Soil Geochemical Dispersion Pattern around Molybdenite Deposits in Koheda Area, Karimnagar District, Telangana.

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Abstract

The present investigation is aimed to assess the ore bearing potential of Koheda and Hausnabad mandles of Karimnagar district of Telangana covering an area of 150 Km^2 that lies between 18^o 15' to 18^o 05' N latitudes and 79^o 02' to 79^o 11' E longitudes. Geologically, the area is exposed by pink and grey archean granites with pegmatite and quartz veins associated with Cu and Mo mineralisation. Soil samples were collected in the present investigation to evaluate the secondary geochemical patterns associated with sulphide mineralisation in Koheda. Soil samples are collected in a grid pattern from a depth of 30 cms. The elements analysed from the minus 80 ASTM sieve fraction of soil samples are Cu, Pb, Zn, Ni, Cr, Co, Mo, W, Fe and Mn. It is inferred that Zn, Co and W could be regional pathfinders, while Cu and Mo can be used as local indicators in the study area. The soils having anomalous haloes of Cu and Zn at Kurella at Southwest of Kurella and Dharmasagarpalli; Zn, Cu, Co, W and Mo at Maisampalli and isolated anomalous concentration of some target elements could prove to be drilling targets for the buried mineralisation at Regonda, Arepalli, Gotlamitta, Ramachandrapuram and Ramannapet.

Keywords: Koheda , Archean granites, secondary dispersion pattern, target elements

Introduction

Koheda area was selected because of the presence of suitable rock type for hosting copper and molybdenum mineralisation. The aim of investigation is to carry out systematic orientation geochemical survey with a view to develop reliable prospecting tools in secondary geochemical landscape. It is envisaged to study abnormal geochemical signatures in soil developed over granites. For the purpose, it is proposed to carry out soil-geochemical survey. The ultimate goal of any such investigation is, of course, to find clues that will help in locating hidden ore deposits within granites. Rose et al., (1979) reviewed the usefulness of soil geochemical exploration in identification of base metal and molybdenite deposits and stated that in the secondary environment a geochemist plays diametrically opposite games of exploration. In the soil surveys the higher values are assumed to be in situ and the anomalies in the soils are close to the target. Fifty soil samples were collected in the present investigation to evaluate the secondary geochemical patterns associated with sulphide mineralisation in Koheda area.

Study area

The area of investigation forms parts of Koheda and Hausnabad mandles of Karimnagar district of Telangana covering an area of about 150 Km^2. It forms part of the Survey of India toposheet No. 56 N/4 and lies between 18º15' to 18º05' North Latitudes and 79º 02' to 79º 11' East Longitudes (figure 1). Physiographically, the investigated area is between two rivers Mohidermedda to the west and Yellamagedda to the east. The distance from Hyderabad to Koheda is approximately 130 km and can be reached via Siddipeth by road. The area is exposed by pink and grey Archaean granites of varying textures with specks and stringers of pyrite, chalcopyrite and molybdenite. Aplite, quartz veins and pegmatites are noticed traversing the granites in some places. Apart from base metals, molybdenite deposits are known to form in granites of Archean-Proterozoic epoch (Kittu and Krishnamurthy, 1967). The geological map of Koheda area is as shown in figure 2. Weathering in granitic terrain produced isolated hillocks, rounded hills with joints of different pattern. The soil is red loam soil with absence of horizons are uncommon.

Fig. 1. Location Map of the Study area

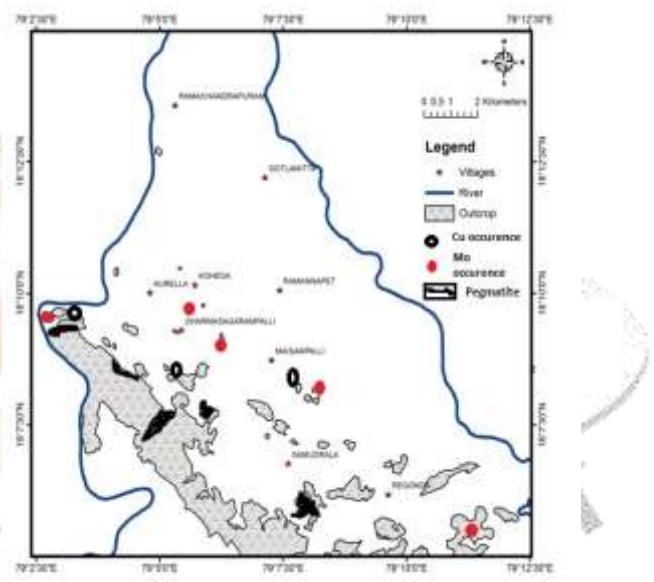


Fig 2 Geology of the study area

Methods and Materials

In the present investigation soil samples were collected in a grid pattern covering the complete area of investigation. The soils were sampled from a depth of 30 cms using soil 'Auger'. It is noticed that this depth represents higher clay content ('B' horizon). Fifty soil samples are collected and were packed in polythene bags and labelled accordingly. The analysis of soil involves sample preparation, digestion or extraction and finally determination of elemental concentration. Soil samples were hand crushed to the size of natural grain size and sieved to obtain minus 80 ASTM mesh to obtain good anomaly to background contrast as proposed by Fletcher (1981) and Beeson (1984). Boiling aquaregia extraction has been recommended as a general decomposition which is oxidizing solvent for sulphides, selenides, tellurides, arsenides and sulfo-arsenides and decomposes to some extent silicates (Chao, et al. 1992). The elements that are estimated in soils are Cu, Pb, Zn, Fe, Mn, Co, Ni and Cr by using Perkin Elmer Atomic Absorption Spectrometer and tungsten and molybdenum was estimated by colorimeter.

Result and discussion

The statistical information of soil geochemical data is given in the table 1. The table provides information about the range, average, standard deviation and threshold values of the elements analysed from the soils of Koheda area. The threshold values needs to be fixed to define the upper limit of normal background value and is calculated as mean plus twice the standard deviation (Rose, Hawkes and Webb, 1979) .

Table 1: Shows comprehensive statistical information of geochemical analysis of soils

Sr. No.	Elements	Range (ppm)	Average (ppm)	Standard Deviation (ppm)	Threshold (ppm)
1.	pH	5.3-8.6	7.4	0.86	-
2.	Cu	22-1160	54	19	92
3.	Pb	26-349	41	9	60
4.	Zn	27-2700	42	13	68
5.	Ni	22-618	42	11	64
6.	Cr	32-219	58	16	91
7.	Co	6-28	11	4	19
8.	Fe	22430-82080	39085	15826	70738
9.	Mn	110-590	191	53	298
10.	Mo	5-72	18	11	41
11.	W	10-80	23	10	43

To evaluate the elemental association in soils Koheda area, correlation coefficients were calculated and are given in table 2. Based on the significant level of correlation being plus 0.5 at 90% confidence level and the groups of elements which show positive correlation among themselves due to their similarities are as follows- Cu – Zn; Pb – Cr; Zn – Ni and Mo – W. Such correlations in the trace constituents of soils are due to the similar behaviour of these elements in the physio-chemical conditions imposed by secondary environment. The association of Cu- Zn in the soils of Koheda area is largely due to their similarity of mobility in the surfacial condition. The mobility of Zn being for greater area than copper, it is found to form wider haloes. The association of Pb with Cr and Zn with Ni in the Koheda soils reflect partly the imprints of the chalcophilic relationship. The association of Cr with Pb in the surfacial conditions is largely the reflection of their immobile nature (Levinson 1974, Rose et al. 1979). The causative factors of Zn association with Ni might be due to the imprints of mafic minerals in the soil formation process.

Tungsten correlation with Mo is presumably due to their geochemical resemblance (Pendias and Pendias 1984). These two elements in the hypergene conditions form complexes such as MoO_4^{2-} and HWO_4^- in aqueous solutions (Rose et al., 1979). These complexes form hydromorphic dispersion patterns of Mo and W in soil as noticed in Koheda area.

Table 2: Shows the correlation coefficient matrix of the elements analysed in soils

	Cu	Pb	Zn	Co	Cr	Ni	Fe	Mn	Mo	W
Cu	1.000	0.180	0.657	0.038	-0.018	0.322	0.075	-0.040	0.234	-0.072
Pb	-	1.000	0.207	0.419	0.695	0.161	-0.057	0.076	-0.004	-0.034
Zn	-	-	1.000	0.173	0.001	0.479	0.183	-0.044	-0.065	-0.144
Co	-	-	-	1.000	0.555	-0.037	0.146	0.447	0.235	0.374
Cr	-	-	-	-	1.000	-0.061	-0.066	0.383	-0.077	0.010
Ni	-	-	-	-	-	1.000	0.185	-0.142	0.012	-0.077

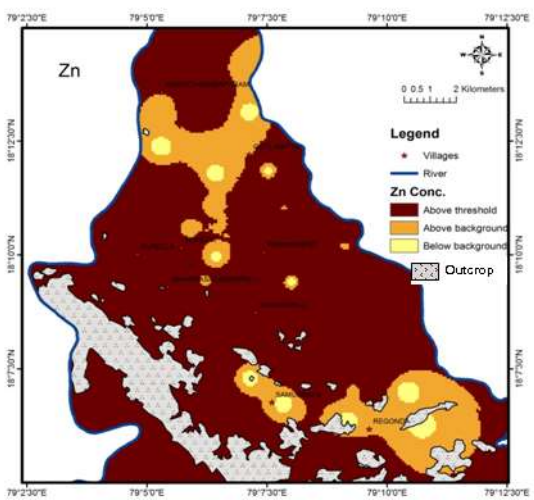
Fe	-	-	-	-	-	-	1.000	0.150	-0.024	0.174
Mn	-	-	-	-	-	-	-	1.000	0.160	0.256
Mo	-	-	-	-	-	-	-	-	1.000	0.587
W	-	-	-	-	-	-	-	-	-	1.000

The pH values for the soil samples is as shown in the table 1. It is noticed that acidic environment (pH<6) has developed in soils around Maisampalli, Kurella, northeast of Regonda and Ramachandrapuram. The rest of the area have alkaline pH values. The acidified water dissolves large quantity of many elements which are associated with the sulphide deposits. The dissolved elements in soils are dispersed in the surfacial environmental around the oxidising sulphide body.

Using the background and threshold concentrations contouring was carried out for each element on Arc-GIS platform. The figure 3 to 10 depicts areas of below background, above background and above threshold concentration for each of the elements analysed. The distribution of elements in the soils from the Koheda area is discussed in four major groups. The groups are made based on the geochemical similarities of the elements. They are as follows:

1.Cu – Pb - Zn 2. Mo - W 3. Fe - Mn and 4. Ni – Cr – Co

1. **Distribution pattern of copper, lead and zinc:** The figure 4 illustrates the distribution of copper in soils from the area of investigation. The background and threshold values for Cu in soils of Koheda area are 54 ppm and 92 ppm, respectively. The total anomalous area measured for this elements is 44 Km^2. The anomalous concentrations in soils are distributed in three major regions viz. Kurella – Maisampalli (21 Km^2), Ramachandrapuram (1 Km^2) and Ramannapeth (22 Km^2). The dispersion of lead in the soils is depicted in the figure 5. The background and threshold values are 41 ppm and 60 ppm, respectively. The total area having above threshold values of lead is 24 Km^2. The above threshold concentration is noticed around Koheda (14 Km^2), Maisampalli (4 Km^2), Ramannapeth (3 Km^2), Arepalli (2.5 Km^2) and Gotlamitta (0.5 Km^2). The figure 3 illustrates the distribution of Zn in the soils collected from Koheda area. The background and threshold values for this element are 42 ppm and 68 ppm, respectively. The localities Kurella, Koheda, Dharmasagarpalli and Maisampalli show above threshold concentration of zinc covering total anomalous area of 65 Km^2. The relative sizes of anomalous patterns of base metals in the soils from Koheda area, indicate Zn is most mobile followed by Cu



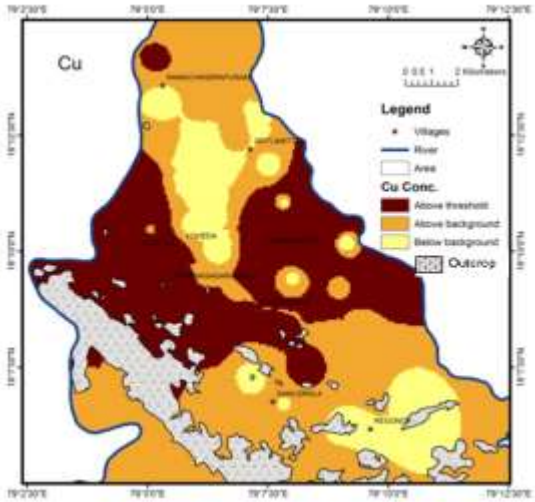


Fig..3 Shows spatial distribution map of Zn Fig.4 Shows spatial distribution map of Cu

and Pb as least mobile. Therefore Zn is pathfinder for sulphide mineralisation in the present study.

2. **Distribution pattern of Molybdenite and Tungsten:** The figure 5 depicts the distribution of Mo in the soils collected from Koheda area. The background and threshold values for Mo are 18 ppm and 41 ppm, respectively. The anomalous area for this element is 20.5 Km^2 is distributed in Maisampalli and east of Maisampalli (13 Km^2), Kurella and its surroundings (5.5 Km^2), north of Arepalli (1 Km^2) and east of Regonda (1 Km^2). The background and threshold values for tungsten are 23 ppm and 43 ppm, respectively are as shown in distribution map . The anomalous pattern of 9 Km^2 at Maisampalli, 10 Km^2 at Regonda and 1 Km^2 near Arepalli are similar to Mo distribution pattern. In the present study area the haloes defined by Mo in soils of Kurella, Maisampalli and east of Regonda could potentially prove the presence of mineralisation in the proximity.

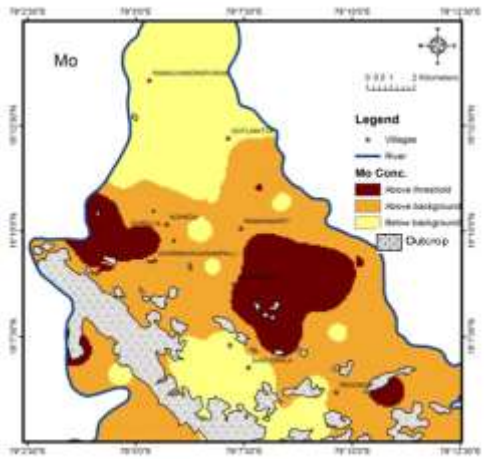


Fig. 5 Shows spatial distribution map of Mo

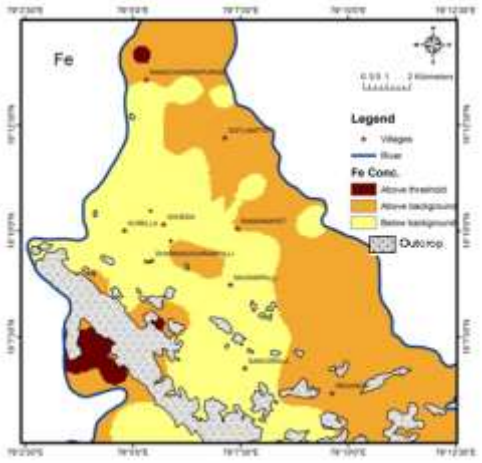


Fig.6 Shows spatial distribution of Fe

3. **Distribution pattern of Iron and Manganese:** The distribution of iron in soils collected from Koheda area is shown in figure 6. The background and threshold values for iron are 3.9% and 7.07%, respectively. The total anomalous region having above threshold

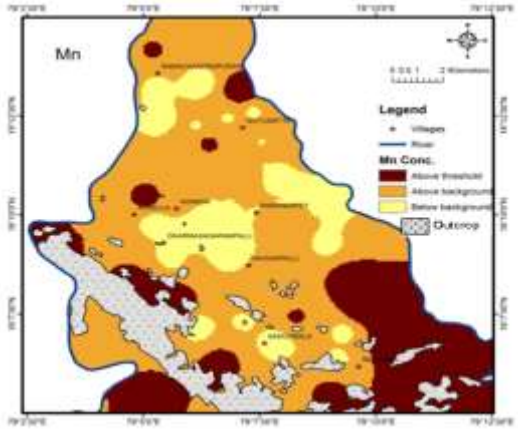


Fig .7 Shows spatial distribution of Mn

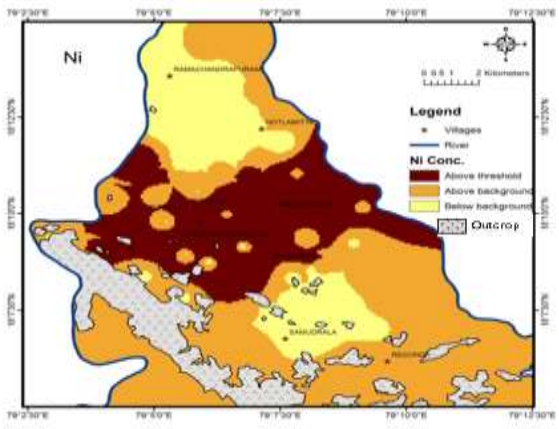


Fig.8 Shows Spatial distribution of Ni

concentration is about 4.5 Km^2. The anomalous areas are distributed in and around Arepalli (4 Km^2) and Ramachandrapuram (0.5 Km^2). The figure 7 illustrates the distribution of manganese in the soils of Koheda area. The background and threshold values for this elements are 191 ppm and 298 ppm respectively. The total anomalous region for this element is 22 Km^2 and happens to be widest halo compared to other elements located around the outcrop region in SW and SE of the area of investigation. Fe and Mn dispersion in soils

do not indicate mineralisation but helps in understanding the mobility and stability of secondary minerals of trace constituents in soils.

4. **Distribution pattern of nickel, chromium and cobalt:** The background and threshold values for nickel are 42 ppm and 63 ppm, respectively and are shown in distribution map of the area in figure 8. The area of interest having threshold concentration was measured for this element is about 35 Km^2 which is along a broad belt northwest of Koheda to east of east of Ramannapeth. The values for chromium are 58 ppm and 91 ppm as background and threshold concentration, respectively and the dispersion pattern is illustrated in figure 9. Anomalous region of chromium are found towards northwest of Koheda (2.5 Km^2). The other zones of above threshold values are noticed between villages – Kurella, Gotlamitta, Dharmasagarpalli and east of Maisampalli. The distribution of cobalt in soils of Koheda area is depicted in figure 10. The background and threshold values for cobalt in the area of investigation are 11 ppm and 19 ppm, respectively. The areas above threshold concentration is 6 Km^2. Part of this is noticed towards northwest of Koheda, ENE of Maisampalli, west of Maisampalli, Arepalli and north of Gotlamitta.

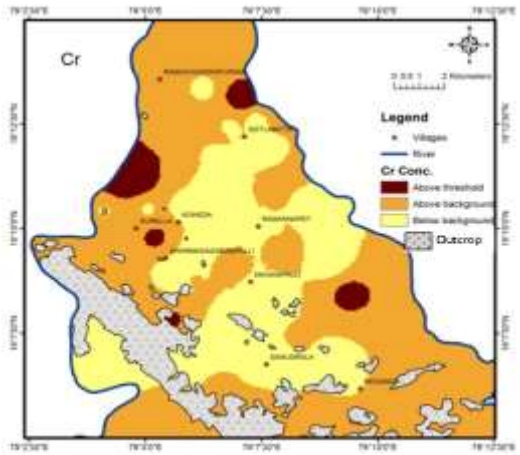


Fig.9 Shows spatial distribution of Cr

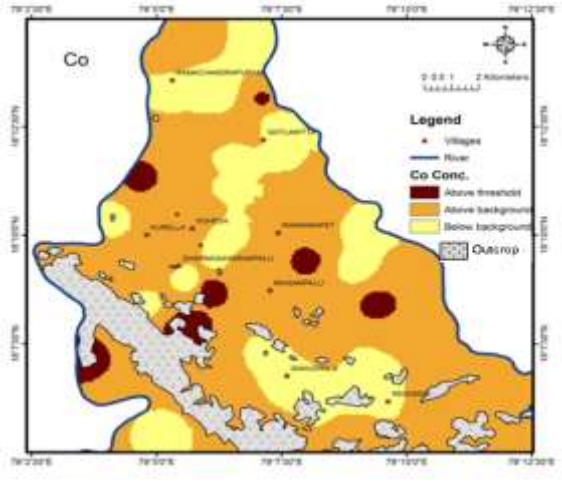


Fig .10 Shows spatial distribution of Co

Conclusion

The soil geochemical survey carried out in the Koheda area brings forth the following features.

The acidic pH in conjunction with anomalous values of some target elements – Zn, Cu, Co, W and Mo at Kurella, Maisampalli, Ramachandrapuram and Gotlamitta, represent proximity of oxidising sulphide deposits. The shape and size of the geochemical affinity elements have similar pattern.

On detail examination of relative sizes of anomalous haloes for the target elements are Zn (65 Km^2), Cu (44 Km^2), Co (6 Km^2), W (20 Km^2) and Mo (20.5 Km^2) indicates their relative mobilities in the mineralised soils and reflect their genetic association with ore deposit.

On examination of the outcrops at Koheda, Dharmasagarpalli, Maisampalli and Regonda indicate the presences of oxidising specks of molybenite, chalcopyrite, pyrite etc. It is inferred that Zn, Co and W could be regional path finder's while Cu and Mo can be used as local indicators.

Apart from above mentioned localities, isolated anomalous concentration of some target elements are noticed at Regonda, Arepalli, Gotlamitta, Ramachandrapuram and Ramannapeth. These localities may prove drilling target for the buried mineralisation.

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