Headwater capture and drainage re-organization in Asian river systems traced by isotope provenance methods

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Abstract —The Indus River was formed immediately following the India-Asia collision and is know to have undergone major re-organization and headwater capture events since that time. In this study we used U-Pb dating of zircon grains and Pb isotopes in K-feldpsar grains to see how the river has evolved during the Holocene in response to a strengthening and then weakening monsoon. Our data show that the Sutlej and Beas River used to flow much further SE on the edge of the Thar Desert but switched away to the north into the modern Punjab around 4-5 ka, probably contributing to the collapse of the Indus Valley Civilization Our data also show that zircon grains take ca. 5 ky to travel from the Himalaya to the Indus delta and that reworking of older sediments in the foreland have dominated the delta sediment budget since ca.5 ka. U-Pb zircon dating of zircons and Ar-Ar dating of micas in the Red River system shows that the present river has been close to its present state in Vietnam since the Late Miocene, implying surface uplift and drainage capture much earlier, likely starting in the Oligocene in SE Tibet. Ar-Ar ages indicate that the Lo River is the most important net contributor to the modern Red River delta. However, this contrasts with zircon U-Pb data indicating that the upper reaches of the Red River dominate that mineral group. We suggest that the mis-match reflects the rapid transport of mica relative to zircon in the river and the fact that the Red River is not in equilibrium. We hypothesize that the zircons were eroded >8 ka under a regime of stronger monsoon that enhanced erosion in the northern drainage basin, while modern erosion is focused in the south, especially in the Song Chay Massif."

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