Geophysical Research Abstracts
Vol. 21, EGU2019-11393, 2019
EGU General Assembly 2019

Stratigraphic discontinuities in the Cenozoic gravel deposits of the Atacama Desert: paleoclimatic-environmental and temporal significance

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Deserts are ideal geological scenarios to understand the climatic influence in the sedimentary processes. Arid environments are extremely sensitive to climate changes, which can be preserved through the geological record. The Atacama Desert in northern Chile, has erosion and rainfall rates extremely lows, allowing the preservation of surfaces and sedimentary deposits that records the onset of the hyper-arid conditions towards the upper-Miocene. The sedimentation from the Miocene to recent times in the Atacama Desert had been controlled by episodes of torrential and ephemeral rains, whose frequency decrease when aridity intensifies. Prolonged periods of hyper-aridity favor the development of stable surfaces that remain fossilized as stratigraphic hiatuses. These hiatus could reflect relatively long periods of time. Stages of minor aridity are characterized by a major accumulation of discrete torrential deposits separated by unconformities which corresponds to relatively short periods of time. Thus, can changes in the sedimentation frequency of torrential deposits be evidenced throughout the sedimentary record? Is the onset of hyper-arid conditions reflected in a decrease in the frequency of these deposits? To tackle these questions, we consider the Atacama Gravels deposits localized in the Rio Salado canyon, at the El Salvador region, as the study area. There, the gravel deposits fill a paleo-valley which is subsequently incised exposing the whole stratigraphy. At the top of these deposits, different pediments surfaces are developed. The gravel deposits comprise three sequences limited by stratigraphic discontinuity which likely represents hiatuses. The clasts count and the analysis of the fine-sediments in the matrix allows to reconstruct the provenance of the sediments, revealing that each sequence is dominated by different source areas. At the base of the younger sequence, an ash level of ca. 15 Ma is interbedded, whereas another of ca. 10 Ma is present towards the upper part of the same sequence. The sequences are slightly thinning and finning-upwards, and they are in onlap relation with each other, revealing a back-stepping of the system. The sedimentary facies through the entire deposits vary from fluvial channelized with phreatic calcretes at the base, to alluvial facies with sheet-flows/debris-flows deposits and a gypsisol level at the top, which reveals an aridification in the environment. Through the use of exposure ages in pediment surfaces using 21Ne and 10 Be, and by 21Ne in depth-profiles in the boundaries of the sequences, we propose to obtain the time-gap present in these discontinuities. Considering the available data-age in the basin, we expected to obtain ages in the pediment surfaces around 9 Ma, and time-gap of the hiatuses in the order of ma. We hope to determine the filling times of the basin, which is an example of an Andean forearc Cenozoic basin in an arid climate, and the paleoclimatic and environmental importance in terms of its geomorphological evolution.