NEW HYPOTHESES ON THE TECTONIC EVOLUTION OF THE ANDES

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ABSTRACT: The research performed in recent years in the Andes has identified a series of processes that controlled the orogenic cycle in a classical B-subduction-type setting. Many different processes associated with mountain building are heavily controlled by the initial crustal setting.
Two end-members are recognized: (1) Initial thickened crust produced by tectonic stacking through a normal period of subduction, and (2) initial attenuated crust as result of a previous extensional period. The first type is characterized by significant crustal delamination, important flare-up of rhyolitic ignimbrites and acidic flows, generalized extension, and subsequent upper crustal contraction in the order of few hundred kilometers with development of thin-skinned fold and thrust belts. The second end-member is characterized by a wave of contractional deformation in a thick-skinned thrust belt, controlled by the thermal stage of the middle-upper crust and previous weakness zones, followed by generalized extension and the eruption of important basaltic floods of poorly evolved magmas with OIB signature, covering thousands of square kilometers, with minor delamination along the axis of the cordillera. Strikingly, both scenarios are associated with the same process: a steepening of the subduction zone, and a general retreat of the magmatic arc system to the trench. Both processes need a previous period of flat-slab subduction or an important shallowing of the oceanic slab underneath the continental lithosphere.
Three flat-slab subduction zones have been recognized in South America along the Andes in present times, the Bucaramanga, the Peruvian and the Pampean flat-slabs. However, in recent years paleoflat-slab subduction zones have been documented in several segments where shallowing of the subduction and subsequent steepening have occurred. The new studies have demonstrated that there is no segment from Colombia to Patagonia where flat-slab subduction has not being recognized in Cenozoic times. This implies that shallowing of the subduction zone was not an exceptional process, but a frequent setting in a positive trench roll-back subduction. The tectonic analyses through time in the Andes have shown that during negative trench roll-back the retreat of the trench had not favored the formation of flat-slabs. This fact explains why during most of the Mesozoic until Late Cretaceous times no flat subduction has been recognized.
The studies of the Paleozoic tectonic settings have shown that flat subduction is well documented in the Permian, when strong deformation was associated with broken-foreland areas, a typical setting linked to flat-slab subduction. This broken foreland was followed by generalized rhyolitic eruptions with dominant acidic volcanic plateau of wide distribution. Some authors are documenting similar settings in the early Paleozoic during Ordovician times.
As an important conclusion we can advance that during most of the Phanerozoic different orogenic cycles associated with periods of mountain building were linked to shallowing and steepening of the subduction zones.

KEYWORDS: FLAT-SLAB SUBDUCTION, OROGENIC CYCLES.