Michigan 48104, U.S.A.		
Langozki, Yosef	Neve Rassco 133/2, Ramat Hasharon	Geologist	Israel Defence Forces
Laronne, Eugen Y.	46 Ha'oranim St., Kfar Shemaryahu	Geophysicist	I.P.R.G. (1)
Lassman, Noach	39/4 Borochov St., Jerusalem	Geologist	G.S.I. (3)
Levanon, Amos	78 Arlosoroff St., Holon	Geophysicist - Geologist	I.P.R.G. (1)
Levite, Dov*	9 Hazon St., Jerusalem	Geologist	G.S.I. (3)
Levy, Itzhak	14 Narkis St., Qir'on	Geologist	G.S.I. (3)
Levy, Joseph	25 Hadror St., Ashkelon	Geologist	G.S.I. (3)
Levy, Zeev	16 Tzirlson St., Tel Aviv	Geologist	Hebrew Univ. of Jerusalem
Loewengart, Stefan	P.O. Box 1808, Haifa	Geologist - Chemist	Technion Inst., Haifa
Magaritz, Mordechai	1 Hanna Senesz St., Holon	Geologist	Hebrew Univ. of Jerusalem
Marcus, Ido			Netivei Neft Inc., Tel Aviv
Mart, Joseph		Economic Geologist	Timna' Copper Mines, Timna
Martionotti, Guido	58 Anilevich St., Jerusalem	Paleontologist	Lapidoth (2)
May, Paul R.	3379 South Dayton Court, Denver Colorado 80321, U.S.A.	Geologist	Ocean Exploration Co.
Mazor, Emanuel	6 Hagalil St., Rehovoth	Geologist	Atomic Energy Comm. & Weizmann Inst.
Meluvni, Alexander		Student	Hebrew University, Jerusalem
Merdler, Alfred	28 Avraham Shapira St., Ashdod	Geologist	Mekorot
Michaelson, Haim	24 Brodetsky St., Tel Aviv	Geologist	Tahal (5)
Mimran, Yaacov	24 Hapisga St., Jerusalem	Geologist	G.S.I. (3)
Mimran, Yehudit			
Mishraki, Samih	Kfar Rama	Geologist	Univ. of the Negev, Be'er Sheva
Mishnaevsky, Gideon	32 Shemaryahu Levin St., Jlm.	Geologist	

Name	Address	Position	Place of work
Mor, Doron	Kibbutz Merhavya	Teacher	
Moshkovitz, Shimon	46 Rachel Imenu St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Movshowitz, Mordechay	83 University St., Tel Aviv	Geologist	Tahal (5)
Moser, Frank	20 Beit Hakerem St., Jerusalem	Geologist	
Nachmias, Joseph	43 Mexico St., Jerusalem	Geologist	G.S.I. (3)
Nathan, Yaakov	12 Qore Hadorot St., Jerusalem	Geologist - Mineralogist	Hebrew Univ. of Jerusalem
Neev, David	7 Bialik St., Jerusalem	Geologist	G.S.I. (3)
Nevo, Eviatar	Sa'ar, D.N. Western Galilee	Biologist	Hebrew Univ. of Jerusalem
Nir, Dov	5 Haporetsim St., Jerusalem	Geographer	Hebrew Univ. of Jerusalem
Nir, Yaakov	Cottage 25, Motsa Illit	Marine Geologist	G.S.I. (3)
Nissenbaum, Arie			Weizmann Inst. Rehovot
Olami, Yaacov	14 Kadima St., Haifa	Engineer	Israel Electric Co.
Openheim, M.J.*	84 Herzl Blvd., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Orni, Efraim	38 Herzl Blvd., Jerusalem	Geographer	Jewish National Fund
Paparo, H.	P.O. Box 120, Azor	Geophysicist	I.P.R.G. (1)
Paporisch, Yehoyakim	29 Brandeis St., Tel Aviv	Geographer	University of Tel Aviv
Parnes, Abraham	38 Hanevi'im St., Jerusalem	Paleontologist (Honorary Member)	G.S.I. (3)
Peleg Yakov	140/13 Balfur St., Bat Yam	Pedologist	Soil Conservation & Drainage Dept., Tel Aviv
Perath, Itamar	55 Hebron Rd., Jerusalem	Geologist	G.S.I. (3)
Picard, Leo	16 Ibn Gvirol St., Jerusalem	Prof. of Geology (Honorary Member)	Hebrew Univ. of Jerusalem
Perrot, J.	P.O. Box 182, Jerusalem	Archeologist	
Pomerancblum, Malvina	Rue Senador Vergueiro, Apt. 210 Rio de Janeiro, Brazil	Geologist	
Price, Moshe	5 Remez St., Ramat Hasharon	Petroleum Geologist	Lapidoth (2)
Raab, Menachem	21 Yefe Nof St., Jerusalem	Paleontologist	G.S.I. (3)
Rabovsky, Yehuda	65 Herzl St., Tel Aviv	Hydrologist	Tahal (5)
Rabinowitz, Dan	54 Ibn Gvirol St., Tel Aviv	Geologist	Tahal (5)
Rahamim, Shlomo	6 El'Al St., Ramat Gan	Geologist	Lapidoth (2)
Reiner, Zeev*	19 Bustenai St., Jerusalem	Geologist	G.S.I. (3)
Reiss, Ze'ev	1 Ruth St., Jerusalem	Paleontologist	Hebrew Univ. of Jerusalem
Riber, Joshua	9D Simon Bolivar St., Jlm.	Geologist	G.S.I. (3)
Roded, Reuven	6 Rabbi Meir St., Jerusalem	Geologist	G.S.I. (3)
Rohrlich, Vera	51 Gilboa St., Haifa	Geologist	Technion Inst., Haifa
Ron, H.	Kabri, D.N. Western Galilee		
Ron, Zvi	22 Oren St., Haifa	Geographer	Haifa College, Daliya Rd,, Haifa
Rosenberg, Eliyahu	5/1 Ma'oz Aviv	Petroleum Geologist	
Rosenfeld, Amnon	41 Herzog St., Jerusalem	Micropaleontologist	G.S.I. (3)
Rosenthal, Asher	16 Disraeli St., Haifa	Geologist	Mekorot, Tel Aviv
Rosenthal, Eliahu	74 Tchernichovsky St., Jlm.	Hydrogeologist	G.S.I. (3)
Rot, Israel	Tsur Hadassa, D.N. Harei Yehuda	Geologist	G.S.I. (3)
Rothmann, Saul	6 Koveshei Katamon St., Jlm.	Geologist - Paleontologist	Hebrew Univ. of Jerusalem
Salzmann, Uzi*	144 Dizengoff St., Tel Aviv	Geologist	Tahal, Tel Aviv (5)
Sass, Eytan*	74 Tchernichovsky St., Jlm.	Geologist	Hebrew Univ. of Jerusalem
Sakal, Immanuel	2 Ya'abets St., Rehovoth	Geologist	Israel Defence Forces
Schneiderman, Nahum	80/10 Anilevich St., Jlm.	Geologist	Hebrew Univ. of Jerusalem
Schulman, Nachman	2 Neve Geranot, Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Schulman, Haim		Geologist	Hebrew Univ. of Jerusalem
Sevorai, S.	Beit Sturman, 'Ein Harod	Teacher	
Shahar, Ya'acov	2 Hasayarim St., 'Arad	Geologist	'Arad Chem. Industries, 'Arad
Shachnai, Emmanuel*	11 Ramat Dania, Jerusalem	Hydrogeologist	G.S.I. (3)

Name	Address	Profession	Place of work
Shadmon, Asher*	56 Nayot, Jerusalem	Engineering Geologist	Ministry of Development, Jlm.
Shafrir, Moshe	5 Hashomer St., Holon	Hydrogeologist	Tahal (5)
Shalmon, Shlomo	Gesher, D.N. Beit She'an	Teacher	Oranim Teachers Seminary
Shapiro, Baruch	Hebrew University, Jerusalem	Student	
Shenhav, Haya	13 Lloyd George St., Jerusalem	Geologist	G.S.I. (3)
Sherman, Jack	12 Aviv St., Neve 'Oz	Geologist	Netivei Neft, Tel Aviv
Shertok, Ehud	Hebrew University, Jerusalem	Student	
Shiftan, Ze'ev	6a Katzenelson St., Jerusalem	Chief Hydrogeologist	Tahal (5)
Shiloni, Simcha	31 Hehalutz St., Jerusalem	Geologist	Hydrogeological Service, Jlm.
Shiloni, Yair	Motsa Illit	Geologist	G.S.I. (3)
Smiluv, Gabi	Gal Ed, D.N. Megiddo	Geologist	Tahal (5)
Shimron (Smajovic) Aryeh E.	3/6 Neve Granot, Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Schlein, Naphtali	22 Brenda St., Petah Tiqwa	Geologist	Lapidoth (2)
Shelomi, Y.	Ga'aton, D.N. Western Galilee		
Shoresh, Rami	4 Eli Cohen St., Bat Yam	Geologist	I.P.R.G. (1)
Schwartz, Moshe	Hebrew University, Jerusalem	Student	
Silhov, Shalom	1209/8 Ussiskhin St., Ashquelon	Geologist	
Skolnik, Amiram	Kabri, D.N. Western Galilee	Zoologist	
Slatkine, Anatole	14 Palmach St., Haifa	Geologist	Technion Inst., Haifa
Slatkine, Frieda	14 Palmach St., Haifa		
Sneh, Amihai	59 Borochov St., Jerusalem	Geologist	I.P.R.G. (1)
Solel, Josef	7 Rashi St., Ramat Gan	Student	
Starinsky, Avraham	5 Shikun Yefe Nof, Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Steinitz, Gideon	9 Hameyassedim St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Steinitz, Heinz	23 Hehalutz St., Jerusalem	Zoologist	Hebrew Univ. of Jerusalem
Striem, Hans Ludwig	17 Herzog St., Giv'ataym	Geoscientist	Nuclear Research Center, Nahal Soreq
Tzur, Yoav		Geologist	Tahal (5)
Wachs, David	Hebrew University, Jerusalem	Student	
Wakshal, Eliyahu	33 Golomb St., Giv'ataym	Hydrogeologist	Tahal (5) & Hebrew Univ., Jlm.
Weiler, Yehezke'el	3 Hisachon Levinyan, Jlm.	Geologist	Hebrew Univ. of Jerusalem
Weissbrod, Tuvia	11 Koveshei Katamon St., Jlm.	Geologist	G.S.I. (3)
Weissman, David	47 Borochov St., Givataim	Student	
Weissman, Gedalia	4a Freud St., Haifa	Engineer	Technion Inst., Haifa
Wishkin, Yehoshua	53 Ben Zion St., Rehovot	Student	
Wolff, Ori	26 Groniman St., Tel Aviv	Geologist	Lapidoth (2)
Wolf, Aliza	32 Menuha Wenahala St., Rehovot	Student	
Wuerzburger, Uri S.	2 Ben Zion St., Jerusalem	Geologist	G.S.I. (3)
Yaalon, Dan	17 Eliezer Halevi St., Jerusalem	Geologist	Hebrew Univ. of Jerusalem
Ya'ari-Cohen, Gideon	14a Ehud St., Haifa	Pedologist	Dept. of Soil Conservation & Drainage, Tel Aviv
Yedidya, Yo'ash	Ramat Hashofet	Teacher	Oranim Teachers Seminary
Yuval, Zvi	P.O. Box 120, Azor	Geophysicist	I.P.R.G. (1)
Zak, Israel	32 San Martin Cottages, Jlm.	Geologist	Hebrew Univ. of Jerusalem
Ze'ira, Uri	Qibutz Merom Hagolan, Quneitra	Conservationist	
Zohar, Eliyahu	25 'Aza St., Jerusalem	Geologist	G.S.I. (3)

----

(1) The Institute of Petroleum Research and Geophysics, P.O. Box 120, Azor.
(2) Lapidoth, Israel Oil Prospectors Co., 19 Brodetzki St., Tel Aviv.
(3) The Geological Survey of Israel, 30 Malkhei Israel St., Jerusalem
(4) The Israel Petroleum Institute, 26 University St., Tel Aviv
(5) Tahal, Water Planning for Israel, 54 Ibn Gvirol St., Tel Aviv.

MEMBERS TEMPORARILY ABROAD

Name	Address
Amit, Ora	Federacion Zionista de Chile, Cossila 5007, Serrano 202, Santiago, CHILE
Arkin, Jacob	Embassy of Israel, Near Debre Zeit Rd., Addis-Ababa, ETHIOPIA
Arad, Arnon	Apartado Aeveo 2930, Barranquilla, COLOMBIA, S.A.
Beyth, Michael	Embassy of Israel, Near Debre Zeit Ro., Addis Ababa, ETHIOPIA
Baida, Uri	Asesor de Tahal, INCORA (of 513) C.A.N., Bogota, COLOMBIA
Bar-Joseph, J.	Apt. 803 Hermosillo, Son,, MEXICO
Buchbinder, Binyamin	Department of Oceanography, Texas A & M. College Station, Texas 77843, U.S.A.
Eisin, B.Z.	1821 Eaton St., Apt. 8, Denver, 80214, Colorado, U.S.A.
Gilboa, Y.	c/o OTI, Calle Bruch 150, Barcelona 6, ESPANA
Gill, G.	260 Bd. St. Germain, Paris VII, FRANCE
Gill, D.	1106 McIntyre, Ann Arbor, Michigan 48105, U.S.A.
Goldberger M.	38, Baterman Bd., Croxley Green, Rickmanworth, Herts, ENGLAND
Golani, Uri	Residencia Los Jardines P.H., Calle Los Jardines, La Florida, Caracas, VENEZUELA
Kestner, Miriam	Dept. of Geology, Harvard University, Boston, Mass. U.S.A.
Kolton, Y.	Coahila 462 North, Ciudad Obregon, Son, MEXICO
Levite, Dov	P.O. Box 3387, Addis Ababa, ETHOPIA
May, Paul	3379 South Dayton Court, Denver, Colorado, 80222, U.S.A.
Oppenheim, M.	Geological Museum, Exhibition Rd., London, ENGLAND
Reiner, Ze'ev	156 East 178 St., Bronx, N.Y. 10453, U.S.A.
Shachnai, E.	P.O. Box 3387, Addis Ababa, ETHIOPIA
Saltzman, U.	218-9 Nimitz Dr. West Lafayette, Indiana 49706, U.S.A.
Sass, E.	562 Castle Kirk Drive, Baton Rouge, La 70808, U.S.A.
Shadmon, A.	c/o U.N.D.P., P.O. Box 1864, Manila, PHILIPPINES