Kinematic history of the Fuegian Andes as indicated by U-Pb detrital-zircon geochronology and rare earth element geochemistry of the Magallanes foreland basin

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The southernmost (Fuegian) Andes are an important component of the greater Scotia arc, whose tectonic history is widely believed to have fundamental implications for biogeography, ocean circulation, Antarctic glaciation and global climate. We use variations in the geochemistry of Cretaceous & Paleogene strata of the Magallanes foreland basin (Argentina) in order to provide further constraints on the kinematic development of the adjacent Fuegian Andes and the Patagonian orocline.

We report U-Pb ages of detrital zircons collected from Magallanes sandstones and whole-rock REE concentrations and Nd isotope ratios of Magallanes mudstones. Comparison of these results with the geochronologic and geochemical signatures of Patagonian & Fuegian metamorphic complexes, the Patagonian batholith, the Tobífera/Lemaire/Chon Aike large igneous province and the Roca Verdes basin-fill yield insight into the temporal evolution of the Fuegian Andes hinterland.

Whereas variations in REE concentrations (La/Yb: 4-10) and Nd isotope ratios ($\varepsilon Nd(t)$: -6 to +1) of foreland basin strata provide some insight into the relative sediment contributions from batholith, Tobífera, Rocas Verdes and metamorphic complex hinterland units, detrital-zircon geochronology reveals a dramatic change in provenance between the middle Eocene and middle Oligocene. Cretaceous through middle Eocene foreland basin strata have detrital-zircon populations uniformly dominated by 60-120 Ma grains, suggesting dominant derivation from the Patagonian batholith. A middle Oligocene sample, however, lacks batholith-aged zircons and is dominated by 160-190 Ma zircons presumably derived from Tobífera rocks that compose the Cerro Verde thrust sheet of the Fuegian hinterland. These data suggest significant Eocene-Oligocene out-of-sequence deformation in the rear of the Fuegian orogenic wedge.

Application of multi-collector mass spectrometry to Argon geochonology

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ARGUS is a static vacuum gas-source multi-collector mass spectrometer specifically designed for argon isotopic analyses. It is characterized by a low volume analyzer (490cc), a modified high-sensitivity Nier-type source, and isotope multi-collection using five electronically inter-calibrated Faraday collectors equipped with high-gain amplifiers.

Inter-comparison of co-irradiated mineral age standards has been performed and ages calculated relative to Taylor Creek Rhyolite sanidine (28.34 Ma; Renne *et al*. 1998). Argon was released in a two-step heating schedule using a CO_2 laser; a low-power degassing step was followed by a high-power fusion step (used for all age determinations). Multiple determinations of Alder Creek sanidine yield an average age of 1.193 ± 0.005 Ma (n=57) that overlaps the accepted age of 1.193 ± 0.001 Ma (Nomade *et al*. 2005). Heidelberg biotite yields an age of 25.0 ± 0.3 Ma (n=3) that is indistinguishable from the accepted age of 24.7 ± 0.3 Ma (Fuhrmann *et al*., 1987). Analysis of sanidine from the Limberg Tuff yields an age of 17.2 ± 0.2 Ma (n=3) that is slightly older than the 16.3 ± 0.4 Ma (n=6) age reported by Kraml *et al*. (2006). The best explanation is that excess ^{40}Ar yields anomalously older ages. Further high-resolution step-heating experiments will test this hypothesis.

The Earthtime initiative is aimed at integration of high-precision geochronology with quantitative chronostratigraphy. Mineral standard ages determined with ARGUS demonstrate that the multi-collector mass spectrometry is extremely valuable for intercalibration with other decay systems and techniques.