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Lithium isotope as a proxy for water/rock interaction between hydrothermal fluids and oceanic crust at Milos, Greece

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Hydrothermal activity at Milos in the Aegean island (Greece) is mainly located at rather shallow depth (about 5 m). It is interesting to compare these chemical compositions and the evolution processes of the hydrothermal fluids at deep sea hydrothermal vents in Mid-ocean Ridge (MOR). Lithium (Li) is a highly mobile element and its isotopic composition varies at different geological settings. Therefore, Li and its isotope could be used as an indicator for many geochemical processes. Since 6Li preferential retained in the mineral phase where 7Li is leached into fluid phase during basalt alteration, the Li isotopic fractionation between the rocks and the fluids reflect sensitively the degree of water-rock interaction. In this study, Bio-Rad AG-50W X8 cation exchange resin was used for purifying the hydrothermal fluids to separate Li from other matrix elements. The Li isotopic composition (δ7Li) was determined by Multi-collector Inductively Coupled Plasma Mass Spectrometry (MC-ICP-MS) with precision better than 0.2‰ (2σ, n=20). The Li concentration in the hydrothermal fluids falls between 0.02 to 10.31 mM. The δ7Li values vary from +1.9 to +29.7‰ indicating significant seawater contamination have occurred. These hydrothermal fluids fit well with seawater and brine two end-member binary mixing model. During phase separation, lithium, boron, chlorine, iodine, bromine, sodium and potassium were enriched in the brine phase. On the other hand, aluminum, sulphur and iron were enriched in the vapor phase. There is no significant isotope fractionation between the two phases. The water/rock ratio (W/R) calculated is low (about 1.5 to 1.8) for the Milos fluids, restricted seawater recharge into the oceanic crust. Moreover, the oceanic crust in the region becomes less altered since the W/R is low. The δ7Li value of the hydrothermal fluids can be used as a sensitive tool for studying water-rock interaction.