Noble gas and major element composition of deep groundwater in the fore-arc region of southwest Japan; widespread distribution of fluids dehydrated from the Philippine Sea Plate

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Chemical and isotopic studies including analyses of noble gases were conducted on the groundwater in the fore-arc region of southwest Japan (Kii Peninsula and Shikoku Island) where the Philippine Sea Plate is subducting. High $^{3}He/^{4}He$ ratios relative to the atmospheric value (up to 6.7 Ra) were observed throughout the studied area, covering a wider area than documented previously. From the wide distribution of high $^{3}He/^{4}He$ values and the associated ^{20}Ne and Cl^{-} concentrations, Morikawa et al. (2016) infer that aqueous fluids derived from dehydration of the subducting slab are present at depth beneath the entire peninsula. These aqueous fluids may ascend along the major north-dipping boundary faults. The variety of water types documented may be due to water–gas separation and the subsequent incorporation of gaseous species into shallow meteoric groundwater. The observed high $^{3}He/^{4}He$ ratios in the absence of a mantle wedge below the southern part of the Kii Peninsula may reflect the oblique ascent of these fluids along north-dipping boundary faults.
As already reported by Dogan et al. (2006) and Umeda et al (2006), moderately high-$^{3}He/^{4}He$ groundwater has been observed on Shikoku Island, west of the Kii Peninsula, although no sampling point exceeded 4 Ra. By analogy with the Kii Peninsula, incorporation of the ascending fluids along faults accounts for the groundwater of this area, but this moderately high $^{3}He/^{4}He$ ratio (< 4 Ra) is possible to relate the slab configuration. The depth of the slab surface is relatively shallow, and therefore the thickness of the mantle wedge beneath Shikoku Island is less than that below the Kii Peninsula, resulting in a low mantle-He budget around the pathway of the fluids.

References: Dogan et al. (2006) *Chem. Geol.,* **233**, 235-248, Morikawa et al. (2016) *Geochim. Cosmochim. Acta*, **182**, 173-196, Umeda et al. (2006) *Geochem. Geophys. Geosyst.* **7**, Q04009, doi:10.1029/2005GC001210

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