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PETROGRAPHY OF THE UPPER PART OF KOHISTAN AND SOUTHWESTERN GILGIT AGENCY ALONG THE INDUS AND KANDIA RIVERS

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ABSTRACT

This paper presents a petrographic account of the common rocks of the previously unmapped area of Indus Kohistan and southwestern Gilgt Agency. The study is based on field observations and thin sections of 55 rocks selected from over 200 samples quickly collected along the Indus Valley Road and Kandia River.

The major rocks of the area are amphibolites (gneissose metaigneous; some banded ? metasedimentary) and norites-diorites (the former also having a clinopyroxene), and minor (?) alpine peridotites, granitic rocks, pegmatites, and low grade regionally metamorphosed schists in the Kandia Valley. The norites-diorites are abundant in the north, the amphibolites in the south. Tentative ages have been assigned to the rocks; the various igneous rocks are considered to be related to the Himalayan orogeny and emplaced between Middle/Late Cretaceous and Early Tertiary.

Comparison of the rocks from various parts of the northern West Pakistan shows that the Hornblendic Group of Martin et al. (1962) extends from Chilas in Gilgit Agency to at least western Dir — a distance over 160 miles. There is a probablity that the group may be extending in the adjacent eastern Afghanistan which is covered by the Hindukush Range. North to south, the group may occupy a territory as wide as 60 miles.

INTRODUCTION

In the geological map of Pakistan, compiled by Bakr and Jackson (1964), an area over 7,000 square miles in Kohistan of Hazara, Swat and Dir, and the southern part of Chitral and Gilgit is shown unmapped. The Department of Geology. University of Peshawar, started a project in 1968 to investigate this area, mainly along the Indus and Swat Rivers which are easy of access because of roads. Results of the first phase, covering the southern part of Indus Kohistan, Swat, have already been published (Jan and Tahirkheli, 1969). It was mainly a continuation of the work of Martin, Siddiqui and King (1962) in the Lower Swat. Later on, when the work was extended to the north, the area was found to be geologically very complex and needed a more careful and thorough investigation before producing an account of its geology. In the meanwhile, it was thought appropriate to give some information on the petrography of the rocks sampled.

This paper is based on field observations and thin section study of the common rocks quickly sampled along the Kandia River and the Indus Valley Road between Thor (Gilgit Agency) and Kayal (Indus Kohistan, Swat) nalas. Over 200 samples were collected and 55 of these were selected for thin section study. Another 50 were crushed and studied in oil under the microscope for quicker composition determination. Since norites are abundant, fresh, and previously undescribed, many of the sections were cut from these in order to get more informations on their mineral composition.

Most of the area under discussion is covered by amphibolites (metaigneous and minor ? metasedimentary) and norites-diorites which have been intruded by ultramafic, granitic and pegmatitic rocks. Similar rocks, occurring along the Swat River, have been called the Upper Swat Hornblendic Group by Martin *et al.* (1962). Low grade schists, entirely different form these, also occur along the east-west trend of the Kandia River. The age relationship of these to the metasedimentary amphibilites is not clear.

The Upper Swat Hornblendic Group.

Martin *et al.* (1962) gave this name to the hornblende-rich rocks occupying a wide belt of country in the Upper Swat. The group was considered to be thrust over the younger (Siluro-Devonian) rocks of the Lower Swat-Buner Schistose Group which occur to the south. Bakr and Jackson (1964) have tentatively placed such rocks, exposed south of Kalam along the Swat River, in the Precambrian. Recent work shows that the group extends from Chilas in the Gilgit Agency to western Dir and it is just possible that it may be extending further west into Afghanistan*— a

*If these rocks extend in eastern Afghanistan, which is covered by the Hindukush-Karakorum System, then they pose a serious structural problem on regional basis too. Throughout the Indus Valley, the Shah Dheri-Kabal area (Rehman and Zeb, Ibid.) and in Timurgara, Dir (Jan, Kempe and Tahirkheli, 1969), the Hornblendic Group has a general east-west or northeast-southwest trend. This is in proximity to the general trend of the Hindukush Range in the adjacent regions. On the other hand, the Himalayas in the Kohistan have been shown to extend, at least, up to the Indus River (Wadia, 1961; Gansser, 1964). Hayden (1915) considered the belt of igneous and menamorphic rocks of the outer mountains of Dir and Swat to be a continuation of that found in Hazara. The Hazaran area is generally agreed upon to be Himalayan.

- It may also be mentioned here that Pasco had pointed out the similarity between the hornblende gneisses near Timurgara and the Jagdalak ruby mines, 130 miles WSW in Afghadistan, in 1950. Interesting enough, by 1968, purplish ruby-corundum was found to occur also near Timurgara.

distance well over 160 miles. South to north, the group extends for about 60 miles in the Swat River Valley before the pink and green mottled volcanic rocks are encountered north of Kalam.

According to Martin *et al.*, the Hornblendic Group ranges in composition from hornblende-bearing schists and gneisses to diorites, and quartz diorites and granites. In addition, the group also contains more basic rocks such as norites and peridotites. Davies (1964) also reported the presence of syenites, and considered the rocks to be plutonic in character. Jan and Tahirkheli (1969) distinguished the garnet-rich amphibolites from the rest of the rocks of the group in Indus Kohistan, Swat. So far, however, none of these workers mapped separately the various rock units in the group.

The rocks of the Timurgara, Dir, area are a continuation of the Hornblendic Group and have been classified into four separately mapped units, namely: Banded Gneisses, Dioritic Rocks, Ultramafic Rocks, and Granitic Rocks (Jan, Kempe and Tahirkheli, 1969). A similar mapping pattern was followed by Rehman and Zeb (Ibid.) in the Shah Dheri-Kabal area of the Upper Swat and the group was calssified into Amphibolites and Banded Amphibole Gneisses, Dioritic Rocks, Ultramafic Rocks,and Quartz Diorites. In the present work, it was found that such a sub-division can be extended through most of the area covered by the Hornblendic Group. provided the map used is at least 1″=1 mile or even larger.

The banded (? metasedimentary) amphibolites, pink feldspar norites, peridotites and granitic rocks, easily distinguishable in the field, can be mapped. However, one faces a great difficulty in telling apart the "igneous looking" amphibolites from diorites and non-pinkish norites not only in hand specimens but also under the microscope some times. On an inch to four miles map (used by the author), separate mapping of most of the rocks, particularly the amphibolites and diorites-norites, is impossible.* In some places, this may be the case even on a large scale map because the amphibolites and diorites-norites are intimately associated. It is possible that the "igneous-looking" amphibolites may in fact be diorite-norite intrusions now metamorphosed (see p. 40). If this is true, drawing a line between the amphibolites and diorites-norites will be difficult because of all types of gradational rocks. For this reason also, the author is unable to produce a geological map at this stage.

Concerning the age of the Hornblendic Group, it is thought here that the group is not entirely a Precambrian or Palaeozoic mass. There might be some justification to consider the banded amphibolites (? metasediments) so old, but the rest of the

*The maps were enlarged to 2 Inches = 1 mile but on these one can not accurately locate himself because the present road is not shown on the original topographic maps.

rocks are younger in age and might be connected with the Himalayan orogeny. Misch (1949, p. 216) writes: "Another group of rocks in the Nanga Parbat area consists of very extensive masses of norite and hypersthene diorite with local dunite. These rocks border the gneiss massif both on the east and northwest. The eastern norite area is on the south in contact with the predominantly basic lavas of the Cretaceous-Eocene volcanic formation. The norite is contemporaneous with or slightly younger than the lavas. That both are genetically related has already been pointed out by D. N. Wadia (1932)."

"Most of the noritic rocks", according to Misch, "have been more or less metamorphosed. There are all passages to statically recrystallized metanorites and metadiorites with crystalloblastic hornblende, epidote, etc. As the borders of the gneiss massif are approached, static recrystallization gradually gives way to kinematic metamorphism, and mesozonal amphibolites are formed .... Both rock units, e.g. the norite bodies and the gneiss massif, have here participated in the same process of tectonic deformation and of crystallization....This process of synkinematic metamorphism took place during the Early Tertiary main Himalayan orogeny, not a very long time after the original norite bodies had formed." The western noritic outcrop of the Nanga Parbat region has been shown by Misch (p. 212) to extend towards Chilas. In a later section, the present author has considered that the norites occurring about 10 miles to the east of Chilas are petrographically similar to those of the Kohistan area. The alpine peridotites of the Himalayas, according to Krishnan (1956, p. 79), are Middle to Late Cretaceous. It is considered here that such peirdotites are intrusive in the norite-diorite rocks of the area and are thus younger than the latter.

On these grounds, it is tentatively thought here that the noritic-dioritic rocks may have been emplaced during the earliest phases of the Himalayan orogeny (Middle to Late Cretaceous), followed by the alpine peridotites and the granitic rocks in the Late Cretaceous to Early Tertiary period. There, however, is no positive evidence to support this, and detailed field and geochronological work is needed to clarify the whole problem.

THE KANDIA SCHISTS

For most of its east-west course between Tuti and Richa, the Kandia River flows in low grade regionally metamorphosed rocks of grey, brown, pinkish and green colours. The rocks are well-jointed and often make vertical cliffs along the northern bank of the river and at other places. The major outcrop appears to be wider (over 5 miles) in the east, gradually thinning out in the west and becoming less significant to the west of Richa. The rocks are distinctly schistose, some tend to