Rb-Sr Ages of cordierite-gneisses of southern Karnataka

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Abstract
The cordierite-gneisses of southern Karnataka give Rb-Sr ages of 3600±90 m.y. indicating their relationship to 3000 m.y. event in the Dharwar craton, for which evidence is available in a number of areas.

Introduction
The cordierite-bearing gneisses constitute an important but less studied lithological unit in the southern parts of the State with diverse lithological associations. Their mode of origin and stratigraphical position is not clear. They have been interpreted as altered variants of the charnockite series (Jayaram, 1912) and as contact metamorphites (Sen, 1912). Rama Rao (1925, 1926) and Radhakrishna (1954) have studied these rocks and are inclined to classify them as metamorphosed supracrustals, probably also as "basic fronts" of granitization episodes. Anantha Iyer and Narayanan Kutty (1975), on the basis of chemical and petrographic evidence regard these rocks as regional metamorphites, formed under probable P. T. conditions 650 – 750°C and 6 – 8 kb. Cordierite granulites also occur in the Rhodesian craton with similar lithological associations and Clifford (1974) provides evidence in support of the cordierite-bearing rocks of Transvaal predating the Swaziland Sequence, which includes rocks older than 3000 m.y.

Geochronological studies could provide pertinent information in this regard and elucidate features of the early metamorphic history of the Dharwar craton. In the present work, cordierite-bearing gneisses in parts of Bangalore District of southern Karnataka have been selected for Rb-Sr geochronology studies.
Field aspects and mineralogy

The cordierite-bearing gneisses occur as linear bands and isolated stringers within the migmatite complex. The thickness varies from 15 to 100 m and the strike length from a few metres to as much as 3 km. The more prominent of these occurrences are located NNE of Doddaladamarapalya (Lat. 12°54'35" : Long. 77°23'40"), South-East of Jeksandra (Lat. 12°38'50" : Long. 77°26'30") and NNW of Valagerehalli (Lat. 12°35'5" : Long. 77°15'30"). See Fig. 1.

Figure 1. Location map of areas studied.
1. Peninsular gneiss 2. Charnockite 3. Closepet granite

These gneisses are intimately associated with quartz-magnetite granulites and strike North-South with an easterly dip at 45°–60°. In some localities a poorly defined mineral lineation by sillimanite and garnet porphyroblasts is observed; while elsewhere they are traversed by aplite and pegmatite veins. The exposures in general, are highly crumpled. However, a conformable relationship between them and the enclosing gneisses could be seen in all the areas.

Although the individual bands are separated from each other, the mineral assemblage is strikingly similar. The latter consists of cordierite, sillimanite, garnet, biotite, feldspar and quartz, cordierite and biotite being the abundant constituents.
Cordierite occurs both as grains and as large porphyroblasts, and the biotite is of the brown variety. Sillimanite and deep red to pink garnets occur as porphyroblasts in dimensions comparable to cordierite in places. Zircon and apatite are the principle accessories.

Analytical data

In the present study, cordierite gneisses from the localities indicated in Table I have been studied by the Rb-Sr method. Rb and Sr stable isotope dilution measurements, as well as Sr\(^{87}/Sr^{86}\) measurements have been carried out with the AEI-MS-702 Mass spectrometer, fitted with a triple filament thermal ionization source. The results on whole rocks, biotites and a cordierite crystal are shown in Table I: An isochron plot (Fig. 2) shows that the cordierite gneisses define an isochron of (3,010±90) m.y. with an initial Sr\(^{87}/Sr^{86}\) ratio =0.703±0.001. The biotites that appear to be associated with the surrounding Peninsular gneisses (B-1) yield a mineral age of 2400±60 m.y. while those that adjoin the Closepet granite (B-2) yield a mineral age of 2020±60 m.y. It is also interesting to note that the data point for the cordierite crystals (C-1) fall on the higher age isochron. While the actual sites...
for the Rb viz. cordierite lattice, or biotite inclusions in the same (though these were not observable in thin sections) are uncertain, it is obvious that the mineral has remained a closed system after the earlier 3000 m.y. event.

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\text{AGE} = 3010 \pm 90 \text{ M.Y.} \quad (S.87/1) = 0.701 \pm 0.001.
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Figure 2. Isochron for cordierite gneiss.

Discussion

There has been quite some evidence of a 3000 m.y. event in this cratonic region (Venkatasubramanian, 1974). In the field, the cordierite gneisses appear more deformed and disturbed as compared to the surrounding migmatites. Paleosome in the cordierite gneisses are interbanded by granitic leucosomes comparable in character to the surrounding gneisses. Similar discordant leucosomes are found in the Harohalli and Doddaladamarapalya areas. In the vicinity of R-11 (13th mile, Bangalore-Magadi Road), the cordierite gneisses are associated with tremolite and actinolite-bearing mafic rocks. The biotite ages of B-1 (Doddaladamarapalya) show the undoubted influence of the ubiquitous later event (2500 m.y.) among the Peninsular gneisses (Crawford, 1969; Venkatasubramanian, 1974) while the biotite
ages (B-2) of Harohalli are indicative of resetting by the later Closepet granite event. While Rb-Sr data on cordierite gneisses from other Archaean cratons are not available in literature, the present data are not inconsistent with the association of cordierite-garnet assemblages with high grade gneiss complexes.

References


