



Age and origin of the Gezira alluvial fan between the Blue and White Nile rivers

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The Gezira is a low-angle alluvial fan bounded by the Blue Nile to the east and the White Nile to the west. It is the main agricultural region of Sudan and produces high quality long-staple cotton for export. Dark cracking clays (vertisols) cover much of the Gezira and range in age from 50 kyr to Holocene. The Gezira is traversed by a series of defunct sandy channels that originate between Sennar and Wad Medani on the present-day Blue Nile. With a radius of 300 km and an area of 40,000 km² the Gezira is a mega-fan. The younger channels range in age from early Holocene to 100 kyr, while near surface channels filled with rolled quartz and carbonate gravels have ages back to >250 kyr. Boreholes in the Gezira reveal coarse alluvial sands and gravels in now buried channels overlain by alluvial clays, forming a repetitive sequence of fining-upwards alluvial units. that probably extend back to Pliocene times. The fan is up to 180 m thick with a volume of ~1,800 km³. The sandy or gravelly bed-load channels coincide with colder drier climates and sparse vegetation in the Ethiopian headwaters of the Blue Nile and the alluvial clays denote widespread flooding during times of stronger summer monsoon. The early stages of such flood events were often accompanied by mass burial of Nile oyster (*Etheria elliptica*) beds, such as the 45-50 kyr floods that deposited up to 5 m of clay in the northern Gezira.

A unique feature of the eastern Gezira is a former Blue Nile channel at least 80 km long running parallel to the present river and entirely filled with volcanic ash. The channel was only 3-4 m deep and 20-30 m wide. Very fine laminations and cross-beds, together with locally abundant phytoliths and sponge spicules, suggest slow-moving water, with flow dispersed across many distributary channels. The ash geochemistry is similar to that in the lower part of the Kibish Formation in the lower Omo valley of southern Ethiopia and points to a minimum age of 100 kyr and a maximum age of 190 kyr. The Ethiopian volcano that provided the ash was located on the interfluvium between the upper Omo and the upper Blue Nile. Although the Blue Nile has frequently changed course in the last 250 kyr, it has flowed close to its present channel at least three times in that time.