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The White Nile sedimentary system

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The Nile River flows for ∼6700 km from south of the Equator to finally reach the Mediterranean Sea at northern subtropical latitudes (Woodward et al. 2007). This is the longest sedimentological laboratory on Earth, a unique setting in which we are investigating changes in sediment composition associated with diverse chemical and physical processes, including weathering and hydraulic sorting. The present study focuses on the southern branch of the Nile across 20° of latitude, from hyperhumid Burundi and Rwanda highlands in central Africa to Khartoum, the capital city of Sudan at the southern edge of the Sahara.

Our study of the Kagera basin emphasizes the importance of weathering in soils at the source rather than during stepwise transport, and shows that the transformation of parent rocks into quartzose sand may be completed in one sedimentary cycle (Garzanti et al. 2013a). Micas and heavy minerals, less effectively diluted by recycling than main framework components, offer the best key to identify the original source-rock imprint. The different behaviour of chemical indices such as the CIA (a truer indicator of weathering) and the WIP (markedly affected by quartz dilution) helps us to distinguish strongly weathered first-cycle versus polycyclic quartz sands (Garzanti et al. 2013b).

Because sediment is efficiently trapped in East African Rift lakes, the composition of Nile sediments changes repeatedly northwards across Uganda. Downstream of both Lake Kyoga and Lake Albert, quartzose sands are progressively enriched in metamorphiclastic detritus supplied from tributaries draining amphibolite-facies basements. The evolution of White Nile sediments across South Sudan, a scarcely accessible region that suffered decades of civil war, was inferred from the available information (Shukri 1950), integrated by original petrographic, heavy-mineral and geochemical data (Padoan et al. 2011). Mineralogical and isotopic signatures of Bahr-el-Jebel and Sobat sediments, derived respectively from Archean gneisses of Uganda and Neoproterozoic basements of Ethiopia, become gradually homogenized and enriched in quartz, and remain finally unchanged down to Khartoum. This suggests massive sediment dumping in the Sudd and Machar Marshes, and explains why White Nile sediment contribution to the main Nile is negligible (Garzanti et al. 2006).

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