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The Andean Amazon Basin (Ecuador): evidence for tectonic orogenic growth in the clast supplying Andean cordilleras

W. Winkler (1), R.A. Spikings (2), G.M.H. Ruiz (3), N. Martin-Gombojav (1), A. Egüez (4)

(1) Geological Institute, ETH-Zentrum, 8092 Zürich, Switzerland, (2) Département de Minéralogie, Université de Genève, 13 Rue des Maraîchers, 1205 Genève, Suisse, (3) Faculty of Earth and Life Sciences, Vrije University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands, (4) Instituto Geologico, Escuela Politécnica Nacíonal, Ap. 17-1-2759, Quito, Ecuador

(wilfried.winkler@erdw.ethz.ch, richard.spikings@terre.unige.ch, ruig@geo.vu.nl, nergui.martin-gombojav@erdw.ethz.ch, art_eguez@hotmail.com)

The Andean Amazon Basin, a shallow marine to continental retro-arc foreland basin, east of the developing Andean orogen, has been active since the mid-Cretaceous to Recent. Consequently, the clastic sedimentary record is useful for monitoring the long lasting history of the supplying Andean chain. Detrital grain analyses (heavy minerals), fission track thermochronology of detrital zircons (lagtime), and the thermochronology of cordilleran rocks (multiphase $^{40}Ar/^{39}Ar$ analysis, apatite and zircon fission track analysis, apatite (U-Th)/He analysis) reveal a punctuated tectonic control on the uplift and exhumation related cooling history of the Andean cordilleras in Ecuador.

Zircon-tourmaline-rutile dominated heavy mineral spectra and highly variable (400-0 Ma) lagtimes measured in detrital zircon grains (Ruiz, 2002; Ruiz et al., 2004) suggest that the Amazon Basin was supplied by both the Guyana Shield to the east and a primordial Andean Cordillera Real to the west during the late Early to Late Cretaceous. Sediment input from the Guyana Shield died out during the Maastrichtian and an increasing amount of detrital metamorphic mineral grains in Cenozoic sedimentary rocks documents the continuous exhumation of deep levels of the nascent Andean chain. The exposure of high-grade metamorphic source rocks first occurred during the Eocene and Oligocene, resulting in erosion and reworking of kyanite and sillimanite grains into the Andean Basin. In addition, varying detrital zircon fission track ages (lagtimes) document the reactivation and quiescence of particular faulted blocks of continental crust of different metamorphic grades within the Andean source region.

The input of mafic mineral grains into the Amazon Basin since the Miocene, suggests that the Cordillera Occidental (which hosts an extensive mafic crystalline basement sequence) became a provenance region for the Amazon Basin. It can be inferred that since the latest Miocene - Pliocene, an orographic situation similar to today has existed (e.g. Steinmann et al 1999, and present work).

Thermochronological data derived by the $^{40}Ar/^{39}Ar$ and fission track methods from the metamorphic basement and cover sedimentary rocks of the Andean belt (Steinmann et al., 1999; Spikings et al., 2000, 2001, in press) indicate that the contemporaneous continental margin was being rapidly cooled (e.g. $\geq$20˚C/km) during 85-60 Ma, 43-30 Ma, 15$\pm$1 Ma and 9$\pm$1 Ma. Apatite fission track ages from the igneous basement rocks within the Subandean Zone suggest they were rapidly cooled during the Late Miocene (Ruiz, 2002). Furthermore, apatite (U-Th)/He data, when combined with apatite fission track data from the same samples, record rapid cooling in the northern Cordillera Real and faulted rocks of the Cordillera Occidental at 5.5 – 3.3 Ma (Spikings and Crowhurst, 2004; Winkler et al., in press). These sharply defined periods of cooling have been attributed to exhumation processes, which can be temporally related to, i) periods of terrane accretion with the allochthonous forearc, ii) the impact and subduction of the Carnegie Ridge, and iii) transcurrent reactivation of the ocean-continent suture during the latest Miocene – Pliocene. The high correlation between temporal changes in sediment composition, periods of cooling in the source terranes and large-scale tectonic rearrangements within Ecuador and the subducting oceanic crust suggests that tectonism has been the dominant control on orogenesis and erosion within this part of the Northern Andes. The Ecuadorian sector of the Andean belt has resided at an equatorial position throughout the Cretaceous and Cenozoic and it's uplift, exhumation and orogenic history was not obviously controlled by climatic factors.

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