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Hf leaching experiments on sediments

Introduction: The application of hafnium (Hf) isotopes to the marine realm represents an exciting new and yet not fully explored tool for the reconstruction of paleoclimatic and paleoceanographic processes. The few time-series studies available are based on Hf isotope analyses from ferromanganese crusts (e.g. Piotrowski et al., 2000; van de Flierdt et al., 2004). These studies suggest that Hf has a similar residence time in the ocean than neodymium (600 – 2000 years), implying that the Hf isotopic composition of past seawater may be used as a proxy for ocean circulation patterns and/or input sources. Furthermore, the observation has been made that the Hf isotope composition of seawater does not match that expected from dissolution of bulk continental crust. This mismatch is generally considered to be due to the incongruent weathering of Hf on the continents. Incongruent weathering means that only the easily leachable fraction of the bulk source rocks is dissolved and subsequently delivered to the ocean. This fraction has much higher Hf isotope ratios than the bulk source rocks, since a large portion of the Hf in a rock is retained and preserved in resistant zircons with very low Lu/Hf ratios (e.g. Patchett et al., 1984). A more congruent weathering style, however, may be found in glacial environments where the grinding of rocks by glaciers is likely to cause a physical breakdown of zircon minerals. In such a scenario a more bulk rock like signature is released from the continents to the ocean (van de Flierdt et al., 2002). In summary, it is likely that the Hf isotope composition of seawater is an excellent tracer for enhanced physical weathering and thus glaciation, which would make it a very powerful tool for the study of past climate.