Multi-cosmogenic nuclides approaches for characterizing changes in erosion rates in the Himalayas

Vincent Godard*†[1], Pierre-Henri Blard[2], Saptarshi Dey[3], Clément Desormeaux[4], Lionel Siame[1], Régis Braucher[1], and Aster Team[1]

[1]Centre européen de recherche et d'enseignement des géosciences de l'environnement – Institut de Recherche pour le Développement, Aix Marseille Université, Collège de France, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut de Recherche pour le Développement : UMR$_D$161, $AixMarseilleUniversité : UM34, CollègedeFrance :$ $UMR7330, CentreNationaldelaRechercheScientifique :$ $UMR7330, InstitutNationaldeRecherchepourl'Agriculture, l'Alimentationetl'Environnement :$ $UMR1410 - -France$

[2]Centre de Recherches Pétrographiques et Géochimiques – Institut National des Sciences de l'Univers, Université de Lorraine, Centre National de la Recherche Scientifique, Institut National des Sciences de l'Univers : UMR7358, Centre National de la Recherche Scientifique : UMR7358 – France

[3]Department of Geology and Geophysics, IIT Kharagpur – Inde

[4]Géosciences Rennes – Université de Rennes, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Observatoire des sciences de l'environnement de Rennes – France

Résumé

Records of past denudation rates are essential for understanding how surface processes have responded to climate changes on different time scales, and for assessing the sensitivity of this response to local environmental, climatic and geomorphological contexts. In particular, the links between climate variations over the last few million years and the dynamics of erosion are being actively debated. The measurement of cosmogenic nuclides concentrations in sedimentary series is a classic technique for obtaining time series of paleo-denudation rates over time scales of up to 10 Ma, although the dynamics of sediment transport and accumulation can sometimes complicate signal interpretation. The development of complementary techniques is therefore necessary to better understand the joint evolution of climate and surface processes. We have acquired a new data set for 10Be-26Al-21Ne concentrations in sediments exported from a series of small basins draining the Ladakh batholith on the right bank of the Indus river (NW India). Nuclides pairs analysis shows a systematic deviation from the ratios predicted for steady-state erosion. In the case of the small (a few km^2) and steep basins that we sampled, significant burial and storage cannot be invoked to explain the observed imbalances. Instead, we interpret these ratios as symptomatic of accelerated erosion, as has been proposed in other slowly eroding contexts. We developed an innovative Bayesian inversion method for this type of multi-nuclide dataset, incorporating information on the topographical context of the basins (steepness index). The joint inversion

*Intervenant

†Auteur correspondant: godard@cerege.fr

of the dataset enables us to identify a two-stage exhumation history, marked by a phase of slow erosion (a few m/Ma) over several million years, followed by a clear acceleration (> 10 m/Ma) around 1 Ma ago. Modifications in climate patterns during the Middle Pleistocene Transition (MPT) are often proposed as a possible cause of change in the dynamics of surface processes, although there is still little existing data to support this association.

Mots-Clés: Geomorphology, Cosmogenic Nuclides, Himalayas, Surface processes, Erosion