Geophysical Research Abstracts
Vol. 21, EGU2019-10972, 2019
EGU General Assembly 2019

Cenozoic paleoclimate evolution in the Coastal Cordillera of Northern Chile (20º00'-21º30'S)

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The distribution and characteristics of the Cenozoic alluvial and fluvio-alluvial deposits in the Coastal Cordillera and the Coastal Plain in northern Chile reflect the paleo-climatic conditions in this area. Here, pre-Upper Oligocene fluvio-alluvial rocks (Cañón del Loa Beds, CLB) have been recognized in the canyon walls of the Loa River and adjacent pampa, Oligocene-Pliocene alluvial deposits (Alto Hospicio Gravels, AHG) are broadly distributed in the Coastal Cordillera, and more restricted Pleistocene-Holocene alluvial deposits (PHAD) crop out in the Coastal Cordillera and Coastal Plain. The components of the Cenozoic alluvial units are derived from erosion of the basement units that crop out in the Coastal Cordillera.

The CLB have an exposed surface area of ca. 24.2 km2 in the studied area, and are localized near the canyon of the Loa River, where they unconformably cover the Paleozoic-Mesozoic basement. This unit has a maximum thickness of 300 m and consists of conglomerates with rounded to well-rounded clasts and minor intercalated sandstones. This unit was deposited syntectonically in hemigrabens limited by NNW-SSE to NNE-SSW striking normal faults linked to the Atacama Fault System. In the top of this unit, there is a gypsic soil, indicating an important hiatus in sedimentation.

The AHG have a broad distribution and cover ca. 3412 km2 of surface in the studied area. This unit consists of a sequence of gravels with minor volcanic ashes and evaporitic layers. Radiometric ages (K-Ar and 40Ar/39Ar) vary between 24.7 and 2.7 Ma. These deposits have a maximum thickness of 200 m, and accumulated in N-S oriented structural basins.

The PHAD have an area of 209 km2 in the Coastal Cordillera and 37 km2 in the Coastal Plain. They consist of unconsolidated angular sand and gravels, with local intercalations of volcanic ash. This unit has few centimeters to 1 m thick. It is highlighted that in the Coastal Plain these deposits are confined to the southern part of the studied area, suggesting a latitudinal climatic segmentation.

In general terms, the lithological characteristics and distribution of the CLB suggest that they were deposited under semi-arid paleoclimatic conditions. This setting could be a result of a local climatic condition or to a latitudinal climatic segmentation. The AHG have characteristics that indicate an intensification of arid conditions, and their broad distribution shows that the paleoclimatic condition affected an extensive swath of the Coastal Cordillera of northern Chile. The PHAD have a smaller areal distribution and relative thickness that suggest deposition during hyperarid climatic conditions. In summary, the alluvial record of the Coastal Cordillera shows a gradual increase in aridity in the climatic conditions through time.

It is important to emphasize that the alluvial deposits of the Coastal Cordillera are a more accurate register of its local climatic conditions, whereas the extensive alluvial deposits in the Pampa del Tamarugal and the western Precordillera are a product of the prevailing climatic conditions that characterize the Altiplano situated far away from the Coastal Cordillera.

This work is part of the National Mapping Program of the SERNAGEOMIN (Chile).