BASIC DYKES SEQUENCE IN THE PRECAMBRIAN COMPLEX SOUTH-EAST OF TURA, GARO HILLS, MEGHALAYA, ASSAM

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ABSTRACT

Basic dykes and sills of three widely differing periods have affected the Precambrian rocks exposed south-east of Tura, Garo Hills. From their metamorphic history and structural behaviour not only the sequence of their emplacement but the conditions of the country rock during the periods of their emplacement have been deciphered. Basite-Metadolerite-Basaltic dykes and sills is the order of sequence seen.

INTRODUCTION

NO large-scale mapping of any area in the Precambrian exposures in Assam has been undertaken so far. During the period November 1968 to May 1969, the writer had the opportunity to carry out such mapping in an area covering 5 sq km south-east of Tura (90° 30′ 35″ E : 25° 30′ 53″ N ; Fig. 1, inset), the headquarters of the Garo Hills District, Assam. The result had been very revealing and forms the subject of a different communication. Here it is proposed to deal only with the basic hypabysal rocks traversing the series of ancient crystalline rocks.

The Precambrian complex forms a prominent physiographical feature in the area south-east of Tura and mainly comprises of biotite schist, quartzofeldspathic gneiss, calc schist and calc gneiss all of which intruded by basic intrusives of different ages and granite (Fig. 1). These basic intrusives show different structural behaviour and have different metamorphic history. From their grade of metamorphism and from their varying structural patterns a definite order of sequence can be established such as Basite-Metadolerite-Basaltic dykes and sills.

BASITE

The earliest of the basic intrusives in the area are the basite. Narrow, only 30 cm to 8 m across and of limited areal extent upto 700 m in length (Fig. 1), they are mostly concordant masses showing an E-W to ENE-WSW trend.

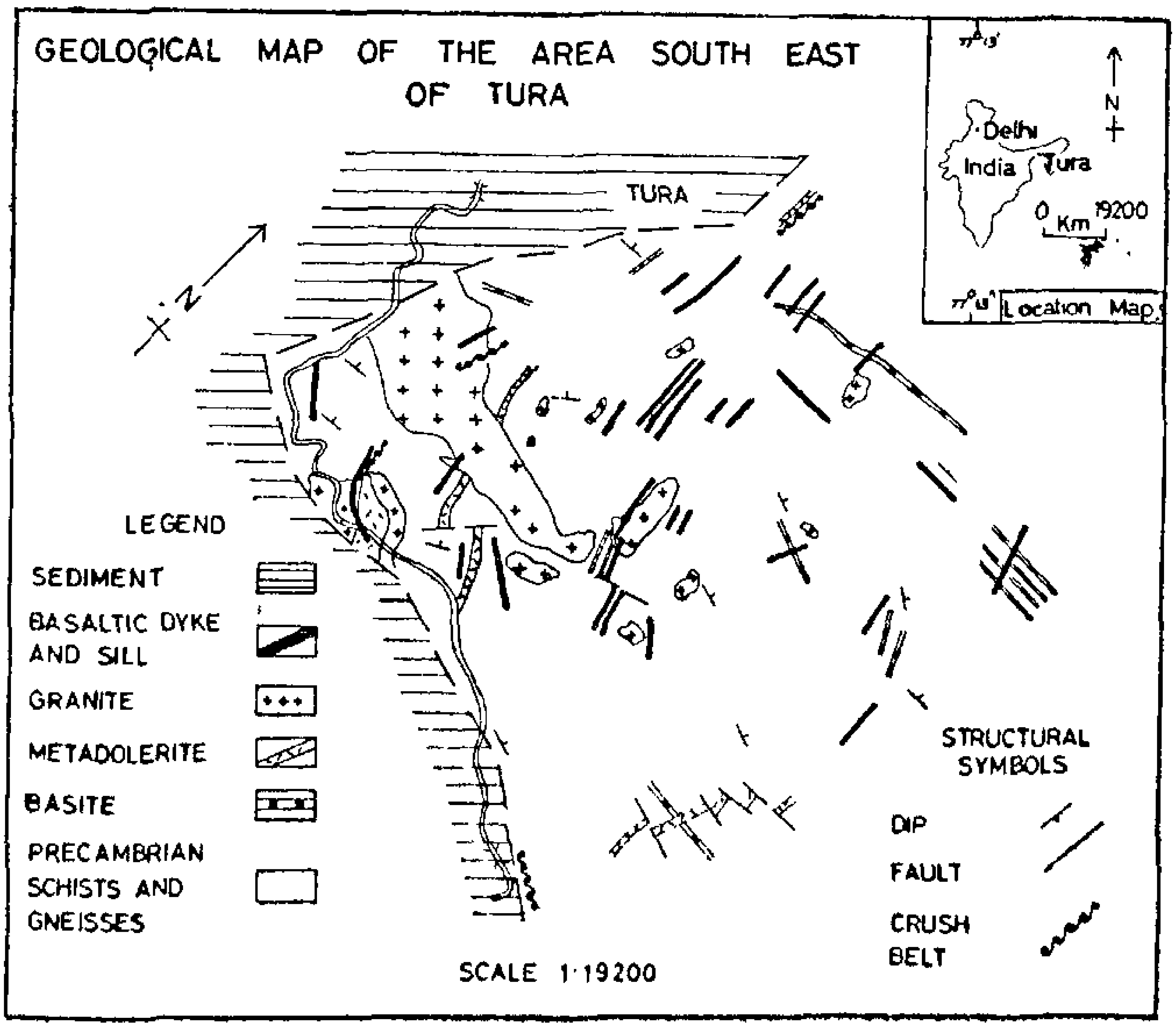

FIG. 1. Geological map of the area south-east of Tura, showing the distribution of different basic intrusives and granite. (Thickness of some of the basic masses is slightly exaggerated.)

They have sharp contact with the country rock and rarely show discordant relation. Usually foliated but sometimes strongly so, they commonly exhibit marked lineation. The foliation is generally parallel to the margins and is affected by later deformations. Plagioclase (An_{32-39}), hornblende and biotite are the chief constituents but quartz also is present in small quantity. The rock rarely shows relict subophitic texture. Subhedral hornblende grains with schiller structure indicate complete replacement (conversion) of pyroxene into hornblende. Elongate flakes of biotite show preferred orientation and discordant relation to hornblende, indicating their growth after hornblende. Epidote, ilmenite, sphene, magnetite and rare garnet occur as accessories. The mineralogical composition approximates that of a metamorphosed basic igneous rock, which is suggestive of an igneous origin for the rock.

Metadolerite

A suite of NW-SE to N-S-trending metadolerite dykes are of common occurrence in the area (Fig. 1). They show discordant relation with schists and gneisses cutting them at acute angles but rarely at right angles and at places they cut the basite also (Fig. 1). These dykes vary from 5 m to 60 m across and can be followed for few kilometres. Usually, they are medium to coarse-grained and characterized by sub-ophitic texture near the centre grading off to a fine-grained margin. In the fresh centres of the rock, plagioclase, pyroxene and hornblende are the main constituents but hornblende is dominant ferro-magnesian mineral in the amphibolitized variety. Plagioclase (An_{30-50}) with complex twinning, occurs as lath-shaped clouded crystals and constitutes the major part of the rock. Pyroxene mostly augite ($Z\wedge c = 42°$) with rare hypersthene forms euhedral prismatic crystals, but usually clouded due to exsolution. Even in the least amphibolitized centres, hornblende ($Z\wedge c = 18°$) is present but in variable amount as individual prismatic primary plates and as rims around iron ore and pyroxene. Irrespective of the mode of origin, all hornblende show identical optical properties. Magnetite, ilmenite, quartz and rare garnet occur as accessories.

Basaltic Dykes and Sills

Of very common occurrences in the area is a swarm of basaltic dykes and sills of varying trend and composition (Fig. 1). Individual dykes and sills vary in thickness from less than 10 cm to 20 m and can be followed for considerable distances. The trend of the dykes and sills varies from N-S to NNW-SSE and E-W to ENE-WSW respectively. Usually medium-grained, there are varieties which are fine-grained. They cross-cut the basite, metadolerite and the granite as also the dominant foliation of the schist and gneiss. Four petrographic types of these dykes and sills have been recognized, namely, dolerite, olivine dolerite, tachylite and granophyre of which dolerite is the most widespread, the others being of limited occurrence. Plagioclase (An_{35-45}) and pyroxene are the dominant minerals in the dolerite which exhibits both ophitic and porphyritic textures. In olivine dolerite, the dominant minerals are olivine, plagioclase (An_{45-60}) and pyroxene and it is characterized by porphyritic and ophitic textures. Mostly tachylite occurs as narrow selvage to dolerite dykes and sills, constitutes mainly of brownish glass densely charged with a separation of magnetite. Only a single instance of granophyre was noticed in the area near the Deputy Commissioner's bungalow. All the basaltic dykes and sills are fresh and show little alteration. At places they are affected by mylonitization and brecciation, however.

Discussion and Conclusions

In the basite, considerable mineralogical changes have occurred due to metamorphism and no relict pyroxene is seen. The foliation of the rock is mostly parallel to that of the schist and gneiss indicating its development with the dominant foliation of the country rock. The foliation of the basite has, however, been affected by subsequent deformations. Although the metadolerite is partially amphibolized, no secondary fabric has developed, which is indicative of the emplacement of the metadolerites having taken place in stress-free environments. The altered margins, however, indicate emplacements in hot country rocks following (brought about by) regional metamorphism. The metadolerite dykes cross-cut the basites (Fig. 1), hence are younger in age. The basaltic dykes and sills cross-cut the basite and metadolerite (Fig. 1), have chilled margins which latter fact emphasises that they were emplaced in cold country rocks after the close of regional metamorphism. Mylonitization and brecciation of the basaltic dykes and sills are due to brittle movements at depth. Petrographically these basaltic dykes and sills differ from the Sylhet trap occurring elsewhere in Assam (Murthy, personal communication) and may be older than the Sylhet trap which is of Upper Jurassic in age.

From the evidences described, it would appear that the basic intrusives affected the Precambrian rocks in the south-east of Tura in three distinct periods separated by wide intervals of quiescence. Due to lack of necessary data, it is not possible to date these periods more precisely, not according to tectonic movements. The varying conditions of the country rock during which each type was emplaced can, however, be easily recognized. During the emplacements of basites, an amphibolite facies of metamorphism was prevalent and the country rock was in stress. The metadolerite dykes were emplaced in stress-free environments but in elevated temperatures, while the basaltic dykes and sills were emplaced in cold country rocks.

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CONVECTION OVER A NATURALLY PERMEABLE BED

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ABSTRACT

The temperature distribution for a poiseuille flow over a naturally permeable bed is presented for the two cases, conducting and insulating upper plate. It is found that, the temperature distribution increases linearly in the case of insulating wall, whereas, it is parabolic in nature, in case of conducting wall. It is also found that, the Nusselt number increases steadily up to the value of $\sigma = 2$ and it is uniform for $\sigma > 2$; where $\sigma = h/\sqrt{k}$. h is the distance between the upper plate and the permeable bed and k is the permeability of the bed.

1. INTRODUCTION

THE poiseuille flow of a Newtonian fluid over a porous surface and the corresponding slip boundary condition at the permeable wall has been investigated, both theoretically and experimentally, by Bevers and Joseph (1967). Their results show that the rectilinear flow of a viscous fluid over the surface of a permeable material induces a boundary layer region, within the material. The effect of this boundary layer is to alter the nature of the tangential flow near the nominal boundary. The slip boundary condition proposed by them is in agreement with their experimental data. They have shown that the discharge is greatly enhanced over the value it would have if the bed were impermeable, indicating the presence of a boundary layer in the bed. Throughout their analysis, they have considered only the velocity of the flow but not the temperature distribution in the bed. Since there exists a boundary layer, i.e., viscous dissipation in the bed, we should take into account, however small, the variation of temperature induced by the viscous dissipation. This is one of the convection problems over a permeable surface.

In general, the problem of convection consists of the transport of heat by a moving fluid in which variation of temperature, and hence of density, produces a distributed buoyancy force that itself modifies the flow pattern. This interaction of density and velocity fields is the essential feature of convection. Thus to find the convection in poiseuille flow both the velocity and temperature fields must be determined together, throughout the whole region of flow. Solutions of this kind are mathematically complicated and in such circumstances simple problems like forced and free convection are usually studied theoretically in detail.

In forced convection problem, the density of the flow is regarded entirely unaffected by the heat transfer, which therefore acts only to mark part[illegible] of fluid passing near certain boundaries. These marked elements are swept away in the flow produced by externally applied forces (namely the applied pressure in the poiseuille flow) and are distributed throughout the region by convection and diffusion, without affecting the field of flow in any way. This amounts to finding the temperature distribution due to heated or cooled boundaries in a