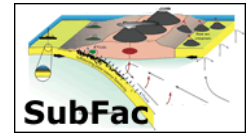


Izu-Bonin-Mariana across-arc variations in chlorine stable isotopes show fluid source depth profile within the subduction zone



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$\delta^{37}\text{Cl}$ values were determined for volcanic gases, geothermal well waters, and ash and lavas samples along the Izu-Bonin-Mariana volcanic arc. In addition, serpentine seamounts (Conical, South Chamorro, Torishima), sediments (ODP Sites 800, 801, 802, and 1149), and basalt samples from the Guguan cross-chain were analyzed for $\delta^{37}\text{Cl}$ values. There is no variation in $\delta^{37}\text{Cl}$ values along the length of the arc in either gas or ash samples. In contrast, there are distinct variations across the arc, from the forearc seamounts, volcanic front gases and ashes, and the cross-chain, implying variations in the fluid source at different depths within the subduction zone. $\delta^{37}\text{Cl}$ values for structurally bound chloride (SBC) of serpentinite clasts and serpentinite clays from the Conical, South Chamorro, and Torishima seamounts are slightly positive (average = $+0.4 \pm 0.4\text{‰}$; $n = 24$), identical values to seafloor serpentinites, suggesting a serpentinite (chrysotile/lizardite to antigorite transition) source. Volcanic gases and ashes are negative, consistent with a sediment-breakdown source. Subducting sediments have primarily isotopically negative SBC $\delta^{37}\text{Cl}$ values, ranging from $+0.3$ to -2.5‰ ($n = 13$). Basalts from the Guguan cross-chain range from 0.0 to $+0.5\text{‰}$ ($n = 3$), again indicating a serpentinite source, likely fluids derived from antigorite breakdown at ~ 200 km depth. We show that Cl-isotopes are a sensitive tracer of serpentinite fluid source, complementary to other geochemical tracers that allow us to further constrain the inputs and outputs at the subduction factory.

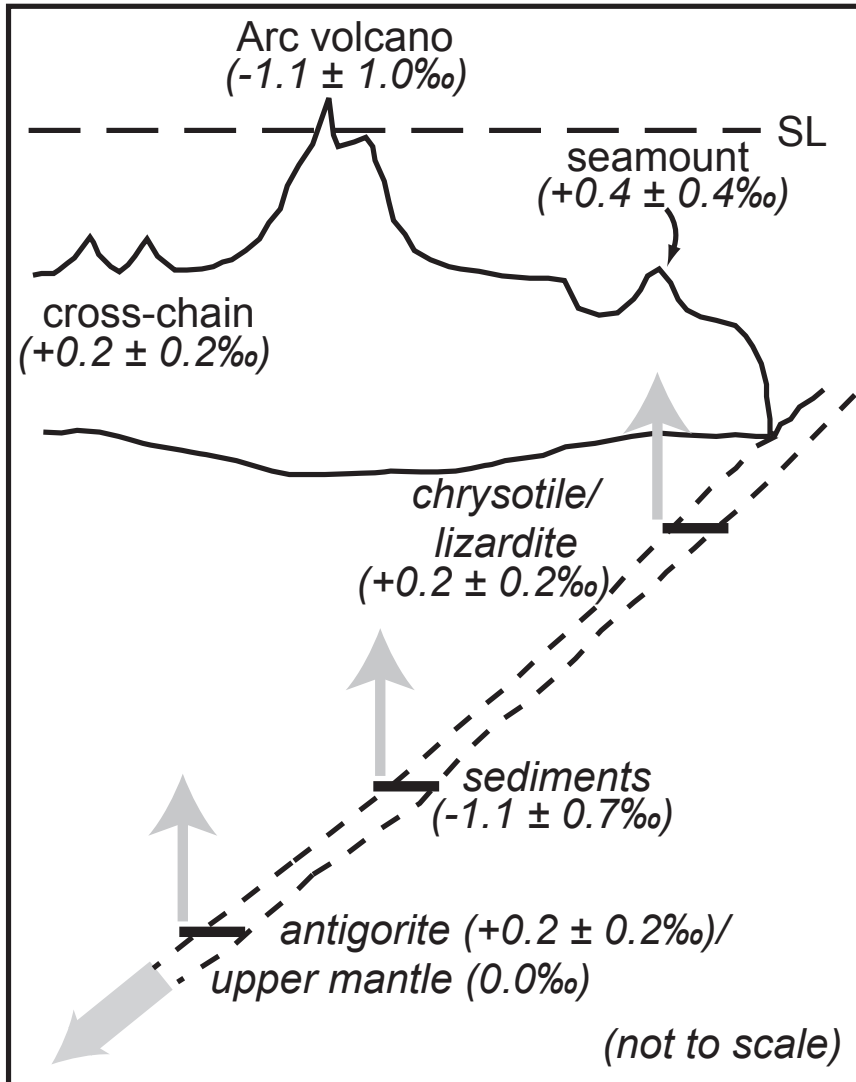


Figure: Schematic diagram showing the fluid sources in the subducting slab to outputs across the arc. Thin gray arrows represent rise of fluids. SL = sea level. We show that breakdown of serpentinite phases at different depths results in distinct Cl-isotope composition in the fore-arc and the volcanoes behind the volcanic front. The release of negative $\delta^{37}\text{Cl}$ below the volcanic front, in contrast, is from the breakdown of subducted sediments.