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Tel.: +49 (0)331-977-5789, Fax: +49 (0)331-977-5700
E-Mail: infos@geo-union.de

Editorial office
Schriftleitung

Dr. Christof Ellger

GeoUnion Alfred-Wegener-Stiftung
c/o Universität Potsdam, Institut für Erd- und Umweltwissenschaften
Karl-Liebknecht-Str. 24-25, Haus 27, 14476 Potsdam, Germany
Tel.: +49 (0)331-977-5789, Fax: +49 (0)331-977-5700
E-Mail: christof.ellger@geo-union.de

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Editors

Ulrich Riller & Paul Göllner
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Tectonic and climatic coupled processes in North Patagonian Andes: Miocene orographic barrier uplift and rain shadow generation

J. Bucher[1], A. Bilmes[2], L. D'Elia[1], M. López[1], M. García[1], A. Varela[1], J. R. Franzese[1]

[1]CONICET-UNLP, Centro de Investigaciones Geológicas, La Plata, Argentina
[2]CENPAT-CONICET, IPGP, Puerto Madryn, Argentina

The relationships between climate and tectonic processes are in the geoscience spotlight during last years. The uplifting of a mountain range may constitute a topographic barrier to atmospheric circulation, thus producing the generation of an orographic rain shadow capable of driving important climatic and ecological changes. The link between tectonic and climatic processes has been analysed in several regions of the world. As for the Andean chain, a main phase of orogenic growth occurred during the Miocene, configuring several Andean segments. Some of them were widely analysed, and tectonically controlled climate changes were established. Several works indicate that, in late Miocene times, the orographic uplift of the Central Andes triggered meaningful climatic changes, from wet to dryer conditions. The Southern Andes remain less understood in terms of tectono-climate interactions, and only a few semi-quantitative approaches were addressed for the past 20 Ma. In this work, we analyzed a continuous palaeosols succession recorded in a North Patagonian Miocene foreland basin in order to understand the moisture regime changes in response to the uplifting of the Patagonian Andes. Based on macromorphological, micromorphological and geochemical analysis, supported with a time scheme, the palaeosols were characterized with their corresponding Mean Annual Paleoprecipitation (MAP) and Mean Annual Temperature (MAT) values. Alfisol-like palaeosols were identified at the base of the foreland infill (15-14.6 Ma) with MAP of 1229 ± 108 mm/yr. Andisol-like palaeosols were recognized in the middle section of the sequence (14.6-12.75 Ma) with MAP of 1056 ± 108 mm/yr, whereas Aridisol-like palaeosols localized at the top of the infill (12.75-11.5 Ma) presented MAP of 677 ± 108 mm/yr. Mean Annual Temperatures has not meaningfully changed since the Miocene (~11 ± 2.1°C) to the present (11°C). These data indicate a continuous decrease in MAP (>600 mm/yr) and stable MAT between 15-11.5 Ma for the North Patagonian extra Andean region. The decrease in the rainfalls may be related to the uplift of the Patagonian Andes and the rain shadow generation. The results indicate that although the Patagonian Andes started the uplift around 19 Ma, a time-delay of ~4 Myr with the rain shadow generation occurred, and the rain shadow effects were effectively recorded since ⍰14.6 Ma. Therefore, between 19-14.6 Ma, the North Patagonian Andes were not high enough to generate a rain shadow effect.

New insights about South American hydroclimate changes during Heinrich Stadials

M. C. Campos[1], C. Chiessi[1], M. Prange[2], S. Mulitza[2], H. Kuhnert[2], A. Paul[2], I. M. Venancio[3], A. L. S. Albuquerque[4], F. W. Cruz[1], A. Bahr[5]

[1]University of São Paulo, São Paulo, Brazil
[2]University of Bremen, Bremen, Germany
[3]Center for Weather Forecasting and Climate Studies (CPTEC), National Institute for Space Research (INPE), Cachoeira Paulista, Brazil
[4]Fluminense Federal University, Niterói, Brazil
[5]Heidelberg University, Heidelberg, Germany

Heinrich Stadials (HS) are cold Northern Hemisphere abrupt millennial-scale events frequently related to decreases in the strength of the Atlantic meridional overturning circulation (AMOC). Model simulations and paleoclimate records indicate that the reduction in oceanic heat transport to the Northern Hemisphere during periods of weak AMOC cools down the North Atlantic and warms up the South Atlantic. This perturbation in the cross-equatorial heat transport would in turn affect tropical rainfall. Indeed, South American hydroclimate records indicate marked precipitation anomalies during HS of the last glacial period. However, the scarcity of high-resolution marine records off South America, especially between 7 and 20°S, hampers a mechanistic understanding of tropical South American hydroclimate responses to HS. Here we investigate piston core M125-95-3 collected at 10.95°S from a site influenced by the terrigenous discharge of the São Francisco River, eastern South America, for the last ca. 70,000 years. In order to reconstruct changes in precipitation over the São Francisco River drainage basin we determined the major elemental composition along the piston core. To gain mechanistic insights into tropical South American hydroclimate changes we analyzed a HS-simulation with a high-resolution version of the atmosphere-ocean general circulation model CCSM3. Our new elemental record shows marked increases in São Francisco River sediment discharge to the eastern South Atlantic during HS. It is the southernmost marine paleoclimate record off eastern South America that unequivocally records the HS of the last glacial period. Additionally, our high-resolution model output allows new insights into the drivers of changes in South American hydroclimate during HS.

Multi-physics inversion of gravity and magnetic data in Los Humeros Super Hot Geothermal System, México

J. Carrillo Lopez[1], M. A. Perez-Flores[1], E. Schill[1]

[1]CICESE, Applied Geophysics, Ensenada, Mexico

Over the last decades, the worldwide increasing demand for clean energies has become the geothermal energy an important alternative resource. The GEMex project is a