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OCCURRENCE OF PLATINUM GROUP OF ELEMENTS (PGE) IN AND AROUND SOLAVANUR AREA, METTUPALAIYAM ULTRAMAFIC COMPLEX, TAMILNADU, SOUTH INDIA

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Abstract:

This area has been named with reference to the nearest village Solavanur. Also this area is called as "S" area for report writing and convenience to presentation. The general trend of the block is N 75°E – S 75°W with 75° – 80° dipping towards south. The strike is changing little towards northern side (Nalla side). This area has consist of two meta-pyroxenite band with interbands of meta gabbros in the eastern side. In the western side the metapyroxenite band is the tremolite and hornblende. This band is closely associated with Gabbro/Gabbroic anorthosite. This band is traceable more than 5 lkm from east to western direction. The gabbros and meta pyroxenite bands are formed gradationally. Collected chip/groove samples in different location to evaluate geological set up.

Key Words: Solavanur, Meta-Pyroxenite, Lithounits, Anorthositic & Metaigneous Rocks.

Introduction:

Mohan and Jayananda (1999) consider, based on the geographic distribution, lithology geochronological and isotopic data, the southern Indian shield is divided into three principal domains. The Dharwar Craton (DC), Southern Granulite Terrain (SGT) and Eastern Ghat Mobile Belt (EGMB). Drury and Holt (1980) stated that the SGT is a mosaic of fault/shear zone bounded areas. Basker Rao (1996) considered the Palghat–Cauvery shear or Cauvery shear zone as an E-W tract of ductile shear zone which marks the southern margin of Dharwarcraton and zone of neoproterozoic reworking of the archaeans believed to be a zone of deep rooted section of an ancient orogenic belt (Ramakrishnan, 1993). Further, it divides the SGT into the Northern area (>2.5 Ga) and the southern area, the latter recording neoproterozoic granulite event. The study area falls with northern area of SGT. The northern area comprises of the granulite hill ranges of Biligirirangan hills, the Nilgiris and Salem Madras regions. Though they are different in several aspects, they have all under gone a common major granulite event at Ca 2500 Ma. The late ArchaeanGranulite area fringe the shear wear craton.Madurai area is located between Palghat – Cauvery shear zone in the north and Achankovil shear zone in the south. It is essentially a high-grade charnockite-khondaliteterrane comprising of granulite fancies rocks (Drury and Holt, 1980), which is the largest and the least studied terrane of South India. The largest highland granulite massifs in South India, including the Palani, Anaimalai and Cardamom hills are located in the Kodaikanal region of the Madurai Area in the south of Palghat – Cauvery shear Zone, the supra crustal rocks are particularly abundant.

Study Area:

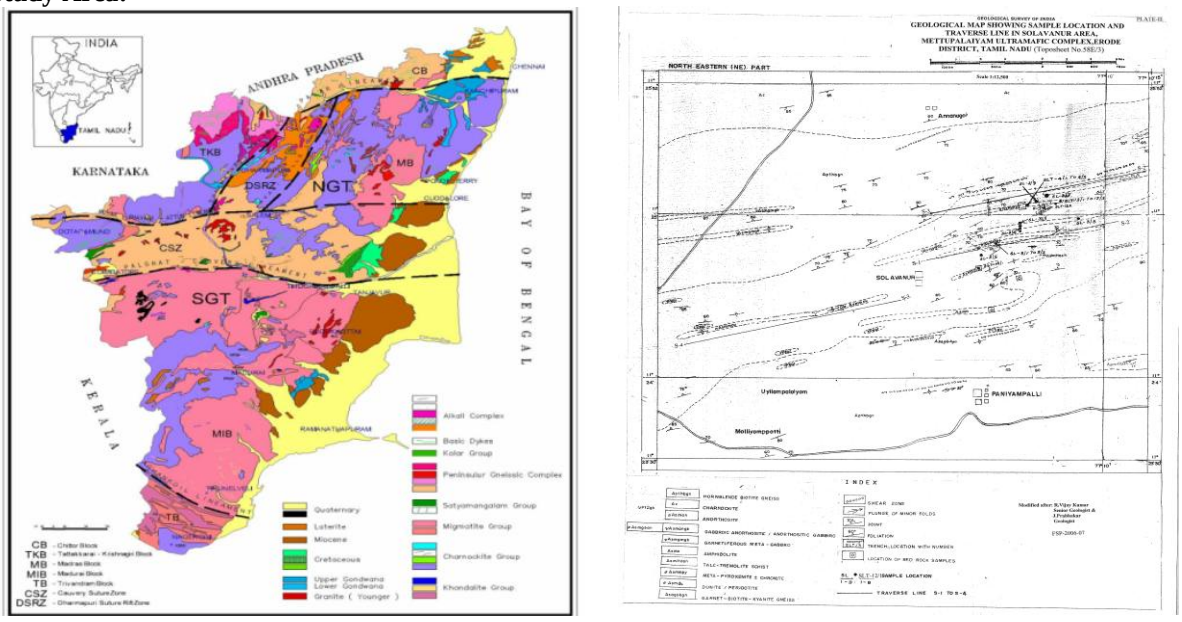

Figure 1: Study Area

This area bounded between the north latitude 11°23' 30"–11°25' 52"and longitude 77°07'30"- 77°10' 15" with reference to the nearest village Solavanur. The general trend of the lithounits is N 75°E – S 75°W with 75°–80° dipping towards south. This area consists of three meta-pyroxenite band with interbands of metagabbros in the northern side. Therefore these meta-pyroxenite bands are known to form northern zone. In this zone south of the northern band only the amphibolite band is closely associated with meta-pyroxenite. Gabbro/Gabbroic anorthosite is formed is the of these meta-pyroxenite bands.These bands are traceable for more than 4 km from east to west. The contact between gabbro and metapyroxeniteis gradational. In contact with gabbro band, medim to coarse-grained garnet are present on both side. Chip/groove samples have been collected in different location for further study.The southern zone consists of only one talctremoliteactinolite schist with two segments of pinching and swelling nature. This band is located in between the pegmatoidal granite in the north and the amphibolite in the south. Chip/groove samples have been collected for petrological studies.A total number of 24 chip/groove samples were collected during traverse mapping of 6.00 km in Solavanuras shown in geological map.

Methodology:

Field Techniques and Sampling:

A systematic geological mapping was carried out on a scale 1: 50 000 with the survey of India Toposheet as the base. The geological mapping generally proceeded in five stages.

- ✓ Planning for field work
- ✓ Observations, mapping and collecting data by examining all geological features of the ground.
- ✓ Laboratory studies.
- ✓ Computing, Synthesis and subsequent interpretation of data through application of modern techniques.
- ✓ Finally the state of preparing geological map with report of the work.

A systematic representative samples of different rock types were collected. About 200 fresh and unaltered rock samples representing different rock types of the area from different locations were collected. The collected samples were numbered with location. Utmost care was given while taking measurement of attitudes and structural features and also in the collection of representative samples.

Laboratory Method:

Around 100 thin sections were prepared from different rocks for petrographic study. The thin sections were made by using epoxy resin mounting. Final thickness was brought with standard birefringence colours. The polished thin section has the following advantages over the conventional covered section.

- ✓ Petrographic study was made with petrological microscope.
- ✓ Areas of petrographic interest have been marked for subsequent microprobe study.
- ✓ Microchemical tests were performed.
- ✓ Better microphotography was possible.

Result:

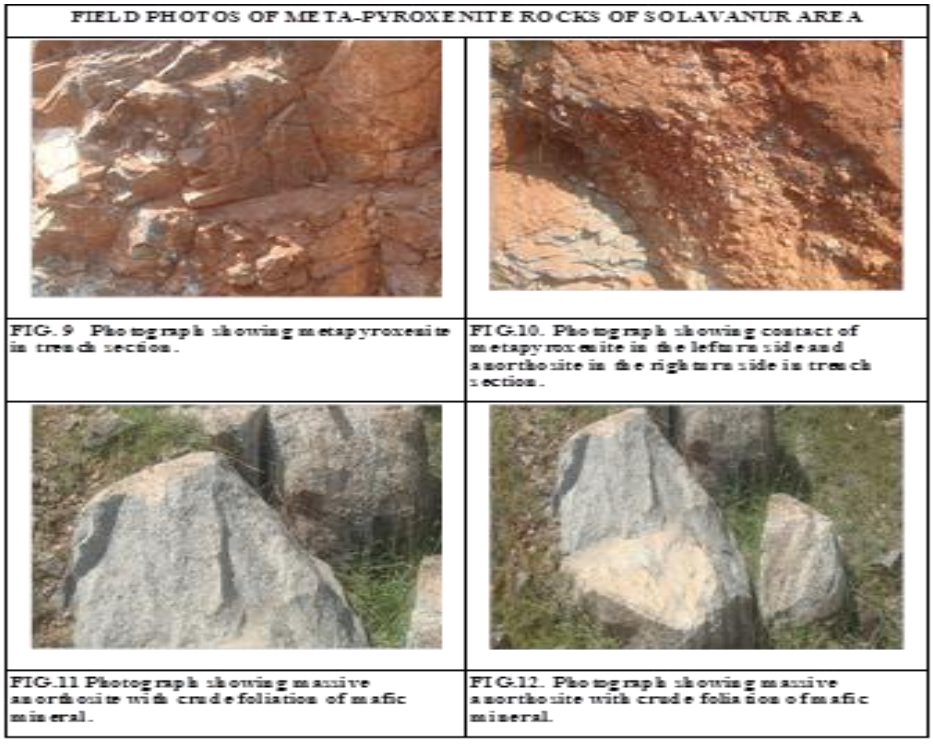

Figure 2: Field Photos

Description of Rock Types:

Dunite / Peridotite:

Dunite / peridotiteoccurs as small linear lenses within the anorthositic gabbro / gabbroic anorthosite of the mafic-ultramafic suite and are restricted in the SolavanurArea in the NE part. Good exposures of dunite are located 750 m NE of Solavanur and 750 m NW of Pachamallanur on road.

Meta-Pyroxenite:

Meta-pyroxenite bands in the NW part occur as linear and conformable bands within the quartzo-feldspathic gneiss + garnet as well as within the gabbroic anorthosite / anorthositicgarbbro of the mafic – ultramafic suite in the Peddikutai Reserved Forest. A total of three small bands of meta-pyroxenite were delineated in the NW part of which one band occur within quartzofeldspathic gneiss, 1.1 km NNE of 348 hill and the other band 500 m SSW 348 hill within the differentiated sequence in Peddikuttai R.F trending NE-SW direction. The third band is traced 1.8 km NNE of Periyakallipatti that occurs within the anorthositic gabbro trending in ENE – WSW direction and occurs near to the northern contact with the gneisses, which is highly sheared.In the SW part meta-pyroxenite / pyroxenite occur within the hornblende biotite gneiss around Tenkal Malai, south of Peddikuttai, SE of Sembaravallipudur and in Modur-Peddikuttai R.F. and south of Irumbarai. In the Modur Peddikuttai R.F four small-detached lenses of meta-pyroxenite are traced of which three bands occur within gabbroic anorthosite and one small band occurs within the gneisses. The NE part is divided into Solavanur Area and Mallanayakkanpalaiyam Area. In the Solavanurarea, two detached bands of meta-pyroxenite are traced west of Solavanur. The first band is traced 2.25 km WSW and the second band is traced 500 m WSW of Solavanur. The second band is essentially composed of serpentinised bottle green pyroxene (retrograded to amphiboles). To the north of 324 hill three parallel bands of meta-pyroxenite were delineated. The southern band occurs at 600 m, the central band at 615 m and the northern band at 900 m north of 324 hill. The southern band is a very small band and appears to coalesce with the central band. The northern band is a very prominent band of sheared meta-pyroxenite and occurs in the northern part close to the contact with country rock hornblende biotite gneiss. Towards the northern contact of this band, sheared meta-anorthosite is exposed. The hornblende biotite gneisses exposed in the southern contact of the mafic-ultramafic suite south of Solavanur shows small detached, boudinaged and folded lenses of meta-pyroxenite. Besides, meta-pyroxenite / anorthositic gabbro with lenses of meta-pyroxenite occur 250 m SE of Kurumbapalaiyam. In the Mallanayakkanpalaiyam Area three parallel bands of meta-pyroxenite were delineated. The southern band occur 300 m NNE, the central band occur 400 m NNE of Mallanayakkanpalaiyam and the northern band occur immediately to the south of Mill Medu is shown in geological map of traverse line and sample locations in Plate – I & II.

Amphibolite and Basic Dykes:

The rock occurs as lensoidal body within the gneisses, charnockite as well as gabbroic anorthosite / anorthositic gabbro. Amphibolite bodies are traced mostly in the SW and NE part of the study area. In the SW part a thin linear band of amphibolite occurs in the Modur – Pedikuttai R.F. Another dyke trending ENE-WSW is traced 200 m south of Chinnakallipatti. Both the dykes are emplaced parallel to the regional trend and of first generation. A second generation of dolerite trending NNE-SSW occurs 800 m SE of Rangampalaiyam. This dyke is intruded into the gneisses and cuts the MBQ band and the garnetiferous gabbro. However the cross cutting relation between the two generations of basic dykes is not seen.

Petrography:

Garnetiferous Hornblende Biotite Gneiss and Metaigneous Rocks:

The chief constituents are quartz, feldspar, hornblende, garnet and biotite. The foliation becomes more pronounced due to the parallel alignment of pyroxenes, garnets and hornblende. The felsic streaks also exhibits a good linear disposition. Sieve texture is common in garnets. In thin sections the rock exhibit gneissic texture due to parallel prism of hornblende, elongated and ribbons of quartz, with wavy lenticular structure. There is a well-defined planar orientation of biotite plates. Cataclastic textures like undulose extinction, bending and kinking of mica plates and plagioclase twin lamellae, mortar structure and fracturing of quartz grains are common. Occasional aggregation of mica and feldspar indicate metamorphic differentiation.

Meta-Anorthosite:

In the massif type anorthosite in Solavanurarea, the plagioclases constitute major mineralogical composition with minor orthoclase, garnet, hornblende and pyroxene minerals.Metaanorthosites show granulitic texture with triple junction and straight interface boundaries shown in microphoto-VI Fig-12. In some places, garnet show with initial breakdown to plagioclase and hornblende. In some anorthositic section, sieve texture in hornblende is common. Clinopyroxene + plagioclase → garnet (Harley, 1989). The following mineral assemblages are observed, based on thin section studies.

Solavanur Area:

Samples consist of spinal assemblage are at taken spinal is present within the garnet. In samplesortho pyroxene, Clinopyroxene, sample ofEquigranular texture with olivine &clinopyroxene are noticed. Besides plagioclase and amphibole are present. Therefore, above mentioned both section rock types called plagioclase-

bearing metapyroxenite are shown in microphotos. In thin section, gabbroic-anorthositeconsists of plagioclase with a few orthopyroxene, clinopyroxene and little orthoclase. Alteration of plagioclase to sericite is observed. Based upon extinction angle, it has been inferred that plagioclase feldspar here is labradorite – bytownite composition. In thin section meta-pyroxenite collected from the western part of the study area (Solavanur area) shows, the rock contains mainly of pyroxene, tremolite, actinolite and relatively less amphibole. Tremolite-actinolite shows long prismatic crystals and columnar to fibrous aggregates shown in microphotos. Pyroxene alters to talc, tremolite and actinolite. Malachite's stains are present with peacock coloured, bornite. Two types of anorthosite are exposed in this area. One is massive type. It is exposed in the south of sample one is layered type, which is cobanded with metaultramafic rocks. More over anorthosite is very much restricted in the investigation area and occurs only in the NE part of the mapped area around Solavanur. It is grey or whitish blue, medium to coarse grained and massive with a crude foliation. It is essentially composed of plagioclase (80%) and mafic minerals like hornblende, orthopyroxene, garnet and magnetite as accessory mineral. Plagioclase shows lamellar and Carlsbad twins, with bent cleavage planes. Protomylonitic texture is seen with fine-grained material surrounding the feldspar.

Microphoto:

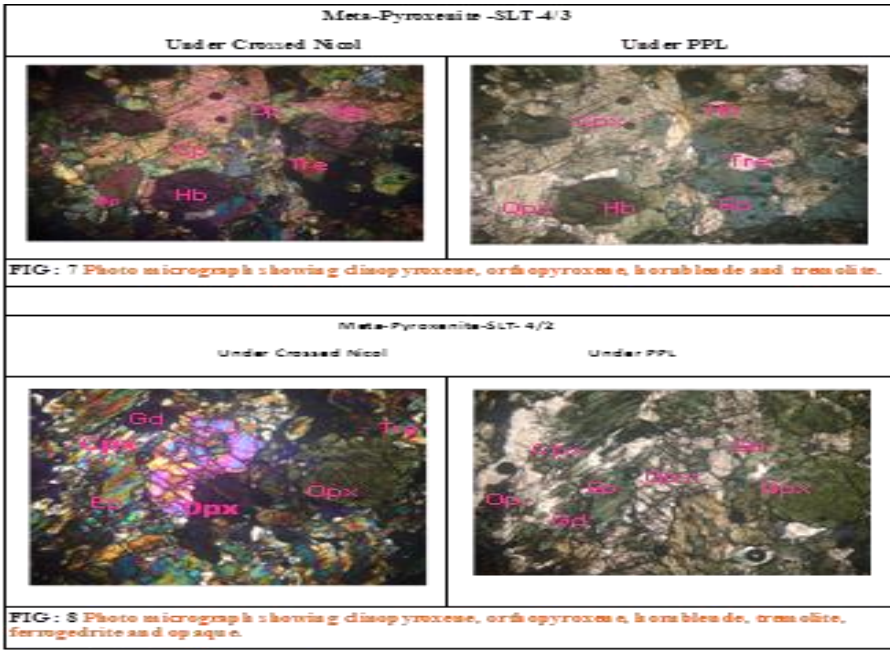

FIG : 7 Photo micrograph showing clinopyroxene, orthopyroxene, hornblende and tremolite.

FIG : 8 Photo micrograph showing clinopyroxene, orthopyroxene, hornblende, tremolite, ferrogedrite and opaque.

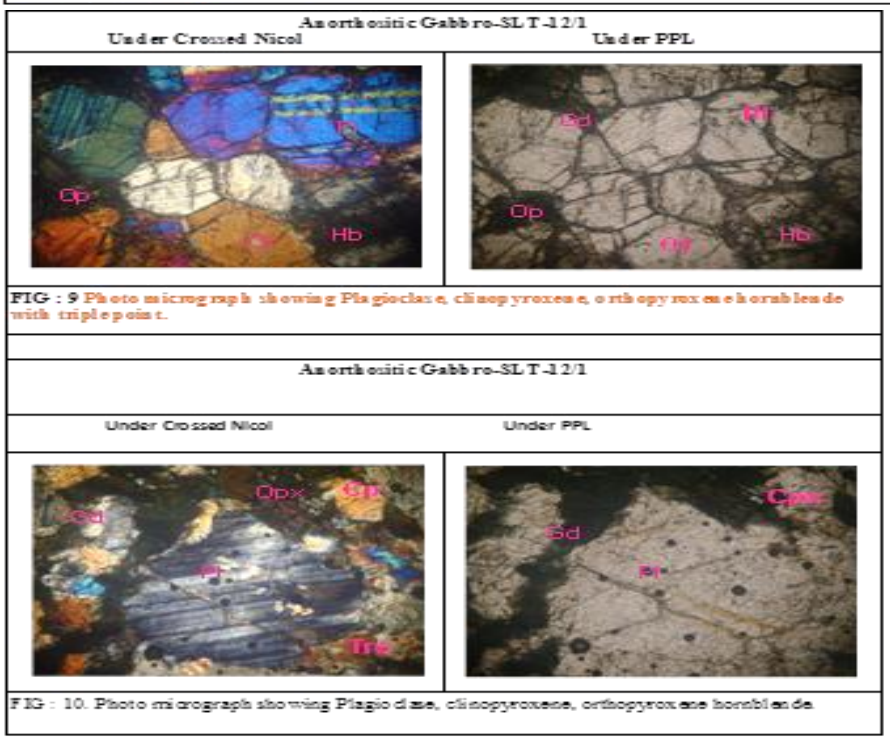

FIG : 9 Photo micrograph showing Plagioclase, clinopyroxene, orthopyroxene hornblende with triple point.

FIG : 10. Photo micrograph showing Plagioclase, clinopyroxene, orthopyroxene hornblende

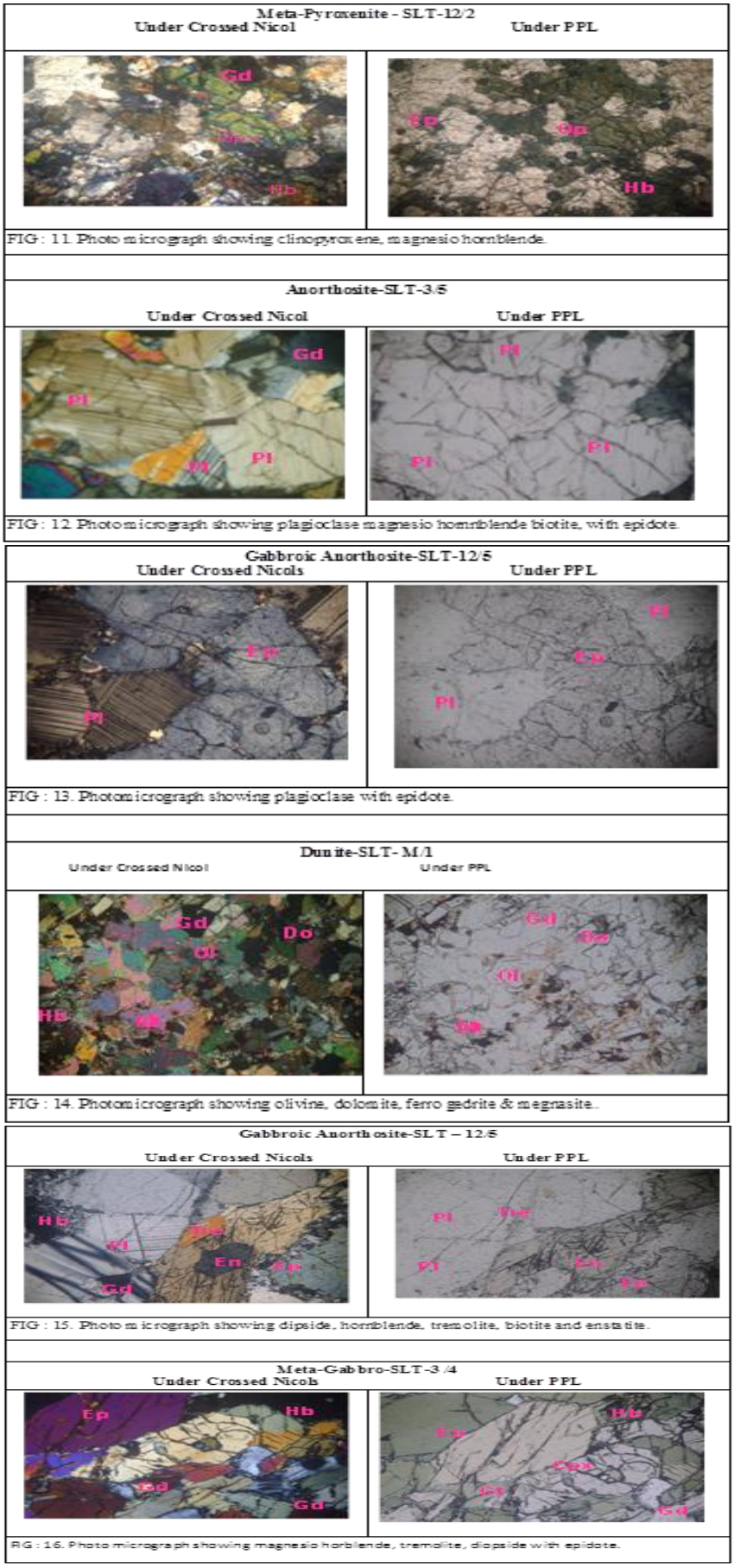

Figure 3: Microphotos

Major Elements Analysis of the Mafic-Ultramafic Rocks of Solavanur Area (S –Area) in Mettupalaiyam Ultramafic Belt (MUB):

Table 1

Lab No.	Dunite	Gab – An	– Py	– Py	– Py	– Py	– Py	Gb (S)	Hb.An
Sample No.	SLT-M/1	SLT-12/1	SL-4/1	SLT-12/4	SLT-12/5	SL-3/1	SL-3/2	SL-3/4	SL-3/5
SiO_2 (%)	39.23	46.54	46.51	43.99	46.83	47.31	49.16	49.54	46.41
TiO_2 (%)	0.05	0.20	0.84	0.31	0.98	0.63	0.61	0.71	0.23
Al_2O_3 (%)	1.89	28.44	14.15	15.78	7.24	9.84	8.46	11.48	28.79
Fe_2O_3 (%)	8.69	4.12	**16.51**	**13.24**	**14.28**	**12.60**	**11.98**	**10.23**	4.70
MnO (%)	0.17	0.05	0.20	0.21	0.22	0.18	0.17	0.22	0.07
MgO (%)	**29.39**	3.22	9.28	**14.15**	**15.50**	**14.03**	**14.99**	9.12	2.37
CaO (%)	**20.31**	**15.60**	**11.21**	**11.19**	**12.89**	**14.32**	**13.23**	**16.02**	**15.38**
Na_2O (%)	0.18	1.65	0.99	0.93	1.27	0.97	1.12	2.12	1.79
K_2O (%)	0.06	0.14	0.19	0.17	0.63	0.09	0.26	0.31	0.19
P_2O_5 (%)	0.02	0.03	0.12	0.02	0.16	0.03	0.02	0.26	0.06
SUM	**99.99**	**99.99**	**100.00**	**99.99**	**100.00**	**100.00**	**100.00**	**100.01**	**99.99**
Sc (ppm)	13	14	48	24	56	45	31	20	9
V (ppm)	69	92	305	126	333	247	204	143	85
Cr (ppm)	**3340**	189	834	201	653	**1706**	**1634**	994	108
Co (ppm)	49	18	109	84	90	84	75	49	24
Ni(ppm)	568	111	**1310**	615	200	369	624	366	80
Cu (ppm)	11	57	4672	118	117	35	9	97	15
Zn (ppm)	27	28	216	92	99	99	94	93	39
Ga (ppm)	3	16	13	11	11	14	12	14	18
Rb (ppm)	4	4	5	6	7	5	5	6	6
Sr (ppm)	152	228	63	24	105	64	49	420	185
Y (ppm)	4	6	13	7	24	12	10	14	9
Zr (ppm)	12	15	15	16	43	47	43	86	21
Nb (ppm)	2	2	3	4	4	4	4	5	3
Ba (ppm)	26	55	151	34	81	136	40	76	57
Pb (ppm)	4	6	4	2	4	5	2	8	8
Th (ppm)	2	2	2	2	2	2	2	3	2
U (ppm)	1	1	1	1	1	1	1	2	1

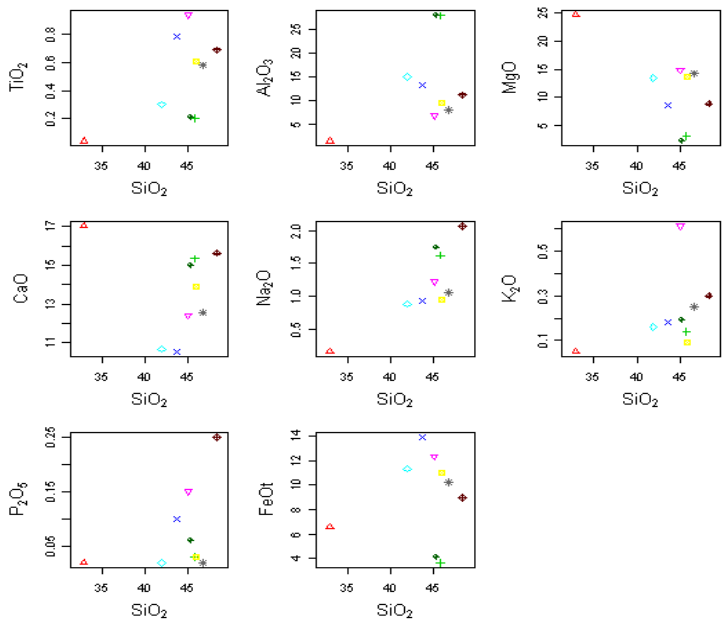

Figure 4: Binary variation diagrams are showing the plots of metapyroxenite/metagabbro suite of rocks a)

SiO_2Vs $TiO_{2,}$ b) SiO_2Vs $A_2lO_{3,}$ c) SiO_2VsMgO, d) SiO_2VsCaO, e) SiO_2Vs Na_2O, f) SiO_2Vs K_2 O, g) SiO_2Vs P_2 O_5 &g) SiO_2VsFeO(t).

Conclusion:

The Solavanur area has been divided into two sectors named as western and eastern for exploration point of view from the sample location SLT-M/1 (metaanorthosite). Based on the petrographic study, the western part of metapyroxenite samples are showing more tremolite and hornblende minerals. In the eastern sector shows more hornblende and tremolite minerals in these area lithologically different types of metaultramafic rocks are present. In the western sector the metapyroxenite bands are traceable by its tremolitic pebbles and cobbles. In the eastern sector the metapyroxenite bands are gradationally contact with metagabbro and sharp contact with meta-anorthosite. Layering type of meta-anorthosite is co-banded with metapyroxenite throughout the area.

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