NATIONAL GEOCHEMICAL SURVEY PROJECT

Ministry of Energy
& Infrastructure

Geochemistry of Stream Sediments in the Mount Carmel Area, Israel

S. ILANI, M. SHIRAV (SCHWARTZ) & L. HALICZ

Report GSI/15/92, Jerusalem, June 1992

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The National Geochemical Mapping Project aims at comprehensive sampling, analysis and interpretation of various geochemical parameters. These data are used in determining the natural geochemical background, locating mineralization occurrences and in designating anthropogenic activity causing enrichment of potential hazardous trace elements. This project is being carried out by the Geological Survey of Israel on behalf of the Earth-Science Research Administration of the Ministry of Energy and Infrastructure.

Part of the above project includes a stream sediment geochemical survey of the Mount Carmel area, and the evaluation of the data collected are presented in this report.

GEOGRAPHY

Mount Carmel is located in northern Israel, south of Haifa bay, between the Yisre`el Valley in the east and the Mediterranean coastal plain in the west (Fig. 1). The area is a mountainous longitudinal ridge extending overabout 20 km, in a NW-SE direction. The highest peak is 546 m above sea level; most of the area is in the range of 200 to 400 m asl. It is built mostly of Upper Cretaceous limestones, dolomites and chalks intercalated with volcanics.

The climate is Mediterranean-humid, with rainy winters (650 mm annual rainfall) and dry summers. Rendzina soils cover chalks in the northern and southern parts of the area, whereas terra rosa soils cover the limestones and dolomites in the center. Soils are relatively thin, ranging from 10 to 30 cm thick. Most of the area consists of rock outcrops usually forming a rugged landscape. Karstic phenomena occur mostly in dolomites and limestones, and to a lesser extant in chalk. Broad valleys have formed over volcanic tuff (i.e., Kerem Maharal) and are typically covered by dark brown, relatively thick, soils. The area is heavily forested, partly by natural growth, but most is artificially planted with pines and cypresses.

Approximately 20% of the area (the most northern part of the Carmel Mount, see Figs. 1 and 8) is occupied by the city of Haifa with a population of almost 300,000 and adjacent industrial areas. Two large

villages, 'Isfya and Daliyat el Karmel, are located along the crest of the mountain. The coexistence of adjacent urban and rural areas forms a unique setting for the study and comparison between geochemistry and trace element behavior.

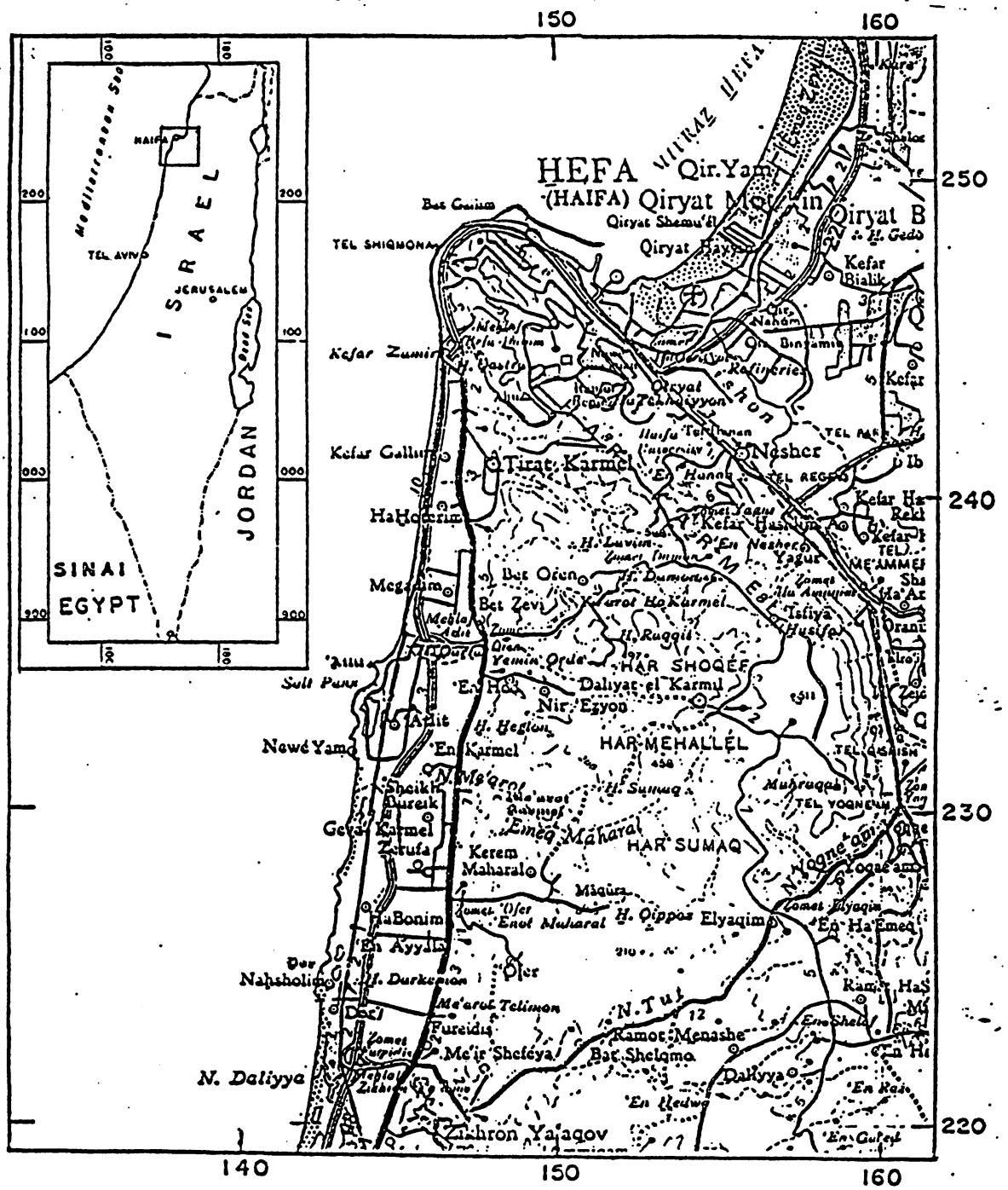

Figure 1: Location map

GEOLOGICAL BACKGROUND

The exposed rock sequence in the Mount Carmel area (Fig. 2) is composed mainly of Cenomanian to Turonian carbonate and volcanic rocks, forming block structures (Bein and Sass, 1980). The northern and eastern boundaries of Mount Carmel are delineated by faults. The western boundary follows Cretaceous reef bodies in a north-south trend, forming cliffs which were shaped by coastal abrasion during the Pleistocene. The southern border of Mount Carmel is marked by the Menashe Syncline composed mostly of Eocene and Senonian chalks. The rock sequence of Mount Carmel is varied both in facies and thickness due to diverse environments of continental slope, outer shelf, reef belt, shelf basin and inner shelf platform, that prevailed during Albian up to the Turonian times.

Continental slope sediments are represented mainly by alternations of calcilutites and finely laminated calcarenite, with abundant chert horizons. They are found in the subsurface along the western part of the coastal plain and are exposed at the foot of north-western part of Mount Carmel.

Sediments deposited in the outer shelf consist of limestones and chalks with some cherts. The rocks are mostly allochthonous calcilutite made up of skeletal debris and some autochthonous planktonic elements. Reefs are present throughout the entire sequence in the western part of the Carmel Mountains. They range from small patch reefs to large barrier reefs mainly built of rudists and some chondrodonts. The main textures are biolithites, packed biomicrites and biosparites.

The sediments of the shelf basin consist of lithoclast calcarenites, marly calcilutites and some small hippuritid patch reefs. Dolomites were the main deposits which accumulated on the inner shelf platform. The limestones of this environment consist mostly of miliolid biopelmicrites and some patch reefs and calcarenites.

Figure 3 presents a lithostratigraphic scheme of Upper Cretaceous rocks in the Mount Carmel area.

Volcanism

The volcanic rocks exposed in the Mount Carmel area (Bein & Sass, 1980) are of Late Cretaceous age. Most of these consist of basic pyroclastics associated with basaltic lavas. They form lenticular bodies at various levels within the stratigraphic sequence between the upper part of the Yagur Formation (Late albian to Early Cenomanian) and the lower part of the Senonian Menuha Formation (Fig. 3). Three main types of pyroclastic rocks, relating to the distance from the center of eruption and to the rate of accumulation are present.

a) Black to gray pyroclastics, usually massive, agglomeratic in places, containing volcanic bombs and xenoliths up to several meters in diameter. They are considered to represent near vent facies.
b) Varigated (gray, brown, red and green) pyroclastics, consisting of well bedded tuffs, lapilli tuffs and agglomerates up to 60 m in thickness, containing bombs and xenoliths of up to a few decimeters in diameter. These rocks represent accumulation on the steep flanks of volcanoes, at a distance of up to 1.5 km from the vent. The original cone was abraded by the sea before the deposition of the succeeding carbonates.
c) Yellow tuffs, usually fine-grained and well bedded, with bedding planes parallel to the adjacent carbonates, forming wide "blankets" up to 20 m in thickness. These tuffs were deposited relatively far from the cones, at a slow rate of accumulation.

Mineralization Occurrences

Some small epigenetic mineralization sites of iron and manganese-oxides were found and studied (Ilani et al., 1982; Ilani et al., 1985; Ilani et al., 1990). The mineralized features occur as discontinuous veins and lenses, varying from a few meters to tens of meters in length and from a few millimeters to several decimeters in width. They form fissure-veins along faults in the contact zone between the dolomites and limestones and the volcanics. The iron oxides are mostly goethite associated with some hematite (and jasperoid when enriched in silica). Chemical composition of four samples from iron-oxide veins are presented in Table 1.

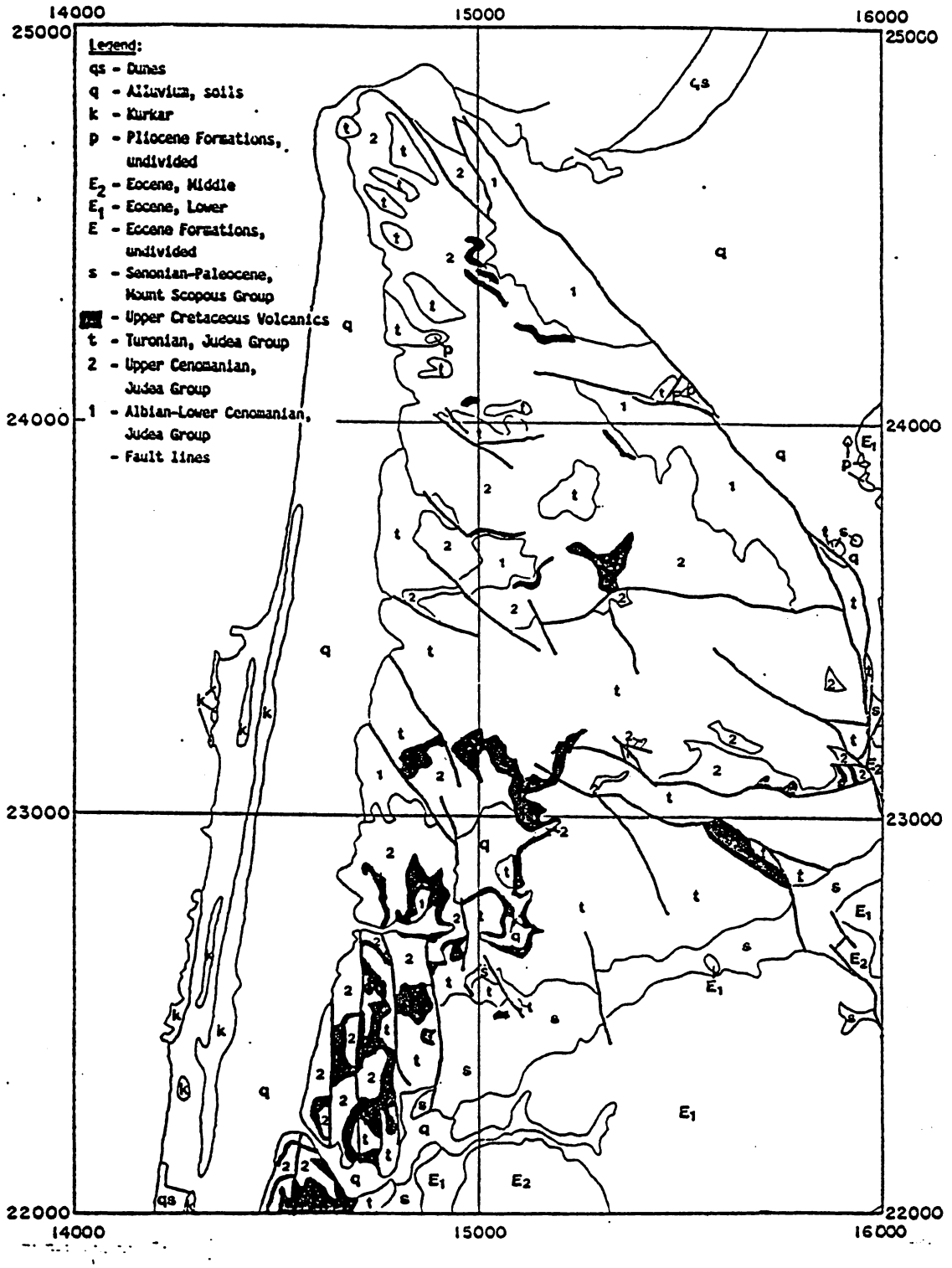

Figure 2: Geological map of the Mount Carmel area (from Sneh, Bartov & Rosensaft (in prep.): Geological map of Israel 1:200,000; Geological Survey of Israel; Atlit and Haifa bay sheets edited following Arad, 1965; Karcz, 1959; Kashai, 1966; Bein, 1974; Sass, 1980)

The manganese mineralization is composed mostly of hollandite and wad. In some anomalous samples (not included in table 1) the manganese content is up to 4.3% and silica up to 68%. Trace elements enriched within the mineralization occurrences include cobalt (up to 1100 ppm), vanadium (up to 800 ppm) and nickel (up to 450 ppm). Some samples are anomalous in Ag, Cr, Cu, Pb and Zn.

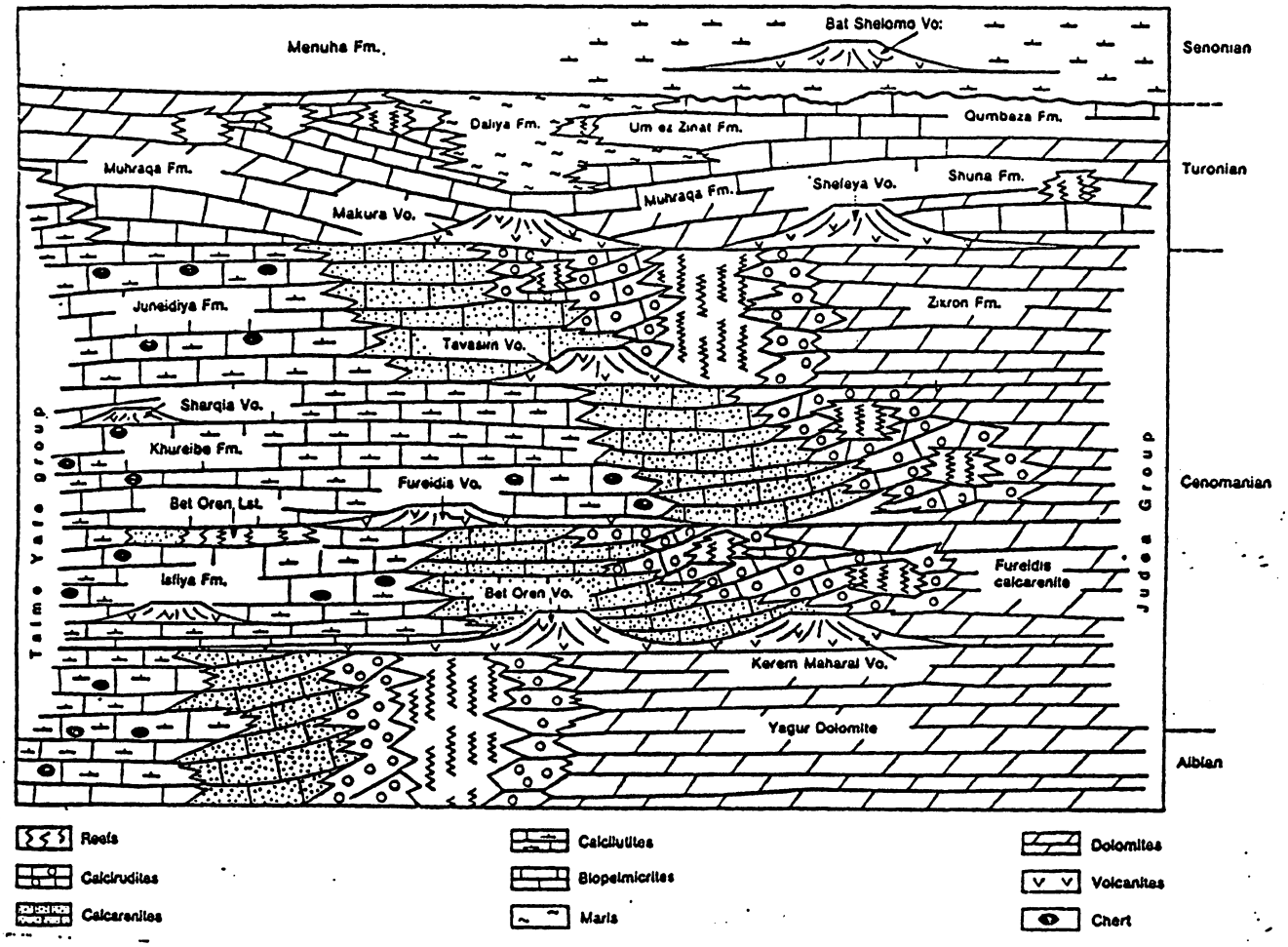

Figure 3: Lithostratigraphic scheme (not to scale) of Upper Cretaceous rocks, Mount Carmel (from Bein and Sass, 1980).

METHODS

(A) Sampling and Sample Preparation

Stream (wadi) sediment samples sites (Fig. 4) were chosen according to the drainage pattern, at an average density of 1.5 samples per 1 square kilometer. After scraping away the upper layer of the stream bed to depth of about 20 cm, one kg sample was taken and packed in a marked polyethylene bag. In places where the soil was rich in gravels, the sample was sieved in the field to a fraction < 5 mm. Field data were recorded on mnemonic-coded, single-page data cards.

In the laboratory, the samples were dry sieved to pass 100 mesh. Wet samples which were collected during winter underwent wet sieving through a 100 mesh sieve and oven drying at 80°C for 24 hours. The -100 mesh (-0.150 mm) fraction was chemically analysed.

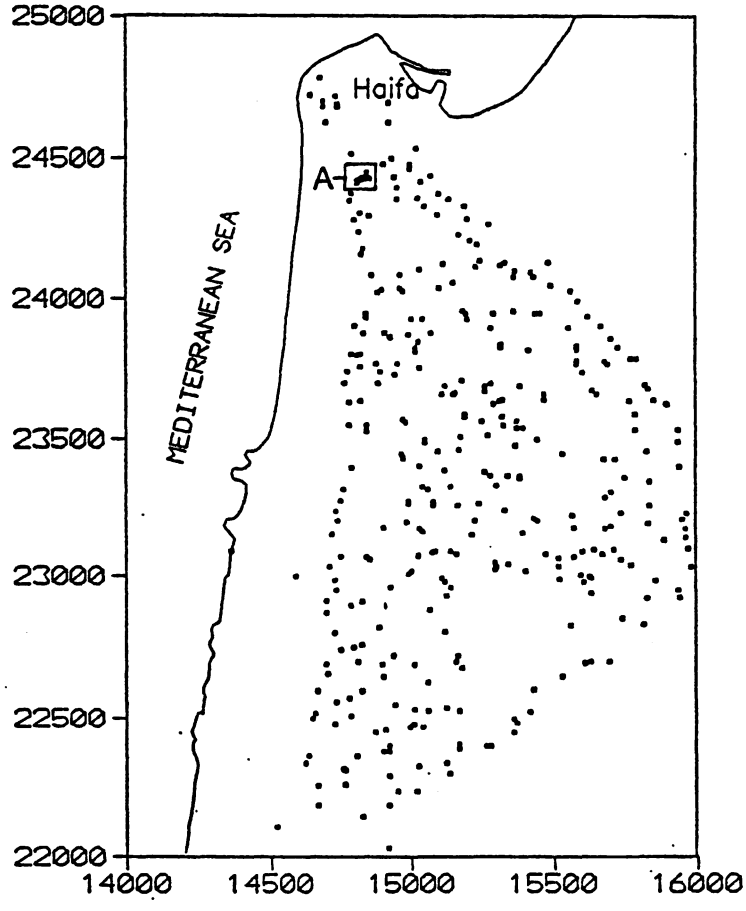

Figure 4: Sampling sites. [The area indicated by an A is discussed in page 18].

(B) Analytical Procedures

Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES) was applied for the determination of major and trace elements in the stream sediment samples. Synthetic solutions were used for calibration, matched with Na_2O_2 and hydrochloric acid. Scandium (Sc II 361.384 nm) served as an internal reference and substantially reduced short-term variability.

500 mg of the sample was mixed with 2.5 g Na_2O_2 (Merck GR) in a zirconium crucible and heated for 40 minutes in a muffle furnace (500°C). After cooling to room temperature, the crucible was rinsed in 50 ml water and 25 ml of 1+1 HCl (v/v) added rapidly in order to achieve clear solutions. Scandium was added to the solutions so that the final volume (100 ml) contained 5 mg/l Sc.

Arsenic and antimony were determined separately using a hydride generator with direct introduction into the Atomic Absorption instrument. Curves for multi-element determination were established by calibration with composite standards prepared by stepwise dilution of stock solutions made from pure metals or analytical grade salts. Natural Standard Reference Materials are analysed using the procedure described above in order to test the accuracy and precision of the determinations.

For the determination of Au, 20 gm of sample was roasted for one hour at 600°C in a muffle furnace to remove sulfur. After cooling, the sample was digested with aqua regia (50 ml) on a hot-plate for one hour. The mixture was then evaporated to a moist state, 20 ml of hydrochloric acid (1+4) added, and the sample filtered. The solution was transferred to a volumetric flask (100 ml). A 5 ml portion of "Aliquat 336" + DIBK mixture (saturated with 1+1 HCl) was added and the flask shaken. The concentration of gold in the organic phase was measured using atomic absorption spectrometry.

Elements routinely determined by the above methods and their limit of detection (in ppm) in the sample are: -

Majors:	Si	200	Fe	50
	Al	100	Ti	50
	Ca	100	P	1000
	Mg	10	S	1000
Traces:	Ag	3	La	3
	As	.2	Mn	.5
	Au	10 ppb	Mo	5
	Ba	1	Ni	5
	Be	.5	Pb	5
	Cd	1.5	Sb	.1
	Ce	10	Sr	.1
	Co	10	V	5
	Cr	.5	Y	4
	Cu	1.5	Yb	.5
	Eu	.5	Zn	5

RESULTS

(A) Data Presentation

Detailed information on all stream sediment samples collected on Mount Carmel is presented in Appendix A. Table 2 summarizes the descriptive statistics of these samples, including minimum, maximum, mean, median, standard deviation, 25 and 75 percentiles and the results of a normality test for each element. The test was carried out using NCSS (Number Cruncher Statistical System; Hintze, 1990) which employs the Martinez and Iglewicz normality test. The geochemistry of some selected rock type samples is presented in Table 1.

Single-element geochemical maps were prepared for all trace and some major elements in order to examine their aerial distribution and relation to the environment. Plates A-D present 8 coloured geochemical maps of elements exhibiting the main spatial distribution trends, which were prepared at the BGS (British Geological Survey). The geochemical data points which have a random distribution are input to an image analysis system, comprising of an I^2S Model 70 hardware and SYSTEM 101 software (Green, 1984). The data points are gridded with a minimum-curvature surface fitting function, in which all analytical values lie on the generated surface. The IMAGE-FILE created is in the form of 512 by 512 continuous pixel grid; each pixel has a digital value which relates to chemical concentration. The basic geochemical image appears as a grey-

Table 1: Major and trace elements content in some rock types from the Mount Carmel area.

	Carbonates					Pyroclastics				Basalts		Iron Oxides Veins			
Sample	41241	41251	43421	45271	43351	43561	43601	44001	46051	45091	47361	43781	45101	42511	42521
(Wt%)															
SiO_2	3.3	2.1	6.4	0.1	2.2	34.0	52.1	26.5	35.9	45.0	34.0	26.5	5.0	1.4	3.2
Al_2O_3	0.2	0.1	1.5	<	<	9.7	18.2	6.6	8.1	11.7	6.9	0.2	0.4	0.2	0.1
Fe_2O_3	2.2	2.2	2.0	0.6	2.5	7.7	12.6	6.7	9.8	12.3	9.8	54.5	79.2	75.0	53.0
CaO	53.5	48.4	51.1	29.4	53.7	15.5	8.0	16.5	16.1	8.4	11.8	9.9	3.1	7.6	19.5
MgO	0.4	0.2	1.0	12.6	0.2	6.3	4.2	4.7	8.5	5.9	8.3	0.4	0.5	0.2	0.2
TiO_2	0.02	0.01	0.35	<	0.02	1.7	2.5	1.2	1.7	2.1	1.6	0.02	0.04	0.04	0.02
P_2O_5	0.1	<	0.1	<	<	0.3	0.6	0.4	0.6	0.7	0.1	0.1	0.3	0.1	0.1
SO_3	0.4	0.4	0.3	0.5	0.3	0.2	<	0.3	<	0.2	0.2	0.2	0.2	0.2	0.1
(ppm)															
Ag	4	12	2	19	4	1	<	<	<	<	2	<	1	1	<
As	9	30	9	3	6	2	2	3	2	2	1	50	400	75	80
Ba	4	<	14	<	<	31	280	110	104	456	1130	2	3	55	20
Be	0.2	0.2	0.3	0.3	0.2	1.6	1.6	1.1	1.7	1.5	1.1	0.5	1.1	0.3	0.4
Ce	2	11	13	10	<	59	47	48	69	55	10	4	26	14	9
Co	12	3	4	2	<	30	66	45	48	71	66	25	72	19	8
Cr	23	25	95	13	8	239	213	244	451	239	315	72	62	49	15
Cu	16	20	<	6	<	40	70	21	43	50	39	22	130	<	<
Eu	<	0.1	0.2	0.3	0.2	0.2	0.2	2.0	2.2	2.6	1.0	1.6	2.6	2.5	1.8
La	2	3	1	<	<	28	17	37	43	38	5	12	21	22	13
Mn	170	117	338	316	152	384	874	514	630	945	788	99	125	210	220
Mo	1	3	26	1	24	19	21	5	1	15	7	71	91	36	57
Ni	10	36	100	4	64	232	188	328	420	224	160	124	179	50	70
Pb	4	4	<	5	<	8	20	17	14	19	26	<	15	<	<
Sb	0.3	0.5	0.1	0.1	0.2	0.6	0.1	0.3	0.2	0.3	0.1	1.4	3.1	2.0	2.0
Sr	179	160	404	130	96	176	343	130	221	500	84	8	<	7	36
V	43	46	63	10	31	154	183	119	107	191	289	231	723	227	347
Y	1	<	4	2	1	16	24	15	19	18	9	<	<	6	<
Yb	<	<	1	<	<	2	3	1	1	1	1	2	4	2	2
Zn	<	4	21	2	9	56	125	94	59	138	80	89	133	63	174

Table 2: Statistical parameters of stream sediment major and trace element data from the Mount Carmel area. The parameters were calculated only for samples with values higher than the detection limit.

Element	No. of samples above DL*	min.	25%-ile	median	75%-ile	max.	mean	Std. deviation	Normal Distribution
(Wt%)									
SiO_2	367	3.7	24.4	33.6	41.7	94.0	33.6	11.7	Yes
Al_2O_3	367	0.4	5.8	8.7	11.3	18.5	18.5	3.6	Yes
Fe_2O_3	367	0.2	3.6	5.5	7.7	14.6	5.7	2.6	Yes
CaO	367	1.1	10.8	19.5	28.0	47.8	19.9	11.1	Yes
MgO	367	0.2	1.0	1.4	2.1	13.9	1.9	1.7	No
TiO_2	367	0.03	0.51	0.81	1.2	3.4	0.88	0.47	No
P_2O_5	362	0.1	0.2	0.2	0.4	1.8	0.3	0.2	No
SO_3	363	0.1	0.2	0.3	0.4	0.8	0.27	0.12	Yes
(ppm)									
Ag	133	3	3	4	7	24	5.5	3.1	No
As	367	1	3	4	7	45	5.3	3.6	No
Au (ppb)	36	10	17	40	110	650	102	147	No
Ba	367	1	127	178	231	9708	313	735	No
Be	352	0.6	1.1	1.5	2	3.6	1.6	0.6	Yes
Ce	362	11	33	51	67	104	51	21	Yes
Co	311	10	15	21	29	68	24	13	No
Cr	367	15	83	120	154	389	124	56	No
Cu	367	2	31	40	54	167	45	22	No
Eu	298	0.5	0.9	1.4	1.8	5.8	1.5	0.7	No
La	364	4	23	32	40	68	32	12	Yes
Mn	367	36	367	582	794	1572	598	286	Yes
Mo	138	5	5	7	11	31	9	5	No
Ni	360	5	33	55	98	376	75	63	No
Pb	363	5	23	32	43	493	39	38	No
Sb	308	0.1	0.2	0.4	0.5	3	0.4	0.3	No
Sr	367	22	97	166	269	860	204	141	No
V	367	8	65	92	122	264	95	39	Yes
Y	364	4	15	21	28	57	22	10	Yes
Yb	367	0.5	2	2	3	6	2.3	1.1	Yes
Zn	366	11	66	88	112	915	101	80	No

*DL - Detection Limit

tone map which is then transferred to a Mac II image processing system. The Mac II system has a versatile software for creating coloured geochemical maps from the basic grey-tone image, enabling user-defined colour classes (data bins). The classes used for presentation on the maps are percentile classes - 25, 35, 50, 65, 75, 90, 95 and the 99%-ile.

(B) Inter-elements Relationships and Aerial Distribution

In order to study the inter-relationships among the elements, R-mode factor analysis (varimax rotated) was applied, using the NCSS software (Hintze, 1990). Since the variables (=elements) are measured on different scales and metrics, the data was standarized before the computation (Joreskog et al., 1976). For a variable X_i the trasformation is:

$$Z_i = \frac{X_i - \bar{X}_i}{S_i}$$

where $\bar{X}_i$ and S_i are the mean and standard deviation of variable i.
The results of the factor analysis are presented in figure 5.

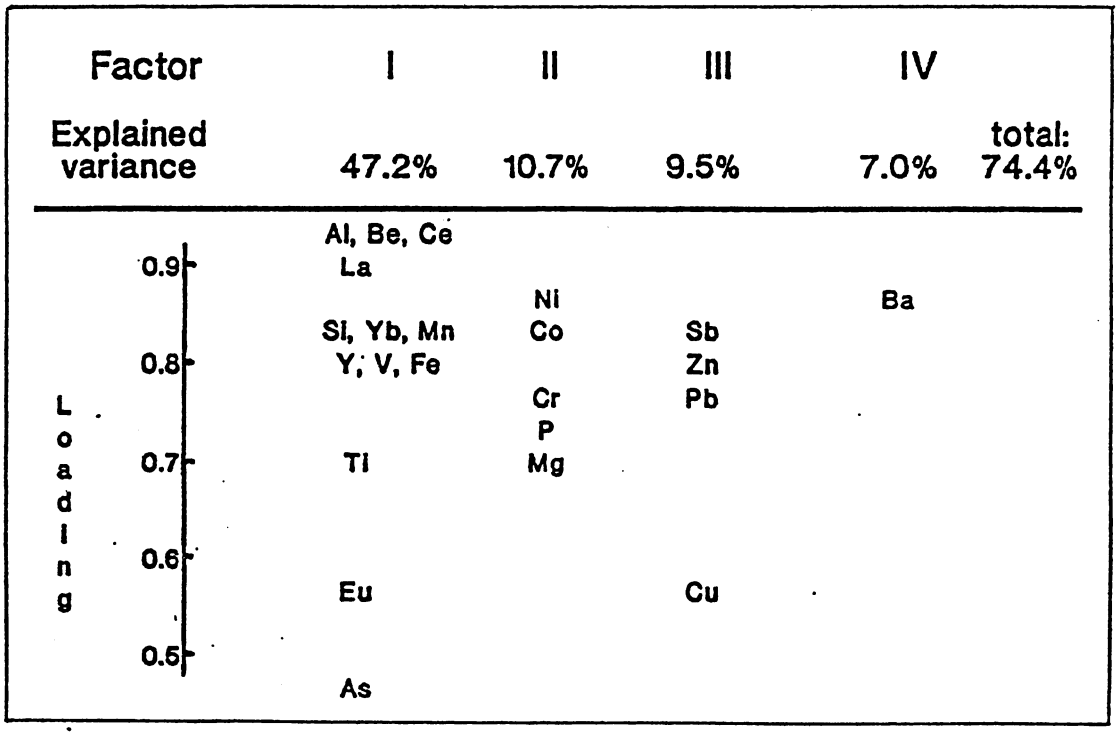

Figure 5: Factor analysis results.

Four main factors are indicated, and can be largely explained on the basis of the mineralogy of the stream sediment. Thus the significant correlation between the lanthanides, Al, Si, Fe, V etc. (**Factor I**) represents the trace element suite which is associated with the clay fraction of the sediment, along with partial contribution of heavy and ore minerals. The analytical data of the elements which are included in this factor usually show normal distribution, indicating a single population with higher concentrations in the southern part of the area, where volcanic rock exposures provide stream sediments enriched in these elements (see Table 2 and Plate A).

The close relationship between Mg, Cr, Ni, Co and P (**Factor II**) is indicative of ferro-magnesian minerals. Samples enriched in these elements occur in the southern part of the studied area (Plate B) where volcanic rocks exposures are abundant (see geological map, Fig. 2). The aerial distribution of magnesium in the stream sediments depicts not only the volcanic drainage area, but the Albian-Lower Cenomanian dolomitic formations as well, especially on the northeastern flanks of Mount Carmel (Fig. 2 and Plate D).

Factor III indicates high correlation between Pb, Zn, Sb and to a lesser extent - Cu (loading value: |0.55|). Stream sediments enriched in these elements are located within the metropolitan area of Haifa (Plate C). These elements have an high rate of dispersion to the environment e.g. by combustion of leaded fuel (Pb), sewage sludges (Pb, Zn), refining (Pb), usage in paint pigments (Pb, Sb, Zn), various chemicals (Pb, Sb, Cu), stabilizers in plastics (Pb) etc.; Thus, Factor III determines a geochemical signature of an urban area, where high levels of lead, zinc and antimony reflect contamination of the environment by industrial activities, domestic waste and motor vehicle emissions. Elevated concentrations of lead, zinc and copper were detected in soils from the Haifa region (Foner, 1990) and similar phenomenon has been reported from the UK (Moir & Thornton, 1989).

Factor IV, which explains 7% of the total variance is linked only to barium. The spatial distribution of this element (Plate D) is related to outcrops of Senonian and Eocene rocks, which are usually enriched in barium and contain barite concretions and mineralization occurrences (Bogoch et al., 1987; Gilat, 1992). Although the volcanic rocks contain up to 1000 ppm barium, the anomalous amounts of this elements in stream

sediments derived from the Senonian-Eocene exposures "mask" the volcanic contribution of Ba when the data are gridded for the geochemical map (Plate D).

Figure 6 presents the location of samples which gained the highest factor scores for factors II, III and IV. Samples showing high factor scores for Factor II are mainly concentrated in the middle and southern part of the area where volcanic outcrops are abundant. High scores of Factor III were gained for samples within the area of Haifa and for Factor IV - within the area of Senonian-Eocene outcrops.

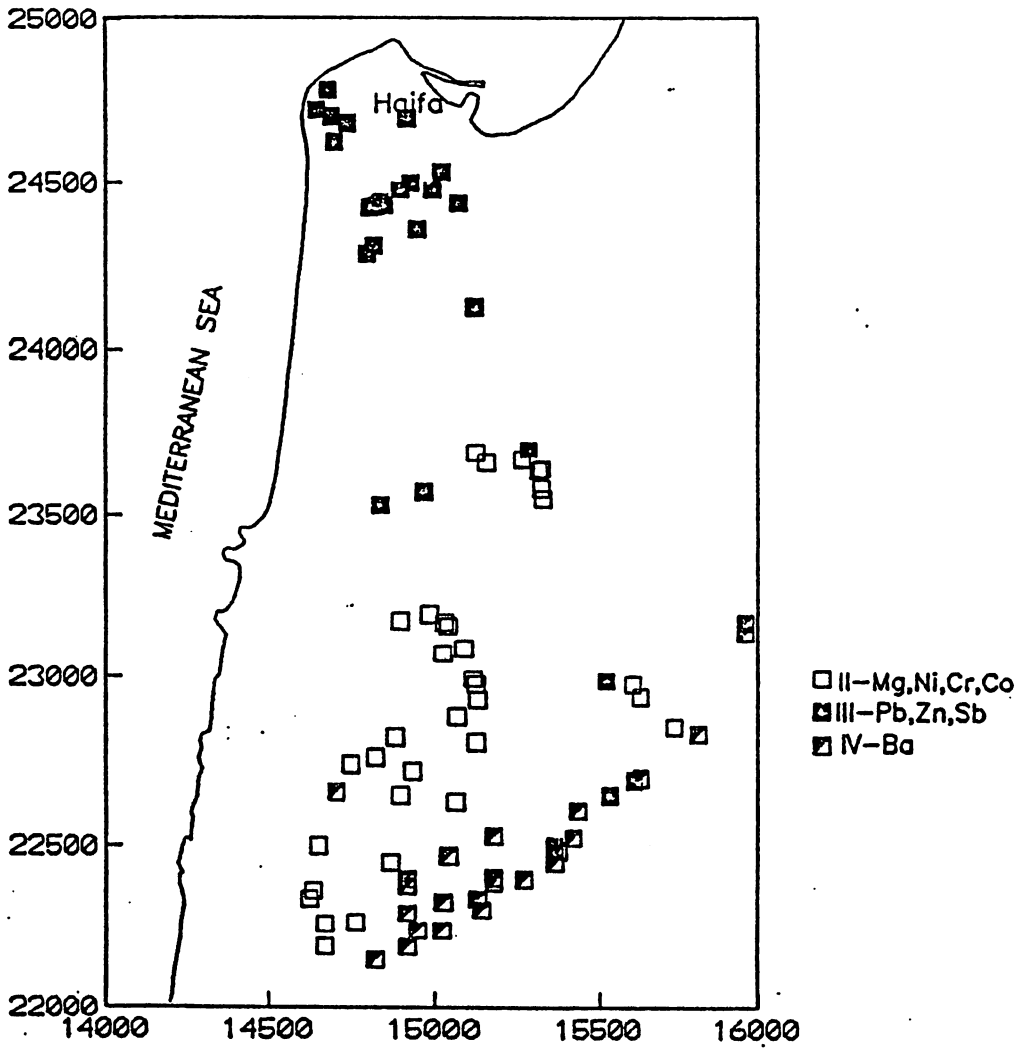

Figure 6: Location of samples which gained the top 10% scores for Factors II, III and IV.

(c) Significance of Non-Normal Distribution of Data for Some Trace Elements

The geochemical data for all trace metals which are incorporated in Factors II, III and IV do not exhibit normal distribution (Table 1). When plotted as a probability graph (Fig 7), the plotted points usually have the form of a bimodal distribution consisting of two non-intersecting lognormal populations (A and B on Fig. 7). With the aid of an interactive computer program to fit mixtures of normal (or log-normal) distributions (Stanley, 1987), the parameters for partitioned "background" and "anomalous" populations for some trace metals were calculated (Table 3).

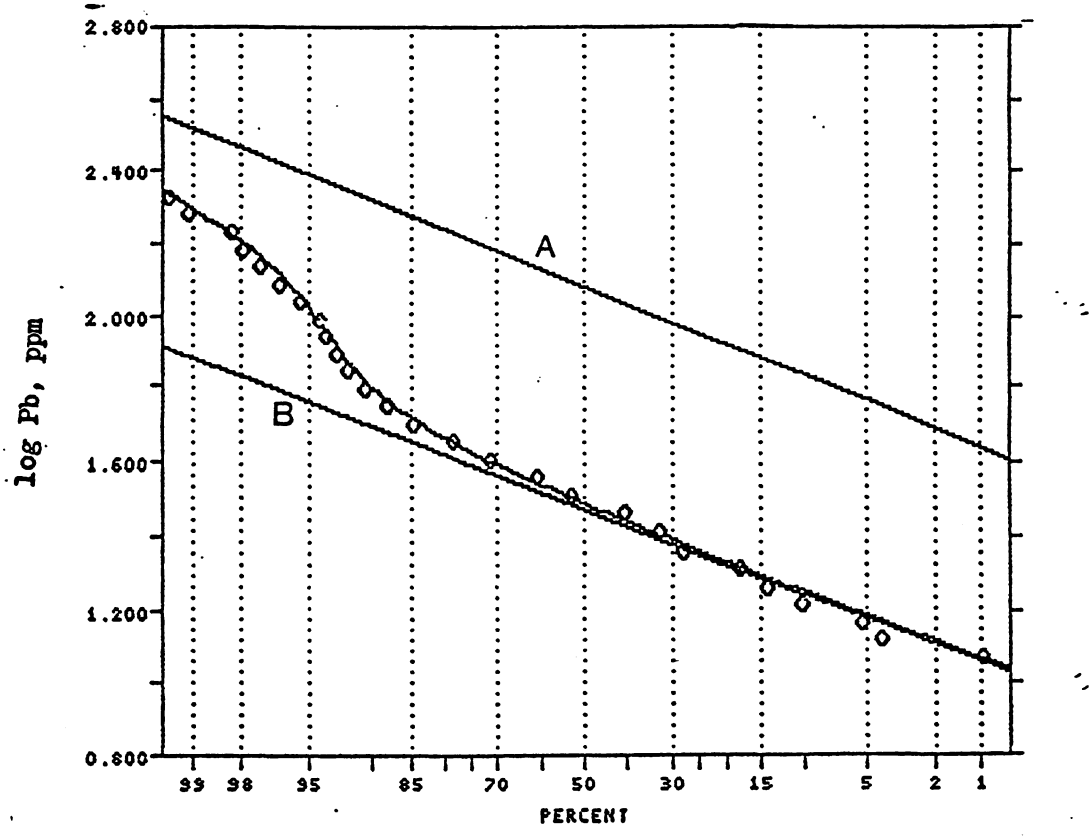

Figure 7: Partitioned log probability plot of Pb determinations on stream sediments, Mount Carmel area. A- anomalous, and B- background populations (see Table 3).

Table 3: Estimated parameters of partitioned populations - stream sediment data, Mount Carmel area (data in ppm).

Element	Population	Proportion %	Mean	Standard Deviation
Cr	Anomalous	6	324	16
	Background	94	116	18
Co	A	7	108	23
	B	93	42	15
Ni	A	6	267	56
	B	94	65	40
Pb	A	9	120	23
	B	91	29	5
Zn	A	5	401	65
	B	95	84	15
Sb	A	6	1.3	0.5
	B	94	0.3	0.1
Ba	A	6	2265	602
	B	94	162	36

Knowing the interelement relationships and their spatial distribution (see previous discussion), the "anomalous" top 5-10% populations can thus be explained on the basis of enrichment due to volcanic rocks outcrops (Cr, Co, Ni), environmental contamination (Pb, Zn, Sb) and high barium formations (Senonian-Eocene).

ENVIRONMENTAL IMPLICATIONS

Mount Carmel is a unique environment, due to its geographical position near the Mediterranean coastline, its climatic peculiarities (influenced by the coast, slopes and mountain), topographic variety and rich flora and vegetation. The importance of Mount Carmel as a nature site and its ability to attract recreationers led the Israel authorities to declare it a National Park. The area of the park covered by this designation extends over 90 km^2 (Fig. 8). In contrast to the open, green park and reservation sections, the northern part of Mount Carmel is covered by the built up area of Haifa (~300,000 inhabitants) and adjacent industrial zones (Fig. 8) in which refining, chemical, mineral, textile and leather

industries are dominant. The current study undoubtedly demonstrated some environmental contamination "fingerprints" within the metropolitan area of Haifa, in the form of elevated concentrations of Pb, Zn and Sb. Although much more detailed research is needed in order to define the exact sources of contamination and their future probable potential, the lead enrichment could be explained by vehicle emissions, and the high amounts of zinc and antimony are probably related to the heavy industry in the area.

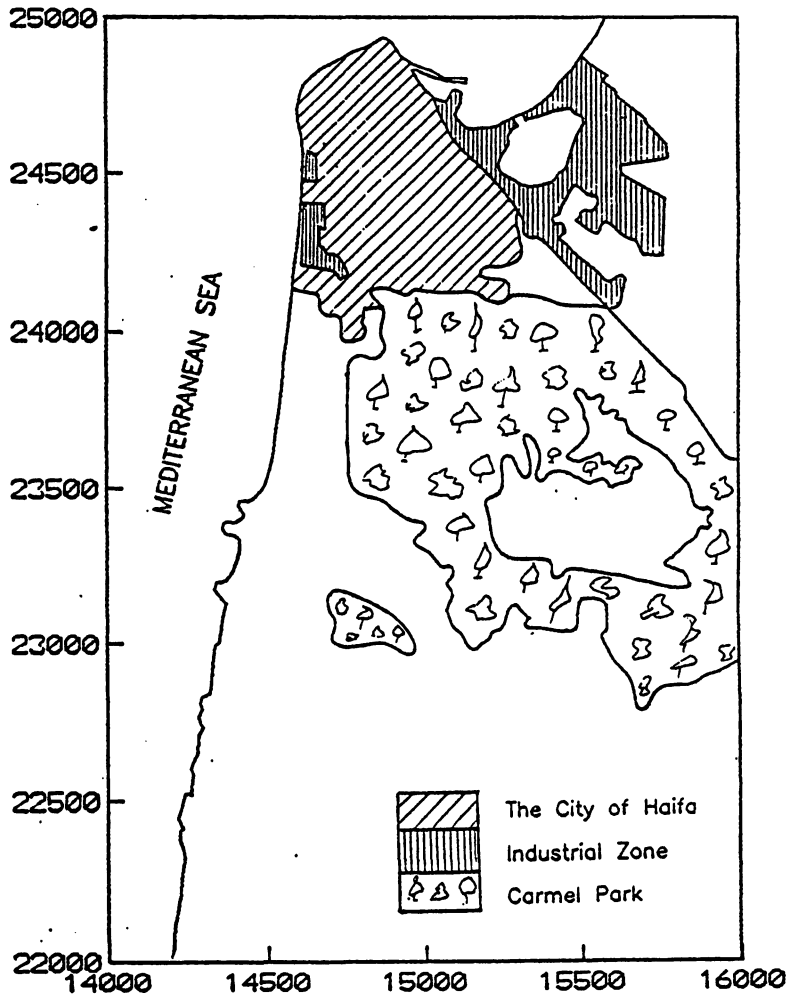

Figure 8: Main land use distribution in the Carmel area. (after Atlas of Haifa, Soffer & Kipnis, Eds.)

In one location, on the western flank of Mount Carmel and within the built up area of Haifa (see A on Fig. 4), some stream sediment samples contained gold. A detailed sampling phase of this location revealed that the anomalous gold concentrations (up to 3.2 ppm) originated in a leaking sewage system, which probably carried small gold particles that were introduced to the system by dental technicians and/or goldsmiths. Some other local enrichments of samples in heavy metals were recorded near other populated areas (such as Daliyat el Karmel and Nahal Oren area), probably in relation to refuse disposal sites.

Due to the exceptional sensivity of the Carmel area, the contamination signature found in the course of this geochemical survey should urge the authorities in charge to initiate follow-up surveys in the area as well as a multi-disciplinary research in order to identify the contamination sources and to assess their environmental impact.

SUMMARY AND CONCLUSIONS

A total of 367 samples were taken from ephemeral streams draining the Albian - Eocene rocks of Mount Carmel and covering an area of ~200 km^2. These were analysed for their major and trace element content. The data were treated statistically and the following conclusions reached:

1. Statistical analysis of the element data indicates that they occur in associations which can be explained on the basis of the mineralogy of the stream sediment or by anthropogenic activity:

   Al, Si, Fe, La, Ce, Mn, V, Y - clay fraction and heavy minerals.

   Ni, Co, Cr, P, Mg - ferro-magnesian minerals.

   Ba - barium enriched stream sediments derived from Senonian-Eocene formations.

   Pb, Zn, Sb - anthropogenic contamination.

2. The spatial distribution of the trace elements as expressed on geochemical maps usually depicts the outline of the expected source rocks, i.e: Cr, Ni and Co enriched stream sediments in the volcanic area drainage system, etc.

3. A definite contamination signature of high Pb, Zn and Sb was found within the metropolitan area of Haifa and near refuge disposal sites. These indications should initiate follow-up detailed studies.

4. No metallization was found in the area. The Fe-Mn veins and mineralized lenses do not create detectable dispersion trains.

ACKNOWLEDGEMENTS

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REFERENCES

Arad, A., 1965. Geological outline of the Ramot Menashe region. Isr. Jour. Earth Sci., V. 14, pp. 18-32.

Bein, A., 1974. Reef development in the Judea Group from Carmel and Coastal Plain. Ph. D. thesis, Hebrew University of Jerusalem, 154 p. (in Hebrew).

Bein, A. and Sass, E., 1980. Geology. in: Atlas of Haifa and Mount Carmel. A. Soffer and B. Kipnis (Eds). Applied Scientific Research Co. University of Haifa.

Bogoch, R., Buchbinder, B. & Nielsen, H., 1987. Petrography, geochemistry and evolution of barite concretions in Eocene pelagic chalks from Israel. Jour. Sed. Pet., Vol. 57, No. 3, 522-529.

Foner, H.A., 1990. Heavy metal pollution from combustion sources in Israel. Ph.D thesis, University of leeds, UK. 216 pp.

Gilat, A., 1992. Tectonics and associated mineralization activity, southern Judea, Israel. Ph.D thesis, Ben-gurion University, Beer-Sheva, 280pp.

Green, P.M., 1984. Digital image processing of integrated geochemical and geological information. Jour. Geol. Soc. Lond., 141, pp. 941-949.

Hinze, J.L., 1988. Number Cruncher Statistical System. Kaysville, Utah.

Ilani, S., Strull, A. and Assael, Y., 1982. Metallic mineralization phenomena along tectonic faults in Israel. Isr. Geol. Surv. Rep. ME/15/82;
Israel Atomic Energy Commision, Soreq Nuclear Research Center, Rep. ZD/67/82. 58 p. (in Hebrew).

Ilani, S., Kronfeld, J. and Flexer, A., 1985. Iron-vein mineralization correlated to structural lineaments and the search for base metals in Israel. J. Geochem. Explor. 24: 197-206.

Ilani, s., Kronfeld, J., Flexer, A. and Livnat, A., 1990. Epigenetic manganese occurrences within Cretaceous strata of Israel. Mineralium Deposita. 25: 231-236.

Joreskog, K.G., Klovan, J.E. & Reyment, R.A., 1976. Geological factor analysis. Elsevier, 178 pp.

Karcz, I., 1959. The structure of the northern Carmel. Isr. Res. Counc. Bull., V. 8G, No. 2-3, pp. 119-130.

Kashai, E., 1966. The geology of the eastern and south western Carmel. Ph. D. thesis, Hebrew University of Jerusalem, 115 p. (in Hebrew).

Moir, A.M. & Thornton, I., 1989. Lead and cadmium in urban allotment and garden soils and vegetables in the United Kingdom. Env. Geoch. and Health, V. 11, pp. 113-120.

Stanley, C.R., 1987. Instruction Manual for PROBPLOT. Association of Exploration Geochemists, Special Vol. 14.

P L A T E S

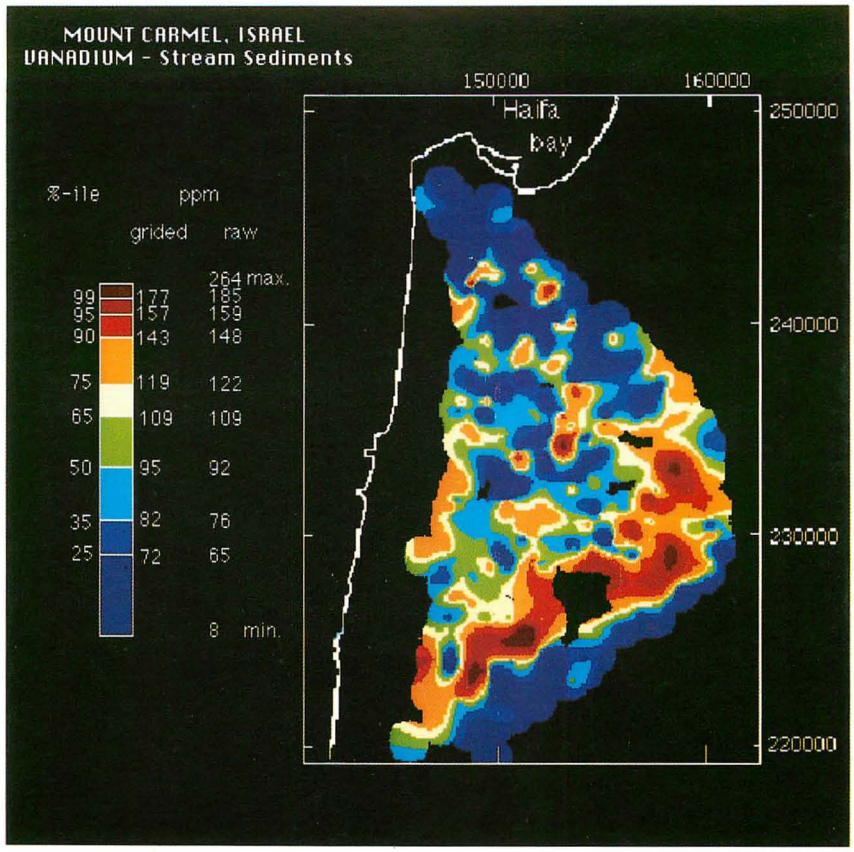
A - Geochemical maps of manganese and Vanadium

B - Geochemical maps of nickel and chromium

C - Geochemical maps of lead and zinc

D - Geochemical maps of barium and magnesium

Plate A


MOUNT CARMEL, ISRAEL
VANADIUM - Stream Sediments
150000
160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
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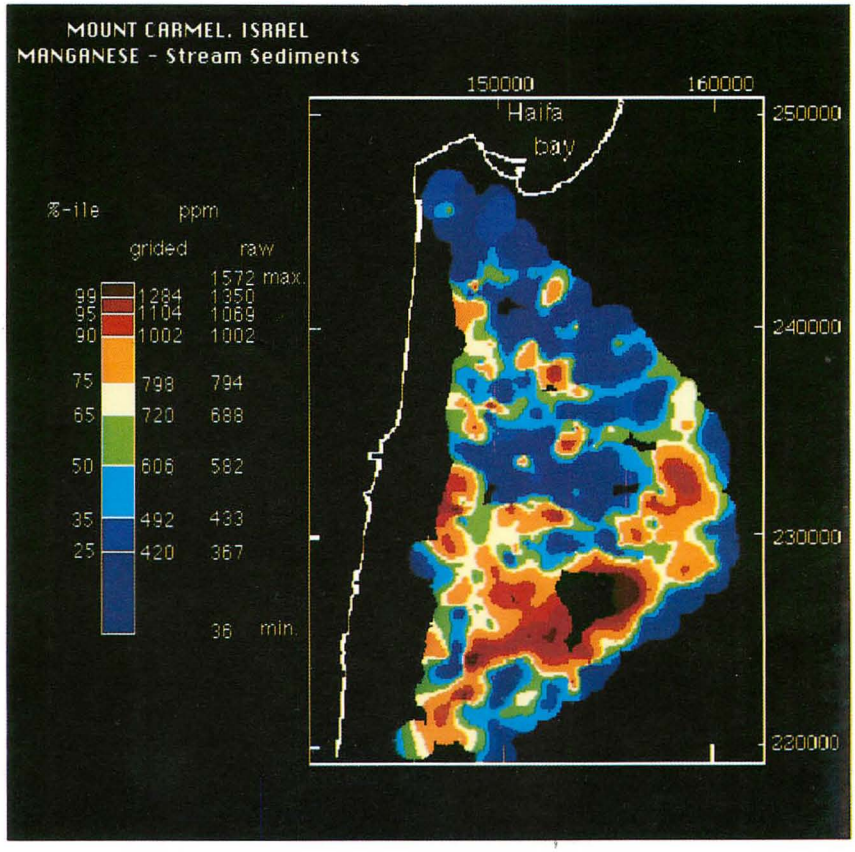
95 157 159
90 143 148
75 119 122
65 109 109
50 95 92
35 82 76
25 72 65
8 min.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MANGANESE - Stream Sediments
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160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
1572 max.
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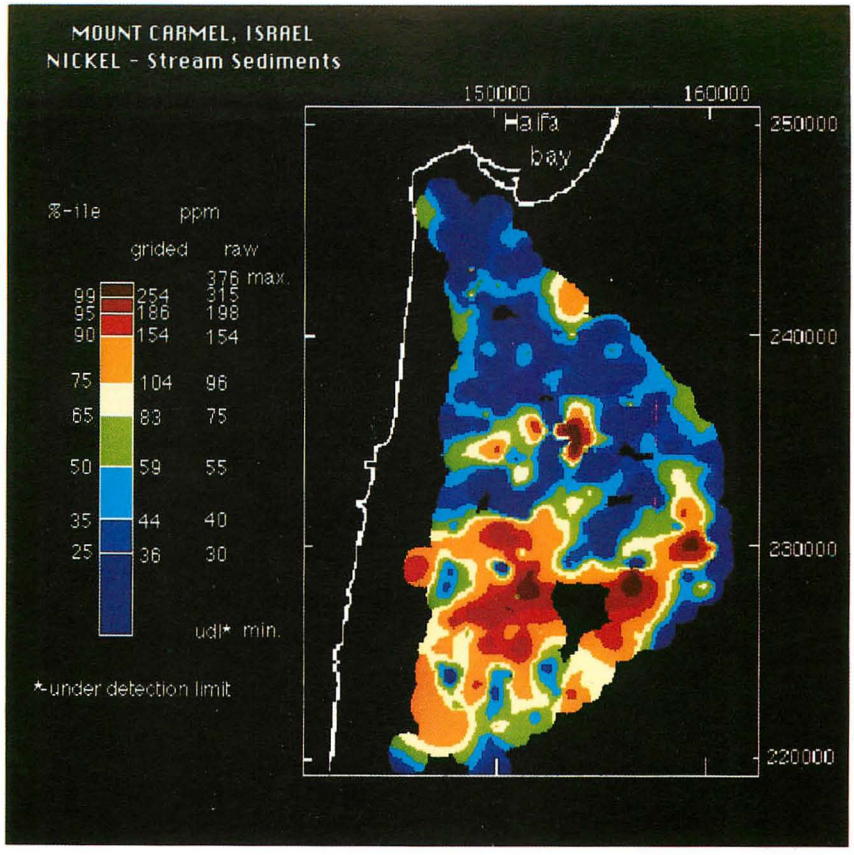
50 606 582
35 492 433
25 420 367
36 min.

Plate B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NICKEL - Stream Sediments
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160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
376 max.
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75 104 96
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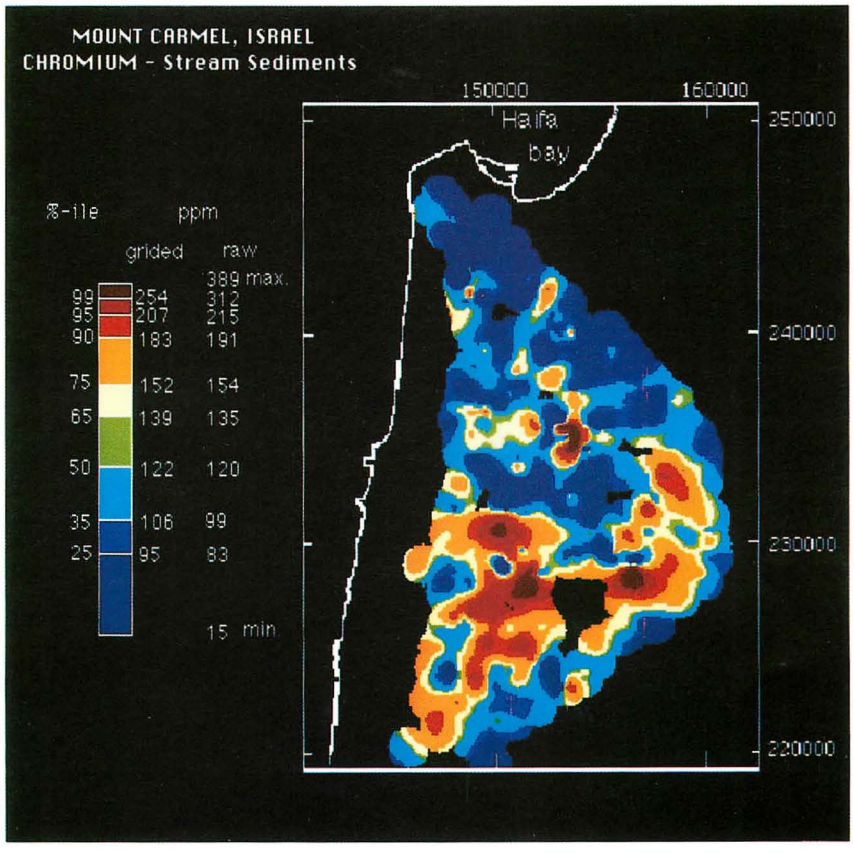
35 44 40
25 36 30
udl* min.
*-under detection limit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CHROMIUM - Stream Sediments
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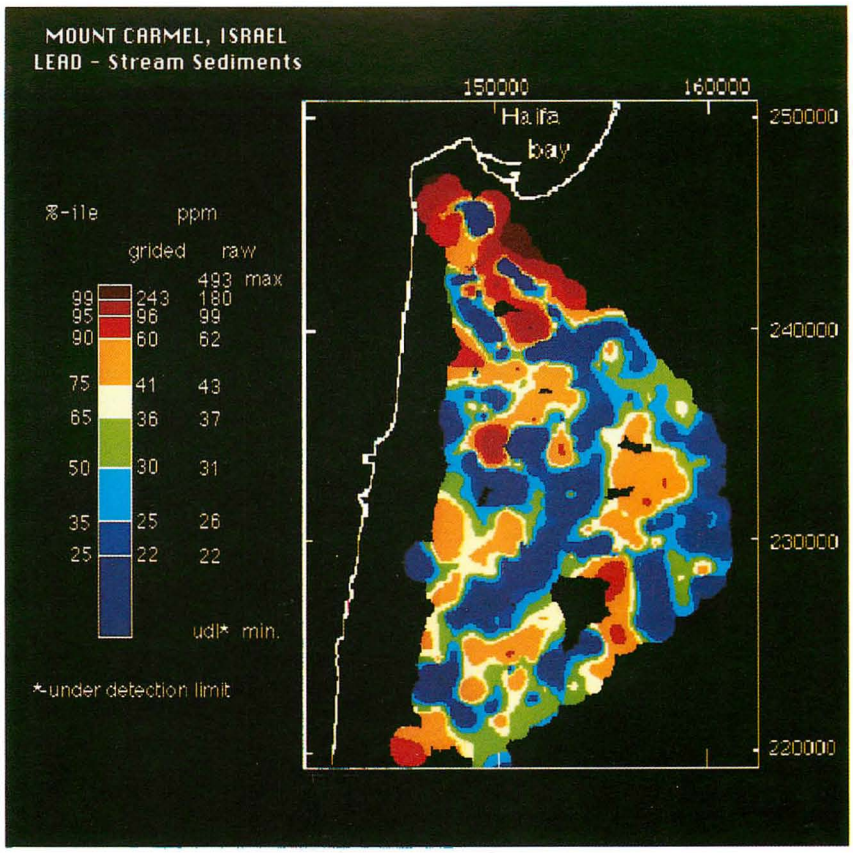
160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
389 max.
99 254 312
95 207 215
90 183 191
75 152 154
65 139 135
50 122 120
35 106 99
25 95 83
15 min

Plate C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LEAD - Stream Sediments
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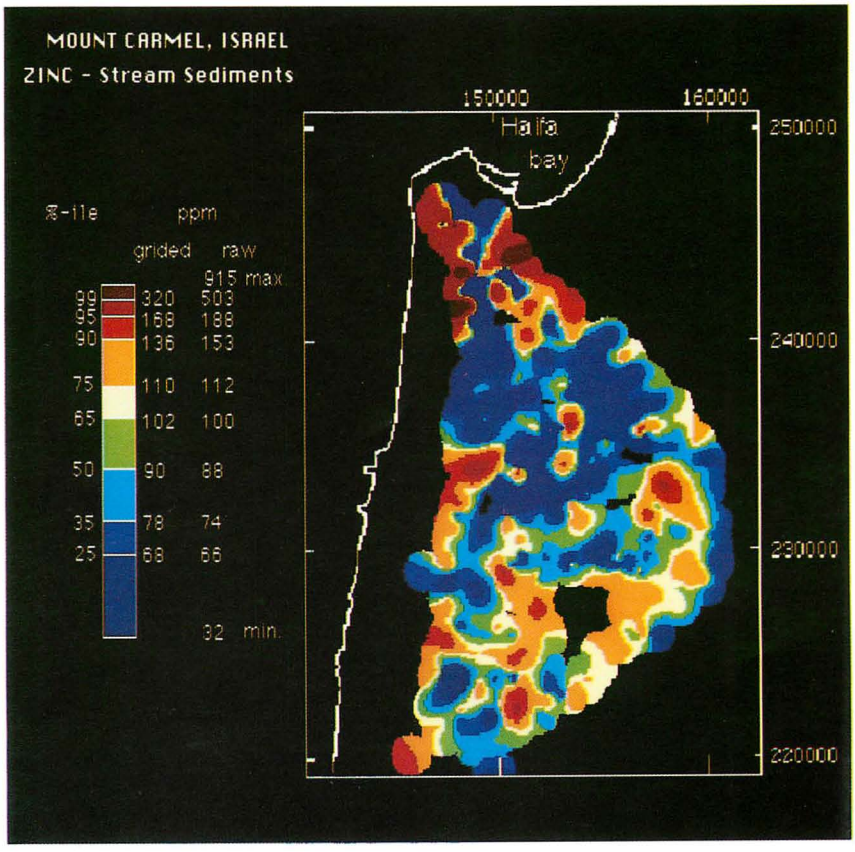
160000
250000
240000
230000
220000
Haifa
bay
%-ile
ppm
grided
raw
493 max
99
95
90
75
65
50
35
25
243
96
60
41
36
30
25
22
180
99
62
43
37
31
26
22
udl* min.
*under detection limit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ZINC - Stream Sediments
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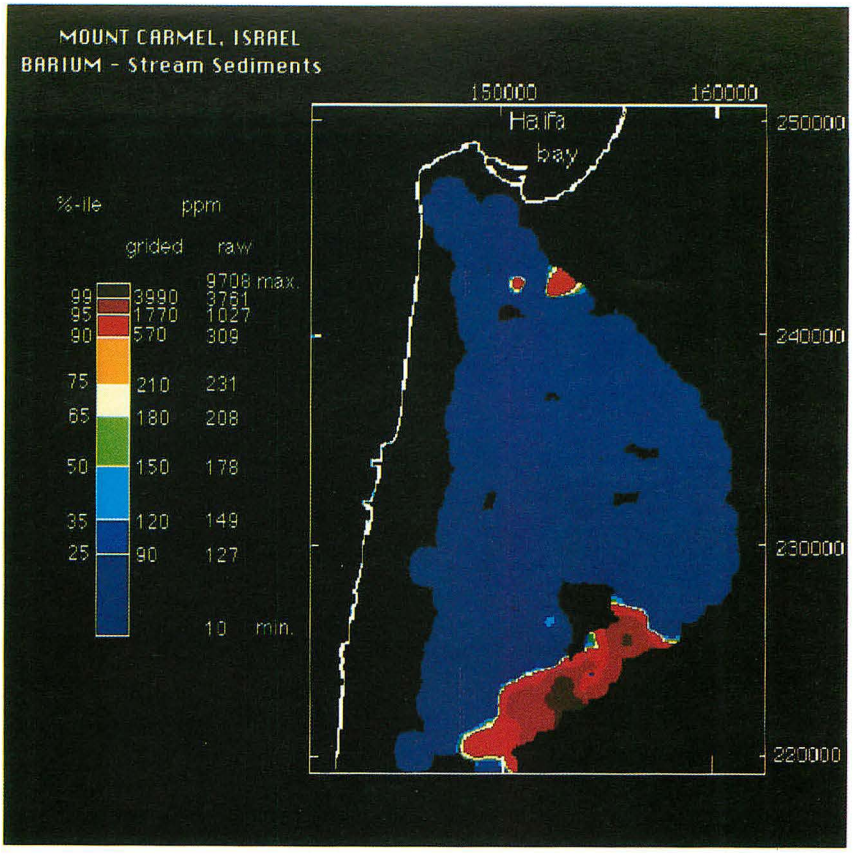
160000
250000
240000
230000
220000
Haifa
bay
%-ile
ppm
grided
raw
915 max
99
95
90
75
65
50
35
25
320
168
136
110
102
90
78
68
503
188
153
112
100
88
74
66
32 min.

Plate D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BARIUM - Stream Sediments
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160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
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65 180 208
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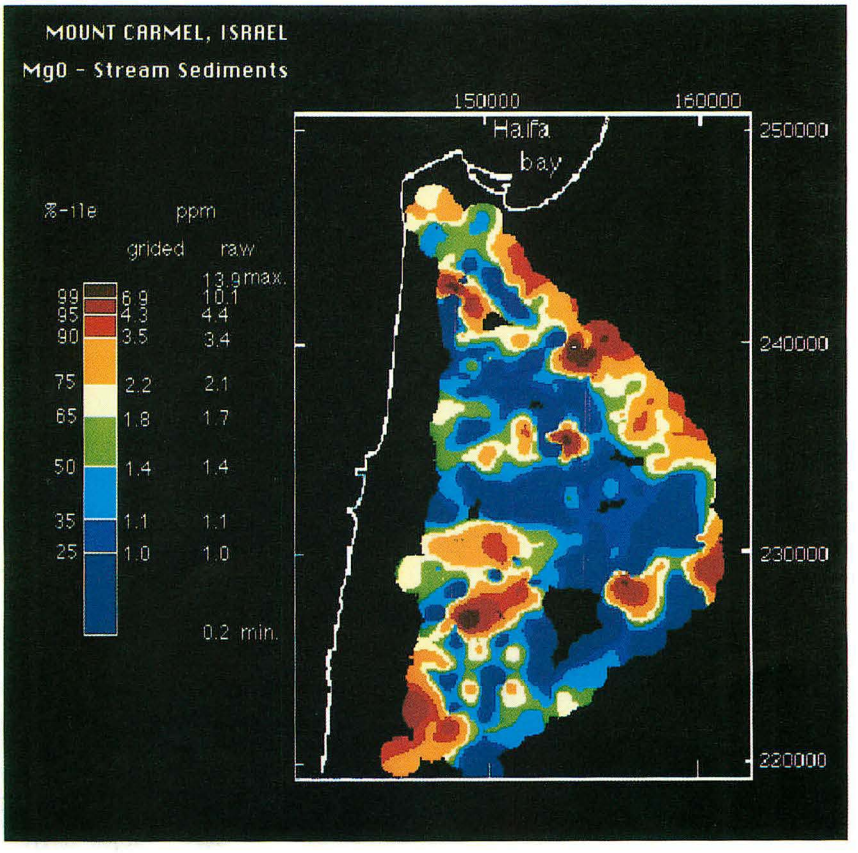
25 90 127
10 min.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MgO - Stream Sediments
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160000
Haifa
bay
250000
240000
230000
220000
%-ile
ppm
grided
raw
13.9 max.
99 6.9 10.1
95 4.3 4.4
90 3.5 3.4
75 2.2 2.1
65 1.8 1.7
50 1.4 1.4
35 1.1 1.1
25 1.0 1.0
0.2 min.

SAMPLE	E	N	SiO2	Al2O3	Fe2O3	CaO	MgO	TiO2	P2O5	SO3	AG	AS	AU	BA	BE	CE	CO	CR	CU	EU	LA	MN	MO	NI	PB	SB	V	Y	YB	ZN
4250	14760	22320	55.5	16.0	10.6	2.5	1.4	1.66	0.20	0.05		7		290	2.5	95		189	42	2.7	52	1350		65	25	0.1	142	37	4	112
4253	14765	22315	42.1	12.5	9.5	14.2	2.6	1.52	0.30	0.05		5		210	1.7	64		167	45	2.6	35	840		125	20	0.6	114	24	2	92
4260	14790	23400	47.1	13.0	7.3	8.8	1.3	1.12	0.20	0.05		15		260	2.0	72		164	36	1.8	39	910		40	30		115	30	3	108
4261	14760	23320	50.2	15.5	8.8	5.5	1.0	1.25	0.20	0.05		9		250	2.5	80		132	34	2.2	49	1000		40	30		138	35	4	143
4257	14780	22575	38.2	12.4	8.6	13.5	1.6	1.42	0.40	0.20	4	7		159	1.7	67		143	48	2.1	37	800	6	87	36		126	24	2	97
4262	14750	23275	32.4	10.5	5.6	5.5	0.8	0.77	0.20	0.20	5	3		136	1.6	57		97	39	1.6	31	660	5	44	38		89	21	2	75
4263	14720	23150	36.7	11.5	7.8	16.1	2.9	1.27	0.40	0.30	4	3		207	1.7	64		149	59	2.0	35	850	6	104	50		106	22	2	98
4264	14660	22520	45.7	12.1	7.2	20.3	1.4	1.11	0.40	0.20	3	3		227	1.8	68		126	35	1.7	36	900	6	62	40		110	26	3	95
4265	14670	22600	35.4	11.0	8.8	16.7	2.5	1.48	0.30	0.20		2		189	1.7	71		154	36	2.4	41	680		112	35		112	21	2	99
4266	14735	22560	24.4	8.2	6.9	31.6	2.6	1.25	0.40	0.30		2		191	1.3	59		127	32	2.0	34	370		103	23		86	15	1	75
4267	14700	22690	34.0	8.7	6.1	27.6	1.8	0.96	0.50	0.40		3		153	1.2	52		126	40	1.6	28	605	5	85	32		79	17	2	145
4268	14700	22870	35.9	9.7	5.7	22.3	1.4	0.87	0.50	0.30	6	3		184	1.4	52		102	30	1.5	29	715		50	48		81	20	2	105
4269	14700	22910	35.0	8.9	4.8	26.2	1.3	0.74	0.10	0.30	7	3		168	1.3	50		84	33	1.3	25	590	5	38	36		75	19	2	56
4270	14735	22950	40.2	11.7	6.8	12.0	1.5	1.01	0.10	0.20	6	3		209	1.7	60		108	30	1.6	31	740	6	53	42		101	23	3	69
4271	14730	22985	38.0	10.8	5.5	19.5	1.8	0.82	0.20	0.30	5	3		172	1.6	58		97	22	1.4	30	685	8	40	32		87	22	2	68
4272	14710	23035	50.3	14.1	8.2	2.1	1.4	1.18	0.20	0.20	9	5		217	2.3	81		131	36	2.1	45	1075	5	63	52		122	33	4	121
4273	14750	23070	36.8	11.2	7.9	19.5	2.5	1.27	0.30	0.20	4	3		188	1.7	66		170	35	2.0	36	845	5	121	41		106	23	2	87
4274	14840	23070	27.1	9.4	6.7	26.0	2.5	1.25	0.40	0.30	13	2		201	1.4	50		138	40	1.8	27	685	6	112	37		95	16	2	81
4275	14850	23060	36.1	11.1	7.8	18.1	2.6	1.27	0.40	0.30	13	4		234	1.8	66		170	39	2.1	36	830	5	118	45		105	22	2	93
4276	14925	22960	42.0	12.1	8.3	16.3	2.6	1.42	0.40	0.20	6	4		253	1.9	74		198	35	2.1	40	1020	5	135	38		118	26	3	102
4277	15000	23020	32.4	10.1	6.8	26.6	2.2	1.16	0.40	0.30	6	3		152	1.4	54		170	34	1.8	31	750	6	140	35		87	19	2	81
4278	14990	23010	16.0	3.7	2.0	17.4	0.9	0.27	0.10	0.60	3	1		67		23		47	44		10	375		19	23		34	7	1	161
4279	15025	23075	33.6	10.7	8.6	19.0	4.2	1.46	0.50	0.30	8	2		191	1.7	62		215	42	2.1	34	775		180	47		99	19	2	104
4280	15040	23160	39.6	12.8	10.5	11.5	3.3	1.74	0.60	0.30	9	3		207	2.1	72		253	45	2.6	42	980	5	198	47		134	23	2	119
4281	15030	23170	35.0	11.4	8.9	19.2	2.8	1.48	0.60	0.30	7	3		200	1.8	69		230	36	2.3	39	765	5	170	46		113	22	2	102
4282	14985	23195	42.0	13.2	11.8	13.2	4.0	1.95	0.70	0.20	3	3		291	2.1	76		260	47	2.7	44	915		225	47		126	23	2	115
4283	14740	23200	36.5	10.2	5.0	27.2	2.0	0.76	0.60	0.50		3		149	1.4	53		173	38	1.3	29	615	6	45	48		86	20	2	120
4284	14735	23235	54.2	13.8	7.7	3.6	1.3	1.22	0.30	0.30	6	4		258	2.2	82		167	34	2.1	46	1400	5	67	52		127	33	3	118
4285	14520	22110	35.3	11.1	6.2	22.5	3.4	1.01	0.30	0.30	5	3		214	1.6	56		131	37	1.6	30	720		63	63		102	2.	2	139
4286	14670	22190	42.0	12.6	9.8	11.7	3.5	1.68	0.50	0.20	5	3		212	1.8	65		185	43	2.1	36	980	5	121	46		121	24	2	99
4287	14670	22260	46.5	13.6	10.7	7.3	3.2	1.87	0.30	0.20	5	3		231	2.0	70		187	46	2.3	39	1065	6	134	48		131	26	3	109
4288	14915	22030	18.0	4.8	2.5	35.2	0.9	0.31	0.20	0.40	13	1		232	0.8	27		55	39	1.0	17	355		30	27		47	16	1	64
4289	14825	22150	36.0	6.5	4.1	21.7	1.3	0.59	0.40	0.40	6	2		1183	1.1	46		115	48	1.3	29	720		73	34		62	29	3	89
4290	14920	22295	18.0	5.5	3.1	37.3	0.9	0.34	0.30	0.40	8	3		483	0.9	31		101	35	0.9	19	385	8	46	21		65	22	2	56
4291	14920	22380	19.0	4.6	3.0	37.2	0.9	0.37	0.70	0.40		3		473	0.9	36		123	63	1.0	26	320		50	28		75	34	3	87
4292	14920	22400	19.0	5.5	3.0	36.0	0.9	0.34	0.30	0.50	3	3		455	0.8	35		110	49	0.9	24	350	6	41	31		70	29	2	88
4293	14900	22380	26.5	7.6	5.4	25.5	1.4	0.77	0.20	0.40	3	4		369	1.2	50		143	39	1.3	30	570	7	79	39		97	27	2	101
4294	14950	22240	41.5	9.5	5.7	14.0	1.6	0.69	0.20	0.30	6	4		1325	1.6	53		138	35	1.5	36	715	6	104	48		83	33	3	91
4295	14920	22190	27.8	5.5	3.0	27.8	1.0	0.43	0.50	0.50	7	2		1073	0.9	34		98	33	1.1	23	405		46	35		61	23	2	90
4296	15020	22240	28.0	6.8	4.0	29.6	1.4	0.45	0.40	0.40	4	2		1735	1.1	40		113	40	1.2	30	615		76	33		73	33	3	111
4297	15025	22330	26.0	5.8	3.3	31.5	1.7	0.38	0.50	0.60	3	2		3469	0.9	38		92	41	1.4	35	745	7	88	39		62	44	3	188
4298	15040	22470	20.5	7.0	5.9	34.8	2.3	0.92	0.40	0.40		2		669	1.2	50		173	45	1.3	33	505	5	133	47		108	23	2	123
4300	15005	22480	24.6	7.0	3.5	33.2	0.8	0.55	0.20	0.40		3		180	1.1	40		126	39	1.2	26	385		44	21		84	23	2	70
4301	14995	22470	33.2	8.5	4.9	18.7	1.1	0.79	0.30	0.30	3	3		312	1.4	54		130	43	1.6	32	385	5	67	35		90	27	3	94
4302	14905	22460	29.8	9.5	5.0	22.4	1.2	0.81	0.30	0.30	4	3		297	1.4	52		131	42	1.6	32	635	6	76	33		95	25	2	82
4303	14870	22450	48.3	14.3	12.1	5.7	2.6	2.32	0.50	0.20		4		229	2.1	75		210	51	2.7	43	625	5	160	36		185	27	3	118

SAMPLE	E	N	SiO2	Al2O3	FeO	CaO	MgO	TiO2	P2O5	SO3	AG	AS	AU	BA	BE	CE	CO	CR	CU	EU	LA	MN	MO	NI	PB	SB	V	Y	YB	ZN
4304	15125	22540	55.7	15.7	8.5	6.5	1.2	1.29	0.30	0.10		5		404	2.5	93		180	40	2.5	55	1110		88	44		151	45	5	102
4305	15170	22530	14.8	4.8	2.0	42.6	0.6	0.29	0.10	0.40	3	3		128	0.7	25		95	35	0.9	18	1190	5	43	17		63	18	2	81
4306	15360	22450	47.0	8.6	4.7	17.1	1.4	0.63	0.40	0.30	3	3		1424	1.5	52		135	50	1.8	40	160	5	97	36		86	41	4	106
4307	15370	22485	56.1	11.0	5.6	8.4	1.3	0.83	0.30	0.20	4	3		689	1.8	64		144	61	1.9	42	410		103	40		92	38	4	113
4308	15360	22500	40.0	8.2	3.8	23.6	1.4	0.51	0.40	0.50	4	3		2726	1.2	42		120	58	1.8	37	1010		104	37		70	42	4	101
4309	15415	22525	45.5	9.2	4.4	11.3	1.3	0.58	0.30	0.40	7	2		1617	1.4	47		123	46	1.7	35	805		86	37		73	34	3	107
4310	15120	23390	27.5	10.3	4.2	32.7	1.0	0.57	0.10	0.30	5	5		88	1.3	39		67	25	1.1	21	490		31	27		84	14	2	42
4312	15140	23330	33.5	11.2	5.2	23.2	0.9	0.79	0.10	0.30	7	5		152	1.6	53		91	30	1.5	30	332	6	44	33		94	22	3	63
4313	15530	23450	35.3	12.1	5.7	21.5	1.2	0.88	0.20	0.30	4	7		130	1.7	60		113	32	1.6	34	515	5	50	47		110	25	3	96
4325	15180	23710	18.3	5.8	2.7	34.0	1.0	0.41	0.20	0.40	8	4		78	0.9	30		86	27	1.1	17	640	5	24	34		56	12	1	58
4326	15120	23690	34.5	9.3	7.3	25.0	4.4	1.16	0.30	0.30		3		92	1.2	56		202	44	1.9	32	355	6	188	60		104	16	2	113
4327	15110	23660	26.5	9.4	5.7	29.4	2.7	0.90	0.40	0.30	7	3		127	1.4	49		175	51	1.6	27	560	7	122	31		92	16	2	72
4328	15150	23660	33.7	10.6	7.3	23.3	4.1	1.26	0.30	0.30	3	3		158	1.6	58		213	48	1.9	33	595		191	34		106	18	2	87
4329	15155	23665	24.0	9.4	4.3	26.3	0.8	0.61	0.10	0.40	12	3		113	1.3	45		83	34	1.5	25	460	6	35	30		80	17	2	54
4330	14825	22910	35.3	10.3	5.0	16.3	0.8	0.83	0.10	0.20	3	6		167	1.7	57		102	21		28	600	19	85	25	0.4	89	22	3	58
4332	14785	22895	43.6	13.1	6.4	5.5	0.9	1.03	0.20	0.20	3	6		203	2.1	70		116	60		34	811	14	78	35	0.3	108	28	4	80
4333	14730	22800	47.4	15.3	8.0	1.6	0.9	1.29	0.10	0.20	4	9		213	2.6	84		163	59	2.3	44	952	13	117	38	0.4	135	35	4	102
4339	14750	22740	29.6	8.3	7.3	25.8	3.1	1.34	0.40	0.20	3	3		111	1.4	53		201	34		26	376	23	217	8	0.1	89	16	2	75
4340	14795	22750	39.1	11.3	7.3	15.1	2.1	1.28	0.40	0.20		4		222	2.0	74		152	33	0.6	39	816	20	159	22	0.2	109	25	3	77
4341	14810	22700	40.8	12.1	6.4	12.3	1.5	1.09	0.20	0.20		6		177	1.9	63		119	31		29	770	19	82	26	0.3	112	25	3	86
4343	14935	22720	42.4	12.1	8.6	10.8	3.3	1.49	0.30	0.20		5		393	2.0	67		219	64	0.8	37	937	17	201	27	0.4	120	28	3	114
4344	14895	22690	34.0	10.3	7.1	16.0	1.7	1.25	0.40	0.30	3	4		164	1.7	61		167	80		30	680	20	152	21	0.3	98	21	3	86
4345	15010	22690	40.3	12.0	6.4	3.6	0.8	1.11	0.30	0.30		6		169	1.9	67		140	59		33	922	11	124	25	0.5	110	27	3	88
4346	15160	22700	45.9	15.2	7.8	3.3	0.9	1.21	0.30	0.20	3	14		197	2.5	79		144	47		40	1069	15	104	38	0.9	141	32	4	114
4347	15165	22720	47.6	15.3	7.9	9.9	1.0	1.15	0.50	0.20		10		543	2.5	75		162	75		44	1109	20	150	42	0.8	148	39	5	120
4348	15180	22680	54.1	16.8	8.3	2.1	0.8	1.39	0.20	0.20	3	8		224	2.7	92		155	52		46	1264	15	109	41	0.7	154	40	5	100
4349	15430	22605	36.6	9.0	4.1	27.8	1.0	0.58	0.30	0.20		5		1027	1.5	48		163	73		32	760	26	123	16	0.5	97	50	5	107
4350	15610	22695	58.3	8.4	3.9	11.9	1.1	0.77	0.50	0.30		3		2593	1.4	53		118	48		33	587	11	102	26	0.7	72	43	4	99
4351	15570	23070	40.9	14.5	6.6	18.2	1.0	1.02	0.20	0.20		6		189	2.2	71		134	31		33	757	23	90	29	0.3	127	30	4	74
4352	15600	23090	53.9	18.5	8.8	3.7	0.9	1.35	0.10	0.10		11		229	3.0	91		178	29		50	1043	16	97	43	0.4	169	39	5	91
4353	15640	23095	48.0	16.8	7.6	8.9	0.8	1.12	0.10	0.20		9		188	2.7	82		153	36		40	886	19	92	42	0.4	152	35	5	85
4354	15670	23080	40.1	13.2	5.7	15.1	0.8	0.93	0.20	0.20		5		170	2.0	67		128	30		33	615	21	86	30	0.4	116	28	4	72
4355	15710	23095	48.0	17.3	8.1	7.9	1.0	1.25	0.20	0.20		10		204	2.7	85		172	49		45	986	21	115	42	0.4	152	36	5	102
4358	15735	23060	41.3	15.2	8.4	12.8	1.7	1.77	0.30	0.20		4		158	1.7	53		163	56		18	632	22	126	22	0.2	152	22	3	93
4359	15770	23040	50.7	17.8	10.6	10.5	2.4	2.00	0.30	0.20		4		196	2.2	68		190	65		23	804	22	150	34	0.2	186	24	3	104
4363	15560	22825	58.1	18.0	8.4	2.0	1.1	1.38	0.30	0.20		8		338	2.9	103		166	51		48	1572	13	203	51	0.4	151	42	6	118
4365	15120	22805	43.9	12.8	9.2	4.3	1.5	1.44	0.50	0.20		6		176	2.3	81		199	48	2.8	47	976	6	183	30	0.6	145	30	3	143
4366	15065	22880	43.5	11.2	11.1	5.3	4.2	1.85	0.60	0.20		3		215	2.1	76		290	51	3.1	46	1035		276	23	0.2	134	25	3	120
4367	15125	22930	40.4	11.1	11.1	9.7	3.8	1.92	0.50	0.20		4		181	2.1	75		280	53	3.1	46	818	5	300	18	0.3	143	23	2	124
4368	15140	22960	27.9	7.3	4.8	18.0	1.1	0.77	0.20	0.30		3		115	1.4	43		120	48	1.7	28	557	10	125	15	0.4	91	18	2	81
4369	15120	22980	36.0	9.8	11.2	12.4	4.5	1.98	0.40	0.20		10		185	1.8	71		312	67	2.9	43	736		319	11	0.3	156	19	2	122
4370	15110	22995	33.0	9.0	8.6	18.4	2.3	1.52	0.50	0.20		4		150	1.7	60		210	46	2.1	36	685		202	13	0.4	126	19	2	95
4371	15075	23085	25.7	6.5	4.9	23.4	1.2	0.81	0.20	0.30		5		109	1.3	41		138	31	1.7	26	516	6	119	17	0.8	86	15	2	66
4372	15085	23090	34.0	9.2	8.5	13.4	2.3	1.46	0.50	0.30		4		163	1.8	57		195	46	2.3	36	704	7	194	39	1.1	117	19	2	106
4373	15140	23090	35.5	9.5	7.7	14.6	1.9	1.35	0.50	0.30		6		145	1.8	63		160	40	2.0	38	652	5	129	21	0.5	119	21	2	94
4374	15160	23080	26.5	6.9	5.9	21.1	1.7	1.07	0.40	0.30		4		108	1.2	47		142	34	1.8	28	438		120	15	0.4	92	14	1	78

SAMPLE	E	N	SiO2	Al2O3	Fe2O3	CaO	MgO	TiO2	P2O5	SO3	AG	AS	AU	BA	BE	CE	CO	CR	CU	EU	LA	MN	MO	NI	PB	SB	V	Y	YB	ZN
4375	15215	23150	34.0	9.0	7.8	17.5	1.8	1.33	0.40	0.30		6		146	1.6	59		177	41	1.9	38	641		148	19	0.5	118	20	2	93
4377	15225	23200	36.0	10.6	7.3	15.4	1.6	1.16	0.30	0.20		7		125	1.8	63		145	56	2.2	38	1261	5	108	23	0.4	129	21	2	88
4379	15240	23265	25.0	6.7	3.7	31.1	0.9	0.55	0.10	0.30		6		87	1.1	33		81	35	1.0	23	323		77	3	0.5	85	14	1	58
4380	15330	23240	24.0	6.2	3.5	23.0	0.9	0.50	0.20	0.40		5		81	1.0	34		93	39	0.9	23	362	9	76	14	0.5	80	13	1	125
4381	15380	23370	27.0	7.8	4.2	27.6	1.0	0.60	0.20	0.30		9		79	1.3	38		101	34	1.4	26	350	8	88	13	0.6	100	16	2	80
4382	15380	23360	29.0	7.8	4.3	26.9	1.1	0.63	0.20	0.30		7		87	1.3	40		88	42	1.3	27	378	12	83	12	0.5	100	17	2	73
4383	15340	23370	11.5	2.8	1.4	42.9	1.6	0.22	0.10	0.40		5		13		19		62	28	0.7	25	100	7	62	2	0.5	54	6	1	54
4384	15300	23335	39.5	10.0	5.6	15.9	1.0	0.84	0.40	0.40		7		152	1.7	58		133	65	1.5	35	625	6	91	34	0.5	118	22	2	109
4385	15280	23370	16.0	4.2	2.1	38.6	0.9	0.28	0.10	0.40		4		30	0.6	15		51	38	0.7	15	143	7	56	6	0.4	63	7	1	48
4386	15260	23385	20.5	6.4	3.2	33.0	0.9	0.38	0.10	0.30		5		40	0.9	22		119	70	1.0	17	160	9	64	13	0.5	80	9	1	66
4387	15095	23460	40.0	10.3	5.6	17.5	1.0	0.81	0.10	0.30		8		157	1.7	57		120	50	1.8	35	512	8	87	25	0.5	115	22	2	72
4388	15050	23490	53.0	13.7	7.8	4.5	1.4	1.20	0.50	0.20		8		197	2.3	77		164	65	1.9	48	785		92	33	0.4	147	31	3	138
4389	15050	23500	22.5	5.1	2.9	28.0	1.2	0.43	0.10	0.40		3		77	0.9	28		110	30	1.5	23	290		51	15	0.4	82	11	1	54
4390	15030	23405	23.5	5.9	3.2	31.8	0.9	0.47	0.10	0.30		4		79	0.9	31		76	25	1.2	23	297	6	75	18	0.4	88	12	1	55
4391	14980	23560	29.5	6.7	3.8	22.4	1.8	0.58	0.20	0.40		4		107	1.1	44		119	35	1.4	28	404	16	68	20	0.7	96	14	1	79
4392	14705	22660	33.6	7.5	5.5	24.5	1.6	0.97	1.80	0.30	3	4		132	1.2	50		115	60	1.6	37	589	16	116	31	0.4	106	17	1	157
4393	14825	22600	52.8	13.1	8.5	2.7	1.4	1.39	0.20	0.30		6		228	2.1	87		169	50	2.3	54	1082	18	114	51	0.4	161	33	3	111
4394	14900	22650	44.9	11.2	9.7	6.6	2.6	1.60	0.50	0.20		3		132	1.8	66		228	40	2.1	47	748		209	26	0.3	148	24	2	106
4395	14940	22550	56.0	13.4	8.2	1.6	1.0	1.33	0.20	0.20		6		222	2.1	86		164	27	2.3	54	1134	11	106	43	0.3	163	35	3	103
4396	15010	22535	51.0	12.5	7.8	5.8	1.2	1.26	0.30	0.30		7		256	2.0	84		180	86	2.2	55	1041	11	120	62	0.5	164	35	3	134
4397	15060	22630	52.8	13.8	10.7	2.9	2.1	2.11	0.70	0.20		6		297	2.3	97		233	50	2.8	64	1279	12	234	53	0.5	207	33	3	140
4398	15060	22530	38.1	10.0	6.8	9.7	1.4	1.20	0.50	0.40		6		212	1.6	66		161	33	1.3	45	760	14	148	30	0.5	149	24	2	113
4399	14805	22365	50.0	14.0	8.4	2.2	1.1	1.25	0.20	0.20		9	20	189	2.2	80		151	23	2.5	56	1014	9	111	55	0.5	173	33	3	105
4511	14650	22500	29.0	8.0	7.0	20.3	2.1	1.43	0.50	0.30		5		182	1.2	40		128	45	1.5	36	566	10	104	22	0.4	136	14	1	100
4512	14780	23550	22.5	6.5	4.0	26.8	1.7	0.61	0.30	0.40		6		88	0.8	31		119	72	1.1	30	401	9	83	39	0.6	108	12	1	139
4513	14840	23530	20.5	6.7	3.5	26.3	1.1	0.49	0.30	0.40		6		86	0.9	41		80	90	1.0	26	287	12	77	32	0.5	102	11	1	213
4514	14840	23550	34.0	8.8	5.7	17.5	2.0	0.95	0.30	0.30		5		152	1.2	55		136	84	1.7	36	626	14	94	57	0.6	130	19	1	153
4515	14970	23570	21.5	5.5	4.4	26.3	2.8	0.71	0.40	0.40		5		85	0.8	43		142	62	1.7	32	414	11	146	180	1.0	109	12	1	126
4517	15260	23690	14.5	3.4	1.8	31.9	1.3	0.27	0.30	0.40		3		30		12		50	69	0.6	21	193	8	63	22	0.4	84	6	1	58
4518	15260	23670	30.0	8.3	8.2	14.6	5.0	1.40	0.30	0.30		3		126	1.4	58		299	135	2.2	40	664	11	314	39	0.4	149	15	1	119
4520	15380	23690	16.5	4.5	2.9	17.6	1.5	0.50	0.20	0.40		3		48	0.6	32		89	116	0.9	24	263	9	109	20	0.4	100	8	1	58
4521	15280	23700	22.5	6.2	4.3	24.3	2.0	0.68	0.30	0.50		4		72	0.9	44		141	120	1.0	31	240	10	154	37	0.4	120	11	1	182
4522	15630	22700	25.2	3.6	1.9	29.5	1.0	0.28	1.10	0.40		3		1052	0.6	31		79	53	0.6	19	460		118	23	0.5	49	21	2	135
4523	15695	22700	23.9	7.3	3.6	26.2	0.9	0.56	0.20	0.30	6	4		143	1.1	47		76	31	0.6	24	420		60	19	0.3	71	17	2	63
4525	15740	22850	39.5	12.6	9.9	7.0	2.4	2.10	0.20	0.10		3	20	146	1.3	50		175	44	1.9	25	626		112	16	0.2	161	19	2	109
4530	14590	23000	31.3	10.4	7.3	14.0	2.0	1.44	0.10	0.30	4	7		116	1.3	56		163	38	1.6	27	513		180	16	0.3	122	18	2	71
4533	15625	23000	35.8	11.2	5.6	9.6	0.6	0.89	0.20	0.30	20	7		151	1.8	69		120	34	1.6	35	629		58	23	0.5	104	24	3	102
4535	15825	22920	49.3	16.9	9.3	1.8	0.5	1.43	0.10	0.10	6	8		211	2.8	104		161	28	2.4	57	1004		58	37	0.4	158	40	5	100
4537	15940	22925	34.3	10.8	5.6	18.7	0.9	0.91	0.30	0.30	8	9		328	1.6	66		128	33	1.6	36	582		89	13	0.6	109	27	3	86
4540	15970	23100	34.0	11.3	8.2	14.7	2.6	1.56	0.30	0.20	3	6		115	1.5	62		157	38	1.8	32	601		141	19	0.3	139	20	2	81
4542	15960	23140	17.6	5.7	2.9	36.8	0.5	0.49	0.70	0.40		9		174	0.8	37		153	52	0.5	21	173		54	8	0.7	75	24	2	92
4544	15950	23205	44.2	13.9	7.7	6.3	0.8	1.26	0.20	0.20	4	10		311	2.2	83		160	35	1.9	46	804		62	20	0.3	138	33	4	109
4545	15965	23230	42.9	13.9	7.6	9.3	1.4	1.21	0.10	0.20	5	8		192	2.2	82		143	33	1.8	43	768		63	26	0.7	137	30	3	91
4546	15940	23405	38.7	11.8	6.3	12.9	1.2	1.04	0.10	0.20	6	9		166	1.9	75		129	30	1.6	40	663		39	18	0.3	122	27	3	83
4549	15935	23535	25.2	7.0	3.7	27.8	1.9	0.62	0.10	0.40	8	17		114	1.2	47		82	30	0.7	21	425		24	9	0.6	82	16	2	53
4550	15895	23625	29.8	9.5	5.0	20.8	3.1	0.73	0.10	0.30	10	8		132	1.6	76		105	36	1.2	31	547		56	23	0.6	101	21	3	113

SAMPLE	E	N	SID2	AL203	FE203	CAO	MGO	TIO2	P205	SO3	AG	AS	AU	BA	BE	CE	CO	CR	CU	EU	LA	MN	MO	NI	PB	SB	V	Y	YD	ZN
4552	15530	22650	38.3	7.3	3.4	19.9	1.1	0.48	0.20	0.50		3		4260	1.0	31		125	81	5.8	60	972	16	177	72	1.9	70	46	4	123
4553	15520	22990	42.3	13.4	7.3	12.7	0.6	1.05	0.20	0.20	4	10		235	2.2	86		139	35	1.7	44	794		83	86	1.2	135	32	4	109
4554	15515	23035	20.9	8.9	4.3	14.3	0.4	0.53	0.10	0.20		6		97	1.3	51		92	17	0.9	25	318		71	22	0.4	81	16	2	56
4556	15470	23080	11.7	4.4	1.7	41.2	0.3	0.27	0.10	0.40	6	5		47	0.6	32		48	13	0.5	13	209		17	5	0.3	38	11	1	19
4557	15400	23020	47.7	16.1	8.6	6.0	0.5	1.29	0.10	0.10	4	7		213	2.5	98		152	33	2.3	53	931		102	32	0.5	155	37	4	95
4558	15340	23045	33.3	9.5	5.1	22.0	0.8	0.72	0.20	0.30		6		141	1.4	50		92	30	1.6	30	491		36	14	0.4	76	20	2	69
4562	14360	23090	29.0	7.9	4.0	26.1	1.1	0.59	0.20	0.40	4	6		101	1.1	41		84	23	1.5	25	318		48	10	0.4	62	16	2	65
4563	15700	23180	46.5	13.7	8.1	8.5	0.9	1.18	0.20	0.20		9		196	2.3	79		150	28	2.4	49	794		65	25	0.4	128	34	4	112
4564	15680	23170	37.3	10.7	5.9	20.0	0.8	0.88	0.20	0.30		7		143	1.6	57		120	22	1.6	35	560		71	15	0.5	105	25	3	75
4565	15885	23130	41.4	11.5	6.6	11.1	0.9	1.02	0.30	0.30	4	7		181	1.8	68		120	36	2.1	40	662		315	14	0.4	97	27	3	105
4567	15835	23260	51.2	16.9	10.1	1.1	0.8	1.40	0.20	0.10		14		232	2.8	95		164	34	3.0	59	1002		162	23	0.5	148	40	4	122
4119	15650	23660	28.7	7.6	4.6	21.6	2.5	0.64	0.30	0.40		8		151	1.4	51		114	27	0.7	25	497	31	43	43	0.5	96	18	2	70
4120	15765	23635	40.0	11.1	6.4	4.7	1.8	0.87	0.20	0.20		10		240	2.0	60		133	62	1.7	40	749		40	18	0.6	125	24	3	82
4121	15785	23590	35.3	9.6	5.6	16.6	1.7	0.81	0.30	0.30		13		175	1.7	58		115	52	1.6	37	663		25	21	0.4	109	25	3	72
4127	14625	22340	33.0	9.4	9.9	12.1	5.8	2.13	0.50	0.20		4		227	1.6	53		168	63	2.2	37	764		128	17	0.2	128	17	2	81
4129	15040	23330	24.0	7.4	4.0	26.2	0.8	0.61	0.10	0.30		8		140	1.1	37		82	22	1.2	26	413		8	19	0.3	58	16	2	44
4130	15060	23320	21.4	6.6	3.4	34.9	0.8	0.50	0.10	0.40		7		131	0.9	32		66	25	1.0	23	324		6	6	0.4	51	14	2	37
4131	15080	23275	43.0	12.7	7.1	9.5	1.1	1.08	0.20	0.30	4	10		266	2.2	73		127	35	1.7	48	831		35	28	0.3	103	31	4	77
4132	15080	23260	32.5	10.4	5.9	18.1	1.0	0.81	0.20	0.30		8		175	1.8	57		104	36	1.5	38	613		25	26	0.3	100	24	3	65
4133	15165	23260	42.5	13.2	7.3	11.6	1.0	1.10	0.20	0.20		10		234	2.2	73		135	66	2.0	50	891		127	29	0.5	115	32	4	80
4134	14990	23275	20.7	7.3	3.7	35.0	0.8	0.51	0.10	0.40		7		122	1.0	32		68	30	0.5	24	338		8	20	0.1	55	15	2	44
4135	14990	23265	41.8	12.7	7.2	7.6	1.1	1.04	0.30	0.30		9		252	2.2	70		132	54	1.9	48	869		31	32	0.3	105	31	4	93
4136	14970	23435	19.8	6.8	3.3	36.5	0.9	0.45	0.10	0.40		5		107	0.8	27		63	31	0.6	21	269		2	19	0.3	51	12	1	45
4137	14965	23450	24.3	7.6	3.8	36.0	1.1	0.55	0.20	0.40		5		142	1.2	38		81	46	0.6	25	299		12	27	0.2	77	16	2	62
4138	14765	23700	33.1	9.2	5.4	18.3	1.6	0.81	0.30	0.30		7		191	1.6	54		102	52	1.2	37	670		18	26	0.3	81	24	3	72
4139	14825	22760	34.2	8.5	10.7	12.3	10.1	1.86	1.30	0.20		12		231	2.2	79		241	83	3.0	55	652		210	15	0.1	124	21	2	98
4140	15320	23640	34.8	8.9	10.2	10.8	9.9	1.84	0.90	0.20		3		220	1.7	64		340	66	2.1	44	749		337	17	0.1	122	20	2	86
4142	15310	23635	37.7	10.2	11.0	8.7	8.9	1.85	1.00	0.20		4		232	2.0	75		389	61	2.5	52	1027		376	23	0.2	114	24	3	99
4144	15325	23550	33.6	10.1	8.6	14.3	2.4	1.40	0.60	0.30		13		229	1.8	68		278	53	2.0	45	776		216	23	0.6	104	24	3	87
4146	15370	23540	29.5	9.8	5.5	23.5	1.0	0.77	0.20	0.30		9		159	1.6	48		106	34	1.2	35	502		25	25	0.4	89	21	3	67
4147	15390	23540	38.6	11.8	6.6	16.0	1.2	0.99	0.20	0.30		8		189	2.0	64		141	33	1.5	45	722		40	27	0.3	110	30	4	85
4148	15440	23500	21.7	7.2	3.7	34.0	0.9	0.52	0.20	0.40	4	7		102	1.0	32		85	24	0.7	24	303		12	24	0.2	63	15	2	53
4526	15630	22940	37.2	10.1	11.7	9.1	6.5	2.06	1.60	0.20		11		186	2.0	87		285	82	3.0	62	876		274	18	0.1	141	25	3	113
4529	15605	22980	32.8	9.0	9.3	15.8	6.5	1.45	0.70	0.20		4		176	1.5	56		323	66	2.1	38	856		293	24	0.1	112	18	2	93
4531	15595	23005	27.0	7.7	5.0	22.4	1.4	0.71	0.30	0.40	3	8		153	1.4	47		99	72	1.3	33	555		18	29	0.3	75	20	3	70
4534	15855	22985	48.0	14.0	10.5	1.6	0.9	1.16	0.30	0.30	3	11		225	2.5	78		174	70	1.8	53	965		48	30	0.4	155	34	3	133
4536	15815	22830	20.1	5.3	2.9	37.0	0.8	0.42	1.20	0.40		7		353	0.8	30		170	101	1.0	31	327		46	34	0.4	65	34	3	109
4538	15935	22950	43.0	13.5	8.1	8.6	2.5	1.15	0.50	0.30	4	9		238	2.5	79		156	63	2.0	53	933		54	49	0.5	138	34	4	118
4539	15980	23035	22.1	7.0	3.9	28.5	5.9	0.56	0.30	0.40		6		126	1.0	36		98	36	0.7	26	434		14	22	0.3	63	17	2	54
4543	15960	23170	30.3	9.0	5.8	17.9	2.8	0.88	1.70	0.30		7		192	1.6	53		120	33	1.5	42	605		36	29	0.6	86	35	4	79
4547	15935	23495	31.4	8.1	5.4	24.4	1.3	0.82	0.40	0.40	3	6		149	1.5	50		126	36	1.6	36	606		55	33	0.4	93	24	3	83
4551	15850	23640	38.8	10.5	6.5	16.3	3.2	0.94	0.50	0.30		8		180	2.0	62		128	39	1.8	44	848		42	31	0.4	115	28	4	97
4555	15515	23065	40.0	15.2	8.9	11.1	1.1	1.11	0.40	0.20		9	20	220	2.8	77		165	73	1.0	56	826		57	45	0.6	138	35	4	110
4559	15300	23035	36.0	10.3	6.5	18.9	1.1	0.93	0.30	0.30	3	5		280	2.4	57		127	88		41	681		51	40	0.3	94	25	3	105
4560	15295	23025	34.0	9.6	6.2	20.3	1.1	0.88	0.30	0.40	3	6		165	1.8	56		119	72		39	637		32	35	0.6	96	24	3	76
4568	15835	23350	51.0	17.7	10.9	1.6	0.9	1.48	0.30	0.10		8		250	3.4	95		198	67	1.3	68	1234		100	43	0.5	171	44	6	132

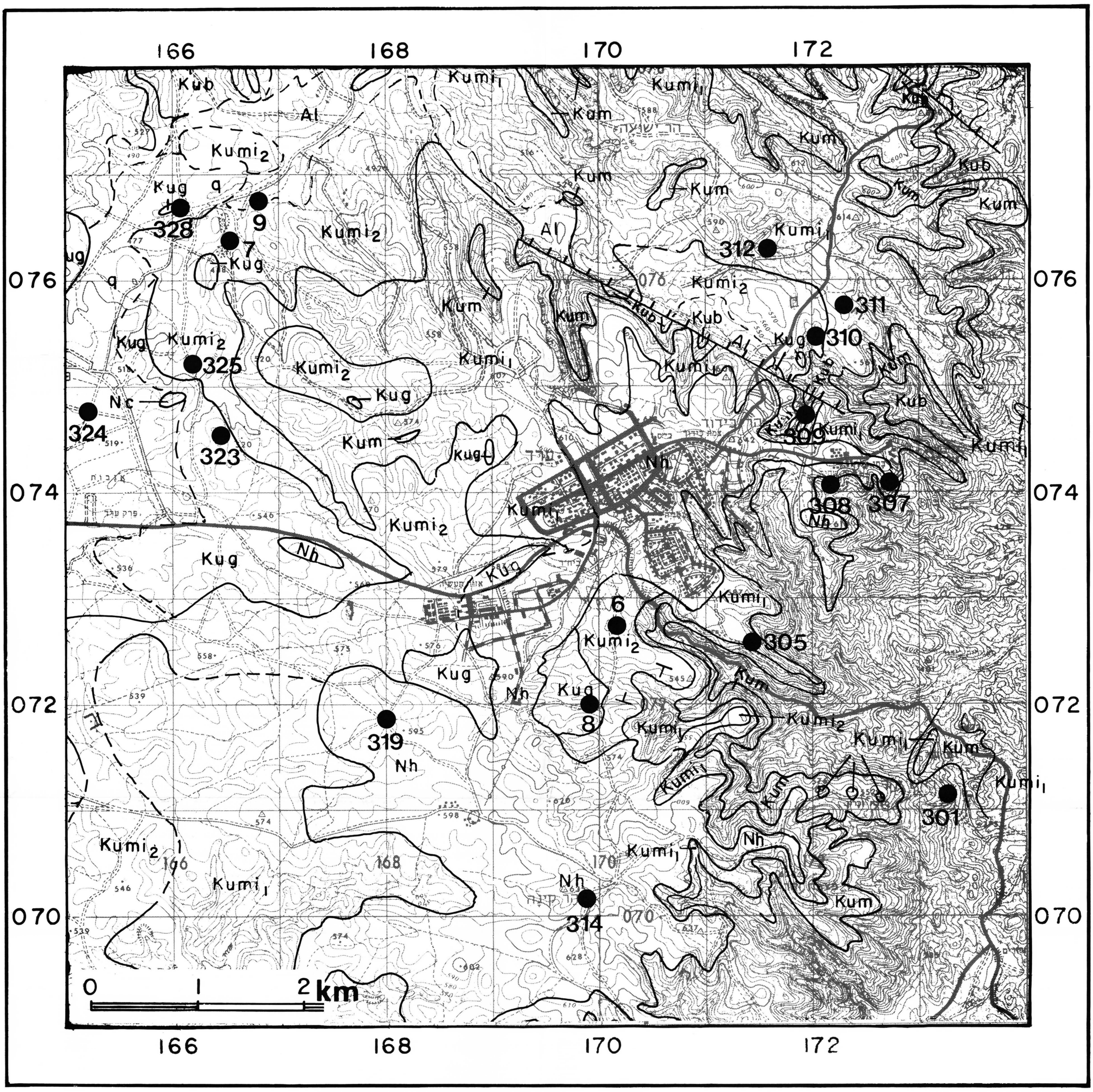
SAMPLE	E	N	SiO2	Al2O3	Fe2O3	CaO	MgO	TiO2	P2O5	SO3	Ag	As	Au	Ba	Be	Ce	Co	Cr	Cu	Eu	La	Mn	Mo	Ni	Pb	Sb	V	Y	Yb	Zn
4570	15785	23535	39.6	12.6	7.8	10.3	2.9	1.07	0.30	0.20		7		185	2.5	68		158	50	0.7	51	834		54	37	0.4	124	32	4	100
4581	15190	23580	27.1	7.3	4.5	31.5	1.7	0.64	0.20	0.40		9		89	1.2	39		98	39		28	367		16	24	0.2	72	17	2	48
4582	15190	23590	21.5	5.6	3.5	35.0	1.3	0.48	0.20	0.40		4		66	0.9	31		72	25	0.5	21	310		5	23	0.2	47	13	2	34
4583	15175	23510	27.9	9.6	5.8	25.8	1.1	0.72	0.20	0.30	3	6	30	126	1.8	51		114	43	0.8	37	512		25	31	0.4	87	23	3	74
4584	15170	23465	17.8	5.6	3.2	36.8	0.9	0.42	0.20	0.50	3	4	85	58	0.8	28		68	49	1.1	21	291		30	24	0.2	48	12	1	47
4585	15290	23950	29.0	9.1	5.7	24.5	1.2	0.79	0.40	0.40		8		129	1.7	53		127	46	1.1	38	606		40	30	0.4	100	24	3	81
4586	15280	23900	24.1	7.4	4.9	28.0	1.2	0.61	0.30	0.40	3	7		128	1.4	47		130	72	0.9	34	549		23	48	0.4	82	21	3	99
4587	15200	23930	44.6	15.2	9.2	5.4	1.2	1.27	0.20	0.20		5		248	2.8	89		177	63	1.7	60	1158		57	44	0.3	132	38	5	88
4588	15195	23950	34.6	11.4	6.7	18.7	1.4	0.94	0.20	0.30		7		175	2.1	63		137	39	1.4	44	686		33	34	0.3	108	27	3	73
4589	15185	23960	25.3	7.5	5.0	29.0	1.3	0.68	0.30	0.40	4	5		136	1.4	48		103	60	1.1	34	532		23	41	0.4	80	21	3	76
4590	15360	23960	15.0	2.9	1.2	43.5	2.0	0.17	0.10	0.40		3		5		13		58	6		10	108		7	16	0.1	22	5	1	27
4591	15435	23950	8.0	2.4	1.1	47.8	1.6	0.16	0.20	0.50	4	2		1		11		50	10		10	95		3	37	0.2	20	5	1	30
4592	15450	23950	18.5	5.8	3.6	31.2	3.7	0.51	0.20	0.40	6	6		69	1.0	34		93	27	0.8	25	340		15	26	0.4	65	15	2	58
4593	15550	23900	21.0	6.3	3.7	28.0	2.2	0.52	0.20	0.40	10	7		78	1.0	36		95	66	0.8	27	384		24	29	0.4	67	16	2	53
4594	15580	23835	27.0	7.2	4.8	18.0	1.7	0.64	0.30	0.40	8	6		102	1.4	45		121	105	0.7	33	575		50	34	0.5	84	20	2	71
4595	15580	23820	21.9	6.7	4.4	31.1	1.5	0.58	0.40	0.40		10		92	1.3	42		98	47	0.8	30	541		30	29	0.5	80	18	2	64
4596	15580	23785	21.9	6.4	4.2	34.4	1.8	0.55	0.20	0.40		6		71	1.2	38		96	35	0.7	28	398		93	22	0.3	75	16	2	47
4597	15580	23770	21.9	6.1	4.2	34.4	2.5	0.55	0.20	0.40		6		69	1.2	39		103	26	0.8	28	410		25	35	0.6	70	17	2	66
4598	15600	23740	19.0	5.9	3.5	27.5	1.6	0.47	0.30	0.40	6	5		64	1.0	34		82	95	0.8	25	375		20	28	0.5	66	14	2	49
4599	15635	23675	22.5	5.2	3.3	3.6	3.6	0.44	0.40	0.40	7	5		95	0.9	33		78	50	0.7	23	360		23	49	0.6	56	13	2	155
4781	14817	24425	35.4	0.4	0.4	37.0	0.6	0.03	0.10	0.50		2	300	27		1		124	8	1.0	2	37		20	4	0.1	17	2	1	20
4782	14819	24427	94.0	0.5	0.5	4.0	0.2	0.03	0.05	0.10		2	300	25		4		207	2		1	73		10	2	0.1	8	1	1	14
4783	14821	24428	38.4	10.7	11.8	11.5	7.2	2.95	0.70	0.20		30	500	45	0.8	62		129	36	2.4	38	77	9	190	43	1.3	242	16	2	114
4784	14818	24428	49.8	12.8	14.6	3.1	3.7	3.42	0.80	0.10		45		79	0.8	71		146	35	2.5	46	36	9	170	46	1.0	264	19	2	160
4785	14823	24429	20.0	3.6	2.5	30.0	1.4	0.36	0.40	0.60		3	40	129	0.7	26		54	32	0.6	14	234	5	45	65	0.8	39	9	1	280
4786	14826	24430	20.0	3.8	2.7	29.5	1.5	0.37	0.40	0.60		4	60	138	0.8	30		55	35		15	241		25	64	0.7	43	10	1	325
4787	14828	24431	19.9	3.7	2.5	30.5	1.4	0.37	0.60	0.60		2	350	193	0.8	19		55	70		13	215		25	63	1.1	37	10	1	571
4788	14829	24431	17.1	3.4	2.3	28.5	1.5	0.32	0.40	0.70		2	150	136	0.7	25		48	48		12	209		25	44	0.7	38	8	1	307
4789	14826	24433	19.9	3.7	2.5	25.5	2.0	0.34	0.20	0.50		2		100	0.9	22		50	15	0.5	13	255		25	42	0.3	45	9	1	62
4790	14832	24433	23.5	4.5	3.2	31.0	1.6	0.44	0.30	0.50		3	25	134	1.0	26		58	23		16	302		20	88	0.6	51	12	1	181
4791	14835	24434	24.7	4.9	3.4	30.5	1.7	0.46	0.20	0.50		4	15	136	0.9	30		62	23		18	334		35	121	0.7	50	13	1	169
4792	14838	24435	24.9	4.9	3.6	30.0	1.7	0.47	0.30	0.50		3	40	145	1.1	29		66	30	0.5	18	346		25	109	0.6	55	14	1	194
4793	14840	24436	27.0	5.1	3.7	30.5	1.8	0.49	0.20	0.50		3	10	143	1.1	29		67	25	0.9	19	362		30	110	0.5	58	13	1	154
4794	14845	24435	26.9	5.1	3.7	27.5	2.0	0.49	0.20	0.50		3	10	151	1.2	29		68	25	0.8	19	363		25	146	0.8	60	14	1	171
4795	14847	24434	27.7	5.3	4.1	20.5	2.0	0.51	0.20	0.50		4	10	154	2.1	31		162	29	4.9	20	379		125	200	1.7	71	14	1	222
4796	14849	24433	28.8	4.9	3.8	29.5	2.2	0.51	0.20	0.60		3	20	160	1.1	30		68	26	0.6	19	372		30	178	0.7	60	13	1	179
4797	14852	24432	30.3	5.9	4.4	24.0	1.9	0.57	0.20	0.50		4	12	168	1.2	38		76	22	0.6	22	415		30	152	0.5	67	15	2	180
4798	14853	24432	39.5	8.1	5.8	11.0	1.7	0.76	0.20	0.30		4	50	216	1.7	47		93	12	0.9	30	569		40	43	0.3	76	20	2	77
4799	14840	24440	14.7	2.2	1.4	42.0	1.5	0.19	0.20	0.70		2		59		11		36	16		8	149		25	22	0.3	29	6	1	63
4800	14840	24442	19.6	3.2	2.5	23.0	1.2	0.34	1.10	0.70		2	650	290	0.6	18		59	167		12	197		40	101	1.7	33	8	1	915
4801	14840	24445	23.8	4.9	3.4	15.0	1.2	0.45	0.20	0.50		3		134	1.0	30		60	15		18	343		30	49	0.6	56	13	1	106
4802	14840	24448	27.4	5.6	4.1	22.5	1.3	0.53	0.20	0.50		4		164	1.3	36		73	14	1.0	21	403		35	62	0.5	67	15	2	106
4804	14842	24453	17.6	3.6	2.6	9.5	0.9	0.35	0.20	0.40		3		101	0.9	20		48	18		14	284		20	35	0.3	45	10	1	80
4122	14765	22265	35.0	8.0	9.0	16.1	5.1	1.57	0.30	0.20		3		102	1.1	32		146	46	0.7	19	530		135	12	0.1	92	13	1	73
4128	14635	22365	33.3	8.2	9.1	17.4	5.3	1.98	0.40	0.20	7	2		261	1.4	50		156	43	1.6	29	700		135	17	0.1	125	14	1	74
4141	15290	23625	33.5	8.8	5.2	19.1	1.1	0.80	0.20	0.30	24	4		173	1.6	49		113	40	1.2	28	570		50	30	0.3	99	20	2	81

SAMPLE	E	N	SiO2	Al2O3	Fe2O3	CaO	MgO	TiO2	P2O5	SO3	Ag	As	Au	Ba	Be	Ce	Co	Cr	Cu	Eu	La	Mn	Mo	Ni	Pb	Sb	V	Y	Yb	Zn
4143	15320	23580	41.0	10.4	10.8	10.0	4.3	1.90	0.60	0.20	7	4		233	2.0	78		372	52	2.2	44	1000		340	31	0.1	153	23	3	98
4145	15370	23565	22.9	5.4	3.2	31.0	1.2	0.51	0.20	0.40	9	2		93	0.9	33		72	26	0.6	18	380		30	19	0.2	61	14	1	44
4149	15465	23640	42.6	12.1	7.1	12.8	1.1	1.06	0.10	0.20	16	7		182	2.2	69		145	36	1.4	41	720		65	37	0.3	139	29	3	91
4299	15010	22480	23.8	6.0	3.7	33.1	0.6	0.59	0.40	0.20		4		217	1.0	33		110	36	0.9	25	369		40	18	0.2	79	22	2	38
4532	15630	22995	45.2	12.5	8.1	7.9	0.8	1.22	0.20	0.10		7		190	2.1	72		139	35	1.4	43	850		65	27	0.3	136	30	3	74
4561	15295	23050	23.5	6.7	3.8	31.7	0.8	0.54	0.20	0.10		4		87	1.0	28		66	31	0.6	21	320		30	23	0.2	70	15	1	43
4566	15830	23191	41.2	11.1	7.3	2.4	0.6	1.14	0.30	0.20		9		168	2.0	67		129	37	1.4	40	880		60	28	0.3	123	29	3	83
4569	15825	23460	48.1	16.0	10.5	1.4	0.8	1.37	0.20	0.10		11	120	233	3.2	90		173	44	2.2	59	1020		90	34	0.2	170	40	4	115
4601	15465	23660	24.7	6.5	3.6	32.9	1.3	0.53	0.20	0.10		5		100	1.1	30		73	26	0.6	20	420		25	13	0.2	69	16	2	14
4602	15735	23230	51.5	13.9	9.1	1.6	0.8	1.51	0.20	0.10		9	210	258	2.6	82		154	59	2.1	56	1050		75	25	0.3	153	42	4	100
4606	14780	23630	42.8	12.0	7.3	13.0	1.2	1.09	0.20	0.10		6		200	2.2	67		125	48	1.0	44	880		55	22	0.2	119	32	3	77
4607	14775	23740	45.0	12.8	8.1	6.6	1.6	1.14	0.30	0.10		7		225	2.4	73		149	55	1.8	49	990		50	28	0.3	122	34	4	70
4608	14790	23805	31.1	7.8	4.8	27.6	2.0	0.73	0.20	0.10		4		154	1.3	44		92	40	0.8	26	520		40	27	0.2	75	19	2	32
4609	14810	23800	30.8	7.6	4.6	25.5	2.0	0.69	0.20	0.10		3	165	145	1.4	47		87	38	1.0	29	450		40	22	0.3	73	19	2	33
4610	14820	23805	31.1	8.0	5.0	27.0	1.9	0.74	0.30	0.10		5		164	1.4	44		91	40	1.0	28	585		45	25	0.2	74	19	2	43
4611	14800	23905	33.3	9.1	5.7	26.5	1.2	0.82	0.10	0.10		5		171	1.6	52		98	40	1.0	31	580	5	45	44	0.5	82	21	2	32
4612	14840	23935	45.9	11.5	7.4	12.2	1.4	1.21	0.10	0.10		4	15	239	1.9	67		129	58	1.5	40	900		55	31	0.3	113	29	3	53
4613	14840	23950	32.0	8.7	5.3	24.0	0.9	0.82	0.20	0.10		4	15	185	1.9	45		100	56	0.8	30	600		40	131	0.4	80	22	2	41
4614	14880	24025	43.5	11.6	7.2	13.3	1.6	1.09	0.10	0.10		5		207	2.1	63		129	44	1.3	40	770		35	31	0.3	111	27	3	49
4615	14895	24035	45.5	12.6	8.0	11.5	1.0	1.15	0.20	0.10		6	45	216	2.4	75		141	48	1.2	44	840		60	30	0.3	126	30	3	55
4616	14960	24040	21.2	5.1	3.3	42.0	1.8	0.54	0.30	0.10		3		115	0.8	27		74	34		18	360	5	40	47	0.3	49	12	1	57
4617	14970	24030	18.2	4.7	2.8	45.7	0.9	0.41	0.20	0.10		3		89	0.7	25		61	49	0.5	18	320		25	16	0.2	46	13	1	17
4618	14960	24085	20.7	5.4	3.1	42.8	1.0	0.46	0.10	0.10		3		103	0.8	27		62	26		18	330		25	12	0.1	46	14	1	24
4619	14860	24085	34.7	8.9	5.5	27.7	1.0	0.83	0.20	0.10		5		178	1.5	48		98	50	1.0	33	620		40	26	0.2	77	22	2	37
4620	14825	24160	41.9	11.1	7.2	18.6	2.4	1.06	0.20	0.10		4	100	214	2.1	68		128	47	1.2	40	730	6	55	21	0.2	107	28	3	91
4621	14830	24180	47.5	11.4	7.3	13.0	1.2	1.11	0.10	0.10		5		257	2.1	73		128	49	1.4	42	910		45	18	0.2	108	31	3	49
4622	14815	24240	47.4	12.5	8.0	7.7	1.8	1.20	0.20	0.10		4		230	2.2	85		140	43	1.4	43	925	6	65	26	0.3	123	29	3	70
4624	14800	24285	31.7	7.5	4.2	23.3	1.5	0.72	0.40	0.20		5	50	196	1.4	42		96	56	0.6	29	400		30	30	0.3	61	20	2	568
4625	14785	24355	26.3	6.6	3.8	30.2	1.5	0.61	0.10	0.10		2		139	1.2	36		80	41		24	450		30	19	0.2	56	18	2	16
4626	14790	24380	6.1	1.4	0.6	34.1	12.1	0.13	0.20	0.10	4	1	40	75		3		32	23		5	100		10	7	0.2	9	5	1	68
4627	14810	24425	21.1	4.3	2.3	31.7	1.3	0.39	0.50	0.30	5	2	95	199	0.7	24		78	140		16	190		20	51	1.2	28	11	1	533
4628	14810	24415	20.6	4.8	2.6	33.1	1.2	0.42	0.20	0.20		2	50	204	0.8	23		69	71		18	275		20	66	0.6	34	13	1	146
4629	14790	24515	26.0	5.5	3.1	29.3	1.8	0.46	0.40	0.20		2		144	0.9	24		63	99		18	351		25	50	0.4	40	13	1	84
4630	14820	24310	66.1	16.4	9.4	10.6	2.1	1.44	0.20	0.20		5		353	3.6	104		202	82	1.3	67	1077		85	99	0.4	175	47	5	165
4631	14850	24300	22.8	5.8	3.2	28.4	5.9	0.49	0.20	0.10		2		118	1.1	36		74	34		22	252		20	21	0.2	44	15	2	38
4632	15115	24125	30.1	4.8	2.9	28.0	2.8	0.44	0.10	0.20		3		135	0.8	25		125	95		18	341	8	30	252	0.7	48	13	1	150
4633	15030	24105	29.1	4.2	2.3	32.3	1.8	0.40	0.20	0.20		2		128	0.6	21		110	57		16	202		25	87	0.3	38	11	1	108
4635	15410	23820	36.4	10.4	5.8	18.1	1.0	0.85	0.10	0.10		4		152	1.9	55		128	49	0.8	37	535		45	24	0.1	102	25	3	46
4646	14900	23175	37.8	9.1	8.9	13.7	3.2	1.57	0.50	0.10		3		243	1.9	65		246	69	1.8	43	742		180	31	0.2	93	22	2	68
4647	14700	24625	24.8	5.2	3.1	26.0	1.4	0.48	0.30	0.20		4		173	0.9	30		73	62		21	308		25	94	2.3	38	15	2	257
4648	14645	24720	42.1	8.8	5.6	17.5	2.3	0.94	0.40	0.10		3		235	1.8	56		121	80	1.2	36	453		60	125	1.0	77	25	3	245
4649	14680	24780	34.6	6.4	4.1	26.1	2.1	0.67	0.10	0.10		2		194	1.2	38		85	56		26	458		30	188	0.5	59	19	2	138
4650	14690	24680	38.4	8.7	5.4	22.6	1.2	0.86	0.10	0.10		4	15	208	1.8	56		111	33	0.8	34	673		45	39	0.3	81	23	3	38
4651	14690	24700	34.9	7.6	4.7	20.1	1.7	0.74	0.40	0.20		3	15	241	1.5	42		113	68		30	542		40	75	0.8	67	21	2	332
4652	14740	24680	31.1	6.3	3.7	23.7	1.8	0.60	0.40	0.30	3	3	20	214	1.2	38		118	86		26	428		40	100	0.7	53	17	2	365
4653	14740	24690	28.1	5.3	3.0	24.5	1.4	0.47	0.20	0.20		2		124	0.9	27		71	37		20	374		15	31	0.2	36	15	1	44

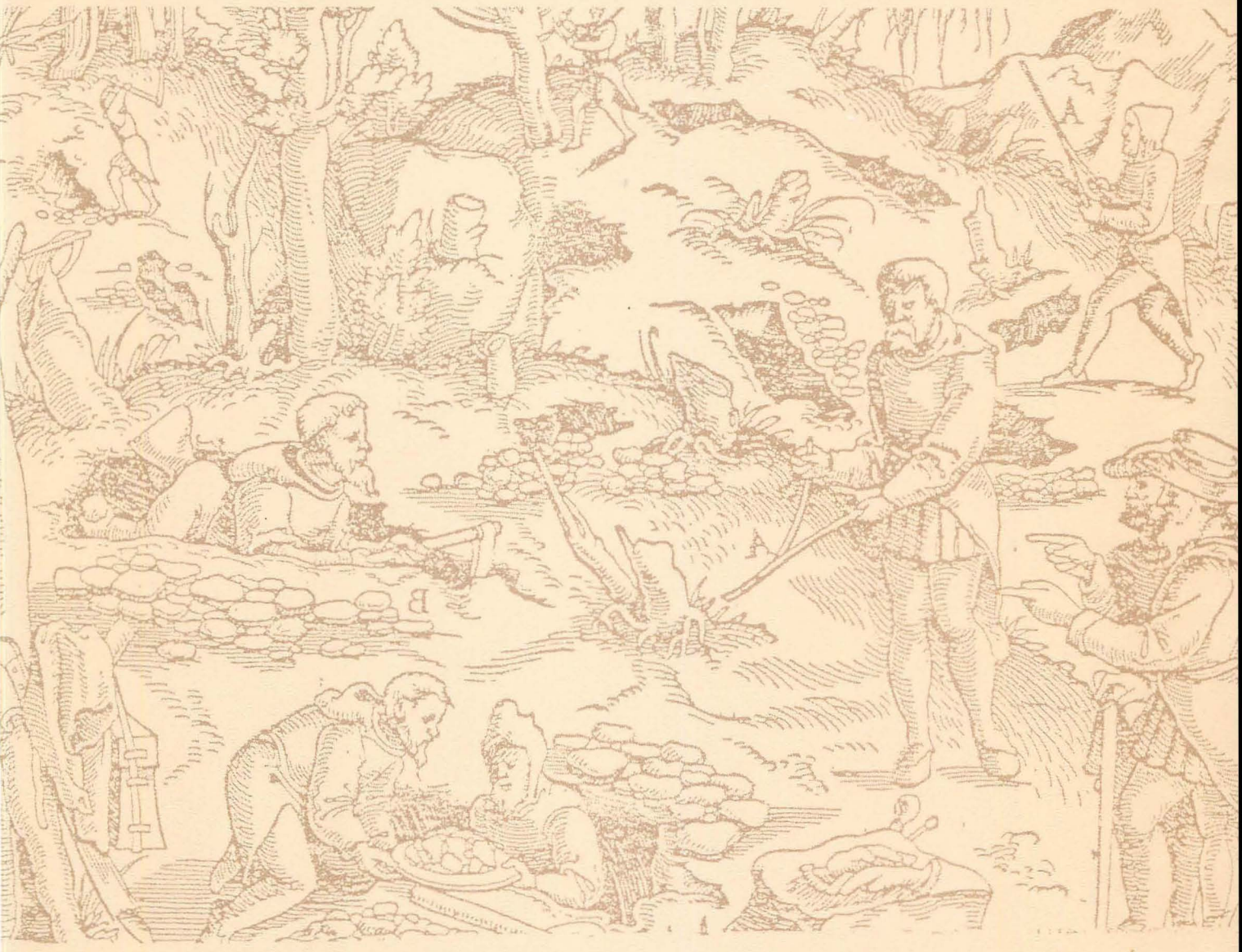
SAMPLE	E	N	SiO2	Al2O3	FeO	CaO	MgO	TiO2	P2O5	SO3	AG	AS	AU	BA	BE	CE	CO	CR	CU	EU	LA	MN	MO	NI	PB	SB	V	Y	YB	ZN
4654	14735	24715	26.2	5.5	3.3	31.6	3.1	0.57	0.10	0.10		3		152	1.0	31		77	46		21	388		20	34	0.4	47	16	2	48
4655	15315	23840	22.3	5.2	3.2	32.6	0.8	0.49	0.20	0.20		3		114	1.0	34		76	28		25	386		25	22	0.2	49	17	2	20
4656	15315	23830	44.4	11.3	7.2	8.9	1.0	1.05	0.20	0.20		7		221	2.6	76		157	82	1.1	49	820		60	39	0.2	122	32	4	71
4657	15015	23815	31.9	7.2	4.4	20.6	1.0	0.70	0.30	0.20		4		171	1.5	45		101	39	0.5	31	497		35	32	0.2	69	21	2	38
4658	15015	23830	33.8	8.1	5.2	20.9	1.1	0.75	0.30	0.20		4		205	1.8	52		113	43	0.7	34	567		40	42	0.3	79	23	3	70
4659	14925	23865	37.7	8.1	5.1	24.3	1.2	0.85	0.10	0.10		3		190	1.6	44		117	34		31	466		40	34	0.2	79	20	2	32
4660	15030	23755	39.3	9.3	6.0	15.3	1.1	0.88	0.60	0.20		5		217	2.2	61		127	37	0.7	41	665		55	39	0.3	87	27	3	87
4661	14950	23770	20.6	3.6	2.1	38.7	1.6	0.34	0.20	0.10		2		92	0.6	15		69	26		15	259		10	15	0.1	32	10	1	11
4662	14940	23730	41.0	10.0	6.3	9.3	1.1	0.89	0.30	0.10		5		223	2.3	59		129	78		43	825		50	25	0.2	92	29	3	65
4663	14820	23635	45.0	11.1	7.8	2.6	1.0	1.09	0.20	0.10		6		248	2.8	79		155	78	0.9	54	1044		60	40	0.3	116	36	4	64
4664	14785	22510	51.7	11.6	9.0	7.9	1.1	1.40	0.20	0.10		14		279	2.8	86		173	44	1.5	56	1419		85	37	0.3	136	36	4	61
4665	14730	22480	16.2	3.4	2.7	46.1	0.8	0.56	0.10	0.10		3		75		19		59	30		18	250		20	16	0.1	40	10	1	1
4666	14885	22820	31.6	7.5	9.4	17.1	7.1	1.59	0.80	0.10		2		233	2.2	72		233	67	1.6	53	1017		190	15		98	20	2	81
4667	14875	23770	32.4	7.2	4.7	24.2	1.7	0.69	0.30	0.20		4		169	1.6	46		107	57		30	610	7	40	26	0.2	75	21	2	60
4668	14820	23760	39.0	9.1	6.2	2.1	1.3	0.93	0.20	0.20		4		200	2.2	57		144	31		40	508		45	39	0.2	88	26	3	54
4669	14890	23740	55.5	12.3	9.2	1.5	1.0	1.38	0.20	0.10		8		323	3.3	89		191	62	1.5	61	1351		75	41	0.3	139	41	5	80
4670	14880	23700	19.9	4.2	2.8	11.4	0.6	0.41	0.10	0.20		3		103	0.7	21		109	23		17	328		20	21	0.2	37	12	1	20
4671	15100	24040	44.3	12.9	7.5	4.9	1.1	1.05	0.10	0.10		7		224	2.3	73		131	32	1.6	43	799		60	31	0.2	119	30	3	94
4672	15150	24060	12.0	2.1	1.0	45.0	0.5	0.15	0.05	0.30		2		49		11		25	17		8	122		10	17	0.1	25	6	1	50
4673	15245	24135	20.9	5.1	2.8	15.4	0.9	0.43	0.10	0.30		3		92	0.9	29		64	24	0.6	17	317		35	26	0.2	58	12	1	74
4674	15230	24115	41.7	10.6	6.3	14.1	1.1	1.05	0.20	0.20		6		196	1.8	62		124	32	1.5	36	619		55	24	0.2	115	25	3	97
4675	15315	24120	51.9	12.9	8.1	4.6	1.5	1.35	0.20	0.10		5		255	2.3	78		147	55	1.8	44	713		80	32	0.3	142	30	3	113
4676	15330	24130	23.0	5.4	3.0	27.9	2.6	0.49	0.10	0.30	4	4		100	0.9	32		64	55	0.8	19	317	5	35	34	0.3	63	13	1	110
4677	15360	24080	11.3	2.4	1.4	32.5	11.1	0.27	0.05	0.20		4		47		14		37	16		7	171	10	30	13	0.4	41	6	1	49
4678	15365	24100	3.7	0.4	0.2	33.3	13.9	0.04	0.05	0.20	4	2		4		2		15	10		1	47	6	10	6	0.2	20	2	1	22
4679	15430	24080	6.5	1.7	1.0	31.6	12.6	0.18	0.05	0.20	6	5		18		9		29	17	0.5	4	102	10	20	11	0.4	37	4	1	35
4680	15420	24095	12.8	3.3	1.7	38.8	1.5	0.25	0.10	0.30	7	2		67	0.6	17		45	17	0.8	11	161		15	20	0.2	44	8	1	65
4681	15480	24130	11.4	2.3	1.3	35.7	7.3	0.22	0.10	0.20		4		38		12		33	19		8	167	7	20	13	0.3	36	6	1	45
4683	15560	24030	29.3	6.9	4.1	19.8	3.6	0.68	0.20	0.20		6		343	1.1	40		82	48	0.8	24	520	5	40	25	0.4	91	18	2	120
4684	15585	23995	22.1	5.5	3.3	17.1	3.0	0.51	0.10	0.30	3	7		97	0.9	32		69	26	0.7	19	385		40	27	0.4	85	14	1	70
4685	15620	23940	13.6	3.5	2.0	10.4	1.9	0.30	0.20	0.30	3	3		73	0.6	22		41	24		13	253		25	22	0.3	62	9	1	55
4686	15665	23905	33.1	9.1	5.5	4.9	1.6	0.83	0.20	0.20	4	5		151	1.7	53		111	61	1.3	32	693	7	50	30	0.4	119	22	2	90
4687	15700	23860	30.6	8.8	5.3	14.3	3.0	0.78	0.20	0.20	4	5		118	1.5	45		101	48	1.0	25	472		50	32	0.5	114	17	2	85
4688	15725	23830	21.4	4.5	2.6	26.7	3.7	0.43	0.10	0.30	8	4		77	0.8	27		59	24	0.6	17	308		25	28	0.4	64	12	1	55
4689	15680	23780	21.0	4.5	2.5	31.5	3.3	0.40	0.10	0.20	5	3		69	0.8	27		57	19	0.8	17	272	5	25	37	0.3	62	12	1	43
4690	15690	23770	18.3	4.4	2.7	15.2	3.9	0.41	0.30	0.30	6	4		73	0.8	26		53	29	0.8	16	318		25	27	0.4	61	11	1	72
4691	15770	23790	39.1	10.4	6.3	4.6	2.0	0.93	0.20	0.20		7		170	1.9	59		115	54	1.2	37	777		50	31	0.5	125	25	3	95
4692	15790	23790	44.2	11.1	7.0	7.2	3.3	1.07	0.20	0.20		7		201	2.1	66		142	57	1.3	40	753	5	65	35	0.3	128	28	3	95
4694	15830	23680	44.9	11.2	6.7	9.7	3.6	1.00	0.20	0.20		7		186	2.1	60		120	39	1.7	41	762	5	55	32	0.3	127	30	3	93
4695	15490	24050	37.5	9.8	5.9	13.4	3.2	0.89	0.20	0.20	4	8		300	1.8	55		115	53	1.3	34	674	5	60	43	0.4	123	24	3	90
4696	15170	24230	48.4	13.4	8.3	5.2	1.3	1.16	0.10	0.10	3	7		242	2.5	75		154	54	1.6	46	796		55	37	0.5	131	32	4	89
4693	15820	23695	38.2	9.6	5.9	7.0	2.3	0.89	0.40	0.30		6		169	1.8	58		109	47	1.2	35	740		45	36	0.2	110	24	3	98
4697	15210	24210	28.4	4.9	4.4	32.4	2.1	0.83	0.30	0.20	3	2		182	0.9	29		90	23	1.1	18	352	5	60	15	0.1	58	10	1	39
4698	15235	24195	25.1	6.3	5.2	35.2	1.8	0.84	0.30	0.30	4	3		100	1.2	38		120	38	0.9	24	399		80	23	0.2	80	13	1	94
4699	15200	24290	51.5	14.0	9.0	3.3	2.1	1.28	0.20	0.10	4	9		236	2.9	86		167	41	2.0	53	988	11	70	53	0.8	170	35	4	104
4700	15275	24270	43.9	5.2	3.1	25.1	2.6	0.50	0.20	0.20	7	4		177	1.0	38		75	44	1.2	22	367		120	87	0.3	56	16	2	156

SAMPLE	E	N	SiO2	Al2O3	Fe2O3	CaO	MgO	TiO2	P2O5	SO3	AgS	AuA	BaA	BeE	CeE	CoO	CrO	CuU	EuU	LaA	MnN	MoO	NiI	PbB	SbB	VV	YB	ZN
4701	15125	22340	30.0	5.0	2.9	34.4	1.5	0.32	0.80	0.40		2	3761	1.0	29		106	49	1.3	36	694		90	22	0.3	62	45	3	103
4702	15170	22390	37.1	5.5	3.3	26.8	1.6	0.39	0.60	0.50		4	4569	1.1	33		113	63	1.4	36	455		95	36	0.3	69	42	3	130
4703	15170	22405	29.4	5.0	3.2	33.3	1.4	0.36	0.60	0.40		3	3731	1.0	29		102	53	1.2	32	663		75	26	0.2	61	37	3	80
4704	15025	24365	19.9	4.1	2.5	42.5	1.0	0.29	0.50	0.30	3	3	1162	0.8	29		80	40	1.0	26	537		40	29	0.3	55	29	2	63
4705	15135	22305	41.7	5.8	3.8	25.5	1.2	0.55	0.40	0.30		4	2209	1.2	39		113	51	1.2	32	493		55	32	0.2	61	32	3	84
4706	15190	24335	61.2	10.4	7.0	3.2	1.5	0.90	0.20	0.20	3	5	1518	2.3	63		183	70	1.6	49	846		85	37	0.2	99	43	4	109
4707	15280	22400	56.9	9.1	6.1	9.0	2.1	0.70	0.60	0.30		4	3185	2.0	55		192	73	1.8	54	1016		165	35	0.3	93	57	5	132
4708	15265	22400	32.0	4.3	2.8	36.6	1.4	0.31	0.50	0.80		3	9708	0.9	31		100	42	1.2	39	663		80	25	0.3	62	50	4	85
4709	15570	23175	49.8	13.9	8.9	10.3	1.1	1.22	0.20	0.10	3	10	228	2.8	80		180	40	2.0	52	932	5	55	48	0.3	148	36	4	95
4710	15565	23220	33.7	8.1	6.0	25.8	1.1	0.79	0.20	0.30	6	7	141	1.7	45		114	38	1.3	31	549	7	35	39	0.3	97	22	2	81
4711	15430	23210	23.0	4.6	3.3	40.0	1.0	0.46	0.30	0.40	5	5	94	1.0	28		62	110	0.6	17	283	6	1	32	0.3	60	12	1	89
4712	15440	23200	39.0	8.1	6.3	18.4	0.9	0.95	0.30	0.30	8	6	177	1.8	54		123	18	1.1	34	653	5	30	44	0.4	109	25	2	86
4713	15390	23155	39.0	9.7	7.7	19.6	1.2	0.95	0.20	0.30	7	6	185	2.2	55		131	33	1.3	35	635	9	40	44	0.3	123	24	2	85
4714	15365	23480	22.9	5.7	4.2	40.7	0.9	0.50	0.10	0.40		5	93	1.2	28		76	18	0.8	18	288	6	15	29	0.3	72	13	1	46
4715	15250	23565	55.0	12.8	11.0	1.8	1.1	1.43	0.20	0.10	8	7	303	3.1	84		196	49	2.0	53	1126	5	55	62	0.4	167	37	4	117
4716	15270	23515	52.0	14.5	11.9	1.4	1.0	1.34	0.20	0.10	5	8	254	3.3	79		200	40	2.1	52	901	6	70	61	0.4	182	36	4	141
4717	15680	23290	54.0	12.6	10.6	2.2	1.0	1.45	0.30	0.10	5	10	291	3.0	82		210	37	2.2	58	1132	6	60	64	0.4	167	42	4	150
4718	15700	23310	33.5	7.3	5.8	28.1	1.0	0.79	0.30	0.30	4	5	147	1.7	45		113	26	1.4	29	563	6	15	41	0.3	102	21	2	91
4719	15675	23430	38.0	8.6	6.9	23.0	1.0	0.95	0.30	0.30	7	10	233	2.0	54		134	26	1.3	35	688	6	30	43	0.4	120	25	2	120
4720	15715	23430	54.5	11.3	9.5	5.9	1.2	1.35	0.40	0.20	4	7	274	2.7	73		202	26	1.7	49	1049	7	60	56	0.4	159	35	3	173
4721	15750	23365	49.0	11.7	10.1	7.8	1.0	1.36	0.30	0.20	6	8	256	2.8	74		185	34	1.8	49	1032	8	50	61	0.5	163	35	3	163
4726	15070	23880	22.5	5.2	4.2	29.4	0.8	0.51	0.20	0.40	6	3	125	1.4	32		86	25	1.4	20	390		1	35	0.6	62	14	1	48
4727	15040	23930	47.5	10.9	9.4	9.9	1.0	1.21	0.20	0.20	6	7	252	2.6	70		163	29	1.6	44	929		35	60	0.3	137	31	3	98
4728	15000	23930	36.5	7.9	6.6	19.9	1.0	0.84	0.30	0.30		4	229	2.0	50		114	29	1.2	30	575	6	25	52	0.3	98	21	2	74
4730	14905	23880	45.5	8.7	7.3	16.9	1.0	0.98	0.20	0.20		5	264	2.1	59		122	24	1.3	37	802	6	25	48	0.2	107	25	2	78
4731	14830	23880	28.0	5.6	4.7	14.3	0.7	0.64	0.20	0.30	6	3	152	1.4	39		85	24	0.9	25	532	6	1	41	0.3	75	17	2	85
4732	14990	23875	30.0	6.4	5.2	32.7	0.9	0.67	0.20	0.40	3	5	189	1.5	39		94	25	0.8	25	506	8	10	43	0.2	80	18	2	72
4733	15025	23850	25.5	5.7	4.5	36.1	0.8	0.58	0.20	0.40	4	3	154	1.3	34		82	21	0.7	22	448	6	1	36	0.2	70	15	1	47
4734	15070	24440	15.0	2.5	2.2	47.2	3.5	0.29	0.30	0.50	3	2	108	0.6	16		55	36		10	205	7	1	161	2.0	44	7	1	187
4823	14920	24625	36.1	8.3	4.3	20.5	1.6	0.71	0.10	0.20		4	197	1.3	37		78	22	1.3	26	456	7	38	15	0.2	83	19	2	90
4824	14930	24500	29.4	6.5	3.3	23.3	1.3	0.54	0.10	0.20		4	184	1.1	29		65	51	0.5	20	408	5	36	135	0.5	65	16	2	151
4825	14900	24480	36.3	9.4	5.1	11.1	1.2	0.83	0.20	0.20		4	232	1.6	46		85	152	1.3	31	541		40	117	1.0	87	23	3	188
4826	14940	24435	38.4	7.7	4.1	17.7	0.9	0.81	0.10	0.10		4	274	1.3	40		72	20		25	483		36	32	0.2	80	19	2	72
4827	14950	24400	30.8	7.4	4.1	22.2	1.0	0.76	0.10	0.20		3	281	1.3	36		79	30	0.5	24	464		33	32	0.2	79	18	2	122
4828	14950	24360	43.0	11.1	6.2	6.7	1.1	0.97	0.40	0.20		8	288	1.8	54		110	100	1.6	35	713		59	111	1.7	119	26	3	241
4829	15050	24335	22.5	6.3	3.7	28.0	0.9	0.71	0.10	0.20		4	154	1.0	26		73	28	0.7	19	292		50	16	0.1	71	13	1	53
4830	15095	24305	21.3	5.2	2.9	29.2	0.9	0.51	0.10	0.20		3	177	0.9	22		59	70	0.9	15	297		34	25	0.2	62	11	1	148
4831	15100	24380	44.9	12.6	6.4	8.3	1.8	1.02	0.10	0.10		12	231	2.1	58		106	26	1.9	39	637	5	57	18	0.4	133	27	3	94
4832	15135	24360	33.3	7.8	4.1	17.1	4.3	0.77	0.30	0.30		4	186	1.3	38		80	23	0.9	25	433		48	52	0.5	104	18	2	116
4833	15035	24420	25.3	6.1	3.0	27.3	2.0	0.54	0.20	0.20		3	165	1.0	26		63	25	0.6	17	324		35	13	0.2	64	13	1	76
4834	14995	24480	19.7	4.4	2.1	30.1	1.4	0.37	0.40	0.30		2	194	0.7	17		46	52		13	187		20	55	0.6	48	9	1	503
4835	14995	24465	20.6	5.0	2.2	22.8	1.0	0.38	0.20	0.30		3	133	0.7	20		44	38		14	310		20	23	0.2	52	10	1	99
4836	15020	24535	26.1	5.6	3.2	21.9	3.2	0.53	0.40	0.40		3	237	0.9	25		60	97	0.5	17	352		43	493	3.0	66	13	1	375
4837	14920	24695	28.6	5.3	2.5	28.4	1.2	0.45	0.50	0.30		3	262	0.8	22		51	57		16	299		28	78	1.0	48	12	1	269
4838	14839	24430	47.1	11.6	5.3	2.2	1.0	0.93	0.10	0.20		5	273	1.7	54		93	25	1.4	36	627		40	14	0.3	94	25	3	68

מפה גיאולוגית של איזור המיפוי בערד ומיקום משטחי הדיגום (לפי זוהר ושילוני, 1987).



		סימול Symbol	עובי מ' Thickness (m)	ליתולוגיה Lithology		
Pleistocene to recent		Al	1-15		Alluvium אלוביום	
		Q			Loess אדמות לס	
		Nc	0-10		Ahuzam Fm.	
Neogen		Nh	0-100		Hazeva Fm. תצ' חצבה	
Eocene		Tlz	0-40		Zor'a Fm. תצ' צרעה	Avedat Gr. חב' עבדת
Paleocene		Tlt	40		Taquiye Fm. תצ' טקי'ה	
Senonian חבל	Maastrichtian	Kug	5-80	HATRURIM	Ghareb Fm. תצ' ערב	חב' הר הצופים Mt. Scopus Gr.
		Kuhr			Hatrurim Fm. תצ' חתרור'ם	
	Campanian	$Kumi_2$	10-22		Phosphate Series פרט הסידרה הפוספטית	תצ' מישש Mishash Fm.
		$Kumi_1$	12-30		Main chert פרט הצור המסיבי	
	Santonian	Kum	5-80		Menuha Fm. תצ. מנוחה	
	Turonian	Kub			Nezer-Shivta Fm. תצ. נצר-ש'בטה	


A
A
B