Helium isotopes in submarine ridge flank basaltic fluids

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There are two helium isotopes: ^{3}He and ^{4}He. While ^{4}He (α particle) can be replenished by radioactive decay of uranium, ^{3}He is almost exclusively primordial and is degassed from earth's mantle. As a consequence, oceanic volcanic rocks (partially from melting upper mantle) contain helium ten-fold enriched in ^{3}He/^{4}He relative to atmospheric helium (atmospheric air ~1.4×10^{-6}; mid-ocean ridge basalts ~1.1×10^{-5}). Subsequently, hydrothermal plumes produced in active mid-ocean ridges and seamounts such as Hawaiian Islands introduce ^{3}He-rich fluids into the deep ocean. However, there is little known about what the helium isotopes are after seawater circulates within the oceanic basement. This research provides helium isotope data for basaltic fluids from sedimented ridge flank area.

The uppermost (40-500 m) ridge flank basement (> 1 My) is the largest aquifer on earth, holding an amount of hydrothermal fluid at ~2% of the ocean volume and hydrothermal flux ~5-60% of riverine input. Within the sediment-buried 3.5 Myr old basaltic crust of the eastern Juan de Fuca Ridge flank, the circulating basement fluids have moderate temperature (~65°C). High integrity basaltic fluid samples were collected through submarine observatories—Circulation Obviation Retrofit Kits (CORKs) 1026B, 1301A, 1362A and 1362B installed by Integrated Ocean Drilling Program (IODP) and Ocean Drilling Program (ODP) program. We present helium concentrations and isotopic compositions and their geochemical interpretations. We will also put our data in a global geographic perspective and discuss the importance of ridge flank circulation as an important conduit for helium degassing.