# Overpressured subduction plate boundary caused by infiltration of mantle-derived fluids: Evidence from helium isotope analysis on veins in subduction mélange

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Fluid overpressures have been invoked as one of the key factors controlling slow earthquakes in subduction zones. The generation of fluid overpressures has been thought to occur by in-situ processes such as compaction disequilibrium and mineral dehydration in sediment and oceanic crust. To determine the origin of fluid responsible for overpressured subduction plate boundary, we examined noble gas and microthermometric analyses on quartz-calcite veins in the subduction mélange deformed at ~10–15 km depth.

The analyzed veins are sigmoidal extension vein arrays and shear veins. The former represents Riedel shear zones formed during subduction under vertical $\sigma_1$. The latter records the numerous low-angle brittle thrusting at very small shear strength with recurrence time comparable to that of slow earthquakes, which could account for the generation of tectonic tremors [1]. Homogenization and ice melting temperatures of fluid inclusions indicate that the both types of veins recorded the fluids with salinity of 3–7 wt% and near-lithostatic fluid pressures at 10–15 km depth. The measured $^{3}He/^{4}He$ range 1.6–2.5 Ra (Ra is the $^{3}He/^{4}He$ of air) regardless of types of veins, indicating the presence of mantle helium. The ratios of non-radiogenic heavy noble gas isotopes ($^{36}Ar$, $^{84}Kr$, and $^{130}Xe$) are similar to those of seawater and serpentinite in slab mantle [2]. Because porosity in sediments already decreased to <1 % at depths of 4–5 km [3], seawater captured in the pores would be completely expelled from the subducting sediments before reaching to 10–15 km depth, and thus the serpentinized slab mantle is the likely origin of the $^{36}Ar$, $^{84}Kr$, and $^{130}Xe$. The measured $^{3}He/^{4}He$, non-radiogenic heavy noble gas ratios, and salinity are consistent with those of slab-derived fluids observed in mantle wedge peridotites from subduction zones [4, 5], suggesting that fluids released from subducted serpentinite to the mantle wedge migrate toward shallow depths along subduction boundary. From a mixing calculation using $^{36}Ar$, $^{84}Kr$, and $^{130}Xe$ data, more than 64% of vein-forming fluids were originated from the subducted serpentinite. Therefore, the migration of mantle-derived fluids has a potential to induce brittle failures in plate boundaries via increasing fluid pressures.

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