Transport in active margins: Comparison of results from I^{129} and Be^{10} studies

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Active margins are the location of large-scale movement of elements and compounds between crust and mantle, including the potential for transport of marine sediments into subduction zones with subsequent release of elements from volcanoes. Two cosmogenic isotope systems have been applied for the investigation of this question: ^{10}Be (e.g. Morris *et al*, 2002) and ^{129}I (e.g. Fehn, 2012). Although both of these isotopes have similar production modes, they differ considerably in half-lives (1.5 Ma for ^{10}Be; 15.7 Ma for ^{129}I) and geochemical characteristics. Because Be is readily incorporated into mineral phases, ^{10}Be concentrations were determined in solid samples. Results demonstrate that in many cases marine sediments have been carried to the mobilization zone under the main arc, but that less than half of Be is transported back to the surface.

Because iodine is predominantly found in aquatic fluids, investigations were carried out on samples collected from crater lakes, fumaroles and geothermal sites at active volcanic centers. $^{129}I/I$ ratios in the fluids decrease with increasing slab age, an observation consistent with transport of iodine within marine sediments to the location of re-mobilization under the main volcanic arcs. Sediment-derived iodine was found in all study sites around the Pacific Rim, including some where ^{10}Be was absent. The observed $^{129}I/I$ ratios reflect values integrated over the full thickness of the marine sediments transported into the subduction trenches, suggesting that iodine is quantitatively released into the volcanic fluids.

Results from ^{10}Be and ^{129}I studies demonstrate transport of marine sediments into subduction zones and the subsequent integration into or release from active volcanoes. Elements such as Be are predominantly taken up by rock forming minerals and only a fraction of it reappears in surface deposits. The presence of iodine derived from marine sediments demonstrates that volatile elements are also transported to the mobilization zone, but that most of those elements are released back to the surface, preventing transport into the mantle.

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Tellurium stable isotope variations in chondrites

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Different carbonaceous chondrite groups exhibit distinct stable isotope signatures for several elements including Cr, Cu and Zn reflecting mixing of two isotopically distinct reservoirs in the early solar nebula [1-2]. Furthermore, moderately and highly volatile elements such as Ag, Zn and Cd display relatively large stable isotope variations in unequilibrated ordinary chondrites that are indicative of evaporation/condensation processes due to parent body metamorphism [2-4]. Similar variations are expected also for other moderately and highly volatile elements as e.g. tellurium (Te). Previous studies revealed that Te was homogeneously distributed and well mixed in the early solar system resulting in no resolvable nucleosynthetic or radiogenic Te isotope variations in bulk meteorites [5,6]. The methods used in these studies were not specifically developed or optimized to yield precise and accurate Te stable isotope data, although the data hint at the presence of Te stable isotope variations in unequilibrated ordinary chondrites [6].

Improved methods to derive high precision and accurate Te stable isotope data were developed in this study. Tellurium isotope data are measured using a Neptune MC-ICPMS, whereas mass bias is corrected using a double spike technique. The reproducibility (2SD) of standards consuming 10 ng Te is 0.02 ‰/amu or better, whereas 2 separately processed powders of Allende reproduce to 0.03 ‰/amu. This is an improvement in precision of over 20 times compared to previous analyses that employed standard sample bracketing [6]. Initial data reveals resolvable Te stable isotope variations between different chondrite samples and an overall variability of about 1 ‰/amu. This study will obtain high precision Te stable isotope data for a comprehensive suite of ordinary, carbonaceous and enstatite chondrites.

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