Petrographic and mechanical characterization of Kumrat granite: Correlation between destructive and non-destructive testing techniques

Ihtisham islam[1,2], Waqas Ahmed[2*], Irshad Ali[1], Muhammad Yasir[2]

[1]*Departement of Geology, Shaheed Benazir Bhutto University Sheringle, Pakistan*
[2]*National Centre of Excellence in Geology, University of Peshawar, Pakistan*
*waqas.nce@uop.edu.pk

The Kumrat area, located in the Khyber Pakhtunkhwa province of Pakistan, is a part of the Kohistan batholith, which constitutes the southwestern portion of the intra-oceanic Kohistan island arc. Kumrat granite of this area is analyzed in terms of its petrographic features and mechanical properties using destructive and non-destructive techniques. The field observations and petrographic studies of representative samples revealed that the granites are sub-equigranular to in equigranular, coarse to medium-grained, and exhibit no preferred orientation. The granites consist mainly of alkali feldspar (mostly orthoclase), quartz, and plagioclase with accessory amounts of biotite, chlorite, muscovite, sericite, opaque ore mineral, and trace amounts of sphene. The quartz was mostly strained and showed strong undulose extinction. Chlorite was observed as a secondary mineral, formed through alteration of biotite. The mechanical and physical properties of the samples, including uniaxial compressive strength, uniaxial tensile strength, specific gravity, porosity, and water absorption, were determined for different textural varieties of the rocks. The average compressive strength for coarse and medium-grained varieties were calculated as 56.5 MPa and 78.9 MPa, respectively that fall into the category of strong rocks. The values of specific gravity, porosity, and water absorption were within the permissible range for their use as construction material. Non-destructive testing revealed a significant positive correlation between ultrasonic pulse velocity and Rebound Hardness number and compressive strength, with acceptable correlation coefficients. The relationship between ultrasonic pulse velocity and water absorption and porosity showed that as pore space increases, there is a decrease in the velocity and vice versa. Likewise, the correlation of Schmidt Hammer with water absorption and porosity showed a good relation, where as porosity increases, there are higher chances of water absorption with a decrease in Rebound Hardness number value and vice versa. The detailed petrographic features, mechanical properties, and correlation of destructive and non-destructive techniques of the investigated rocks revealed that the medium-grained granites are slightly stronger than coarse-grained granites, probably due to their finer grain size. This study provides valuable insights into the properties and characteristics of Kumrat granite, which can help in its appropriate utilization as a construction material.

Keywords: Kumrat Granite; Uniaxial compressive strength;Uuniaxial tensile strength