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Geochemistry of trace alkali elements in the seafloor hydrothermal fluids

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Hydrothermal fluid contains many elements at high concentrations as a result of fluid interaction with rock/sediment and seawater dusring fluid circulation beneath the subseafloor. In particular, Rb and Cs are known as ”soluble elements” which is easily leached from the rock/sediment into the fluid because of their large ion radii. Thus, trace alkali element compositions of hydrothermal fluids would provide information about water/rock interactions.

We determined Rb and Cs concentrations of hydrothermal fluids collected from four fields in the Izu-Ogasawara arc (Myojin Knoll Caldera, Myojinsho Caldera, Bayonnaise Knoll Caldera and Suiyo Seamount), from six fields in the Mariana Trough (Alice Springs Field, Forecast Vent Field, Pika Site, Archean Site, Snail Site and Urashima Site), and from the Iheya North Knoll hydrothermal field in the Okinawa Trough, to discuss their diversity.

Analysis of Rb and Cs concentrations of each sample was conducted using ICP-QMS. To determine the endmember Rb and Cs compositions for each hydrothermal field, the analytical results of the samples were extrapolated to zero Mg concentration. The endmember concentrations of Rb and Cs are plotted in Figure 1. In addition to the results of this study, data from hydrothermal field in the EPR 21^{o}N[1] and MAR (TAG and MARK)[6] located in sediment-starved mid ocean ridge setting, in the Escanaba Trough and Guaymas Basin[2] located in a sediment-hosted setting, and in the Lau Basin[3] and Manus Basin[4] located in a back-arc basin setting are plotted in the same figure. Moreover, compiled data for volcanic rocks and sediment material around these hydrothermal field are overimposed as shaded region in Figure 1.

A range of Rb/Cs ratio of hydrothermal fluids from an arc setting (square symbols; Rb/Cs=12.8 to 26.7) can be distinctive that from a back-arc setting (circle symbols; Rb/Cs=18.6 to 100.1). Rb and Cs concentrations in hydrothermal fluids from a sediment-hosted hydrothermal field is characterized by their substantially high concentrations. Moreover, it is likely that the range of Rb/Cs ration of hydrothermal fluids are comparable for those of volcanic rocks/sediment surrounding these hydrothermal field. It would be suggest that the distribution of Cs from rocks to hydrothermal fluids in arc setting is higher than one in other tectonic setting.

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[6] Campbell et al. (1988) *Nature*, **335**, 514-519.

Keywords: trace alkali elements, hydrothermal fluids, arc, back-arc basin, sediment

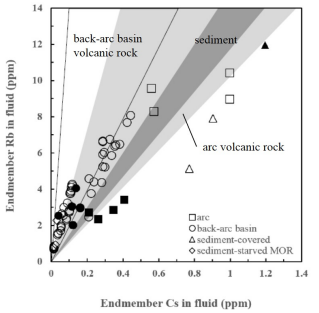

Fig. 1 Relationship between Rb and Cs end-member concentrations in hydrothermal fluids measured this study (solid symbols) and compiled data from submarine hydrothermal systems of various tectonic setting (open symbols). Symbols are; squares; Izu-Ogasawara and Kermadec arc[2] of arc hydrothermal systems, circles; mid/southern Mariana Trough, Lau Basin[3] and Manus Basin[4] of back-arc basin (BAB) hydrothermal systems, triangles; Iheya North Knoll at Mid Okinawa Trough, Guaymas Basin and Escanaba Trough[2] of sediment-hosted hydrothermal systems, and diamonds; EPR 21°N[1], TAG and MARK[6] in Mid Atlantic Ridge of sediment-starved mid-ocean ridge (MOR) hydrothermal systems. Moreover, the range of Rb/Cs in volcanic rock collected around each the hydrothermal site were compiled and were drawn meshing in Fig. 1. The meshing show; area surrounded solid line: BAB volcanic rock, dark gray; sediment, and light gray; arc volcanic rock, respectively.