The Os isotopic composition of the western Aleutian adakites

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The Re-Os isotopic system possesses great potential as a crustal recycling tracer. This is because Re is incompatible during mantle melting, while Os is compatible, resulting in significantly higher Re/Os and time integrated Os isotopic signatures in the crust than in the mantle. However, its application to track recycled crust in the source of oceanic basalts has been hampered by the lack of understanding of Re and Os behavior at subduction zones. In particular, whether Re and Os are mobilised during eclogite melting, a process inferred to be significant during the early Earth, remains unconstrained. To answer this question, we measured Os, Re and $^{187}Os/^{188}Os$ in primitive submarine lavas (Mg# > 0.6) from the western Aleutian arc comprising strongly adakitic rocks derived from eclogite melting (high-Mg# andesites, dacites and rhyodacites), as well as non adakitic high-Mg# andesites, basaltic andesites and basalts for comparison.

The $^{187}Os/^{188}Os$ of the samples investigated ranges from 0.141 to 0.8676 and correlates negatively with Os concentrations, suggesting that crustal assimilation or addition of Os via authigenesis is responsible for the most radiogenic compositions. The most primitive adakitic rocks have $^{187}Os/^{188}Os$ ranging betwen 0.144-0.148, similar to the $^{187}Os/^{188}Os$ of the most primitive non-adakitic lavas (0.141-0.151). This is significantly lower than the $^{187}Os/^{188}Os$ expected for a melt dominantly derived from the local ~50-60Ma subducting oceanic crust ($^{187}Os/^{188}Os$ ~0.5). Hence, the Os isotopic signatures of the western Aleutian samples indicate that limited Os has been mobilized during eclogite melting. Instead, the Os budget of the adakitic rocks most likely derives from limited melt-peridotite reaction on the way to the surface, consistent with their low Os abundances. On the other hand, the most adakitic lavas show high Re contents (up to 1.5 ppb) consistent with the mobilization of Re in eclogite melts. These findings have important implications for the Re/Os of residual slab recycled during the Archaean.