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Geology of Dakshin Gangotri Hill Range, Antarctica

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ABSTRACT

Geological and structural studies of the *Dakshin Gangotri* (Schirmacher) range Queen Maud Land of East Antarctica were carried out from Jan 12 to Feb 5 1984. The dominant rock types are high grade quartzo feldspathic gneisses with intercalations of metabasites. Gneisses have been broadly differentiated into pyroxene granulite banded gneiss garnet biotite gneiss augen gneiss and biotite gneiss. In addition amphibolites migmatites and mylonites are also prevalent. Intrusives are pegmatites of different ages and basic rocks. The dominant foliation trend is E-W with moderate dips towards south. Rocks have undergone polyphase deformation. Zones of shearing are present along the entire range. Mineral assemblages of gneisses indicate that they are products of regional metamorphism of pelitic and quartzo feldspathic sediments under the almandine amphibolite and granulite facies. In the central part of the range the garnet biotite gneiss near its contact with the augen gneiss shows disseminations of sulphides and pockets of graphite.

INTRODUCTION

Schirmacher range of Queen Maud land of east Antarctica named after *Dakshin Gangotri* the Indian Research Station is about 16 km long between latitude (70°44 30 S and 70°46 30 S) and longitude (11 °22 40 E to 11°54 00 E). It is an E-W trending low lying range with a maximum width of 2 7 km in the central part.

Northern periphery of this hill range has an abrupt and steep fall towards the shelf-ice. The southern periphery underlies the continental ice-sheet, which cascades down gently over the bed rock. A characteristic feature of the southern periphery is the presence of a number of glacier outlets, giving rise to about 12 prominent glacial lakes, the largest lake being 1 km x 0 75 km and the smallest 400 m x 130 m.

The entire range shows characteristic piedmont glacial features, derived from the inland continental sheet glaciers which once flowed over the Schirmacher range. Land forms of glacial origin like U-shaped valleys, moraines at higher elevations and glacial polishing of the bed rock are abundant.

Geological and structural mapping of the *Dakshin Gangotri* hill (Schirmacher range), Queen Maud Land was carried out on scale 1 25,000 (Fig 1).

GEOLOGICAL SET-UP

The stable craton of east Antarctica comprises unfossiliferous, Precambrian high-grade gneisses and crystalline schists with granite intrusives. The Precambrian crystallines constitute mountain ranges like Humbold, Wholthot and Gruber in east Antarctica. The study area lies about 100 km north of this mountain range as a low lying isolated ridge. High grade gneisses, amphibolites, migmatites and mylonites are exposed in the *Dakshin Gangotri* range.

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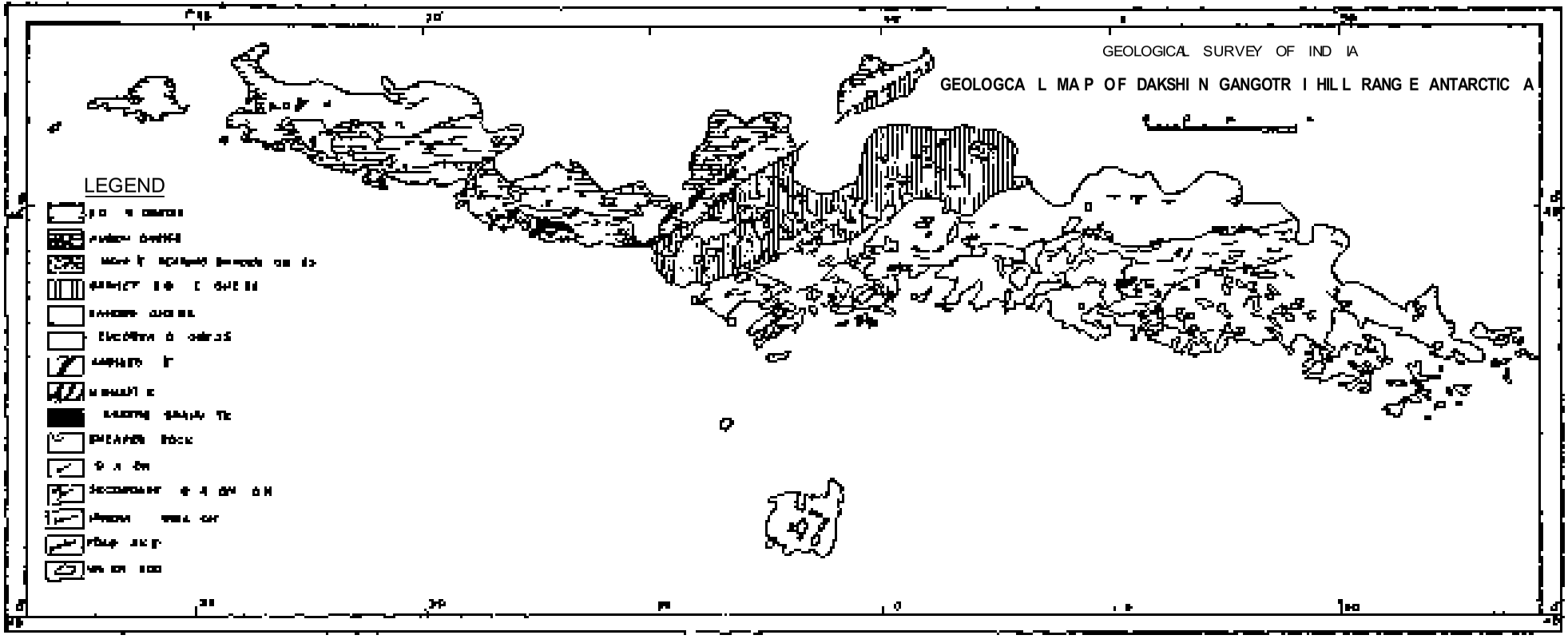
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Fig 1.

DESCRIPTION OF LITHOLOGICAL UNITS

On the basis of nature and composition, the gneissic rocks have been subdivided into four major groups, (i) banded gneiss (ii) garnet-biotite gneiss (iii) augen gneiss and (iv) biotite gneiss. These four groups of gneisses comprise more than 90 percent of the exposed bed rock.

i Banded Gneiss

This is the dominant litho unit which is exposed in the eastern part of the range extending up to the central part. It is well foliated showing general ENE-WSW strike with minor variations towards NW-SE and moderate dips towards south. Minor strike variations to NW-SE and rare steep dips are also noticed. In the central part, these banded gneisses show shearing and minor intercalation of pyroxene granulites. A conformable band of leucocratic gneiss was noted in the central part. Mineral assemblage includes quartz, potash feldspar, albitic plagioclase, biotite, hornblende and garnet, with apatite zircon, and opaques forming the accessories. Feldspars show minor sericitisation. Garnet occurs as small porphyroblasts and hornblende form prismatic poikiloblastic grains. Gneissosity is defined by strong parallel alignment of biotite flakes.

A single conspicuous exposure suspected to be of pyroxene granulite is located along the eastern boundary of a lake (77°44 S 11°40 E). These are brown coloured non foliated rocks with positive geomorphic expression. Mineral constituents of this coarse grained rock are orthopyroxene (hypersthene enstatite) hornblende plagioclase (oligoclase) and quartz. Accessories include tourmaline ilmenite rutile and zircon.

ii Garnet Biotite Gneiss

Rocks are medium grained, grey to brown cloured, well foliated, occupying the central part of the range. In general, these rocks show E-W to NW-SE trend with minor variations in the eastern part.

Petrographic studies indicate that pink coloured idioblastic garnet constitute the predominant mineral of this unit. These garnets are fractured and contain inclusions of quartz opaques and rarely zircon. Other minerals include microcline perthite plagioclase (composition An_{38}) biotite horn blende and rarely orthoclase. Accessories include apatite zircon and opaques. Gneissosity is defined by alternate layers of quartzo feldspathic and mafic minerals. Foliation is defined by the parallel alignment of stretched biotite flakes and it often wraps around the garnet porphyroblasts.

The garnet biotite gneiss is separated from the augen gneisses in the west by a thick zone of limonitised gneisses. These gneisses contain disseminations of chalcopyrite and arsenopyrite. Gneissosity in these rocks is manifested by alternate light coloured bands comprising of calc silic ates and darker bands composed mainly of biotite and amphiboles. These rocks show E-W trend in the south and NE-SW trend in the north with moderate dips towards south. Rocks of this unit show shearing.

In the southern part, near the contact of augen gneiss with sulphide bearing gneiss there is a migmatite zone where blocks of dark amphibolites are found embedded in a quartzo-feldspathic gneiss. The main constituents of amphibolitic patches are hornblende and tremolite. Kyanite has also been noticed as broad, elongated flakes.

iii Augen Gneiss

This forms the predominant rock unit of the western part of Schirmacher range. These rocks form an open antiform, with flat beds in the axial part.

Augen gneiss is coarse grained and inequigranular. Elongated grains of biotite and hornblende are oriented in a parallel fashion exhibiting a strong foliation. Feldspar and quartz grains are inter-locked.

showing granoblastic texture. The porphyroblasts of microcline form augens within a matrix of quartz biotite hornblende and K-feldspar. Accessories include apatite zircon and opaques. In the shear zones the augens are flattened and elongated in the direction of shearing. Towards the northern part of the range the augen gneiss has become streaky in nature and can be described a streaky gneiss.

iv **Biotite Gneiss**

Exposed in the western most part of the range and follows a general trend of WNW-ESE with moderate dips towards south. Minor variations in this trend is noted near its contact with the augen gneiss.

Elongated flakes of biotite with their parallel alignment imparts a strong foliation to this rock. Mafic minerals include short prismatic crystals of hornblende. Light coloured layers are dominated by orthoclase and quartz.

INTRUSIVES

(a) *Amphibolite* Several concordant lenticular bodies of dark coloured slightly weathered well foliated amphibolite have been noticed in the *Dakshin Gangotri* range. Hornblende biotite plagioclase (oligoclase) and quartz form the principal mineral constituents. Two generations of hornblende could be noticed one showing chloritised nature and the other occurring as fresh grains. Few anhedral grains of weakly pleochroic cordierite have also been noted.

(b) *Pegmatite* Pegmatites of various generations exhibiting concordant as well as discordant relationships with the gneisses are exposed throughout. They are composed mainly of pink potash feld spar quartz mica tourmaline and calcite. One pegmatite in the western part contains 10 cms long tourmaline crystals and 2 cm books of mica.

(c) *Quartz Veins* Usually thin and are conformable with foliation of gneisses or occur along the joint planes.

(d) *Quartz Calcite Veins* They are lenticular and sheared. Some veins show scheelite under ultra violet light.

(e) *Dolerite* Medium grained dark coloured dolerite dykes are common. They represent the latest intrusive activity and consist of plagioclase augite quartz and K-feldspar with Sub ophitic and inter granular texture.

STRUCTURE

Preliminary Studies indicate four phases of tectonic deformation. The first phase (D1) is mainly represented by remnant schistosity (S1) and rare occurrence of isoclinal reclined folds (F1). These F1 folds are preserved in the banded gneisses of the eastern part of the range. The second deformation (D2) refolded thesestructures into tight isoclinal folds (F2) with transposed foliation (S2) which is the predominant foliation of this area. These rocks have later undergone a shearing movement (D3) along a broad zone. The resultant mylonitic foliation (S3) is present along the shear zones with striations on the S2 surfaces. The latest deformation (D4) has refolded all the earlier structures into open upright folds (F3) without prominent development of axial plane cleavage. Such folds are common in the central and western part of the range.

METAMORPHISM

Mineral assemblage indicates that the gneissic rocks of the area are products of regional metamorphism of pelitic and quartzo feldspathic sediments under the sillimanite almandine orthoclase sub

facies of the almandine amphibolite facies (Fyfe *et al* 1958). Pyroxene bearing gneisses in the eastern part of the area showing hornblende orthophyroxene plagioclase assemblage can be grouped under the hornblende granulite sub-facies of the granulite facies.

MINERALISATION

Leached and weathered surfaces with malachite stains are present sporadically throughout the area. A zone of gneisses with disseminations of pyrite, chalcopyrite, arsenopyrite, and pockets of graphite has been recorded at the western contact of garnet-biotite gneiss with the augen gneisses. The limonitic surfaces give the rock the appearance of gossan. Scheelite grains are noted in calcite veins.

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REFERENCE

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