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Geology, Mineralogy, Petrography and Geochemistry of Amgaon Granite at Khursipar, Manegaon, Dahegaon Villages in Gondia District, Maharashtra, India

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Abstract

The rocks of the area belong to the early Precambrian, Amgaon Group and overlying Dongargarh Supergroup. They consist of granite gneisses and granite and area covering soil mantle. Physiographically the area is gently undulating developed on granitic gneiss and granite.Titanomagnetite deposit in the Khursipar-Dahegaon-Manegaonvillage is mainly associated with alternate bands of granite,epidorite,granitic gneiss and gabbroic rock. Massive magnetite, ore body flanked by foliated gabbro,disseminated, lensoid massive magnetite is exposed in small patch, small isolated magnetite lenses, disseminated ore in gabbroic rocks, massive or band passes into band ores. The principal iron mineral is hematite while ilmenite is main titanium bearing mineral goethite, magnetite are noticed in minor amounts. Microscopic studies show that orthorhombic pyroxenes are having straight extinction and stronger Pleochroism along with prismatic cleavages in perfect two directions at 90°.

Hornblende is the principal mineral of amphibolites. Its cleavage angle at 56° and 124°. It is opaque green, greenish brown or brown in colour.Ilmenite is a weekly magnetic Titanium-iron oxide mineral which is iron- blackor steel-grey. It is a crystalline iron titanium oxide ($FeTi_3$). It crystallizes in a trigonal system.Magnetite is black or brownish-black in colour. Magnetite reacts with oxygen to produce hematite.The granite around Khursipar and Manegaon areas are oversaturated, the average content of SiO_2 is 72.05 which are ranges from 70.45 to 73.45%. The

bivariant plot of SiO_2 verses mostof the major oxides show negative correlation whereas only MgO show slightly positive trend. The composition of all pure quartz is close to the 100 percent SiO_2. The Mineral chemistry of Quartz of studied granite shows SiO_2 content is 100%. The potash feldspar of granites is either Orthoclase or Microcline, or both. Orthoclase, Sanidine, Microcline and Anorthoclase.Nephelene of this granite show very high content of SiO_2. Which is ranges from 56.82 to 59.6 along with moderate content of Al_2O_3(27.8 to 30.1) Na_2O of this nephelene show (4.9 to 5.9) wt %). Whereas fair amount of K_2O (4.2 to 5.3 wt %). Manegaon, Khursipar granite contains of accessory amount of orthopyroxene (hypersthenes). SiO_2content of hypersthenes show very wide range (32.4 to 59.6 wt %). The average content of Fe_2O_3 is 19.4 whereas MgO ranges from 9.2 to 18.7%, along with it show few content of CaO (3.8) also. Hypersthenes of this granite show 1.5 % of Na_2O with very little content of MnO and K_2O. Magnetite of this study contains cent % composition of Fe_2O_3(98.7%) which is range from 98.1 to 99 %. The remaining elements are Al_2O_3 andK_2O. The diagnostic characteristics of this magnetite is it content of V_2O_5 (0.4 to 0.9 wt %). In Ilmenite average TiO_2 concentration is 43.12 which is having wide range *i.e*. 35.0 to 48.88 similarly it is having Fe_2O_3 which is ranges from 49.9 to 51.8 and average content is 50.75 wt %. As per the standard it shows MgO and MnO also ranges 0.45 to 0.29 respectively.

Key words: Dongargarh Supergroup, Titanomagnetite, Trigonal System, Pleochroism.

Introduction

Khursipar, Manegaon and Dahegaon areas belong to early Precambrian Group which forms basement which is known as Sakoli triangle and falls in the Toposheet no. 64 C/3 and C/7. Physiographically the area is gently undulating which comprises granite gneiss and granite covered by alluvium. The rocks of the area belong to early Precambrian, Amgaon Group and overlying Dongargarh Super Group[2,10,12-14]. These consist of granite gneisses and granite, which are traversed by numerous dykes of metabasic nature. The Amgaon and Sakoli Group are separated by NNE-SSE Pangri-Gumdoh fault[11]. The character and relation of the rocks in this part of the shield are indicated by the following geological column worked out by Sarkar, (1957 and Modified in 1980).

The rocks of the Amgaon Group extend north-eastwards in Toposheet 64/7 and southward in 64/4 Deshpande[4] and Chatterjee[3]. The shape of the Sakoli basin is more or less triangular it forms a synclinorium with its axis

plunging towards SW [12,13]. The triangular shape of the Sakoli outcrop was first recorded and referred to as "Bhandara triangle" by Bhattacharjee[1]. The rocks show various types of textures like blastoophitic, spinifex, intergranular, interlocking *etc*. [7]. The lenses and layers of massive Fe-Ti oxide emplaced along a narrow rectilinear zone which marks the contact between granite and granitic gneiss[5,16]. The unique feature of these oxide ores and associated intrusive rocks is their magmatic origin[6,8].

Geological Setup :

The rocks of the area belong to the early Precambrian, Amgaon group and overlying DongargarhSupergroup[2]. They consist of granite and gneisses. The characterization and of the rocks in this part of the shield are indicated by the following geological column worked out by Sarkar,[12] (1957) and Modified in 1980).

Table 1. Generalized Stratigraphic succession of Khursipar area

(Sarkar S. N. (1957)

Chhattisgarh supergroup	Raipur GroupChandrapur Sandstone
----------Unconformity----------	
Khairagarh group	Khairagarhorogenic phase (C.900 Ma?) Mangikhuta Volcanics Karutola Formation Sitagota Volcanics (1367 Ma)(Intertrappean Shale (1686 Ma)Bortalao FormationBasal Shale (1534 Ma)
----------Unconformity----------	
Nandgaon Group	Dongargarh granite (< C.2200 Ma) PitepanivolcanicBijli rhyolites (C.2200 Ma)
Amgaon Group	Amgaon Orogeny, Group Metamorphism and Granitization (>C.2300Ma?)Quartz-Sericite schist, Felspathic Quartzite, Garnet, epidote, Hornblende,Biotite Quartzite, Quartz-Felspar biotite gneissHornblende Schist and Amphobollite.

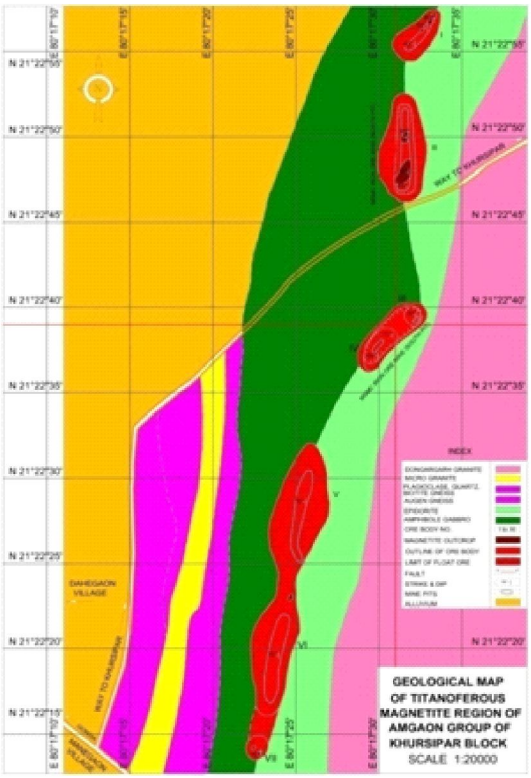

Figure No: 1. a) Geological map of the Titanoferous Magnetite of Amgaon group of Khursipar

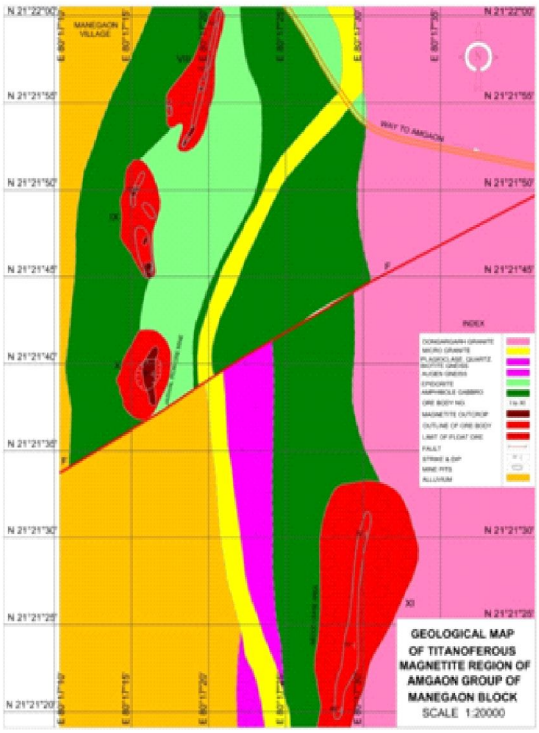

Figure No. 1. b) Geological map of the Titanoferous Magnetite of Amgaon group of Manegaon

The Granite having mottled structure are seen in North Orientation having coordinate N 21° 22.9’ 23" And E 80° 17.6’11" (Fig. 2-D). The iron ore body having coordinate N 21° 22.9’47" and E 80° 17 .5’90" and northern flank of the lake. Mafic Xenoliths in Granite have seen having coordinate N 21° 22.6’99" And E 80° 17. 7’13" later we have seen granitic gneiss having younger Quartz intrusion with Orientation of mafic mineral and havingcoordinate N 21° 22.5’87" and E 80° 17 .2’84".

Weathered micaceous schist having coordinate N 21° 22.5’25" and E 80° 17 .2’63" on North-South Orientation in Gully. Foliation also observed in quartz and augen gneiss having coordinate N 21° 22.4’66" and E 80° 17 .2’79" hornblende granitic gneiss having coordinate N 21° 22.4’58" and E 80° 17 .2’98" (Fig. 2- A and B). Microgranite having coordinate N 21° 22.4’59" and E 80° 17 .3’12" then we have seen contact of Microgranite with granite having coordinate N 21° 22.4’62" and E 80° 17 .3’20".

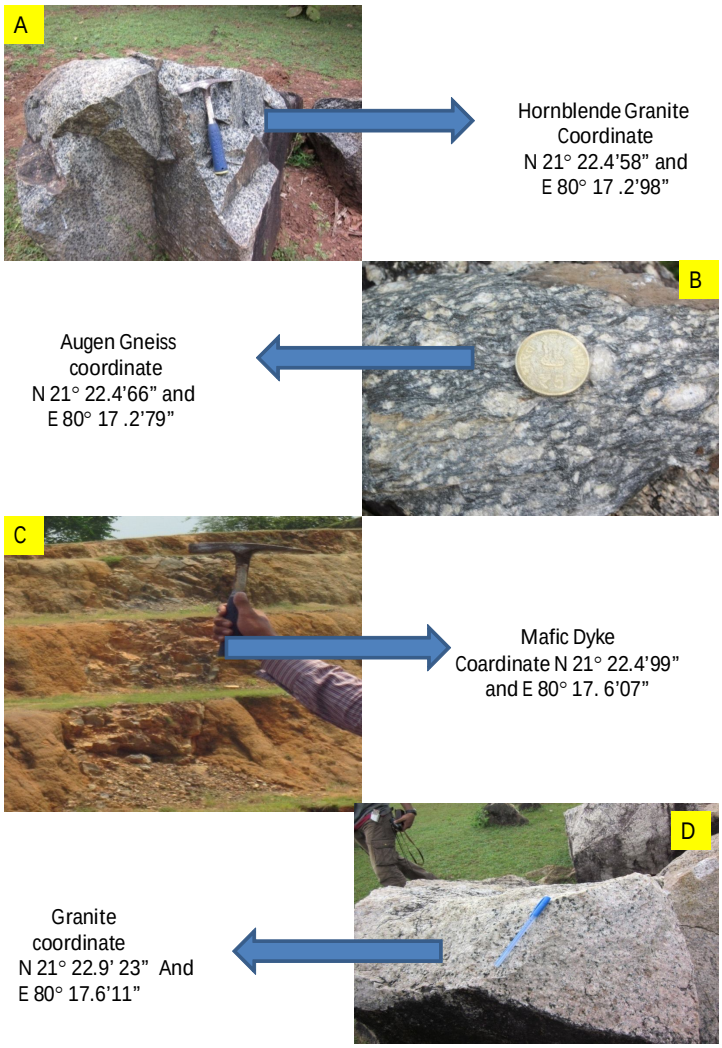

Fig. 2. Location of Outcrops

Petrography :

Selected Rock samplesstudied through petrological microscope and Scanning Electron Microscope-Electron Dispersive Spectrometry (SEM-EDS). In study area, asrock type in this area is generally mafic to ultramafic in nature. Common lithology was found in this area are granite, amphibolites, epidorites, granitic gneiss (Amgaon gneiss), F-B-Q gneiss, as well as some metabasic gabbro in some extent.

Granite :

Granite is the felsic igneous rock; mineralogical analysis has been carried out

through petrological microscope and Scanning Electron Microscope-Electron Dispersive Spectrometry (SEM-EDS). And Broadly it consist of Feldspar (Microclene, Perthite) quartz, hornblende, biotite, chlorite, Orthopyroxene, also chloritoid, muscovite and spinel.

The rock granite are leucocratic in colour and it show porphyroblastic textures, the grain size are varies from coarse to medium grain.

Under Microscopic studies the orthorhombic pyroxenes are distinguish as it shows straight extinction and stronger Pleochroism. They also have prismatic cleavages that are perfect in two directions at 90°. And it is greenish or brown in colour.

Hornblende is the principal mineral of amphibolites. Its cleavage angle at 56° and 124°. It is opaque green, greenish brown or brown in colour. And it is easily alter to chlorite. Like other mica mineral the biotite has a perfect basal cleavage and bird's eye extinction (Fig. 3-Gand H). The feldspar lath shaped two sets of cleavage. Microcline has cross-hatched twinning, feldspar are colorless or cloudy in colour (Fig. 3-B). And perthite is in a typical texture in alkali feldspar, due to exsolution of contrasting alkali feldspar compositions during cooling of an intermediate composition, microperthitic textures visible in light microscope. and quartz has euhedral crystals, colorless in colour and cleavage is none and twinning is not seen in quartz (Fig. 3-B).

Ilmenite is a weekly magnetic Titanium-iron oxide mineral which is iron- blackor steel-grey.Ilmenite and magnetite exhibits the Exsolution Texture (Fig. 4-E). It crystallizes in a trigonal system. In reflected light it may be distinguish from magnetite by more pronounced reflection Pleochroism and a brown-pink tinge. Ilmenite may alter to a gray –white material known as leucoxene, which is mixture of titanium minerals, such as a rutile \,anatase,andtitanite (sphene).Magnetite is black or brownish-black in colour (Fig. 4-F)

Geochemistry :

To understand the major oxide chemistry and mineral chemistry of selected samples of granite of the present study, X-Ray Fluorescence (XRF) Spectrometry and Scanning Electron Microscopy- Electron dispersion Spectrophotometery (SEM-EDS) were carried out respectively at Department of Earth science, Indian Institute of Technology, Bombay.Major elements were determined by X-ray fluorescence spectrometry (XRF) using Philips MAGIX PRO (Model PW2440) fully automatic, microprocessor controlled, and 168-position automatic PW 2540 vrc sample changer X-ray spectrometer along with a 4 KW X-ray generator. A rhodium (Rh) anode is used in the X-ray tube, which may be operated at up to 60 kV and current up to 125 mA, a maximum power level of 4 kW. Suitable software "Super Q" was used to take care of dead time correction and inter-element matrix effects. International rock reference samples were used to prepare calibration curves for major oxides. Sample pellets were prepared for analysis by X-ray fluorescence spectrometry (XRF), using a backing of boric acid and pressing it at 25 tons of pressure. A hydraulic press (Herzog, Germany) was used to prepare the pellets for XRF analysis to determine major elements. The trace elements show accuracy of about 10 % relative and that of major elements are better than 5 %.

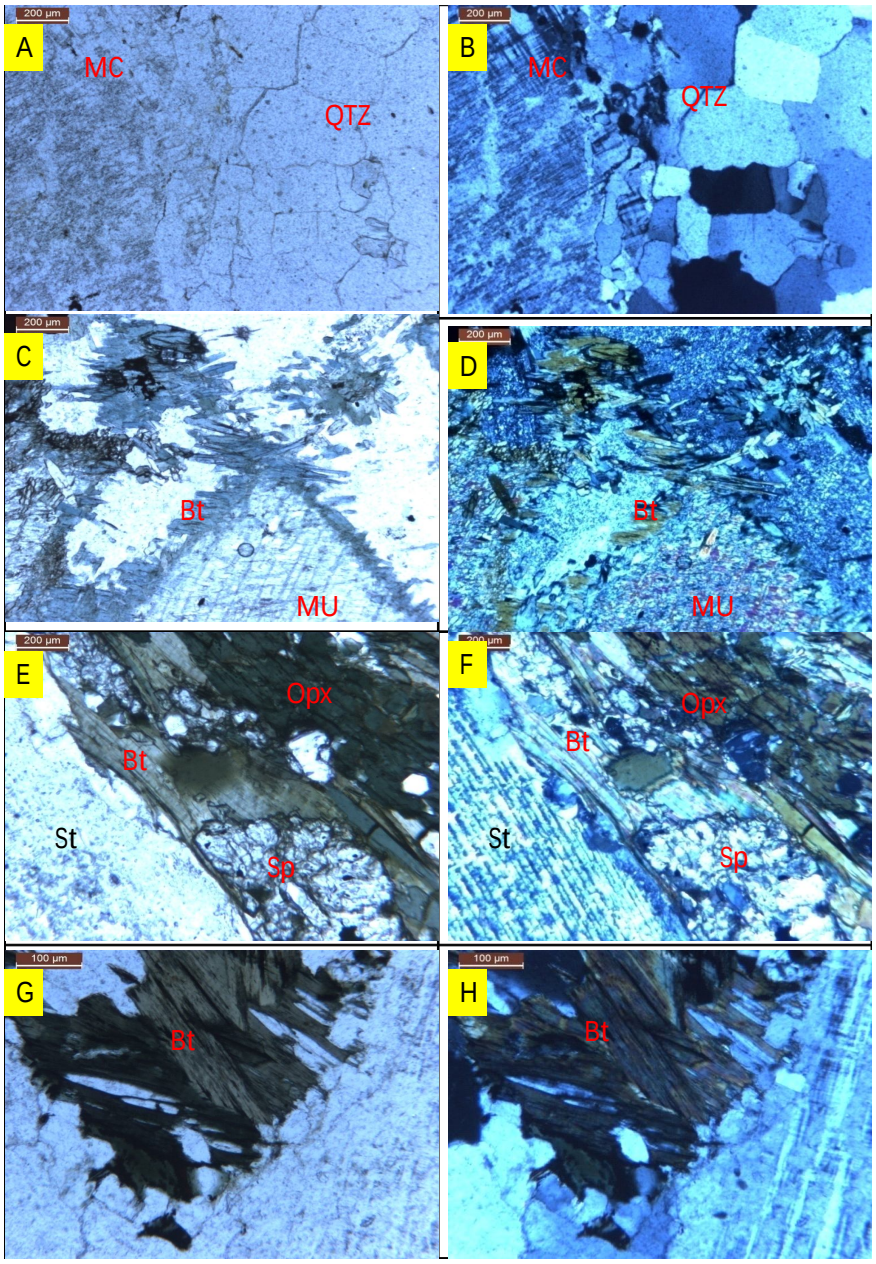

Fig. 3. Photomicrograph plate showing a) and b) Microcline and Quartz porphyroblastic texture Coarse to medium grained crystals C) and d) biotite having medium to fine and muscovite having fine grained Texture e) and f) biotite, orthopyroxene, sericitization and spinel g) and h) biotite having very coarse grained crystals.

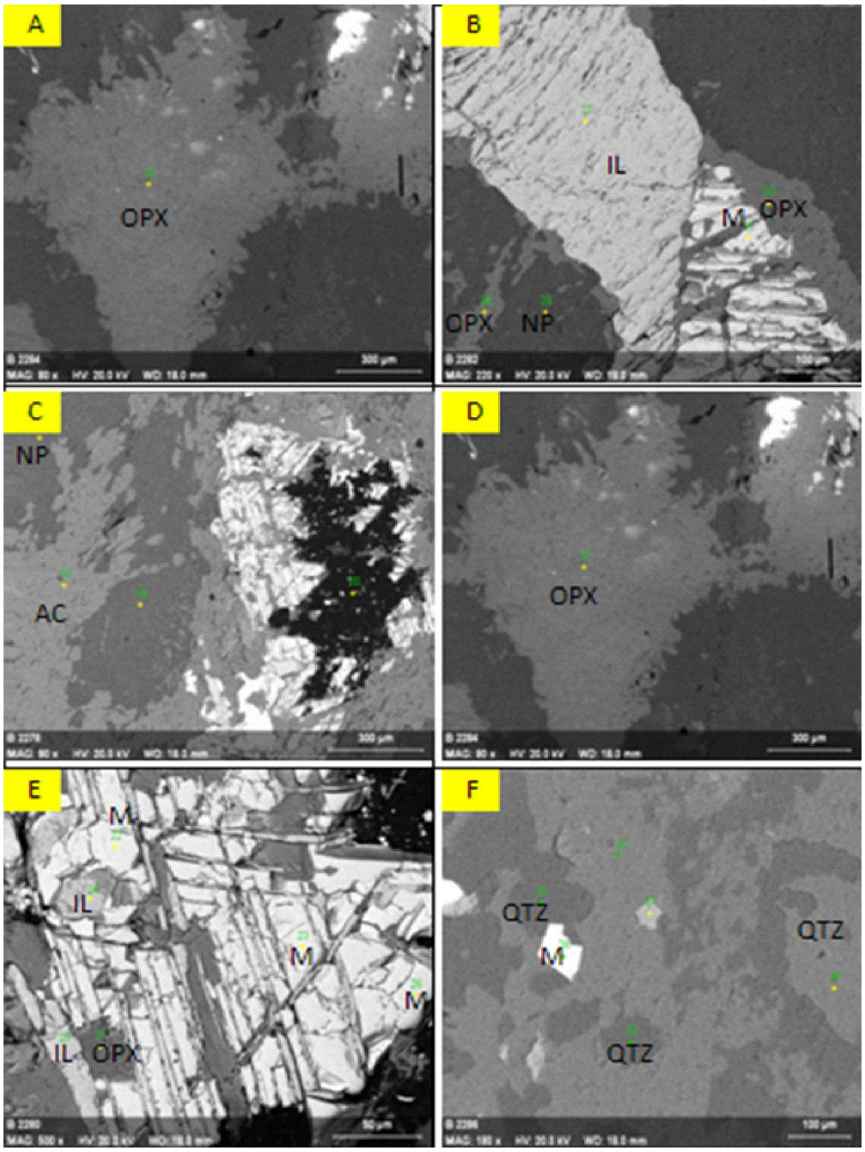

Fig. 4. SEM-EDS Images Khursipar showing Plate A) Showing very coarse grained crystals of orthopyroxene and B) Very coarse grained crystals of ilmenite and magnetite having exsolution structure in which host mineral is magnetite and guest mineral is ilmenite and gangue mineral is orthopyroxene and nephelene plate C) Showing crystals of Nephelene and Acmite and D) showing very coarse grained crystals of orthopyroxene plate E) showing Exsolution Texture of ilmenite and magnetite and plate F) showing medium grained crystals of magnetite and coarse to medium grained crystals of Quartz.

Major Oxide Chemistry :

The granite around Khursipar and Manegaon areas are oversaturated, the average content of SiO_2 is 72.05 which are ranges from 70.45 to 73.45%. The bivariant plot of SiO_2 versesmost of the major oxides show negative correlation whereas only MgO show slightly positive trend. It may be due to the moderate percent of MgO; this MgO may come from adjacent mafic rocks. Which is ranges from 0.9 to 1.01.

Al_2O_3 ranges are from 8.84 to 9.96 and the average is 9.51. The content of TiO_2 ranges from 0.29 to 0.38. The Harkar diagram of SiO_2 versesTiO$_2$show negative correlation. (Fig. 5). Fe_2O_3 contents of the studied granite show enriched range (Fe_2O_3= 3.39 to 4.09 wt %). It may be due to the iron ore deposit. Titanoferous magnetite ore bodies are very close to these granitic bodies. The granite of the study area show very little amount of P_2O_5(0.064).

Khursipar, Manegaon granite show fair amount of CaO which is ranges from 1.29 to 2.89. studied granite shows higher concentration of alkalis which is ranges from 10.00 to 11.29 having average content is 10.64 wt %. Among Na_2O and K_2O has more or less similar concentration. The average content of Na2O is 5.26 whereas K_2O shows average content is 5.38%.

The granite is per alkaline in nature which is shown in the fig. 6 [9].

Table 2. Representative Major Oxide of the granite around Manegaon and Khursipar villages

Table No. 4.1 Major Oxide wt. % of selected granite samples and normative content of the study					
SAMPLE ID	KGR-1	KGR-2	KGR-3	MG-1	MG-2
Oxide wt. %					
SiO_2	71.45	72.48	73.45	72.45	70.45
TiO_2	0.34	0.38	0.31	0.29	0.39
Al_2O_3	9.86	8.84	9.96	8.96	9.96
Fe_2O_3	3.89	3.39	3.18	4.09	3.59
MnO	0.71	0.77	0.71	0.69	0.75
MgO	0.9	1.01	0.9	0.9	0.9
CaO	2.29	2.5	1.29	2.89	2.57
Na_2O	5.5	5.1	5.3	4.91	5.5
K_2O	5.79	5.45	4.79	5.09	5.79
P_2O_5	0.07	0.06	0.07	0.05	0.07
Total (T1)	**100.80**	**99.98**	**99.96**	**100.32**	**99.97**

MINERALS %					
Quartz (Q)	24.94	29.72	29.33	28.69	23.69
Corundum(C)	0.00	0.00	0.00	0.00	0.00
Orthoclase(Or)	34.22	32.21	28.31	30.08	34.22
Albite(Ab)	18.48	15.13	24.56	17.75	18.99
Anorthite(An)	0.00	0.00	0.00	0.00	0.00
Diopside(Di)	6.26	6.93	4.77	6.34	6.24
Hypersthene(Hy)	0.00	0.00	0.76	0.00	0.00
Magnetite(Mt)	0.00	0.00	0.00	0.00	0.00
Ilmenite(Il)	0.64	0.72	0.59	0.55	0.74
Apatite(Ap)	0.17	0.14	0.17	0.12	0.17
Acmite(Ac)	11.25	9.81	9.20	11.83	10.39
Na-Metasilicate(Ns)	3.56	3.93	2.29	2.41	3.67
Wollastonite(Wo)	1.29	1.40	0.00	2.55	1.88
Hematite(Hm)	0.00	0.00	0.00	0.00	0.00
Total (T2)	100.80	99.98	99.96	100.32	99.97
T1-T2	0.00000	0.00000	0.00000	0.00000	0.00000

Granite Mineral Chemistry :

The mineral of granite, consist of quartz, plagioclase feldspar, Orthoclase feldspar, felspathoid, orthopyroxene, magnetite, ilmenite, hematite and micas. Analytical data of the mineral chemistry of the granite given in the table no.3 and 4

Mineral Chemistry of Quartz:

Quartz is the second most abundant mineral in the Earth's continental crust, after feldspar. It is made up of a continuous framework of SiO_4 silicon-oxygen tetrahedral, with each oxygen being shared between two tetrahedral, giving an overall formula SiO_2. The composition of all pure quartz is close to the 100 percent SiO_2. The Mineral chemistry of Quartz of studied granite shows SiO_2 content is 100%. This is given in the Table No. 3 and 4. The graphical presentation of SEM-EDS data is indicated in the Fig. 7.

Feldspars :

The potash feldspar of granite is either Orthoclase or Microcline, or both. Orthoclase, Sanidine, Microcline and Anorthoclase all have the same composition (K,Na) $AlSi_3O_8$. Except for anorthoclase, potassium (K) typically exceeds the amount of sodium (Na) in each

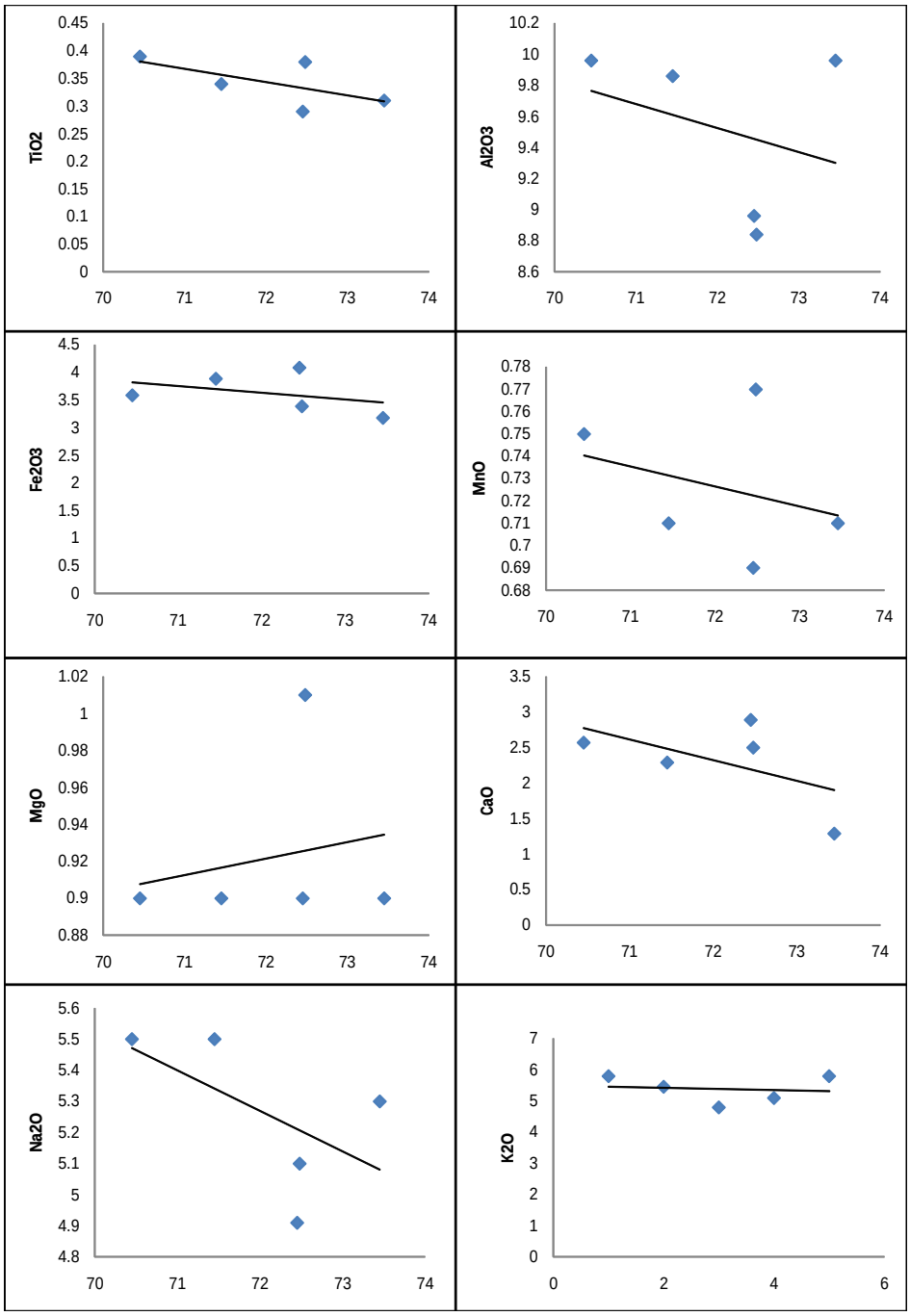

Fig. 5. Bivarient plots of SiO_2 wt % versus Major Oxide

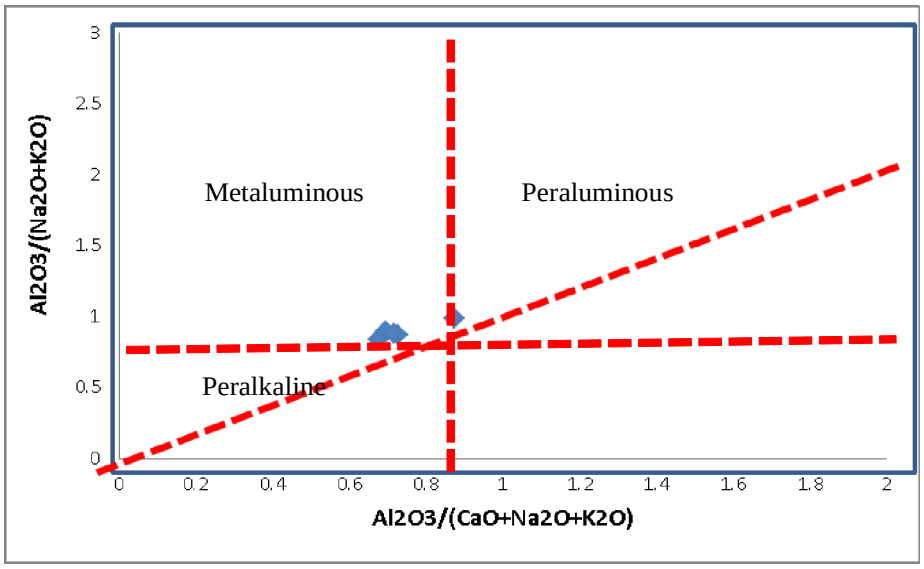

Fig: 6. Alumina Saturation (Shand Index) diagram forKhursipar, Manegaon granites (Modified after Maniar and Picoli 1989)

of these minerals. Orthoclase, Sanidine, Microcline and Anorthoclase all are polymorphs. Polymorphs have the same chemical composition but different crystal structures. Sanidine and Anorthoclase are high temperature alkali feldspars. Both of these minerals cristallize in the monoclinic crystal system Al and Si are randomly within the crystal structure. Sanidine contains more potassium than anorthoclase, which is sodium rich.Orthoclase are the alkali feldspar that typically crystallizes at intermediate temperature (lower than Sanidine and Anorthoclase, higher than Microcline). Orthoclase crystallizes in the same crystal system class as Sanidine and Anorthoclase but the distribution of Al and Si in orthoclase due to either the lower temperature or crystallization or to a slower rate of cooling. Orthoclase typically forms in intrusive rock that cooled fairly slowly. The slow cooling rate allowed both the ordering of Si and Al on the tetrahedral sites and the exsolution of microscopically visible lamellae to occur.

Microcline is the alkali feldspar that typically crystallizes at low temperature (lower than orthoclase) or as a result of a very slow cooling rate. Microcline typically forms in intrusive rocks, especially pegmatites that cooled extremely slowly. Granites of this study contain fine to coarse grained microcline having chemical composition is $KAlSi_3O_8.SiO_2$ content is 65.25 whereas Al_2O_3 shows minor variations (18.7 to 19.6 wt %). The Na_2O content vary from 0.6 to 1.1 wt %. Whereas uniform level of CaO (0.00 to 0.4 wt %). Microcline of this study show good content of Al_2O_3 (18.7 to 19.6) similarly K_2O (13.6 to 14.1).

Nephelene and Cancrinite :

The pure compound $NaAlSiO_4$ can be

made artificially. Natural nephelene contain potassium, several of them approaching the formula $KNa_3(AlSiO_4)_4$, apparently as a reflection of the space requirements of the nephelene structure, in which one alkali position in four is larger than the other three and preferentially accommodates potassium. Nephelene of this granite show very high content of SiO_2. Which is ranges from 56.82 to 59.6 along with moderate content of Al_2O_3(27.8 to 30.1) Na_2O of this Nephelene show (4.9 to 5.9) wt %). Whereas fair amount of K_2O (4.2 to 5.3 wt %). Nephelene of this granite shows little amount of MgO (0.7 to 0.8 wt %). Due to the mafic intrusive bodies which is very close to the granitic bodies**.** Cancriniteof this granite displays very high concentration of SiO_2. Which is ranges from 72.3 to 73.5 and Na_2O content is 14.1 to 14.8 but few content of Al_2O_3. (2.6 wt %) CaO of Cancrinite ranges from 4.2 to 4.9 wt %.

Acmite:

Normative calculations ofthis granite gives good % of acmite (average 10%). Similarly it is support to the petrography also. It show 50 % of silica with similar amount of Al_2O_3(15 to 8 wt %) and Fe_2O_3(15.0 wt %) thecontent of Na_2O is 2.3, MgO= 9.0, K_2O=0.4, and show quiet high content of CaO which is 7.7wt %.**Hypersthenes (OPX)**

Hypersthenes' is a name given to the mineral when a significant amount of both elements are present. The chemical formula is (Mg, Fe) SiO_3 having colour often grey, brown or green and Pleochroism is strong. Petrographically or chemically the composition is given as relative proportions of enstatite (En) and ferrosillite (Fs) (e.g. $En_{80}Fs_{20}$). Essentially all of the orthopy-roxene contain one or more Ca, Mn, Fe^{+3}, Ti, Al, Cr, and Ni, in most cases at a level below 15 mole percent of their oxides. In some cases, the identity of these contained ions can be correlated with geological occurrence. Manegaon, Khursipar granite contains of accessory amount of orthopyroxene (hypersthenes). SiO_2content of hypersthenes show very wide range (32.4 to 59.6 wt %). The average content of Fe_2O_3 is 19.4 whereas MgO ranges from 9.2 to 18.7%, along with it show few content of CaO (3.8) also. Hypersthenes of this granite show 1.5 % of Na_2O with very little content of MnO and K_2O.

Magnetite :

Magnetite is a common naturally occurring iron oxides (chemical formula Fe_3O_4) and member of the spinel group. Naturally magnetized piece of magnetite, called loadstone, will attract small pieces of iron. Small grains of magnetite occur in almost all igneous and metamorphic rocks. It is black or brownish-black in colour. Magnetite reacts with oxygen to produce hematite. Commonly igneous rock contains grain of two solid solutions, one of the magnetite and ulvospinel and the other of ilmenite and hematite. Composition of mineral pairs are use to calculate how oxidizing condition are found in magma. Magnetite of this study contains cent % composition of Fe_2O_3(98.7%) which is range from 98.1 to 99 %. The remaining elements are Al_2O_3 andK_2O. The diagnostic characteristics of this magnetite is it content of V_2O_5 (0.4 to 0.9 wt %).

Ilmenite :

Ilmenite is a weekly magnetic Titanium-iron oxide mineral which is iron-blackor steel-grey. It is a crystalline iron titanium oxide ($FeTi_3$). Ilmenite is commonly recognized in altered igneous rock by the presence of a white alteration product, the pseudo-mineral leucoxene. Ilmenite most often contain appreciable quantities of magnesium and manganese and the full chemical formula can be expressed as (Fe, Mg, Mn, Ti) O3. Ilmenite form a solid solution with geikielite ($MgTiO_3$) and pyrophanite ($MnTiO_3$) which are the magnesian altered ilmenite and talc manganiferous end members of solid solution series. At higher temperature it has been demonstrated there is a complete solid solution between ilmenite and hematite. Ilmenite is typically close to $FeTiO_3$ in composition, but it may contain up to about 6 percent Fe_2O_3 in solid solution.Minor substitution of Mg for Fe (1 percent or less MgO) is not uncommon. Average TiO_2 concentration of the ilmenite is 43.12 which is having wide range *i.e.* 35.0 to 48.88 similarly it is having Fe_2O_3 which is ranges from 49.9 to 51.8 and average content is 50.75 wt %. As per the standard it shows MgO and MnO also ranges are 0.45 to 0.29 respectively.

Table 3. Analytical data selected minerals of granite by Scanning Electron Microscopy-Electron dispersion Spectrophotometery (SEM-EDS)

	36	**39**	**40**	**35**	**17**	**29**	**33**	**34**	**18**
Oxide wt. %	**QTZ**	**QTZ**	**MC**	**MC**	**NP**	**NP**	**CC**	**CC**	**AC**
Na_2O	0.00	0.00	1.11	0.62	5.93	4.87	14.10	14.75	2.30
MgO	0.00	0.00	0.49	0.19	0.78	0.74	5.17	5.34	8.96
Al_2O_3	0.00	0.00	19.57	18.75	27.83	30.09	2.72	2.51	15.83
SiO_2	100.00	100.00	65.27	65.21	59.59	56.79	73.53	72.34	49.78
K_2O	0.00	0.00	13.56	14.12	4.20	5.34	0.27	0.19	0.37
CaO	0.00	0.00	0.00	0.44	0.79	0.89	4.20	4.86	7.74
TiO_2	0.00	0.00	0.00	0.61	0.10	0.19	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe_2O_3	0.00	0.00	0.00	0.06	0.00	0.09	0.00	0.00	15.01
V_2O_5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	99.23	99.00	100.00	100.00	100.00

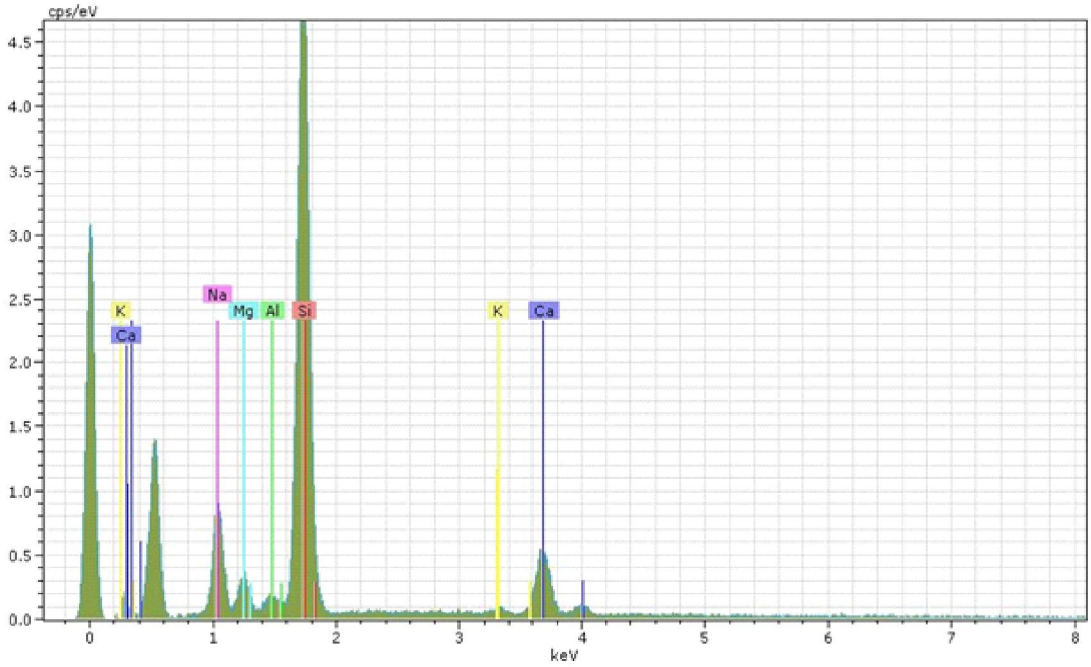

Fig. 7. Quantitative analysis of selected minerals by SEM-EDS

Table 4. Analytical data selected minerals of granite by Scanning Electron Microscopy- Electron dispersion Spectrophotometery (SEM-EDS)

Oxide	**28**	**30**	**32**	**21**	**22**	**31**	**26**	**38**	**24**	**25**	**27**
wt. %	**OPX**	**OPX**	**OPX**	**OPX**	**M**	**M**	**M**	**M**	**IL**	**IL**	**IL**
Na_2O	2.0	3.0	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MgO	9.1	9.9	15.6	18.7	0.0	0.0	0.0	0.0	0.1	1.3	0.0
Al_2O_4	17.2	18.0	4.5	27.0	0.0	0.3	0.3	0.2	0.8	0.0	2.2
SiO_2	43.6	44.8	59.6	32.4	0.1	0.5	0.0	0.8	8.6	0.0	0.0
K_2O	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0
CaO	6.5	6.9	1.9	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0
TiO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	48.8	45.6
MnO	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.4
Fe_2O_3	21.2	17.3	17.7	21.5	99.0	99.0	98.6	98.7	50.5	49.9	51.8
V_2O_5	0.0	0.0	0.0	0.0	0.8	0.0	0.4	0.0	0.0	0.0	0.0
Total	100.002	100.002	100	100.002	100.0	100	99.5	99.9	100.0	100	100

Conclusion

The study area forms part of Amgaon Group of rocks which is represented by amphibolites and granitic gneisses. The rocks of the area belong to the early Precambrian, Amgaon Group which is overlain by Dongargarh Supergroup. The granite around Khursipar and Manegaon areas are oversaturated, the average content of SiO_2 is 72.05, which ranges from 70.45 to 73.45%. The bivariant plot of SiO_2 verses most of the major oxides show negative correlation whereas only MgO show slightly positive trend. The Harkar diagram of SiO_2 versesTiO$_2$ show negative correlation. Fe_2O_3 contents of the studied granite show enriched range (Fe_2O_3= 3.39 to 4.09 wt %). It may be due to the iron ore deposit. Titanoferous magnetite ore bodies are very close to these granitic bodies. The granite of the study area show very little amount of P_2O_5(0.064). Khursipar, Manegaon granite show fair amount of CaO which is ranges from 1.29 to 2.89. studied granite shows higher concentration of alkalies which is ranges from 10.00 to 11.29 having average content is 10.64 wt %. Among Na_2O and K_2O has more or less similar concentration. The average content of Na_2O is 5.26 whereas K_2O shows average content is 5.38%.The granite is per alkaline in nature.

The mineral chemistry of quartz studied granite shows SiO_2 content is 100%. Nephelene of this granite show very high content of SiO_2, which are ranges from 56.82 to 59.6% along with moderate content of Al_2O_3. The potash feldspar of granites is either orthoclase or microcline, or both. Manegaon, Khursipar granite contains of accessory amount of orthopyroxene (hypersthenes). SiO_2content of hypersthenes show very wide range (32.4 to 59.6 wt %). The average content of Fe_2O_3 is 19.4 whereas MgO ranges from 9.2 to 18.7%, along with it show few content of CaO (3.8) also. Hypersthenes of this granite show 1.5 % of Na_2O with very little content of MnO and K_2O. TiO_2 concentration of the ilmenite is 43.12 which is having wide range *i.e.* 35.0 to 48.88 similarly it is having Fe_2O_3 which is ranges from 49.9 to 51.8 and average content is 50.75 wt %. Magnetite of this study contains cent % composition of Fe_2O_3(98.7%) which is range from 98.1 to 99 %. The remaining elements are Al_2O_3 and K_2O. The diagnostic characteristics of this magnetite is it content of V_2O_5 (0.4 to 0.9 wt %).

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