REE behaviour across the Cretaceous-Tertiary boundary

M. Ortega-Huertas — *Departamento de Mineralogía y Petrología, Universidad de Granada, Spain*

F. Martínez-Ruíz — *Scripps Institution of Oceanography, University of California, San Diego. USA*

M. Oddone — *Dipto. Chimica Generale, Università di Pavia, Italy*

I. Palomo — *Departamento de Mineralogía y Petrología, Universidad de Granada, Spain*

Introduction and aims

The rare-earth elements (*REE*) do not fractionate during sedimentary processes, and their secondary remobilisation is not significant, therefore they provide information on the source area, since the sedimentary particles conserve the chemical record of the source (e.g. McLennan, 1989; Condie, 1991). In the Cretaceous-Tertiary boundary (KTB) they can provide information on the source area and depositional conditions. We have studied different sequences that belong to the Betic Cordilleras (Spain): 'Agost' (A) and 'Caravaca' (CA), and Basque Cantabrian basin (Spain and France): 'Sopelana' (SO), 'Monte Urko' (URT), 'Zumaya' (ZU), 'Hendaye' (HY) and 'Biarritz' (B).

Methods

The INAA method for *REE* determination was developed at the University of Pavia using a 250 Kw Triga Mark II reactor. Induced radioactivity was measured by γ-ray spectrometry using a HP-Ge detector connected to ADCAM 100 and to a personal computer. Data reduction was carried out using the computer assisted Omnigam/N spectral analysis.

Results

Fig. 1 shows the most significant results. The *REE* contents were re-calculated on a carbonate-free basis, as it is accepted that carbonates do not concentrate *REE* (e.g. Courtois and Hoffert, 1977).

Discussion and conclusions

Adsorption to sedimentary particles is the main extraction mechanism of the *REE* dissolved in seawater. Their total content in the sediment and the development of Ce anomalies depend on the

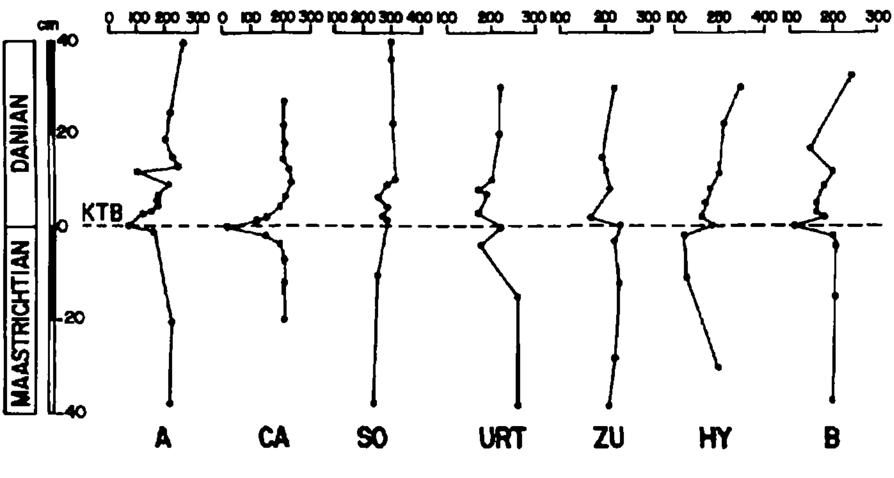

FIG. 1. Distribution of *REE* content (p.p.m.).

environment and the depositional conditions (Murray *et al.*, 1990). In the 'A' and 'CA' sections *REE* behaviour is induced by the inherited minerals: illite-kaolinite and some smectites (Martínez-Ruíz *et al.*, 1992), although the presence of neoformed smectites in the KTB must also be taken into account. The samples of the KTB in both sections present a significant decrease in the total *REE* content (Fig. 1), also indicated by the normalisation to chondrites and NASC patterns. Smit and ten Kate (1982) interpreted that this decrease could be related to the extremely low values of the *REE* in extraterrestrial materials. However, our opinion is that, even assuming the presence of such material, its contribution must be significantly attenuated by that of terrestrial materials. The low *REE* content in seawater and in basaltic rocks, whose alteration could be related to the origin of the smectites (Martínez-Ruíz *et al.*, 1992), would explain the impoverishment in KTB sediments in both sections. The value of the Ce/Ce* ratio is 1 at 'A' and 0.90 at 'CA' (calculated following Liu *et al.*, 1988). This coincides with depositional environments relatively close to continental margins, following the classification of Murray *et al.* (1990).

No significant impoverishment in *REE* was observed in the sections of the Basque Cantabrian basin (Fig. 1). The KTB layers present normalisation to chondrites and to NASC patterns (Haskin *et al.*, 1968) similar to those of the Maastrichtian and Danian sediments. There is no decrease of *REE* content in the KTB layer, which suggests an important detrital input to the basin obliterating the presence of possible neoformed phases. The curves of normalisation to chondrites, with *LREE* enrichment and a basically flat pattern for *HREE*, agree with sediment supply from the upper continental crust (acid rocks). The accumulation of sediments from emerged continental areas on passive margins, such as the deposit considered here, would mainly consist of recycling of sedimentary and/or plutonic and metamorphic rocks with slight volcanic contribution (Potter, 1987). The normalisation to chondrites patterns of *REE* are in this case similar to those of post-archaic shales (McLennan, 1989).

References

Condi K.C. (1991) *Geochim. Cosmochim. Acta*, **55**, 2527–31.

Courtois, C. and Hoffert, M. (1977) *Bull. Soc. Geol. France.*, **19**, 1245–51.

Haskin, L.A., Haskin, M.A., Frey, F.A. and Wildeman, T.R. (1968) In: L.H. Ahrens (ed.). *Origin and distribution of the elements.* Pergamon Press, Oxford, 889–912.

Liu, Y.G., Miah, M.R.U. and Schmitt, R.A. (1988) *Geochim. Cosmochim. Acta*, **52**, 1361–71.

McLennan, S.M. (1989) In: B.R. Lipin and G.A. McKay (ed.). *Geochemistry and Mineralogy of Rare earth elements.* Reviews in Mineralogy, Min. Soc. Amer., **20**, 169–200.

Martínez-Ruíz, F., Ortega-Huertas, M., Palomo, I. and Barbieri, M. (1992) *Chem. Geol.*, **95**, 265–81.

Murray, R.W., ten Brink, M.R.B., Jones, D.L., Gerlach, D.C. and Russ, G.P. (1990) *Geology*, **18**, 268–71.

Potter, P.E. (1987) *J. Geol.*, **86**, 423–49.

Smit, J. and ten Kate, W. (1982) *Cretaceous Research*, **3**, 307–32.

Acknowledgements

The work was supported by Projects PB.92.0960 and PB.92.0961 (DGICYT, Spain) and Research Group 4065.