

Identification and Characterization of Meteorite Collision: Panthalassic Deep-sea Record in the Upper Triassic of Japan

佐藤, 峰南

<https://hdl.handle.net/2324/1500494>

出版情報 : 九州大学, 2014, 博士 (理学), 課程博士
バージョン :
権利関係 : やむを得ない事由により本文ファイル非公開 (3)

氏 名 : 佐藤峰南

論 文 名 : Identification and Characterization of Meteorite Collision: Panthalassic Deep-sea Record in the Upper Triassic of Japan

(日本の遠洋性堆積物に記録された三疊紀後期隕石衝突の解明)

区 分 : 甲

論 文 内 容 の 要 旨

Ni-rich magnetite and microspherules have been reported from a claystone layer in the Upper Triassic bedded chert succession of the Sakahogi section in Japan, and are considered to have been derived from an extraterrestrial impact event. In order to confirm the ejecta layer formed by the impact event, the stratigraphic variations of PGE concentration and Os isotope of the bedded chert and claystone were examined.

The Sakahogi section (~26 m in thickness) crops out in the Mino Belt, central Japan, and consists of the red to greenish-gray bedded chert. The radiolarian biostratigraphy indicates a middle Norian age of the claystone layer. The bedded chert of the Sakahogi section is reconstructed as a deep-sea sediment of pelagic facies forms in an open ocean realm of the Panthalassa Ocean. Ni-rich magnetite and microspherules occur in a thick claystone layer (~5 cm in thickness) intercalated within the red bedded cherts.

The claystone layer is characterized by platinum group element (PGE) positive anomalies and osmium (Os) isotope negative excursion, coincident with enrichments of Ni and Cr and abundant Ni-rich magnetite grains and microspherules. The middle Norian PGE positive anomalies were also recognized from claystone layers of three bedded chert successions in Southwest Japan: (i) Unuma section in the Inuyama area, Mino Belt, (ii) Hisuikyo section in the Kamiaso area, Mino Belt, and (iii) Enoura section in the Tsukumi area, Chichibu Belt. The claystone layer contains anomalously high contents of iridium, up to 41.5 parts per billion (ppb) in the Sakahogi section, comparable to the levels found at the K/Pg boundary. Os isotope fingerprint of an extraterrestrial impact was discovered from the middle Norian claystone layers in the Sakahogi and Enoura sections. Os isotope data exhibit a marked negative excursion from an initial Os isotope ratio ($^{187}\text{Os}/^{188}\text{Os}_i$) of ~0.477 to unradiogenic values of ~0.126 in the PGE-enriched claystone layer in the Sakahogi section. This excursion indicates the input of meteorite-derived Os into the sediments. The timing of the Os isotope excursion coincides with both of the elevated Os concentrations and lowered Re/Os ratios. Changes in the Os isotope ratio and Re and Os concentrations of the chert and claystone layers in the Enoura section are correlated to those of the Sakahogi section. These geochemical lines of evidence demonstrate that a large impactor produced a decrease in seawater $^{187}\text{Os}/^{188}\text{Os}$ ratios in the middle Norian.

Identification of the impactor was attempted by comparing the isotope and elemental ratios measured in the ejecta layers with geochemical composition obtained from meteorites. The Ru/Ir and Pt/Ir ratios of all the claystone samples from the study sites are plotted along the mixing line between chondrites and upper continental crust. Although chondrites cannot be distinguished from iron meteorites by using PGE/Ir ratios,

the Cr/Ir ratios of the claystone layers ranging from 10^4 to 10^5 indicate the clear contamination of the chondritic materials. The size of the impactor can be inferred from the sedimentary Os isotope ratios by reasonable estimates of the range in the amount of Os released from the impactor into the seawater. Assuming 22 to 100% release of chondrite-derived Os into the seawater, the impactor is calculated to be 3.3–7.8 km in diameter.