Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 913

Weathering of Amphibolite and Mobility of Elements under Semi-arid Conditions, Southern India

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The behaviour of elements during rock weathering and their distribution within a weathering profile are not well understood. A review of the available information on the problems of rock weathering and element distribution, particularly REE and other trace elements, suggest that the geochemical behaviour of many elements during weathering can not easily be generalized because many physio-chemical and biological factors of rock weathering are location specific. We have been studying the Archaean igneous and metamorphic rocks of the catchment area of the Cauvery River in southern India for their weathering and soil geochemistry. Field observations in this region reveal that the gneisses have become more susceptible to weathering compared to massive charnockite and granites, which stand out relatively fresh. It is very rare to see the weathering profile moving vertically downwards. A blanket of brownish-red regolith overlies the whole area and we have not come across typically horizonated soil profiles in the "classical sense". On a hilly area near Halagur, 120 km SW of Bangalore City, a body (8x3 m) of komatiitic amphibolite, located within 3000 Ma high-grade orthogneiss in southern India, shows an interesting pattern of chemical weathering. Along the amphibolite-gneiss contact as well as within small fractures high degree of alteration and development of reddish-brown soil like material was noticed. These fractures occur as a network within the profile and the intensity of weathering alteration decreases on either side of the fracture-altered zones through saprolite, mildly altered to fresh rock. The width of these fractures being more at the contact with the granite and in the saprolite sections of the profile. Based on the mineralogical, geochemical and the extent of weathering characteristics, the whole profile could be differentiated into three different sections: (1) Saprolith stage: no change in mineralogy as well as physical appearance except an increase in fractures and cracks; geochemically an addition of REE only. (2) Saprolite stage: change in colour from black to pale green and massive hard rock become friable; new secondary minerals such as talc, chlorite and vermiculite are formed. Elemental behaviour indicate removal of Al, Fe, Ti, Ca, Na, Sr and REE; a greater loss of Eu and gain in Mg and Si. (3) Soft soil stage: reddish-brown soft soil like material having chlorite and smectite as major minerals. Geochemically, gain in Al, Fe and REE and loss in Ni, Cr and other mobile elements is noticed. Although, all the major and trace elements show different degrees of enrichment or depletion at different stages of weathering the behaviour of REE is quite interesting. Chondrite normalized REE patterns of all the bulk samples of the profile are almost identical to each other, however, their abundance varies significantly (Figure 1.). Within the profile there is an enrichment of the REE in the very initial and in the advanced stages of weathering, effected by different mechanism; the intermediate saprolite stage shows a complementary loss. Weathering and associated elemental mobility seem to have been mediated by microbial activity.

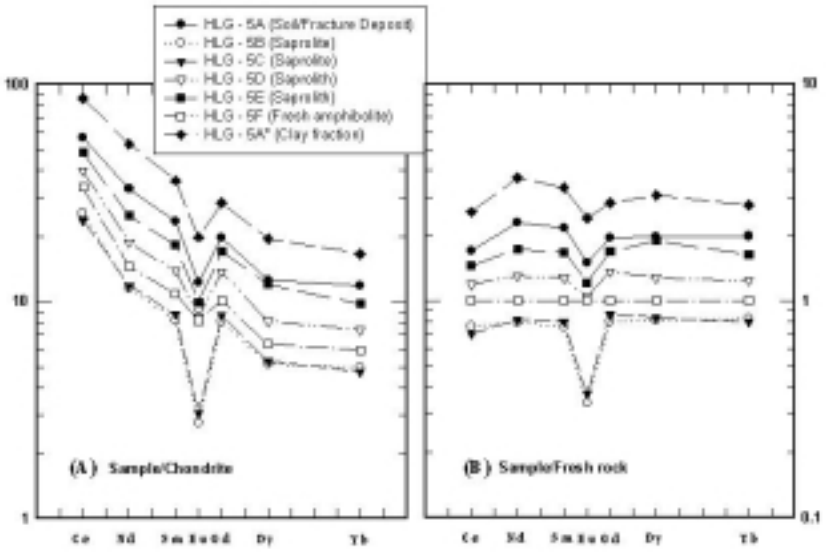

Figure 1: REE patterns of various samples of the weathering profile. In (A) pattern are normalised with respect to chondrite and in (B) patterns of (A) are renormalized to fresh rock.