Temporal isotopic variation of a superplume: evidence from Hotta and Bosei seamounts in the northwestern Pacific

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The northwest Pacific Ocean is known to contain numerous mid-Cretaceous seamounts and large igneous provinces (LIPs). These seamounts and LIPs are considered to have been formed during large-scale magmatic events in the Earth's history, so-called superplume activity. Since superplume activity is considered to be affected by large-scale mantle upwelling originating from the core-mantle boundary, research into large-scale magmatism may provide clues into understanding material recycling throughout the silicate Earth. Despite their potential importance, mid-Cretaceous seamounts have been studied in less detail than their present-day ocean island counterparts.

The present-day South Pacific region is referred to as a superswell or the South Pacific Isotopic and Thermal Anomaly (SOPITA) due to its unusually shallow ocean floor, active intraplate volcanism and the occurrence of isotopically anomalous magmas. These geological, geophysical and geochemical features can be attributed to superplume activity commencing abruptly at ca. 125 Ma. The volumetrically vast magmatic output was maintained between ca. 120 and 100 Ma, before declining markedly at 80 Ma, and then decreased monotonically to 30 Ma and the steady state levels observed in the present-day South Pacific. Given that the magmatism in the mid-Cretaceous was considerably more vigorous than it is today, the seamounts that formed during that period can provide essential information regarding the causative superplume activity. Seamounts in the NW Pacific are thus particularly important, as they likely formed in response to mid-Cretaceous superplume activity.

The Joban Seamount Chain is one such seamount chain that is currently subducting beneath the NE Japan arc. Compared to the other NW Pacific seamount chains, the geochemistry of the Joban Seamount Chain has been less extensively studied. In particular, the origin of the Joban seamounts has never been investigated using Pb, Nd and Sr isotopic composition. This study was therefore conducted to elucidate the as-yet ambiguous geochemical characteristics of the Joban Seamount Chain using Pb, Nd, Sr isotopic composition and 40Ar-39Ar dating as a key to clarify the occurrence of superplume activity.