Geol. Bull. Univ. Peshawar, 1984, Vol. 17, pp. 61–68

A NOTE ON KOT-PRANG GHAR MELANGE AND ASSOCIATED MINERAL OCCURRENCES

S. SHAHID HUSSAIN, TAHSEENULLAH KHAN,
HAMID DAWOOD AND IFTIKHAR KHAN
Gemstone Corporation of Pakistan Limited, Peshawar.

ABSTRACT

Lower Mohmand and western part of Malakand Agency are characterised by ophiolitic Late Jurassic to Cretaceous Melange Complex. Middle to Late Paleozoic metasediments, and Malakand-Kot and Silai Patti-Kolangi granitic gneisses of Cambrian age make up the rest of the rock sequence within the area. Thrust faults, intricate folds, joints, and complex foliation planes are the major structural features. These structures are the result of multiple tectonic events in this region. Gemstone and metallic ore mineralization has taken place in the Melange Complex, of which emerald, epidote, beryl, rutile, jadeite/nephrite, manganese and chromite may be of economic significance.

INTRODUCTION

The investigated area lies between longitudes 71° 32′ to 72° 10′ E and latitudes 34° 22′ to 34° 38′ N. The two main localities, Kot and Prang Ghar, are located 129 km and 57 km north-east of Peshawar, respectively (Fig. 1). Lower Mohmand and western part of Malakand have not yet been geologically surveyed in detail mainly because of inaccessibility, and until the present work only sketchy geological informations were available.

Ahmad (1966), and Arbab and Siddiqui (1972) investigated the emerald occurrences at Nawe Dand, Dando Kandao and Prang Ghar. Ahmad (1966) has described emerald association with quartz veins intruding hornblende schist whereas Arbab and Siddiqui (1972) reported slates and phyllites in Dando Kandao and surroundings. Arbab and Siddiqui (1972) assigned Palaeozoic and Late Cretaceous ages, respectively, to the metamorphic and igneous rocks exposed in the area.

Aslam *et al.* (1977) described the rocks of upper Mohmand Agency and classified the sequence into Quaternary deposits, Mohmand Intrusives, Yousaf Khel Formation and Gandao Formation. They assigned tentative ages of Recent, Late Cretaceous to Early Tertiary and Siluro-Devonian to these formations, respectively.

Chaudhary *et al.* (1976) reported calcareous and pelitic schists with arenaceous bands in western part of Malakand Agency and correlated these rocks with Attock Slates and Abbottabad Group of Precambrian age. Work has also been carried out on Dargai ultramafics for chromite prospection by Anwar *et al.* (1977) and Uppal (1972).

In search of gemstones the Lower Mohmand and western Malakand agencies were explored and geologic mapping was done on 1:12500 scale. Some of the significant results of these investigations are summarised as follows.

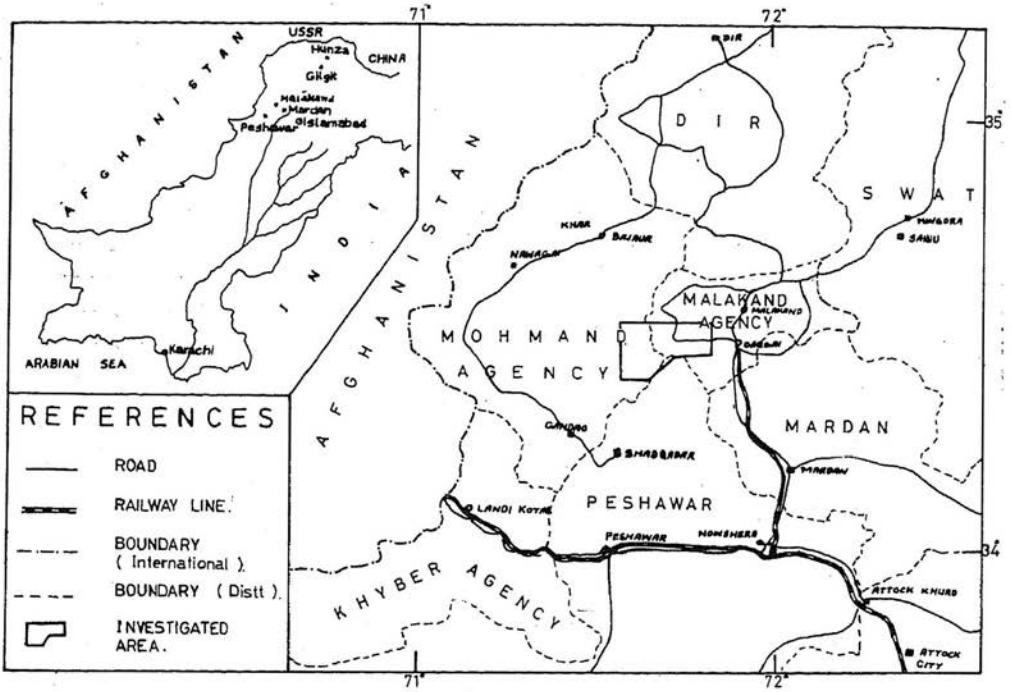

Fig. 1. Location map.

GEOLOGY AND PETROGRAPHY

The following rock sequence is exposed in the area.

Kot-Prang Ghar Melange Complex		Late Jurassic to Cretaceous.
Thrust		
Chlorite-mica schist	]	
Graphitic schist	]	
Garnetiferous schist	]	Middle to Late Paleozoic.
Siliceous schist	]	
Malakand-Kot and Silai Patti	]	Cambrian.
Kolangi garnitic gneisses.	]	

The Kot-Prang Ghar Melange Complex is comprised of randomly oriented blocks of greenstone, greenschist, pyroclast and tuffites. Serpentinite, pyroxenite, peridotite, gabbro, and talcose rocks (altered ultrabasic/basic rocks) constitute the ophiolitic complex.

The Melange Complex cross-cuts the surrounding rocks. Thrust faulting, angular relationship, shearing at the contacts and development of breccia, especially in the ultrabasics, indicate that the contacts between different rock units within the complex are tectonic.

The greenstone is granular and fine- to medium-grained. It commonly displays pillow structure and contains feldspar, quartz, chlorite, epidote, mica, carbonate, magnetite, and ± chalcopyrite. Greenschist is of pyroclastic origin and contains chlorite, mica, epidote, feldspar, quartz, carbonates, limonite and magnetite.

Tuffs have been metamorphosed into medium- to coarse-grained quartz-mica schist. Bulk of the quartz-mica schist is composed of quartz with alternating thin layers of mica. Yellowish-brown to greyish-white phacoidal lenses of quartzite having saccroidal texture are present in the Melange Complex at a few places. Massive and compact quartzites crop out at several localities in the form of tectonic blocks.

Serpentinites are fine- to medium-grained and greenish-grey, or yellowish-brown. Apart from serpentine other minerals identified are olivine, pyroxene, carbonates, mica, magnetite, chromite, tremolite and asbestos.

Pyroxenite/peridotite lenses are present in Dargai ultrabasics and in Moto Shah Kandao of Prang Ghar. Pyroxene is the essential mineral constituent in pyroxenite. Other minerals observed are olivine and opaque ores. Peridotite is composed of olivine, pyroxene and opaque ores.

Gabbros are granular in texture. Most of the gabbroic lenses are variably altered. Unaltered minerals are pyroxenes, feldspar and mica. Talc, chlorite and carbonates are the secondary minerals developed as a result of alteration and metamorphic effects.

Talc-bearing rocks may be classified into talc schist, talc-chlorite schist, talc-carbonate schist, soapstone, and carbonates. The talcose rocks have a characteristic mottled off white, greyish, greyish-brown and pale brown colour. These are the alteration products of igneous rocks.

Chlorite-mica schist is grey to greenish-grey or brownish-grey and exposed in the southern parts of the mapped area. Chlorite, mica, quartz, feldspar, carbonate, magnetite and graphite are the common minerals present in these rocks. Garnet is an accessory mineral developed locally in Kot area. Calcareous schist and marble are interbedded with chlorite-mica schist.

Graphitic schist is medium-grained, blackish-grey to black coloured and contains feldspar, quartz, mica, carbonate, graphite, magnetite, limonite and chlorite. Laminae of felsic and micaceous minerals in the rock make a conspicuous

feature. Northeast of Jawar Kandao (Prang Ghar) garnet has locally developed in a 30 m wide zone.

Garnet-mica schist is well-exposed west of Silai Patti and northeast of Kot. It is grey, greyish-brown and brown in colour, and fine- to medium-grained. Main mineral constituents are feldspar, quartz, garnet and mica. Graphite, chlorite, magnetite and limonite are the accessories. Most of the garnet porphyroblasts are opaque. Translucent crystals are rarely found. Garnet crystals vary in size from 1.0 cm to 3.0 cm. Garnetiferous calcareous schist, marble, quartz-biotite schist and quartzites are also present within garnet-mica schist unit.

Siliceous schist crops out in the north of Kot area. It is coarse- to medium-grained and whitish-grey to brownish-grey in colour. Quartz, mica ± chlorite are the constituent minerals. Platy minerals are well-developed along the schistosity planes. Coarse-grained siliceous schist is also present in other rock units as mentioned above.

Malakand-Kot and Silai Patti-Kolangi granitic gneisses are white, dirty white, greyish-white and coarse-grained. Foliation and gneissosity is developed within these rocks. Quartz is more abundant than feldspar. Other minerals identified megascopically are mica and amphibole. In Silai Patti-Kolangi granitic gneiss ferromagnesian minerals are more abundant than those of the Malakand-Kot granitic gneiss.

A carbonatite body about 160 m wide and more than 1000 m long occurs in metasediments at Silai Patti, Malakand Agency. Carbonates make up the ground mass. Accessory minerals are amphibole, epidote, apatite, vermiculite, magnetite, ilmenite, muscovite etc. The quantity of accessory minerals varies at places (see Ashraf and Chaudhry, 1977).

GEOLOGICAL STRUCTURE

Kot-Prang Ghar Malange Complex is comprised of two major tectonic zones thrusted to the south over schistose rocks. Starting from Usman Khel Garhi the Melange Complex divides into two distinct zones in western directions. Each zone is comprised of metasediments, metaigneous and pyroclastic rocks. Dargai ultramafic complex (previously known as Dargai Ultramafic Klippe) is a part of the Melange Complex which trends NNE–SSW. Kot-Prang Ghar Melange Complex extends in northwest and southwest directions through Kot, Khanori and beyond in Malakand Agency and through Prang Ghar, Nawe Killi and Tortum in Mohmand Agency respectively (Fig. 4). The upper and lower tectonic zones of the Melange Complex have got structural and lithological similarities which may probably represent a single zone prior to folding (Figs. 2 & 3). Two types of regional folds have been observed in the rocks of Malakand and Mohmand Agencies. Folding has taken place along NW–SE and NE–SW axes (Fig. 5). Intricate superposed, tight micro-drag and isoclinal plunging folded structures are very prominent. Inter and intraformational faults, joints, foliations and lineations represent fabrics of the rocks. Multiple tectonic episodes have abolished consistency in bedding and foliation planes.

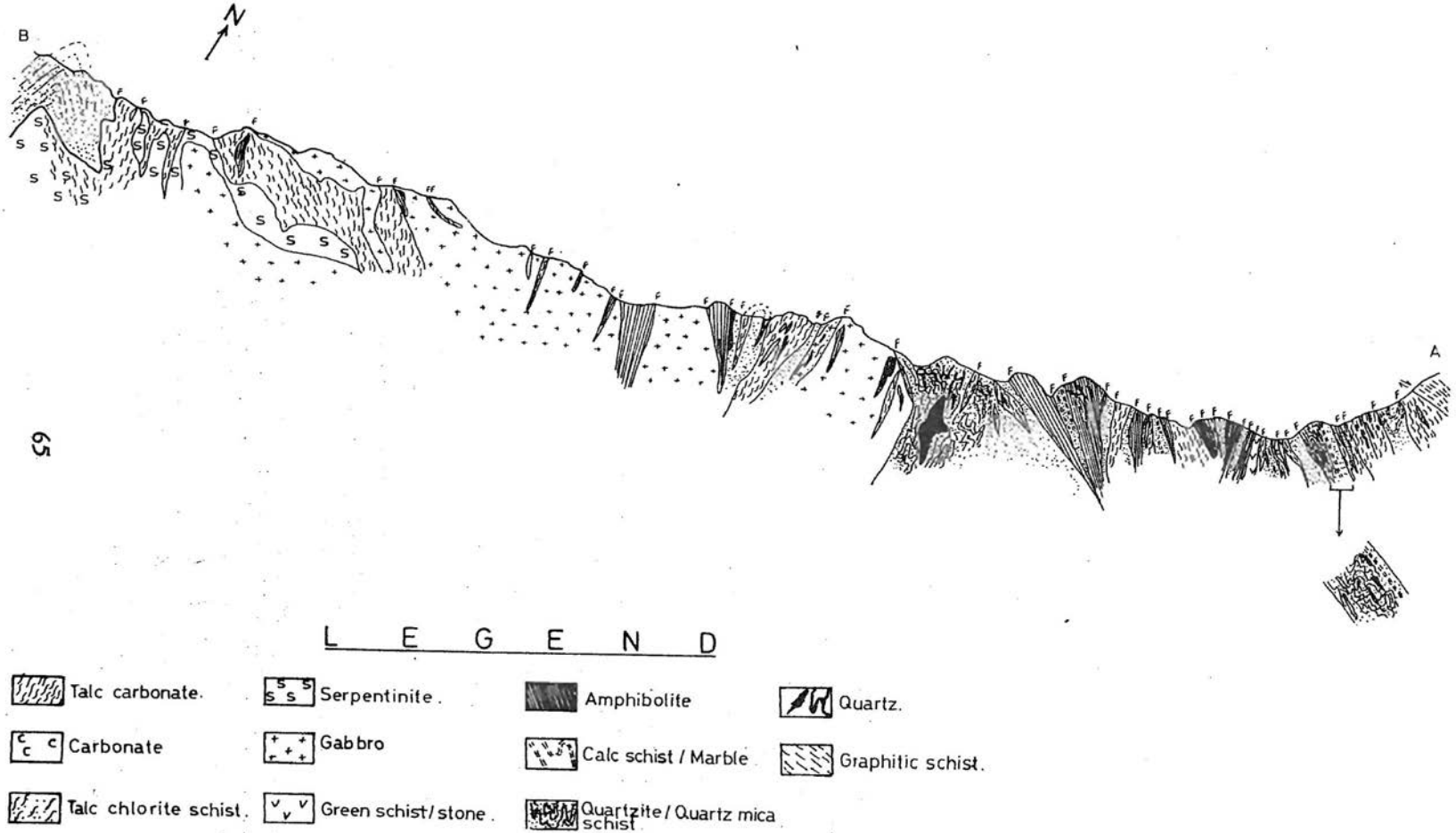

Fig. 2. Geological section from near Kot towards Khanori along line A — B.

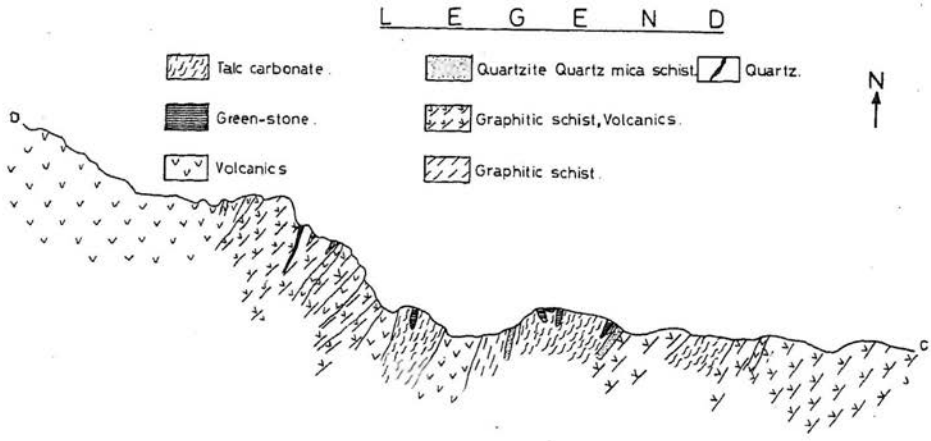

Fig. 3. Geological section of Isa Baba Ziarat-Barre Sar area, Mohmand Agency.

MINERAL OCCURRENCES

During present exploration work a number of gemstone/mineral occurrence have been discovered, which are briefly described below :

Emerald : Showings/crystals have been observed at Dandao Kandao and northeast of Prang Ghar and Bucha (Rafiq and Jan, 1983) and Nawe Dand (previously known) in lower Mohmand Agency. A tiny crystal of emerald has also been noticed at Khanori in Malakand Agency in association with actionlite in altered basic rocks. These emeralds are light green to bluish-green. Tiny grains and elongated crystals are opaque, translucent to transparent and are usually broken along the basal cleavage planes. Emerald is hydrothermally/pneumatolytically mineralized and is associated with quartz and calcite veins in talc-carbonates along micro-faults/joints.

Epidote : Brown, brownish-green, and yellowish-green crystals of epidote occur in hydrothermal veins and as alteration product in gabbro and greenstone of the Melange Complex at Usman Khel Garhi, Kot, Manzari Baba Ziarat and Bucha of Malakand and lower Mohmand agencies, respectively. The crystals are transparent to translucent and well terminated.

Beryl : Showings/crystals of blue beryl are found in small pegmatites at Barh ~ 330 m east of Kot in Malakand-Kot granitic gneiss. These are opaque and fractured. Maximum dimension of the beryl crystal recorded is 3 x 6 mm. Similar showings have also been noticed in Batoo Shah of the same area. Besides quartz and feldspar, fluorite is usually associated with beryl.

Rutile : Brown to reddish-brown showings of rutile have been observed in Silai Patti-Kolangi granitic gneiss at Silai Patti and talc-chlorite schist south of Kot. At

both these localities rutile is opaque and the mineralization is associated with hydrothermal quartz veins. Heavy mineral analysis of stream sediment sampling has revealed rutile occurrences at several places in Malakand and lower Mohmand Agencies.

Jadeite/Nephrite : Light green lenses, with maximum size of 1 x 2 m occur within serpentinite mass at Spo-Darra, Dabar and Maizar of lower Mohmand Agency. At Spo Darra calcite veins and pockets containing yellowish-brown to light brown translucent hessonite garnets are present within jadeite/nephrite. Size of the hessonite garnets range from specks to 2 mm across.

Manganese : Stringers and pockets of manganese ore, 0.3 m to 2 m in width and upto a maximum of 10 m length, are located in hydrothermal quartz veins within tectonic block of quartzite and quartz mica schist at Kassai and northwest of Moto Shah (lower Mohmand Agency). Eight outcrops have so far been observed. Pyrite, epidote and quartz are the associated minerals.

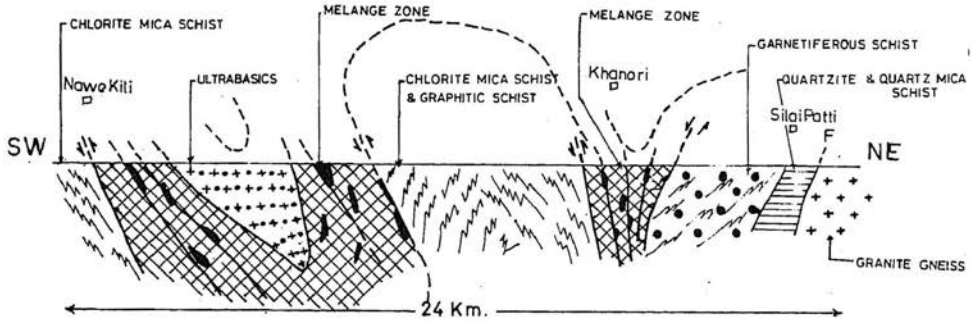

Fig. 5. Diagrammatic cross-section showing the geological structure of the Kot-Prang Ghar area.

Chromite : Lenses, pockets and disseminations of chromite occur in ultramafic rocks near village Parai, Yousaf Baba, Auro Khawar, Balola, Bucha and Mamanai Gudar in lower Mohmand Agency and at Hero Shah, Ospan Khare and Qila in Malakand Agency. The lenses are, generally, from 30 cm to 1 m in length but some are longer. A few lenses of chromite having similar size have also been discovered from Khanori, Malakand Agency.

Several showings of black tourmaline, green garnet, serpentine, rodingite and actinolite in Malakand Agency, and hematite, magnetite, chalcopyrite and actinolite in lower Mohmand Agency have been noticed.

All these mineral showings and occurrences indicate that the environment for the mineralization of gemstones and metallic ores are favourable in the Melange Complex.

Acknowledgements. The authors are grateful to K.R. Mirza and A.H. Kazmi for encouragement, guidance and supervision during this research. J. Anwar provided assistance during the field work. Amanullah Khan, Farid Khan, Jalil Khan, Ahmed Jan, and Malang Sher (executive staff of Mohmand and Malakand Agencies) are thanked for providing maximum help and security.

REFERENCES

Ahmad, W., 1966. A short note on emerald deposits, Nawe Dand, Mohmand Agency, Peshawar Division. Geol. Surv. Pak. Pre-publ. Issue 29.

Arbab, M.S.H. & Siddiqui, R.A., 1972. Reconnaissance geology of southern half of Mohmand Agency and Tangi area of Peshawar District, N.W.F.P. Geol. Surv. Pak. Inf. Rel. 71.

Ashraf, M. & Chaudhry, M.N., 1977. A discovery of carbonatite from Malakand. Geol. Bull. Punjab Univ. 14, 89—90.

Aslam, M., Khalil, M.A., & Salim, M., 1977. Geology of Gandao Quardangle, Mohmand Agency, N.W.F.P., Pakistan. Geol. Surv. Pak. Inf. Rel. 130.

Chaudhry, M.N., Ashraf, M., Hussain, S.S., and Iqbal, M., 1976. Geology and Petrology of Malakand and a part of Dir (Toposheet No. 38 N/14). Geol. Bull. Punjab Univ. 14, 17—39.

Jan, M.Q., 1968. Petrography of the emerald bearing rocks of Mingora, Swat and Prang Ghar, Mohmand Agency. Geol. Bull. Univ. Peshawar 3, 10—11.

Rafiq, M., & Jan, M.Q., 1983. A discovery of emerald near Bucha, Mohmand Agency. Geol. Bull. Univ. Peshawar, 16, 188.

Uppal, I.H., 1972. Preliminary account of the Harichand Ultramafic Complex, Malakand Agency, N.W.F.P., Pakistan. Geol. Bull. Punjab Univ. 9, 53—63.

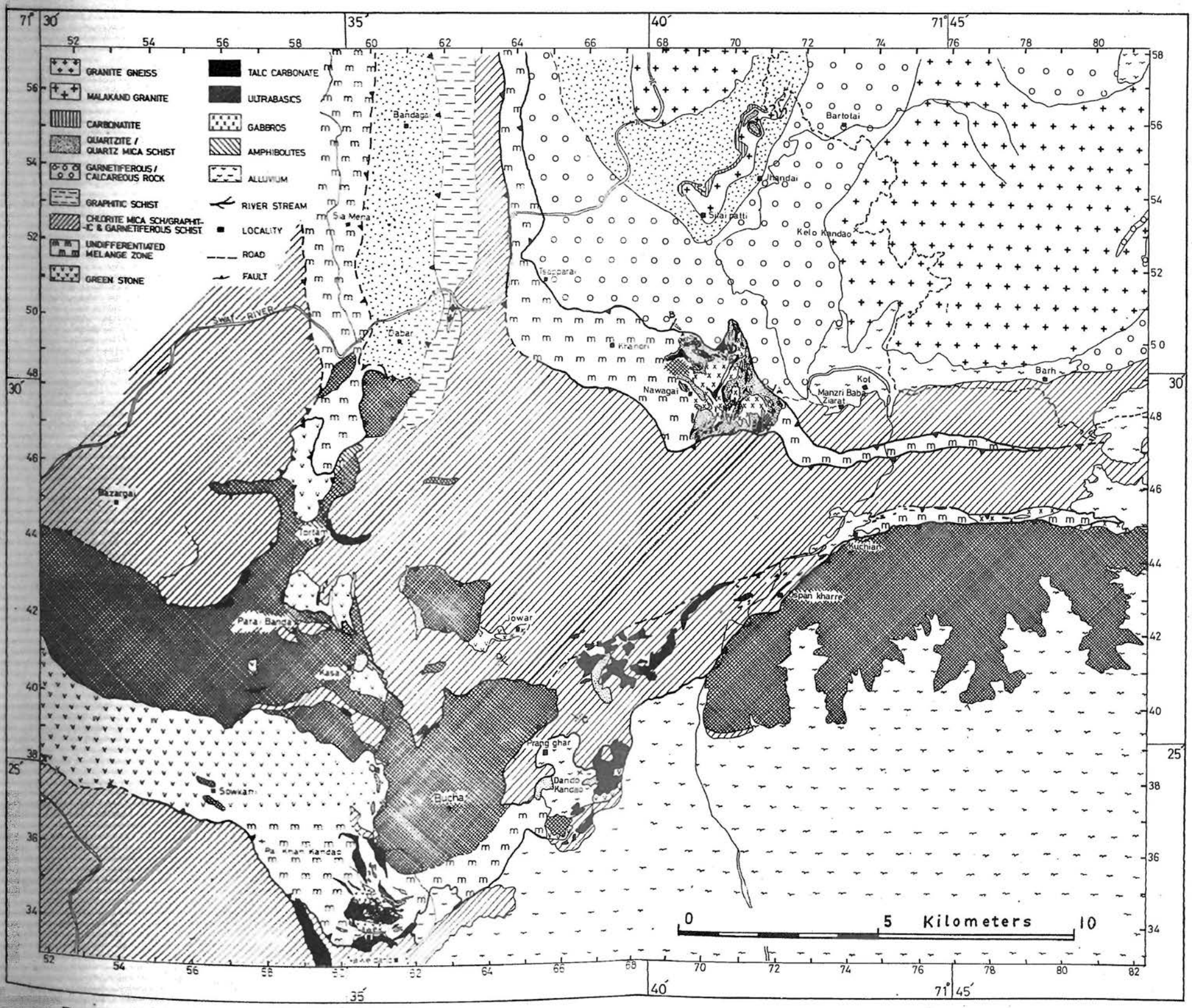

Fig. 4. GEOLOGICAL MAP OF KOT–PRANG GHAR AREA. A—B and C—D refer to geological cross-sections in Fig. 2 and Fig. 3 respectively.