Pedogeochemical exploration for base metals and Ag in Tale-e-Messy area in the enorthwest of Bam (Kerman, Iran)

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Abstract

Tale-e-Messy is located in the northwest of Bam in southern Iran resulted in the discovery of the base metals mineralization. This area is geologically composed of variety of volcanic rocks such as Rhylite, Tuffic rhylite, Dacite, Andesite and Andesitic basalt of Eocene age. Before this surveying, Rhylite type had not been recognized, therefore, after petrographical and XRF about dominated outcrops in Tale-e-messy, this type of rocks was determined. Studying the aim of pedogeochemical exploration in this area is surveying of secondary geochemical halos to know the probably mineralization potential, surveying the weathering location ratio of Mineralization and determining the appropriate points for drilling .Therefore three stages of operation were carried out in this study :1-Designing of network . 2- Preparation. 3- Analyzing of geochemical samples and describing and processing of them.

The area of about 2.5 Km2 with square cells which dimensions are 100.100 m has been covered by this study. Sampling operation has been done the air photo (1.5000) where sampling points had been determined on the photo. The samples were analyzed for six elements (Cu, Pb, Zn, Ni, Fe, and Ag) and the conclusion of these samples was processed. After these stages, two areas were determined as an Anomaly (Northwest and Southeast of Tale-e-Messy) and background concentration of Ag and variation in samples suggest multiple source of the metal in the investigated soil.

Keywords: *Pedogeochemical exploration, Base metals, Ag, Tale-e-Messy*

1. Introduction

Geochemical surveys based on the chemical analysis of samples of soil from the special points that have been determined for sampling. In addition, these maps provide information on pollutant sources, weathering, and transport processes of the area. The fundamental premise is that soil samples are composite products of weathering which cover over the cap rocks. (Cocker, 1996, 1999). Hence many countries including Europe, North America and Japan have prepared countrywide geochemical maps (Webb et al., 1978; Kautsky and Bølviken, 1986; Thalmann et al., 1988; Reid, 1993; Atsuyuki et al., 2005). A few soil geochemical explorations have been carried out in Iran mainly for mineral exploration purposes. The Base metal Exploration project in Bam carried out by the National Iranian Cooper Company studies (NICC). This project covered a considerable portion of the Tale-e-messy area which represents the geologically important area in Kerman province. This paper presents geochemical maps of the soil samples, based on the data generated from this project, and interpretations for geochemistry on geological grounds.

Tale-e-messy area is situated in the northwest of Bam in southern Iran where is mainly important for base metals and Ag exploration (Fig. 1). Geologically; the Tale-e-messy area lying in the southwest of Orumiye-Dokhtar complex of Iran mainly consists of volcanic rocks

such as Rhylite, Tuffic rhylite, Dacite, Andesite and Andesitic basalt of Eocene age. (Geological Survey of Iran, 1977).

2. Methodology

For the base metal exploration project, soil samples were collected from cells which dimensions are 100.100 m has been covered by this study and the area of about 2.5 Km^2 with square (Fig 2). Sampling operation has been done the air photo (1.5000) where sample points had been determined on the photo. Samples were taken at about 0.3 m–0.6 m depth in order to minimize the effect of contamination. Also samples were collected using the hand pit method and a total of 4–5 kg of raw samples (without sieving) was taken from each cell. All soil samples were air dried and divided into two duplicates using the cone and quarter method and one duplicate was selected for chemical analysis. Samples were separated using a mechanical sieve shaker into size fractions. Since <63 μm sediment size fraction has the highest concentration of most of the elements, it was selected for chemical analysis.

The concentrations of 6 elements were determined by AAS Atomic absorption using a Philips-PW1404 spectrometer. Duplicates and replicates were analyzed to check the precision after every 10 samples. With a few exceptions (Pb), there were no major discrepancies in duplicate samples. Agreement among the replicate analyses was excellent except again for Pb (relative average deviation of <5). Detection limits of the analyzed elements are given in below:

Ag (1ppm), Co (5ppm), Cu (5ppm), Mo (10ppm), Pb and Zn (5ppm).

Data of all 240 soil samples from tale-e-messy area were combined into a single worksheet. An ID was assigned for each sample to represent its cell (Table 1). Normality of data was examined using histogram in SPSS15 software package. Basic statistics and Pearson product moment correlation were calculated for each element of all 240 samples (Table 2).

The sample interval for all of the locations was about 100m and any influence of the sampling location areas to the cells decreases heavily depending on the sampling by expert. Therefore using a 100 m interpolation distance, a 50 m grid cell size and inverse distance weighted interpolation method proved to be advantageous over the other methods. Trials with different interpolation distances and techniques validate the above selection. Interpolation and plotting was carried out using the Arc Map. All samples after normalizing were used for drawing distribution map.

3. Results and discussion

3.1. Element distribution

The arithmetic mean 95% confidence interval of the mean and standard deviation of each element in all 240 samples are shown in Table 1.

3.2. Major elements

Mean, maximum and minimum of Cu and Pb value in the Tale-e-messy soil samples were respectively 81.42ppm, 4279ppm, 3.75 and 107.19ppm, 6040ppm, 7ppm. It was noted that the Cu concentrations in most areas were much higher the average upper crustal value. Co and Mo have a lower concentration. Also Cu, Pb, Zn and Ag concentrations in samples show

much higher skewness, indicating that their concentrations were not normally. This means, concern elements have been enriched in soil.

Element relationships can provide interesting information on element sources and pathways (Manta et al. 2002). The relevant data for all samples show significant correlations between Cu and Zn as well as Cu and Pb. This indicates that Cu in soil samples has a strong association with Zn and Pb statistically, and it may shares a common origin with them. Other positively correlated relationships, such as those in Zn–Pb, Cu-Co and Cu–Pb–Zn may also be seen. On the other hand, Co does not show strong correlation with Cu as well as Zn, indicating that their distributions were not controlled by same factor. Ag is not strongly associated with other elements in top sediment samples. The results of the correlation study, therefore, evidence dependence between some elements likes Cu, Pb, Zn are stronger than within others.

The distribution map of Cu clearly shows striking anomalies in two important areas separated in this project. First area is situated in the northwest and second one is located in the southeast respectively with 1.5 acre and 4.5 acre (fig 3-A).

The distribution map of Pb (Fig 3-B) and Zn (Fig 3-C) are almost similar to that of Cu, the lower mean Pb contents in samples being reported from (14ppm) and Zn (11ppm). Therefore a similar distribution pattern to Zn and Pb can be expected. A high positive correlation between Pb:Zn is also an evidence for this relationship. As a result with considering all parameters and factors mostly Cu, pb and zn distribution maps, the chemical results and also relation between concern elements, 2 area have been suggested for more detailed exploration in this project.

Table 1- Statistical parameters of elements

Statistical		Cu	Pb	Zn	Co	Ag	Mo
N	Valid	240	240	239	240	240	240
	Missing	0	0	1	0	0	0
Mean		81.42	107.19	61.25	9.77	1.40	11.8654
Median		33	28	53	10	1.3	10
Mode		25	24	47	11	1.3	7.9
Std. Deviation		291.5041	438.7828	49.2739	2.9705	0.4528	9.6080
Variance		84974.64	192530.3	2427.9	8.8236	0.2050	92.3133
Skewness		12.8383	11.0773	3.1623	0.4339	1.3855	1.8721
Kurtosis		182.1245	142.7880	13.0434	6.9164	3.2689	5.3622
Minimum		3.75	14	11	3.6	0.81	0
Maximum		4279	6040	368	29	3.7	65

Table 2- Correlations Normal Data's (Pearson correlation)

Components	Cu	Pb	Zn	Co	Ag	Mo
Cu	1	0.576	0.431	0.189	0.208	0.155
Pb	0.576	1	0.693	0.192	0.256	0.104
Zn	0.431	0.693	1	0.753	0.413	0.129
Co	0.189	0.192	0.753	1	0.464	0.005
Ag	0.208	0.256	0.413	0.464	1	-0.151
Mo	0.155	0.104	0.129	0.005	-0.151	1

Figure 1: location of study area in Iran map ( ). ■

Fig 2- Sample location map of Tale-e-messy area

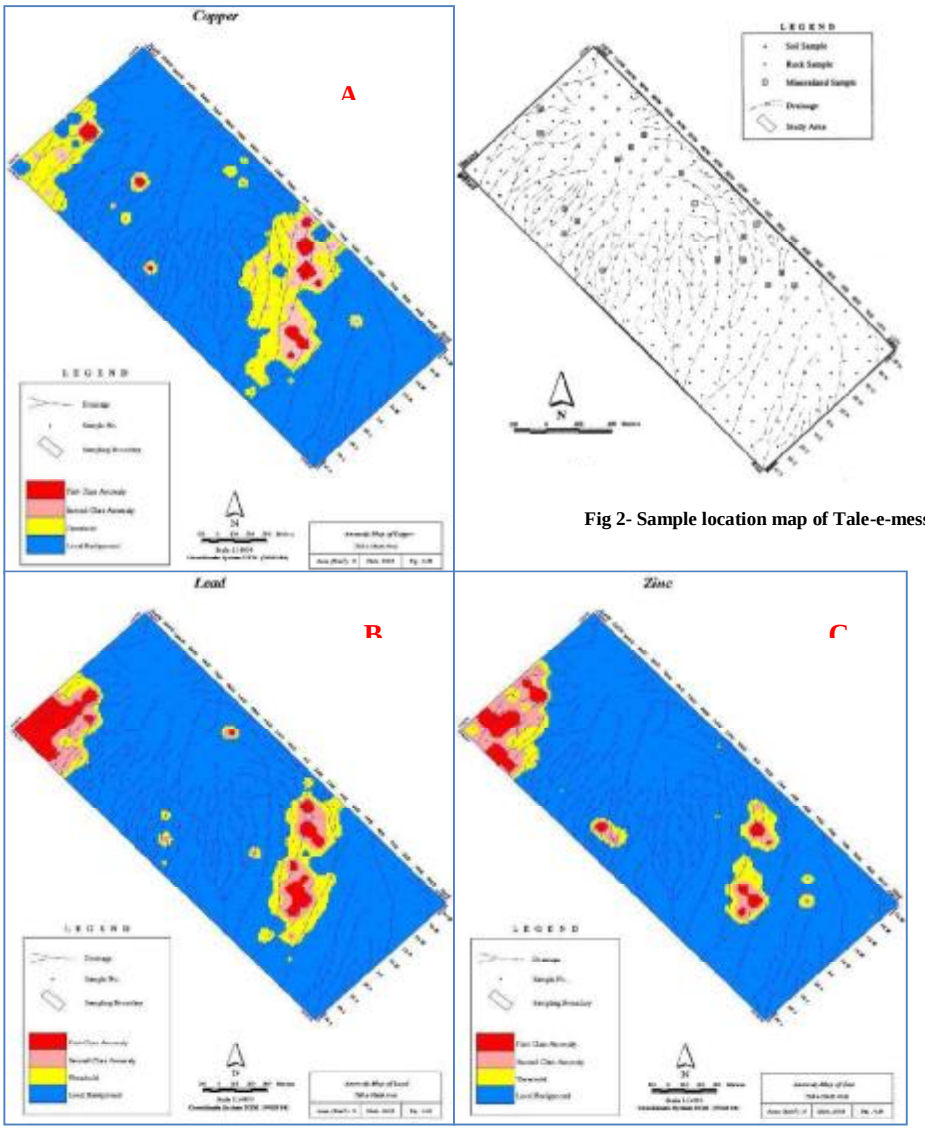

Fig 3- Distribution Map of Cooper (A), Lead (B), Zinc (C)

Refrences

1-Atsuyuki, O., Noboru, I., Shigeru, T., Yoshiko, T., 2005. Influence of surface geology and mineral deposits on the spatial distributions of element concentration s in the stream sediments of Hokkaido Japan. J. Geochem. Explor. 86, 86–103.

2- Cocker, M.D., 1999. Geochemical mapping in Georgia, USA: a tool for environmental studies, geologic mapping and mineral exploration. J. Geochem. Explor. 67, 345–360.

3- Cocker, M.D., 1996. Background stream sediment geochemistry and hydrogeochemistry of a major river basin in Georgia: use in industrial mineral resource evaluation and environmental studies. In: Austin, G.S., Hoffmann, G.K., Baker, J., Zidek, J., Gilson, N. (Eds.), Proceedings of the 31st Forum on the Geology of the Industrial Minerals—the Borderland Forum. N.M. Bur. Min.Miner. Resour. Bull., vol. 154, pp. 197–206.

4- Hand Book of Exploration Geochemistry, Soil Geochemistry.

5-Manta DS, Angelone M, Bellanca A, et al (2002) Heavy metals in urban soils: a case study from the city of Palermo (Sicily), Italy. Sci Total Environ 300:229–243.

6- Reid, J.C., 1993. A geochemical atlas of North Carolina, USA. J. Geochem. Explor. 4711–4727.

7- Webb, J.S., Thornton, I., Thompson, M., Howarth, R.J., Lowenstein, P.L.,1978. TheWolfson Geochemical Atlas of England and Wales. Oxford Univ. Press, Oxford. 74 pp.

8- Kautsky, G., Bølviken, B., 1986. Geochemical Atlas of Northern Fennoscandia Nordkalott Project. Geol. Surv. Sweden. 19 pp. with 144 maps.

9- Thalmann, F., Schermann, O., Schroll, E., Hausberger, G., 1988. Geochemical Atlas of the Republic of Austria, Geol. Surv. of Austria, 141 pp with 35 maps.