5.3.73

Variation of the slab input and its effects on partial melting along the Kermadec arc

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Along-arc variations in the chemical and isotopic composition of Kermadec-New Zealand arc lavas imply significant changes of the composition of the slab-derived component and the mantle wedge. Volcanic rocks north of about 30°S show the influence of a fluid from altered basaltic oceanic crust, whereas the southern lavas have chemical signatures implying the subduction of sedimentary material. Here we present new geochemical and isotopic data for lavas from the Kermadec-New Zealand arc.

Co-variations among fluid-mobile element ratios indicate that the composition of the fluid derived from the subducting oceanic crust is not homogeneous but varies considerably. Because the element ratios do not correlate with radiogenic isotope ratios, we suggest that the fluid compositions are principally controlled by fractionation processes in the slab or mantle wedge rather than by variations in the composition of the subducting crust. The along-arc variation of the fluid sources is highlighted by the Cl/K ratios which decrease from the northern Kermadec arc to New Zealand, mainly due to an increasing input of K from sedimentary sources. These sediments are derived from the high-grade metamorphic rocks in the Southern Alps of New Zealand, and swept northwards to the Kermadec Trench by strong ocean currents. Element co-variations are most consistent with the sediment-derived component being added to the sub-arc mantle as a fluid rather than a melt. The variable input of slab fluids also affects the partial melting behaviour of the sub-arc mantle, which is more depleted in the north than in the south. However, the southern Kermadec magmas apparently form by lower degrees of partial melting than the northern Kermadec magmas, probably reflecting less water input from the slab.

5.3.P01

Surface appearance of slab-derived helium in non-volcanic area in Kii Peninsula

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A total of 27 well gas samples collected from southwest Japan was subjected to precise analysis of He, Ne and Ar isotopic compositions [1]. The sampling area covers localities where mantle-derived helium emanates in the fore-arc of the Kii Peninsula, and is known as the “Kinki-spot” [e.g., 2]. The Kinki spot apparently is located within the fore-arc with no obvious magmatic activity, which contrasts to the occurrence of similarly high $^3He/^4He$ ratios along the volcanic front of NE Japan. Our high density sampling revealed more clearly that the high $^3He/^4He$ ratio wells are distributed in the Kii Peninsula above the area where the young and hot Philippine Sea Plate is subducting with a relatively steeper dip than in the adjacent area; this situation favors the near-trench side of the subducting slab entering eclogite facies conditions involving slab dehydration, without inducing melting of the mantle wedge. The aqueous fluids derived from the slab acquire mantle-He during their passage through the mantle wedge. Thus, the observed association of mantle-He and the fore-arc dehydration of the Philippine Sea Plate indicates that fluid derived from the subducting slab is contributing to the occurrence of mantle-He in well gases of the Kii Peninsula. The high $^3He/^4He$ region of Kii Peninsula also coincides with the occurrence of long-period tremors. These are caused by the movement of fluids derived from the subducting slab. Localized stresses cause significant uplift in the area, interpreted as indicating that intra-crustal fractures provide pathways through the crust for the fluids derived from depth. Thus, magma is not necessarily required as the carrier of mantle-derived helium to the surface of the fore-arc region of Kii Peninsula.

References

[1] Matsumoto et al., (2003) *EPSL* **216**, 221-230.
[2] Sano and Wakita (1985) *JGR* **90**, 8728-8741.