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Dating the Indo-Asia collision in NW Himalaya: constraints from Sr-Nd isotopes and detrital zircon (U-Pb) and Hf isotopes of Paleogene-Neogene rocks in the Katawaz basin, NW Pakistan

Guangsheng Zhuang (1), Yani Najman (1), Ian Millar (2), Catherine Chauvel (3), Stephane Guillot (3), and Andrew Carter (4)

(1) Lancaster Environment Centre, Lancaster University, Lancaster LA1 4YQ UK (g.zhuang@lancaster.ac.uk), (2) NERC Isotope Geosciences Laboratory, Nottingham NG12 5GG, UK, (3) ISTerre, CNRS, Université Grenoble I, BP53, 38041 Grenoble cedex, France, (4) Department of Earth and Planetary Sciences, Birkbeck, London WC1E 7HX, UK

The time of collision between the Indian and Asian plates is key for understanding the convergence history and the impact on climatic systems and marine geochemistry. Despite much active research, the fundamental questions still remain elusive regarding when and where the Indian plate collided with the Asian plate. Especially in the west Himalaya, the questions become more complex due to disputes on the amalgamation history of interoceanic Kohistan-Ladakh arcs (KLA) with Karakoram of the Asian plate and the Indian plate. Here, we present a result of multiple-isotopic geochemistry and geochronology study in the Katawaz Basin in NW Pakistan, a remnant oceanic basin on the western Indian plate which was the repository for the sediments eroded from the west Himalaya (Qayyum et al., 1996, 1997a, 1997b, 2001; Carter et al., 2010), to evaluate the time and character of collision in this region.

In this study, we analyzed 22 bulk mudstone samples for Sr-Nd isotopes and 11 medium-grained sandstones for detrital zircon (U-Pb) geochronology and Hf isotopes. We constructed the Cenozoic chronology in the Katawaz Basin based on our newly collected detrital zircon U-Pb ages and fission track ages. We present the first record of Katawaz chronology that constrained the Khojak Formation to be < 40 Ma to < 22 Ma. The result is consistent with the previous nanofossil study that constrained the upper part of underlying Nisai Formation to be the Middle to Late Eocene. Our current study revealed that the Katawaz sedimentary sequence ranges in age from Eocene to the earliest Miocene.

The samples from the Nisai Formation show the 87Sr/86Sr - εNd values overlapping those of the end member of the Karakoram of Asian origin, revealing the arrival of Asian detritus on the Indian plate prior to 50 Ma. There are two parallel lines of evidence supporting this conclusion: (1) young zircon grains (< 120 Ma), characterizing the KLA and Karakoram, persistently exist throughout the whole sedimentary section and (2) the detrital zircons from KLA and Karakoram which are distinctive in Hf isotopes also show the presence throughout the sequence. Collectively, we argue that 1) the major collision between the Indian and Asian plates occurred no later than 50 Ma in the NW Himalaya and 2) the amalgamation of KLA with the Asian plate occurred prior to the major Indo-Asia collision.

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