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A geochemical study on the Lansdowne granite and granite gneiss, Garhwal Lesser Himalaya, Uttarakhand (India)

Deepa Arya[1], Gunjan Arya[1, 2], R.B. Ananth[3]
[1]Department of Geology, CAS, Kumaun University, Nainital, Uttarakhand-263001, India.
[2]Department of Geology, B.D. Govt. P.G. College Jaiharikhal, Pauri Garhwal, Uttarakhand- 246193, India.
[3]Department of Geology, Institute of Science, Banaras Hindu University, Varanasi- 221005, India
*Corresponding author: arya.earth11@gmail.com

ABSTRACT

The Lansdowne klippe in the Lesser Himalaya is a thrust-plunging syncline comprising Precambrian granite and granite gneiss, prominently exposed around Jaiharikhal-Lansdowne in Garhwal region. The study area consists metasedimentary rocks, quartzose-phyllite, mylonite/phyllonite, granitic and augen gneisses. Granites exhibit medium-coarse, hypidiomorphic, and porphyritic textures with minerals Pl-Kfs-Qtz-Bt-Mus-Tour-Mag-Ap-Zr-Ep. Granite gneisses exhibit a mineral composition similar to that of granite, but with a well-developed foliation plane. Near fault zones, mylonitic textures with quartz ribbons and sericite occurrences, indicate NW-SE shearing. Textural features (porphyritic, perthitic) and geochemical characteristics (alkalic-ferroan, peraluminous), suggest slow cooling from a direct magmatic origin within syn-collisional to post-orogenic settings.

Keywords: Garhwal Himalaya, Lansdowne-Jaiharikhal granite and granite gneiss, Lansdowne klippe, Mineral chemistry, Geochemistry, Syn-collisional.

INTRODUCTION

Since ~55 Ma, intense Cenozoic crustal thickening of the crust created the Himalayas due to continental collision between India and Eurasia. Since the Proterozoic era, various granitoids have been emplaced until recent times. The intense pressure and temperature, generated during this process, caused the partial melting of the continental crust leading to the formation of large volumes of granitic magma (Rai and Kumar, 2015). Five significant belts of granite plutons in the Himalaya based on geographical distribution are, Karakoram axial batholith, Trans-Himalayan batholith, Northern Himalayan Granite belt, granitoids of the Higher Himalayan Crystalline belt, and Lesser Himalayan Granite belt (Le Fort, 1988). The occurrences of granites from the Lesser Himalayan sequence, are well exposed in the Himachal and Garhwal-Kumaon regions of the Himalayas (Bhatnagar and Sharma, 1989; Tandon and Bhatt, 1995; Santosh et al., 2003; Islam et al., 2005). These granites were formed by the partial melting of a metasedimentary source rock, possibly a pelitic rock, in a continental crustal setting (Chakraborty et al., 1994; Dasgupta et al.,1996; Upadhyay and Singh, 2000).

The earlier works in the Lansdowne region (Auden,1937; Shanker and Ganesan 1973) proposed that the granite gneiss intruded into underlying metamorphites (chandpurs/ chails) before the formation of the Garhwal thrust (pre-Miocene). Vishnoi (1971) provided detailed information about the geology of the area. Eldson and Gupta (1981) determined petrochemical properties and suggested magmatic origin of granite gneisses, with pronounced gneissosity due to later deformation. This paper focuses on the analysis of geochemical and mineral chemistry data of the area in order to enhance our knowledge to understand the origin, crustal evolution and tectonic setting.

GEOLOGY AND FIELD RELATIONSHIP

The proposed study area lies in the Lansdowne Pauri Garhwal, Lesser Himalaya, Uttarakhand. It lies between latitudes 29°49'0" N and 29°51'30" N and longitudes 78°39'0" E and 78°41'30" E in Geological Survey of India toposheet no. 53K/9. Lesser Himalaya meta-sedimentary rocks and the crystalline nappe/klippe are well exposed (Figure 1) with dominating litho-units Lansdowne granite and granite gneiss. The proximity with thrust, resulted into deformation and transformation of Lansdowne granite to granite gneiss, further follows by augen gneiss and mylonite (Gupta, 1976a,b). The Bijni member rests over sedimentary rock of the Krol nappe and Garhwal thrust consisting quartz, schist and phyllite sequence (Auden, 1937). This phyllite is considered as Amri phyllite, correlated with Chandpur phyllite belonging to Chail nappe (Saklani, 1993). The Lansdowne formation tectonically overlies it and the Amri thrust marks the contact (Valdiya, 1980). Moreover, it has also been described as Lansdowne metamorphic (Gupta, 1976a, b) and Lansdowne crystallines (Valdiya, 1980). The Garhwal nappe comprises deformed phyllite and schist, capped by a small outcrop of Lansdowne granite and granite gneiss (Figure 2). The granite gneiss in the sequence changes from mylonitic gneiss at the base to granite gneiss in the upper sections (Gupta, 1976b). Additionally, there is evidence of granite intrusion above the metasediments in the Lansdowne area (Kumar and Daundhiyal, 1980). The Garhwal thrust is tectonically significant as it delineates major structural units in the lesser Himalaya that facilitated the emplacement of older Precambrian rocks over younger sedimentary sequences.