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Quantifying the influence of climate on denudation rates along the Chilean Coastal Cordillera between 20 and 40°S

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This study addresses the influence of climate and tectonics on denudation rates in the region between Pacific and the western flank of the Andes in Chile, covering latitudes between 20° and 40° S . Spatially and temporally uniform large-scale plate tectonic forces characterize the study area. Contrary to this large-scale uniformity, there is a marked contrast with the large climatic gradient and topography. Climate ranges from hyper-arid in the North to humid temperate climate in the South. Whilst, the Coastal Cordillera that is so prominent in the hyper-arid North essentially disappears in the humid South and the average elevation decreases from 1000 to 200 m. Because of feedback between denudation and tectonic uplift topography is, however, only a first order qualitative measure. To investigate possible feedback, and to quantify regional denudation rates and their temporal evolution,(U-Th)/He and fission-track low-temperature thermochronology in apatite and exposure age dating (21Ne and 10Be in quartzes) are applied. Iso-elevation and vertical sample profiles along strike of the Coastal and Central Andean Cordillera for low-temperature thermochronology provide quantitative constrains of the denudation of the uppermost 1-4 km. Furthermore, exposure age dating of rivercut surfaces and fluvial sediments from drainage systems -cross-cutting the Andes- provide recent uplift rates and long-term denudation rates.

Preliminary results of this study provide two new and crucial pieces of information to our understanding on the evolution of the Coastal Cordillera. Firstly, onset of uplift in northern Chile took place at ˜44 Ma, followed by a short period of significant erosion.

During this period a landscape of subdued relief was formed. Arid conditions were established soon after in Early Oligocene times. Very low erosion rates of less than 0.5m/My have persisted since (Dunai et al., in press). These findings are compatible with the hypothesis that the onset of aridity in northern Chile could be the reason, rather than the consequence, of uplift of the high Andes during the Miocene (Lamb & Davis, 2003). Climate-controlled sediment starvation is thought to cause high shear stress, focusing the plate boundary stresses that support the high Andes. The second important evidence relates to denudation rates obtained for each of the climatic zones in Chile. They show a regional trend with the highest denudation rates found in the semi-arid areas, with up to 200m/My. Recurrent changes in vegetation cover in these transitional zones -related to global climate change- could explain greater rates of erosion. In contrast in humid areas, despite higher rates of precipitation, continuous vegetation cover seems to slow down erosion at geological time scales. In the humid southern Chile average erosion rates are found to be about 100m/Ma.

References

Dunai, T. J., González-Lopéz, G. and Juez-Larré, J. (in press), Oligocene/Miocene age of aridity in the Atacama desert revealed by exposure dating of erosion sensitive landforms. Geology.

Lamb, S. and Davis, P. (2003). Cenozoic climate change as a possible cause for the rise of the Andes. Nature 425, 792.