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Formation of the Patagonian Plateau lavas: Insights from dynamical models

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The Patagonian basalt field that erupted between ∼35˚S and 52˚S in South America is one of the largest continental basaltic provinces. The genesis of the northern Patagonian intraplate basalts has been linked to the shallow asthenospheric upwelling due to rollback subduction and variations in slab curvature. In the southern Patagonia, the Chile Ridge (Nazca-Antarctic spreading center) has been subducting at a low angle to the Chile Trench at ∼ 46˚20′ S since the Middle Miocene, forming the Patagonian slab window. It has been suggested that the widespread alkaline back-arc basalts, the seismic anisotropy patterns observed in the Chile Ridge subduction region and the rapid changes in geochemical characteristics of the arc volcanics above the southern edge of the subducting Nazca plate are controlled by mantle circulations associated with the slab window. Recent observations and progress in dynamic models for subduction zones provide new constraints in detailing the mantle flow field in the vicinity of a slab window. However, the combined effects of a dynamic slab, mantle rheology, plate age and variations in slab geometry have not been explored. In addition, without either significant back-arc extension or the presence of mantle plume, the heat source for generation of the voluminous lavas in the northern Patagonia is unclear. Furthermore, the origin of the unusual trace element characteristics of lavas recovered from the Chile Ridge adjacent to the Chile Trench, showing affinities to arc magmas, remains enigmatic. To address these issues, three-dimensional numerical models with a composite (Newtonian and non-Newtonian) rheology for the southern Andean subduction system for region ∼ 25˚-55˚ S and 60˚-100˚ W extending from the surface to 1000 km depth are constructed. Model results and predictions for the recent Patagonian magmatism and patterns of seismic anisotropy are presented.