Mantle driven Cretaceous flare-up events in Cordilleran arcs

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Studies of continental arcs have patterns of episodic magmatism characterized by flare-ups and lulls. A variety of models have been published to explain these patterns ranging from models that (1) invoke upper plate cyclic crustal processes driven by internal feedback; (2) rely on episodic mantle melting processes, or (3) reflect external lower plate changes. This study addresses the role of mantle magmas during episodic flare-ups in Cretaceous Cordilleran continental arcs.

Geochronological and geochemical data sets were compiled from published papers, online databases, and our new analyses for three Cretaceous arc segments: the western Peninsular Ranges Batholith (wPRB), the Peruvian Coastal Batholith (PCB), and the Chilean Coastal Batholith (CCB). In addition, AFC modeling was used to estimate the permitted amounts of assimilated crustal material.

Bedrock zircon age patterns from all three areas define a flare-up peak from 105 to 90 Ma characterized by gabbro with Sr_i <0.705 (average of 0.704), εNd from 0 to +7.5, $^{208}Pb/^{204}Pb$ from 38.2 to 38.7, and $^{206}Pb/^{204}Pb$ from 18.3 to 18.7. These values are attributed to a depleted mantle source. AFC modeling indicates that most of the gabbros have experienced fractional crystallization combined with variable, but less than 10-30% of crustal assimilation implying that the great majority of these magmas are mantle derived. This suggests that melting of crust is not required for triggering and forming a magmatic flare-up. Associated felsic rocks with similar or slightly more crustal isotopic signatures are consequently the result of large amounts of mantle melts that assimilated some lithospheric sources. Thus our data strongly suggest that the episodic patterns of magmatism in these arcs are driven by episodic mantle magma input.