Geology and Petrography of rocks of Torapadi layered complex, Thiruvannamalai District, Tamil Nadu

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Abstract

The current research presents field characteristics and petrography of Ultramafic rocks of Torapaddi layered complex. Lithologically Torapadi is mainly comprisedof migmatised charnockite,pink granitic gneiss, pyroxene granulite (as enclaves) and ultramafic rocks.The ultramafic body represented by Pyroxenite,Gabbro-Norite,Gabbro and Gabbroic Anorthosite.These litho-units cut by later intrusive represented dolerite. Petrography reveals the mineral assemblage, textural characteristic of Torapadi layered complex.

Keywords:Ultramafic rocks, Gabbro,and Petrography.

1. Introduction

Layered complex are a potential source for the PGE Mineralisation and study of mantle derived rocks. In the present study a part of the Torapadi layered complex was studied for its geology and petrography.Six differentrock types were collected in the detail field investigation and analysized for their respective petrographic characteristic. The study revealed that the layered complex is composed of migmatisedcharnockite and pink granitic-gneiss. The area is interbedded with pyroxene granulite and ultramafic rocks such asPyroxenite,Gabbro-Norite,Gabbro, and Gabbroic Anorthosite.Theultramafic bodyoccurs asarcuate band striking NE–SW to ENE-WSW direction, with its convex side pointing northwards (Fig.1). The eastern part of the Ultramafic body is represented by Gabbro, and, Gabbroic-Anorthosite. The study also confirmsthat the area has under gone amphibolite facies to granulite facies metamorphism. The present study concernwith thedocumentation of detailed geological field characteristics, present knowledge of Torapadi layered complex, rocks significance and distribution within the Torapadi hill area.

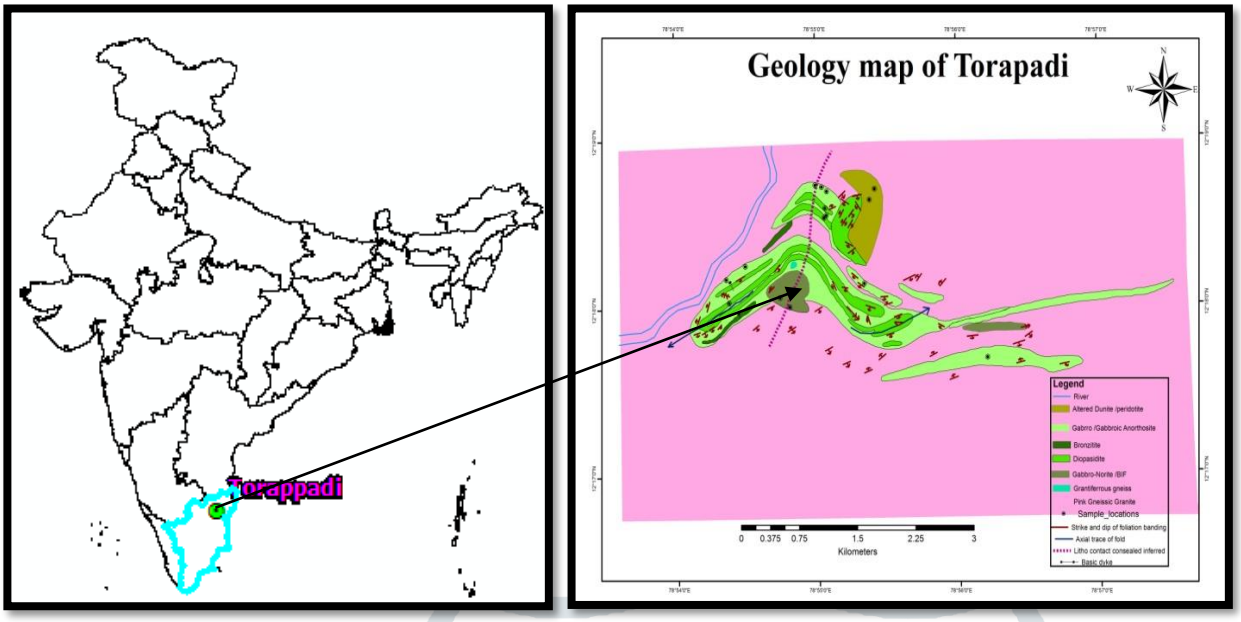


Figure 1: Location and Geology map of the Torapadi layered complex (GSI 1999)

2. Geological setting of the study area.

The Torapadi layered complex is the part Eraiyur reserved forest in the thiruvannamalai district of Tamil Nadu.The study area falls in the Toposheet no 57/L15and 57/P3,lies between north latitude 12º15′ and 12º15′30″ and east longitudes 78º 54′ and 79º 00′ 20″.It is located at the viscinity of Torapadi village.

The southern Peninsular India mainly consists of the Dharwar craton, the Cuddapah basin, the EasternGhats Mobile Belt and the Southern Granulite Terrain(Drury et.,al,1984).The Southern Granulite Terrain is composed predominantly of granulite to amphibolites gneiss, charnockite, layered complexes and anorthosite and crossed by large shear-zones(Radhakrishnan, 2009).Dash et al., 2013 divided the SGT into three separate units, (a) the Northern Block, (b) the Madurai Block, and (c) the Trivandrum Block which is separated by two major shear zones, that is the E–W trending Palghat–Cauvery in the north and NW–SE trending Achankovil in the South.Radhakrishnan, 2007 provided extensive information on mafic dyke data includes 2.1 Ga old Agali-Coimbatore dyke swarm, 1.8Ga Dharmapuri dykes,and1.65 Ga Thiruvannamalai dyke swarm. Dash (2013) referred that madras –Thiruvannamalai block is the part of northern block of southern granulite terrain is bounded by Mettur and Palghat Cauvery shear zone to the northwest and south, and the bay Bengal to the east. This terrain consists of hypersthene bearing granulites (Charnockite), hornblende-biotite gneiss-granite and mafic dykeswarms. Subbareddy et al (1989) mentioned that the Thiruvannamalai rocks are subjected to high amphibolite to granulite facies metamorphism and have undergone folding, faulting, and shearing.

Torapadi area comprises migmatized charnockite, mafic-ultramafic rocks andyounger intrusives and alluvium as a recent sedimentary deposit.Altered ultramafic rocks representedby dunite/peridotite are exposed in the northeastern foothill of the Torapadi hill. The altered ultramafic rock shows presence of Magnesite and Kankary fragments. Banded structure of pyroxenite is identified in the Torapadi area. Ray (1988) noted that Torapadi layered complex is made up of deformed Precambrian ultramafic and mafic members and tonalitic terrain surrounding the hill is at places covered up by Kankar (concretion).Gopalakrishnan(1999) reported the primary igneous layering, rhythmic layering and cumulus layers within pyroxenite,gabbro, gabbro-norite and gabbroic anorthosite.It is a rare type of hornblende bearing and olivine-bearing ultramafic body and rocks do not fit properly in the existing Olivine-Orthopyroxene-Clinopyroxene and Olivine-Pyroxene-Hornblende triangular diagrams (Ray and Bose,1993). Gopalakrishnan (1995) carried out systematic geological mapping, petrological studies and petrochemical studies with special reference to PGE potentiality of these ultramafic rocks.

The generalised stratigraphy of the study area is present below (GSIGoplalakrishnan1999

Stratigraphy of the study area(GSI Goplakrishanan 1999)

Formation	**Lithology**
	Recent Alluvium
Younger Intrusive	Pegmatite and Quartz veins
	-------Unconformity-------
Gneissic Complex	Quartzofeldspathic rock Pink gneissic granite
	-------Unconformity-------
Ultramafic and ultrabasic Intrusive	Quartz magnetite rock Gabbro/gabbroic anorthosite Gabbro-Norite Pyroxenite Altered ultramafic rock (dunite/peridotite)
	-------Unconformity-------
Charnockite Group	Migmatizedcharnockite

3. Field relationship

Mafic-ultramafic body of Torapadi area it occurs as enclaves within thecounty rock. The area consists of Pyroxenite, Gabbro, Gabbroic Anorthosite, Pink Gneissic Granite, Charnockite, Quartzo feldspathic rock. The field relationship of each is given below.

3. 1.Gabbro

Gabbro is the dominant lithology of this study area it has a mesocratic texture, looks like salt and pepper. It consists of pyroxene and plagioclase in an equal amount, it is weakly foliated and shows weakly layered mafic and felsic rich bands, in the weathered outcrop small box work was noticed.

Gabbroic Anorthosite

The rock also shows cumulus layering, anorthosite rich as a mafic grlobules are noted is associated with magnesite as a very small patch. Some of the rock units showed higher percentage of anorthosite mineral representing the rock is Gabbroic anorthosite (figure2e).

3.2. Pyroxenite

Pyroxenite is a medium to coarse grained, massive, melanocratic rock.It occurs as traceable bands and lenses within the migmatitic charnockite and gneisses. Based on field and petrographic observations,two distinct types of Pyroxenite has be identified viz.Bronzitite and Diopsidite. Bronzitite is medium-to coarse-grained, dirty brown in colour (Figure2b). Occurrence of unmappable sized thin band of enstatolite within bronzitite bands has been noticed.Medium grained Diopsidite is greenish to bottle green in colour and its occurrence is more ubiquitous in the southwestern part of the Torapadi hill (Figure 1). The outcrops of pyroxenite bands shows alteration and weathering.

3.3. Charnockite

Massif Charnockite is greasy looking medium grained granular texture rock, pinkish to greyish in colour and exhibits the gneissic by the parallel alignment of melanocratic and leucocratic Mineral Fabric. Two sets of intersecting foliation strike 305°and 290° are distinguished in the study area.

3.4. Quartzo-feldspathic Rock

This lithounit is a medium grained brownish white coloured rock. It is exposed as minor outcrops associated with gabbro and pyroxenite (bronzitite). It is occurred on the southern part of torapadi hill.

3.5. Pink Gneissic Granite

The rock is Massive leucocratic pinkish in colour and predominately composed of quartz, feldspar and biotite. Schlieren structureis visible in the outcrops. The rock unit occur as interbands between two Gabbro/pyroxenite bands.

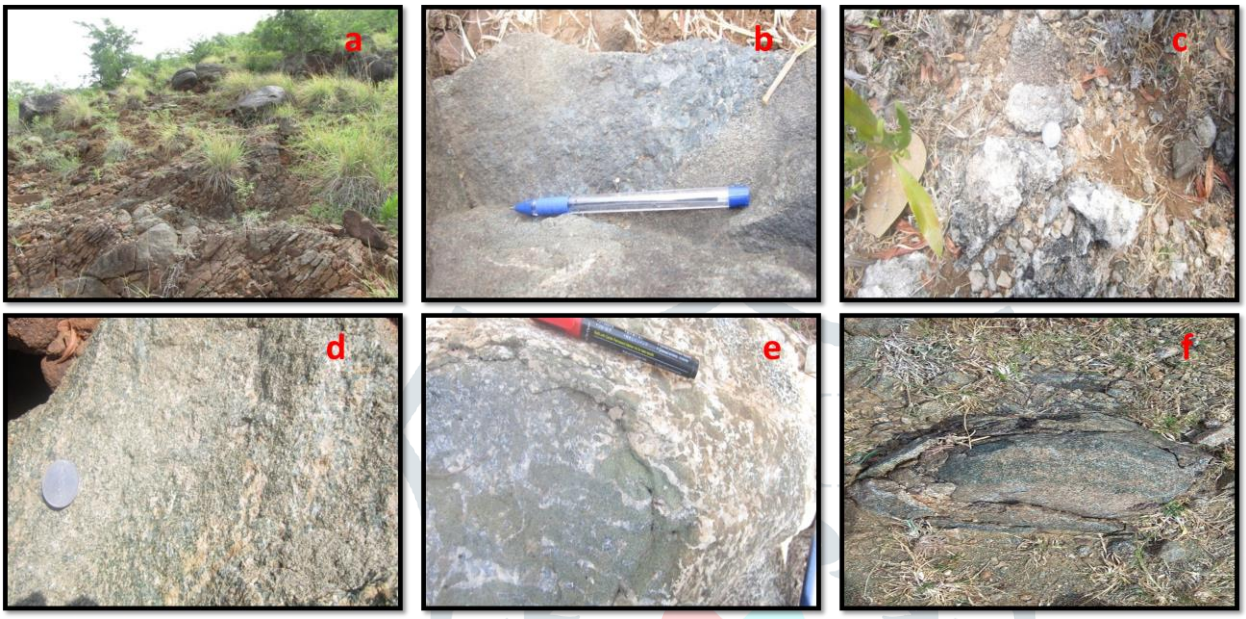


Figure 2. Field Photograph (A) Gabbro showing elephant skin weathered nature (B) Coarse-grained pyroxenite (C) Altered Ultramafic rocks are showing weathered kankary fragments (d) Medium grained pyroxenite (e) Anorthosite is abundant gabbroic anorthosite rock (f) Spheroidal weathering in the Gabbro

4.1.Petrography

The detailed Petrographicstudywas performed, for the representativesample collected during the field investigation, with the help of Zeiss petrological microscope. The description has been made based on mineralogy and texture.

4.1.1. Bronzitite

In thin section, it exhibits coarse-grained Equigranular texture.It is mainly composed of bronzite and enstatite as essential minerals (almost 80-90%) whereas olivine and hornblende are present in subordinate amount. Bronzite exhibit pale coloured, pink to green pleochroism. Under the microscope bronzite and enstatite display similar characteristic both have same pleochroism.Bronzite show many inclusions and olivine occur as inclusion within the bronzite (plate 4). Alteration and fractures were noticed in enstatite.Green coloured hornblende found in bronzitite mostly is an alteration of pyroxenes.

4.1.2.Diopsiditite

Under the microscope, the rock is coarse-grained, equigranular in texture, is composed of diopside,enstatite, and, hornblende. Alteration and tensional crack were noticed in the diopside.Diopside occurs more than 70% in the section. Hornblende is present as alteration product of pyroxene (plate 6). Diopside displays inclined extinction angle 48°.Two types of twin were identified, viz. contact twin and lamellar twin. Some of the sections showed the presence of both the pyroxene i.e. clinopyroxene and orthopyroxene, distinguished by extinction angle and pleochroism.Enstatite shows pink to green pleochroism and diopside exhibit green pleochroism and enstatite shows parallel extinction.

4.1.3. Gabbro

In thin section, the rock is medium to Medium-grained exhibiting granulitic texture. It is composed of Plagioclase feldspar (50%), diopside (40%), with minor amount (<10%) of hornblende, muscovite and quartz.Diopside shows cumulate texture, it has euhedral to subhedral crystals and shows strong green pleochroism(Plate.1). Often presence of exsolution lamellae of orthopyroxene in diopside is observed.Euhedral grains of plagioclase exhibits polysynthetic twinning. Plagioclase feldspar showed tapering twin lamellae which is formed as a result of shearing. A small amount of tiny granules of anhedral shapedquartz was also identified present.Muscovite appeared with colourless and parallel extinction. Hornblende is displayed the two sets of cleavage at an angle of 56°and 124° angle.

4.1.4. Gabbroic Anorthosite

It is medium to coarse-grained, having granulitic texture. It is composed of plagioclase (60-70%),hypersthene(10%),enstatite, diopside(>10%)as major mineralsand hornblende, olivine and biotite,as in minor amounts(<10%).Gabbroic anorthosite comprises predominantly of plagioclase feldspar and less amount of pyroxene.Most of the Plagioclase feldspar exhibits euhedral,polygonal crystals shape, lamellar twinning and the triple junction at 120°interfacial angle (Plate2). Both clinopyroxene and orthopyroxene are present. Greenishbrown colored Hornblende with two sets of cleavage is mostly the alteration product of pyroxenes.

4.1.5. Quartzo feldspathic rock

Under the microscope, this lithounit shows hypidiomorphic texture and is composed of plagioclase feldspar (55%) essential mineral, quartz (20%), microcline, orthoclase (15%) and garnet (10%) as minor minerals. Micro-Perthite intergrowth in K-feldspar was also noticed (plate5). Quartz shows anhedral crystals, wavy extinction. Microcline occurred in more percentage than orthoclase.

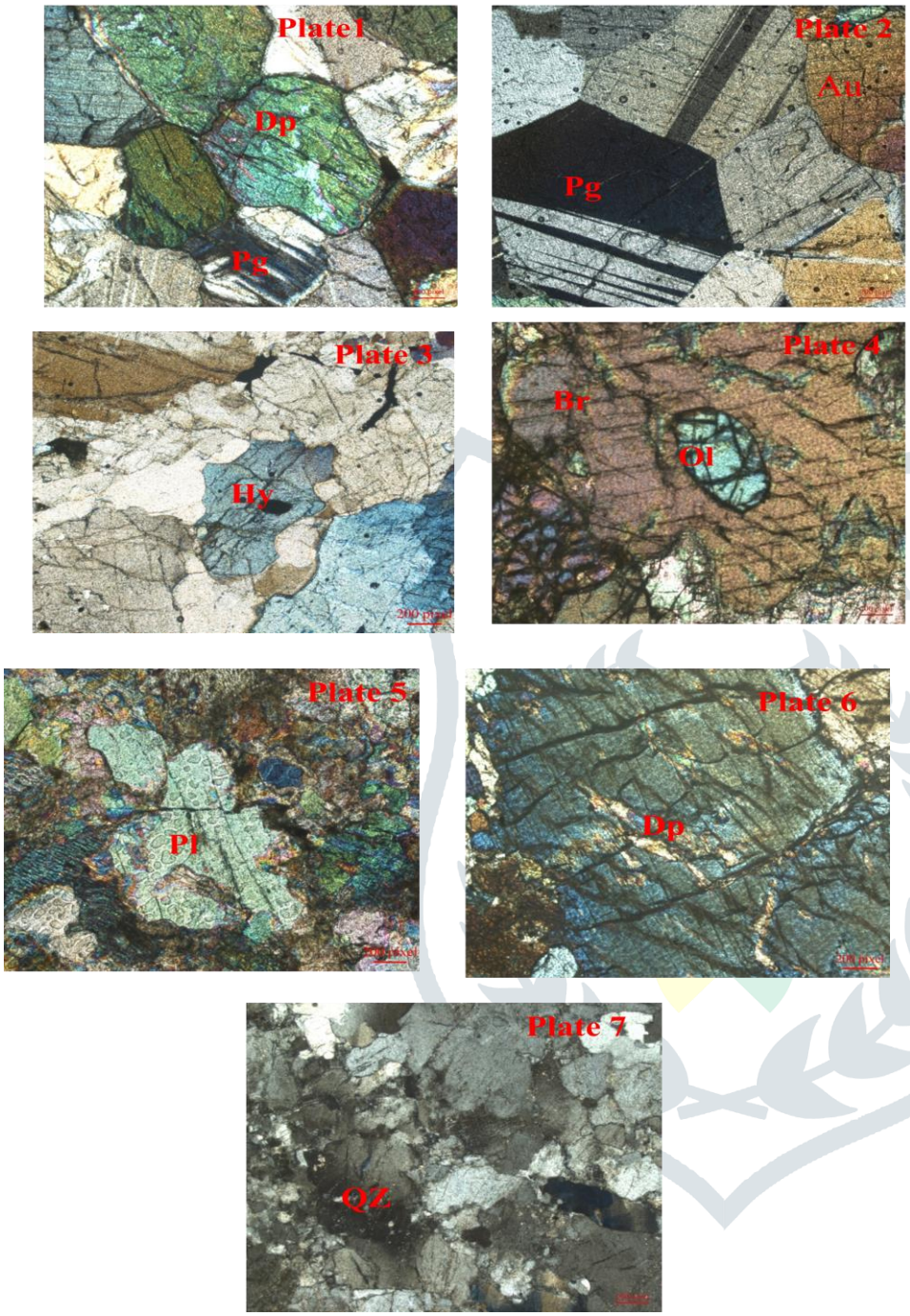
4.1.6. Charnockite

It is mainly composed of Quartz (30-40%), Plagioclase feldspar (20%) and hypersthene (10%) as major minerals. Biotite and Garnet was found to occur in minor amounts. Quartz shows anhedral crystal shape and exhibits undulatory extinction. Plagioclase feldspar shows poorly developed twinning (plate3).

4.1.7. Pink Gneissic Granite

In thin section, this lithounit exhibits gneissose texture and is mainly composed of quartz and alkali feldspar (plate7). K feldspar includes both orthoclase and microcline. Biotite and hornblende were found as minor minerals. Most of the grains are non-pleochroic. Quartz shows anhedral crystal, undulatory extinction. K-feldspar shows perthite intergrowth.

Figure 3- Photomicrograph of lithounits of Torapadi area.**Plate.1: Note the** culmulate texture in gabbro. **Plate 2**.Gabbroic Anorthosite displays triple junction of plagioclase. **Plate 3.**Charnockite showing



replacement of hypersthene by hornblende. **Plate 4 Pyroxenite: Note the** inclusion of olivine within bronzite.**Plate5**.Quartzofeldspathic rock showing hypiodiomorphic texture.**Plate.6.**Diopsiditite with fracture.**Plate7.**Pink Gneissic granite with quartz and alkali feldspar.

5. Conclusion

The present study gives detailed Petrological and field relationship of Torapadi layered complex occurring in the northern part of southern granulite terrain. The litho units of Torapadi area includes pyroxenites,gabbro, gabbroic-anorthosite, migmatized charnockite, quartzo-feldspathic rock,pink Gneissic granite and dolerite dyke.Gabbro,and gabbroic anorthosite show cumulus layers of the

pyroxene along primary igneous structure in the Torapadi hill.Under the microscope, the Gabbro and gabbroic anorthosite show the presenceof diopside and plagioclase feldspar as the essential mineral and represent the triple junction.The quartzo-feldspathic rock and pink gneissic granite interbands with ultramafic rocks in the thin section these rocks displays the micro-perthite twining. Two types of pyroxenites present in the Torapadi layered complex Bronzitite is entirely composed of bronzite, coarse-grained rock. Bronzite is altered to hornblende.Bronzite contains inclusion of olivine. The mafic-ultramafic rock of Torapadi frequently associated with magnetite, present minor amount of opaque minerals. Field observation, mineralogical and textural evidence indicates the rocks of Torapadi area indicate they have under gone Amphibolite facies to Granulite facies metamorphism.

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