Global halogen flux of subducting oceanic crust

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The behavior of halogens within subduction zones is not well constrained, despite the significant role they are expected to play in modulating fluid properties and element transport. In order to investigate the degree to which halogens undergo devolatilization from subducting altered oceanic crust (AOC) and are recycled to the deep mantle, this study compares bulk halogen concentrations (F, Cl, Br, I) from modern AOC drill cores and exhumed high-pressure metamorphic rocks from three paleo-subduction settings. Metamorphic samples include eclogites from the Raspas Complex in Ecuador, the Zambezi Belt in Zambia, and Cabo Ortegal in Spain. Following preparation via pyrohydrolysis, bulk F and Cl concentrations are measured by ion chromatography (IC). Bulk Br and I are measured using ICP-MS.

Preliminary data show initial decoupling of F and Cl after hydrothermal alteration in oceanic crust, with F and Cl being predominantly hosted in the upper and lower crust, respectively. During prograde metamorphism of AOC, F is fluid-immobile and is decoupled from the heavy halogens. HP samples retain F in concentrations (80-130 μg/g) similar to seafloor values (60-190 μg/g). Cl and Br are strongly coupled, a trend consistent with previous work. The covariance between Cl and Br suggests that these elements likely share mineral host phases and are therefore susceptible to the similar fluid transport processes. Cl and Br are effectively mobilized during prograde metamorphism, with HP samples containing between 5-40% Cl and 40-50% Br relative to the average contents of modern AOC. Eclogites from the Zambezi Belt present an exception to this trend due to Br and Cl-enrichment by HP fluid infiltration. I displays behavior dissimilar to the other halogens. Between seafloor samples and eclogites, I concentrations decrease by a factor of ~2, demonstrating moderate retention of I within subducting AOC.