Tracing pluvial periods in an ancient desert environment

T.J. DUNAI

School of GeoSciences, University of Edinburgh, Drummond Street, Edinburgh EH8 9XP, Scotland;
tibor.dunai@ed.ac.uk

Depositional surfaces of early Miocene sediments are preserved in the Coastal Cordillera, Atacama Desert, northern Chile [1]. Measurement of cosmogenic ^{21}Ne in clasts from erosion-sensitive sediment surfaces show that these surfaces have been barely affected by erosion since 25 Ma. Predominantly hyperarid conditions since 25 Ma are required to create and preserve these oldest continuously exposed surfaces on Earth [1].

Subsequent to depostion these sediment surfaces have been slightly altered by erosion and deposion. During a resampling campain, aimed at constraining the timing of erosion and deposition, eighty quartz pebbles were collected at the inlet of the first in a series of salt carst depressions at the bottom of a wide 'valley' on the sediment surface [1]. The ^{21}Ne ages of these clasts show distinct clusters at 3.5-4 Ma, 8-10 Ma, 13-15 Ma, 17-18 Ma, ~24 Ma, 33-35 Ma.

The ages that are younger than the deposition age give the timing of pluvial phases, in which the runoff was strong enough to incise hardrock channels into the surrounding hill slopes, and deposit material onto the sediment surface that had little to no pre-exposure to cosmic rays. Ages concordant to the deposition age probably represent laterally dislocated material of the original sediment surface. Ages greater than the deposition age indicate that portions of the local source region of the clasts were very slowly eroding/stable prior to the pluvial episode that eroded and transported them onto the sediment surface.

The inferred pluvial phases are age-concordant with episodes of supergene enrichment in porphyry copper deposits of the Pre-Cordillera and the Andes to the east of the study area [2]. The timing of all inferred pluvial phases is age-concordant with periods global and/or regional climate change (global cooling, regional wet-phases; [3,4].

References

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