

Evidence for a Paleo-Okavango Delta and overlying mega-lake from airborne TEM data

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ABSTRACT

The near juxtaposition of the Makgadikgadi Basin, the world's largest saltpan complex, with the Okavango Delta, one of the planet's largest inland deltas (technically an alluvial megafan), has intrigued explorers and scientists since the middle 19th century. It was also clear from early observations that the Makgadikgadi Basin once contained a huge lake, popularly referred to as Paleo Lake Makgadikgadi. Through a contract with a commercial company, the Botswana Department of Geological Survey has acquired a helicopter time-domain electromagnetic (HTEM) data set across the entire Okavango Delta. The HTEM data were of extremely high quality, mainly due to very low noise levels (there are no large power lines and only a small number of settlements and tourist lodges in the delta) and significant contrasts between the electrically resistive units (i.e., dry and fresh-water-saturated sand and basement) and electrically conductive ones (i.e., saline-water-saturated sand and clay). Our inversions of these data returned electrical resistivity models containing three principal layers: (i) an upper heterogeneous layer that is largely resistive, (ii) an intermediate conductive layer, and (iii) a lower resistive layer. According to borehole logs and groundwater sampling, the electrically conductive layer is due to a combination of clay and saline-water-saturated sediments. We interpret these sediments to have belonged to Paleo Lake Makgadikgadi, which would have extended into the region presently occupied by the Okavango Delta. The total area of Paleo Lake Makgadikgadi would therefore have exceeded 90,000km², larger than Earth's most extensive fresh-water body today, Lake Superior. Our HTEM data also provide evidence for a southeast-dipping paleo megadelta or megafan beneath the Okavango Delta's upper fan and the Paleo Lake Makgadikgadi sediments. Seismic refraction/reflection experiments and boreholes suggest that this feature is composed of fresh-water sediments, probably representing a Paleo-Okavango Delta resting on top of basement rock. If this interpretation is correct, then the clay layers of the Paleo Lake Makgadikgadi sediments act as an aquitard protecting the fresh-water sediments of the paleo-delta from salt water contamination above.

Key words: TEM, Okavango Delta, Paleo Lake Makgadikgadi