NOTES ON THE IGNEOUS ROCKS OF SPINKAI AND ADJACENT AREAS OF TIRAH, KHYBER AGENCY.

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INTRODUCTION

A brief petrographic account of the most common igeneous rocks of the Spinkai area (Tirah) is presented in this note. The village of Spinkai (70° 41′, 38°, 55°, 30″) is about 2.3 miles to the south of Afghanistan border. Some of the rocks were collected in place about a mile east of the village, others could not be studied and collected in situ because of difficulties involved on free movement in the heart of the tribal area; the writer, therefore, had to rely on samples collected from the stream boulders in Spinkai and Khaist nalas. The upper reaches of the latter are only 3.5 miles to the east of Spinkai and, apparently, the same igneous belt stretches in both the areas. Out of the 30 samples collected, 17 were selected for thin section study.

Reconnaissance survey reveals that like the adjacent Kohat district, much of the Tirah Tribal territory is free of igneous and metamorphic rocks. Traverses in the Spinkai area indicate that crystalline rocks, mainly igneous, are confined to a narrow strip of country (only a few miles broad) extending along Afghanistan-Pakistan border. The Country rocks on the southern contact are Palaeozoic in age, (Tahirkehli *et al.*, 1971). Tertiary and Mesozoic sedimentary rocks are exposed further south and east. This leads to think that in this part of the Safed Koh Range, the intrusive activity was either confined to the central part of the range, or that the main activity was older than the Tertiary (and even Mesozoic). Dolerite

intrusions of probable Permian age (Tahirkehli, Personal Communication) are common to the northeast between Torkham and Jamrud. Ahmad *et al.* (1969) have also reported basic and acid igneous rocks of Late Mesozoic to Early Tertiary age from the Warsak area, farther northeast.

PETROGRAPHY

The Spinkai Area.

The majority of the rocks in the mountains in the north and east of Spinkai are granitic in composition. They intrude calcareous and other rocks of the Palaeozoic age near Spinkai. In addition, greenish dioritic rocks, simple pegmatites, and quartz veins are also common. Less abundant are quartz-mica-feldspar schists and amphibolites. All of these latter are fine to medium-grained and contain igneous intrusions. Some of them are banded, microfolded, and may have pegmatitic veins parallel to bands. The lighter colour bands in some gneissose banded granites are strongly microfolded in various patterns. The foliation of the rocks is generally parallel to the regional strike which is roughly east-west with moderate northerly dip.

The granites are usually medium-grained, hypidiomorphic and subequigranular to equigranular. Some are coarse-grained pegmatitic (average grain size 4-6 mm), with subequal grains. The distinctly gneissose varieties are allotriomorphic in some cases. They are mainly composed of plagiolase (± microcline or perthite), and quartz (up to 40% in some), with minor quantities of micas (biotite/chlorite ± muscovite), traces of epidote(up to 5% in some), iron ore, sphene and, in some, zircon and apatite. A few of the granites, on contact with calcareous rocks, are graphite-bearing. Graphite may be up to 15%, as disseminated grains, thin films along fractures, and in pockets. It is considered to be a reduced form of CO_2 or CO_3 acquired from the calcareous rocks through the process of gaseous or hydrothermal emanations, Tahirkheli *et al.* (1971). The gneissose

granites have no potash feldspar, or only in traces, but in general they have a higher proportion of biotite (in some up to 25%).

The plagioclase is generally altered to sericite and/or kaolinite, rarely to saussurite; only faint twinning is noticeable.The determination of its composition is thus difficult, but where determinable, it turns up to be sodic (An<20). The alteration may be uniform or selective even within a single grain. Some plagioclase is strained and, in few, the fractures are filled by reddish iron oxide. In the pegmatitic granites, some of the plagioclase is antiperthitic. In these rock, the potash feldspar is perthitic. The microcline of the granite is generally fresher than the plagioclase and a few of its grains look perthitic.

The quartz is nearly always strongly strained, fractured, and often anhedral. In few samples, it is in the form of fine granules with some degree of parallel arrangement, suggesting that the mineral may have crystallized or recrystallized under stress. This is also indicated by the interpenetrating borders of the adjacent quartz grains in a few sections.

The feldspars and quartz make about 90% of the granites except in the gneissose varieties where biotite/chlorite are rather abundant. Chlorite (pale green or colourless) looks to be after biotite, which is totally destroyed in rare cases. Both of these minerals occur along grain boundaries, intergranular spaces, and rarely along fractures. The biotite is very strongly pleochroic from reddish-brown to pale yellowish-green in the less altered gneisses. Muscovite, noted in only two gneisses, is in minor quantity and associated with biotite. The micas may be twisted and folded around other grains, particularly in the gneissose granites. The epidote has developed at the expense of plagioclase but it may also occur along fractures. Iron ore (magnetite) is often oxidized red to brown and may stain the rocks.

As previously stated, some dioritic rocks, schists, and amphibolites also occur in the area. Most of the formers appear to be true dolerites in mineralogy but one of such fine-grained rocks is mainly composed of pale green amphibole (? hornblende) , epidote and chlorite, with minor leucoxene (after ilmenite), plagioclase, and traces of quartz. The rock is traversed by veins (< 1mm) of epidote and minor quartz. It then closely resembles some of the "altered" dolerites of the Attock-Cherat Range and might itself be a metadolerite.

Examination of the calcareous rocks on contact with granite, about a mile east of Spinkai, reveals that they are recrystallized into marbles for a distance of at least 50 feet. They are mainly composed of carbonate, with minor amount of chlorite. The latter is fibrous and may be in patches or along poorly-defined bands. A few of the marbles are entirely made of carbonate. Some contain patches of yellowish-green serpentine near the contact; others have weakly pleochroic phlogopite with rounded ends and heavily charged with ore dust. A few have brown oxidized ore and, near the contact, zoisite.

The calcareous rocks, occuring as "partings" within the granite and those on the immediate contact of granite in the main marble mass, have been transformed into skarn. It is composed of abundant tremolite and carbonate, with minor quantity of epidote, chlorite, graphite, sphene, hematite, and plagioclase. The latter shows intense alteration and is very corroded on margins. The tremolite is eaten away on margins as well as in the middle part and looks poikiloblastic. The carbonate effervesces strongly by treatment with acid and is probably calcite. The grains of the rock greatly vary in size form fine to medium; the chlorite is intimately intermixed with the carbonate in the finer parts.

Khaist Nala.

The study of stream boulders, two miles upstream of Khaist

Khula, shows that the upper reaches of the stream are occupied by crystalline rocks. Most of them are igneous; boulders of medium-grained leucocratic granites are the most abundant. Some are pegmatitic like those of the Spinkai area and a few are distinctly porphyritic. Dioritic rocks are next abundant, whereas amphibolites and schists are in minor quantity.

Under the microscope, the granites are equigranular to subequigranular, hypidiomorphic to allotriomorphic, rarely gneissose. They are composed of feldspar and quartz, with minor quantity of micas and ore. Some contain garnet and, in a few, sphene and zircon are also present in traces. The feldspar is mainly sodic plagioclase but in a few, perthite is the major or only type. The former is more sericitized or kaolinized than the latter. In some, only faint twinning (of albite $\pm$ Carlsbad type) is seen due to greater alteration. Some plagioclase is weakly zoned. Straining is rather common in many of them; the mineral may be fractured and later filled by veinlets of feldspar and quartz. The perthite is mostly of string type, but minute granules of plagioclase are also seen in the potash feldspar. Quartz is generally more than 20% but in some it falls down to only 10-12%. It is strongly strained, often fractured, and anhedral.

The micas are represented by biotite, rare muscovite, and secondary chlorite after the former. Some chlorite has abundant ore dust. Much of these minerals lie between the early-formed feldspar and quartz grains but some are embedded within the plagioclase or along fractures in quartz and perthite.Late stage magmatic processes or metamorphism might be responsible for the latter mentioned occurrence. An interesting phenomenon is the intergrowth of muscovite and biotite. The former is subordinate in proportion and occurs as "lamellae" parallel to biotite cleavage. The garnet is colourless, often fractured, and partially chloritized. In one section it looks to be poikiloblastic. The iron ore may be fresh, oxidized or sphenized.

A section of the dioritic rocks is medium-grained, hypidiomorphic and gneissose. It is made of abundant brown to green pleochroic hornblende, kaolinized plagioclase, minor epidote, rare quartz and red iron oxide. Some of the feldspar is intensely kaolinized and stained brown by iron oxide.

A sample of dark green serpentinite was brought from the upper reaches of Tor Algad, about 15 miles west of Spinkai, near the border of Kurram Agency. According to the local who brought the sample, the rocks form a "very large" body. It is mainly composed of serpentine with traces of (?) chromite and a brownish mineral looking like rutile. The area of the sample is about 50 miles to the east of a large ultramafic body, shown on the geological map of Pakistan, to the south of Parachinar, Bakr and Jackson (1964). It will be of interest to trace these serpentinites westwards and see any connection with the Kurram ultramafics.

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