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Climatic control on the Southern Andean volcanic arc location

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The Southern Andes Volcanic zone (SVZ) is located between latitudes 33-46°S in the western margin of the South American continental plate, above the subducting Nazca oceanic plate. Although the slab dip angle is constant (~25°) along strike, the distance between the volcanic arc and the subduction trench decreases southward. In the northern segment (33-41°S) the volcanoes are co-located with the main orogenic water divide, whereas in the southern segment (41-46°S) the water divide is shifted eastward and the volcanic arc is shifted westward. The eastward water divide migration in the southern segment is explained by an orographic effect due to the westerlies winds, which causes high precipitation (>2 m/yr) and erosion rates (>1.5 mm/yr) on the upwind side of the orogen. Thermomechanical visco-elasto-plastic numerical models exploring the effects of the topographic shift on the magma upwelling path explain the westward migration of the volcanic arc. Results show that when the topographic barrier is shifted to the east with respect to a central magmatic source, asymmetric strain due to the magma emplacement into the crust drives preferential westward magma upwelling. The southern segment of the SVZ is proximal to an important strike slip fault system, the Liquiñe-Ofqui fault zone. We propose that the (re-)activation of these fracture zone on the western side of the Southern Andes is related to the orographic migration of the water divide during magma upwelling. This conclusion is further supported by the lack of structures accommodating magma emplacement/eruption and volcanoes east of the water divide. If correct, this is the first-recognized example of a climatic control on the location of a volcanic arc in convergent settings.