

## Signals of anthropogenic Os in surface waters from precipitation

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Measurements of Os isotopic compositions of paired sediment and water in river systems find that sample pairs are often not in equilibrium with one another. The  $^{187}\text{Os}/^{188}\text{Os}$  ratios of the sediments from the Connecticut River are between 1.6–2.1 much higher than those of the water samples ( $\approx 0.7$ – $0.9$ ). Similarly, sediment and water samples from the Orinoco River also do not have matching isotopic compositions [1]. The divergence of sediment Os isotopic composition from waters suggests that the latter have been impacted by addition of nonradiogenic Os. A recent study shows that the  $^{187}\text{Os}/^{188}\text{Os}$  ratio of surface seawater in the Sargasso Sea is lower ( $\sim 0.85$ ) than the deep ocean ( $\sim 1.05$ ) [2]. Precipitation samples measured from North America and Antarctica all have nonradiogenic  $^{187}\text{Os}/^{188}\text{Os}$  ratios:  $\sim 0.2$  (Hanover, High Sierra Nevada) and  $0.4$  (Ross Sea) [3]. Likewise, a rainwater proxy collected from Angel Falls in Venezuela is also nonradiogenic ( $^{187}\text{Os}/^{188}\text{Os} = 0.4$ ) [1]. Nonradiogenic Os from precipitation could explain the consistent suppression of Os isotopic composition in river water samples relative to their sediment pairs and the lowered isotopic composition of surface ocean water. The question is what is the source(s) of nonradiogenic Os in the precipitation.

Few sources of atmospheric Os are nonradiogenic in nature. Two potential sources are cosmic dust and volcanism but cannot provide sufficient Os to reduce the isotopic composition of precipitation. However, Os from the refining of Pt-ores ( $^{187}\text{Os}/^{188}\text{Os} \sim 0.2$ ) could provide sufficient nonradiogenic Os to match that measured in the North American precipitation. In highly oxidizing environments at elevated temperatures (conditions experienced during turning of Pt-rich sulfide matte), Os becomes gaseous  $\text{OsO}_4$ , explaining why the distribution of nonradiogenic Os is so global in extent. If all Os from the refining of Pt, which has been used extensively in catalytic converters for the last 30+ years, ended up in the ocean, there would be sufficient Os to suppress the isotopic composition of the surface layer. The large quantity of Os that is currently being spread across the earth surface has a direct impact on our understanding of the Os budget of the oceans and other large bodies of water.

[1] Chen *et al.* (2006) *EPSL* **252**, 138–151. [2] Ramirez *et al.* (2006) *EOS* **87**, OS32B-07. [3] Chen *et al.* (2007) *EOS* **88**, OS11B – 0511.

## Geochemistry and geochronology of the North Qaidam UHP terrane, NW China

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The North Qaidam orogenic belt located at the NW of China, which has been recently recognized as an UHP metamorphic belt due to the discoveries of cosite and diamond in this belt [1–2]. HP to UHP eclogite, garnet pyroxenite and minor paragneiss occurred as lenses alone or compound in the regional gneisses. Eclogites mainly exposed, from east to west, in Shaliuhe, Yematan, Xitieshan and Yukahe area.

Zircon LA-ICP-MS U-Pb dating yield the metamorphic ages of 431–431 Ma and 431–432 Ma for the Yukahe eclogites and its country rocks, 421–458 Ma both for the Xitieshan eclogite and country rock, and 420–425 Ma for the Shaliuhe eclogites. The metamorphic ages of these eclogites are well consistent with their country rocks. Note that, residual magmatic cores were generally discovered in zircons and obtained the protolith ages of these eclogites of  $>750$  Ma.

Major and trace element data of these eclogites show that the protolith of Yukahe and Xitieshan eclogite have characteristics similar to WPB or “E” MORB formed in a extensional tectonic setting. Shaliuhe eclogites were more complicated, protolith of the high-Ti eclogite was typical of OIB, but the low-Ti ones was more like the back-arc basin basalt. The  $\epsilon\text{Nd}$  values of Yukahe, Xitieshan and Shaliuhe eclogite at 800 Ma are  $-5.34$  to  $+4.46$ ,  $-4.86$  to  $-5.53$ ,  $-4.51$  to  $+5.09$ , respectively, show both oceanic and “continental” affinities. But the  $^{147}\text{Sm}/^{144}\text{Nd}$  values of Yukahe and Xitieshan eclogites are lower than the chondritic values of  $0.1967$ , similar to the LREE-enriched geochemical characteristics of continental basalts. These features together with the geochemical data suggest that the protolith of Yukahe and Xitieshan eclogites may formed in the continental rift or an incipient oceanic basin.

The consistent metamorphic ages of eclogites with their country rocks, and the elemental and Sm-Nd isotopic features, especially the existence of  $>750$  Ma protolith ages of the eclogites undoubtedly suggest that eclogites from Yukahe, Xitieshan and Shaliuhe area of the North Qaidam were formed by continental deep subduction in early Paleozoic.

[1] Yang *et al.* (2001) *I*, **75**(2), 175–179. [2] Song *et al.* (2005) *EPSL* **234**, 99–118.