Dissolved helium isotopes in groundwater: Implication for subduction of continental crust in an active arc-continent collision

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Here we use helium isotopes in groundwater from along the Chauchou/Tulungwan fault system in southern Taiwan to evaluate the involvement of the upper mantle in an active arc-continental collision. Helium isotope ratios of sixteen groundwater samples, four bedrock samples, and one hot spring sample, collected along 10 km on the fault, were measured and reported as R_A (relative to an air helium isotope ratio ($^3He/^4He$) of 1.39×10^{-6}). Measured groundwater helium isotope ratios, ranging from 0.07 to 1.00 R_A, express a clear mixing model with three endmembers of air (1.00 R_A), crust (0.06 R_A) and upper mantle (8 R_A). Samples from southern part of the fault show normal distribution of crustal signal. By correcting the helium from air-contamination, samples from northern part of the fault with 0.30-0.78 R_A reveal significant upper mantle signal. The Chauchou/Tulungwan fault system, in the area of detected mantle-derived fluids, projects down dip to a zone of ambient tremors and a nearby zone of high conductivity; both features extend to nearly 40 km, which is close to the crust-mantle boundary in this area. These observations suggest that mantle-derived fluids penetrate the crust through the zone of the tremor activity, reaching the surface long the Tulugwan fault zone. This study shows that non-volcanic, mantle-derived fluids can be involved in tectonic processes associated with an active arc-continent collision zone.

Keywords: Chauchou fault, noble gas, active tectonics, mantle-derived fluids

