The Ultimate Cause for Ir Concentration in the Late Devonian Marine Sediments

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Studied samples show evidence of Ir anomaly, by an average of fifty times enrichment in iridium compared to present day ocean crust. Ir anomalies are often considered unique indicators for cosmic events. Chondritic meteorites are rich in trace elements such as Ir, Se, Ni, Co and Cr compared to the means of earth's crust. Consequently, high concentration of these metallic elements, especially Ir in sedimentary layers has been reported of indication the meteorite impact at the sedimentation time. Positive Ir anomalies in Cretaceous/Tertiary (K/T) boundary sequences are commonly referred to as being caused by the impact of a Chondrite of about 10 km in diameter, which caused the extinction of many organisms including dinosaurs. High concentration of Ir has also reported on the Permian/Triassic boundary on the time of another mass extinction. The recognition of the Late Devonian mass extinctions is a relatively new in the geological literatures. However the meteorite impact is one of the most reported hypotheses as the ultimate or motive cause for the bio event on Frasnian/Famennian boundary. Participation of the meteorite in concentration of Ir at F/F boundary marine sediments is verified in this study by using of multiple gamma-rays in advanced method of Instrumental Neutron Activation Analysis (INAA-MG) for determination of Ir in carbonate rock samples from south China.

The Liujing section in Hengxian, Guangxi is one of the well known Devonian sections in South China. It crops out sixty kilometers east of Nanning. The uppermost part of the Gubi formation is characterized by dark gray micritic limestone intercalated with laminations of calcareous claystones corresponding to Famennian. The basal part of the Rongxiang Formation is thin bedded gray micritic limestone overlying massive and brecciated limestone, corresponding to Famennian. The boundary between the Gubi and the Rongxian formations has been well documented by conodont zonations. In order to study Ir anomaly on the F/F boundary in Liujing section, only the uppermost Gubi and the lowermost Rongxian formations have been measured on interval of about 8 m thick. The collected samples are micritic limestones from the upper part of Gubi Formation and the basal part of Rongxian Formation.

Anomalously high concentration (~1000 ppt) was detected for two samples at F/F boundary, some of which are characterized by negative ^{13}C anomalies and high concentration of redox sensitive elements. Submarine volcanisms may have caused high concentration of Ir in oceanic sediments. Phanerozoic largest volcanic episodes occurred in northern Iran and East European platform at around the F/F boundary, but the Ir concentration of the alkali basalt is only 57 ppt, far below the observed anomalies. Microbial activities could concentrate Ir in sediments, though the community was common throughout the F/F boundary to the Famennian after mass extinction. Pelagic deep-sea sediments are likely to concentrate more cosmic dusts and Ir, because the sediment accumulation rate is very low. However, the maximum concentration of Ir in sediments from the eastern Philippine Sea and offshore Hawaii Islands is only 239 ppt, still quite lower than the observed F/F boundary strata.

Significant positive excursion in $^{87}Sr/^{86}Sr$ ratio at the F/F boundary interval suggests an increased ^{87}Sr contribution from intense continental weathering. The possibility of bolide impacts cannot be ruled out, but observed geochemical parameters seem to suggest that the continental weathering is the major source for Ir at the late Devonian. Ir anomaly cannot be used as sole evidence in support of bolide impacts. Ir anomalies have to be critically evaluated within the context of the overall PGE distribution pattern, the contemporaneous continental deep weathering as well as possible enrichment by sulfides under water column anoxia.