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Regional tectonics, age and emplacement mechanisms of the end-Cretaceous to Palaeocene arc plutons, Precordillera of Vallenar, northern Chile.

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The Andean margin in northern Chile exposes a pattern of east-younging Triassic, Jurassic, Cretaceous and Palaeocene magmatic arcs. The emplacement of the end-Cretaceous to Palaeocene magmatic arc in the Precordillera of Vallenar occurred during a fundamental switch in deformation style of the upper plate of the Andean margin from extensional /transtensional to contractional deformation. Previous studies, to the north of Vallenar, suggest that the margin was already in contraction by 66-65Ma. This is consistent with plate reconstructions that indicate the onset of collision between the Nazca Plate and the South American plate was initiated between 60 to 70 Ma. In this study, we provide closer constraints for this regional tectonic switch, and the onset of collision between the Nazca Plate and the South American plate by combining precise $^{40}Ar/^{39}Ar$ geochronology with structural field observations. These techniques demonstrate the relationship between the ages for emplacement and cooling and subsequent deformation of the end-Cretaceous to Palaeocene magmatic arc.

The emplacement of the composite, granodiorite to diorite, Las Campanas pluton during upper plate extension was accommodated by a floor-subsidence mechanism and normal-slip reactivation of the east-dipping Agua de los Burros extensional growth fault. This created a syn-plutonic, steep, brittle-ductile shear zone located on the pluton's western side that exhibits a consistent east-down sense of shear. $^{40}Ar/^{39}Ar$ ages

on hornblende (71.2 $\pm$ 0.3 Ma) and biotite (71.0 $\pm$ 0.9 Ma) from the shear zone and a biotite age (70.2 $\pm$ 0.9 Ma) from the pluton interior are the same within error, demonstrating rapid cooling of the pluton.

The emplacement of the composite, monzogranite to dioritie, Chehueque pluton was also accommodated by floor-subsidence mechanisms during upper plate extension, but a switch from regional extension/transtension to contraction prior to cooling can be inferred. The pluton has yielded a biotite age of 66.8 $\pm$ 0.6 Ma and a hornblende age of 67.0 $\pm$ 0.7 Ma. The Chehueque pluton has a brittle-ductile shear zone along its western margin similar to that of Las Campanas. However, this shear-zone is much wider and shows both east-down and east-up sense of shear indicators. We attribute this duality in sense of shear to two phases of deformation during the emplacement and cooling in this part of the magmatic arc. The initial extensional phase is directly linked to floor-subsidence emplacement mechanisms that generated passive down-bending in the host rocks towards the pluton. This was closely followed by deformation linked to the initial stages of regional contraction that superimposed an east-up sense of shear; these kinematic indicators can be matched between the host rocks and pluton. This difference in syn-plutonic deformation style and ages of the Las Campanas and Chehueque plutons therefore constrains the time of the switch from regional extension/transtensional deformation to contractional deformation in northern Chile to c.67 Ma in latest Cretaceous to early Palaeocene time.