Tectonothermal history of rift-related volcanics along the eastern margin of Gulf of Suez, Egypt: Evidence from fission track analysis and paleostress

EZZ EL DIN ABDEL HAKIM KHALAF & MOHAMED SALEH HAMMED

Cairo University-Faculty of Science-Geology Department, Giza, Egypt

To constrain the rift-related volcanic evolution of the Gulf of Suez, macro-scale tectonic studies, paleostress, and fission track data were performed at Wadi Matulla.The results provide insights into the processes driving late stage vertical motion and the timing of exhumation of the study area. Fission track ages of individual crystals of detrital apatite separated from Coniacian-Santonian sandstones (Matulla Formation) indicate the contribution of detritus from source rocks of at least four distinct age groups. All the measured apatite grains are of fluorapatite composition. The rift-related volcanics at Wadi Matulla are represented by doleritic sills and dikes intruding different stratigraphic horizons of Coniacian-Santonian, Campanian-Maastrichtian and Middle Eocene ages. The data are interpreted to represent an intraplate thermotectonic episode during the Late Oligocene. Structural data collected from Neoproterozoic basement, Late Cretaceous and Tertiary sedimentary cover suggest extensional tectonics resulted in formation of half-graben basins. Basin axes are parallel to the trend of Pan-African structural elements which acted as stress guides.

The resultant apatite fission track ages are nearly concordant with a mean age of 31±1.5 Ma, where the mean track length is ~14.8 μm with ~1.12 μm standard deviation. At that time, the intraplate stresses responsible for deformation, uplift and erosion, were induced by the collision of Africa with Laurussia. Assuming a geothermal gradient of 25ºC/km, such lengths suggest that these apatite grains were subjected to temperature over 110 ºC at level above 2 km with extremely rapid cooling during the Early Oligocene time (31±1.5 Ma). In other words, these rocks were never subjected to temperature in excess of 40-50 ºC after the thermal event of the volcanic injection. Apatite fission track data indicate that the cooling phase started in Oligocene and was related to extension, flank uplift and erosion along the actual margin of the Red Sea. Relations between structures, depositional ages of sediments and apatite fission track data indicate that the initiation of rift flank uplift, erosion and plate deformation occurred nearly simultaneously. It is proposed that the present apatite track age dates the injection time of the rift-related volcanics and accordingly the initiation of the Suez rift.

Compared to the previously reported apatite data from the Gulf of Suez of the studied area, the age here is older and indicates less exhumation of the studied region. Given reasonable assumptions, the difference in the amount of exhumation since Oligocene is estimated being larger than ~1 km, probably controlled by the material to be exhumed and local geological setting.