# Pb isotope analysis of galena from hydrothermal deposits in the mid-Okinawa Trough using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry

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Galena is a major mineral phase that hosts Pb in hydrothermal deposits formed beneath/on the seafloor. The Pb isotope composition of galena reflects the sources of Pb, such as volcanic rock and sediment. Several previous studies reported Pb isotope compositions of the hydrothermal deposits worldwide including Dupré et al. (1988) for the Red Sea, LeHuray et al. (1988) for the Pacific Rise, and Andrieu et al. (1998) for TAG area. Hydrothermal fields in the Okinawa Trough develop within thick layers of terrigenous sediment. Contribution from the sedimentary source is expected to appear significantly in the Pb isotope composition, as already reported by Halbach et al. (1997). In this study, we applied a laser ablation-multiple collector-inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) for determination of Pb isotope compositions of galena grains recovered from the hydrothermal deposits in the mid-Okinawa Trough.

The hydrothermal deposits were obtained during the seafloor drilling campaigns conducted under the framework of the Next-generation Technology for Ocean Resources Exploration Project. The drilling campaigns were conducted in 2014 (CK14-04 Cruise) and in 2016 (CK16-01 and CK16-05 Cruise) using the D/V *Chikyu*. We analyzed the Pb isotope compositions of the galena collected from the Iheya North Knoll hydrothermal field and from the central part of Izena Hole both located in the mid-Okinawa Trough. The Pb isotope compositions were determined for 56 representative polished sections using LA-MC-ICP-MS after microscopic observation and elemental analysis using an electron probe microanalyzer (EPMA). We adopted a standard-sample bracketing method in LA-MC-ICP-MS, which used NIST SRM610 glass as the standard, correcting for the isotopic fractionation. This method has an advantage enabling precise measurements of Pb isotope compositions from massive samples in a short time. This method requires no chemical pre-treatment and analyzes separate mineral grains by confirming their textures and assemblages. Therefore, the method can track changes in Pb isotope compositions in different mineralization stages, which is difficult to make by a conventional thermal ionization mass spectrometry (TIMS) using bulk sulfide samples. Analytical bias and precision of the LA-MC-ICP-MS method now rivals to those of conventional TIMS.

We revealed considerably homogeneous Pb isotope compositions of the galena samples recovered from the entire depth range of each site irrespective of the different mineral assemblage around the galena grains analyzed. However, the Pb isotope compositions differed significantly between the Iheya North field and the Izena hole **(Fig. 1)**. The galena grains from the Iheya North field showed $^{206}Pb/^{204}Pb$ = 18.409 ±0.017, $^{207}Pb/^{204}Pb$ = 15.583 ±0.011, and $^{208}Pb/^{204}Pb$ = 38.500 ±0.046. These compositions are close to those of the volcanic rocks in the Okinawa Trough. Those from the Izena Hole showed $^{206}Pb/^{204}Pb$ = 18.550 ±0.014, $^{207}Pb/^{204}Pb$ = 15.630 ±0.010 and $^{208}Pb/^{204}Pb$ = 38.700 ±0.057. These compositions plot on the mixing lines drawn between the volcanic rocks and the terrigenous sediments in the mid-Okinawa Trough. The results show that the sources of Pb in the hydrothermal deposits are the volcanic rocks and the terrigenous sediments. The Pb isotope compositions varied suggesting various contributions of Pb from the different source materials even in the same tectonic setting.

 

Keywords: Iheya North Knoll, Izena Hole, D/V Chikyu, LA-MC-ICP-MS

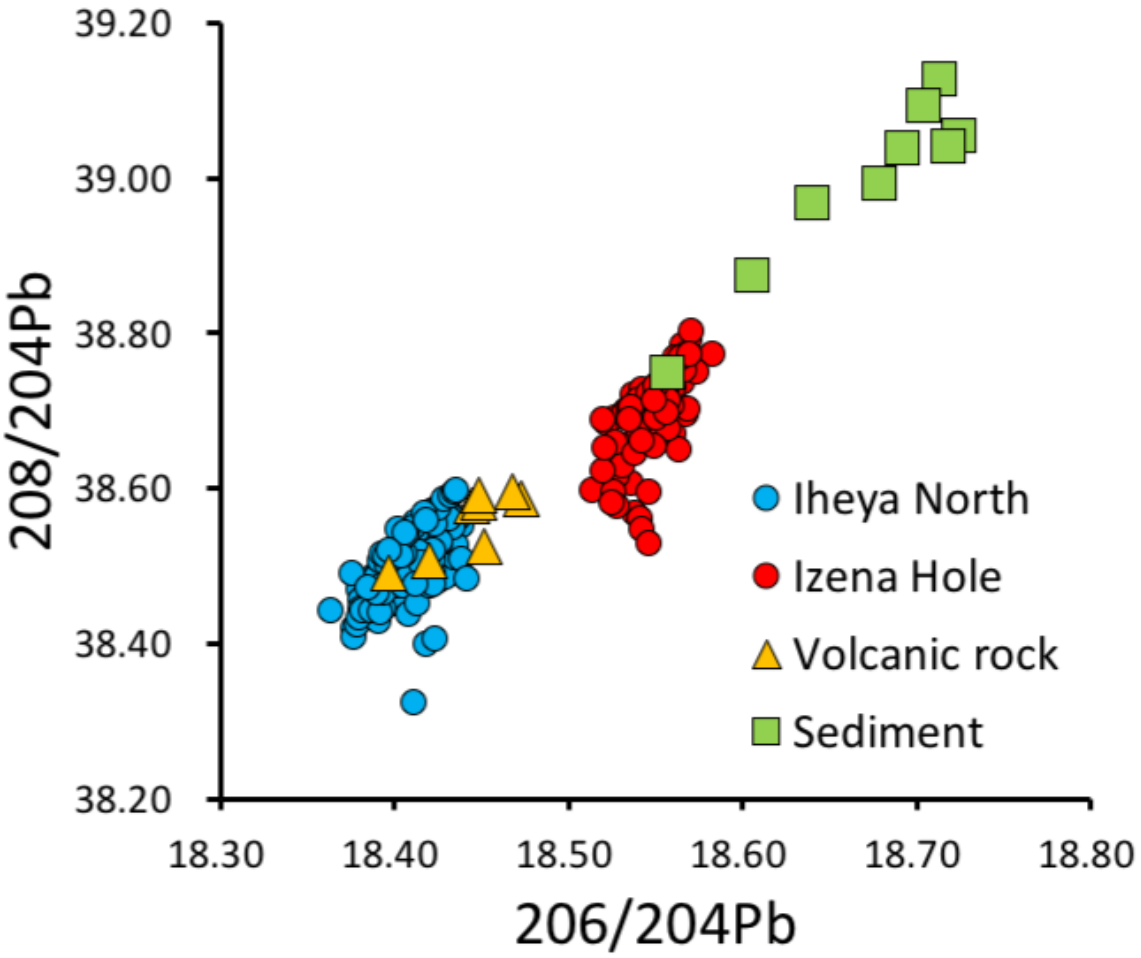


**Fig.1** 208Pb/204Pb versus 206Pb/204Pb diagram for galena obtained from the Iheya North Knoll hydrothermal field and the Izena Hole. Data for volcanic rock and sediment from nearby area are from Halbach et al. (1997) and Bentahila et al. (2008).

 