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Magmatic processes and chemistry in the Late Cretaceous to Recent Andes

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The geochemical composition, temporal and spatial distribution and volume of late Cretaceous to Recent magmatic rocks all along the Andean margin are controlled by mantle and crustal components whose origins reflect both plate tectonic parameters and the local geology. This magmatism is variable in time and extent with emplacement histories variously linked to the relative rate of trench advance or retreat, convergence angle, slab dip, periods of slab breakoff and to what extent the slab has penetrated the lower mantle. Variations in magma chemistry reflect the nature and percentage of components from the subducting slab, subducted pelagic and terrestrial sediments, forearc crust and mantle lithosphere removed in the subduction process, the mantle wedge and the composition, thickness and stress state of the lithosphere and crust through which the magmas pass. Seismic images allow the subducted Nazca slab to have reached the mantle transition zone at ~6°S at ~70 Ma and after ~35 Ma at ~38°S (e.g., Chen et al., 2019), and to have facilitated compression in the arc and retroarc, and allowed perturbations on the down-going plate to produce shallowing and steepening of the subducting slab. Slab shallowing leads to arc-related magmatism expanding into the retroarc and steepening to arc magmatism retreating towards the arc front as mantle melts generated in the expanding wedge produce retroarc magmatism. If the crust is sufficiently thickened by compression during this period, the crust and mantle lithosphere can delaminate and associated melting can produce giant ignimbrites. Given forearc removal by subduction erosion and crustal delamination under the Puna-Altiplano plateau, Neogene crustal loss in the central Andes may exceed crustal gain by magmatic addition. Throughout, the influence of variable mantle and crustal sources can be traced by major and trace element and isotopic tracers that track magma evolution from the subducting slab to the surface.