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A COMPARATIVE STUDY OF THE CHAKRADHARPUR AND THE ARKASANI GRANITE GNEISS, SINGHBHUM DISTRICT, BIHAR

P. SANYAL, D. S. BHATTACHARYYA AND D. DASGUPTA
Department of Geology and Geophysics, IIT, Kharagpur

Abstract

The Arkasani granite gneiss occurs as detached elongate outcrops close to the northern margin of the Chakradharpur granite gneiss. Both show imprints of the same deformation and same textural and structural characters. While the Chakradharpur gneiss ranges from tonalite – granodiorite – granite – alkali feldspar granite, the Arkasani gneiss is an alkali feldspar granite. Major element compositions of the two are either gradational or overlapping. The former has higher Na_2O values and the latter higher K_2O values. The two groups of gneisses are genetically related.

Introduction

The granitic rocks of Singhbhum area have been loosely designated as granitic rocks without quantifying the mineralogical and chemical characteristics of these rocks.

An attempt is made in the present paper to bring out the tectonic, petrographic and chemical characters of Arkasani and Chakradharpur granitic rocks.

Structure

The main structural characters of these rocks are :

(1) The boundaries of both groups of rocks are gradational at places and sharp at others with the enclosing phyllites and mica-schists.

(2) Foliations are not uniformly developed everywhere. The general strike of foliation is ENE-WSW and dip 55°-65° towards north. The foliations bear a strong mineral lineation plunging at 45° – 50° towards NNE.

(3) These structural features can be traced from inside to outside the gneissic bodies into the enclosing mica-schists and phyllites with exact orientations. The foliations cut across the contact at places and run parallel to it at others.

(4) The gneissic rocks show enclaves of quartzites, phyllites, mica-schists and hornblend schists with sharp or gradational boundaries.

(5) A striking feature is the presence of amphibolite dykes with little or crudely developed foliations and lineations in the easternmost outcrop of the Arkasani gneiss (Fig. 1). There are practically no dykes in the other outcrops of the Arkasani and the Chakradharpur gneiss.

Thus, from the view point of tectonic structures, there is no discernible distinction in the nature of the Arkasani and the Chakradharpur gneisses. However, the northerly dip of foliation, almost downdip plunge of stretching lineations and the associated asymmetry of the folds indicate a southerly tectonic transport. From this point of view the Arkasani granite gneiss sheets occupy slightly higher tectonic levels than the Chakradharpur gneiss sheet.

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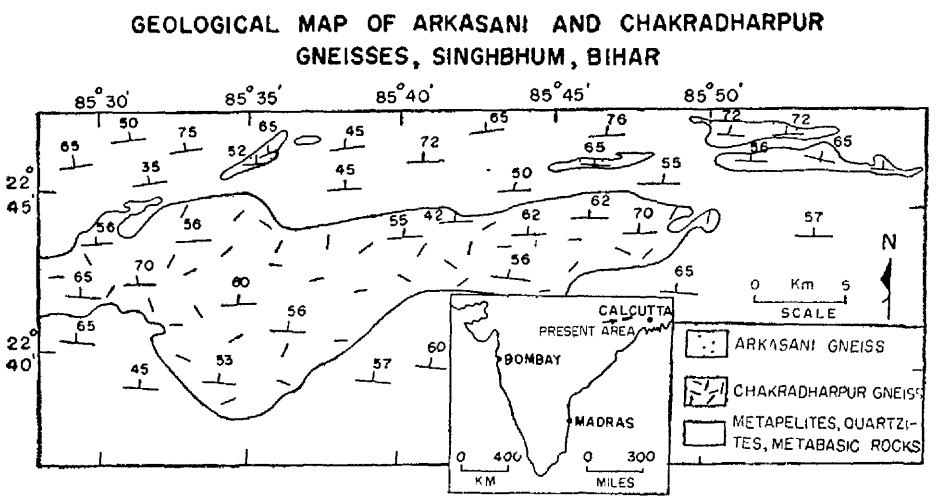

Figure 1. Regional Geological map of Chakradharpur and Arkasani gneiss.

Petrography

The main petrographic characters are:

(1) Both the Arkasani and the Chakradharpur granite gneisses show different degrees of heterogeneity in texture and composition, though much less in the former.

(2) The constituent minerals are quartz, plagioclase and alkali feldspar with varying proportions of muscovite, biotite, chlorite, epidote, allanite, zircon and opaques. Quartz grains are both deformed and recrystallized. The feldspars are generally undeformed and frequently form large porphyroblasts. The alkali feldspars are commonly orthoclase and microcline. The plagioclase feldspars range from An_5 to An_{20}.

(3) The texture is a true metamorphic granoblastic and highly inequigranular with interleaved layers of phyllosilicates. Intergrowth textures such as granophyric and graphic are present in both groups of gneisses and constitute less than 1.5% of the total volume. Myrmekites, albite rims, chess board albite and interstitial microcline are all present in minor proportions.

(4) Modal composition of thirty samples of the gneisses are plotted on Streckeisen's diagram (Fig. 2). It is obvious that the Chakradharpur gneisses are far more heterogeneous in composition than the Arkasani gneiss. While all samples of Arkasani gneiss fall entirely within the field of alkali feldspar granite, the majority of the samples of the Chakradharpur granite fall in the field of granite, granodiorite and tonalite (Fig. 2). This clearly brings out the differences in the nature of the two gneissic bodies, viz., the composite nature of the Chakradharpur gneiss in contrast to fairly uniform nature of the Arkasani gneiss.

Geochemistry

Major element analysis of eighteen samples of Chakradharpur gneiss and twelve of Arkasani gneiss have been analysed (details available on request). Al_2O_3, Fe_2O_3,

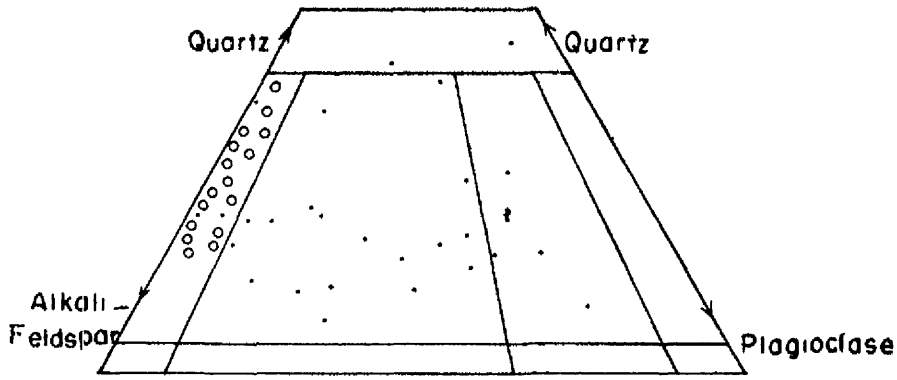

Fig-2

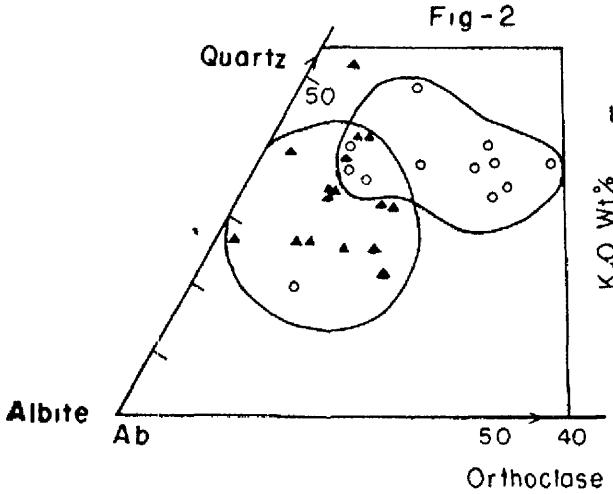

FIG-3

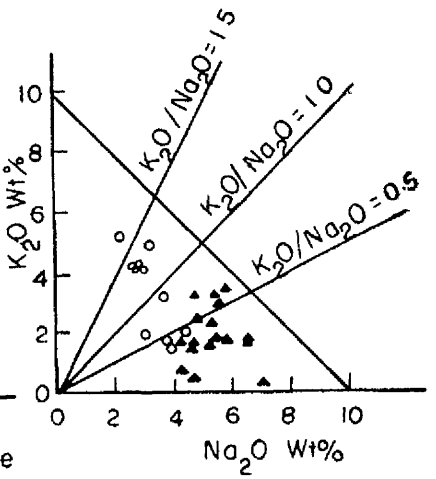

FIG-4

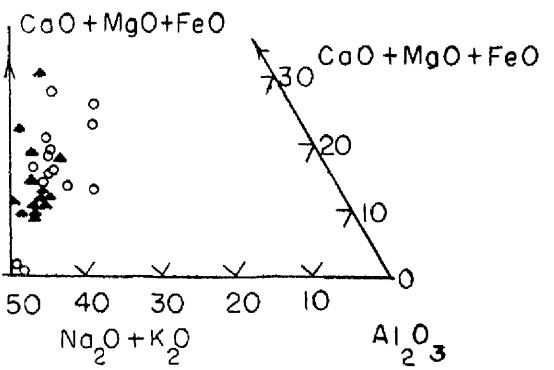

FIG-5

Figures 2 to 5.

Fig 2 Streckeisen's diagram. Dots=Chakradharpur gneiss, Circles=Arkasani gneiss

Fig 3 Quartz - orthoclase - Albite triangle.

Fig 4. K_2O *vs* Na_2O wt percentage

Fig 5 $(CaO+MgO+FeO) - (Na_2O+K_2O) - Al_2O_3$ triangle

CaO, MgO and TiO_2 were estimated by rapid method using complexiometric titrations; Na_2O and K_2O were estimated by Flame Photometer. SiO_2 was determined by spectrophotometer. FeO was determined by titration. The relevant chemical parameters and their graphical relationships are presented below.

Fig. 4 shows plots of K_2O against Na_2O (wt. %). Majority of the Arkasani gneissic samples have $K_2O/Na_2O > 0.5$ while those of Chakradharpur gneiss have $K_2O/Na_2O < 0.5$, though several samples overlap. However, the total alkalis ($Na_2O + K_2O$) of both groups are almost the same. Fig. 3 represents plots in the triangle, quartz-albite-orthoclase; compositions of the two groups are overlapping, but Arkasani gneisses are enriched in orthoclase while the other in albite. Plots in the triangle $(CaO + MgO + FeO) - (Na_2O + K_2O) - Al_2O_3$ (Fig. 5) indicate that all samples are corundum normative, yet the Arkasani gneisses range into higher Al_2O_3%.

The sum of the chemical characters discussed above bring out the following features:

(1) The Arkasani and the Chakradharpur gneisses are compositionally gradational or overlapping.

(2) Total alkalies are almost the same in both.

(3) Several samples of Arkasani gneiss have higher K_2O and Al_2O_3 content and those of Chakradharpur gneisses higher Na_2O content.

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Reference

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