Magnetotelluric measurements in the focal area of the 2023 Kahramanmaraş Earthquakes, Türkiye

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SUMMARY

On February 6, 2023, a catastrophic earthquake of Mw7.7 occurred in the Kahramanmaraş region on the Pazarcık fault segment of the East Anatolian Fault (EAF) zone near Gaziantep. The aftershocks of the earthquake showed that post-seismic deformation continued in the northeast and southwest direction along the EAF and Dead Sea Fault (DSF). Nine hours after the initial seismic event, a second destructive earthquake occurred in the Sürgü segment, which separates westward from the EAF zone, to approximately 100 km north of the initial event. This second earthquake had a magnitude of Mw7.6. These left lateral strike-slip earthquakes affected approximately ten provinces within the region and it has been argued that these earthquakes have filled the seismic gap in the EAF zone. The EAF zone is one of the most active fault zones in Türkiye along with the North Anatolian Fault (NAF) zone. These two shear zones have been formed under the effect of the northward subduction of the African Plate beneath the Anatolian Plate, the northward movement of the Arabian Plate with respect to the stable Eurasian Plate, and the westward movement of the Anatolian Plate.

One of the strongest earthquakes on the NAF zone occurred in 1999 in Izmit with a magnitude of Mw7.4 and may have been triggered by crustal fluids beneath the focal area. The objective of this study is to verify a possibility that such crustal fluid triggered the Kahramanmaraş earthquake in a similar way. Whether or not crustal fluid around a focal area triggered an earthquake can be investigated through magnetotelluric (MT) measurements. Therefore, we conducted wide-band MT measurements at 34 stations in the epicentral area of the Kahramanmaraş earthquake with the aim of obtaining the subsurface electrical resistivity structure and elucidating the potential contribution of crustal fluid to the earthquake generation process in the region. Our study encompasses the first event's epicenter and surrounding region.

Keywords: Kahramanmaraş Earthquakes, Crustal fluids, Magnetotelluric, East Anatolian Fault Zone