Evaporites reveal Pleistocene basin dynamics in the Danakil depression (northern Afar, Ethiopia)

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The Danakil depression (Afar, Ethiopia) is a rift valley forming the southernmost part of the Red Sea rift. It is situated between the Ethiopian plateau and the Danakil block and is thought to represent an advanced stage of rifting, characterized by important tectonic and volcanic activity. Its floor is situated 120 meters below sea level and is covered by salt pans.

This study focuses on a 625 m deep borehole drilled in the central part of the basin. It mainly consists of evaporites dominated by halite along with clastic and carbonate sediments. Lithostratigraphy and facies description were completed by micropaleontological, geochemical, mineralogical and organic matter analysis. They reveal the complex history of this rift basin. Two marine Red Sea incursions are identified. Strong water stratification during the older marine incursion led to the formation of sapropel layers and magnesite. The restriction of the basin and the strong aridity led to the formation of evaporites, culminating in the deposition of potash salts. Between the two marine events, continental evaporites contributed to several hundreds of meters of basin fill. The younger marine incursion was probably characterized by wetter environments, resulting in the deposition of smaller volumes of evaporites. Since then, hypersaline lakes and salt pans filled the basin. Ongoing radiocarbon and U/Th datings will constrain further the Pleistocene stratigraphy and timing of the marine incursions.

These findings shed a new light on the basin history. The successive flooding and desiccation events are a consequence of sea-level variations but also important tectonic activity. Rift margin uplift prevented flooding during the Holocene sea-level highstand and contributed to the restriction of the depression. Significant basin subsidence at very short time scales created accommodation space for the voluminous sediment infill. This implies very active rifting during the last 250 ka.