

Multi-scale basin dynamic study of the Danakil Depression (Afar)

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Rifts and passive margins are fundamental features of the structure of Planet Earth. They mark the transition from continents to oceans and, as such, are an essential component of plate tectonics. However, the interactions between tectonics, sedimentology and magmatism controlling rift structure and evolution are poorly known due to the complexity of the factors playing at very different temporal and spatial scales. The Danakil Depression is part of the Afro-Arabian Rift System and is the only emerged region on Earth currently experiencing the transition from continental rifting to oceanic spreading.

An integrative review of the tectonic, magmatic and sedimentological history of the Afar region and the compilation of new geological maps allows to develop a new model for the evolution of the Afar Depression. The gradual and active transition from continent to ocean is reflected in the Pleistocene to Holocene environmental conditions of the Danakil Depression. Field studies evidence at least four floodings of the basin by the Red Sea during the Quaternary. Field data complemented by remote sensing allow to characterize the parameters controlling the marine incursions in the basin. The last marine incursion occurred ~130 ky ago, resulting in the deposition of several hundred of meters of evaporites during its desiccation stage. The study of a 625 m deep core drilled in the central part of the Danakil Depression allows to characterize the paleoenvironmental and paleoclimatic conditions of the Depression since the Late Pleistocene. This study furthermore identifies the mechanisms of evaporite formation, providing important clues on the understanding of older enigmatic salt giant deposits in Earth history. Finally, the hypersaline Lake Afdera is a peculiar Recent sedimentary setting in the Danakil Depression. The origin of the Lake is discussed based on bathymetric mapping.

Overall, the present study allows the better understanding of the evolution, the chronology, the structure and the paleoenvironmental and paleoclimatic conditions of the Danakil and Afar Depression, as well as some of the mechanisms controlling these dynamic and complex systems. This regional study gives new insights on the understanding of rifting processes shaping our Planet since more than two billion of years

Jury:

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Prof. Tesfaye Kidane (external expert)

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