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Seismic Attenuation Imaging in the Western Part of the North Anatolian Fault Zone

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Colossal and devastating earthquakes are typically associated with the slip and rupture of fault zones. Fault zone imaging is challenging yet crucial to understand fault structure and behavior, and consequently hazard assessment and mitigation. Seismic attenuation imaging provides constraints on the fault zone structure that are independent of seismic velocity imaging. Here, we image the S-wave total attenuation (Q_s) structure of the western part of the North Anatolian Fault Zone (NAFZ) using data recorded by the DANA (Dense Array for North Anatolia) array. The area of interest is divided into three distinct regions by the northern and southern segments of the NAFZ, which extends from north to south: the Istanbul Zone to the north, the Armutlu Block in between, and the Sakarya Terrane to the south, respectively. The Armutlu Block exhibits much higher attenuation compared to the other two regions. The anomaly body has an attention value of 0.0008 with a notable 3D distribution pattern: It extends from 30.2°*E* to 30.6°*E* and around roughly 40.6°*N* following the northern strand of the NAF and shows a west-east trend, dipping deeper into the crust to the east from depths of 5 to 15 km. Combining previous geological, geodetic, micro-seismicity, and other geophysical observations, we inferred that the high values are a sign of fluid pathways. Micro-seismicity and strain distributions around the Armutlu Block are in line with the assumption fluids migrate through cracks and increased permeability attributed to the background stress, particularly residual stress after the 1999 M7.4 Izmit earthquake and M7.2 Düzce earthquake.

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