massive precipitation of halite in the evaporation ponds and in the southern basin are reflected by relatively low sodium concentration in the northern basin.

4) Bottom sediments and interstitial water

Bottom sediments from two sediment cores (50 cms long) taken at water depths of 240 and 320 m and six grab samples were analyzed. The predominent type of sediment is clayey silt, the major minerals are carbonates and clays. Halite was found in the deep water core only in concentrations ranging from 14 to 40% at depth intervals between 10 and 32 cms. Gypsum was found in concentrations ranging from 7 to 24%. Sulfide content ranges from 30 to 1230 mg/kg. Organic carbon averages 0.8%, and the ratio between easily oxidizable organic matter and organic carbon is 1.6.

Interstitial waters showed very little changes in their major ion content and ion to chloride ratios with depth in the core. Their chemical composition is similar to the overlying deep water of the Dead Sea. H_2S concentrations range from 190 to 265 mg/kg in the Dead Sea water column.

The interaction between bottom sediments and brines resulted in changes in concentration of the major ions in interstitial water which do not exceed 2% of the ionic concentration in the interstitial water, thus no major dissolution or precipitation of halite or carbonate took place. The decrease in sulfate concentration and sulfate to chloride ratios in interstitial water compared to overlying Dead Sea water and the dilution of H_2S in interstitial water and of sulfides in bottom sediments point to the reducing environment prevailing in the bottom sediments of the Dead Sea. Sources of sulfur for the formation of sulfides may be gypsum from bottom sediments and/or sulfate from the overlying Dead Sea water.

5) Suspended matter in Dead Sea water

A method for the determination of suspended matter concentrations in Dead Sea water samples was developed. Sampling was performed every two months in 5 stations during 1979/80. Water samples (10 litres) were taken from different depths in each station. The upper 30 m which were diluted by floodwaters were sampled every 5 m. At depths greater than 30 m samples were taken every 50 m. The samples were filtered and the brine was washed out, using organic solvents.

The suspended matter content ranged from 3 mg/l in the summer and fall to 30 mg/l in the winter. Especially high values were obtained in surface waters after the floods. The mineralogical composition was determined by X-ray diffraction. The major minerals are detrital quartz, calcite and kaolinite; minor amounts of mixed layered clays and illite were also detected. Evaporite minerals are not detected, apart from very low concentrations of aragonite and gypsum in a few near bottom samples. Mineralogical analysis of sediments collected in sediment traps during October 1980 showed a similar mineralogical composition. Sediments collected during November and December 1980 contained halite cubes. A comparison between the sediments collected in sediment traps in 1959 (Neev and Emery, 1967) and those collected during the fall of 1980 shows that while Neev and Emery found that about 86% of the sediment collected is composed of aragonite and gypsum, most of the sediment collected in 1980 is composed of detrital minerals; gypsum and aragonite form only about 2% of the sediment. Also halite was detected for the first time in sediment traps in November 1980.

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pH AND Eh CHANGES IN MARGINAL POOLS OF THE RED SEA: THEIR EFFECT ON CARBONATE FRACTIONATION

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Stromatolitic microbial ecosystems are among major sites of generation of fossil fuels and minerals because they dominate a depositional setting with a high preservation potential due to anaerobiosis (Friedman 1980).As a result of growth and metabolic activities these micro-organisms also precipitate calcium carbonate (Oppenheimer and Master 1965, Friedman and Sanders 1978, pp. 156-157). This depositional process is

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at present not understood but one explanation put forward is based on photosynthesis and its resulting pH changes.

Oppenheimer and Master (1965) observed pH changes in the range 7.4 to 9.2 in the supernatant sea water over samples of blue-green algae from Florida. These pH changes, which were diurnal in nature and paralleled the photosynthetic cycle, resulting in the dissolution of quartz and the precipitation of carbonate. The experiments were carried out in aquaria. We have attempted to reproduce the results of Oppenheimer and Master with algae taken from two sea-marginal pools of the Red Sea: The "Solar Pool" near Eilat, and the pool at Ras Muhammed, at the southern tip of the Sinai Peninsula.

A number of field trips failed to confirm Oppenheimer and Master's observations. Table 1 shows a series of typical measurements taken at the Solar Pool during the height of the summer. Similar results were obtained from the pool at Ras Muhammed. Measurements during the winter season were also essentially the same as those shown in Table 1.

Table 1. pH measurements* over 24-hour period, Solar Pool, Gulf of Elat, Red Sea (July 7/8, 1976).

Time	Above Algal Surface	1 cm Below Algal Surface	6 cm Below Algal Surface
1400	7.3	–	6.8
1600	7.2	6.8	6.6
1800	7.6	7.1	6.7
2000	7.5	6.7	6.6
2200	7.3	6.9	6.1
2400	7.6	6.6	6.1
0200	7.7	6.7	6.6
0430	7.6	6.9	6.6
0700	7.6	6.9	6.5
0900	7.6	6.8	6.6
1100	7.6	6.7	6.3

* Almost identical pH measurements were obtained on April 26, 1979, at the Solar Pool, and on September 28, 1978 and April 23, 1979 at the Ras Muhammed Pool.

Samples of the algae were transferred to the laboratory and an attempt was made to repeat Oppenheimer and Master's *in vitro* experiments. The pH values obtained were very similar to those shown in Table 1, and this was true whether the algae were immersed in their (natural) hypersaline water or in normal sea water.

Tables 2 and 3 show, respectively, the longterm changes in silica concentration and the longterm and diurnal changes in alkalinity over the algae: no evidence of quartz dissolution or of carbonate deposition can be discerned.

Table 2. Silica concentration in (1) waters from sea-marginal pools, (2) pool waters in experiments covering algal mats and quartz, and (3) pool waters from control experiments.

SiO$_2$ Concentration (mg SiO$_2$/ml)

	Solar Pool			Ras Muhammed Pool		
Date	Pool Water	Pool Water Covering Algal Mats and Quartz	Control	Pool Water	Pool Water Covering Algal Mats and Quartz	Control
5/13/79	11	24	26	8	18	20
5/20/79	10	28	29	8	21	22
6/13/79	9	26	20	8	19	20

Table 3. Alkalinity* of pool waters covering algal mats over a period of one month and during periods of alternating strong sunlight and darkness.

Alkalinity (as HCO$_3$, mg/l)

	Solar Pool				Ras Muhammed Pool			
	Sunshine		Darkness		Sunshine		Darkness	
Date	Sample	Control	Sample	Control	Sample	Control	Sample	Control
5/6/79	294	242	303	235	358	340	375	346
5/13/79	313	248	318	252	402	397	405	396
5/20/79	329	252	327	250	388	376	388	373
6/13/79	311	440	312	259	361	434	364	454

* Experiments took place in the presence of ground calcite.

Changes in concentration of silica were monitered over a period of one month. To control experiments, 0.5% mercuric chloride solution was added to stop biological activity.

All the algal systems examined in our experiments showed marked changes in redox potential when exposed to sunlight. Figure 1 illustrates this effect. Figure 2 shows how rapid these changes can be.

Both the laboratory specimens and the algal mats in situ (and the latter can be up to 1 m thick or more)
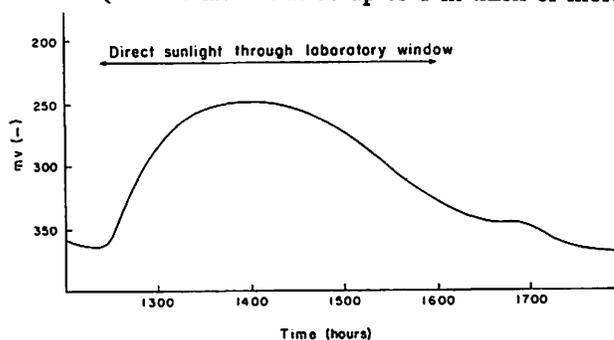

Fig. 1. Changes in redox potential of water covering algal mats. Note effect of exposure of algal mats to sunlight. Measurements employed Ag/AgCl - platinum electrode pair. For this laboratory experiment, algal mats and water were obtained from the Solar Pool.
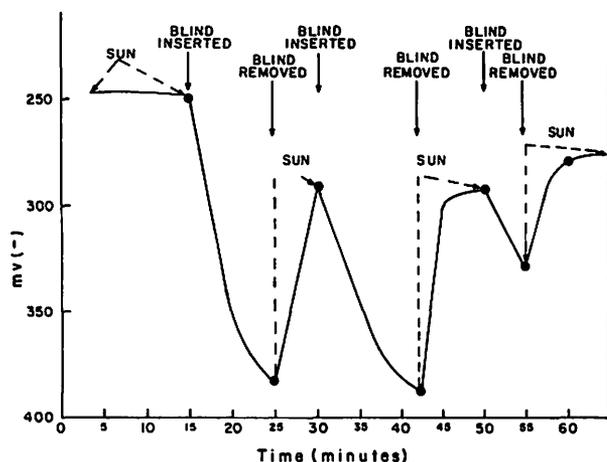
Fig. 2. Rapid effect of changes of illumination on the redox potential of water covering algal mats. In this experiment, a blind was periodically introduced to shield algal mats from sunlight. Measurements employed Ag/AgCl - platinum electrode pair. Algal mats and water from the Solar Pool.

produce large quantities of H_2S. This H_2S production appears to offset the CO_2 production which in Oppenheimer and Master's experiments caused pH fluctuations of up to 2 pH units. H_2 production typically occurs under the anaerobic conditions present in *thick* algal mats. It must, therefore, be concluded that in the type of geological setting studied, the reason for carbonate deposition is not due to pH changes caused by algal photosynthesis.

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POTENTIAL TERTIARY SOURCE ROCKS IN THE ISRAELI COASTAL PLAIN AND THE GULF OF SUEZ: A COMPARISON

Amos Bein and Ora Amit

The Tertiary section along the Israeli coastal plain is comprised of shales, marls and chalks which tentatively might be considered good source rocks. However, no oil has yet been found in this section. On the other hand, in the Gulf of Suez a considerable amount of oil was generated in Tertiary source rocks and is found in Tertiary reservoirs. In order to explain the lack of oil in the Tertiary sequence of the Israeli coastal plain versus its abundance in the Gulf of Suez, parameters identifying and qualifying source rock were evaluated. These parameters, which are discussed in Tissot and Welte (1978), claim to answer whether sufficient organic matter of the right type is present in a basin and whether the organic matter was exposed to temperature appropriate for generating oil.

Twelve core samples of the Israeli coastal plain, representing the Beit Guvrin, Ziqim, Mavqiim and Yafo Formations, taken from depths of 590 to 1950 m and ten core samples from two wells in the Suez area of lower and Middle Miocene taken from depths of 2060 to 2500 m were examined.

The organic carbon content in most of the samples is above 0.5%, indicating the presence of sufficient organic matter to generate oil.

In the Suez samples the n-alkanes in the C_{15}+ range fall mostly between n-C_{15-24} with a maximum at n-C_{17-19}; higher n-alkanes are very faint and do not show any preference. In the Israeli sequence there seem to be two n-alkane distribution patterns; in the first group only the relatively lighter n-alkanes (n-C_{14-22}) with a maxima at n-C_{15-17} were recorded. In the second group n-alkane up to n-C_{31} were recovered with a pronounced odd over even preference in the n-C_{25-31} range. In both groups the n-C_{22} is usually predominant over its adjacent n-alkanes. The lack of odd over even predominance in the n-alkane distribution patterns may either reflect maturation or may indicate lack of terrestrial derived organic matter. In the Suez area samples and the Israeli samples which do not show odd over even preference, the distribution pattern indicates marine derived organic matter rather than maturation as will later be discussed. In the Israeli samples which do show