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Density structure and isostasy of the lithosphere in Egypt and their relation to seismicity

Mikhail Kaban (1), Sami El Khrepy (2,3), and Nassir Al-Arifi (2)

(1) GeoForschungsZentrum Potsdam, Telegrafenberg, 14473 Potsdam, Germany (kaban@gfz-potsdam.de), (2) King Saud University, Riyadh, Saudi Arabia, P.O. Box 2455, Riyadh 11451, Saudi Arabia, (3) National Research Institute of Astronomy and Geophysics, NRIAG, 11421, Helwan, Egypt

A joint analysis of the new satellite-terrestrial gravity field model with the recent data on the crustal structure and seismic tomography model was conducted to create an integrative model of the crust and upper mantle; and to investigate the relation of the density structure and the isostatic state of the lithosphere and to the seismicity of Egypt. We identified the distinct fragmentation of the lithosphere of Egypt into several blocks. This division is closely related to the seismicity patterns in this region. The relatively dense and strong lithosphere in the Nile Delta limits the seismic activity within this area, while earthquakes are mainly associated with the boundaries of this block. In the same way, the relatively strong lithosphere in the Suez Isthmus and its northern Mediterranean bounderies prevents the Gulf of Suez from opening further. The central part of Egypt is generally characterized by an increased density of the mantle, which extends to the Mediterranean at a depth of 100 km. This anomaly deepens southward to Gilf EL Kebir and eastward to the Eastern Desert. The average density of the crystalline crust is generally reduced in this zone, indicating the increased thickness of the upper crust. The low-density anomaly under the northern Red Sea is limited to 100–125 km, confirming the passive origin of the extension. Most of the earthquakes occur in the crust and uppermost mantle in this structure due to the hot and weak upper mantle underneath. Furthermore, an asymmetric lithosphere structure is observed across the Northern Red Sea. The isostatic anomalies show the fragmentation of the crust of Sinai with the high-density central block. Strong variations of the isostatic anomalies are correlated with the high level of seismicity around Sinai. This tendency is also evident in the North Red Sea, east of the Nile Valley, and in parts of the Western Desert.