Trace element, volatile element, boron isotope, and XANES analyses of olivine-hosted melt inclusions from Chile and Argentina indicate a mantle wedge hydrated and oxidized primarily by hydrous melts of subducting sediment and oceanic crust

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It is well established that during plate subduction there is a significant transfer of material from the slab to the overlying mantle wedge, much of which is recycled back into continents or islands via arc magmatism. The mechanisms that determine what is recycled back to the surface versus transferred into the deep mantle have important implications for models of the evolution of the earth. The Southern Volcanic Zone (SVZ) of Chile is an excellent natural laboratory in which to develop constraints of the subduction system because the volcanics of the SVZ are often primitive, and because volcanics erupt not only along the arc front, but also far behind the arc within fields of monogenetic cones.

We have measured olivine-hosted melt inclusions from fast-quenched arc-front and rear-arc scoria samples for trace elements, volatile elements, boron isotopes, and $Fe^{3+}/\sum Fe$. Co-variations in trace element ratios and $\delta^{11}B$ (which ranges from -12 to 2 ‰) indicate that a slab component with a fairly uniform composition is variably mixed into the mantle wedge sources of monogenetic cones in both the arc front and rear arc, and this same component constitutes an almost constant proportion of the mantle sources of arc-front stratovolcanoes. A mass balance argument demonstrates that this component cannot be an aqueous fluid, and must instead constitute hydrous melts of both sediments and ocean crust. The rear-arc cones have small slab signatures, yet high water contents, because they are produced by very low degrees of melting. Rear-arc cones have MORB-like $Fe^{3+}/\sum Fe$, which suggests that high water contents are not the cause of oxidized arc magmas. Co-variations in $Fe^{3+}/\sum Fe$ and $\delta^{11}B$ support a model in which a hydrous melt oxidizes the SVZ mantle wedge.