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New geological investigations regarding MCT along southwestern part of Malakand granite gneiss, Malakand Agency, N.W. Pakistan

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ABSTRACT: *The western part of previously called Malakand granite gneiss and its contact with metasediments was studied at several localities. The objectives were to study the relationship of granite and metasediments and find out the evidences of MCT at the contact, if any does exist. Along contact zone at Baru locality, the granite is fine- to medium-grained, weakly foliated and shows micro inter-fingering inside metasediments. Backing and chilling effects are clearly visible at contact. Also a band of garnet mica- schist (2-5 m thick) has been developed in metasediments all along the contact zone that looks to be piezothermal in characters and probably have resulted from the granite intrusion. This band disappears away from the contact. Similar observations were made at the northern contact of granite and metasediments at Totai locality. This study indicates that the contact between granite (southwestern part of Malakand granite) and metasediments is intrusive in nature and no indications of MCT exist as was previously reported by Chaudhry et al., (1991).*

A traverse, across strike from Baru area at the southern contact of granite up to Hazarnao top covering the area SW of Mekhband, was undertaken to study the nature of so called granite gneiss in its interior parts. During this traverse it was observed that this part of previously called granite gneiss is not gneissic in nature but comprises fine- to medium-grained weakly foliated granite that contains patches of granite gneiss. This part of granite shows close resemblance to the granite occurring at Baru locality.

The granite NE of Mekhband locality, not included in this study, may be comprise granite gneiss but the granite SW of Mekhband is fine- medium in texture and weakly foliated. We consider this part of granite as a phase that may be older than Malakand proper granite and younger than the granite gneisses lying NE of Mekhband.

INTRODUCTION

Malakand granite and granite gneiss lie between longitude 71° 43'- 72° 0' and latitude 34° 29'- 34° 37' (Fig.1). Many workers (Tipper, 1906; Hayden, 1915; Chaudhry et al., 1974; 1976; 1991; Hamidullah et al., 1986) have conducted considerable geological investigations comprising geological mapping and tectonic and lithostratigraphic studies on Malakand granite and Malakand granite gneisses. Chaudhry et al. (1976) and Hamidullah et al. (1986) have studied geochemistry and petrogenesis of granitic rocks of the area.

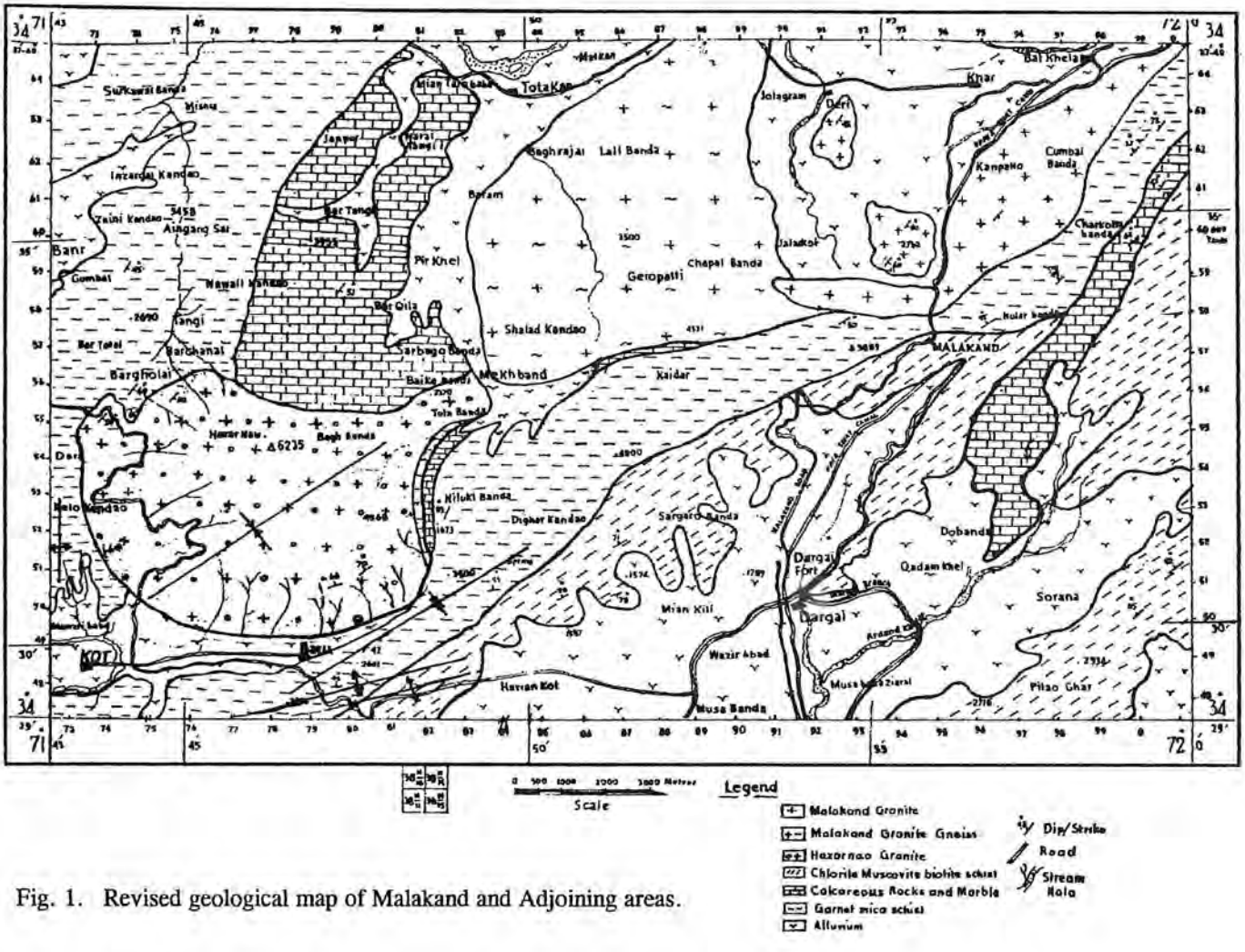

Fig. 1. Revised geological map of Malakand and Adjoining areas.

The Malakand granite consists of two distinct parts. The northern part, which is gneissic in nature and the southwestern parts, which is weakly foliated and occurs at Malakand proper. In this study two types of investigations were conducted. In the first type the contact relationship of granite and metasediments was studied at Baru locality at the southern contact. In the second type of investigation the area SW of Mekhband covered by so called Malakand granite gneiss was thoroughly studied to establish whether it should be considered as a part of Malakand granite gneiss located northeast of Mekhband or a part of weakly foliated granite lying near the contact at Baru locality.

REGIONAL GEOLOGY OF MALAKAND QUADRANGLE AND ADJACENT AREAS

Regional geology of Malakand and adjacent areas consists of metamorphic and granitic rocks of different ages. The mentioned rock units can be broadly divided in to the following:

Metamorphic rocks

Metamorphic rocks of the area consist of pelitic, calcareous, arenaceous metasediments and amphibolites. Pelitic sediments consist of schistose rocks widely found in the region. They are blackish grey to green in colour and consist of bands of calcareous schists, biotite-chlorite schists and garnet- mica schists and marble. Marble ranges in colour from black through gray to white. Arenaceous rocks include quartzite and quartz- mica schist. Quartz- mica schist is similar to quartzite except for the high proportion of muscovite in the former that occurs along the contact of granite in the northwest. Amphibolite is found in the form of sills and rarely as dikes. These sills and dikes are confined to the contact zones of granite. Amphibolites are green colored, medium to coarse grained and foliated bodies and have most probably formed as a result of metamorphism of basic to ultra basic intrusion (Chaudhry et al., 1974; 1976).

Granitic Rocks

Granitic rocks of the area can be divided into Malakand granite gneiss and Malakand granite.

Malakand Granite Gneiss

It is a whitish- gray to dark- gray and medium to coarse-grained foliated rock. Rock compositions in the Streckeisen's triangle plot in granite and granodioritic fields (Chaudhry et al., 1976).

Malakand Granite

Fine to medium leucocratic Malakand granite is an intrusive body that has discordant relationship with the country rocks. Apophyses of granite are often seen in the country rocks. Moreover, screens and xenoliths of country rocks are quite common near the contact. Backing, chilling and thermal effects are also very obvious along the contact zone of the granite. Abundant pegmatite and aplite veins cross- cut the granite. Some pegmatites contain fluorite and calcite pods as well as tourmaline (Chaudhry et al., 1974; 1976).

PRESENT INVESTIGATION

Present work consists of two parts; first the study of contact relationship of Malakand granite and metasediments at Baru locality to confirm or otherwise the reported MCT along this contact and second to investigate the characteristics and field features of Malakand granite gneiss located in the SW of Mekhband where it looks quite different both from the gneissic as well as weakly foliated parts of Malakand granite.

INVESTIGATIONS FOR CONTACT RELATIONSHIP OF GRANITE GNEISS AND METASEDIMENTS AT BARU LOCALITY

The contact relationship of granite and meta sediments was studied at southern contact at Baru locality to confirm or otherwise the existence of previously reported Main Central Thrust (MCT) along this contact of granite. A detailed geological map (Fig. 2) was prepared for this study which shows all lithologies and their inter relationship along this contact. The area consists of fine-to medium-grained, weakly foliated granite, which has several textural varieties ranging from very fine-grained (aplitic) to coarse-grained granite. Textural varieties include fine- medium grained granite, porphyritic/ flaser granite, aplite/ sheared granite and patches of granite gneiss. Aplites and sheared zones reported by (Khaliq, 1999) were also confirmed in this study. Majority of samples collected from quartz veins were identified to be pegmatites in petrography. Textural varieties mentioned above are briefly described in the following section.

Fine-to medium-grained granite is the dominant lithology in the area and it contains all other textural varieties of granite in the form of patches and bands. This unit becomes very fine grained in nature at contact with metasediments. This change in texture is interpreted as chilling effects along intrusive contact of granite. Another unit of granite in the form of porphyritic/ flaser granite occurs as a 50 m thick band inside the fine- medium grained granite. Due to local shearing the original texture of this unit has changed into fine- grained fabric. There are also found distinct zones of aplite/ sheared granite running parallel to each other and range in thickness from a few cm to over several meters. Local scale shearing effects can be observed in most of the zones. Patches of granite gneiss are also found inside the fine-medium grained granite. The intensity of patches of granite gneiss increases in the interior of granite.

Metasediments occur in the form of garnet- mica schist unit along the contact zone. Thickness of this unit varies from a few to over several meters and it is gray to dark brownish in colour. This study shows that the contact of granite and metasediments is intrusive in nature and small scale shearing found in some units of granite, as described above, is probably associated with tight folding resulted into several anticlines and synclines around the contact zone. The zone of its southern contact is tightly folded and contains several anticline and synclines (DiPietro & Isachsene, 2001). Major anticlines in the area run thorough Baru locality in east- west direction, through Kot-Batoo locality in north- south direction and along Dargai- Kot road west of Haryan Kot. The major synclines of regional extension run through the center of Malakand granite in NE- SW direction and in metasediments south of Baru Nala besides several local synclines in the area. The contact in Baru stream clearly shows micro inter-fingering of granite in metasediments (Plate 1) At this locality the granite is massive and fine-grained due to chilling effects. Moreover, a continuous band of garnet has developed in metasediments all along the contact zone, which looks to be piezothermal in characters, and probably resulted from intrusion of granite. This garnet band disappears away from the contact. All these observations endorse the intrusive nature of granite contact at this locality. No indications of Main Central Thrust (MCT) were observed along this contact as was previously reported by Chaudhry et al. (1991). Similar observations were also made at Tangi locality at the eastern end of Baru stream.

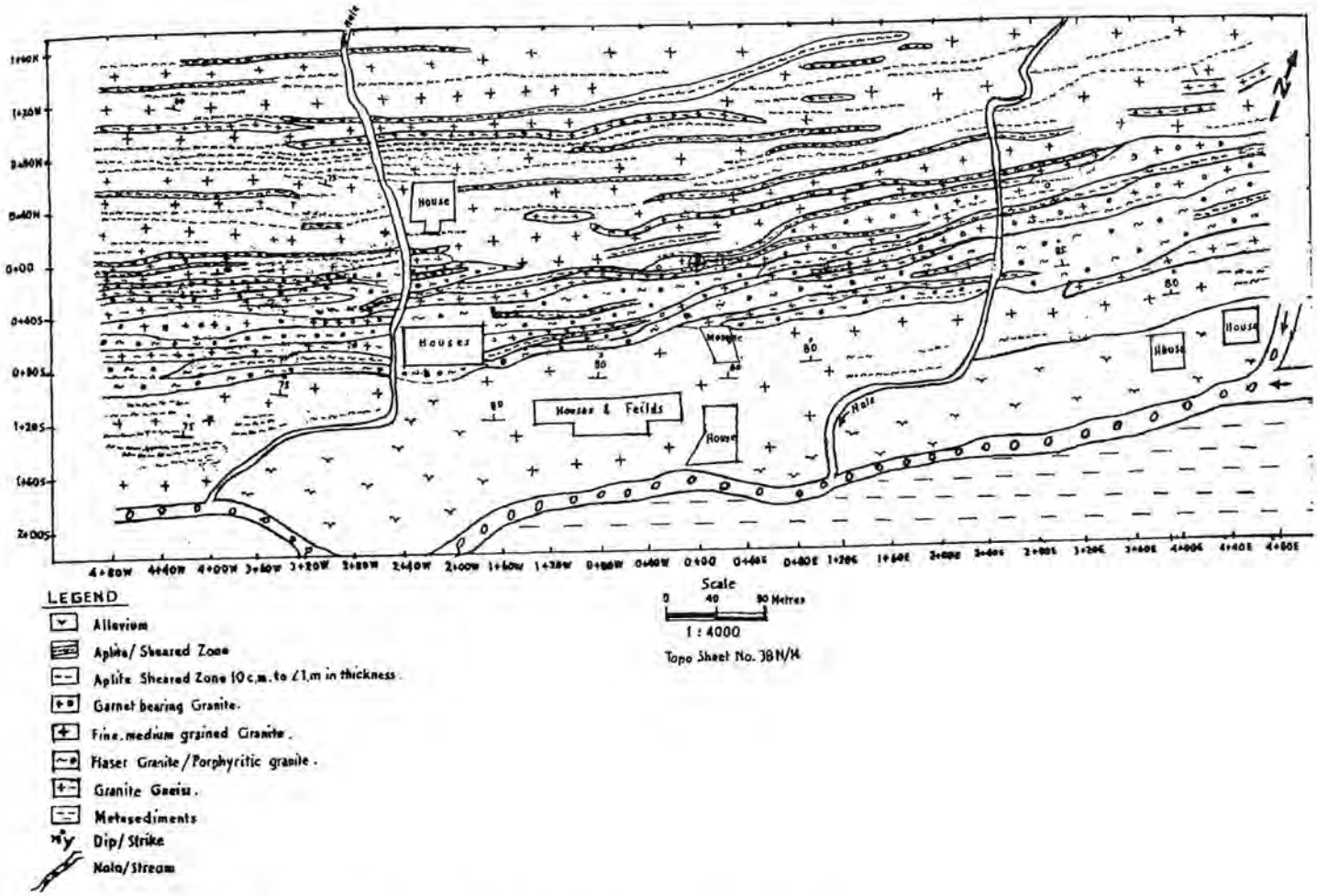

Fig. 2. Geological map of the southern contact of Malakand Granite at Baru locality.

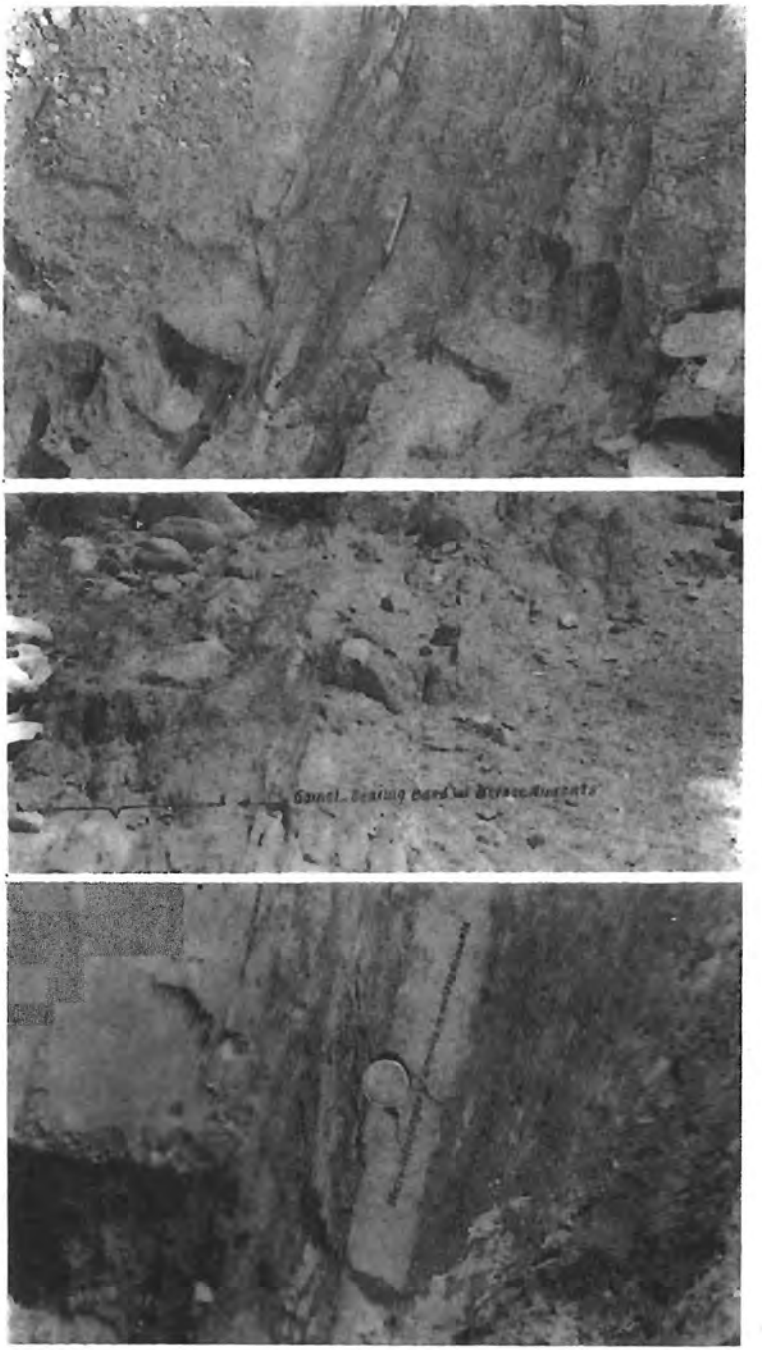

Plate 1. Photographs showing intrusive contact of Malakand granite with metsediments. Micro inerfingering of Malakand granite in metasediments is clearly visible at Southwestern contact of Mlakand granite (Kot-Baru Section).

REGIONAL INVESTIGATION

During this investigation regional geology of Malakand quadrangle was studied (Fig. 1). A traverse from Baru locality to Hazarnao top, across the strike of the granite, was undertaken. During this traverse it was noted that this granite (previously called granite gneiss) is dominantly fine-to medium-grained, weakly foliated and contains patches of granite gneiss at places. Bands of fine-grained granite/ aplite were also observed along this traverse. This granite shows close similarity to the granite occurring at Baru locality as described in previous section. This investigation clearly shows that the granite in the SW of Mekhband is different from the granite gneiss occurring northeast of it. Moreover, this granite is also different in characteristics from the granite at Malakand proper as the former consists of several textural varieties of granites and contains patches of granite gneiss while the latter lacks these properties. Therefore, the part of Malakand granite located SW of Mekhband indicates a different phase of granite probably younger than the granite gneiss lies northeast of Mekhband and older than the Malakand proper granite. This granite has been named as "The Hazarnao granite" on the basis of present investigation.

CONCLUSIONS

This study indicates that the southern contact between Malakand granite and metasediments is intrusive in nature and no indications of MCT are found along this contact as was previously reported by Chaudhry et al. (1991).

The southwestern part of Malakand granite gneiss located in the southwest of Mekhband locality is not gneissic but it dominantly consists of fine-to medium-grained weakly foliated granite with patches of granite gneiss at places. On the basis of present studies we, therefore, considered this part of Malakand granite gneiss as a phase of granite, which is probably younger than the granite gneisses lying northeast of Mekhband and it is older than the Malakand proper granite and it has been named as "The Hazarnao granite".

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