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GEOLOGY OF THE KAR GAH QUADRANGLE DISTRICT GILGIT, NORTHERN AREAS, PAKISTAN

BY

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ABSTRACT

The Kar Gah quadrangle (43 I/1) lying in the district Gilgit has been mapped on 1:50,000 scale. Mapped area shows variety of rocks including metasedimentary, metavolcanic and plutonic. Metasedimentary and metavolcanic rocks are classified as Gilgit formation (paragneisses and schists together with amphibolites), Thelichi formation (turbidites, marble, green schist and basic dykes) and Greenstone complex (metavolcanics and metatuffs). The plutonic rocks are named as the Kohistan batholith which consists of diorite, granodiorite, granites, aplite and pegmatite.

Structure of the mapped area is depicted by a syncline which is occupied by the rocks of the Thelichi formation. The mapped area contains mineral showings of insignificant economic importance.

INTRODUCTION

1.1 Purpose and Scope

The Geological Survey of Pakistan, Directorate of Northern Areas is conducting systematic geological mapping of the Northern Areas of Pakistan on 1:50,000 scale. As a part of this programme Toposheet No. 43 I/1 of Kar Gah quadrangle, district Gilgit was mapped in the field season of September to October, 1991.

1.2 Location and Accessibility

The area is situated towards west of the Gilgit city and is bounded by latitude 35° 45' to 36°00' N and longitude 74°00 to 74° 15' E. The Gilgit River flows in the NE corner of the toposheet. The major tributaries are Shinghai Gah, Kar Gah, Chileli Gah and Gulapur Gah. A jeepable road connects the long Kar Gah valley with the Gilgit city.

Gilgit city is the headquarter of the Northern Areas which is linked with Islamabad through all-weather Karakoram Highway. It is 620 kms from capital Islamabad. Fair weather air service from Islamabad to Gilgit is also available. High mountains with steep cliffs and narrow valleys are the topographic characteristics of the investigated areas. The average relief ranges from 2,300 m to 2,700 m (AMSL). Kar Gah is the major nala of the quadrangle. Deep gorges and the remnants of old terraces indicate high level of nala flows. The highest peak is 4,951 m (AMSL). The area is characterized by dendritic and sub-parallel drainage patterns.

1.3 Climate and Habitation

Major part of the mapped area has cold climatic condition. January is the coldest month of the season when temperature falls down to -7° C in the NE part. This area usually receives heavy snow with scanty rain fall. Mud flows, rock falls in March and April create hindrance in communication. Vegetation is scarce through out the area except along Kar Gah and its tributaries where natural forests

of pine and deodar at altitudes between 2,000 m to 2,500 m are grown. Due to rough terrain and high altitudes the population is sparsely distributed. Wheat and maize are the major agriculture crops. Mulberry, apple, apricot and walnut are the main fruits grown.

1.4 **Previous Work**

Hayden (1914), Wadia (1932), Ivanac, et al., (1956) are among the pioneer workers in the Northern Areas, who described the geology of the Gilgit, Nanga Parbat and the adjacent areas, Gansser (1964) and Bakr (1965) wrote a brief note on the general geology of Gilgit and Baltistan Agencies. Khan, T., et al., (1989) made the first important geological traverse along Shinghai Gah and Kiner Gah and recorded for the first time metasedimentary and metavolcanic within the previously known belt of the Kohistan batholith. Afterwards this area has been thoroughly investigated in context of tectonic setting of the area in particular and the Kohistan Island arc in general (Khan, T., et al., 1994, 1996, 1998, Treloar, et al., 1996).

1.5 **Acknowledgment**

The authors gratefully acknowledge the services of M/S. Ashraf Khan and Dr. M. Ishaq Ghaznavi, for critical review of the report.

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2. REGIONAL GEOLOGY

Rocks exposed in the investigated area are predominantly intrusive and metavolcanic. The metasedimentary rocks are also exposed in certain area. Small exposures of recent deposits are also found along the river and nalas. The following stratigraphic sequences is suggested in this report.

NAME OF THE FORMATION	BRIEF LITHOLOGY	TENTATIVE AGE
Quaternary deposits	Glaciofluvial deposits, colluvium, terrace and stream bed deposits.	Quaternary
Kohistan batholith	Diorites, granodiorite, granites, aplite and pegmatite.	Creto-Tertiary.
Thelichi formation	Calcareous schist, slates, quartzites, marble, metavolcanics and green schists.	Late Cretaceous
Greenstone complex	Meta andesite, meta basalt, metasediments, marble, amphibolite.	Early Cretaceous.
Gilgit formation	Paragneisses, schists, amphibolites.	Early Cretaceous.

3. GEOLOGY

3.1. Gilgit formation:

Along Kar Gah towards southwest of the Gilgit city, the exposed rocks are paragneisses and schists intermixed with orthogneisses. This assemblage of rocks was considered as a part of Greenstone complex by earlier worker but Khan, T., et al., (1994) renamed it as the Gilgit formation after the type locality at Gilgit (out of map). The Gilgit formation comprises mainly paragneisses and pelitic schists with subordinate orthogneiss and amphibolites in the mapped area.

Paragneisses include both metapelites and metapsammites, commonly interstratified at regular intervals. At certain places ptygmatic foldings are very prominent along Kar Gah. The rocks of the Gilgit formation, i.e. paragneisses and schists show amphibolite grade of metamorphism ranging from biotite to sillimanite grade. The paragneisses at higher grade depict partial melting resulting migmatites

and leucogranites in the form of aplite and pegmatite dykes.

In the mapped areas, Gilgit formation is exposed in small area between Kar Gah and Barsinpur Bala area. Its contact with granodiorite is sharp while with Greenstone is faulted. The probable age of this formation is Early Cretaceous? (Khan, et al., 1994).

3.2 Greenstone complex

The name Greenstone complex was assigned by Ivanac, et al., (1956). Later on Tahirkheli (1982) redesignated the terminology as the Rakaposhi volcanic complex and by Peterson, et al., (1985) as Chalt volcanic group. However, the present authors adopted the most suitable terminology as the Greenstone complex on the basis of green coloured volcanic assemblages intermixed with the metasediments.

The rocks of Greenstone complex are exposed towards north-east of the investigated area, in Shinghai Gah, Bai Gah and in the area between forest nursery along Kar Gah and Majne (Fig-1). A small exposure of basalt and quartzite is found along Kar Gah in the area of Gulmikai and Chauki (Fig-1).

In Henzal area, the Greenstone complex is composed of quartzite, phyllite, marble epidotized basalt, andesite and tuff. They are metamorphosed to the amphibolite facies of metamorphism. The thickness of marble bands vary upto 15 metres. Malachite and azurite stainings are prominent in quartz veins which profusely intersected these rocks.

In Shinghai Gah and Bai Gah this complex is composed of greenstone (metavolcanic) and green schists. Greenschist is the result of intensive shearing of volcanic rocks. Megascopically, chlorite, hornblende, epidote, feldspar, magnetite and + talc have been identified in the greenstone. Upper contact with pyroxene diorite in Shinghai Gah is marked by a sheared zone of microdiorite, gabbro and ultramafics. This zone is thin in this area but becomes gradually thick towards west in the area between Majne and Bujar Gah. It is spread over about 2 kms along Kar Gah. Andesite intercalated with tuff and minor chert are exposed at the junction of Chileli Gah and Rondar Nala. Andesite intercalated with tuff and minor chert are rock units exposed at the mouth of Chileli Gah. Needle like crystals of amphibole are prominent in tuffaceous material.

The Greenstone complex has been placed in Early Cretaceous by Tahirkheli (1982) on the basis of fossils discovered in its metasediment unit.

3.3 Thelichi formation:

The Thelichi formation is a mixture of metasediments and metavolcanic sequence, having type locality at Thelichi along the Karakoram Highway. This formation has been described by Wadia (1932) as part of the Salkhala Series and Thelichi Beds by Tahirkheli (1982). However, Khan, T., et al., (1996) named it as the Thelichi Formation.

The Thelichi formation comprises a sequence of slate interbedded with metasandstone, quartzite, marble, basal conglomerate, pebbly slate, basic dykes and green schist (Khan, et al., 1996). In the Chileli area slate is purple and maroon in colour, and underlain by granular greyish white marble which has an apparent thickness of 40 m. Marble is underlain by green schist and contain 1 to 2 m thick intercalation of quartzite.

The basal conglomerate consists of pebbles of quartzite and marble with calcite cement. Near the confluence of Chuku Nala with Chileli Gah, the Thelichi formation is composed of turbidites, hornfels, calcareous schist, chert and green schist. Marble bands are also well exposed about 2 kilometres upstream in Chuku Nala. A 10 m thick marble band is also exposed in Chileli Gah, near the contact of Thelichi formation with granodiorite. In Bai Gali area this formation is composed of predominantly slate, hornfels, marble, tuff and green schist. In the Chileli Gah, the contact of the volcano sedimentary zone of the Thelichi formation is marked by a 5 m thick volcanic breccia and agglomerate. Thelichi formation is also exposed in Shinghai Gah except the presence of basal conglomerates.

Thick banded marble occurs in the middle part of the Thelichi formation. This unit is laterally persistent and serves as a useful marker horizon. The succession of slate above and below the marble unit is almost indistinguishable.

Khan, T., et al., (1996) assigned Late Cretaceous age to the Thelichi formation.

3.4 Kohistan batholith

Kohistan batholith has been studied in the past by Ivanac, et al., (1956), Bakr, (1965), Jan, et al., (1981), Tahirkheli, (1982), Petterson and Windley, (1985), Khan, T., (1994). The multiphase intrusions according to Petterson and Windley (1985), occurred in three different episodes during the Late Cretaceous to Oligocene. The batholith is composed of diorites, granodiorites and granites.

The first phase intrusion comprises deformed diorite, tonalite and gabbroic diorite. The second phase intrusion comprises diorite, granodiorite and granite. The third and final phase intrusion, comprises pegmatite, aplite and leucogranites. The rocks of Kar Gah quadrangle consist of all the three phases of the Kohistan batholith described by Petterson and Windley (1985).

3.4.1 Diorites

Diorite and quartz diorite are exposed along both banks of the Kar Gah and the Shinghai Gah. Mostly the quartz diorite is light grey to grey and weathers to brownish grey. They are medium grained, massive and foliated. Quartz, feldspar, biotite, hornblende are common minerals together with epidote and sericite as secondary minerals. Mafic contents locally vary from some area. Microscopic studies of diorite and quartz diorite contain quartz 5-10%. Quartz grains are anhedral and mostly fresh but at places strained. Plagioclase amounts upto 50%, the grains are subhederal to euhedral. Hornblende is the dominant mafic mineral ranging from 15-45%. Hornblende is partly altered into chlorite and biotite. Diopsidic augite ranges upto 5% in some samples and biotite ranges from 5-10%. Sericite, epidote, chlorite, sphene, apatite and magnetite are the secondary, accessory minerals.

3.4.2 Granodiorite

Granodiorite occurs in the form of pluton and stocks. Major exposures are in the north-west of the quadrangle in the Lunda, along Chileli Gah and Julan area in Shinghai Gah, as well as, in the upper reaches of Gulapur Gah. The granodiorite is light grey to grey, weathers to rusty brown and mostly medium-grained but fine grained varieties are exposed at the contact zone with diorite. The granodiorite body occasionally contains xenoliths of metavolcanic and metasedimentary rocks.

Thin section study shows sub equigranular and porphyritic in texture, with mineral composition as oligoclase 50-60%, k-feldspar 15 - 20%, quartz 15 - 25%, biotite 10-15%. with secondary/accessory minerals 15%. The secondary minerals are sericite, chlorite and epidote, whereas accessory minerals are sphene, zircon and apatite.

Along the Chileli Gah, the granodiorite shows variation in composition, and having metavolcanic and metasedimentary xenoliths. Exfoliation and pot hole weathering are common features. Granodiorite of Lunda area is coarser than Chileli area.

3.4.3 Granites

Granite is exposed in the form of stocks, apophyses and dykes. Mapable exposure of granites are present in the upper reaches of Chileli Gah, Kehna area and near Herpun village along the Gilgit River. A lenticular body is also exposed along the road in the Barsinpur Bala area. Small dykes of leuco-granite are scattered in the mapped area. They are fine grained, equigranular and highly sheared.

Two lensoid bodies of porphyritic granite are exposed in the upper reaches of Chileli Gah. The granite is equigranular at the margins and changes to porphyritic in the central part of the outcrop. It is a compact, massive, mostly leucocratic and at places brownish grey in colour. K-feldspar is the main phenocryst mineral. The crystals are subhedral to euhedral. Mineral composition reveal as quartz about 22%, feldspar mostly microcline about 65%, biotite about 5%, alongwith sericite and chlorite. Zircon is found as accessory mineral. A small granitic body which is exposed in Kehna area is highly sheared. In thin section it is fine to medium grained and partially foliated, with quartz 25 to 30%, plagioclase about 15% and k-feldspar upto 45%. The k-feldspar grains are strained and fractured. Biotite flakes upto 10% contains relics of hornblende. Chlorite, epidote and garnet occur in minor amounts.

3.5 Quaternary deposits

Fluvial deposits are found along the valleys throughout the mapped area. Moraines are mostly found in the Gilgit River valley and in Kar Gah valley. These moraines are composed of multidimensional unsorted material ranging in size from boulder to clay. Larger fragments are more dominant than the finer ones.

The terraces are mostly composed of huge and unsorted debris, having large boulders and blocks of the country rocks ranging upto 5 m in diameter. These debris material deposits often slide causing great damages to the houses and the cultivated land. The villages of the area are situated on the terraces e.g. Uthelkai, Henzal, Shemos etc.

The river bed deposits found in the area consist mostly of material from gravel to sand with minor silt and clay, along the Gilgit River. Other types of river bed deposits which are formed due to damming of the river are found specially in Barsin area. Such deposits consist of homogeneous layers and lenses of very fine clay to silt located at different levels.

4. STRUCTURE

Structure of the mapped area is mainly depicted by the synclincal structure of the Thelichi formation (Jaglot syncline) which trend NW and SE direction. The SE part of the syncline is well exposed at Thelichi, whereas the NW part is truncated by the plutonic rocks of the Kohistan batholith at Chileli. The occurrences of Gilgit formation and Greenstone complex rocks within the Kohistan batholith also show that the area has been subjected to folding prior to the intrusions of the batholith, because the plutonic rocks of the batholith cut their structures. Apart from the major structural scenario, the exposed rocks show consistent NE and SW trend.

5. ECONOMIC MINERALS

The mapped area is almost poor in ore potential. Marble of good quality is present in Henzal area, Shinghai Gah, Bai Gah and Chaku Gah. In Henzal area, it occurs in the form of bands and lenses. The thickness of bands vary from 10 to 30 m. It is nearly equigranular, white to light grey and mostly composed of calcite. In Shinghai Gah, Bai Gah and Chaku Gah marble is greyish, fine grained and impure. Gold occurrence is reported in quartz veins in Henzal area.

Malachite staining is prominent in quartz veins in Henzal area. Quartz crystals of medium size are reported in the upper reaches of Chileli Gah and Shinghai Gah but these deposits have no commercial potential.

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