Notes on the Dolerite Dykes in Northern Hazara

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Introduction

The northern regions of Hazara consist mostly of metamorphic and plutonic rocks of Palaeozoic and Mesozoic times. The plutonic rocks consist of granites and gneisses which are part of the great Himalayan batholiths. The metamorphic rocks consist of almost all grades from chlorite schists to staurolite schists passing further north into sillimanite gneisses in Hazara Kohistan. A little south of Oghi, big crystals of kyanite can be seen in a small portion of Susal Gali granite gneiss. These rocks of different metamorphic grades show all sorts of mineralogical, textural, and structural variation. Almost the whole of the region is isoclinally folded. Analysis of the structural data indicates that this area has been subjected to more than two phases of tectonic events.

The granites and gneisses are also extremely variable, mostly have faulted contacts, and contain accessary minerals such as andalusite, sillimanite, kyanite, and garnet, etc., all of which are generally of metamorphic affinities. There is ample evidence that they are products of assimilation (Shams, 1961). Some granites are also very rich in tourmaline. These granites are of a later time and are generally very massive. Some of them for example the Hakale granite in Mansehra proper is extremely rich in volatile components and has intrusive relations with Mansehra granite.

These rocks are profusely intruded by dolerite dykes and sills at different intervals of gelogical time. They have a tendency to be more abundant in plutonic than metamorphic rocks. The majority of these dykes and sills occuring in metamorphic rocks are regionally metamorphosed with well developed schistose planes striking parallel to the regional strike.

The present notes are a short discussion of the various types of these dolerite veins, their optical characters and a review of their possible relation to the granites.

Abstract

The dolerite veins occur as dykes and sills. They vary in thickness from one to ten feet. The sills are mostly schistose metadolerites, intensely sheared and folded. There foliation is generally parallel to the general strike. The dykes are cross-cutting

veins, very massive, jointed, and have always chilled margins against the country rock. They are relatively more abundant in granites than in metamorphic rocks. Another type includes the altered veins. These diabases are dirty green friable rocks almost completely weathered to dark green clays. They are characteristically abundant along fault zones.

Fresh Dolerite Dykes

These dykes usually consist of augitic pyroxenes, hornblende, andesine, epidote, and a little quartz.

The augitic pyroxenes usually occur as small rounded crystals with abundant rutile needles usually oriented along the C-axis. They have a well developed cleavage and give 2nd order interference colurs in yellows and reds. They usually show alteration to hornblende which is some times well developed as pseudomorphs after augite specially along its margins and fractures.

Hornblende occurs as well developed crystals containing abundant magnetite inclusions. It shows anomalous interference colours generally due to some partial alteration into chlorite.

Andesine always occurs as small laths oriented parallel to the flow direction and imparts the rock its typical ophitic texture. It usually shows alteration to epidote.

Usually a little quartz also occurs in the form of very clear grains of small size. Epidote is formed as an alteration product of the plagioclase, and occur at the margins of these crystals. It has a bolder relief against the enclosing plagioclase, and contains small grains of Fe-ore. Sphene is the usual accessory, relatively very abundant and forms crystals of a pleochroic nature.

Metadolerites

Metadolerites can be roughly classified into (a) Actinolite-albite-epidote schists and (b) Epidiorites of the plagioclase-hornblende type.

The former are relatively more abundant. They have been completely metamorphosed with well developed foliation. They are dark green in colour, very fine grained and massive.

Actinolite occurs as a plexus of small laths with a dark green hornblende of an anomalous pleochroic character and seems to be itself of an actinolitic type. The plagioclase is mostly albite with well developed albite twinning and it is relatively rounded. Epidote is very abundant, developed mostly at the expense of plagioclases.

Sphene occurs as an abundant accessary. A red garnet is usually formed as well developed crystal of a very small size. Quartz is also to be seen.

The epidiorites of plagioclase hornblende type are very massive and coarse grained. They are mostly restricted to Kotli on the Manserah-Batal road.

Hornblende in this case is the most abundant mineral sometimes found pseudomorphosed after augite. It is usually in the form of deep green radiating flakes enclosing plagioclase of the andesine type. It seems that it has changed to a plagioclase. The plagioclase formed in such a manner preserves all the structures of the hornblende crystals. These two minerals grade into one another, and unaltered hornblende can be seen along certain cracks in the plagioclase. The plagioclase rarely shows any tiwinning.

Another independently formed plagioclase is usually oligoclase and andesine. It is well twinned and has mostly utilised the pre-existing epidote. Epidote is very little as compared to the former varieties. Other minerals are red garnet and sphene which occurs as small wedge shaped crystals. Quartz is present.

Petrogenesis

These metadolerites are products of regional metamorphism set in by the tectonic movements most probably in Mesozoic times. The plagioclase of the original dykes was broken into albite and epidote which are more abundant in such cases. Actinolite is another mineral of a later crystallization. It is invariably accompanied by hornblende in nearly equal amounts. According to Tilly's analysis the hornblende in such cases is itself an actinolitic variety (Harker 1932). This has been confirmed to be so in the case of the present mineral under study.

The epidiorite group of these rocks is similar to those of Highlands in which case with the survival of epidote into garnet zone, they form epidote, or zoisite-amphibolite (Harker 1932). This state is exactly similar to and hence these rocks can be put into epidote-amphibolite group. The utilization of felaspares and other mineral to form earlier, recognized by lacroix (Harker 1932) but the relation in the present case seems to be inverse. According to Harker (1932) the utilization of plagioclase in the formation of hornblende may be brought about at very high grades of metamorphism. In this case it may be safely assumed that the formation of plagioclase from hornblende might have been affected due to retrograde metamorphism.

However it is clear that dolerites have been continuously encroaching upon the area through out the geological time. This points to the fact that these dolerites are in no way conventionally related with the intrusion of granitic magmas.

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