The Rare Earth Element geochemistry of Mesoproterozoic clastic sedimentary rocks from the Rautgara Formation, Lesser Himalaya: Implications for provenance, mineralogical control and weathering

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The geochemical studies of clastic sedimentary rocks have attracted attention of several scientists in the world primarily to understand their source rock compositions, paleoclimatic conditions, tectonic setting and in turn to examine the nature and composition of the upper crust through time (Bhatia 1985, Taylor and McLennan 1985, Condie 1993, McLennan et al. 2000). Damta Group (consisting of Chakrata Fm and Rautgara Fm) which is considered to be the oldest and best-preserved supracrustal pelite-quartzite successions in the inner carbonate belt of the Lesser Himalaya (Valdiya 1998) is best suited for this kind of studies. The Mesoproterozoic clastic sedimentary rocks, comprising pelites and quartzites from the Rautgara Formation in and around Rudraprayag, Garhwal region, Uttaranchal, Lesser Himalaya, have been analysed for major and trace elements including Rare Earth Elements (REEs) to evaluate their provenance and weathering history. Except few studies (Bhat and Ghosh 2001, Rashid 2002) the sedimentary geochemistry is almost unattended in the Himalayas despite their occurrence as most abundant rock type. In this context any work from the Himalaya may be considered as a significant contribution towards understanding the Precambrian upper crustal composition in the Himalayan region.

The pelitic rocks from the Rautgara Fm are characterised by moderate SiO_2 and Al_2O_3 contents and show consistent REE patterns with LREE (light REE) enriched and HREE (heavy REE) depleted patterns (La_N/Yb_N=7.4–10.3). The total REE abundances are high (up to 266 ppm) with large negative Eu-anomalies (Eu/Eu*=0.57 to 0.64). The REE characteristics of the Rautgara pelites compare very well with the average post-Archean REE patterns of European Shales (ES), Post Archean Shales from Australia (PAAS) and North American Shale Composite (NASC). Except high SiO_2 contents, the other major and trace element concentrations are significantly low in the associated quartzites. Although the quartzites contain low REE abundances (up to 41 ppm) their patterns including negative Eu anomalies are akin to pelites, suggesting that both the rock types be derived from similar source. The Chemical Index of Alteration (CIA) and A-CN-K plot (Nesbitt and Young 1984) indicates that moderate chemical weathering has taken place in the source region of the Rautgara rocks. The linear correlation coefficients between Al_2O_3, K_2O, TiO_2 and total REE reveal that the accessory minerals (mainly Ti-bearing phases) have hosted the REEs (Taylor and McLennan 1985, Condie 1993).

The evolved felsic composition of the rocks probably related to widespread acidic igneous activity in the source. Besides the provenance, the sedimentary REE patterns seem to have been affected by sedimentary environment also. The paleocurrent studies in the area (Valdiya 1998) indicate that the granitoid rocks from the Aravalli mountain belt and Bundelkhand massif have supplied detritus to the Lesser Himalayan Rautgara sedimentary basin.

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