Variations of U and Mo isotopes across the deep sea Permian-Triassic boundary

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The end-Permian mass extinction is considered to have been associated with a widespread oxygen-deficient oceanic event. Such an oceanic event is inferred based on the concentrations of redox sensitive elements such as uranium (U) and molybdenum (Mo) in sediments. However, the severity and spatio-temporal extent of oxygen deficiency is poorly understood. Isotope systematics of redox sensitive metals may provide new insights. Here, we report variations in isotope ratios of U and Mo ($\delta^{238}U$ and $\delta^{98}Mo$) in the deep-sea sediments across the Permian–Triassic boundary in the accretionary complex of Northeast Japan (Akkamori section). The section consists of late Permian bedded chert, latest Permian siliceous claystone, and the end-Permian to earliest Triassic black carbonaceous claystone. The mass extinction boundary is located at the base of the black claystone.

$\delta^{238}U$ starts to increase from the Permian chert, and shows a maximum value of 0.53‰ in the overlying siliceous claystone, 17 cm below the extinction boundary. This is close to the maximum value reported from the anoxic black shale in Black Sea [1]. Then, $\delta^{238}U$ gradually decreases upward, and shows values around 0.3‰ at the earliest Triassic. $\delta^{98}Mo$ shows a drastic decrease to -1.0‰ in the Permian siliceous claystone below the mass extinction horizon. The $\delta^{98}Mo$ then increases to 2.5‰ at the basal 15 cm of the black claystone above the mass extinction horizon. The trend is supported by similar $\delta^{98}Mo$ variation from the deep-sea Permian - Triassic boundary from the Boreal Sea (Sverdrup Basin; [2]). The increased $\delta^{238}U$ at the end-Permian suggest high contribution of reduced U reflecting reduced oceanic condition. During this reduced water development, $\delta^{98}Mo$ would show low values fractionated by Mn particle activated their transportation in mild sulfidic condition at first, and become to show high value of Mo-sulfide with slight fractionation from seawater in strong sulfidic condition.

[1] Weyer et al., 2008, *Geochim. Cosmochim. Acta* **72**, 345-359.[2] Proemse et al., 2013, *Geology,* **41**, 967-970.