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Stromboli magma genesis: Boron isotopes confirm a subducted sediment component

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Magmatism at Stromboli (Aeolian islands) and the surrounding region has been attributed to many different processes and sources (subduction, mantle plume and different types of mantle). To evaluate the possible subduction component, pumice glass and glass inclusions in pyroxene were analyzed for boron (B) isotopes by secondary ion mass spectrometry (SIMS) at the nordsim laboratory. B is a highly mobile element in aqueous fluids, with higher concentrations in altered oceanic crust (AOC) and subducted sediments (1 to 220 ppm) relative to the upper mantle ($\sim$ 0.1 ppm). Consequently, B is an excellent tracer of fluid flux from the subducted slab and subducted sediments. B isotope ratios (expressed in δ^{11}B notation) are also different in AOC, subducted sediments, and arc volcanic rocks, which makes it possible to distinguish between these contributors.

The most prominent observation from the Stromboli data is uniformly light δ^{11}B values (-7.5‰) and high (61$\pm$2 ppm to 84$\pm$5 ppm) B concentrations which are uncorrelated with δ^{11}B. It is apparent that a source with light δ^{11}B was involved in magma genesis at Stromboli. It is also clear that this source either had a heterogeneous B concentration or that an additional source with similarly light δ^{11}B but different B content was involved in Stromboli magma genesis.

Two component δ^{11}B and ^{206}Pb/^{204}Pb mixing calculations were performed using three end members: mantle (0.06 ppm B, -4‰ δ^{11}B, 0.6 ppm Pb, 18.3 ^{206}Pb/^{204}Pb); composite fluid from AOC plus subducted sediment (64 ppm B, ca –7.5‰ δ^{11}B, 186 ppm Pb, ca 19.2 ^{206}Pb/^{204}Pb); and partial melt of sediment (5 ppm B, -

8.5‰, δ^{11}B, 20 ppm Pb, 19.2 ^{206}Pb/^{204}Pb). The model is not sensitive to changing the mantle from a MORB to a more OIB-like source. The modeling suggests that Stromboli magmas can contain up to 3% of a 'subduction' component. This subduction component is most likely a composite fluid derived from AOC and subducted sediment and partial melt of sediment, with the total sediment contribution between 45-80%.