Noble gas and carbon isotopic compositions of petit-spot lavas from southeast of Marcus Island

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We measured noble gas isotopic compositions of quenched lavas sampled from seamounts, so-called petit-spot volcanoes, on the 160-million-year-old northwestern Pacific Plate. The samples $^{3}He/^{4}He$ and $^{40}Ar/^{36}Ar$ ratios were, respectively, 2.5–8.3 Ra and up to 1735, where Ra stands for atmospheric $^{3}He/^{4}He$, which are analogous to or lower than those of MORB. Considering narrow sampling regions, a secondary effect might be responsible for variation of the data.
During ascent and subsequent cooling of magma in the oceanic lithosphere, chemical components in the magma will be assimilated with those in the lithosphere. Correlation between $CO_2/^{3}He$ ratios and carbon isotopic ratios suggests that carbon was affected by the incorporation of seafloor carbonate. The same would be true of noble gases. The mixing of noble gases among a mantle source, an atmospheric component dissolved in seawater and a radiogenic component can explain the data distribution. There is no $^{3}He/^{4}He$ ratio exceeding MORB-like value. The mantle source of the petit-spot magma was likely to have had a MORB-like $^{3}He/^{4}He$ ratio originally. The eruption of petit-spot magma shows a close relation with the bending of subducting oceanic plates. The MORB-like $^{3}He/^{4}He$ ratio supports the hypothesis that the petit-spot magma is derived from the lithosphere–asthenosphere boundary.

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