The conditions for recording climate cycles using detrital TCNs: modeling and new data from the Platte River (USA)

Vincent Regard*†[1], Sébastien Carretier‡[1], Shlomy Vainer[2], Paul Hanson[3], and Sandrine Choy[1]

[1]Géosciences Environnement Toulouse – Institut de Recherche pour le Développement, Institut National des Sciences de l'Univers, Centre National d'Études Spatiales [Toulouse], Centre National de la Recherche Scientifique, Université de Toulouse – France

[2]Ben-Gurion University of the Negev – Israel

[3]University of Nebraska [Lincoln] – United States

Abstract

Terrestrial cosmogenic nuclides (TCNs) are widely used to estimate millennial-scale denudation rates at the catchment level (Brown et al., 1995; von Blanckenburg, 2005; Codilean et al., 2018). Their integration time-linked to the attenuation depth-ranges from a few thousand to tens of thousands of years, shorter than major climate cycles (100–400 ka). This suggests that sampling sediments over a full climate cycle could record climatic variations and their denudation impacts (Schaller and Ehlers, 2006; Mariotti et al., 2021), though long transport times may limit this approach (Large, 2025; Deiss et al., 2025).
This study investigates climate signal propagation through time and space using two approaches: numerical modeling and new data from the Platte River (Nebraska, USA). We simulate catchments of varying sizes and erosion rates with CIDRE (Carretier et al., 2023), including TCN concentrations in individual grains. Results show partial signal loss, but preservation is possible at high denudation rates.

Fieldwork involved analyzing Be-10 and Al-26 in modern and ancient (0–20 ka) sediments along a 400 km section of the Platte River, far from the mountain front. Remarkably constant TCN concentrations indicate complete climate signal erasure at this distance. We conclude that paleoclimatic studies using TCNs should focus on small, high-denudation catchments, such as the Var (Mariotti et al., 2021).

Keywords: Sediment transport, Climatic cycle, denudation

*Speaker

†Corresponding author: vincent.regard@get.omp.eu

‡Corresponding author: sebastien.carretier@get.omp.eu