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SHORT COMMUNICATION

Rb-Sr Dating of Sambalpur Granodiorite, Western Orissa

The wholerock Rb-Sr isochron age of 2380 ± 44 Ma (Sr_i = 0.70492 ± 14) obtained for the Sambalpur granodiorite indicates an Early Proterozoic granitic activity in this region younger than Singhbhum Granite (ca. 3.3 to 3.1 Ga). Comparable Rb-Sr ages have also been reported for different granites from Mandhya Pradesh.

Introduction: The area around Sambalpur (Fig.1) is mostly occupied by granitic rocks which form the basement of a younger supracrustal cover sequence of Middle to Late Proterozoic age. The grantic range in composistion from tonalite through granodiorite to alkali granite. Considering its composite nature and its aerial extension over a large part of western Orissa, this complex forms the northeastern part of the Central Indian craton (Fig. 1A).

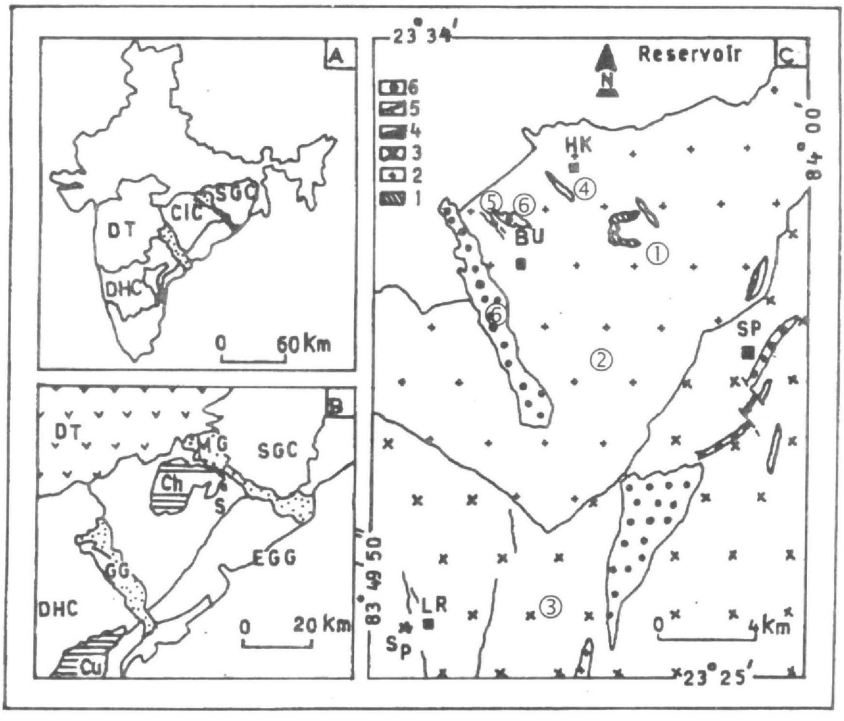

Fig.1. (A) Map of India showing the cratonic areas and (B) Regional setting of the area around Sambarlpur; CIC- Central Indian Craton, DHC- Dharwar Craton, SGC- Singhbhum Craton, EGG- Eastern Ghats Granulite Belt, Cu- Cuddapah basin Ch- Chhattisgarh basin, MG- Mahanadi graben, CG- Godavari graben, DT- Deccan Traps, S- Study area. (C) Generalised geological map of Sambalpur area; 1-Amphibolite, 2- Medium grained granodiorite, 3- Sambalpur granodiorite, 4- Granite, 5-Dolerite, 6-Supracrustal cover sequence. BU- Burla, HK- Hirakud, LR- Larambha, SP- Sambalpur, Sp- Sample location (LR-1 to LR-6).

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Geology of Sambalpur Area: The earliest account of the geology of the Sambalpur area is given by Ball (1877). Banerjee and Chatterjee (1966) published a short note on the Sambalpur granite body describing the different varieties and their general petrographic features. During recent mapping of the area by one of the authors (A.N) several lithological units were delineated (Fig. 1C). The main unit is a dark grey porphyritic rock of granodiorite-adamellite composition occurring around Sambalpur town and extending well beyond the study area to the east, south and west. This unit has been named as the Sambalpur Granodiorite. The rock is characterised by the presence of plagioclase and K-feldspar megacrysts set in a dark grey groundmass containing hornblende and biotite. At places it is weakly foliated and the feldspar megacrysts with rectangular to slightly elliptical shape are roughly parallel to the foliation plane. At other places the rock is a well foliated augen gneiss in which the feldspar forms lenticular augen wrapped round by the foliation. In zones of strong deformation the phenocrysts have been stretched to thin ribbons and pencils. To the north there is another unit of medium grained light to medium grey granodiorite.

A large number of enclaves of medium grained granodiorite can be seen within the porphyritic granodiorite indicating an younger age for the latter. Both the granodiorite units contain amphibolite enclaves of varying dimension. Tonalite forms a minor constituent of the granitic complex. Pink granite occurs as veins, lenses and dykes cutting across the porphyritic granodiorite and the medium grained granodiorite. Enclaves of garnet-biotite schist are common within the medium grained granodiorite. Metasedimentary rocks belonging to the Middle to Late Proterozoic Chhattisgarh Supergroup lie unconformably over the granitic basement. The stratigraphic sequence established for the Sambalpur area is given in Table I.

Table I. Stratigraphic Sequence

Supracrustal cover rocks
——— Unconformity ———
Dolerite dykes
Granite (*sensu stricto*)
Sambalpur Granodiorite
Medium-grained granodiorite
Tonalite
Amphibolite

Rb-Sr Geochronology: Isotopic age data on components of the West Orissa Granitic Complex (WOGC) are lacking. Seven samples, each weighing between 15 to 20 Kg, were collected from a quarry near Larambha village (Lat. 21°21' : Long. 83°30'). The samples are medium grained grey, porphyritic granodiorite with perceptible foliation defined by hornblende and biotite. Petrographic description of the samples are available on request. Processing and mass spectrometic analysis of samples were carried out as described by Bhaskar Rao *et al.* (1992).

Rb-Sr isotopic data is given in Table II and plotted in the Sr evolution diagram (Fig. 2). The data points conform satisfactorily to a linear array. The straight line shown is the two error regression line of all the seven data points. Interpreted as an isochron, it corresponds to an age of 2414 ± 75 Ma with an initial Sr isotopic ratio of 0.70488 ± 0.00024. The MSWD

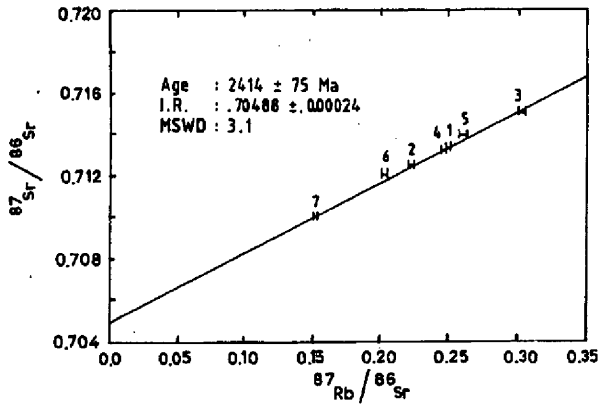

Fig.2.Sr evolution diagram for the Sambalpur granodiorite samples.

is somewhat high (3.09) because of the slight deviation of two points, LR-5 and LR-6, from the best fit line. The exclusion of these two points from the regression considerably lowers the MSWD (0.53) indicating that the remaining five points satisfy the isochron conditions well within experimental errors. However, the age of 2380 ± 44 Ma and the initial Sr isotopic ratio of 0.70492 ± 0.00014 given by the new regression are indistingushable within the analytical error from the previous values. It is therefore, reasonable to assign an age of 2400 Ma with an initial Sr isotopic ratio of 0.70492 ± 0.00014 to the Sambalpur Granodiorite. The reason for the slight deviation of the points LR-5 and LR-6 could not be ascertained from the examination of the thin sections. The high initial Sr isotopic ratio for these rocks suggests a crustal origin of the protolith.

Table II Rb-Sr Isotopic Data.

Sample No.	Rb ppm	Sr ppm	*$^{87}Rb/^{86}Sr$ (atomic)	+$^{87}Sr/^{86}Sr$
LR-1	49.4	754	0.249	0.71353 ± 2
LR-2	50.5	658	0.222	0.71260 ± 2
LR-3	55.8	536	0.301	0.71521 ± 1
LR-4	51.4	603	0.246	0.71333 ± 1
LR-5	53.4	599	0.259	0.71407 ± 2
LR-6	43.9	628	0.202	0.71211 ± 1
LR-7	34.3	655	0.152	0.71011 ± 1

* Error in ($^{87}Rb/^{86}Sr$) is 1%

+ Error shown is in the last digit and represents the standard deviation of the mean.

Comparison with Other Cratons: Ages close to that of the Sambalpur Granodiorites have been obtained by Sarkar *et al.* (1990) for the migmatitic gneisses (2528 ± 489 Ma) and the Sukma granite gneiss (2636 ± 489 Ma) from the Bastar area which, along with the Sambalpur area forms the eastern margin of the Central Indian Craton. These two granitic rocks from the Bastar area are also characterised by high initial Sr isotopic ratios. Parts of the Dongargarh granitic complex, Bundelkhand granitic complex and Malanjkhand granite from the Central Indian Craton have also comparable ages.

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