

THE GEOLOGY AND PETROGRAPHY OF DESHAI-DIWANGAR AREA, USHU GOL VALLEY, SWAT KOHISTAN.*

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ABSTRACT

This paper presents a geological map, petrography and structure of about 160 square kilometres of Deshai-Diwangar area, Swat Kohistan. The area consists of metasedimentary rocks (? Palaeozoic to Mesozoic), intruded by Tertiary Plutonic igneous rocks. The Plutonic rocks consist of gneissose-quartz diorites, orbicular diorites, and quartz diorites of Early to Middle Tertiary period. The Early Tertiary gneissose quartz diorites are intruded by Diwangar Granite (? Middle Tertiary). Locally, small granitic intrusions and veins of a later age than Diwangar Granite are irregularly distributed in the area. Pegmatites and aplites are associated with all types of rocks.

Structurally the area is not very complex. A main fault runs along the Ushu Valley and is older than the Diwangar granite.

INTRODUCTION

This paper is an edited account of a M. Sc. thesis presented to the department of Geology, University of Peshawar, in November, 1973. Mapping was carried out on Survey of Pakistan toposheet No. 43 A/6 on scale 1:50,000.

The area lies in the extreme northern part of Swat Kohistan along Ushu Gol and is delineated by longitudes $72^{\circ}50' N$ and latitudes $35^{\circ}50' E$. Access to the area up to Mahodand is easily gained from Kalam by an unmetalled road which is

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motorable only between the months of March and October. The area is characterised by severe winter and mild summer. During winter the area may record as much as ten feet of snow. Vegetation is sparsely distributed in the area.

Swat Kohistan is mainly occupied by the rocks of the Kohistan basic complex which includes amphibolites, norites/gabbro, diorites, and minor peridotites and granitic intrusions. These are followed northward by metasediments, volcanic rocks, quartz diorites, and granites.

Very little geological data is available on the investigated area. Matsushita (1965) mentioned the occurrence of biotite gneisses and porphyritic granite, and Jan and Mian (1971) have carried out preliminary geological investigation in the area along with petrographic notes on the main rock types.

Geomorphology

The area investigated is characterised by high relief and rugged topography. The mountains in the area have sharp dissected ridges. Vertical cliffs and saw-tooth ridges are the typical features. Near the confluence of the major streams, large alluvial fans are produced. The main valley is U-shaped due to glacial erosion and a large part of it is characterised by the presence of glacial deposits. Hanging valleys, water falls and rapids are quite common in the area. The highest water fall of the area is about 61 metres high and is situated about 3 kilometres north of Mahodand.

Ox-bow lakes and glacial lakes are also present in the area. Some of the glacial lakes are quite large such as that near Mahodand which is approximately 1.6 kilometres long and 90 metres wide. There also are some basins which must have remained lakes in the past. Their present sites are flat 'depressions' in which the river meanders. The drainage, in general, is dendritic with occasional trellised pattern.

GENERAL GEOLOGY AND PETROGRAPHY

The area investigated contains banded metasedimentary rocks on the western side of the Ushu Gol. Their general strike trends NE with steep NW dip. These rocks are intruded by small dioritic and granitic bodies, many of which are concordant with the metasedimentary rocks.

Gneissose quartz diorites make the most dominant rock-type in the area. These are relatively more widespread on the eastern side of the Ushu Gol,

extending northeast upto Dadarili pass. A small orbicular dioritic body is exposed within the gneissose-quartz diorites on the eastern side of the stream, about 0.8 kilometre to the north of Deshai.

On the western side of the confluence near Diwangar, smoky diorites cover a large area and are the second most abundant rock-type. Similar rocks are also found to the west of the area in the Bankhwar (Gabral Valley) and Gojar Khwar.

A stock of granite is observed at Diwangar confluence, extending up to Dadarili pass. Between granite and smoky diorites, metasedimentary rocks also occur, forming a mixed zone intruded by the two earlier mentioned rocks.

The general geology and the rock sequence is established on the basis of field observations. Ages of the rocks are only tentative, no fossils are found in the metasedimentary rocks.

Leucogranites and other minor

granitic intrusions	...	Late Middle Tertiary?
Diwangar Granite	...	Middle Tertiary?
Smoky diorites	...	Early to Middle Tertiary?
Orbicular diorites	..	Early to Middle Tertiary?
Gneissose quartz diorites	...	Early Tertiary?
Metasedimentary rocks	...	Palaeozoic to Mesozoic?

Amphibolites in the metasedimentary rocks resemble those of Swat and Dir areas which are older than the Cretaceous plutonic rocks (Jan and Kempe, 1973). Jan and Mian (1971) reported that the gneissos quartz diorites intrude the Early Tertiary volcanic rocks. Since they are themselves foliated, metamorphosed and followed by a number of dioritic and granitic intrusions, therefore an Early Tertiary age can be assigned to them as well.

Diwangar Granite is separated in time from the gneissose-quartz diorites by the intermediate phases of smoky and orbicular diorites. They do not show metamorphic foliation, so they might be Middle Tertiary while the two intervening diorites are Early to Middle Tertiary. Leucogranites are the youngest rocks. Some of these may be genetically related to Diwangar Granite and may thus be of Late Middle Tertiary age whilst others may be even younger.

Metasedimentary Rocks

Metasedimentary rocks (? Palaeozoic-Mesozoic) occur in small exposures throughout the area investigated. The major outcrop, 3.2 kilometres long and about half a kilometre broad, is present in the south-west of Diwargar confluence along the right bank of the Ushu Gol. The rocks are represented by amphibolites, biotite schists and gneisses, and less abundant micaceous quartzite, intruded by diorites and granites. Ptygmatic folding, migmatitic appearance and differential weathering are the characteristic features of these rocks.

Amphibolites are irregularly distributed in the area. In addition to their occurrence in the main metasedimentary 'belt' they also occur in the form of isolated 'beds' and xenoliths within the plutonic rocks. They are dark green in colour and two varieties, homogeneous and banded, can be distinguished. The homogeneous variety is massive weakly- to non-foliated, and contains local concentration of feldspar in patches, or more rarely in veins, which might be due to metamorphic differentiation. However, some rocks are completely devoid of feldspar while a few contain large crystals of feldspar, 1½ cm in length, in a medium-grained matrix.

The banded amphibolites are fine-grained, containing abundant hornblende, and usually well-foliated. The trend of the foliation is N 10°E, 5°W (Matsushita, 1965). Jan and Mian (1971) considered that their foliation is parallel to that of the gneissose-quartz diorites. However, it has been noted during the present work that their foliation has a different trend than that of the diorites.

Petrographically the amphibolites, as usual, are made up of hornblende and plagioclase with varying amounts of quartz, sphene, epidote and ore are the accessory minerals.

Hornblende, the most frequent mineral, is mostly dark green in colour, sieved and surrounding pyroxene in some non-banded rocks. Sphene and ore are seen as inclusions in the hornblende.

Plagioclase is the next important mineral in these rocks. The composition of the plagioclase could not be determined accurately because twinning is weakly developed and zoning is common. It is partly or completely kaolinized and has abundant ore inclusions. Quartz is found in anhedral grains with undulose extinction.

Biotite schists and gneisses have grey colour and are well-banded and folded. They contain amphibolite patches and lenses surrounded by felsic material. Epidote veins of secondary origin are common across the foliation.

These rocks appear to be more abundant than the amphibolites. In rare cases lenses of amphibolites stretched parallel to the foliation are seen in these rocks producing an 'augen-like' structures. There is a possibility that these lenses and patches were, originally, layers of marly material which has been severally subjected to tectonic forces and metamorphism, or they may have been produced by slumping at the site of deposition before metamorphism (Jan. personal comm).

Under the microscope these rocks are composed of quartz, biotite and feldspar; with or without sphene, hornblende and ore. Quartz is the most abundant mineral and usually occurs in the form of anhedral crystals which show undulose extinction, Biotite is the next important constituent of these rocks and is yellowish to dark brown in thin section. Plagioclase is mostly twinned and zoned. In gneissose variety the plagioclase appears to be as calcic as An₅₀ (Jan and Mian, 1971). Potash feldspar is rarely seen and is intergrown with quartz.

Gneissose Quartz Diorites

Gneissose quartz diorites cover most of the terrain investigated. To the east of Diwangar they probably extend into the Kandia Valley, Indus Kohistan. To the north they extend upto Dadarili Pass. They become less significant to the west of Ushu Gol and, apparently, do not extend into Gabral Valley.

They have a sharp contact with Diwangar Granite, marked by the north-easterly tributary of Ushu Gol. Towards the west they are in contact with the metasedimentary rocks which are intruded by small bodies of granites near the contact.

Except locally, the gneissose quartz diorites are well-foliated on both sides of the Ushu Gol. However, the trend of the foliation is different on the two sides. It is N 55°E with steep northward dip on the eastern side of the stream, and N 20°W, 60 SW on the western side. The two sides are thus regarded to be faulted.

Xenoliths of dark amphibolites and less abundant quartzite are usually seen. Occasionally there is a gradational assimilation of the amphibolites within

the diorites. They are up to a few metres thick, banded, and lie parallel to the foliation of the host quartz diorites. Pegmatites and aplites are also abundant in these rocks. Rarely, along the margins of pegmatites, epidote bands are developed.

The rocks are coarse-grained or, locally, medium-grained, hypidiomorphic to allotriomorphic. Some diorites are coarse-grained in hand specimen, but not so in thin section. The coarse grains in fact are aggregates of small grains as already observed by Jan and Mian (1971). Among the non-gneissose types a coarse-grained diorite with euhedral hornblende is an obvious variety. The gneissose quartz diorites are mainly composed of plagioclase, hornblends, biotite and quartz.

The feldspar is mainly medium andesine. Albite and Carlsbad twinning are common but pericline twinning is not seen. It is locally cloudy, especially along certain zones and cores. Zoning may be oscillatory or normal. Sericite and clayey material are the common alteration products but, rarely, chlorite is also seen in the plagioclase; also present are abundant inclusions of ore and secondary epidote.

Hornblende, the second most abundant mineral, is dark to light green in colour and characteristically poikilitic. It has sieved texture and contains small pyroxene grains in the core. The next important mineral is biotite which is more abundant in the dark coloured diorites. Its colour is usually yellowish to dark brown in thin section. It is also poikilitic, having inclusions of quartz and ore. Secondary muscovite is seen in a few rocks.

Quartz is another abundant mineral in these rocks. It has mostly undulose extinction and often subhedral to anhedral. Myrmekitic intergrowth of quartz and feldspar is locally observed. The common accessory minerals are apatite, sphene, ore, epidote and, rarely, zircon. Apatite is usually found in small grains, irregularly distributed throughout the rocks. Sometimes it is also seen embedded in the plagioclase and hornblende. Sphene is generally associated with hornblende.

Orbicular Diorites

These rocks occur in an elongated outcrop about 600 metres north of Dshai on the eastern side of the Ushu Gol. A minor outcrop of these rocks occurs south of the main mass of the Orbicular diorites on the western side of

the stream and seems to have been separated from the major mass by the main fault. The orbicular diorites are seemingly intruded in the gneissose quartz diorites (Jan and Mian, 1971) Only a brief account is presented here mainly taken from Jan and others' pending publication.

The main mass of the rocks is formed by quartz diorites, however, in the south, and locally in the north, gabbroic norite also occur. The norites and diorites have locally developed into orbicular structure, however, in the former it is much rare.

The orbicules are randomly distributed and do not form in a particular part of the rocks. These may be isolated or in colonies. The colonies are usually less than 1.8 metres across and in some the orbicules are highly concentrated. The orbicules are usually subrounded to ellipsoidal in shape. They are of various dimensions, ranging from 2 to 25 cm in size, many are up to 12 cm (Jan and others, in preparation). The contact of the orbicules with the host rocks is gradational, as observed in thin sections, although in hand specimen it may look sharp.

The orbicules are normally composed of many shells. The minerals in the shells usually have radial arrangement, and many of them look amphibolitic in hand specimen. The mineral composition may vary from shell to shell. The thickness of the shells ranges from half a millimetre to a few centimetres.

The orbicules can be classified into the following three general types (Jan and others, in preparation):

- a) Feldspar-rich radial growth in a main rounded orb that is separated from the host norites by a fine-grained, thin marginal shell.
- b) A central core of diorite/norite separated from a similar host rock by usually many shells but rarely one shell.
- c) Many shells, apparently without a core, in diorites. The type (b) is statistically by far the most abundant of the three.

Microscopically the norites and diorites are non-gneissose and granitoid in texture, although poor foliation is locally seen in some. The norites are composed of medium to calcic labradorite, hypersthene, augitic-pyroxene and hornblende, with rare biotite, ore, quartz and apatite. Some have secondary epidote.

The plagioclase is complexly twinned, is normally zoned, with calcic andesine rims; however, oscillatory zoning is also seen in some. Pyroxene (especially hypersthene) is changed to hornblende and quartz due probably to metamorphism. The norite in one case has locally developed thin bands of anorthositic gabbro and pyroxinite alternating with noritic ones.

The diorites are composed of plagioclase, hornblende, quartz, biotite and minor apatite. In some sections, pyroxene, sphene, secondary muscovite and epidote are also seen. The plagioclase of the diorites is zoned calcic andesine, often strained, locally having myrmekitic quartz and partially clouded. The hornblende is usually poikilitic, green to brown pleochroic and with sieved cores.

Biotite is also poikilitic and, in some sections, muscovite and epidote, probably formed at the expense of plagioclase and hornblende, are associated with it. In a few rocks chlorite has developed at the expense of biotite and hornblende. The pyroxene is usually augitic, often uralitized and enclosed by hornblende.

The mineral content of the shells of the orbicules resembles closely with those of the norites and diorites. However, in general, the shells have a much higher content of the mafic minerals than the host rocks. In some orbicules within the norites, plagioclase rich shells are also present. The detail petrography of a noritic orbicule is presented below.

The innermost shell is made up of plagioclase, hornblende, clinopyroxene, with minor hypersthene and subordinate biotite in the inner part. It is strongly radial and most of the hornblende seems to have grown after clinopyroxene in the outer part of the shell. This is followed by more than 15 rings, of alternating dark gabbroic and light (anorthositic) composition, 1 to 3 cms thick. The dark shells have abundant hornblende and subordinate hypersthene, but the lighter ones always have more hypersthene than hornblende. Traces of ore occur in all, while biotite is found in some shells. The outer shell, or the next to it, is hornblende-plagioclase-biotite hypersthene. Thus they have a close resemblance to the layered noritic rock.

Smoky Diorites

Smoky-looking, non-gneissose diorites cover the northwestern part of the valley. Towards the south they border the meta-sedimentary rock, and extend

up to Doucher stream opposite to Deshai. To the north-west of Diwangar confluence, the smoky diorites are separated from the Diwangar Granite by a narrow belt of meta-sedimentary rocks. The latter contain abundant concordant intrusions of diorites and porphyritic granite. To the south, the contact of smoky diorites and gneissose quartz diorites is sharp and the former appear to be younger.

The rocks are nonfoliated and are well-jointed in many directions. In some places are found amphibolite xenoliths with sharp margins; more rarely, quartzite xenoliths, again with sharp contact, are also seen. Lack of reaction of amphibolitic as well as quartzitic material is suggestive of the fact that the smoky diorite magma has not been much modified by assimilation.

Pegmatites, mostly of granitic composition, have a crosscutting relationship with these diorites. The pegmatites, usually in the form of dykes, vary in thickness. Locally, minor non-porphyritic veins are also observed in the diorites.

Under the microscope the rocks are medium to coarse-grained, hypidiomorphic to allotriomorphic. They are composed of feldspars, hornblende, biotite and less abundant quartz. Apatite, ore, sphene, uranitized pyroxene, sericite and chlorite are also found in minor quantities.

Medium andesine is the plagioclase in these rocks, and characterised by pericline twinning, but albite and Carlsbad twinning are also seen. The plagioclase has abundant inclusions of ore, quartz, and sphene, but is rarely sericitized or kaolinized. The potash feldspar, orthoclase, occurs in association with quartz and is locally altered to kaoline.

Light green to dark green hornblende, the next most frequent mineral in these rocks, occurs mostly in association with quartz and sphene. Poikilitic growth is a characteristic feature of the hornblende; in section No. 832 its rims are developed around uranitized pyroxene. Inclusions of ore, sphene and quartz are common in hornblende.

Biotite is mostly dark brown in colour and is poikilitic. Intergrowth of biotite and hornblende with some quartz is distinct, it also has abundant ore and quartz. Quartz grains are usually subhedral to anhedral, strained and its myrmekitic intergrowth with feldspar is also seen.

Diwangar Granite and other minor Granitic Rocks

Apart from small granite intrusions, a large granite body is exposed at Diwangar confluence. It is a stock in dimension and has been named as Diwangar Granite by Jan and Mian (1971). The granite body covers the northern part of the main valley extending northeasterly up to Dadarili pass. On the west it intrudes a narrow belt of metasedimentary rocks which separate it from the smoky diorites. It has a sharp contact with gneissose quartz diorites, along which the northeasterly tributary of the Ushu Gol has carved its course. The rocks are generally non-foliated, although locally foliated.

At places the phenocrysts of feldspar have trail-like arrangement. The granite is apparently the youngest rock of the area, setting aside the minor bodies, and intrudes the diorites and amphibolites.

The rock is white gray in colour, strongly porphyritic, and contains abundant xenoliths. Phenocrysts of zoned feldspar attain a size of 6 cm in length. Some of the feldspar phenocrysts are more resistant to weathering and stand out prominently in the more weathered groundmass. The rocks are well jointed in many directions, the two vertical joint sets producing steep and high cliffs. Saw-tooth erosion in the Diwangar Granite is noteworthy. Pegmatites of varied thickness are also associated with the granitic body.

Petrographically the granite is coarse-grained, porphyritic, hypidiomorphic to allotriomorphic. It is mainly composed of plagioclase, perthite and quartz. Hornblende, biotite, sphene, ore and zircon make up the accessories.

The small granitic intrusions occur in most of the area investigated. They vary in thickness; some of them (*i. e.* the leucogranite of late Middle Tertiary age) occur in mappable outcrops on a scale of 1:50,000. They intrude various rock types and their frequency is increased in the metasedimentary rocks on the western side of the Diwangar confluence. They are, rarely, seen associated with the main Diwangar granitic body.

Under the microscope the rocks are medium-grained, holocrystalline, hypidiomorphic to allotriomorphic. Myrmekitic intergrowth of quartz and feldspar are the characteristic features of these rocks. Feldspar, quartz, biotite and hornblende are the major constituents of these rocks. Sphene, epidote, apatite and chlorite are the less abundant minerals.

Pegmatites and Aplites

An interesting feature of the area is the presence of pegmatites and aplites of varied thicknesses. The common types are those of hornblende pegmatite which are abundant in the gneissose-quartz diorites. Mostly these are 11 to 15 cm in thickness, having distinct large hornblende crystals in feldspar and biotite matrix. Some of the hornblende crystals attain 11 cm length. Tourmaline crystals of dark green colour are also present in rare cases. These may be representing the late liquid fractions of the diorite magma and may thus be older than the granites.

Pegmatites of granitic composition are also found in the area, particularly on the western side of the confluence. Some of these are in the form of leucosomes in the metasedimentary rocks. These rocks are composed of feldspar, quartz and biotite; zircon and tourmaline also occur very locally. In the gneissose quartz diorites exposed to the north of the orbicular mass, local pegmatite veins with radially grown tourmaline or plagioclase suns are also seen. The length of the crystals in these may reach up to 5 cm. Aplites are rare and they may cut or may themselves be cut in turn by the pegmatites and other granitic rocks, particularly on the western side of the stream. Abundant veins of quartz, some only a fraction of a millimetre in thickness, filling the fractures and joints, are present. Epidote-rich ? metasomatic veins, particularly those in diorites and metasedimentary rocks, also occur.

STRUCTURAL GEOLOGY

Structurally the area is rather simple and no complexity is observed. Among the minor structures, bedding and foliation are quite distinct in metasedimentary rocks. A major fault runs NS along the Ushu Gol Valley. Following is a brief description of the various structural features observed in the area.

Metasedimentary rocks which are exposed near Diwangar strike NE with steep northwesterly dip. The beds on the western side of the Ushu Gol are folded as a result of granitic and dioritic intrusions. Migmatites are also developed locally in the amphibolites on the western side of the Ushu Gol, near the confluence.

Foliation is well developed in the metasedimentary rocks and trends N 10°E, 75°W. In gneissose-quartz diorites the foliation is comparatively less significant and on the eastern side of the Ushu Gol its trend is N 55°E

with, vertical dip. On the western side, it is N 20°W, 60°W. Data collected by Matsushita (1956) is confirmed by the present work. Locally, foliation is also weakly developed in Diwanger Granite.

The interesting features observed in the areas is the drainage pattern which is controlled by structure in the sense that all major valleys are developed at the contacts of the rocks. The Ushu Gol stream, though produced along a major fault, also separate metasedimentary rocks from the gneissose-quartz diorites. All the contacts are sharp and are traceable throughout the area over a large distance.

Joints are well-developed in the area. In the Diwanger Granite two sets of joints trend NS and NW and it appears that they are the conjugate shear fractures. An attempt was made to plot the joints data and determine the major stress directions. Although sufficient number of joint readings could not be collected because of the inaccessibility, from the data available it is understood that the major stresses are oriented in a NNW, SSE direction.

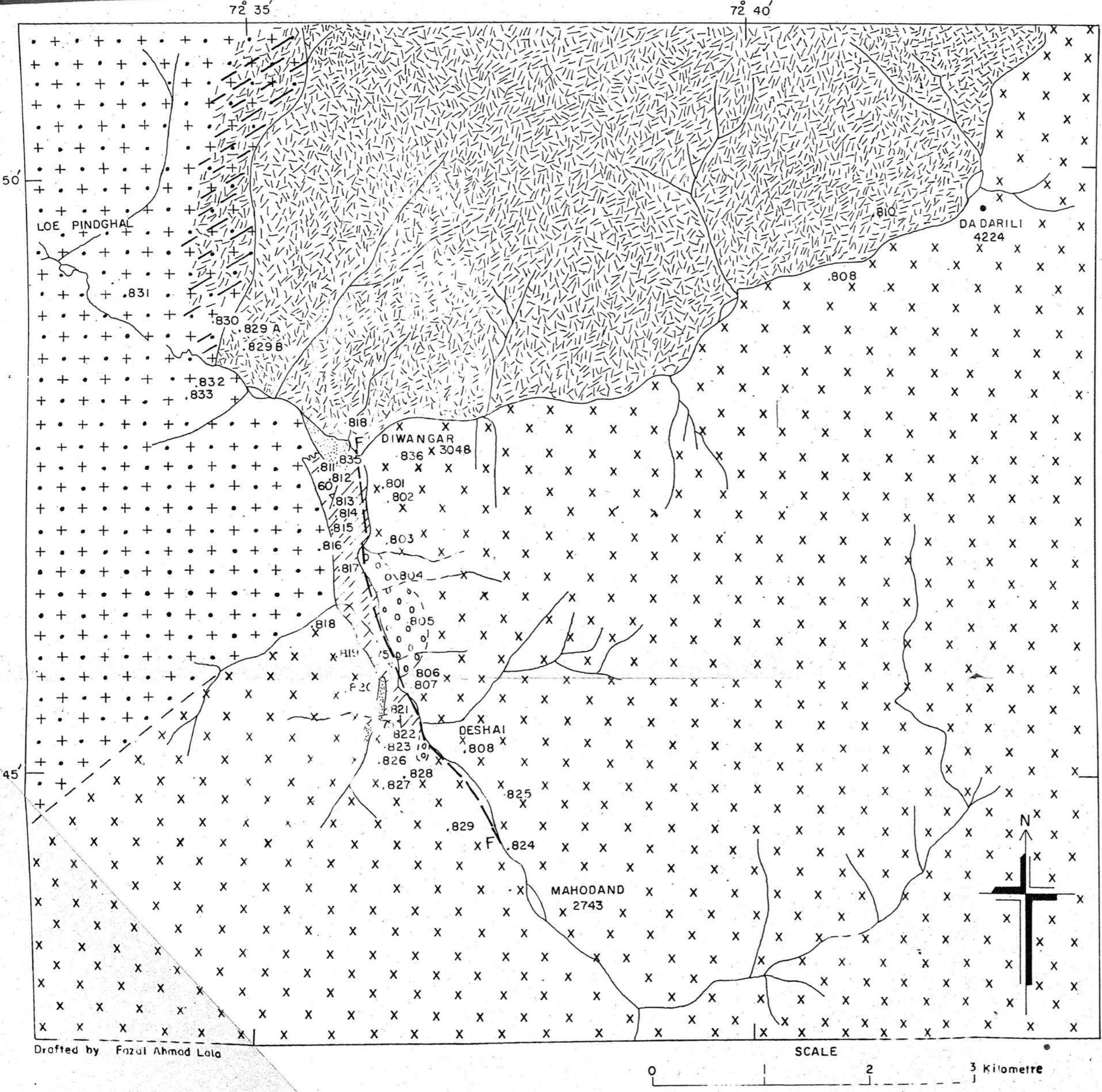
The main fault, the main structural element of the area along the strike of which the main valley is cut, is inferred from the presence of displaced patches of orbicular diorites on either side of the valley. Towards the east, the main body of this orbicular diorite is about 1.6 kilometre north of the one present on the western side. The intrusive body must be older than the fault and is thus displaced by the latter. The abrupt change in the trend of foliation in gneissose-quartz diorites on either side of the Ushu Gol and the straight nature of the valley also support faulting. The age of the fault is most probably Early to Middle Tertiary, because it displaces the orbicular diorite of Early to Middle Tertiary age and is truncated in turn by the Diwanger granite of Middle Tertiary age (Jan and Mian, 1971).

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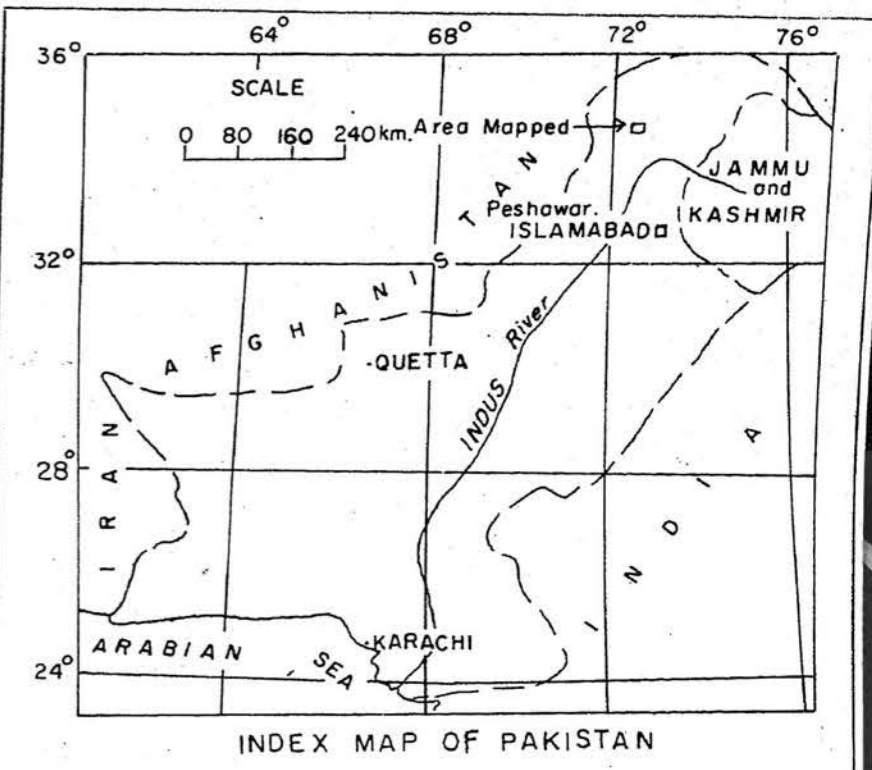
REFERENCES

- BAKR, M. A. & JACKSON, R. O. 1964. Geological map of Pakistan. Geol. Surv. Pakistan.
- DAVIES, R. G. 1965. The nature of the Upper Swat Hornblendic Group of Martin *et al.*, (1962). Geol. Bull, Punjab Univ. 5, 51-2.
- JAN, M. Q. & MIAN, I. 1971. Preliminary geology and petrography of Swat Kohistan. Geol. Bull. Univ. Peshawar, 6, 1-32.
- & KEMPE, D. R. C. 1973. The petrology of basic and intermediate igneous rocks of Upper Swat, Pakistan. Geol. Mag. 110, 285-300.
- & Others. (in preparation). Orbicular diorites of Deshai area, Swat Kohistan, NW Pakistan.
- KHALIL, M. A. & AFRIDI, A. G. 1973. The Geology and petrography of Deshai-Diwangar Area, Ushu Gol Valley, Swat Kohistan, N.W.F.P., Pakistan. Unpub. M. Sc. Thesis, Univ. Peshawar.
- MATSUSHITA, S. 1965. Geological research in the Upper Swat and the eastern Hindukush. In Geology of the Karakoram and Hindukush, Results, of the Kyoto Univ. Sci. Expedition to the Karakoram and Hindukush. (Matsushita, S. and Husita, K., Eds.). 1955, 7, 37-85:



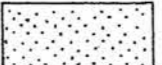

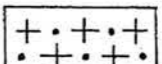
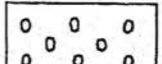
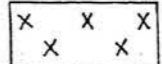
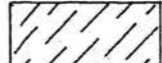

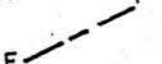


Drafted by Fazal Ahmad Lala

SCALE
0 1 2 3 Kilometre



INDEX MAP OF PAKISTAN

INDEX

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(Late Middle Tertiary.)
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(Middle Tertiary?)
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(Early to Middle Tertiary?)
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Minor Granitic Intrusions
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-  Metasedimentary Rocks
(Amphibolites, Biotite Schist and
Gneisses with Dioritic and Granitic Rocks)
(?Palaeozoic to Mesozoic)
-  Foliation
-  Fault
-  Contacts
-  Inferred Contacts

Numbers 800—836 indicate location of the studied samples.

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FIGURE: I - GEOLOGICAL MAP OF DESHAI-DIWANGAR AREA, USHU GOL VALLEY, SWAT KOHISTAN