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A detrital record of the Nile River and its catchment

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This research uses analyses from Nile catchment rivers, wadis, dunes and bedrocks to constrain the geological history of NE Africa and document influences on the composition of sediment reaching the Nile delta. Methods used include single grain analyses (U-Pb and Hf analyses of zircon, U-Pb dating of rutile, Ar-Ar dating of white mica and plagioclase), and bulk analyses (petrography, Sr, Nd and Hf isotopic analyses, and trace element concentrations).

Our data show evolution of the North African crust, highlighting phases in the development of the Arabian–Nubian Shield and amalgamation of Gondwana in Neoproterozoic times. The Saharan Metacraton and Congo Craton in Uganda have a common history of crustal growth, with new crust formation at 3.0 – 3.5 Ga, and crustal melting at c. 2.7 Ga. The Hammamat Formation of the Arabian–Nubian Shield is locally derived and has a maximum depositional age of 635 Ma. By contrast, Phanerozoic sedimentary rocks are derived from more distant sources.

In the modern Nile drainage, there is considerable evolution downstream, controlled predominantly by changes in local geology and geomorphology. The provenance signature of the White Nile is dramatically different upstream and downstream of the Sudd marshes as a result of sediment trapping. South of the Sudd, White Nile sediments are craton-derived. North of the Sudd, at Kosti, the signature of the White Nile is dominated by material derived from Phanerozoic sandstones supplied via alluvial fans to the west of the river. Further north, south of Khartoum, White Nile sediment composition is affected by its proximity to the Pleistocene Blue Nile sourced Gezira Fan. The Blue Nile's and Atbara's signatures are influenced predominantly by input from the Ethiopian flood basalts in terms of their bulk-rock signature, and by proximity to the Arabian–Nubian Shield in terms of zircon characteristics. A further shift in sediment signature in terms of zircon characteristics is seen by the time the Nile reaches northern Egypt, reflecting the passage of this stretch of the river through Phanerozoic cover sedimentary rocks and overlying modern sands of the Red Sea Hills and Western Desert. By contrast, the bulk isotopic Sr–Nd–Hf data show little downstream evolution and remain dominated by mafic input from the Ethiopian Highlands as far south as northern Egypt. Aeolian input, whilst undoubtedly contributing to Nile sediment, does not mask the predominant influence of local bedrock signature and geomorphological influences.