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

Journal of Conference Abstracts
Volume 5(2), 134

Using Rare Earth Elements as Provenance Indicators in Mudrocks from a Range of Tectonic Settings

Jane L Alexander (alexanderj@postbox.csi.cuny.edu)[1], **Elizabeth H Bailey** (liz.bailey@nottingham.ac.uk)[2] & **Kevin T Pickering** (ucfbktp@ucl.ac.uk)[3]

[1] Department of Engineering Science and Physics, College of Staten Island, 2800 Victory Blvd., Staten Island, NY 10314, USA
[2] Environmental Science, University of Nottingham, Sutton Bonington Campus, Loughborough, Leics. LE12 5RD, UK
[3] Department of Geological Sciences, University College London, Gower Street, London, WC1E 6BT, UK

The rare earth elements (REE) are frequently used as indicators of sedimentary provenance (e.g. McLennan, 1989). However, there has never been a comprehensive study of REE in a large number of sedimentary rocks from a range of tectonic settings, critically assessing their use. We are currently reviewing data for several mudrock suites from various settings do determine how accurately REE content and fractionation patterns correspond with provenance. The basic premise is that sediments derived from mafic igneous rocks (i.e. mainly basaltic) will be less fractionated and have lower total REE concentrations than those derived from rocks with a more intermediate provenance (i.e. dominantly andesitic). Sediments with a quartzose provenance, representing reworked, passive margin deposits, will plot as a separate group.

The mudrocks used in this study come from many different locations, representing a range of tectonic settings. They include samples from the Boso Peninsula, Japan; the Nankai Trough, Japan (ODP Leg 131); the Mississippi Fan, Gulf of Mexico (ODP Leg 96); Alai Range, southern Tien Shan, Kyrghyzstan; Point Leamington, Newfoundland; and the Rybachi Peninsula, Northern Russia. Sediments were analyzed by ICP-AES for major elements and by either ICP-MS or INAA (neutron activation) for the REE.

Using previously published information about the geological settings, backed up with provenance interpretations from major element data using the discriminant function diagrams of Roser and Korsch (1988), the mudrock groups were assigned to broad tectonic settings. The REE content and fractionation of each group was then assessed, and generally these correlate well with the assigned provenance (Figure 1). The groupings shown are a crude, preliminary interpretation of the data. However, most samples plot as expected, with a linear trend from low REE content and fractionation to high REE content and fractionation in mudrocks from active tectonic settings. Sediments with quartzose provenance plot above this trend line, due to the dilution effect of quartz on the total REE content.

The general trends illustrated in Figure 1 suggest that REE content and fractionation are closely related to provenance for the majority of mudrocks. However, individual samples may not plot in the fields identified, perhaps due to having a mixed sediment source. In this case, the provenance signal from major elements is indicative of the larger mineral grains, whereas the REE signal is representative of the clay mineral source. There is also some overlap of samples at the boundaries between provenance fields. It is necessary to examine these issues in detail, before proposing a definitive scheme for determining provenance using REE, but it seems that such a scheme would be useful as a means of interpreting mudrock sequences where a small, infrequent input of course-grained material from a second source may considerably alter the provenance signal recorded by the major elements.

The ultimate goal of this work is to develop discriminant diagrams for the REE, capable of rigorously distinguishing the tectonic environment of deposition for groups of fine-grained sediments, based on the relationships found in this preliminary study.

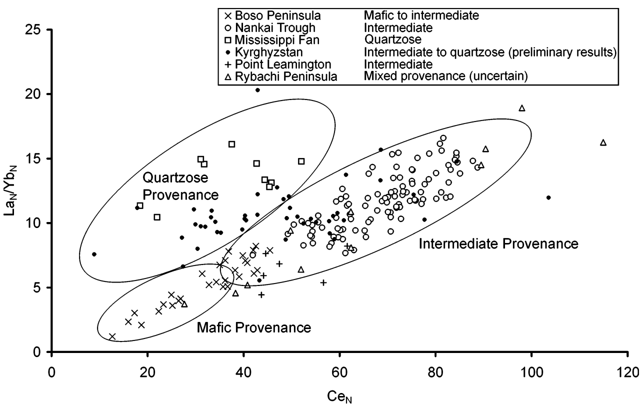

Figure 1: Relationship between REE fractionation and provenance

McLennan SM, *Reviews in Mineralogy*, **21**, 169-200, (1989).
Roser BP & Korsch RJ, *Chemical Geology*, **67**, 119-139, (1988).