

Field features and petrography of igneous rocks from Utla (Gadoon), NW Pakistan: Preliminary investigation

Muhammad Sajid and Mohammad Arif

Department of Geology, University of Peshawar, Peshawar

The igneous rocks around Utla in Gadoon area, NW Pakistan are considered to be a part of the Peshawar Plain Alkaline Igneous Province (PPAIP), which extends from Tarbela in the east to Pak-Afghan border in the west. The rocks of the Utla area most probably represent the eastward extension of the Ambela granitic complex. Some of the previous workers, however, group them with the granitic rocks of Swat and Mansehra.

Field observation and detailed petrographic studies of representative samples suggest that the Utla area largely consists of granitic rocks having intrusive contact with the Late Proterozoic Tanawal formation. At places, green to greenish black and black dykes of apparently basic composition cut across the Utla granite. Texturally, the granitic rocks are predominantly megaporphyritic. At place, however, foliated and fine-grained varieties also occur, particularly along shear zones. Furthermore, the equigranular fine-grained varieties occurring as small patches within the mega-porphyritic granite.

The Utla granites contain phenocrysts of zoned and saussuritized plagioclase, perthitic alkali feldspar, including both the orthoclase and microcline varieties, and quartz. The frequently large size of the phenocrysts makes them visible in the outcrop even from some distance. The extent of albite exsolution is variable, most probably because of difference in the composition of the original homogeneous alkali feldspar grains and/ or degree and rate of their undercooling below the crystallization temperature. The groundmass predominantly consists of alkali feldspar and quartz, minor to accessory amounts of tourmaline, biotite and muscovite, and accessory to trace amounts of apatite, andalusite, zircon, monazite, sphene and garnet.

Among the mafic minerals, tourmaline is the most common and abundant. Most of the tourmaline grains display irregular zoning and variable degree of alteration. The flakes of biotite and muscovite mostly occur in close association and are particularly abundant in the foliated/ gneissose varieties of the granite where they may wrap around the megacrystic feldspars. Textural relationship suggests that some of the muscovite might have formed at the expense of biotite. In some of the studied samples, muscovite is intergrown with quartz. An appreciable amount of sphene occurs in most of the studied samples. Associated almost exclusively with biotite, it occurs as small discrete grains as well as thin rims or broader zones around small grains of an opaque ore mineral.

The markedly different modal mineralogy suggests a two-fold division of the dykes that intrude the Utla granite: (i) basic and (ii) intermediate. The former appear to be much more abundant and are further distinguished into two subgroups on the basis of their textural and mineralogical characteristics. Dykes from one of the subgroups essentially consist of plagioclase

laths and clinopyroxene and display ophitic to sub-ophitic texture and, thus, appear to be dolerite. The clinopyroxene gives a pinkish/ violet color in plane light, and hence may contain a significant amount of Ti. The grains of clinopyroxene show variable degree of alteration to chlorite and amphibole. Besides, brownish hornblende also occurs as discrete grains in some of these dolerite dykes. These rocks also contain accessory amounts of other minerals, including biotite, sphene, epidote, apatite, ilmenite and rutile. Like that in the host granite, sphene in the dolerite dykes occurs both as discrete grains and thin rims or zones around opaque ore grains forming corona texture.

The other group of basic dykes largely consists of plagioclase and amphibole. The subordinate amount of clinopyroxene present in these rocks occurs either as relics within, or totally pseudomorphed by, green amphibole and chlorite. The amphibole also occurs as discrete grains displaying brown color and partial alteration to chlorite and biotite. The occurrence of appreciable amount of epidote and zoisite together with green amphibole and chlorite after clinopyroxene indicates metamorphism of these rocks under greenschist to epidote amphibolite facies conditions. Some of these rocks also display a certain degree of preferred orientation. The more or less commonly occurring accessory phases in these rocks include sphene, rutile, ilmenite, calcite and apatite. Corona texture of sphene around opaque ore mineral is a common texture present in these rocks as also observed in the dolerite dykes described above.

The dykes of intermediate composition are characterized by porphyritic texture with phenocrysts exclusively of brown amphibole. These phenocrysts are replaced by chlorite along cleavages and fractures. Simple twins are also observed in some of the amphibole grains. The groundmass consists mostly of fine-grained chlorite, epidote-clinonzoisite/ zoisite and sphene. Like their basic counterparts, these dykes also contain sphene as thin rims to broad zones around grains of an opaque ore.

The intrusion into Tanawal formation, distinctly porphyritic character, and the more or less common occurrence of appreciable amount of tourmaline are some of the features of the Utlá granites which make them resemble the granitic rocks from Mansehra and Swat. Furthermore, like the Mansehra rocks, some of the samples from Utlá granite also contain andalusite. On other hand, the Utlá rocks, especially the dykes, display opaque ore-sphene corona textures, which is a characteristic feature of the granitoids from Ambela.