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Neogene retro-arc basaltic magmatism in southern Patagonia: are there alternatives to teared slabs and slab window models?

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The Neogene retro-arc magmatism in southern Patagonia (South America) has been associated to the melting of OIB type asthenospheric mantle, related to the opening of a slab window and/or slab tearing beneath South America as a consequence of the subduction of the Chile ridge. This retro-arc magmatism produced alkaline to subalkaline transitional lavas – magmas with geochemical characterictics intermediate between alkaline and calc-alkaline geochemistry – yet the spatial and temporal evolution of the geochemical signatures are largely unconstrained.

Here we use detailed field investigations and new geochemical data from the retro-arc lavas of the Sierra Baguales and Cerro del Fraile-Tres Lagos area (southern Patagonia), that are located about 100-150 km east of the active volcanic arc, to test potential relationships between the geochemical signature and the dynamics of the south-Patagonian subduction system in the last 20 million years.
New geochemical analysis show that basaltic lavas and mafic rocks from Sierra Baguales are primitive magmas with subalkaline to high-K calc-alkaline signature. Positive Pb and negative Nb anomalies are hallmarks of calc-alkaline magmas, but the enriched incompatible trace element patterns differ from typical arc volcanoes.
In contrast, the similar spatially located basaltic lavas from Cerro del Fraile and Tres Lagos have an alkaline and OIB-like signature, suggesting a mantle source without subduction-related component.

Studies have demonstrated that melting of amphibole-rich metasomatic veins or cumulates located in the lithospheric mantle are a viable mechanism for the origin of intra-plate alkaline volcanism (e.g. Pilet et al. 2008). Likewise melting amphibole-rich lithologies in the sub-arc mantle might produce the trace element signatures of arc-related transitional to alkaline magmas and are directly related to the metasomatic process induced by mobile components that form the amphibole-rich rocks. Amphibole-rich cumulates could also be produced by calc-alkaline arc magma differentiation at depth, and their potential delamination (e.g. Müntener & Ulmer, 2006) on a Ma time-scale. Our goal is to test the various hypothesis to produce transitional magmas, characterized by low Nb high Pb content, and spatially related OIB-like magmas, by linking arc and retro-arc geodynamic and magmatism by cumulate melting with mantle melting. Slab window and/or slab tearing models are not required to explain the chemical characteristics of arc-rear arc associations.