CHAPTER I

INTRODUCTION AND GEOLOGY OF THE AREA

INTRODUCTION : The principles of geochemical prospecting are as old as man's first use of metals and minerals. His observations about the fragments of fresh and weathered ore scattered on the surface of the ground which on tracing to the areas of increasing concentrations, often led to the source rock of ore. Thus unknowingly he was following the dispersion pattern that are strictly analogous to those used in modern geochemical survey. Since the advent of industrialisation man has been exploring various mineral resources for his developmental aspects. This resulted in over exploitation and ultimately depletion of the ore deposits.

New areas have to be explored. The course of investigation leading to the prospects of newer deposits has been treacherous and time consuming with relatively low success rate. Hawkes and Webb (1962) defined geochemical exploration as any method of mineral exploration based on systematic measurement of one or more chemical parameters of naturally occuring material. Thus exploration by geochemical method is the practical application of theoretical geochemical principles in mineral prospecting.

The geochemical prospecting is rather a evolving branch in mineral exploration. Advancement in prospecting by geochemical techniques also need the revolution in the ancillary fields of chemical analysis and statistical interpretation of data. The steady growth in geochemistry is marked largely by the progress in analytical chemistry and instrumentation. The ultimate goal, of any such progress is to discover mineral deposits for man's development.

PURPOSE OF PRESENT INVESTIGATION : Koheda area was selected because of the presence of suitable rock types for hosting copper and molybdenum mineralisation. The aim of this contribution is to carry out systematic orientation geochemical surveys with a view to develop reliable prospecting tools in primary and secondary geochemical landscape. For the purpose, it is envisaged to study abnormal geochemical signatures in granites, soil developed over granites and anomalies in the lake-sediments. In order to obtain this, it is proposed to carry out lithogeochemical, soil-geochemical and lake-sediment geochemical surveys. The ultimate goal of any such investigation is, of course, to find clues that will help in locating hidden ore deposits within granites. Limited work has been carried out in this direction in our country. Therefore, the present investigation is aimed at to assess the ore bearing potential of Koheda granites.

LOCATION : The area selected for the present study lies in the Karimnagar district of Andhra Pradesh state. The area forms parts of Koheda and Hausnabad mandles of the district and extends over an area of about 150 km^2. It forms part of the Survey of India toposheet No. 56 N/4 and lies between 18° 15' to 18° 05' N. latitudes and 79° 02' to 79° 11' E longitudes. Physiographycally the investigated area is between two rivers Mohidermedda to the west and Yellamagedda to the east (see Fig. 1.1).

Koheda can be reached either from Karimnagar via Hausnabad or from Hyderabad via Siddipeth, by road. The distance from Hyderabad to Koheda is approximately 130 km. There are only cart tracks and footpaths leading from Koheda village to various pockets of mineralisation within granites and pegmatites.

CLIMATE, PHYSIOGRAPHY AND DRAINAGE : The area is in the semiarid zone and hence, a dry and hot climate prevails for most part of the year. The maximum temperature attained during summer is 45° C and average annual rainfall is 100 cm. recorded during the period from June to September. Outcrops of granites varies in size from boulders to hillocks in the south and southwest of the investigated area. The highest eluvation in this area is 500 mts. above M.S.L. found over Peddagutta near Reganda and the minimum eluvation is 380 mts. above M.S.L. in the rest of the plains towards north. The soils in Koheda are of brown and reddish brown colour with sandy loam particles.

Streams draining the region, are of low order and join either Yellamma Gedda or Mohidermedda vagu streams.

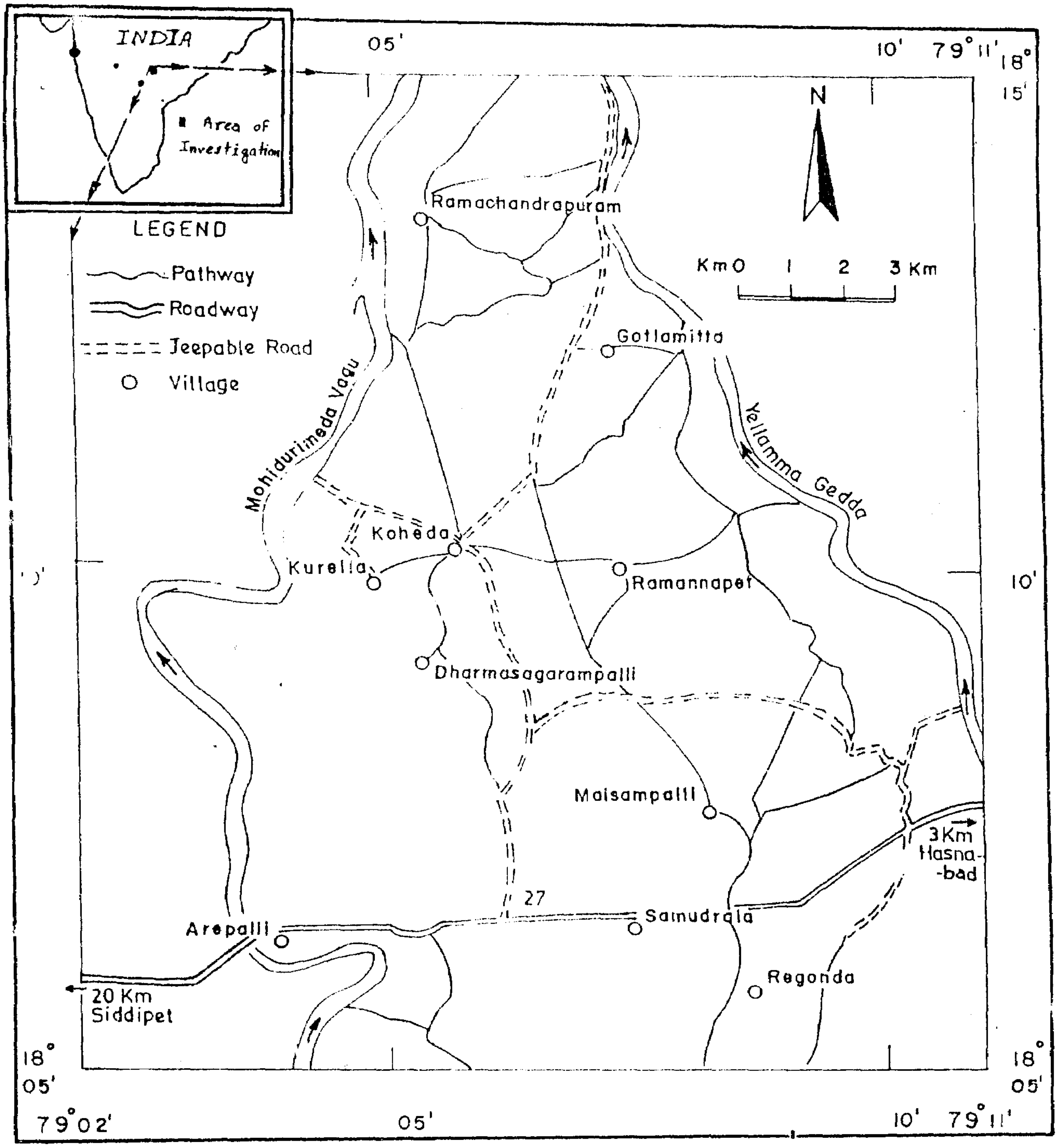

FIG. NO. 1.1 : MAP SHOWING LOCATION OF AREA OF INVESTIGATION

The streams and lakes are seasonal and are dry for most part of the year. The overall drainage pattern observed in the area is dendritic and flow towards north due to gentle slope.

PREVIOUS LITERATURE : Granites of Hyderabad and surroundings has been investigated by many geologists. It has been well recognised that granites from this area are broadly classified into two series - grey and pink - by many authors. Notable Geologist of the easterwhile Nizam State, Munn (1915); Krishnamurthy, et al. (1929), classified the granites into pink series and grey series based on the colour of felspar present. They opinied that the pink series is younger because of its intrusive nature into the grey granites. Similar conclusion were made by Mahadevan et al. (1936), Mukherjee (1938), Mirza (1941) and Heron (1949) after making structural and geochemical investigations. Balakrishna (1964) stated that granites of Peninsular complex are of two types (grey and pink) but it has been found difficult for him to demarcate them separately. Nevertheless, Balakrishna (1964) after studing the elastic behaviour of granites, pointed out that pink granites are younger than the grey series and may be derivative of the former.

Janardhan Rao and Sitarammayya (1971), made an exhaustive field and laboratory investigation of granites of Hyderabad area, and stated that some granites are of migmatic origin, based on the variation of oxide percentage.

Narasimha Rao (1961) while investigating for Cu - Pb mineralisation noticed occurence of molybdenite in Koheda area. Narasimha Rao and Kittu (1967) observed sporadic distribution of molybdenum ore in Koheda granites. Kittu and Krishnamurthy (1967), were of the opinion that molybdenite associated with pyrite and stringers of chalcopyrite are formed in the pegmatite stage of magmatic differentiation.

No geological mapping was undertaken in the present investigation by the author. This is because of the readily available map prepared by Kittu (1968). A review of the descriptions given by Kittu and Krishnamurthy (1967) and Kittu (1968) of various geological formations are briefed in the following pages.

GEOLOGY OF THE AREA : Various types of Archean granites are found in the study area. The pink and grey series predominate, of varing textures. They show medium grain to coarse grain and at places the texture is of pegmatitic nature. Both the series exhibit porphyritic texture in which the phenocrysts are felspars. The essential constituents of the granites from Koheda area are quartz, potasium felspar, hornblend, biotite and accessories are magnetite, epidote, sphene, zircon etc. Apart from these constituents, in all types of granites of this area, specks and stringers of pyrite, chalcopyrite and molybdenite are observed.

Aplite, quartz veins and pegmatites are noticed traversing the granites in some places. Aplites are exposed either as narrow veins or small lenses over a hillock 1½ km. NNE of Samudrala.

The geological map (Fig. 1.2) and succession of Koheda area of Karimnagar district was proposed by Kittu (1968) which is as follows :

Recent	Soil cover.
	Veins of epidote, calcite, felspar, quartz, jasper etc.
	Younger pegmatites.
Archeans	Pegmatites, aplites and quartz veins (Sulphide bearing at some places)
	Porphyritic granite (Grey / pink)
	Amphibolites and hornblende schist.

The quartz veins are found in both types of series. They are also noticed to be associated with pegmatites and exhibit NE - SW trend. Invariably they consist entirely of quartz.

The pegmatites are seen traversing grey and pink series. The pegmatite veins have their trend as NNW - SSE, NE - SW and W - E directions. Their thickness varies from few centimeters to five meters. The principal composition

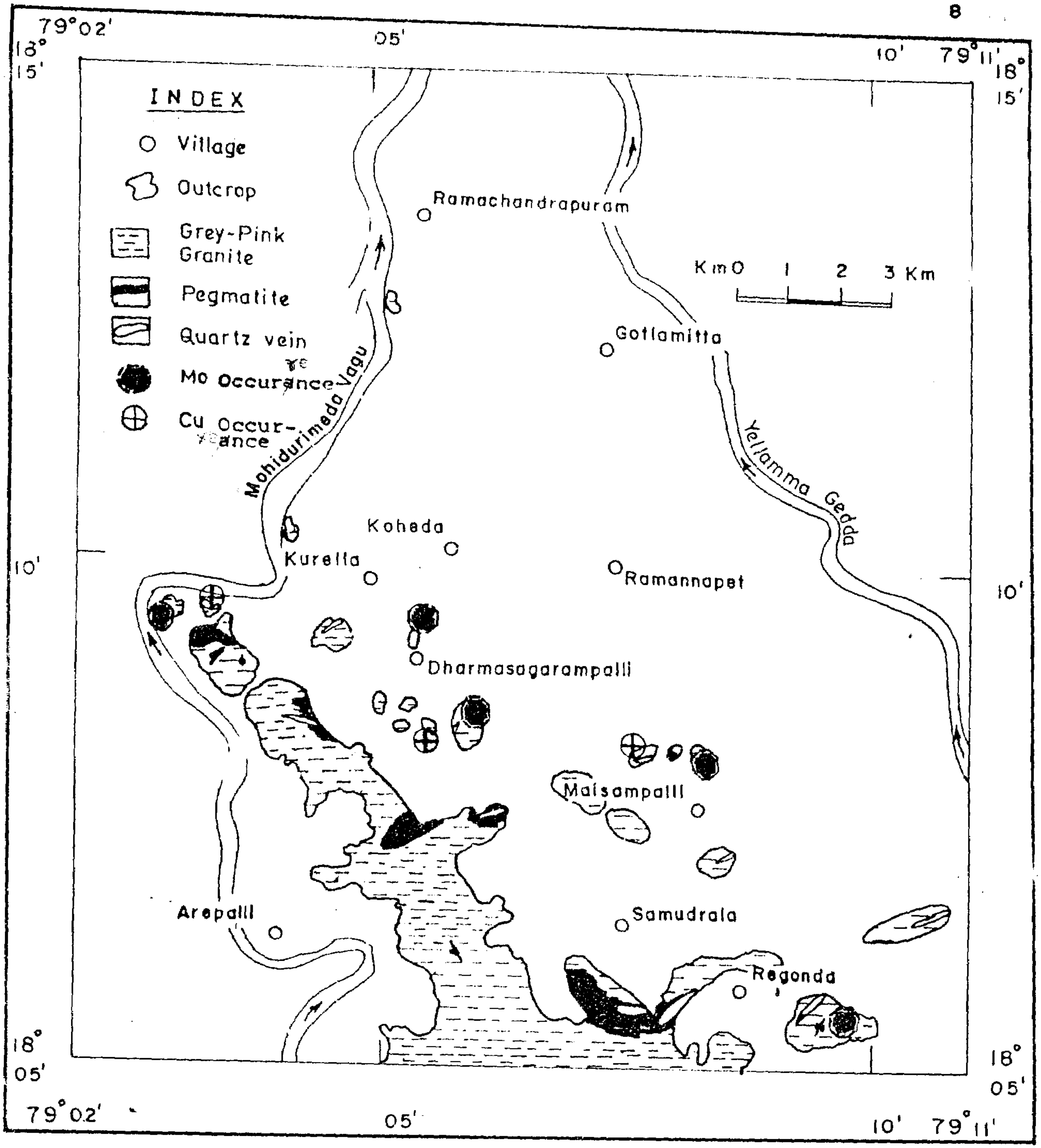

Fig.No. 1.2 : Geological map of Koheda area (after Kittu 1968).

is felspar (Microcline) perthite, quartz (colourless, white and blue), muscovite, sphene, zircon etc.

MINERALISATION : It is generally noticed that the magmatic granites have greater possibility of being associated with mineral deposits. This is because of the process of magmatic differentiation which leads to the concentration of mineralising liquid. This later results in the formation of ore bearing veins. The residual liquid consist of sulphides which are immissicible in their character. They separate out from the rest of the silicate phase and concentrate as sulphide ore.

Base-metal sulphide deposits associated with granites of Archean age is well known. Apart from base metals, molybdenite deposits are known to form in granites of Archean - Proterozoic Epoch. Kittu and Krishnamurthy (1967) investigated the granites in parts of Karimnagar area and reported that molybdenite occurence are confined to pegmatites traversing porphyritic granites. It was noticed that molybdenite is associated with pyrite, chalcopyrite etc. in some of the pegmatites in Koheda area. Kittu (1968) states that there are two generations of pegmatites. The older pegmatites consist molybdenum mineral. The younger pegmatites are those which have felspars and quartz. The thickness of molybdenite bearing veins range from 8 cm to 30 cm. and in length they vary between 10 m. to 40 m. Kittu (1968) further opinied that the ore - bearing pegmatites are genetically related to porphyritic granites. Sharma (1974) noticed that molybdenite bearing veins are generally small and each by itself cannot yeild good amount of molybdenite. In the present study, molybdenite bearing veins are noticed at the following places :

1½ km. south south east of Dharmasagarpalli,
3½ km. west of Kurrella,
1 km. north of Maisampalli and,
2½ km. southeast of Reganda.

Rocks samples collected from these localities indicate stingers / specks of pyrite and chalcopyrite apart from molybdenite. Secondary alteration and leach stains are noticed at some outcrops. The granites of Koheda area are suspected to be productive plutons.

Investigations carried out by exploration geochemist with reference to productive plutons is given in the following pages.

PRODUCTIVE GRANITES : The association of certain kinds of ore deposit with specific type of plutonic rock has been known and used by exploration geologists for many decades. The rock types with which ores are preferentially associated may be termed productive, in the sense that exploration in these environments is likely to be more productive of new ore than exploration in a region picked at random. The syngenetic productive environments originate during ore formation. Rocks of such environments are called as specialized rocks. The common examples are the association of chromite with ultramafics, cassiterite with granite etc.

Most of the early attempts by exploration geologists and geochemists were to distinguish between productive and non-productive granitoids. Determination of one or more elements which are concentrated in abnormal amounts was used to recognise a mineralised pluton or barren intrusion. A large proportion of the periodic table has been proposed to identify "Specialised" and in particular "Tin specialised" granitoids (Rose, et al. 1979). Empirical evidences indicates, however, that a few elements - notably K, Mg, Rb, Sr, Li etc. provide the best general indicators. "Specialised" or "Productive" plutons provide only an indication of the potential mineralisation, provided tectonic and other geological conditions are favourable.

Among the earlier workers on productive plutons was Barsukov (1957), who suggested that mineral chemistry would be helpful in identification of plutons with ore deposits. He noted in his investigation that 80 % of 'Sn' of granites was concentrated in biotite and ore deposit of Sn was discovered with such recognition. Many workers have observed the close association of porphyry - copper deposits with certain granodiorite and granites intrusions and that these igneous bodies are chemically distinct from normal granodiorites and granites either in terms of unusually high or low content of Cu or high content of Cl (Stollery, et al. 1971).

In Western Canada, Garrett (1971 a, 1974 a) has noticed anomalous concentration of Mo, W and Hg in plutons hosting Mo, W and Au mineralisation. However, Ivanova (1963), Sotnikov and Izyumova (1965), Flinter et al. (1972), Sheremot et al. (1973), and others from Russia and Australia do not find higher than normal contents of Mo and W in intrusions associated with Mo and W deposits, although they tend to be enriched in Rb, Li, F, Sn and related elements.

The identification of the geochemical type of granite and, in particular, of the potential ore-bearing varieties, is made possible by certain element - concentration ratios, according to Sheraton and Black (1973) and Tauson and Kozlov (1973). The elemental ratios provides more meaningful and significant information regarding the genesis of some productive plutons. The subtle information regarding the type of ore bearing granite varities with few elemental ratio is as follows :

Trace element ratios in geochemical granitic type (After Tauson and Kozlov 1973)

	K/Na	K/Rb	Ba/Rb	F/Li
Plagiogranites	0.16	1250	45	75
Ultrametamorphic	2.20	385	12	16
Palingenic granite	1.10	240	5.30	16
Plumasitic leucogranites	1.40	100	0.50	31
Agpaitic leucogranites	1.20	290	0.34	29
Average granite	1.20	165	4.10	20

Each of the above granite type has formed by different processes and few of them host a certain type of ore deposit. Plagiogranites forms by differentiation of gabbroic magma. Ultrametamorphic granites originate by partial melting within the crust. Palingenic granites have formed by complete remelting of granitic rocks. Plumasitic granitic rock have high Li, Rb, Sn and F and have formed as late differentiates of the earlier type. Granites rich in alkali minerals - aegerine, riebeckite - are called agpaitic granites (Tauson and Kozlov 1973).

Tischendorf (1974) while discussing the role of volatiles in the formation of granitoids and mineral deposits associated with them states that Sn, Li, Rb, W, Mo, Br, F and H_2O are important components of the granitoids as indicators of their metallogenic potential. Chappell and White (1974) recognises the S - type (sedimentary protolith) and I - type (igneous protolith) granitoids having affinity of a particular type of mineralisation. They further noted that the Sn - U - REE mineralisation is associated with the S - type and Cu - Mo porphyry is associated with I - type granites. Using 30 rare - metal deposits data from easterwhile USSR and Mongolia, (Ivanova and Naumov, 1985), proposed 3 groups of granites.

1. Standard granites 2. Lithium flouride granite including Sn - granites, which are characterised by high content of Li, Rb, Ta, Nb and F, 3. And intermediate granite with associated W deposits.

Ivanova and Naumov (1985) state that trace elements composition in wolframite - Ta, Nb, Sc, Y, REE - plotted against the content of these elements in whole rock provides effective seperation of 3 groups of granites containing W deposits.

Tauson et al. (1983) and Tauson (1984) states the source rocks effects on the granite type and their potential for containing ore, but they suggest that the approaches by both Chappell and White (1974) and Ishihara (1977, 1981) are inadequate because of differing modes of formation of granites. Tauson (1984) postulates a useful rare-metal index F (Li + Rb) / Sr + Ba for identifying plagiogranite (Index = 2.5) and plumasitic granite (Index = 3460).

Taylor and Fryer (1983) found that the diversity of mineral deposits related spatially to granitoid rocks is a direct consequence of the diverse origins of granitic magma, but water is the single most important compositional variable. Granitoids of per -alkaline affinity are, however, essentially anhydrous and other fluid types - dominated by fluorides and carbonates - appear to be important in determining metal concentrations. Specialised granitoids are those enriched in granophile and other related elements such as Be, F, Li, Mo, Nb, Rb, REE, Sn, W, Ta, Y and Zr (Jackson and Ramsay 1986). Tischendorf (1974) demonstrated that specialised granites have significantly higher contents of SiO_2 and K_2O and significantly lower contents of TiO_2, Fe_2O_3, MgO and CaO than normal granites. Granophile elements are - B, Nb, Ta, Cs, U, Th, REE - enriched, and granophobe elements - Ni, Cr, Co, V, Sr, Ba - are impoverised in specialized granites compared to normal granites. There is a strong increase of the granophile elements from the older to the younger intrusive phases in the specialized complexes. Similar investigations were made by Govett and Atherden (1988) in recognition of productive plutons with the help of geochemical signatures of ore bearing granites.

One of the classic source of broad spectrum of Hi-tech metals and minerals are granitic pegmatites. Elements such as Li, Rs, Cs, Be, Sc, Y, REE, Sn, W, Mo, Nb, Ta, U, Th, Zr and Hf have been extracted from them. In the light of current research Cerny (1992) made use of the Ginburg et al.

(1979) classification of granite pegmatites and proposed various mineral deposits associated with them. He also suggested the P and T conditions for the formation of granitic pegmatites hosting various mineralisations. The granite pegmatite were classified in four groups based on the geological environment and genetic features. They are 1. Abyssal class (4 - 9 Kb, 700 - 800 °C) migmatitic leucosome. These either contain poor mineralisation or they are barren, 2. Muscovite class (5 - 8 Kb, 580 - 650 °C). They are products of partial melting / palingenetic granites. The muscovite class are either barren or poorly mineralised with Li, Be, Ti, Nb, Ta, U, Th, Y, REE etc. 3. Rare element class (2 - 4 Kb, 500 - 600 °C) this class is the product of advance fractionation of allochithinous, specialized and fertile (Leuco) granite. They contain minor to extensive and diversified mineralisation of elements such as Li, Rb, Cs, Be, Ga, Y, REE, Sn, W, Mo, Cu, Pb, Zn, Ti, U, Th, Hf, Nb, Ta etc. lastly 4. Miarolitic class - vug bearing "Pockets" of granite pegmatites. They are uniformly of low pressure environment and either poorly or extensively mineralised with optical quality minerals and gemstock in cavities.

CONCLUSION :

* Field observations reveal the presence of granites and granite pegmatites in localities namely; Kurella,

Maisampalli, Dharmasagarpalli and Reganda. They are of intrusive nature and are considered to be of magmatic origin.

* The granites are suspected to be productive type. This is due to the presence of pyrite, chalcopyrite, molybdenite etc. in the granites and are indicators of mineralisation in the area. Therefore, it propitiates for carringout lithogeochemical investigations.

* The geomorphology over these granites is favourable for the formation of lakes. This facilitates in carringout lake sediment geochemical surveys on reconnaisance scale. The plains in the northern region permits to study the geochemical haloes in soils that have genetic relationship with the mineralisation.