

Trace of mantle plume beneath southwest Japan revealed by noble gas isotopes

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Cenozoic alkaline basalts in Southwest Japan

Cenozoic alkaline basalts distributed in the back-arc region of Japanese arcs have been considered to be mantle plume origin (e.g., Nakamura et al., 1990). To investigate the contribution of the plume, we have analysed noble gas isotopes in alkaline basalts from Higashi-matsuura districts in northwest Kyushu and mantle-derived xenoliths from Takashima, which is one of the alkaline basalt volcanoes in the same district.

Two types of fluid inclusions with different $^3\text{He}/^4\text{He}$

Noble gases were extracted by *in-vacuo* crushing and heating methods. The xenolith samples showed variable $^3\text{He}/^4\text{He}$ ratios ranging from 6.1 to $16.6R_A$, indicating that plume-type helium was trapped in some parts of the samples. Stepwise crushing method was applied for two helium-rich xenolith samples. The low $^3\text{He}/^4\text{He}$ sample showed relatively constant $^3\text{He}/^4\text{He}$ ratios of $6-7R_A$ equivalent to the value obtained with replicate bulk analyses. Meanwhile $^3\text{He}/^4\text{He}$ ratios of the sample which showed high $^3\text{He}/^4\text{He}$ ratios in bulk analyses varied from 8.5 to $11.8R_A$ independently of progress of the crushing. The crushing method is effective to extract gases selectively from fluid inclusions. Based on microscopic observation of fluid inclusions in the two samples, helium with low (ca. $6R_A$) and high ($>16.6R_A$) isotopic ratio are considered to be trapped in fluid inclusions of healed fracture origin and in randomly scattered fluid inclusions, respectively. Since $^3\text{He}/^4\text{He}$ ratios of olivines in alkaline basalts around Takashima were $6-7R_A$, the low $^3\text{He}/^4\text{He}$ ratio trapped in the healed fracture-type inclusions might be acquired from their host magma.

Plume-type helium beneath northwest Kyushu

The high $^3\text{He}/^4\text{He}$ ratio of the scattered fluid inclusions indicates that plume-type helium had been trapped in uppermost mantle beneath northwest Kyushu before Higashi-matsuura basalt extrusions at 3Ma. Yanagi and Maeda (1998) suggested that mantle upwelling beneath this region started about 40Ma and continued until just before the alkaline basalt activity. It is possible that plume-type helium was inherited from incipient melts carrying noble gases with plume signature during the mantle upwelling, and when alkaline basalt erupted in Higashi-matsuura, $^3\text{He}/^4\text{He}$ ratio of the plume body had decreased owing to dilution by MORB-like helium in surrounding mantle.

References

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New Ether Lipid Biomarkers from a Thermophilic Methanogen

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The core lipids of Archaea comprise C_{20} , C_{40} and sometimes C_{25} isoprenoid chains linked through ether bonds to glycerol derivatives. These compounds are structurally diverse and potentially very useful as taxonomic markers in subsurface microbial communities and in ancient sediments.

While some intact archaeal lipids have been identified using mass spectrometry and NMR spectroscopy, the most common means of analysing the lipid cores involves cleavage of the ether bonds using HI and subsequent reduction of the alkyl iodides to hydrocarbons with LiAlH_4 . One class of methanogenic lipids, the 3'-hydroxyarchaeols, escaped detection for some years because strong acid treatments in the analysis protocols destroyed hydroxyl-containing isoprenoid chains. We recently examined the lipids of a thermophilic methanogen, *M. thermolithotrophicus*, using milder procedures involving weak acid hydrolysis of polar head groups, derivatisation to form trimethylsilyl ethers and analysis by GC-MS. As well as archaeol, *sn*-2- and *sn*-3-hydroxyarchaeol, we identified a dihydroxyarchaeol, tentatively as **I**. An analysis of the total lipid extract using BBr_3 as an ether cleavage reagent followed by LiBEt_3H , 'Superhydride' reduction revealed a very complex mixture consisting of phytane, biphytane and a suite of related alcohols. The latter compounds were analysed by GC-MS as their trimethylsilyl ethers and found to comprise a mixture tentatively identified as phytan-N-ol (**II**) and biphytan-N-ol (**III**) where N= 3 or 7 or 11 or 15.

Studies are underway to confirm the complete structures, their physiological roles and phylogenetic distributions.