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Sources of Dissolved Osmium in Rivers

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It is usually considered that the isotopic composition of osmium in seawater, registered in marine sediments can be a useful index of continental weathering, as continental crust, mantle and cosmic dust are the three sources of Os to the ocean. However, to interpret it correctly, we have to improve our still too limited knowledge of the various continental sources. Several lithologies have already been proposed as sources of continental Os, but their relative importance is still to be deciphered.

With this end in view we have studied a set of the largest rivers of the world, representative of a diversity of geological and climatic settings. As each lithology leaves its fingerprint on the water's chemical composition of rivers flowing on it, the contribution of each rock source to the dissolved load of a river can be determined (Négrel et al.,1993). To achieve this for Os sources, we characterized each sampled river by its Os isotope composition and its molar ratios of Ca/Na and Na/^{188}Os (Levasseur et al., 1999) and determined these ratios for the potential sources. We show that three main sources have to be considered to explain the data. These are black shales, carbonates, and continental crust silicates (cf. Figure 1). Using a three component model, it is possible to evaluate the proportions of dissolved Os coming from each of them. In most of the studied rivers, silicates are not the dominant source. Using the mean global riverine flux of osmium (Levasseur et al., 1999) and the mean chemical composition of rivers, calculated from the 60 largest rivers of the world (Gaillardet et al., 1999), it is possible to determine the proportion of Os from each source arriving to the sea: 14% are coming from silicates, 31% from black shales and 55% from carbonates. These results are only indicative of the relative importance of the different sources, the characteristics of the components being still not very well constrained. However this means that carbonates are an important source and that their weathering has a buffering effect on the Os isotopic composition of the continental flux although less efficient than for Sr. The fact that the sources of the dissolved Os load in rivers are dominantly carbonates and black shales leads to a revaluation of the potential of the oceanic Os isotopic composition as a proxy of continental crust weathering.

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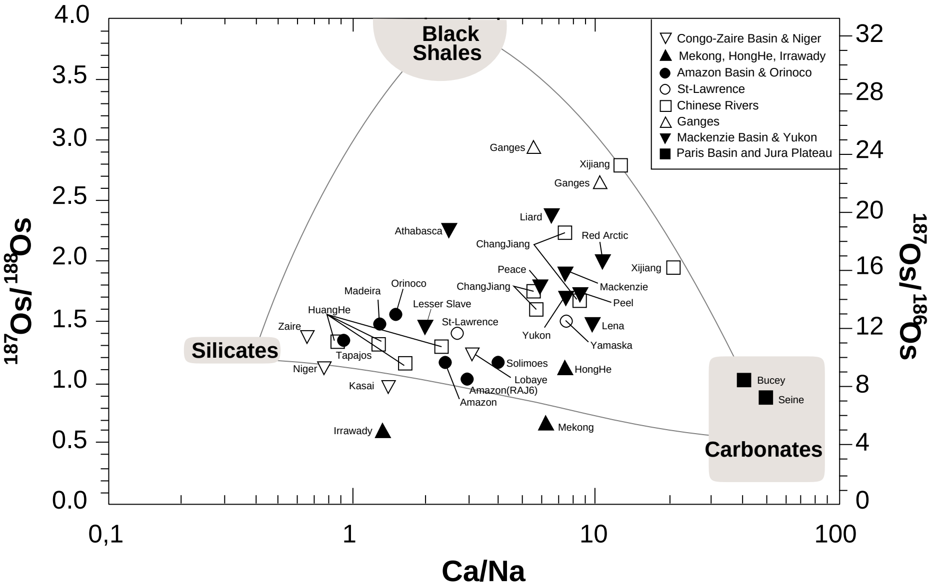

Figure 1: Mixing diagram using the Os isotopic composition and the Ca/Na molar ratio (corrected from cyclic salts and evaporite contributions) in the river waters. The mixing lines joining the end member reservoirs define the domain in which rivers can be described by a mixing between silicates, black shales and carbonates. The Mekong River is not very far from the 3 component mixing zone and, owing to the uncertainties of the model this will not be taken into account. The Irrawaddy River can be suspected of ultramafic contributions.