PETRO – CHEMICAL CHARACTERISTICS AND CRUSTAL EVOLUTION AROUND RAYADURGA AREA, EASTERN DHARWAR CRATON, ANANTHPURA DISTRICT, ANDHRA PRADESH, SOUTH INDIA.

Siddaraju M.S, Basavarajappa H.T and Maruthi N.E

Department of Studies in Earth Science, Centre for Advanced Studies in Precambrian Geology, University of Mysore, Manasagangothri, Mysore-570006, India.

ABSTRACT

The Dharwar Craton in Southern India is divided into two parts- the Western Dharwar Craton (WDC), Estern Dharwar Craton (EDC) separated by the Closepet Granite which was emplaced during the assembly of the EDC and WDC at -2.5 Ga and also the Dharwar craton is noticed in the centre of the craton where in adjacent all along the granites have melted during the emplacement of granite and granitoids along with the Chitradurga throust fault zoneis called Central Dharwar Craton (CDC). The formation and evolution of granitic provinces and batholiths are being increasingly studied, because of their importance for crustal evolution. Rayadurga area comes to Ananthapura District, having five kinds of litho units with economically viable minerals including Iron particularly in zones of gray granite, hornblende Gneiss, pegmatite and dyke rocks. Study area generally consist of several contemporaneous intrusions displaying common or similar geochemical and petrological features that are interpreted as cogenetic, but showing continuous batholith structures in Root zone to intrusion zone. The Closepet Granite has long been recognized as a unique magmatic body. However, most work was focused on its southern part of Closepet granite, near the amphibolite-granulite transition and less work has been performed on its central part which the area of Gap between Rayadurga and Kalyandurga area, this area is focused on not only granitic intrusion and composed of metamorphosed gneissic rocks, Amphibolites, Pegmatites and Pilitic zones, migmatites and Iron formations with lot of soil cover in Precambrian basement rocks of Darwar Craton. The study area belonging to the Andhra Pradesh composed of active and dynamic geological settings with economic mineral deposits. These deposits were noticed all along the lithological contacts of Basins and Schist Belts, adjesent to younger granites and granitoids of Dharwar Cratonin parts of Andhra Pradesh. The final result of this paper highlights the petrochemical Characteristics, better discrimination and detailed Geological mapping and geochemical signatures interprets the crustal evolution including evolution of Granitic rocks in the study area.

Keywords: Petrography, Geochemistry, Rayadurga, Ananthapura district.

1. INTRODUCTION

The geological setting of the study area composed of basement peninsular gneissic with amphibolites of mafic rocks are well exposed with the trending of ZW & SE directions and most of these rocks are dipping towards estern side with the angle of 70^0 to 75^0. The study area consists of Archean granitic exposers here and there with the younger dykes and small patches of iron formations. Mejority of the rocks of Closepet granites from the gap area at Northern extenction are completely varies when composed to the southern portion of the Closepet granite (Ramakrishnan and Vaidyanadhan., 2008) between these two portions towards north and South of the Study area . This is tectonicaly disturbed zone with metamorphism, crustal deformation and crustal evolution with mixed Geological setting. Granite is derived from Latin word 'Granum' means 'grain' due to its granular nature. Granites are more abundant plutonic rocks in the earth crust, and these are purely for volumetric reasons cannot be ignored. Like other igneous rocks, they represent probe into the deep interior (carter et al., 1980). They are closely connected with plate tectonics in particular, but not exclusively, with pate margins. Many types of granite have been associated with mineralization. So there is an economic imperative to learn more about the process of concentration of the important metals into these granitoids (Moyen et al., 2001). The sources region in either case could be crustal, mantel or mixed James Hutton (1788) first suggested that the granite magma developed at great depths in the earth and was made to invade and break into the surrounding state. Darwar craton geologically consist a gneissic basement of tonalite–trondhjemite–granodiorite (TTG) composition (Barker and Arth, 1976; Martin, 1994), called Peninsular Gneisses and dated between 3.3 and 2.7 Ga(Taylor et al., 1984; Meen et al., 1992). Volcano sedimentary greenstone belts unconformably overlying the gneisses, dated between 3.3 and 3.1 Ga for the older ones, and between 3.2 and 2.7 Ga for the younger ones (Peucat et al., 1995). Late Archaean, K-rich granitoids, consisting of N–S elongate bodies, among which the Closepet granite is the most spectacular. Several of these granites have been dated in the range 2.5–2.6 Ga (Crawford, 1969; Krogstad et al., 1991; Nutman et al., 1996; Jayananda et al., 2000). The study area comes to Ananthpura district is underlined by various geological formations such as granites, gneisses, quartz veins and dolerite from Archaean to Recent. The Archaeanrocks includes igneous formations which have been subsequently metamorphosed and intruded by various igneous rocks. Consist of older metamorphic rocks, peninsular gneissic complex, correlatable with Dharwar super group in Karnataka region and younger intrusive rocks (Jayananda et al., 1995). The older metamorphic rocks comprise hornblendite, pyroxinite and amphibolite and occur as enclaves of varying shapes and sizes within the peninsular gneissic complex. Peninsular gneissic complex comprises gneisses, grey granite, and grey granitic gneiss. The study area gneisses show banding due to alteration of light colored quartzofeldspathic minerals and dark colored biotite or hornblende minerals. Within the gneisses are included the biotite gneiss and hornblende gneiss (Basavarajappa and Srikantappa., 2014). The migmatities and the banded biotite-gneiss and biotite-hornblende-gneiss are the oldest and by far the most widespread country rocks. These form low tors or high elongated hill ranges and ridges and also occupy the low lying plains (anil Kumar et al., 1996) (Basavarajappa et al., 2018) (Maruthi et al 2018) (Maruthi and Basavarajappa., 2018). These rocks are highly folded, sheared and faulted and have schistocity trending between NNE-SSW, with moderate to steep dips in either easterly or westerly directions (Siddaraju et al., 2019).The geological formations in the study area consist of older group of metamorphic rocks belonging to the Archaean, younger granites and basic dykes. Archaean rocks have suffered considerable degree of tectonic disturbances resulting the metamorphosed and recrystallized litho-units such as hornblende gneisses, younger granites, banded iron quartzites, pegmatites and dolerite dykes (Chadwick et al., 2000). The younger granites occupy central part of the study area. Field investigations and Petrography of the host rocks were studied in detail with Geochemical, Physical and Optical properties and XRF analysis data characteristics features are studied in the laboratory (Maruthi et al., 2019) (Basavarajappa and Maruthi, 2018).

2. STUDY AREA

Rayadurga is a town in Anantapur district of the Indian state of Andhra Pradesh. It is the headquarters of Rayadurgam mandal in Kalyandurg revenue division. The town is renowned for its Handloom industry. The study area lies in between $14^0$35’ to $14^0$44’ N latitude and $76^0$46’ to $76^0$59’ E longitude with an aerial extent of 924 Km^2.The general elevation ranges from 480 to 785 mts above MSL.The region of Rayadurga area is an arid zone with poor stony red soils, climate ranges from 16.7^0 to 37^0 C. Study area covering mainly red & block soils associated with metamorphosed granitic gneiss composition with ultramafics, pegmatite and grey granite (CGWB, 2013).

Table.1. Samples collected and it’s GPS Locations

Sl No	Samples Name	Villages name	Latitude	Longitude
SR-01	Granite	Pulkunta	$14^0$41’33.4”	76^0 50’14.2”
SR-02	Gneiss	K.P. Doddi	$14^0$36’56.72”	76^0 46’9.534”
SR-03	Dolerite dyke	Bommakapalli	$14^0$41’52.03”	76^0 56’30.574”
SR-04	Iron (BFQ)	Nethrapalli	$14^0$39’21.58”	76^0 55’37.01”
SR-05	Pegmatite	Kannepalli	$14^0$37’11.88”	76^0 59’22.47”

Note: **S**amples at **R**ayadurga area

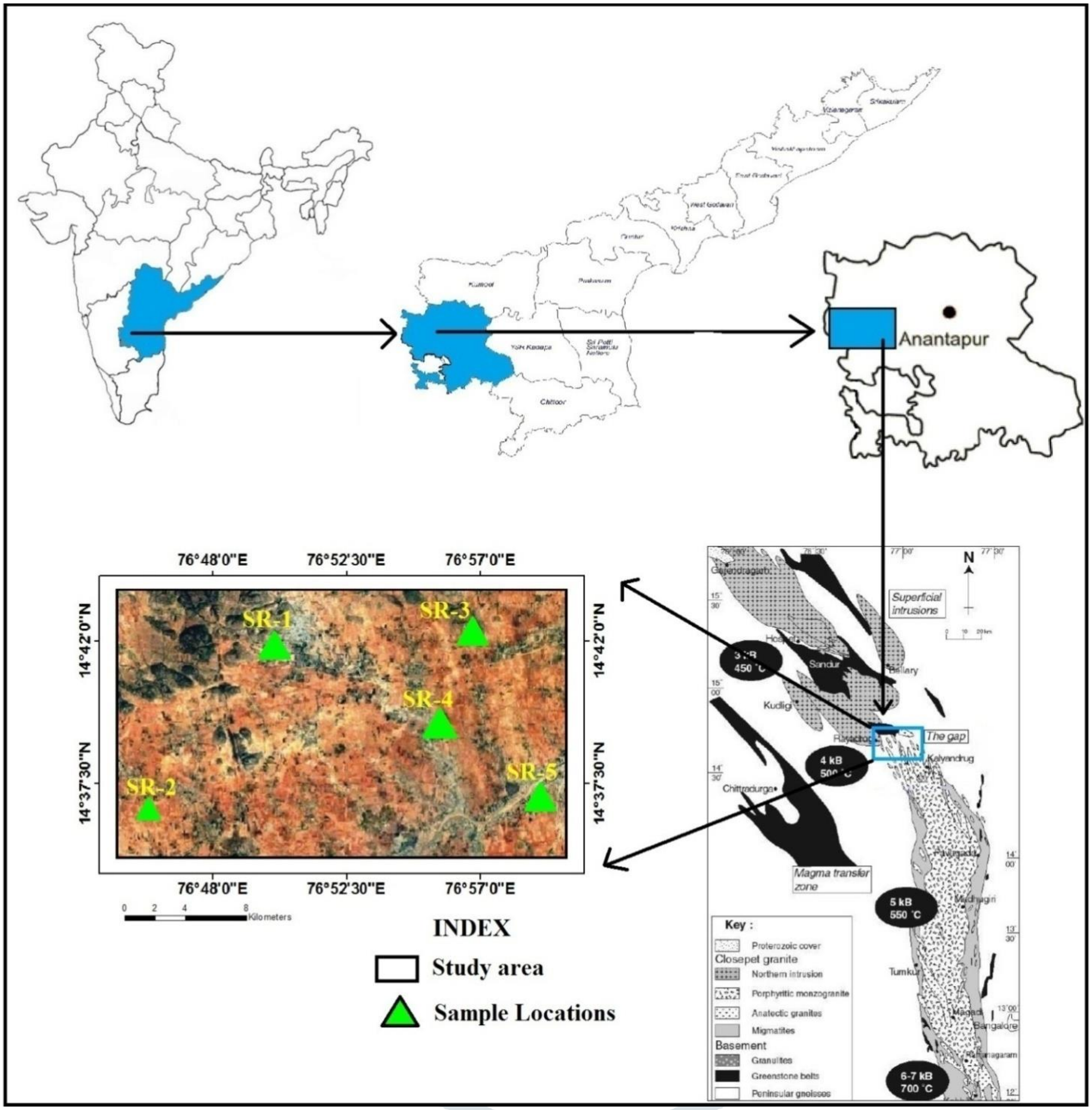


Fig.1. Google Earth image showing the location of the study area.

3. METHODOLOGY.

Field samples were collected and carried to the laboratory for Petrographic study using Petrological, Mineralogical research Microscope Mysore University Earth Science Department. while geochemical data was received through XRF Minerals, Materials Science & Technology Division NIIST Thiruvananthapuram, Kerala. Litho-units such as dolerite dykes, hornblende gneiss, grey granite, BIF, pegmatite veins were encountered during extensive field survey. These litho-units were digitized using Geological map of Karnataka (1981) with 1:250,000 scale using ArcGIS v10.3 and verified during field visits. Survey of India (GSI) topo map and Geological quadrangle map (57b) of 1:2.50.000 scale is used during the field work to study Iron ore deposits and other litho-units. Garmin-12 GPS is used to record the exact locations of each sample with an error of 9 mts during field visits (Maruthi and Basavarajappa., 2019) (Basavarajappa et al., 2018).

4. GEOLOGY AND FIELD SETTING:

Rayadurga comes to Ananthpur district, underlain by various geological formations ranging in Archaean age to Recent. Major part of the district is underlain by the granites, gneisses and schists of Archaean and Dharwar Supergroup (Ramakrishnan and Vaidyanadhan., 2008). Northeastern part of the district is occupied by the quartzites, limestones, shales of Cuddapah and Kurnool Group of rocks. Alluvium is restricted to Pennar, Vedavati and Papagni rivers (Swaminath and Ramakrishnan, 1981). The pegmatite and quartz veins intruding the schists, granites and gneisses are seen throughout the Anantapur district (Radhakrishna, 1983). The geological formations in the Anantapur district can be broadly divided into distinct and well-marked groups: an older group of metamorphic rocks belonging to the Archaean and younger groups of sedimentary rocks belonging to the Proterozoic age (Gopalakrishna et al., 1986). The remaining parts Rayadurga area is occupied by Archaean rocks which consists of schists, gneisses, migmatites, younger granites, pegmatites, quartz veins and basic dykes (Jayananda et al., 1995). The Archaean rocks have suffered considerable degree of tectonic disturbances as a result of which the rocks have been metamorphosed and recrystallised. The western part of the study area is occupied by younger granites (intrusives into Archaean), the central part by Archaean and the eastern part by the Proterozoics, i.e. the rocks belonging to the Cuddapah Super Group and Kurnool Group (Moyen et al., 2003). Pegmatite occur as stingers lenses, pods and veins, either parallel to the foliation of the enclosing rocks or as dykes across the foliation of the older rocks and sometimes laterally grades into the older rocks of fills up the joints in the older rocks with a sharp contact (Jean Francois Moyen et al., 2003). Biotite is generally associated with the whitish pegmatites while it diminishes or even disappears in the pinkish pegmatite. The pinkish pegmatite encloses patches of white pegmatite as Islands (Naqvi and Rogers, 1983; Radhakrishna and Naqvi, 1986).

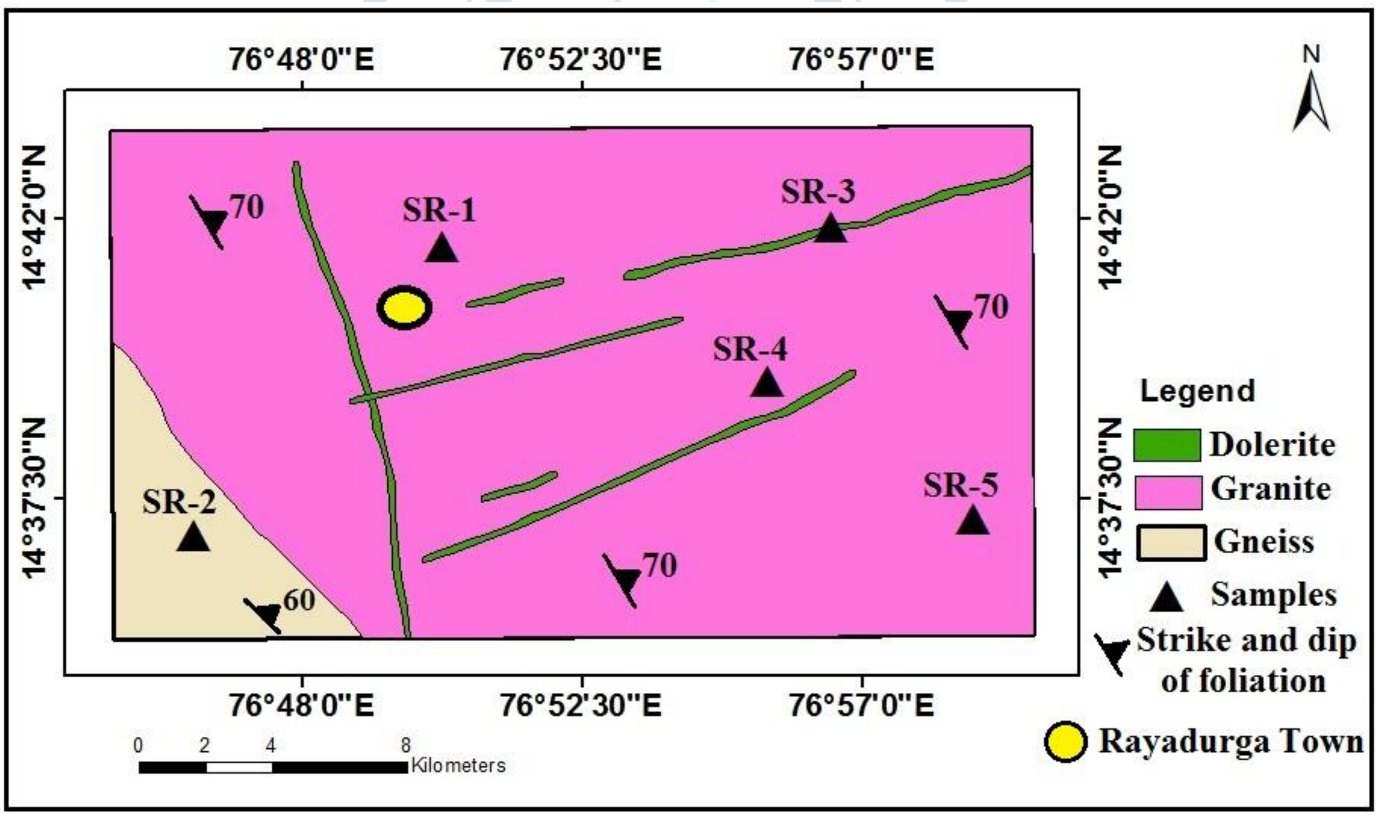


Fig.2. Geological map of the study area (after GSI 1978)

5. PETROGRAPHY

5.1. Gneiss: This type of gneiss is found in some of the oldest parts of the Earth's crust. It was formed from an intrusive igneous rock called tonalite, a variety of granite and an important rock type in the continental crust. Quartz shows Colourless, transparent and unaltered. Form as grains with irregular outlines, without any shape its showing anhedral and euhedral, cleavage absent. Relief low positive, so that the outlines of the grains are not well marked with smooth surface. Birefringence weak, greys or yellows of I order interference colours basal sections are isotropic positive elongation in euhedral grains. Uniaxial positive. Extinction parallel or symmetrical with respect to crystal edges not normaly determinable because of the anhedral form sometimes wavy extinction due to strain. Biotite is Silicate of magnesium, iron, aluminium and potassium with hydroxyl fluorine and monoclinic system. Colour Brown, yellowish brown, reddish brown, dark brown, green or dark green. Cleavage perfect in one direction basal sections do not show any cleavage. Relief moderate positive. Birefringence strong, interference colours range up to II order red but are masked by the strong body colour of the mineral the direction of the cleavage traces is always the slower ray biaxial negative. Extinction shows parallel sometimes wavy extinction in bent tabular forms due to strain. (Fig.3)

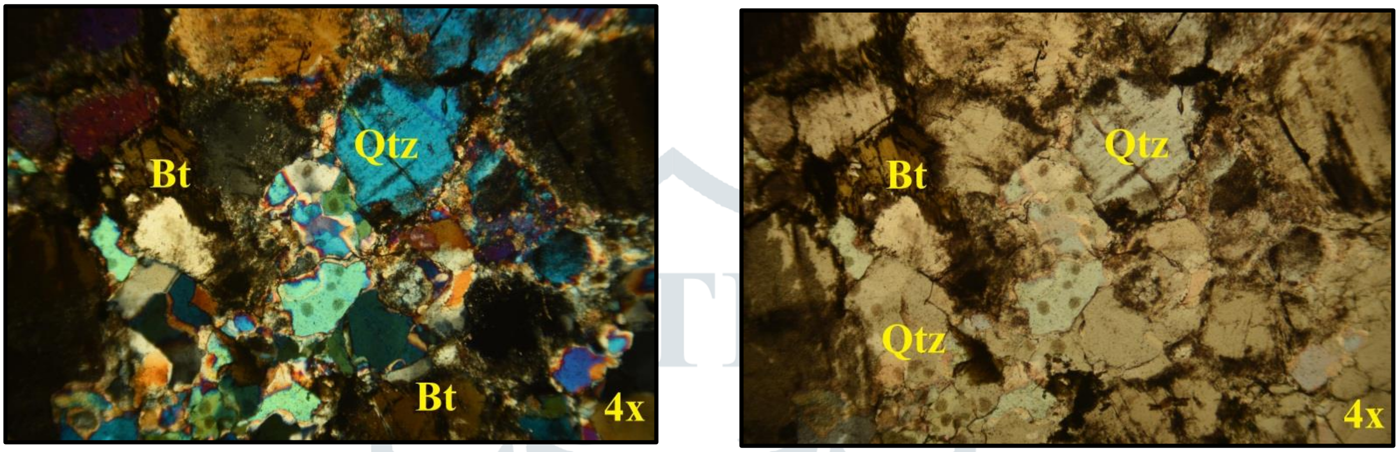
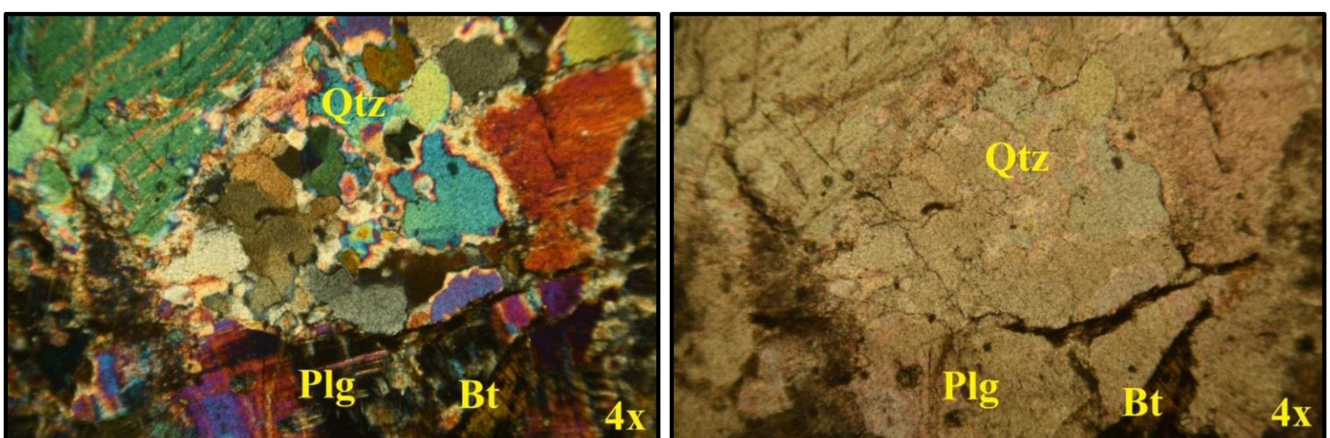


Fig.3. Photomicrographs of Gneiss under PPl and XPL

5.2. Granite: Granite composed of Qurtz + Felspar + Biotite mica. Quartz shows Colourless, transparent and unaltered. Cleavage absent, Relief low positive, so that the outlines of the grains are not well marked with smooth surface. Birefringence weak, uniaxial positive. Felspar shows central part of micro section, colouless, but often cloudy due to alteration. Cleavage is visible as thin lines in two directions nearly 900 other sections will



show no cleavage or one direction only and Relief low negative. Birefringence weak, simple twinning, **Fig.4. Photomicrographs of Graniteunder PPl and XPL**

mineral distinguished from quartz by its cloudy appearance due to alteration, shows low negative relief, presence of cleavage and by simple twinning. Biotite is Silicate of magnesium, iron, aluminium and potassium with hydroxyl fluorine. Colour Brown, yellowish brown, reddish brown, dark brown, green or dark green. Cleavage perfect in one direction basal sections do not show any cleavage. Birefringence strong, parallel extinction. (Fig. 4)

5.3. BFQ: Banded Ferruginous Quartzite represents one of the most distinctive rock types that occur widespread in space and time in the earlier part of the Precambrian in most of the shield areas of the world. Gap area of NE from Nethrapalli Iron ore minerals associated with Precambrian banded iron formations are mainly found in three oxy-hydroxy phases as hematite, martite and goethite. Hematite is colored black to steel or silver-gray, brown to reddish brown, or red. Varieties include kidney ore, martite, iron rose and specularite. While the forms of hematite vary, they all have a rust-red streak. Hematite is harder than pure iron, but much more brittle. Maghemite is a hematite- and magnetite-related oxide mineral. Banded iron formations (BIFs) are chemically precipitated sedimentary metamorphosed rock probably Nethrapalli area iron or consist of environmental on magmatic hydrothermal, metamorphic and sediment origin. They are composed of alternating thin red, yellow, or cream colored layers of magnetite and hematite black to dark gray iron oxidesand iron carbonate siderite layers. This photomicrographs Hematite Optical properties shows color white to greyish white with bluish tint, crystal habit tabular to thick crystals; micaceous or platy, commonly in rosettes. cleavagenone, twinning penetration and lamellar, optic Sign uniaxial, relief very high. Magnetite is isotropic mineralit showing grey with brownish tint color, Surface relief is very high, birefringence none. Hematite overgrowths on and inclusions in magnetite ilmenite inclusions rutile other minor elements showing Manganese and Titanium (fig.5).

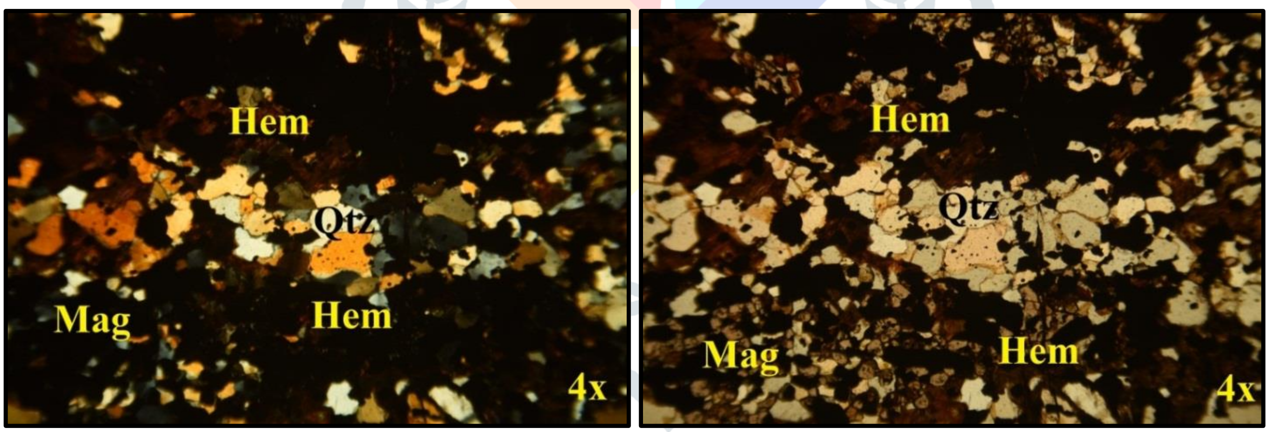


Fig.5. Photomicrographs of Banded Iron formation under PPL and XPL.

5.4. Pegmatite: A pegmatite is a holocrystalline intrusive igneous rock composed of interlocking phaneritic crystals. The pegmatites are the result of crystallization of molten magma waste. These alloys are characterized by being rich in volatiles and incompatible elements. Although the pegmatites show a compositional range, the most common compositional characteristics of granites and consist mainly of quartz, feldspar, potassium, plagioclase and white mica. Pegmatite, Polarised light micrograph of a thin section through pegmatite rock. Pegmatite is an igneous rock associated with granite and syenite deposits. It mainly consists of quartz, alkaline feldspar and mica. To the unaided eye the rock has a light colour. Pegmatite is extracted due to the economic importance of the minerals it contains, such as orthoclase and beryl. In this section are observed feldspar crystals large, and as some of them have twinned lattice. These minerals show a secondary alteration to sericite. Quartz crystals are smaller and appear in colors of gray and white interference of the first order. Highlights include fresh of these in contrast to the feldspars.(Fig.6)

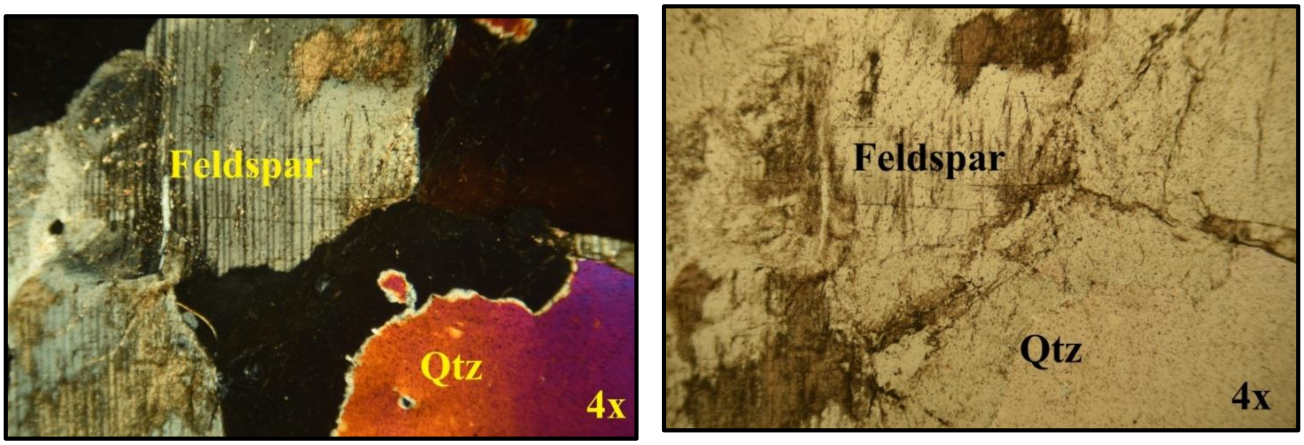


Fig.6. Photomicrographs of Pegmatite under PPL and XPL.

5.5. Dolerite: Dolerite is the name given to basic igneous rocks found in small intrusions that are intermediate in grain size between basalt and gabbro. Small intrusions (dykes and sills) cool more quickly than large intrusions, but more slowly than lavas erupted at the surface and it's a mafic, holocrystalline, subvolcanic rock. A medium grained mafic intrusive rock whose main components are calcic plagioclase and clinopyroxene and which is characterized by ophitic to subophitic texture. The sampled dolerite is principally composed of medium to coarse grained calcic plagioclase and clinopyroxene. The main accessories include biotite, amphibole, and uralite. Rarer accessories include olivine, orthopyroxene, and anhedral quartz. Euhedral to subhedral opaque oxide minerals were noticed. The texture ranges from poikilitic, ophitic, and rarely porphyritic or glomeroporphyritic. The plagioclase laths are randomly oriented and are sometimes zoned. The clinopyroxene of some samples contain exsolvedaugite in inverted pigeonite. Thin section of a dolerite from Rayadurga dyke, showing subophitic texture with labradoritic plagioclase paths partially surrounded by varieties of clinopyroxene (augite and pigeonite). The clinopyroxene is generally augite, but also some pigeonite can be observed.Augite silicate of calcium, magnesium, iron and aluminium, color shows colorless to pale greenish or yellowish brown. Cleavage distinct one set of cleavages in the four sided forms sometimes two sets of cleavages at right angles to each other in eight sided forms. Relief high positive. birefringence moderate and inclined extinction.

Fig.7. Photomicrographs of Dolerite under PPL and XPL.

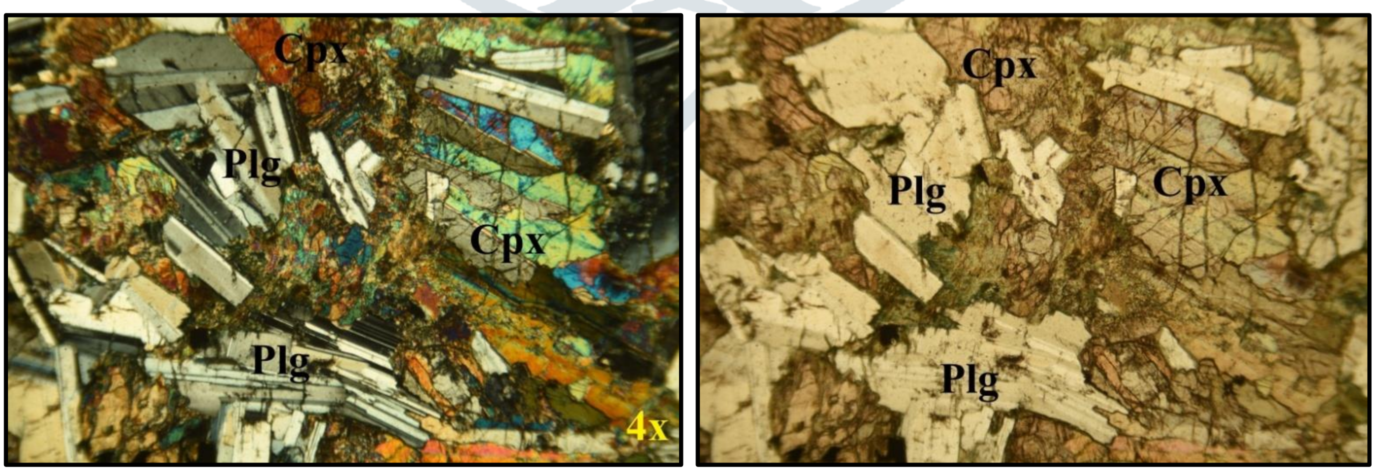


Table.2. Major Elements of the study area.

Major Elements	Granite				
Samples	**SR-1A**	**SR-1B**	**SR-1C**	**SR-1D**	**SR-1E**
SiO2	73.963	72.816	73.065	70.259	70.293
TiO2	0.285	0.346	0.119	0.276	0.22
Al2O3	14.168	13.458	14.871	12.114	12.549
Fe2O3	2.204	2.396	2.385	3.399	3.185
MnO	0.055	0.073	0.014	0.026	0.033
MgO	0.216	0.959	0.199	0.259	0.095
CaO	1.641	2.253	1.823	1.381	1.399
Na2O	3.462	3.866	3.543	3.823	3.425
K2O	3.031	2.775	2.901	7.479	7.852
P2O5	0.762	0.801	0.789	0.773	0.76
Total	**99.787**	**99.743**	**99.709**	**99.789**	**99.811**

Major Elements	Gneiss				
Samples	**SR-2A**	**SR-2B**	**SR-2C**	**SR-2D**	**SR-2E**
SiO2	71.961	71.23	70.76	65.999	69.638
TiO2	0.252	0.452	0.755	0.888	0.486
Al2O3	13.025	12.459	12.84	12.601	11.811
Fe2O3	2.454	3.4	3.199	5.477	4.231
MnO	0.022	0.062	0.095	0.089	0.056
MgO	0.336	0.816	1.024	1.379	0.825
CaO	3.199	3.604	4.116	3.479	3.798
Na2O	4.183	4.331	3.237	3.429	4.262
K2O	3.595	2.581	2.673	5.045	3.545
P2O5	0.806	0.894	1.083	1.27	0.993
Total	**99.833**	**99.829**	**99.782**	**99.656**	**99.645**

Major Elements	Dolerite				
Samples	**SR-3A**	**SR-3B**	**SR-3C**	**SR-3D**	**SR-3E**
SiO2	46.007	43.817	45.694	45.526	44.916
TiO2	0.800	1.221	1.05	0.591	0.648
Al2O3	17.066	14.061	14.353	16.669	16.176
Fe2O3	15.179	19.78	18.052	14.164	16.096
MnO	0.183	0.223	0.22	0.246	0.181
MgO	4.983	5.476	4.85	6.252	6.431
CaO	12.009	11.263	11.422	12.458	11.462
Na2O	2.403	2.461	2.687	2.742	2.426
K2O	0.305	0.546	0.567	0.399	0.48
P2O5	0.726	0.739	0.723	0.563	0.751
Total	**99.661**	**99.587**	**99.618**	**99.61**	**99.567**

Major Elements	Iron		Pegmatite	
Samples	SR-4A	SR-4B	SR-5A	SR-5B
SiO2	51.689	40.563	68.252	60.049
TiO2	0.271	0.298	0.649	0.517
Al2O3	2.721	2.456	12.276	11.781
Fe2O3	34.562	43.045	5.467	15.136
MnO	3.493	7.053	0.084	0.031
MgO	2.75	1.548	1.526	0.162
CaO	3.368	3.897	1.523	1.261
Na2O	0.17	0.15	3.941	2.628
K2O	0.11	0.016	5.235	7.248
P2O5	0.712	0.617	0.788	0.665
Total	**99.846**	**99.643**	**99.741**	**99.478**

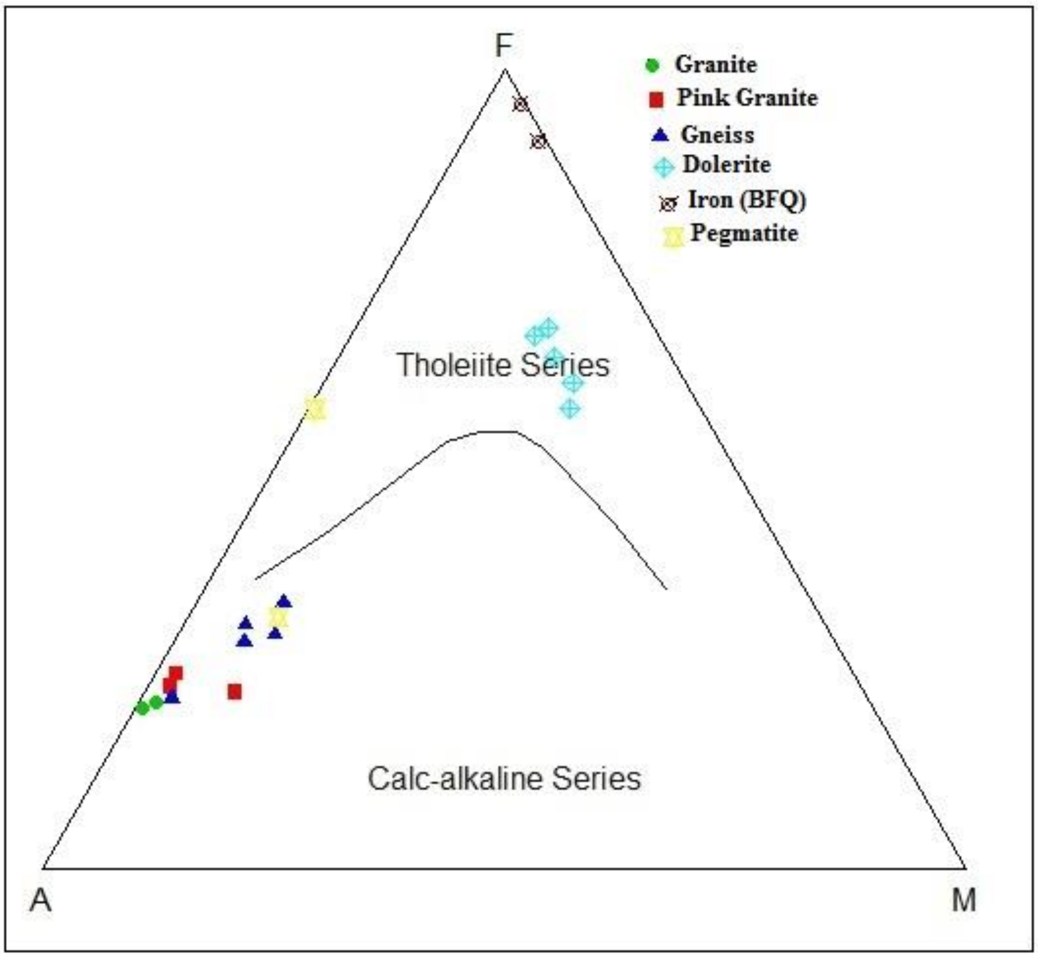


Fig.8. AFM Plot (Irvine and Baragar, 1971)

The AFM construction, extensively used by the petrologists is regarded as a valuable and authoritative mechanism to study variation in differentiated series of rocks, the AFM diagram is still considered as an effective parameter for a critical evaluation of the suite of rocks formed through magmatic differentiation.The geochemical data obtained and plotted in the AFM classification most of the dolerite, pegmatite and iron samples indicating tholeiite series. The alkali-Iron-Magnesium triangular discrimination diagram classify the granites in to calc-alkaline field of Irvine and Baragar (1971). AFM diagram (Fig.8) form a smooth and distinct trend that is characteristic of any sub alkaline series, where in the magma does not show preferential enrichment in either MgO or FeO and with increasing differentiation, there is a drop in the concentration of MgO and FeO and the trend line moves towards alkali rich corner. The differentiation trend of the granites of Rayadurga together with the granites of all the above specified areas broadly resembles the trend shown by the highly alkaline lavas of study area (Irvine and Baragar., 1971).

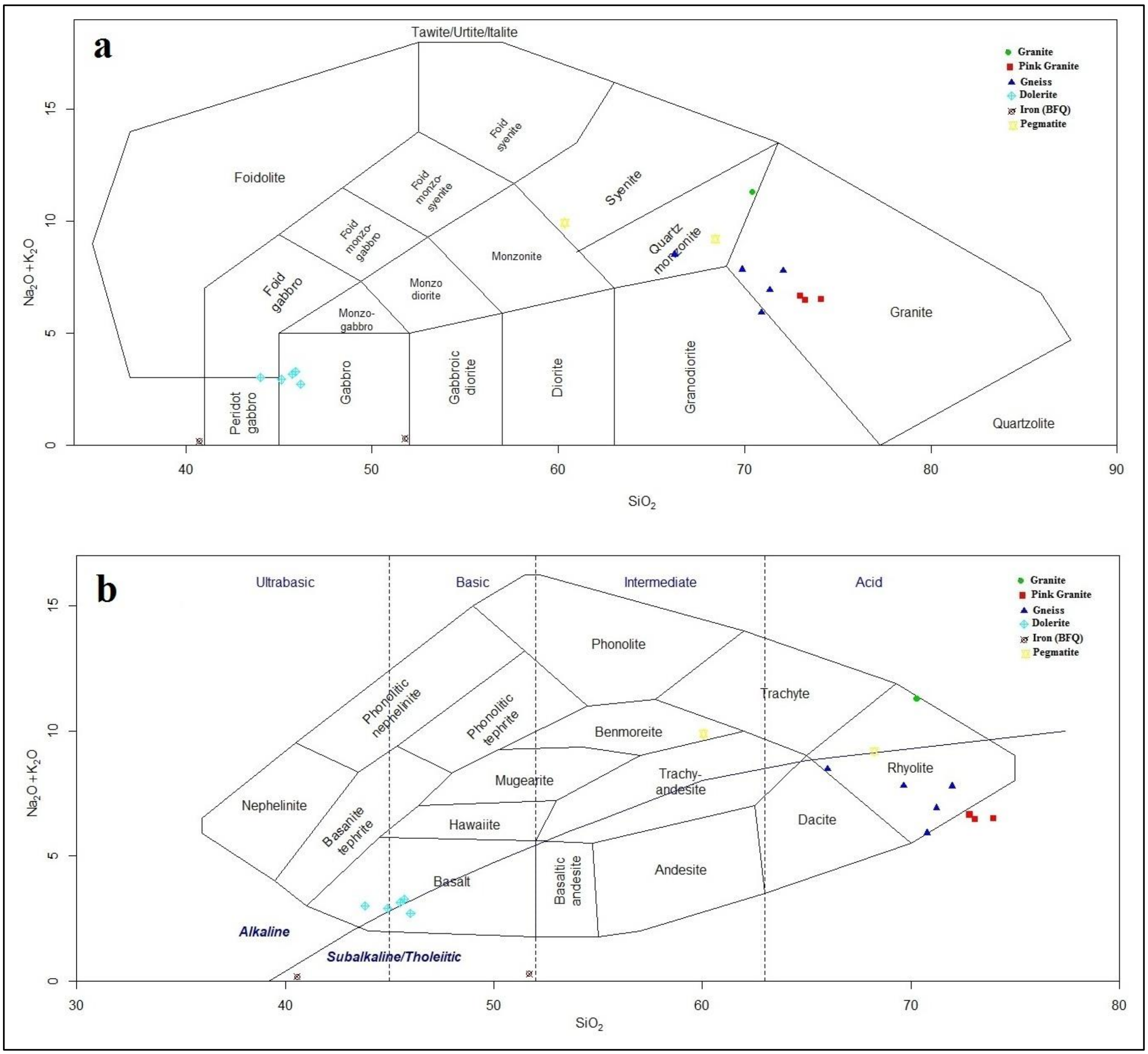


Fig.9. (a-b): Plots of Gneiss, dolerite, iron, pegmatite and granitic rocks of Rayadurga in the (SiO_2Vs Na_2O+K_2O) diagrams (a) Middlemost (1985) and (b).Cox et al, 1979

The granite, gneiss, dolerite, iron and pegmatite of Rayadurga display exhibit geochemical characteristic along with the normative signatures that are in tune with their modal compositions (Table.2). This statement well amply demonstrated in the silica vsalkalies diagram of Cox et al., (1979) and Middlemost (Fig.9 a-b), where in majority of the analysed samples of Rayadurga get plotted in the granite or granodiorite field, that are very typical of rocks derived from acidic melts that carry subalkaline signatures. The Gneiss and granites of Rayadurgain fact have abundant modal quartz and expectedly develop normative quartz feature shared by the granites and quartz syenites from classic and well documents igneous complexes pertaining to the other cratons of the India. (Fig.9 a-b)

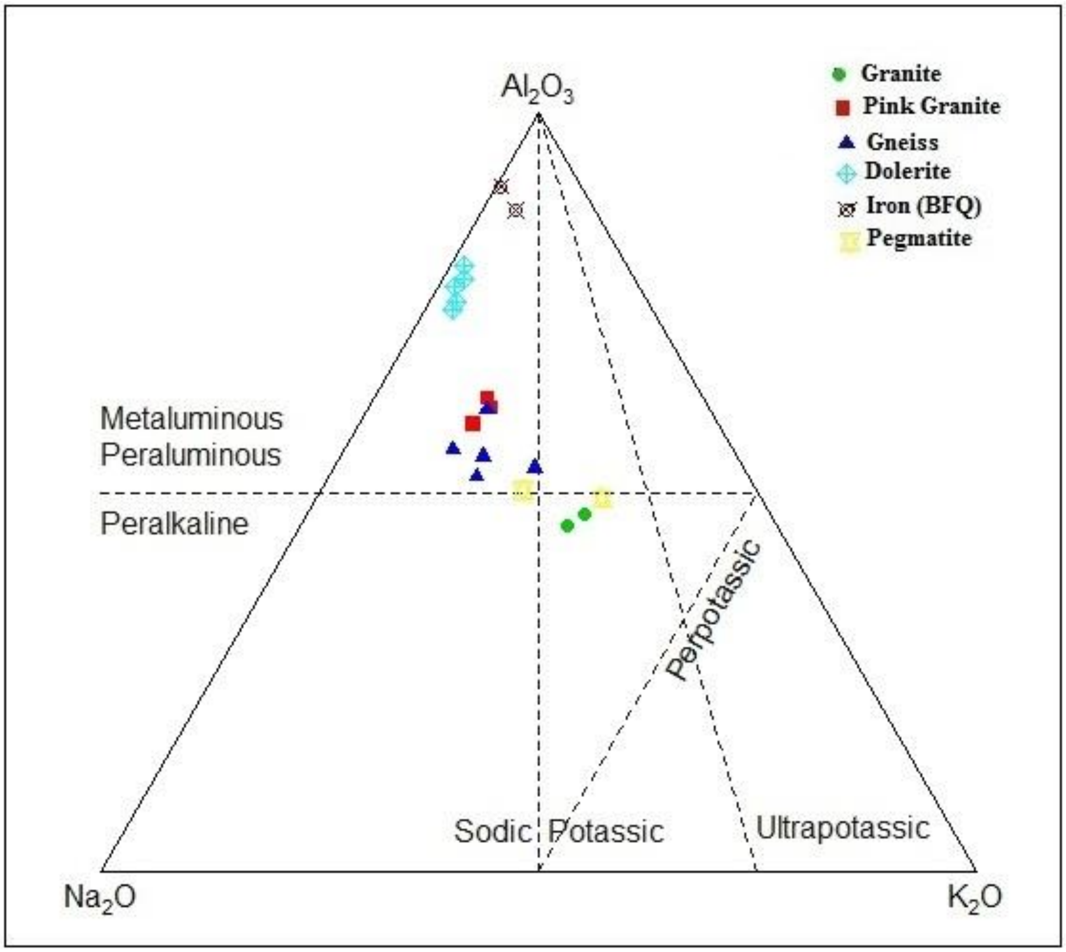


Fig.10. Plots of Gneiss, dolerite, iron, pegmatite and granitic rocks of Rayadurga in the (Na2O-Al2O3-K2O) ternary diagram

One popular method to distinguish and characterize theGneiss, dolerite, iron, pegmatite andgranites in terms of thealumina is to plot the compositions of granites in a conventional Na_2O-Al_2O_3-K_2O ternary diagram (Fig.10) and all the samples of Rayadurga when projected in this diagram reveal their metaluminous nature. Even, the conventional B- A plot introduced by Villaaseca et al., (1996)(Fig.11) is also a similar technique to characterize granites , which involved the variables called B and A , where in B corresponds to Fe+ Mg+ Ti and A correspond Al- (K+ Na+2Ca). This approach not only portrays the variation of alumina saturation but also deals with the changes in Fe + Mg+ TI on one hand and Al- (K+ Na+2Ca) on the other hand and the role of alumina that accompanies differentiation of granitic melts. (Fig.11)

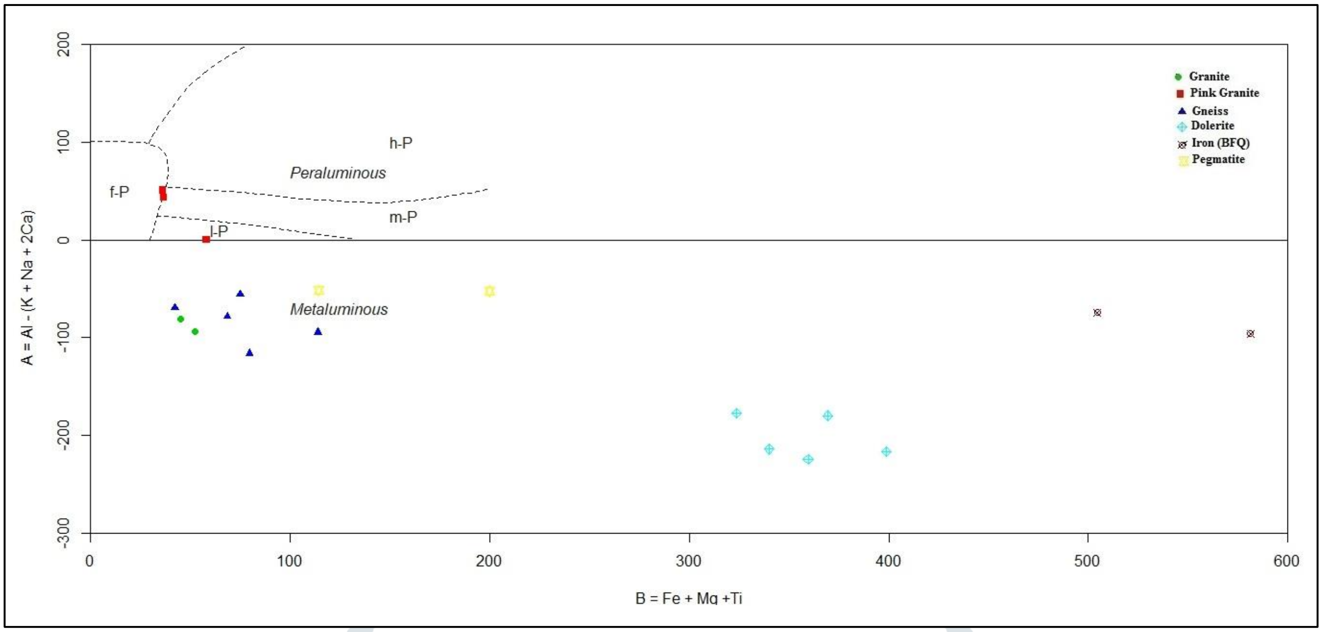


Fig.11. Plots of Rayadurga Gneiss, dolerite, iron, pegmatite and granitic rocks in the B- (Al- (K+ Na+2Ca)) - A (Fe+ Mg+ Ti) diagram (Villasce et al., 1996)

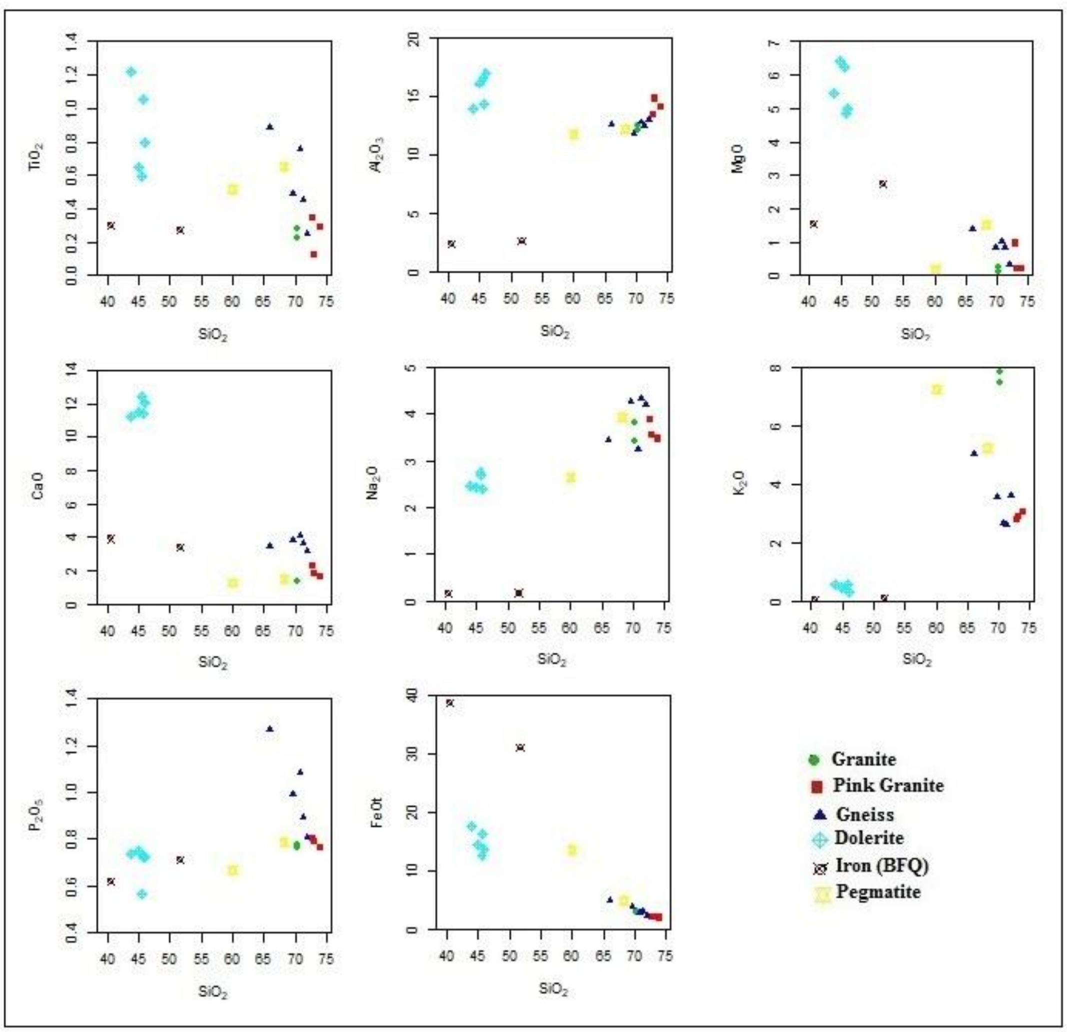


Fig.12. Harkers Variation diagrams of SiO_2Vs Major Oxides of litho - units of around Rayadurga

The variation in the different major oxides within Gneiss, dolerite, iron, pegmatite and granites of Rayadurga is presented in this section. All the oxides of major elements of litho - units of around Rayadurga together with the average values are plotted against SiO2 Harker's variation diagram (Harker, 1960). The average Al_2O_3 when plotted against the SiO_2, depicts an overall rising trend (Fig.12) is seen with increasing differentiation. However one sample though has a low SiO_2 and low Al_2O_3 deviates from the rest and falls away from the main trend. Similar trends are seen even when Na_2O and K_2O are plotted against SiO_2. However, when the FeO, Fe_2O_3, FeOt, MnO, MgO and CaO contents of the granites from the Rayadurga are plotted against SiO_2, steeply falling curves (Fig.12) with increasing differentiation similarly TiO_2 and P_2O_5 (Fig.12) exhibit similar negative correlation in the Harker's diagram. The dominance of FeO over Fe_2O_3 and K_2O over Na_2O without exception characterizes the litho-units of Rayadurga.

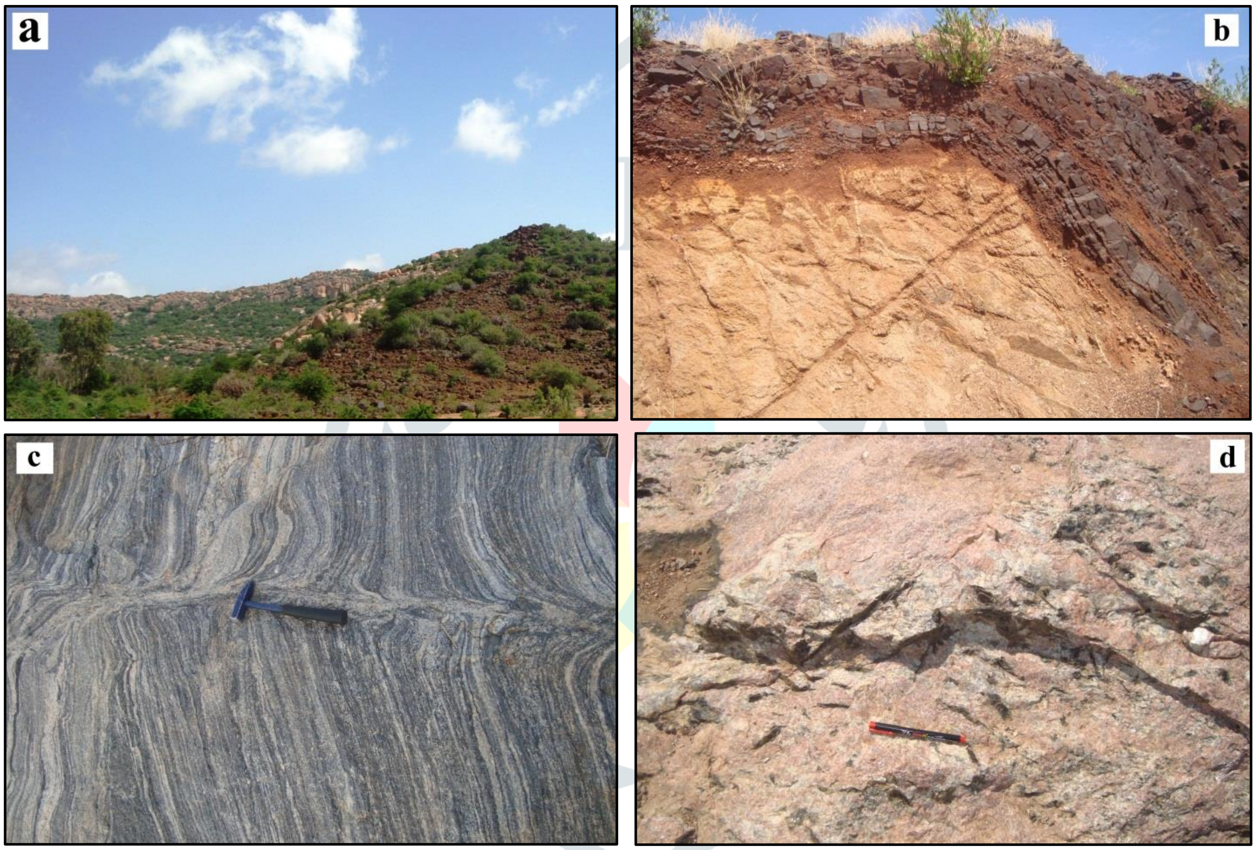


Fig.13. Field Photographs of (a) contact zone of Dolerite and Granite, (b) Iron formation, (c) Gneiss (d) Pegmatite.

6. CONCLUSION

Field investigation, optical properties, XRF analysis, Arc GIS and omnian software's helps to find out Geological, Petrographic, Physical, ore characteristics and Chemical characteristics and discrimination shows purity of the minerals present in the Precambrian rocks. Analyzed and Studies for the selected samples were carried out and identified mineral assemblage of Gneiss, Granite, BFQ, Pegmatite and Dolerite. The dolerite is showing deformed texture at the time of metamorphism and crustal evolution. Na_2O-Al_2O_3-K_2O ternary plots of the study area reveals metaluminous in nature. This approach not only portrays the variation of alumina saturation but also deals with the changes in Fe + Mg+ TI on one hand and Al- (K+ Na+2Ca) on the other hand and the role of alumina that accompanies differentiation of granitic melts. The dominance of FeO over Fe_2O_3 and K_2O over Na_2O without exception characterizes the litho-units of study area. Geochemically the rocks are proved the dominance of Feo over F^{e2} O_3 and K_2O without exception Charecterizes the all lithological setting of Rayadurga. The iron ore is concentrated with high grade and mineral assemblages like two types of pyroxenes with scapolite and titanium rich mineral rutile seems to be higher temperature and pressured mineralization.This study mainly characterization of Rayadurga area litho-units and crustal evolution and crustal formation at the time of midle Archean to proterozoic time of precambrian crust.

Acknowledgment

The authors are indepthly acknowledged Prof. M.S. Sethumadhav, Chairman, DoS in Earth Science, Centre for Advanced Studies in Precambrian Geology (CAS), Manasagangothri, University of Mysore, Mysuru; heartily acknowledged Dr. M. Sundarajan Senior Scientist, Minerals, Materials Science & Technology Division NIIST Thiruvanthapuram, Kerala, India and Geological Survey of India, Bengaluru and UGC, New Dehli.This study is supported by the SC/ST fellowship University of Mysore.

Refrence

1. Anil Kumar, BhaskarRao, Y.J., Sivaraman, T.V. and Gopalan, K. (1996) Sm-Nd ages of Archaeanmetavolcanics of the Dharwarcraton, south India: Precamb.Res, v. 80, pp. 205-216.
2. Barker, F., Arth, J.G., 1976. Generation of trondhjemite–tonalite liquids and Archaeantrondhjemite–basalt suites. Geology 4, 596–600.
3. Basavarajappa H.T and Maruthi N.E (2018). Hyperspectral And Petro - Chemical Signatures Study On Shear Zone Controlled Corundum Bearing Pelitic Rocks Of Budipadaga Area, Chamarajanagara District, Karnataka, India. International Journal of Research and analytical Reviews (IJRAR) Volume 5, Issue 3, pp. 906-913.
4. Basavarajappa H.T and Maruthi N.E (2018). Hyperspectral and Petro - Chemical Signatures study on Corundum Bearing Litho-Units around Sringeri Area, Chikmagalur District, Karnataka, India. RESEARCH REVIEW International Journal of Multidisciplinary Volume 3, Issue10, pp. 899-904.
5. Basavarajappa H.T and Maruthi N.E (2018). Petrochemical characteristics and Hyperspectral signatures on Corundum bearing Precambrian litho-units of Varuna area, Mysuru district, Karnataka, India. International Journal of Creative Research Thoughts, Volume6, Issue1, Pp.998-109.
6. Basavarajappa H.T and Maruthi N.E (2018).Petro – Chemical And Spectral Signatures On Corundum Bearing Precambrian Amphibolites In Sullia Area, Dakshina Kannada District, Karnataka, India. Journal of Emerging Technologies and Innovative Research (JETIR) Volume 5, Issue 7, pp. 75-83.
7. Basavarajappa H.T and Srikantappa .C (2014). Precambrian deep crustal Metamorphism and Fluid regime in Biligiri-RanganGranulites, DharwarCraton, India, Journal of The Indian Mineralogist, Vol.48, No.2, Pp: 289-338.
8. Basavarajappa H.T, Maruthi N.E and Manjunatha M.C (2017). Hyperspectral Signatures and Field Petrography of Corundum bearing litho-units in Arsikere band of Haranahalli, Hassan District, Karnataka, India. International Journal of Creative Research Thoughts, Volume5, Issue4, Pp.3791-3798.
9. Basavarajappa H.T, Maruthi N.E, Jeevan L and Manjunatha M.C (2018). Physico-chemical charectristics and hyperspectral signature study using geomatics on gem verity of corundum bearing precambrianlitho-units of Mavinahalli area, Mysuru district, Karnataka, India. International Journal of Computer Engineering and Technology(IJCET) Volume 9, Issue 1, pp. 102-112.
10. BasavarajappaH.T, and Maruthi N.E (2018). Hyperspectral Signature Study Finds Corundum Alters To DiasporeInflueance Of Climate Change Of DharwarCratonArsikere Band Of Haranahalli, Hassan District, Karnataka, India. Journal of Environmental Science, Computer Science and Engineering and Technology (JECET) Volume 7, Issue 2, Pp.238-246.
11. Chadwick B, Vasudev VN, Hegde GV (2000) The DharwarCraton, south India, interpreted as the result of Late Archaean oblique convergence. Precamb Res 99:91–111.
12. Crawford, A.R., 1969. Reconnaissance Rb–Sr dating of the Precambrian rocks of southern Peninsular India. Journal of the Geological Society of India 10, 117–166.

13. Gopalakrishna D, Hansen EC, Janardhan AS, Newton RC (1986) Southern high grade margin of the DharwarCraton. J Geol 94:247–260.
14. James Hutton (1788) Theory of the Earth, or an investigation of the laws observable in the composition, dissolution and restoration of land upon the globe. Transactions of the Royal Society of Edinburgh, Vol.1, Part 2, pp. 209-304.
15. Jayananda M, Martin H, Peucat JJ, Mahabaleswar B (1995) Late Archaean crust–mantle interactions: geochemistry of LREE enriched mantle derived magmas: example of the Closepetbatholith. Contrib Mineral Petrol 119:314–329.
16. Jayananda, M. and Mahabaleswar, B. (1991) Relationship between shear zones and igneous activity: the Closepet granite of southern India: Proc.Indian.Acad.Sci.(Earth.Planet.Sc.), v.100, pp.31-36.
17. Jayananda, M., Moyen, J.F., Martin, H., Peucat, J.-J., Auvray, B., Mahabaleswar, B., 2000. Late Archaean (2550–2520 Ma) juvenile magmatism in the Eastern Dharwarcraton, southern India: constraints from geochronology, Nd–Sr isotopes and whole rock geochemistry.Precambrian Research 99, 225–254.
18. Jean-François MOYEN, Mudlappa JAYANANDA, Anne NEDELEC, Hervé MARTIN, B. MAHABALESWAR and Bernard AUVRAY4(2002) From the Roots to the Roof of a Granite: the Closepet Granite of South India. Journal of the Geological Society of India, pp 1-11.
19. Krogstad, E.J., Hanson, G.N., Rajamani, V., 1991. U–Pb ages of zircon and sphene for two gneiss terranes adjacent to the Kolar schist belt, South India: evidence for separate crustal evolution histories. Journal of Geology 99, 801–816.
20. Martin, H., 1994. The Archaean grey gneisses and genesis of continental crust. In: Condie, K.C. (Ed.), Archaean Crustal Evolution. Developments in Precambrian Geology 11, Elsevier, pp. 205–259.
21. Maruthi N.E and Basavarajappa H.T (2018). Hyperspectral and Petro - Chemical Signatures study on Corundum Bearing Amphibolite Schist of Magadi Area, Ramanagara District, Karnataka, India. RESEARCH REVIEW International Journal of Multidisciplinary Volume 9, Issue 3, pp. 773-779.
22. Maruthi N.E and Basavarajappa H.T (2018). Hyperspectral And Petro - Chemical Signatures Study On Corundum Bearing Litho-Units Of Precambrian Basement Rocks Around Closepect Granite Madhugiri Area, Karnataka, India. Journal of Emerging Technologies and Innovative Research (JETIR) Volume 5, Issue 12, pp. 619 - 628.
23. Maruthi N.E and Basavarajappa H.T (2018). Hyperspectral Signatures and Petro - Chemical Charectistics Study on Corundum Bearing Litho-Units of Sargur Area, Mysuru District, Karnataka, India. International Journal of Research and analytical Reviews (IJRAR) Volume 5, Issue 4, pp. 65-74.
24. Maruthi N.E, Basavarajappa H.T and Siddaraju M.S. (2019). Hyperspectral And Petro-Chemical Signatures Study On Corundum Bearing Litho-Units Of Precambrian Basement Rocks Around Chitradurga Area, Karnataka, India. International Journal of Research and Analytical Reviews (IJRAR), Volume.6, Issue 2, Page No pp.242-250, June 2019.
25. Maruthi N.E, Basavarajappa H.T, Jeevan .L and Siddaraju M.S (2018). Hyperspectral Signatures On Corundum Bearing Litho-Units Of Precambrian Basement Rocks Around Closepet Granite Pavagada Area, Karnataka. International Journal of Computer Engineering and Technology (IJCET) Volume 9, Issue 3, pp. 86-94.
26. Maruthi N.E, Basavarajappa H.T, Manjunatha M.C, and Harshavardhana A.S. (2019). Hyperspectral Study And Integration Of Petro-Chemical Signatures On Corundum Bearing Litho-Units Around Maddur, Mandya District, Karnataka, India. International Journal of Research and Analytical Reviews (IJRAR), Volume.6, Issue 1, Page No pp.897-903, January -March 2019.
27. Maruthi N.E, Basavarajappa H.T, Reza Ravanshad and Habibul Rahman Masoumi. (2019). Hyperspectral And Petro-Chemical Signatures Study On Corundum Bearing Litho-Units Of Precambrian Rocks Around Bangarpet Area, Kolar District, Karnataka, India. International Journal of Research and Analytical Reviews (IJRAR), Volume.6, Issue 2, Page No pp.795-804, May 2019.
28. Moyen JF, Martin H, Jayananda M (2001) Multi-element geochemical modeling of crust–mantle interactions during late Archaean crustal growth: the Closepet Granite (south India). Precamb Res 112:87–105

29. Moyen JF, Nedlec A, Martin H, Jayananda M (2003) Syntectonic granite emplacement at different structural levels: the Closepet granite, south India. J StructGeol 25:611–631
30. Naqvi SM, Rogers JJW (1983). Introduction In: Naqvi S M and Rogers JJW (eds). Precambrian of South India. Geological Society Memorandum, 4, 6-16.
31. Nutman, A.P., Chadwick, B., Krishna Rao, B., Vasudev, V.N., 1996. SHRIMP U–Pb zircon ages of acid volcanic rocks in the Chitradurgaand Sandur Groups and granites adjacent to Sandur schist belt. Journal of the Geological Society of India 47, 153–161.
32. Peucat, J.-J., Bouhallier, H., Fanning, C.M., Jayananda, M., 1995. Age of Holenarsipur schist belt, relationships with the surrounding gneisses (Karnataka, south India). Journal of Geology 103, 701–710.
33. Radhakrishna BP (1983). Archean granite-greenstone terrain of the South Indian Shield. In: Naqvi S W and Rogers J J W (eds.), Precambrian of South India. Geological Society of India Memorandum, 4, 1-46.
34. Radhakrishna BP, Naqvi SM (1986). Precambrian continental crust of India and its evolution. Journal of Geology, 94, 145-166.
35. Ramakrishnan M. and R. Vaidyanadhan. (2008). Geology of India, Volume-1, Pp: 108-120.
36. Siddaraju M.S, Maruthi N.E and Basavarajappa H.T. Charecterisation And Association Of Molybdenum With Iron Ore Deposit Through Petro-Chemical, Sem And Eds In Rayadurga To Kalyandurga Gap Area Of Closepet Granite DharwarCratonAnantapur District, Andra Pradesh , India. International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.6, Issue 1, Page No pp.1077-1087, January 2019.
37. Swaminath J, Ramakrishnan M (1981). Present classification and correlations. In: Swaminath J and Ramakrishnan M (eds.), Early Precambrian supracrustals of southern Karnataka. Geological Survey of India Memorandum, 112, 23-38.
38. T.R. Carter, A.C. Colvine, and H.D. Meyn (1980). Geology of Base Metal, Precious Metal, Iron, and Molybdenum Deposits in the Pembroke-Renfrew Area. Ontario Geological Survey Mineral Deposits Circular 20, pp,1-175.
39. Taylor, P.N., Chadwick, B., Moorbath, S., Ramakrishanan, M., Viswanatha, M.N., 1984. Petrography, chemistry and isotopic ages of Peninsular Gneisses, Dharwar acid volcanics and Chitradurga granites with special reference to Archaean evolution of Karnataka craton,southern India. Precambrian Research 23, 349–375.
40. Taylor, P.N.,Chadwick, B., Moorbath, S., Ramakrishanan, M. and Viswanatha, M.N. (1984) Petrography, chemistry and isotopic ages of Peninsular gneisses, Dharwar acid volcanics and Chitradurga granites with special reference to Archaean evolution of Karnataka craton, southern India:Precamb.Res, v. 3, pp. 349-375.