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Geological and Petrological Studies of Pegmatites Rocks of in and Around Kadavur Area, Karur District, Tamilnadu

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ABSTRACT

Massif-type anorthosite complexes that commonly form huge intrusions composed of plagioclase cumulate rocks with minor volumes of associated mafic and granitic suites are characteristic features of the Proterozoic crust. Their apparent temporal restriction to the Proterozoic suggests unique tectonic-thermal conditions during this period, although the specific crust-forming processes that lead to their formation are still subject to debate. Their petrogenesis is generally discussed in terms of partial melting of upper mantle or melting of a mafic lower crustal source to generate high-Al basaltic or ferrodioritic parental melts, necessary for the formation of the high amounts of cumulus plagioclase.This study therefore, involves petrographic evaluation of near flat lying pegmatite veins intruding gneisses and granitic rocks around Kadavur area. The size, shape, external and internal structure, texture and mineral content of an individual pegmatite can be shown to be functions of the distance of the body from its batholith source. Not all of these characteristics are independent variables, for the host rock is an important factor in influencing shape and external structure and thus indirectly internal structure. It is suggested that mineralogicaliy and structurally complex pegmatites owe their generally distant position from the batholith to a relatively late withdrawal from the pegmatitic hearth with resulting increased fluidity. The petrography revealed preponderance of Microcline and albite with subordinate muscovite and anhedral quartz, accessory minerals found include tourmaline, garnet, beryl, and Aquamarine.

KEYWORDS: Petrography, Geology, Pegmatite and Kadavur Anorthosite complex.

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INRTRODUCTION

The area selected for the present study forms a part of Madurai block and lies in the Karur district in Tamilnadu, India. Madurai block is the largest Granulite block of Southern Granulite Terrain of India. It is bounded by Palghat Cauvery shear zone in the north and Achankoil shear zone in the south. Madurai block is dominantly composed of high grade metasedimentary rocks, mafic granulites, high land Charnockites Massif Anorthosites and related rocks. The massif Anorthosite showing fine grained gabbros in the border to pure anorthosite in the core forms the focus of interest. Most of the pegmatite body is exhibiting concentration of feldspars in the border zone which decreases towards the core zone. In the core quartz crystallization is found to be dominant. The pegmatite of both areas occurs as a vein and dykes in the country rock [1]. Most of the pegmatite body is exhibiting concentration of feldspars in the zone which decreases towards the core zone. In the core zone only quartz crystallization is found to be dominant. The area studied occupies 50 kilometer roughly and lies between the latitudes 10°30'and 10°35' and between the longitudes 78°5' and 78°15'. It forms the parts of the Survey of India topographic sheet No.58J/2 and 58J/6 the study area at Kadavur, Karur district, Tamilnadu. The location of pegmatites of the study area is shown in Fig.1.

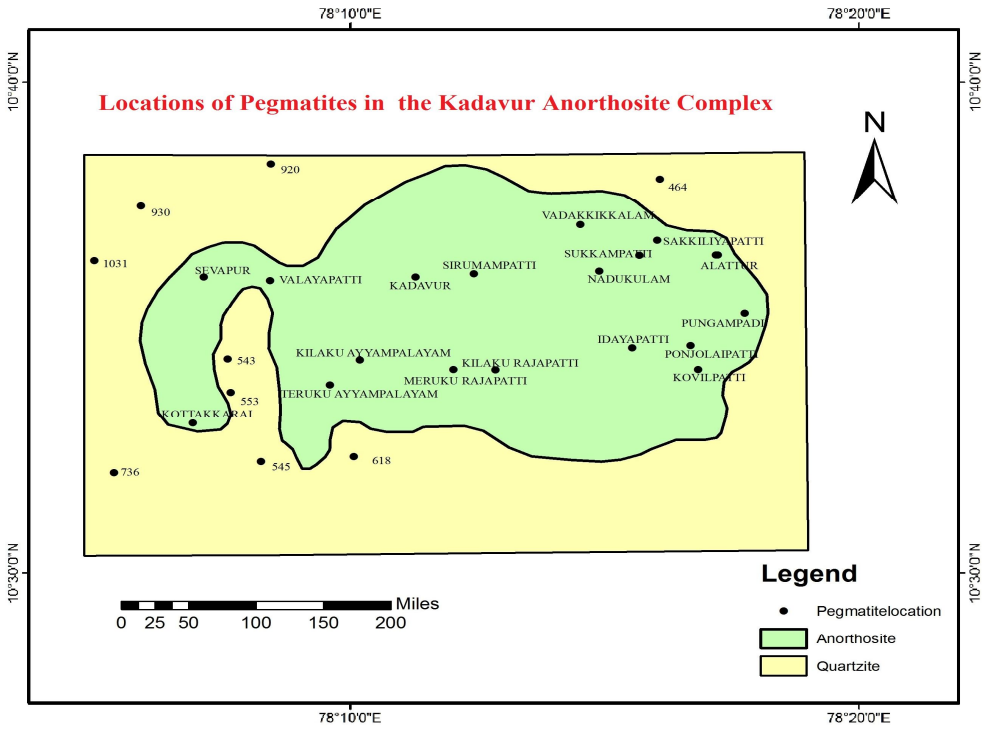

Fig.1.Locations of pegmatites in the Kadavur Anorthosite Complex

METHODOLOGY

Geological field mapping was carried out to collect, identify and study the field occurrences cum structural relationship of all the rock types present in the study area. Fresh and un-weathered rock samples were taken for hand specimen examination. Preliminary observation and identification of each constituent mineral were carried out by using magnifying lens. Measuring strike and dip directions with help of Brunton compass-clinometer and marked sampling point with the help of GARMIN (GPS). For the Petrographic studies were done for 25 selected rock samples were cut into chips with a micro-cutting machine and subsequently polished on glass ground plate using carborundum to obtain required thickness and a perfectly smooth surface, the cut rock samples were there after mounted on a clean glass slide with adhesive.

GEOLOGY OF THE STUDY AREA

The Kadavur meta- igneous complex is exposed amidst a catazonal of high grade supracrustal sequence belonging to the Eastern Ghats precambrain belt. The supracrustal litho logics preserve evidence of polymetamorphic history and are represented by,

(i) Quartzite: Quartz- schists and feldspathic quartzites: Quartz- sillimanite, biotite muscovite-plagioclase – orthoclase (magnetite-zircon- hornblende- blades ilmenite-chlorite)

(ii) Calc granulite: Hedenburgite-plagioclase –scapolite-calcite-(garnet-sphene-apatite-quartz-hornblende-chlorite)

(iii)Amphibolite: Hornblende-plagioclase-quartz (cumingtonite-actinolite epidote-zoisitc sphene-scapolite-chlorite)

Quartzites alternating with quartz-schists and minor feldspathic quartzites are by far the most dominant supercrustal lithology and along with minor intercalations of calc-silicate rocks (calc-granulites) from the metasedimentary component of the supracrustal sequence. Amphibolites, though confolded with the metasedimentary sequence there by forming an integral part of the supracrustal sequence, possibly represent mafic flows, or sills as these occur as layer-like bodies in quartzites. They have major element chemistry comparable to Theolitic basalts. The gabbro-anorthosite complex shows abundant xenolithic inclusions of the host rocks including amphibolites [2.]

RESULT AND DISCUSSION

Field observation showed that Pegmatite which serves as host for these economic minerals occur in association with other rock types like Anorthosite, Hornblende biotite gneiss, granite and gabbro rocks. Pegmatites are known to host many metallic and non-metallic minerals that are of great economic benefits. The mineralogy of pegmatite compose of feldspar, quartz, mica and other

accessory minerals in varying composition, their sizes vary from vein let of about few millimetres bodies to a few kilometres in width. Muscovite is the more abundant mica occurring in the pegmatite of the study area while biotite is very few. Minerals in pegmatite have large crystals, which are identifiable and recognizable in hand specimen [3]. Two different pegmatites are observed around the area, they are barren and complex pegmatite.Barren pegmatite has no evidence of mineralization, it contains minerals like quartz, feldspars (microcline and orthoclase), micas (mostly muscovite). Muscovite is sometimes compacted into dark colouration. This study is targeted at conducting geological mapping of the area with a view to identifying different rock types and to study the field, compositional, structural, and textural relationship among the rock varieties available in the area [4]. The pegmatites within the vicinity of the mining site at Fright have been extensively and deeply weathered revealing the highly resistant fractured quartzitic Bodies. Those that are common include the transparent rock crystals, the milky white quartz, and smoky quartz, rose quartz which could be irregular in shape and in some cases assume the hexagonal crystal shapes [5].Hand specimen observation of the un weathered pegmatite in the study area show interlocking grains of crystals of feldspar, quartz and micas commonly muscovite. Crystals of black tourmaline are embedded within some pegmatitic bodies, some pegmatitic bodies are also found to contain garnets of varying sizes. These garnets have lost their brilliant lustre due to long exposure to the atmospheric condition. Field observation showed that Pegmatite which serves as host for these economic minerals occur in association with other rock types like Anorthosite, biotite gneiss, granite and some pocket of schistose rocks. Pegmatites are known to host many metallic and non-metallic minerals that are of great economic benefits.

FIELD PHOTO DESCRIPTION

Figure.2: Photograph showing boulders of Pegmatite rocks in Valayapatti.

Figure.3: Photograph showing contact between Quartzite and Pegmatite.

Figure.4: Photograph of Pegmatite mining area.

MORPHOLOGY OF PEGMATITE AND ASSOCIATED ROCKS

The morphology of pegmatite mainly in terms of shape and size, associated country rocks and the relation of pegmatite bodies with the wall rocks play an important role in search for pegmatites. Pegmatites are generally confined to coarse to very coarse grained hypabysal igneous rock derived from the granitic magma having rich in volatile constituent by means of which it lower the rate of crystallization of magma[6]. And that volatile rich residual magma after crystallization of granites, intruded into the large bodies of igneous rock, sedimentary or metamorphic equivalent as a vein, dyke sills, batholith, stocks.

(A) Size and Shape

It has been observed all over the area that the pegmatite has very interesting and widely varying in size and shape. Their length varies from a few cm to more than a km and width varies from few cm to 200m.The maximum vertical depth is about 200m. Most of the pegmatites are partially exposed along with lenses which appear to be tabular body. Depending upon the shape of pegmatite body they have been called as dyke, sheet lenses elliptical body. Many pegmatites in the study area are found as irregular tabular, lenticular shaped having maximum thickness of about 8-10m.

(B) Relation between shape of pegmatite and type of wall rocks

It has been observed that the size and shaped of pegmatite bodies reflect the structure by which the emplacement of pegmatite body has been controlled. It is not only the structure but also the country rock which is responsible for imparting a definite size and shape of pegmatite bodies[7]. The pegmatites are generally found as intrusive rock in the country rock. Both simple type and complex type of pegmatites are found in the study area. The pegmatites of the study area are leuocratic in colour having coursed grained, composed of quartz, orthoclase, plagiclase, Biotite, Beryl, occasionally garnet and tourmaline are also found. Good varieties of crystal quartz have been found south of Kadavur basin and prominent graphic intergrowth of quartz and feldspar are found in the area. In pegmatite bodies, quartz veins are found to occur in the North West to south east direction. In some pegmatite, Biotite is found as the laths and in some as books. Garnets are also crystallization in some pegmatites of Kadavur basins.

(C) Mode of Emplacement

The emplacement of pegmatite without the development of apophyses in the wall rocks, indicate the smooth flowage of pegmatite magma through the available planes of weakness in the country rocks. Structural control of the emplacement of a few pegmatite sills was afforded by contacts between dissimilar rock types, as for example between quartzite and quartz-mica schist in Kadavur hill. Such concordant pegmatites may show a marked gradational contact and contain partly digested rock inclusions which indicate that the emplacement was effected by replacement of country rock.

(D) Wall Rock Alteration

The pegmatites usually have sharp contact with the host rocks but are in places separated by a narrow zone of wallrock alteration. The alteration involves development of new minerals, such as tourmaline and epidote, and recrystallization of mica, and also silicification of wall rocks.

Tourmalinization of wall rock has lead to the formation of tourmaline-rich cluster with schistose structure along the wall rock, even when the pegmatites are completely devoid or contain sparse tourmaline[8]. The nature and extent of wall rock alteration mainly depends up on mineralogical composition of wall rock and the attitude of the pegmatite body. The alteration is well observed along the concordant pegmatites which have been emplaced in foliated rocks which facilitate permeation and flow of fluids along the planes of foliation.

PETROGRAPHIC STUDIES

Based on the field observation and megascopic studies in the field and in the hand specimen of the pegmatite and related rocks, typical varieties of pegmatite and related rocks representative samples were selected and more than 25 thin sections were prepared from the specimens collected from the different locations in and around from the Kadavur area. Microscopic assessment of the pegmatite samples in cross polarized light revealed the presence of varying composition of constituent minerals such as microcline, plagioclase, quartz, muscovite and opaque minerals. On the basis of a careful and detailed study of all the sections prepared the petrographic descriptions are given below. They are medium (2.5 to 5 cm) to coarse (7 to 12 cm) grained and mainly composed of quartz, K- feldspar, muscovite and tourmaline with variable accessory minerals such as biotite. On the basis of mineralogical variations, the pegmatites of this sector may be classified into:

i) Simple: Consisting of quartz, feldspar, biotite and apatite

ii) Complex: Containing in addition muscovite, tourmaline and epidote.

Graphic intergrowths of quartz and feldspar, and tourmaline and quartz are also characteristics of complex pegmatites. Based on the dominant mineral content, the Kadavur pegmatites can be distinguished as quartz-rich and feldspar-rich pegmatites. Considering the mineralogical association observed, we have classified these pegmatites into the following types: -

(A) Microcline-Quartz-Muscovite Pegmatite,

(B) Tourmaline-Quartz with or without Feldspar and Mica,

(C) Quartz-Muscovite Pegmatite.

(A) Microcline-Quartz-muscovite pegmatite

This unit comprises microcline, which is generally pink in colour and occurs either as (a) large blocks present in the groundmass of quartz aggregates and muscovite, or as (b) large crystals interlocked with quartz. The concentration of giant feldspar phenocrysts is so much that in patches these larger pegmatitic bodies appear as monomineralic rock. The feldspar patches are invariably

surrounded by comparatively finer aggregates of a quartz (+ muscovite). These pegmatites have sharp contacts with the country rocks (orthogneiss and amphibolites).

(B) Tourmaline-Quartz with or without feldspar and mica

This unit range in composition from dominant quartz and tourmaline (± mica) to dominant microcline and tourmaline (± mica). The black striated tourmaline occurs as solitary ditrigonal crystals or branching crystals or as clusters of radiating finer needles and coarser Columns in the extensive concordant bodies of pegmatite in Kadavur valley. Many of the larger crystals of tourmaline, identified as schorlite and dravite [9], have been deformed by stresses induced during post-tourmaline formation. Such crystals are often curved and show a large number of closely spaced transverse fractures.

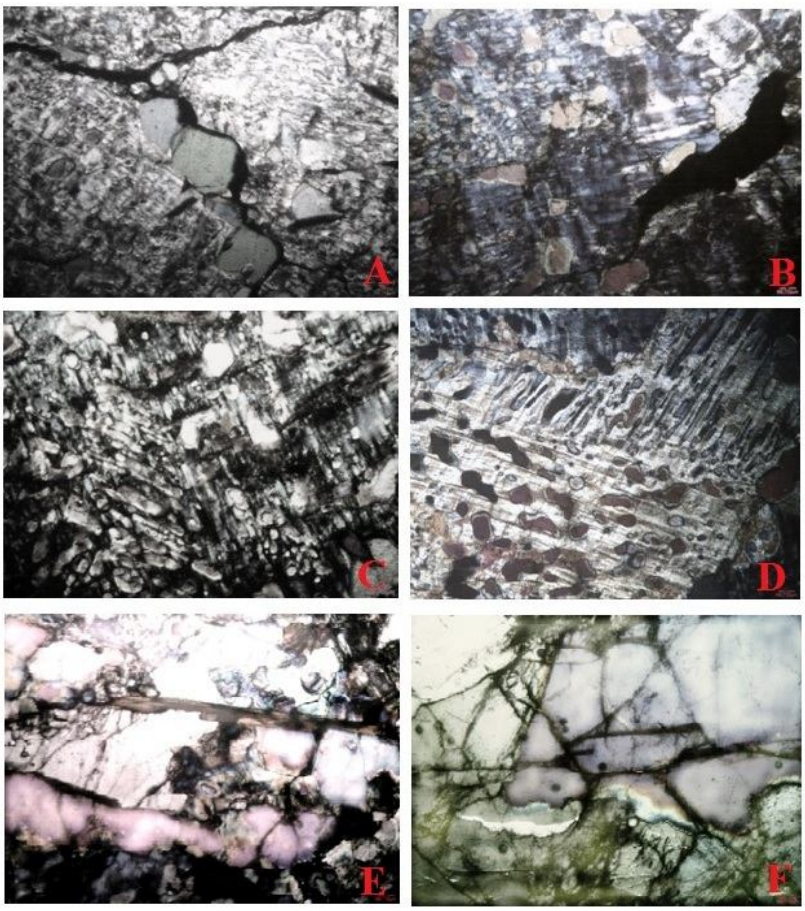

Figure.5: (A) Microphotograph of Pegmatite from Teruku Ayyampalayam. Note the orthoclase feldspar with Quartz grain in them. (B)Microphograph of Pegmatite with Heavy mineral segregation. (C)Microphotograph of Pegmatite showing intergrowth texture of Quartz and orthoclase feldspar. (D) Microphotograph showing the intergrowth texture between Quartz and feldspar from Rajapatti. (E) Microphotograph with development of Biotite Needle. (F) Microphotograph from the core zone of Quartz exhibiting Fluid inclusion.

(C) Quartz and muscovite

This unit almost entirely comprises massive, milky white or colourless quartz and flaky aggregates of muscovite. Quartz generally occurs as sutured or coarse aggregates of anhedral grains. This type of pegmatite is generally en countered in amphibolites and metasedimentary rock.

ECONOMIC GEOLOGY OF THE PEGMATITE

The pegmatite of the study area contains economic mineral such as quartz, feldspar, muscovite, tourmaline, garnet and beryl. Quartz serves as a raw material in the production of abrasives, refractories, and in the making of glass. Feldspars are used in ceramics and in making of glass. They also serve as a source of alumina and as a partial replacement of soda ash. They are indispensable raw material used for the production of porcelain enamels, flux and filter in latex paints[10.] They are employed in the manufacture of abrasive, cleaners, and polishes. Ground feldspars are extensively used in scouring and cleaning, and as non-skid dusting agent for oil and slippery floors. Muscovites are used as raw material in the manufacture of insulators in the electrical industries. They can also be used in cosmetic industries.

CONCLUSION

Pegmatites are crystalline intrusive igneous rocks composed of interlocking crystals, usually larger than 2.5 cm in size. Most pegmatite is composed of quartz, feldspar and mica. The study area Kadavur anorthosite complex is composed of igneous intrusion of anorthosite and related rock intruding in to the structural hillocks, and made up of quartzite. As a later based stage or final stage of emplacement of the residual fluid of magmatic chamber pegmatite are emplaced cutting across the weak zone all along the anorthosite and related rocks. As well as into the country rocks, in the present study following conclusion are brought out. The pegmatites studied are intrusive igneous bodies of highly variable grain size which includes coarse crystal growth. The systematic study of the geological setting and structural features of the pegmatite reveal that they were emplaced along, the joint and fracture plane in the anorthosite and related rocks of the study area. The mineralogy of the pegmatite studied is simple granite pegmatite and they contain quartz, feldspar and mica. Complex pegmatites are commonly zoned. Zoned pegmatites consist of concentric zones with difference in mineralogy and texture and usually showing gradational common boundaries. Quartz varieties are crystalline smoky and are common and they are found to be well developed in core zone of the pegmatite bodies. Intrusion of pegmatite into the anorthosite related rocks is associated with

fluid over pressure that exits the confining pressure of the coast rock. The over pressure (pegmatite) developed due to the volatile component.

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