Enhanced flux of extraterrestrial ^{3}He across the Permian–Triassic boundary

*Tetsuji Onoue[1], Naoto Takahata[2], Honami Sato[4], Akira Ishikawa[3], Katsuhito Soda[1], Yuji Sano[2], Yukio Isozaki[2]

1. Kumamoto Univ., 2. Univ. Tokyo, 3. Tokyo Inst. Tech., 4. Chiba Inst. Tech.

The Solar System contains abundant submillimetre interplanetary dust particles (IDPs) that are enriched in ^{3}He. ^{3}He concentrations in ancient deep-sea sediments have been used to constrain the flux of IDPs onto the Earth for at least the last 100 Myr. However, the use of ^{3}He in detecting IDP flux is often compromised by the diffusional loss of ^{3}He in sedimentary rocks, with the exception of some Ordovician samples that record a period of unusually high extraterrestrial^{3}He ($^{3}He_{ET}$) flux. In this study, we report for the first time the preservation of extra-terrestrial ^{3}Hein deep-sea bedded chertfrom a continuous Permian-Triassic boundary (PTB) section at Waidani in Japan, which was deposited in the Panthalassa superocean.

High ^{3}He/^{4}He ratios (up to 150 Ra; 1Ra = the atmospheric ratio) were detected from acid-insoluble residues fromthe uppermost Permian deposits, which suggeststhe existence of extraterrestrial He hosted mainly in IDPs. The estimated extraterrestrial fraction of ^{3}He across the PTB revealsthat$^{3}He_{ET}$ concentrations are higher in the topmost ~1.5 m ofthe studied Permian deposits, which is 4–5 times greater than that measured in the overlying Triassic unit. Based on the $^{3}He_{ET}$ concentration and sedimentary mass accumulation rate of the PTB section at Waidani, we calculated $^{3}He_{ET}$ fluxacross the PTB.The data document the presence of an up to 4-fold increase in IDP flux for the last 500 kyr interval of the Permian.This unusual signal suggests a significant increase in the influx of interplanetary dust particles, likely related to an asteroid showerin the inner Solar System. High-resolution stratigraphy indicates that peak IDP flux occurred during the final 500 kyr of the Permian, concurrent with a pre-extinction decline in radiolarian diversity.

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