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Petrology and Geochemistry of Granites in and Around Nalgonda District, India

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ABSTRACT

The granites of part of Nalgonda district is a metaluminous, high K-calc alkaline,I-type granite emplaced into the gneissic rock of the Peninsular Gneissic Complex of the Eastern Dharwar Craton. The thin section study clearly evidence that the granite is of pure magmatic origin. The deformation signatures were also noticed of brittle-ductile shear both in field and thin section studies in laboratory. Geochemically, the granite is rich in K_2O+Na_2O, suggesting it is an alkali granite with calc-alkaline magma. On a Yb vs Ta discrimination plot, the granites are falling mostly in the volcanic arc granite field. The REE pattern shows strong Eu negative anomaly, suggesting early separation of plagioclase. The enhance level of LL element relative to HFS element point to the subduction zone enrichment and/or crustal comtamination of the source region.

Introduction

The Indian Peninsula is traditionally considered to be a monolithic continental shield constituted by crystalline rocks. Later, the Precambrian rocks of India were divided into distinct segments based on principal orogenic trend, viz. Dharwar, Eastern Ghat, Aravalli and Satpura. Several genetic classifications have been attempted reflecting divergent interpretation of the tectono-stratigraphic make-up of different parts of the Peninsular shield – [A Manual of the Geology of India ,Vol. 1, Pt. 1, Spl. Pub. No. 77,Geol. Surv. Ind., (2006)]. The basement and crust i.e granites of the middle to late Archaean age are tonalite-trondhjemite-granodiorite (TTG) suites Swami Nath and Ramakrishnan (1981); Naqvi et al. (1983);Rama Rao and Divakara Rao (1994). The Closepet granite of the Indian sub-continent rich in K has been formed during the Archean to Palaeoproterozoic. Radhakrishna (1956); Friend (1984); Divakara Rao et al. (1999); Jayananda and Mahabaleswar (1992); Jayananda et al (1995). The middle to late proterozoic granitic events are of local significance.The younger granite are meta-aluminous, alkali rich-calc-alkaline series ,I type and volcanic arc granites, syn-collision to late orogenic.

Geochemically, the tectonic setting of granite can be inferred clearly through geochemistry. In this paper we describe the geology and geochemistry of a granitic body that intrude into the older gneissic rock (Peninsular Gneissic Complex).

The area under study forms a part of the Eastern Dharwar craton located within the state of Telangana.They area bounded by Latitudes 16°54'00" to 17°11'00" and Longitudes 79°35'00" to 79°50'00" adjoining the Suryapet town of Nalgonda district [fig 1(a,b)].

Geologic setting

Geology of the Dharwar craton has been synthesized and summarize (Swaminath and Radhakrishnan (1981); Naqvi (1981); Radhakrishna,(1983); Radhakrishna and Naqvi (1986); Naqvi and Rogers (1983,1987); Rogers (1996);Naqvi (2005). The Dharwar Province is essentially a granite-greenstone terrain characterized by a number of NNW-SSE trending belts of schistose rocks separated by granitic terrains. The Province is divisible into western and eastern parts along a major shear zone west of the Closepet Granite [A Manual of the Geology of India,Vol. 1, Pt. 1, Spl. Pub. No. 77,Geol. Surv. Ind.,(2006)]. The Eastern Dhawar Craton (EDC) based on the lithological assemblage and its environment of emplacement or geodynamic setting is described an intra-oceanic [Manikyamba et al.(2004,2005); Naqvi et al.,(2006)].It is separated from the Western Dharwar Craton (WDC) by Closepet granite ,Radhakrishna (1956). The EDC comprised different type of granites. The state of Telangana geologically is located in the southeastern corner of the Precambrian shield. It can be physiographically divided into the Deccan plateau and the Gondwana graben. The Deccan plateau is characterized by the basalts seen bordering the western margin and the rest of the area is predominantly occupied by the granite/gneiss variants of the Peninsular Gneissic Complex. The Gondwana graben hosts the entire Gondwana sequence.However, the present study area forms a part of the Peninsular Gneissic Complex- II.

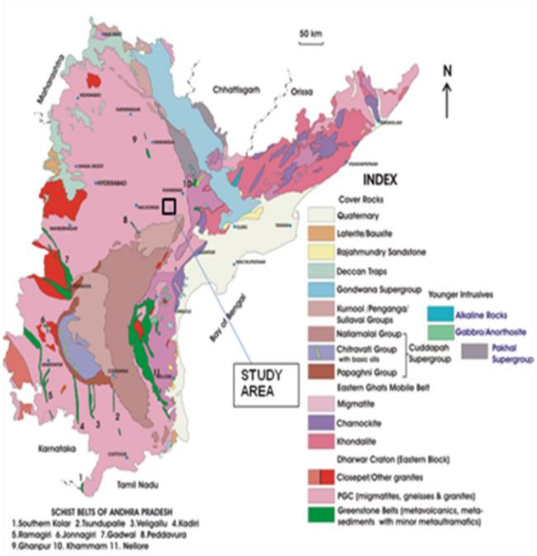

Figure 1 a: Geological map indicating the study area.

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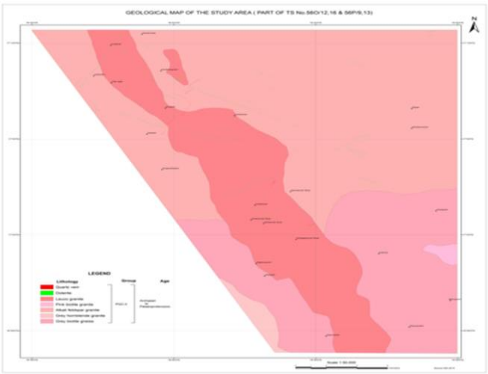


Figure 1b : Geological map of part of Nalgonda district,Telangana,India.

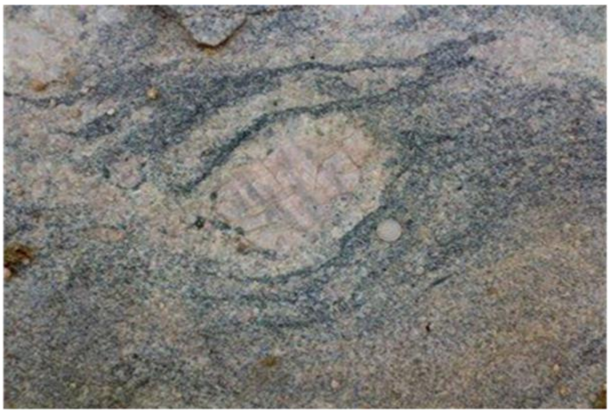
Petrography

Generally the granitoid rocks of the Peninsular Gneissic Complex show equigranular, or hypidiomorphic texture .The leucogranite of the area in and around Suryapet are inequigranular, medium to coarse grained, porphyritic and allotriomorphic in nature.The essential constituents are quartz, K-feldspar (orthoclase,microcline), plagioclase feldspar and minor amount of biotite, apatite and opaques. Microcline is predominant over orthoclase . The microcline phenocrysts have inclusions of quartz and twinned plagioclase with occasional alkali feldspar.The groundmass is composed of quartz, alkali feldspar, plagioclase and biotite with feldspars partially sericitised. The microcline grains at few places are perthitic,partially altered with altered core and comparatively fresh rim. Muscovitisation and chlorotisation of K-feldspar is observed at places.The plagioclase exhibits perthitic texture and the presence of primary biotite is an evidence for its magmatic source. Secondary muscovite is present as an alteration product of K-feldspar and chlorite. Most of the quartz grains exhibit undulose extinction. The K-feldspar are highly sericitised and contain perthitic lamellae and the contact of plagioclase and K-feldspar is myrmekitic in nature. Recrystallised biotite is present in minor amounts with zircon and opaques as accessories. Thin recrystallised zonation of quartz grains is observed within the phenocrysts display undulose extinction.It is noticed that even the K-feldspar phenocrysts have been marginal recrystallised. The K-feldspar is partially replaced by chlorite,titanite(sphene) and biotite along the fractures. Replacement of K-feldspar by the muscovite and chlorite is observed where the grain boundary is recrystallised.

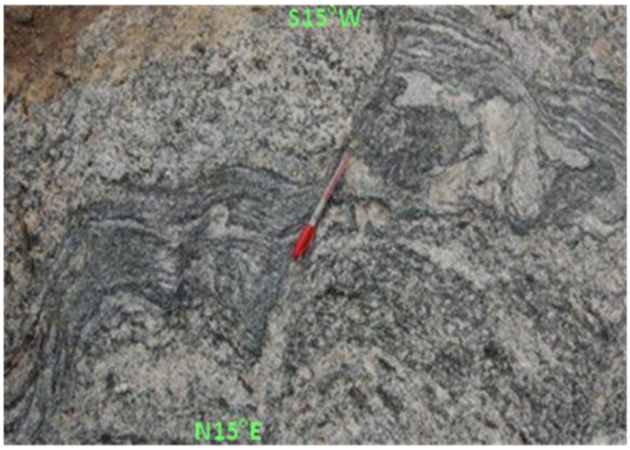
Deformation

The undulose extinction observed in K-feldspar also implies marginal deformation. Anastomosing micro-shear zones defined by very fine grains are noticed indicating deformation at high temperature conditions. The plagioclase grains exhibit imprints of both brittle and ductile deformation and the alkali feldspar that exhibits undulose extinction suggests ductile deformation and the evidence of brittle deformation are reflected in the form of recrystallisation. The plagioclase is partially altered and evidence of brittle deformation in the form fracturing and displacement of lamellae, also the alkali feldspar (albitic) phenocrysts exhibits recrystallised deformation bands at few places. And the evidence for ductile deformation is clearly exhibited by the presence of bent and twinned lamellae. Formation of secondary chlorite and epidote (zoisite) in altered plagioclase is observed. Perthitic lamellae and patchy albitic replacement are also seen . Evidences for brittle ductile shear in the form of recrystallised grains along the periphery of grains is noticed.

The granite is highly deformed with deformed quartz rich bands with wavy extinction.A few grains of quartz are elongated .It is characterized by alternate bands of quartz and altered feldspar and biotite. Sericitisation of plagioclase is observed. The biotite is partially chloritised.The microcline phenocryst exhibits perthitic structure and are deformed with wavy extinction where the micro shears criss-cross the phenocrysts. The plagioclase grains are altered in most places and the evidence of deformation are noticed. Brittle ductile domain where fine recrystallized grain along orthoclase boundary is observed.



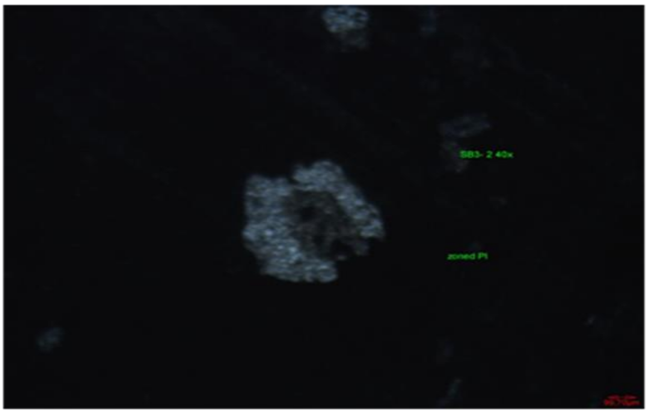
Field Photo 1: Flow texture of the fabric, where syntectonic movement is noticed. Enrichment of biotite at places occurs. Migmatisation of magma is evidenced SW of Undrakonda (N17°05'.724",E79°41'.512")



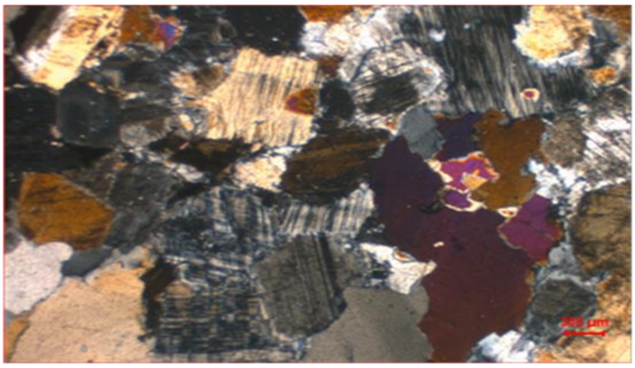
Field photo 2: 79°48'28.9";17°05'17.1"- Ductile shear is evidence by displacement of the gneissic bands.The shear plane is N15°E to S15°W

Field photo 3: Pirla Bodu (79°46'20.4";16°59'26.1") Minor displacement of the pegmatite vein evidence of ductile shear.

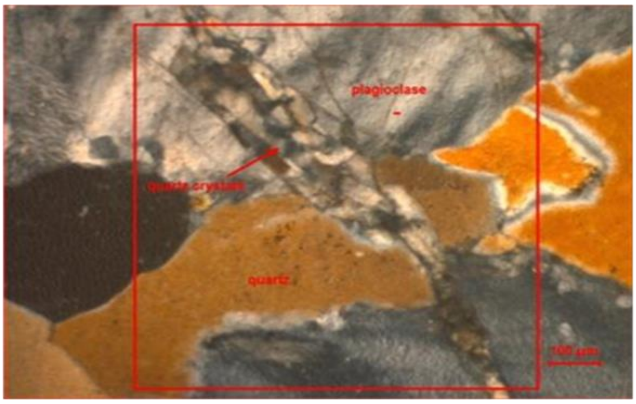
Field photo 4: At Pirla Bodu (79°46'20.4";16°59'26.1") Pegmatite intrusion /injection trending N15°W to S15°E



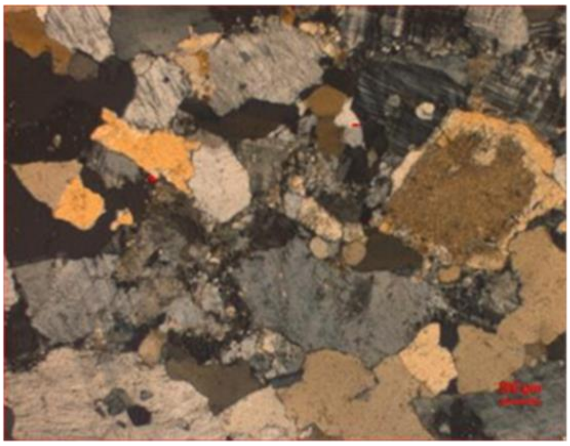
Photomicrograph 1: Zoned plagioclase -1 Km south of Durajpalli (79°39'33.1";17°07'17.7")



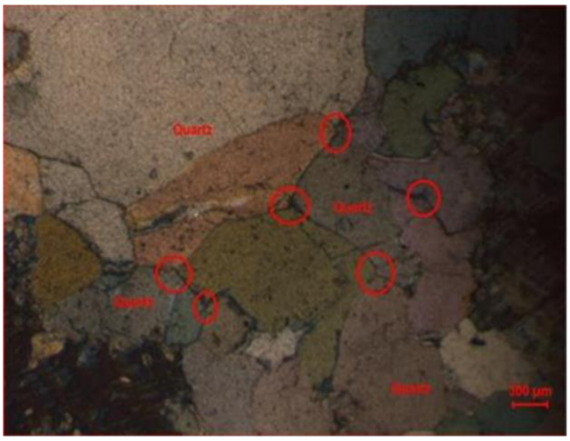
Photomicrograph 2: Perthitic texture and lamellae twinning displayed by feldspars- 2.5 Km SW of Undrakonda (17°05'.72"; 79°41'.51") ,Dharmapur Gutta hill no.414



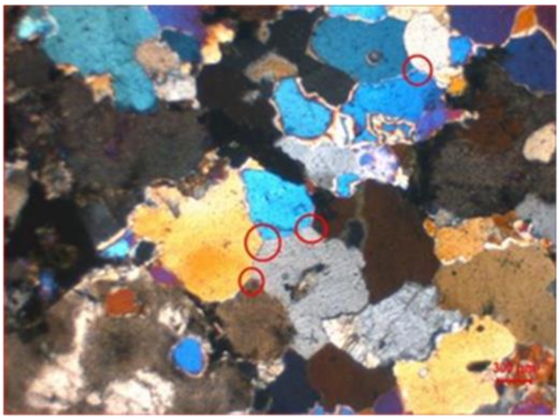
Photomicrograph 3: Fractures are seen on the feldspar grains and are intruded by quartz grains.1 Km south of Durajpalli. (79°39'33.1";17°07'17.7")



Photomicrograph 4: Groundmass of a leucogranite. East of Kadkada (79°37'54.5";17°09'56.3")



Photomicrograph 5: Triple point quartz grains indicates a pure igneous origin of the rock(Tirmalgiri:79°44'34.3";17°06'10.7")



Photomicrograph 6:Triple point between the contacts of the quartz grains signifies pure igneous origin for the rock. 1 Km south of Durajpalli (79°39'33.1";17°07'17.7")

Sampling and analytical techniques

A total 0f 70 samples from the granite body, enclaves and dyke were collected.36 thin sections were prepared and studied by optical microscopy. Sample weights were 1-1.5 kg before crushing and powdering. Major, minor and trace element abundances were determined by X'UNIQUE II (PHILIPS) X-ray spectrometry System at PPOD Lab, AMSE Wing, Geological Survey of India, Bangalore and Chemical Division, Geological Survey of India ,Southern Region, Hyderabad .Whereas the minor, trace and rare earth elements (REE) were carried out by ICP-MS Sciex Elan Model 6100 at Chemical Division, Geological Survey of India ,Southern Region, Hyderabad. The elements include SiO_2,Al_2O_3,Fe_2O_3,Mno, MgO,MnO,K_2O,Na_2O,TiO_2,P_2O_5,Be,Ge,As,Mo,As,Hf,Ta,W,Bi, U,La,Ce,Pr,Nd,Eu, Sm,Tb, Gd,Dy,Ho,Er,Tm,Yb,Lu.The result of the analyses are reported in Table 1 . Although alteration of plutonoic rocks is a common phenomenon in particular for proterozoic rocks, most of the anlysed samples showed only slightly or no substantial mobility during the late phase alteration of the plutonic rocks.This is inferred from moderate content of CaO and medium to high content of K_2O and the reliable loss of ignition (LOI) values. The granites are plotted on an Ab-An-Or diagram of O'Connor,(1965)-(fig 1). The data falls within the granite field,while few samples fall in the granidiorite field.

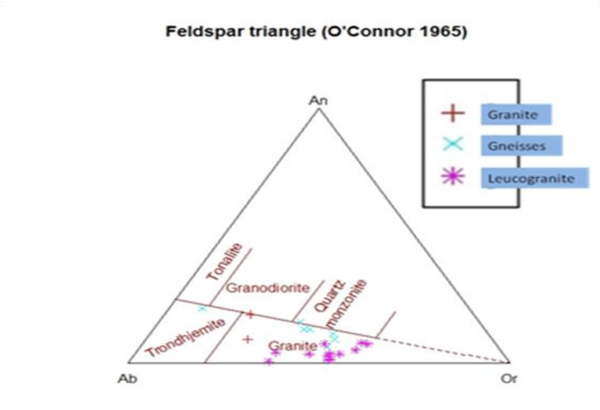
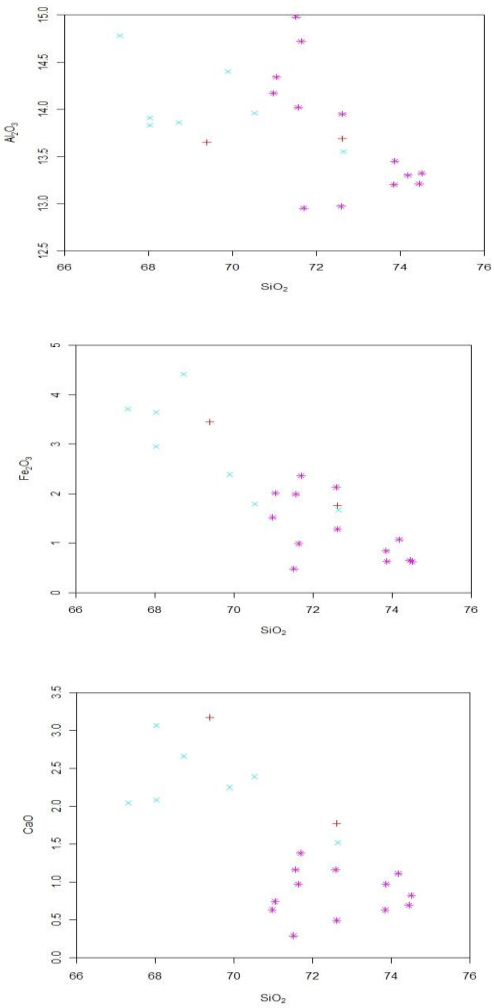


Fig 1: Ab-An-Or after O'Connor, 1965



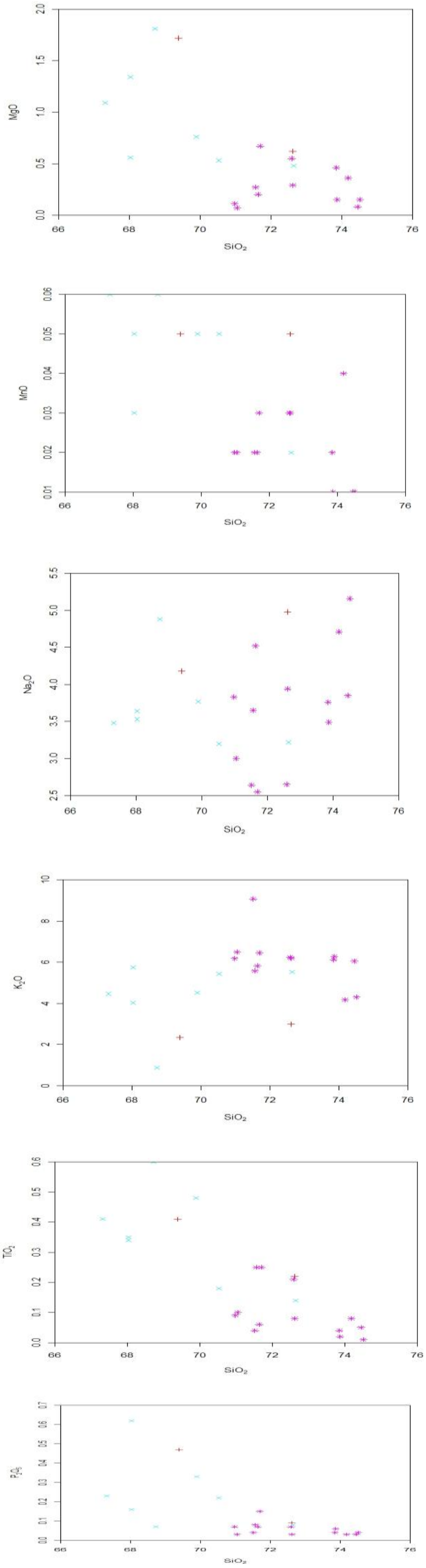
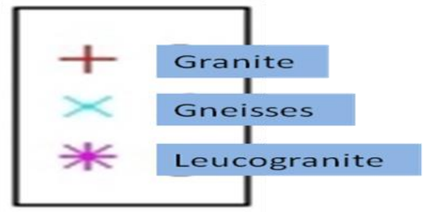


Fig. Harker variation diagram for the granite, part of Nalgonda district, a marked variation in the abundance of some major elements mostly in ranges of SiO2,Fe2O3, Al2O3, CaO, TiO2 and MnO.This variation suggest diverse protolith is directly correlated with the modal abundance of the main mineral phase



Classification/tectonic environment

Classification of the rock with total alkali silica (TAS), SiO2 vrs(K_2O+Na_2O) geochemical rock classification diagram of Cox et al (1979)-(fig 2) adapted by Wilson,1989 for plutonnic rocks shows the plots to fall mostly in the acid field or to be more specific ,mostly they fall in grannite field and very few bordering the granodiorite and syenite field. The solid curve line sub-dividing the alkaline from the subalkaline rocks figure .After plotting the TAS vrs Silica by Middlemost (1994)-(fig 4),the plots fall in the granite field but two plots of the area 4 Km east of appanapeta are falling in the granodiorite field.As per the FeO-K_2O+Na_2O-MgO plot (fig 7), it is clear that the rock is rich in K_2O+Na_2O which means it is an alkali granite.The AFM plot after Irvine and Baragar (1971)-(fig 3) suggests the magma to be of Calc-alkaline in nature.When the major Oxides data were plotted in the R1-R2 diagram of De La Roche et al (1980)-(fig 8) which is based upon the cation proportions expressed as millications on an X-Y bivariate graph using the plotting parameters R1& R2 where R1 is plotted along the X-axis and is defined by R1=4Si-11(Na+K)-2(Fe+Ti) and Fe represents the total Fe while the R2 is plotted along the Y-axis and is defined as R2=(Al+2Mg+6Ca), the plots fall in the granite to alkali granite field.

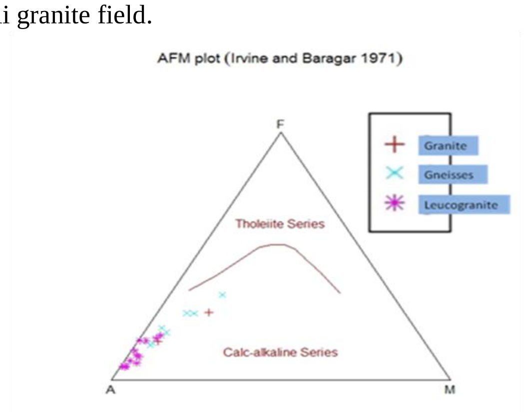


Fig 3: AFM plot after Irvine and Baragar,1971.

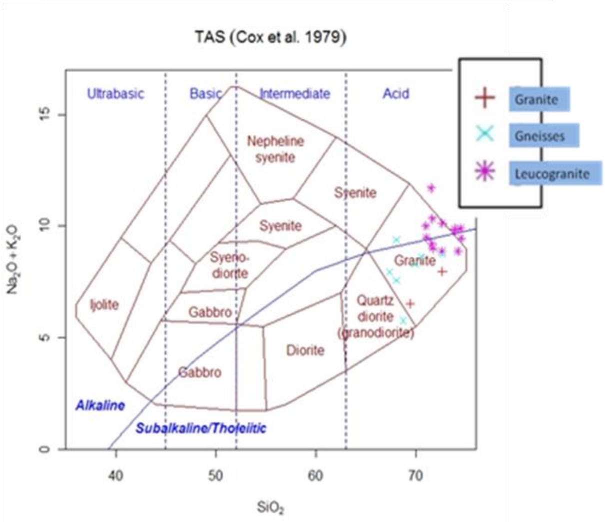


Fig 4: SiO2 vrs Na_2O+K_2O TAS after Cox et al.,1971

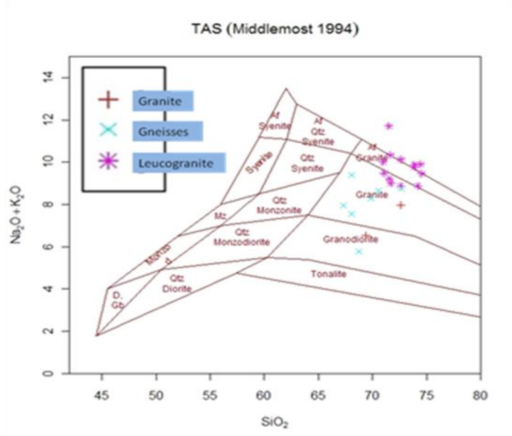


Fig 5: SiO2 vrs Na_2O+K_2O after Middlemost 1994

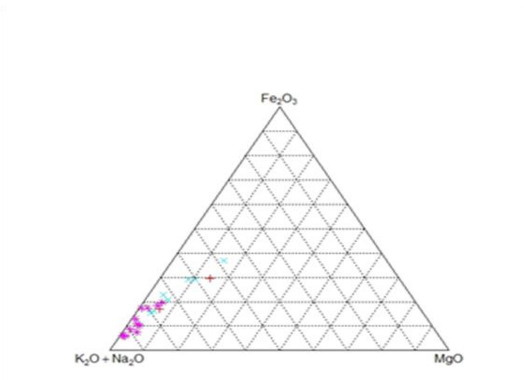


Fig 7: FeO- Na_2O+K_2O -MgO plot

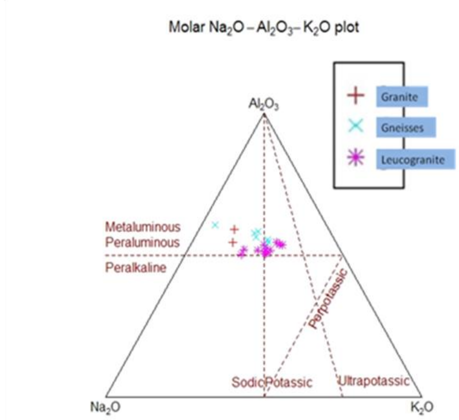


Fig 6: Molar Na_2O-Al_2O_3-K_2O plot

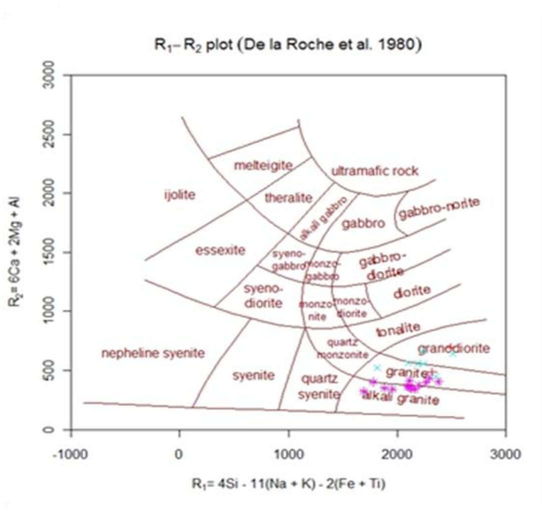


Fig 8: R1-R2 diagram of De La Roche et al (1980)

Table 1

Sample	RS10	S23	S27A	S35B	S15	S25A	S27B	S24	S31	S35A	S39	S42	S46	S47B	S9	S12	S16	S18	S32	S36	S14B	S43
Lithology	biotite gneiss	granite gneiss	Grey granite	Grey granite	Grey granite gneiss	Grey granite gneiss	grey granite gneiss	leuco granite	leuco granite	leuco granite	leuco granite	leuco granite	leuco granite	leuco granite	Leuco granite	Leuco granite	Leuco granite	Leuco granite	Leuco granite	Leuco granite	Por phyritic gneiss	Por phyritic gneiss
SiO2	68.03	70.51	69.38	72.61	67.31	68.03	68.72	74.44	72.58	73.84	71.63	72.61	73.86	74.51	71.51	71.69	71.04	74.18	71.56	70.97	72.64	69.89
Al2O3	13.91	13.96	13.65	13.69	14.78	13.83	13.86	13.21	12.97	13.20	14.72	13.95	13.45	13.32	14.98	12.95	14.34	13.30	14.02	14.17	13.55	14.40
Fe2O3	3.65	1.79	3.45	1.76	3.71	2.95	4.42	0.65	2.13	0.84	0.99	1.28	0.63	0.62	0.48	2.36	2.01	1.07	1.99	1.52	1.67	2.39
MnO	0.05	0.05	0.05	0.05	0.06	0.03	0.06	0.01	0.03	0.02	0.02	0.03	0.01	0.01	0	0.03	0.02	0.04	0.02	0.02	0.02	0.05
MgO	1.34	0.53	1.72	0.62	1.09	0.56	1.81	0.08	0.55	0.46	0.20	0.29	0.15	0.15	<0.01	0.67	0.07	0.36	0.27	0.11	0.48	0.76
CaO	3.07	2.39	3.17	1.77	2.04	2.08	2.66	0.69	1.16	0.63	0.97	0.49	0.97	0.82	0.29	1.38	0.74	1.11	1.16	0.63	1.52	2.25
Na2O	3.53	3.20	4.18	4.98	3.48	3.64	4.88	3.85	2.65	3.76	4.52	3.94	3.49	5.16	2.64	2.55	3	4.71	3.65	3.83	3.22	3.77
K2O	4.02	5.44	2.33	2.98	4.46	5.74	0.88	6.05	6.23	6.12	5.82	6.19	6.28	4.30	9.07	6.45	6.49	4.17	5.57	6.18	5.53	4.52
TiO2	0.35	0.18	0.41	0.22	0.41	0.34	0.60	0.05	0.21	0.04	0.06	0.08	0.02	0.01	0.04	0.25	0.1	0.08	0.25	0.09	0.14	0.48
P2O5	0.62	0.22	0.47	0.09	0.23	0.16	0.07	0.03	0.07	0.04	0.07	0.03	0.06	0.04	0.04	0.15	0.03	0.03	0.08	0.07	0.08	0.33
LOI	0.69	1.19	0.63	0.64	1.09	1.66	1.40	0.41	0.87	0.40	0.52	0.57	0.45	0.48	0	0.86	0.64	0.45	0.77	0.78	0.46	0.65
La	278.41	80.55	71.87	59.40	38.21	29.93	75.30	4.83	55.54	22.21	9.51	17.65	8.04	10.98	6.63	31.87	37.97	44.93	16.41	11.62	59.64	79.87
Ce	522.60	137.66	126.36	103.73	76.01	50.94	142.99	9.17	111.70	44.29	17.77	42.90	13.80	19.68	11.76	57.90	67.80	88.10	29.61	22.28	108.41	139.48
Pr	56.56	12.91	13.78	10.85	9.17	5.22	15.51	1.04	12.45	5.02	1.88	4.64	1.49	1.99	1.14	6.14	7.32	9.72	3.11	2.28	13.21	14.08
Nd	186.50	39.94	49.38	37.63	35.13	17.32	52.50	3.95	42.60	17.59	6.19	17.18	5.04	6.57	3.99	20.39	25.56	32.62	10.58	7.93	48.91	45.02
Eu	2.09	1.13	1.95	0.87	1.21	0.41	0.81	0.16	0.90	0.32	0.25	0.24	0.53	0.17	0.37	0.60	0.81	0.33	0.73	0.37	1.32	1.41
Sm	29.77	4.69	8.65	7.05	10.50	3.23	9.84	1.47	8.76	3.67	1.65	5.71	1.32	1.85	1.13	5.00	4.78	6.32	2.26	1.90	10.74	6.72
Tb	2.46	0.31	0.89	0.84	2.45	0.40	1.21	0.53	1.27	0.35	0.45	1.96	0.29	0.67	0.34	1.31	0.41	0.62	0.29	0.33	1.41	0.53
Gd	19.62	2.83	6.38	5.44	10.76	2.45	7.17	2.11	6.98	2.60	1.78	8.11	1.25	2.53	1.27	5.39	3.23	4.43	1.71	1.68	8.84	4.39
Dy	9.40	1.10	4.09	4.34	16.13	2.11	6.38	3.96	7.12	1.59	3.49	14.91	1.80	4.98	2.67	9.79	1.63	2.94	1.59	2.10	7.54	1.78
Ho	1.49	0.19	0.70	0.82	3.39	0.40	1.28	0.99	1.46	0.28	0.86	3.81	0.40	1.28	0.67	2.33	0.28	0.55	0.34	0.46	1.54	0.25
Er	3.04	0.44	1.60	2.05	8.95	1.06	3.45	3.06	4.05	0.68	2.63	11.78	1.08	3.93	2.17	6.72	0.66	1.30	0.91	1.30	3.74	0.41
Tm	0.40	0.11	0.28	0.36	1.59	0.20	0.64	0.64	0.74	0.10	0.55	2.28	0.18	0.77	0.44	1.15	0.13	0.23	0.16	0.25	0.77	0.05
Yb	2.08	0.86	1.61	1.92	9.19	1.07	4.06	4.15	4.55	0.57	3.44	13.60	1.03	4.69	2.86	6.02	0.86	1.38	0.94	1.65	3.89	0.28
Lu	0.29	0.14	0.23	0.26	1.27	0.15	0.63	0.64	0.63	0.08	0.51	2.05	0.13	0.68	0.40	0.83	0.15	0.19	0.15	0.25	0.54	0.04
Be	3.97	1.96	4.88	6.40	1.75	2.17	5.78	2.21	2.10	2.78	2.84	2.98	2.87	3.24	1.91	2.86	3.43	5.22	1.86	3.37	2.21	2.17
Ge	1.31	1.02	1.13	1.17	1.06	1.10	1.15	1.23	1.16	1.13	1.17	1.27	1.06	1.11	1.12	1.10	1.07	1.24	1.09	1.16	1.21	1.02
Hf	10.00	5.67	4.74	6.93	4.03	3.18	11.51	1.65	8.17	2.75	2.99	4.26	2.16	1.74	3.60	2.55	5.67	3.89	4.32	5.34	6.25	4.34
Ta	0.80	0.68	2.04	0.86	1.09	0.99	2.21	0.61	1.63	0.43	0.89	0.54	0.28	1.64	0.31	0.30	0.90	0.70	0.35	0.60	0.98	1.09
Bi	0.11	0.10	0.31	0.10	0.11	0.17	0.27	0.12	0.10	0.10	0.17	0.38	0.61	1.28	0.10	0.16	0.13	0.24	0.12	0.48	0.10	0.10
U	20.32	3.74	18.93	36.32	8.47	20.63	21.67	19.80	78.18	10.84	28.44	57.04	15.90	21.40	16.72	9.05	17.64	34.45	22.71	62.13	28.14	4.46

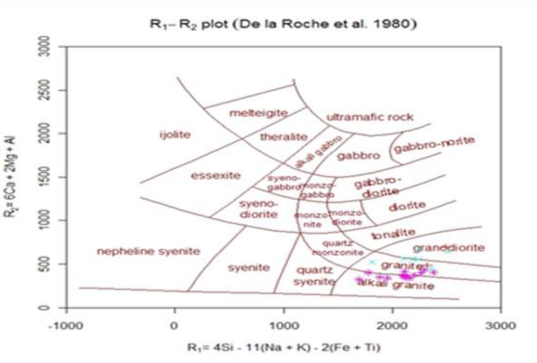


Fig 8: R1-R2 diagram of De La Roche et al (1980)

When the granite data was plotted on a Ta vrs Yb diagram using the composition and discriminant fields of pearce et al (1984)- (fig 9) they fell in the Volcanic Arc Granite field and few plots in the syn-collision granite field.

The same data i.e K_2O-Fe_2O_3 vrs SiO_2 and Fe_2O_3 vrs MgO. When plotted in Maniar and Piccoli,(1989)-(fig 10) which is primarily a major element based on geotectonic classification,it occupied the Island Arc Granite(IAG) + Continental Arc Granite (CAG) + Continental Collision Granite (CCG).

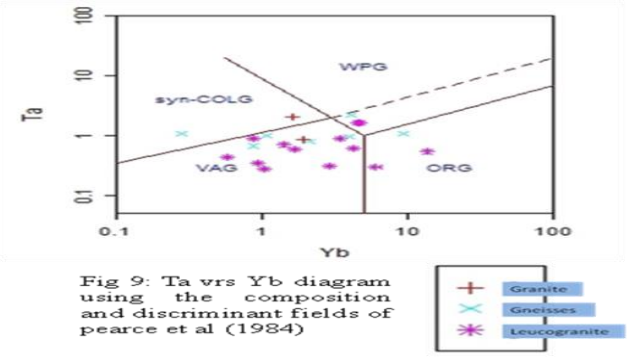


Fig 9: Ta vrs Yb diagram using the composition and discriminant fields of pearce et al (1984)

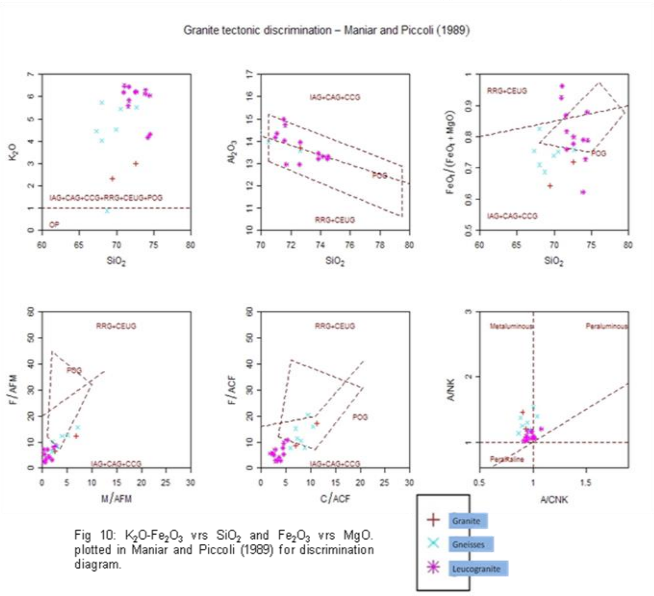


Fig 10: K_2O-Fe_2O_3 vrs SiO_2 and Fe_2O_3 vrs MgO. plotted in Maniar and Piccoli (1989) for discrimination diagram.

Rare earth elements (REE)

The REE pattern of the igneous rock is controlled by the REE chemistry of its source and the crystal melt equilibrium which have taken place during its evaluation. Characteristic chondrite normalised REE pattern of granite shows strong negative Eu anomaly suggesting early separation of plagioclase by Nakamura (1974)- (fig 11).

On a spider diagram multi element profiles normalised to primitive mantle as per Sun & Macdonough (1989)- (fig 12),the Suryapet granite has patterns showing volcanic arc granite such as the enrichment of Large Ion Lithophile Elements (LILE) ba,Sr,Rb,Ce relative to Hgh Field Strength elements(HFSE) and Heavy Rare Earth elements(HREE) Nb,Zr,Ti,Y and Yb.This is similar to typical patterns for volcanic arc granites.They point to the enrichment of Ce and Sm in Calc-alkaline and Shonshonitic Series and also to low value of Y and Yb relative to the normalising composition in the volcanic arc granites. The enhanced level of LL element relative to HFS element in Suryapet granite points to the subduction zone enrichment and/or crustal contamination of the source region as per Pearce et al (1984)- (fig 9).The patterns indicate moderately fractionated LREE and poorly fractionated HREE (fig 12)

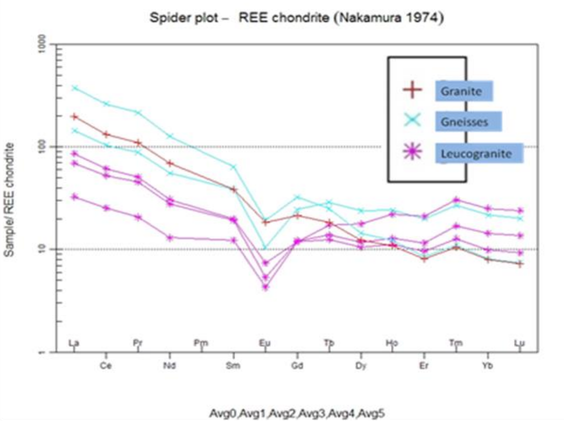


Fig 11:Chondrite normalized rare earth element patterns of the granite,part of Nalgonda district,after Nakamura,1974

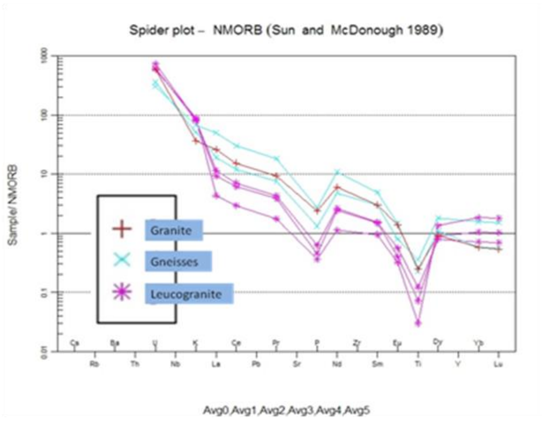


Fig 12:Normalized primitive mantle rare earth element patterns of the granite,part of Nalgonda district,after Sun and Mcdonough,1989.

Summary and conclusions

From field evidences, a flow texture of the fabric, where syntectonic movement is noticed. Enrichment of biotite at places occurs and migmatisation of magma is evidenced . Ductile shear is evidence by displacement of the gneissic bands.And through thin section studies, the deformation like bending of plagioclase and recrystallisation of quartz grains are clearly onserved. Due to the presence of many fresh quartz grains and their triple point contact, this suggest that the source of the rock is purely igneous magmatic origin. The granites plotted on an Ab-An-Or diagram (O'Connor,1965) in fig 1, falls within the granite field. Based on classification of the rock with total alkali silica (TAS), SiO_2 vrs(K_2O+Na_2O) geochemical rock classification diagram of Cox et al (1979)- (fig 4),adapted by Wilson,1989 for plutonic rocks, mostly they fall in granite field and very few bordering the granodiorite and syenite field.And the TAS vrs Silica by Middlemost (1994)-(fig 5), the plots fall in the granite field but two plots of the area 4 Km east of appanapeta are falling in the granodiorite field. As per the FeO-K_2O+Na_2O-MgO plot (fig 7), it is clear that the rock is rich in K_2O+Na_2O which means it is an alkali granite. The AFM plot after Irvine and Baragar (1971)-(fig 3), suggests the magma to be of Calc-alkaline in nature.The major Oxides plotted in the R1-R2 diagram of De La Roche et al (1980)-(fig 8), fall mostly in the granite field except few which fall at the periphery of alkali granite and granodiorite.

Ta vrs Yb diagram using the composition and discriminant fields of pearce et al (1984)- (fig 9) ,they fell in the Volcanic Arc Granite field and few plots in the syn-collision granite field.The same data i.e K_2O-Fe_2O_3 vrs SiO_2 and Fe_2O_3 vrs MgO when plotted in Maniar and Piccoli (1989)-(fig 10) which is primarily a major element based on geotectonic classification,it occupied the Island Arc Granite(IAG) + Continental Arc Granite (CAG) + Continental Collision Granite (CCG).

Characteristic chondrite normalised REE pattern of granite shows strong negative Eu anomaly suggesting early separation of plagioclase as per Nakamura (1974)- (fig 11). And with normalised to primitive mantle by Sun & Macdonough (1989)-(fig 12),the granite has patterns showing volcanic arc granite. Also, the enhanced level of LL element relative to HFS element in Suryapet granite points to the subduction zone enrichment and/or crustal contamination of the source region by Pearce et al (1984) - (fig 9).

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References

Boynton, W.V. (1984). Cosmochemistry of the rare earth elements; meteorite studies. In: Rare earth element geochemistry. Henderson, P. (Editors), Elsevier Sci. Publ. Co., Amsterdam. 63-114Cox, K.G., Bell, J.D., Pankhurst, R.J., 1979. The Interpretation of Igneous Rocks. George Allen and Unwin, London, p. 450.

De La Roche, H., Leterrier, J., Grandclaude, P. & Marchal, M. (1980). A classification of volcanic and plutonic rocks using R1R2-diagram and major element analyses – its relationships with current nomenclature. Chemical Geology 29, 183–210.

Friend, C.R.L. and Nutman, A.P. (1991). SHRIMP U-Pb Geochronology of the Closepet Granite and Peninsular Gneiss, Karnataka, South India. J. Geol. Soc. India 38, 357-368.

Irvine, T. N. & Baragar, W. R. A. (1971). A guide to the chemical classification of the common volcanic rocks. Canadian Journal of Earth Sciences 8, 523–548.

Jayananda, M., Martin, H. and Mahabaleshwar, B. (1992). The mechanisms of recycling of Archean continental crust: example of the Closepet granite, southern India. Proc. 3"I In. Archean Symp.,Perth. 2 13-222.

Jayananda, M., Martin, H., Peucat, J.-J. and Mahabaleshwar, B. (1995). Late Archean crust-mantle interactions: geochemistry of LREE-enriched mantle derived magmas. Example of Closepet batholith, southern India. Contrib. Mineral. Petrol. 1 19,3 14-329.

Lett. 230, 65–83,Maniar, P.D., Piccoli, P.M., 1989. Tectonic discrimination of granitoids. Geological Society of America Bulletin 101, 635–643.

Manikyamba, C., Kerrich, R., Naqvi, S.M., Ram Mohan, M., 2004. Geochemical systematics of tholeiitic basalts from the 2.7 Ga Ramagiri-Hungund composite greenstone belt, Dharwar Craton.Precambrian Res. 134, 21–39.

Manikyamba, C., Naqvi, S.M., Rao, D.V.S., Ram Mohan, M., Khanna,T.C., Rao, T.G., Reddy, G.L.N., 2005. Boninites from the Neo-archaean Gadwal greenstone belt, Eastern Dharwar craton, India: implications for Archaean subduction processes. Earth Planet. Sci. Letters 230 (1), 65-83

Middlemost, A.K.: 1994, Naming materials in the magma/igneous rock system. Earth-Sci. Reviews 37, 215–224.

Nakamura, N., 1974. Determination of REE, Ba, Mg, Na and K in carbonaceous and ordinary chondrites. Geochim. Cosmochim. Acta 38, 757-775.

Naqvi, S.M., 1981. The oldest supracrustals of the Dharwar Craton, India. J. Geol. Soc. India 22 (10), 458–469.

Naqvi, S.M., 2005. Geology and Evolution of the Indian Plate (From Hadean to Holocene—4 Ga to 4 Ka). Capital Publishing Company,New Delhi, pp. 450.

Naqvi, S.M., Khan, R.M.K., Manikyamba, C., Ram Mohan, M.,Khanna, T.C., 2006. Geochemistry of the Neo Archaean high-Mg basalts, boninites and adakites from the Kushtagi-Hungund greenstone belt of the eastern Dharwar craton (EDC); implications for the tectonic setting. J. Asian Earth Sci. 27, 25–44.

Naqvi, S.M., Rogers, J.J.W., 1983. Precambrian of South India (based on the Proceedings of the Indo-U.S.Workshop held at Hyderabad,January 12–14, 1982), vol. 4, Geological Society of India, Memoir, p. 575.

Naqvi, S.M., Rogers, J.J.W., 1987. Precambrian geology of India. In: Oxford Monographs on Geology and Geophysics No. 6. Oxford University Press, New York, pp. 223.

O'Connor, J. T. (1965). A classification for quartz-rich igneous rocks based on feldspar ratios. In: US Geological Survey Professional Paper B525. USGS, 79–84

Pearce, J.A., Harris, N.B.W., Tindle, A.G., 1984. Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. Journal of Petrology 25, 956–983.

Radhakrishna, B.P., 1956. The Closepet Granite of Mysore State, India.Mysore Geological Association (Bangalore) Special Publication, 3, 110 p.

Radhakrishna, B.P., 1983. Archaean granite-greenstone terrain of south Indian shield. In: Naqvi, S.M., Rogers, J.J.W. (Eds.), Precambrian of South India, vol. 4. Geological Society of India, Memoir, pp.1–46.

Radhakrishna, B.P., Naqvi, S.M., 1986. Precambrian continental crust of India and its evolution. J. Geol. 94, 145–166.

Rogers, J.J.W., 1996. A history of continents in the past three billion years. J. Geol. 104, 91–107.

S M Naqvi,J G Rana Prathap 2007.Geochemistry of adakites from Neoarchaean active continental margin of Shimoga schist belt,Western Dharwar Craton, India:Implications for the genesisnof TTG. Precambrian Research,v.56 (2007) 32–54

S M Naqvi,M Ram Mohan,J G Rana Prathap,D Srinivasa Sarma 2009.Adakite-TTG connection and fate of mesoarchaean basaltic crust of Holenarsipur nucleus,Dharwar craton,India.Jour. of Asian earth Sciences, 35(2009), pp 416-434.

Sun, S.S., McDonough, W.F., 1989. Chemical and isotopic systematic of oceanic basalts: implications for mantle composition and processes. In: Saunders, A.D., Norry, M.J. (Eds.), Magmatism in Ocean Basins, vol. 42. Geological Society Special Publication, 313–345.

Swaminath, J., Ramakrishnan, M., 1981. Early Precambrian supracrustals of Southern Karnataka. Geol. Surv. India Memoir 112, 351 p.

V.Divakara Rao,P Rama Rao and MV Subba Rao 1999.The Ghingee grannite,Tamilnadu,South India: Geochemistry and petrogenesis,Gondwana Research, V.2.,No 1,pp 117-126.

Wilson, M. 1989. Igneous Petrogenesis. London: Unwin Hyman.

A Manual of the Geology of India
Vol. 1, Pt. 1, Spl. Pub. No. 77,Geol. Surv. Ind., 2006)