REE and Mo isotopic study of Permo-Triassic sediments from Spiti Himalaya

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The Permo-Triassic transition witnessed the most severe extinction event in the history of life on Earth. This most severe biotic crisis wiped out nearly 90% of all the species in the ocean and about 70% of the vertebrate families on land on Earth and occurred around 251 Ma ago. Several attempts have been made to understand the environmental changes which could possibly have brought this devastation, including volcanic eruption, global climate change, ocean anoxia and extraterrestrial impacts.

To understand environmental conditions which led to PT extinction, we studied the REE, Mo isotopic composition in bulk and authigenic fraction with the aim to understand the depositional environment before, during and after extinction event. REE and Mo composition have been measured on ICPMS and MC-ICPMS with double spike method at PRL.

The ΣREE are very high up to 600ppm in the ferruginous boundary layer as compared to sediments on top and bottom. The enrichment of REE is also accompanied by Eu and Ce anomalies [Where $(Ce/Ce^{*})_{NASC}=2 \times Ce_{NASC}/(La_{NASC}+Pr_{NASC})$ and $(Eu/Eu^{*})_{NASC}=\log \{2 \times Eu_{NASC}/(Sm_{NASC}+Gd_{NASC})\}$] which are redox sensitive. The transient variations of these anomalies is clear indication of frquent marine regression and transgrassion.

Mo is most redox sensitive and abundant transition metal in present day ocean. It enters the ocean through rivers ($\delta^{98/95}$Mo~ 0‰) and remains in the water in moderately unreactive MoO_4^{2-} form. Under the oxidizing marine conditions similar to present day, Mo from water column is slowly removed by incorporation into ferromanganese phases with preferential removal of lighter Mo isotopes (~-0.7‰). As a result, the sea water is enriched in heavier isotope (~2.3‰). However, in euxinic conditions, Mo is quantitatively removed from the solution as MoS_4^{2-} without isotopic fractionation. Therefore Mo isotopic composition of sediments deposited under these conditions represents composition of water.

Our results show extreme enrichment of Mo abundance which is accompanied by disturbance in $\delta^{98/95}$Mo which first reduced to -0.2‰ followed by increase to 0.7‰. This followed by another decrease in $\delta^{98/95}$Mo to -0.2‰. In early Triassic the $\delta^{98/95}$Mo increased towards the present day ocean value indicative of prolong anoxic condition Triassic.