Isotopic geochemical significances of the Cretaceous Oceanic Anoxic Events

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Middle of Cretaceous is geological time interval considered to be the youngest 'Greenhouse' stage throughout the Earth's history. Oceanic Anoxic Events (OAEs) are characterized by deposition of organic-rich black shales in the global ocean such as W. Tethys, Atlantic and Central Pacific, which were intermittently occurred during the middle of Cretaceous epoch. It is interesting that the ages of some OAEs are close to the emplacement ages of large igneous provinces (LIPs). Although the causal linkage between LIP eruptions and OAEs has been proposed, no general consensus has developed yet. We have investigated the possibility of LIP volcanism instigating OAEs by various isotopic records of lead (Pb) in silicate fraction, and osmium (Os) in hydrogenous fraction (Tejada et al., submitted) in pelagic sediment section across two major OAEs; OAE-1a at the Early Aptian (120 Ma), and OAE-2 at the End-Cenomanian (94 Ma). In the presentation we will discuss the potential linkage between OAEs and LIPs by comparing the results of these isotopic records obtained from Selli and Bonarelli intervals (central Italy), which are typical stratigraphic sections for the OAE-1a and OAE-2, respectively. The former is close to the age of Ontong Java plateau , whereas the latter to the Madagascar or Caribbean flood basalt. At the onset of OAE-2 black shale (base of Bonarelli), we found a significant negative isotopic shift in bulk organic carbon. In the same stratigraphic level, Pb isotopic composition from silicate fraction indicates the significant shift toward the isotopic ratios of basaltic rocks of Caribbean and/or Madagascar flood basalt. These data strongly suggest a massive eruption of LIPs at the onset of OAE-2 black shale, which resulted in the Pb isotopic shift of silicate minerals due to the enhancement of supply rate of silicate minerals from the LIPs, and in the carbon isotopic shift due to the massive release of isotopically light carbon from mantle.

In contrast to the OAE-2, Pb isotopic ratios in silicate fraction does not indicate significant shift during the OAE-1a. Isotopic shift of bulk organic carbon illustrates a slight shift. On the other hand the onset of OAE-1a is mar ked by significant negative shifts in marine Os isotopic ratios, suggesting enhanced supply of unradiogenic Os from mantle via volcanism or hydrothermalism at the onset of OAE-1a.

These results suggest that massive eruptions would have occurred both at the onsets of OAE-1a and OAE-2. We attribute the different geochemical signals to the difference in eruption mode (i.e., subaerial vs. submarine). In the presentation we will also discuss the potential linkage between massive eruption and subsequent environmental changes, particularly the occurrence of OAE.