WEATHERING GRADE CLASSIFICATION OF LESSER HIMALAYAN GRANITES, WESTERN INDIA

ETUDE DE L’ALTERATION DE GRANITES DE L’HIMALAYA DANS L’OUEST DE L’INDE

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Abstract

Lesser Himalayan granites show various stages of weathering. Primary cracks, grain boundaries and joints have initiated and controlled the weathering processes and resulted in the decomposition of the granites. Feldspars and mica act as key minerals for the initiation of weathering. Later stages of weathering are dominated by the varying nature of weathered clay.

Résumé

Les granites étudiés présentent différents stades d’altération. Les fissures primaires, les limites de grains et les joints sont les facteurs à l’origine de la décomposition de ces granites. Les feldspaths et les micas sont les minéraux clefs à l’origine de cette altération. Les stades plus avancés de cette altération sont caractérisés par différentes espèces d’argiles.

Introduction

Study of the effects of weathering on rock conditions is of great importance in engineering geological investigations. In recent years, it has received wide attention of the engineering geologists as the consequences of weathering have to be considered in the design and construction of civil engineering structures (Ghosh, 1982a).

Granites and basalts, occupying a large tract of Indian territory, are extensively weathered and hence, practical aspects of the effects of weathering are of significance especially with respect to variability of engineering character for assessment of roadstones and concrete aggregates. Effects of weathering and changes in engineering properties of the granites of Central India are relatively well understood (Ghosh, 1982a; Vaidyanath and Ghosh, 1980, 1981). However, the engineering properties of the Lesser Himalayan granites are relatively poorly studied.

The present study has been taken up in the Lesser Himalayan belt in the granitic areas around Chamba-Dharamsala of Himachal Himalaya and Champawat of Kumaun Himalaya. These granitoid bodies have been designated as Dhaualadhar Granite and Champawat granite respectively. Field and laboratory studies have been undertaken for the assessment of weathering grade in vertical profiles, rockmass description for engineering purposes and to provide a topographic model for the distribution of weathering grades. The area under study receives an annual rainfall of about 160 – 200 cm in a humid tropical region.

Geological setting and rock character

The granites of the Chamba-Dharamsala and Champawat areas in the Lesser Himalayan belt, Western Himalaya (Fig. 1) constitute tectonically emplaced paragneisses/associated metasedimentary rocks (remobilised by anatexis) in the axial belt of the Dhaualadhar Range in Himachal Himalaya (Fig. 2) and the Nag-Tibba Range of Kumaun Himalaya (Fig. 3). In general, the granitic body can be considered to be of S-type and that the early Palaeozoic granite and associated metasedimentary rocks/paragneisses, of heterogeneous source material, possibly experienced different phases of remobilisation and tectonism, the latest being of tertiary age. In addition, occurrence of a number of veins, presumably along fissures or grain boundaries are related to the stress field in operation at the time of formation, which has resulted in the development of micro and macro fissures in the rockmass. Prominent joint directions are: NW-SE: 60°/SW (longitudinal) and NE-SW to NNE-SSW: 60°-80°/NWly (crossjoints). These are widely...
spaced (1 m to 2 m), open and also clay filled in places. Root penetration is very common in these joints.

The Dhauladhar and the Nag-Tibba Ranges of the Lesser Himalaya possibly represent remnants of an ancient geomorphic surface on which the weathering profile is preserved in most places. Late Pleistocene glaciation possibly did not remove the weathered mantle. It is assumed here that the Late Tertiary age profile has been modified by later geomorphic processes of the early Holocene period under a humid tropical climate and hence, the depth of weathering profiles has extended downwards appreciably. In this connection it may be added that the present day relief, witnessing uplifts, shows strong control by folding and faulting (Ghosh, 1982b). Hence, exhumation and dissection facilitated weathering agencies to penetrate deep into the rock.

The granitic body is about 10-12 km wide in the Chamba-Dharamsala region and 4-7 km wide in the Champawat region. These rocks predominantly consist of equigranular to porphyroblastic granite, forming the bulk in the central portion and a marginal zone of gneissose granite (Awasthi, 1982; Ghosh, 1981, 1982c; Sharma and Awasthin, 1980).

On the basis of field and laboratory studies the granites in the present areas can be differentiated into two types as follows:

(i) Equigranular to porphyroblastic non foliated granite with large feldspars — in the central portion.
(ii) Fine to coarse grained and foliated gneissose granite characterised by tourmaline-bearing pegmatite veins — in the marginal zone.

The predominant constituent minerals are quartz, feldspar and mica (Table 1). The feldspar content is mainly characterised by sodic-plagioclase and potash-feldspar. Xenoliths of the metasedimentary rocks are also occasionally seen within the granitic terrain.