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Late Quaternary alluvial fan evolution along the coast of the hyper-arid Atacama Desert - the interplay between climatic and tectonic control

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Due to their sensitivity to both tectonic activity and climatic variations, coastal alluvial fans (CAF) along the western flank of the Coastal Cordillera in the Atacama Desert (northern Chile) are important geo-archives for unravelling Quaternary environmental change. Nevertheless, only limited chronological information is available for these deposits, which is important to understand the CAF evolution along a N-S gradient.
To fill this gap, the present study aims to establish a chronostratigraphic framework for CAF located between ∼20° and ∼25°S by using a combination of post-infrared infrared (pIRIR) stimulated luminescence dating of K-feldspar and electron spin resonance (ESR) dating of quartz. Samples were taken from alluvial fan deposits, as well as from marine and aeolian sediments embedded in the CAF.
First numerical ages derived from ESR and pIRIR methods are mostly in agreement at 1σ and are overall stratigraphically consistent along the sedimentary sequences. Age differences between the two methods have been observed in some alluvial fan deposits, which might be explained by the different bleaching kinetics of both pIRIR and ESR signals during short-term sheet- or debris-flow transport. An independent age control will be provided in the near future by cosmogenic nuclide exposure dating (10Be) of a wave-cut platform which is directly linked to the marine deposits below the CAF.
First numerical dating of marine deposits yields burial ages of MIS 5e (∼125 ka) as well as MIS 5c (∼100 ka)/5a (∼80 ka). These results give insights into the tectonic activity of the area during the Late Quaternary period, for which estimated uplift rates of ∼0.3 m/ka have been derived. Aeolian sand interbeds in the CAF date to ∼30 and ∼45 ka, giving insights into the palaeoclimate and wind pattern in the study area during the Late Pleistocene. Short-term precipitation events led to high-energy debris flows at the western flank of the Coastal Cordillera, at least between ∼30 and ∼60 ka as well as around 15 ka. These first chronological information from the CAF indicate a heterogeneous climate evolution at the Pacific side of the Atacama Desert.