

# A Cenozoic Record of the Osmium Isotope Composition of Sea Water Deduced from an Individual Hydrogenetic Fe-Mn Crust from the Central Pacific Ocean

Abdelmouhcine Gannoun (gannoun@ipgp.jussieu.fr)<sup>1</sup>, Kevin W. Burton<sup>2</sup>,  
Jean-Louis Birck (birck@ipgp.jussieu.fr)<sup>1</sup>, Claude J. Allègre (zerbib@ipgp.jussieu.fr)<sup>1</sup>, Der-Chuen Lee<sup>3</sup>,  
Alex N. Halliday<sup>3</sup> & James R. Hein<sup>4</sup>

<sup>1</sup> Laboratoire de Géochimie et Cosmochimie, IPGP, 4, Place Jussieu, Tour 14-24, 3E, 75252 Paris Cedex 05, France

<sup>2</sup> Department of Earth Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK

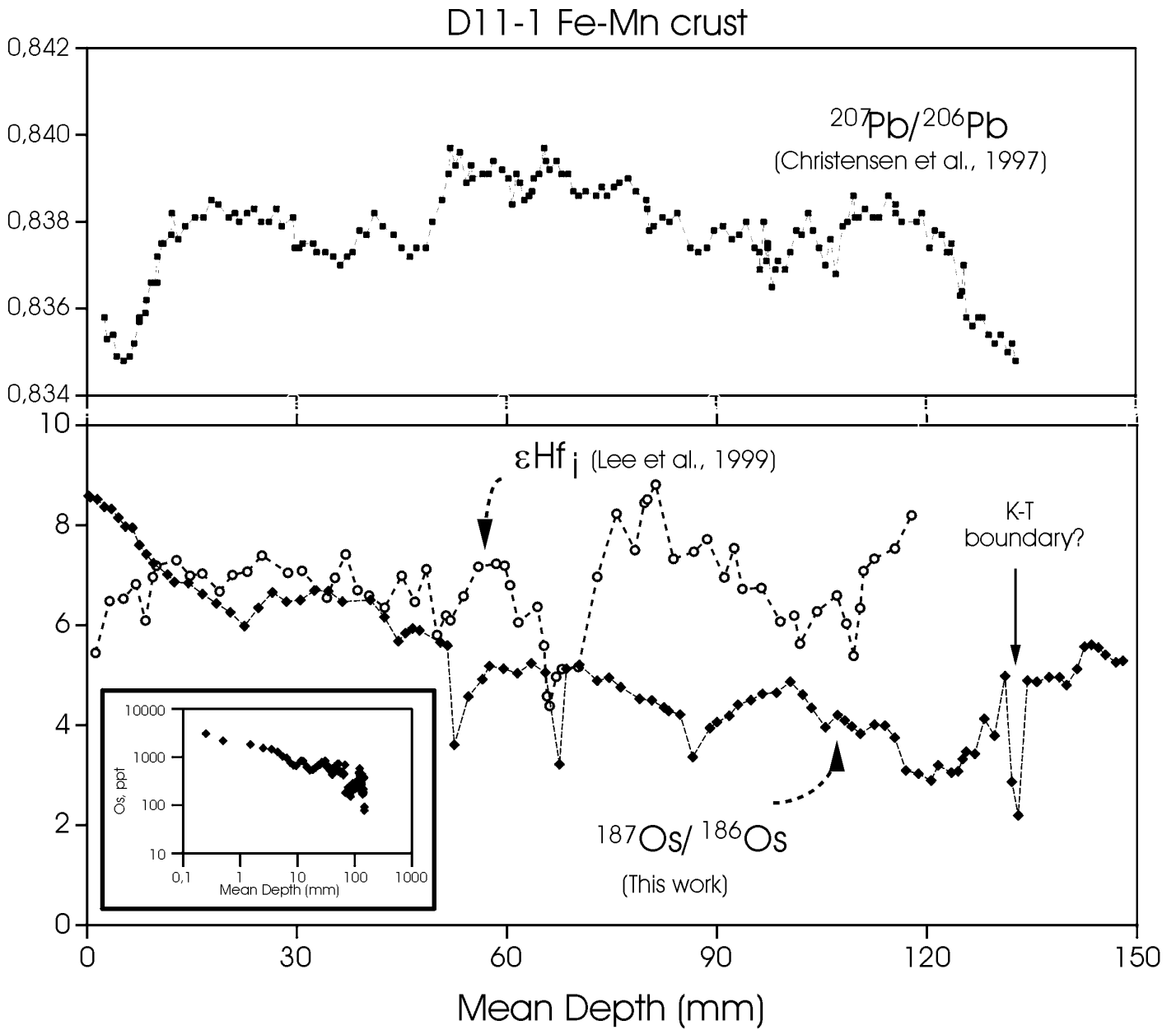
<sup>3</sup> Institut für isotopengeologie und Mineralische Rohstoffe, Department für Erdwissenschaften, ETH-Zentrum, NO C61, Sonneggstrasse 5, CH-8092 Zürich, Switzerland

<sup>4</sup> US Geological Survey, MS 999, 345 Middlefield Road, Menlo Park, CA 94025, USA

The osmium (Os) isotope composition of seawater reflects a balance of input from radiogenic continental material, through erosion, and a non-radiogenic signature derived either from the alteration of oceanic crust, erosion of ultramafic rocks, or dissolution of micrometeorite material. Consequently, this isotope system potentially provides a record of the relative changes in these sources over time, and variations in the Os isotope composition of seawater can be used to constrain climatic or tectonic driven changes in continental erosion or ocean circulation. The Os isotopic composition of seawater has, like Sr, evolved towards radiogenic values through much of the Cenozoic (the past 65 Myr). However, Os and Sr are often likely to be located in different rock types, may well be sourced in different geographical terrains, and possess very different residence times in the Oceans, which explains, at least in part, the decoupling of the marine Os and Sr isotope records for certain time intervals. In this case the Os isotopic system potentially offers a highly sensitive and distinct record of chemical weathering of the continents, but thus far robust records of seawater Os have proved difficult to retrieve.

Hydrogenetic ferromanganese (Fe-Mn) crusts grow by direct accumulation of metal oxides from seawater. Many of the elements they concentrate from seawater can be used for precise dating and such studies have shown that Fe-Mn crusts accumulate at slow growth rates (typically 1-10 mm Ma<sup>-1</sup>) over considerable periods of time. Fe-Mn crusts also possess high Os concentrations, and low Re/Os ratios. Consequently, they can yield precise spatial and temporal information on the Os isotopic composition of the seawater from which they grew, with little <sup>187</sup>Os produced in-situ from the decay of <sup>187</sup>Re. This study presents a high-resolution Os isotopic record for the sample

D11-1 dredged from a Central Pacific seamount (Cruise F10-89-CP; 11°38'N; 161°41'E; 1690-1870 m water depth; 147 mm thickness) in order to constrain the Os isotope record of Central Pacific deep water. These results are compared with global Os and Sr records obtained elsewhere and with high-precision Nd, Hf and Pb isotope records obtained for the same Fe-Mn crust (Christensen et al., 1997; Lee et al., 1999). The outer surface of the crust yields a <sup>187</sup>Os/<sup>186</sup>Os ratio of 8.59±0.01, indistinguishable from direct measurements of seawater from the Central Pacific Ocean (ca. 8.7±0.2; Sharma et al., 1997). The Os isotope record shows a general increase in the <sup>187</sup>Os/<sup>186</sup>Os ratio for much of the time of growth of the crust, and excursions in the Os isotope composition show a clear correlation with changes in the Nd, Hf and Pb isotope composition of the same sample (see Figure 1). Be and Co dating techniques suggest a total age for the crust of ca. 57 Myr. In this case the crust shows the same general shift to radiogenic Os isotope compositions seen in other records, with a distinctive excursion at the Eocene-Oligocene (E-O) boundary. However, the record shows a remarkable resemblance to that recently obtained from a pelagic clay core in the North Pacific (GPC3, Pegram & Turekian, 1999). In particular, at a depth of ca. 132 mm the record shows a distinctive excursion to <sup>187</sup>Os/<sup>186</sup>Os values as low as 2.0 and a pattern of change characteristic of that seen at the Cretaceous-Tertiary (K-T) boundary. In this case the crust must have a total age of ca. 70 Myr, and shows not only the K-T boundary, but also excursions at 33 Myr (i.e. the E-O boundary) and at 25 Myr, and a general shift to more radiogenic isotope compositions from around 40 Myr onwards, similar to that seen in the global Sr record and other Os isotope records. The significance of these isotope variations and chronologies will be discussed.



Christensen JN, Halliday AN, Godfrey LV, Hein JR & Rea DK, *Science*, **277**, 913-918, (1997).

Lee DC, Halliday AN, Hein JR, Burton KW, Christensen JN & Günther D, *Science*, **285**, 1052-1054, (1999).

Sharma M, Papanastassiou DA & Wasserburg GJ, *Geochim. Cosmochim. Acta*, **61**, 3287-3299, (1997).

Pegram WJ & Turekian KK, *Geochim. Cosmochim. Acta*, **63**, 4053-4058, (1999).