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Marine Os isotopic constraints on an impact of large scale magmatism on the environmental event at the T-J boundary

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Attention has been focused on relationships between massive igneous eruptions and major environmental perturbations such as large mass extinctions (e.g., Kuroda et al., 2007). The Triassic-Jurassic (T-J) transition at c.a. 200 Ma marks one of the five biggest mass extinction events in the Phanerozoic when a substantial proportion of marine and terrestrial species became extinct. It also marks extensive magmatic activities associated with the breakup of Pangaea and with the initial stages of rifting in the Central Atlantic Magmatic Province (CAMP). These magmatic activities have been implicated as a possible forcing mechanism for the climatic and biotic changes at the T-J boundary. However, the mechanism triggering the T-J mass extinction is still controversial, because there are remarkable difficulties in correlating the timing of the widespread CAMP volcanic activity with the environmental and biotic events, and in estimating the environmental impact of igneous activity.
Since seawater Os isotopic composition varies in response to change in relative rates of Os supply from continental weathering, mantle activity and extraterrestrial materials (e.g., Peucker-Ehrenbrink and Ravizza, 2000), Os isotopic record from hydrogenous fraction of marine sediments is useful for reconstructing temporal changes in the relative contribution from these sources (e.g., Ravizza and Peucker-Ehrenbrink, 2003; Tugeon and Creaser, 2008; Tejada et al., 2009; Robinson et al., 2009). Such information possibly provides us important constraints on the mechanism of the environmental change and mass extinction. Although Cohen and Coe (2002, 2007) have reported Os isotopic records across the T-J boundary from southern England, no data have been reported from the Paleo-Pacific (Panthalassa) pelagic basin that covered approximately half of the Earths surface. In this study we present a high-resolution isotopic record of osmium extracted from bedded chert successions across the T-J boundary in Kurusu and Katsuyama sections, central Japan, deposited on Pacific deep basins (Panthalassa). Our new dataset indicate that the Os extracted from chert well documents the hydrogenous $^{187}Os/^{188}Os$ records, showing a gradual decrease through the Rhaetian and subsequent sharp increase immediately below the Triassic-Jurassic boundary. The overall resemblance of Os isotopic patterns between the two sites suggests it to reflect seawater isotopic composition. The gradual decrease in $^{187}Os/^{188}Os$ ratios through Rhaetian suggests an increase in relative supply rate of less radiogenic Os from the mantle, associated with the emplacement of the Central Atlantic Magmatic Province. The subsequent rapid increase would have been caused by a rapid increase in relative supply rate of radiogenic Os from the upper continental crust due to an enhanced continental weathering. The enhanced continental weathering could have caused the T-J mass extinction.

Keywords: Triassic-Jurassic boundary, osmium isotope, Pacific, Central Atlantic Magmatic Province