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Subduction Geometry and Volcanic Activity in the Andes: Key to Understanding Thick-skinned Foreland Uplifts and Changes in Foreland Basin Sequence Stratigraphy

Low angle subduction of Nazca Plate beneath Peru since 10 Ma is associated with absence of arc volcanism (no hot asthenospheric wedge present beneath the Andes) and with presence of thick-skinned foreland uplifts in the foreland up to 300 km east of the Andes. These uplifts break up Miocene thin-skinned belts, and there is evidence for similar Paleogene thick-skinned activity. Seismicity data indicates that thick-skinned uplifts are driven by basal shear between Nazca Plate and South American lithosphere. Topography and gravity gradients are not important. Simple thermal models show that low angle subduction causes significant cooling and strengthening of Andean lithosphere over ca. 5-10 Ma. This drives abandonment of thin-skinned belts and can lead to erosion being greater than tectonic growth of the orogen. The result is moderate isostatic rebound of the foreland basin, and development incised sequence boundaries in continental sediments (sea-level change is not involved). Resumed arc activity leads to rapid input of heat into the lithosphere, to re-establishment of thin-skinned deformation, renewed subsidence and abandonment of thick-skinned activity. This simple predictive model is used to link the time and space overlap of different structural styles and foreland stratigraphic architecture in the Andes. Where age of volcanism is known, it is used to estimate the ages of foreland stratigraphy (often no direct dating is available), paleostructure and other aspects of the petroleum system.