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Controls on the location of arc volcanoes: an Andean study

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Depth corrected data of earthquake hypocentres from South America are used to generate new models of depth to the subducting Nazca slab. This new slab model shows a general correlation between the 100 km depth to the slab, the western edge of the Altiplano-Puna Plateau (defined by the 3500 m elevation contour) and the frontal volcanic arc. Across the entire Altiplano-Puna Plateau, volcanic centres are found to be either at or above the 3500 m critical elevation contour, which also defines the cut off for seismogenic thrusting. Normal faults are only found above this critical elevation contour, suggesting that there may be a change in the stress regime associated with high elevations in the plateau. The Salar de Atacama basin (23-24^{o}S) defines a major break in topography on the west side of the Puna Plateau. Here, the volcanism deviates around the eastern edge of the basin, approximately 80 km inland from the general trend of the arc, remaining above the 3500 m elevation contour. The volcanoes bordering the Salar de Atacama have a depth to slab approximately 30 km deeper than those in the adjacent arc segment 200 km to the north of the basin. Across this distance there is no significant difference in subduction parameters such as the slab dip, subduction rate and age of the oceanic plate entering the trench. It is likely, therefore, that melt forms at the same depth in both locations, as the factors affecting the melt source are constant. However, in the case of the Salar de Atacama region, magma is diverted to the east due to preferential emplacement under the higher elevations of the plateau. We suggest that although mantle and subduction processes have a primary control on the location of arc volcanoes, shaping the general trend of the arc, they cannot explain anomalies from the trend. Such anomalies, such as the arc deviation around the Atacama basin, can be explained by the influence of structures and stress regime within the overriding plate.