

Seismic patterns of the Anatolian fault system (Turkey)

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The Anatolian extrusion that occurred in between the North and East Anatolian faults accounts for most of the seismicity and present-day deformation in the eastern Mediterranean region.

The North Anatolian Fault (NAF) is a right-lateral strike-slip fault extending over 1100 km from Eastern Turkey to the Aegean Sea. On this fault the cumulated strain rate, of about 28 mm/yr as measured by GPS, is roughly equal to the strain released seismically as measured by dated offset geomorphological features, through some aseismic creep does exist on at least one fault segment. Paleoseismic trenching suggests that most of the strain accumulated is released in bursts of seismicity along the fault separated by 300 to 600 years of relative quiescence. The last burst of seismicity was the well-known 20th century westward propagating sequence of earthquakes of magnitude greater than 7 which comprised of a cumulated surface rupture of more than 700 km. The last earthquakes of the sequence were the destructive 1999 M=7.4 Izmit and M=7.2 Duzce earthquakes. As a consequence, stresses have sharply increased west of this last rupture bringing fault segments in front of Istanbul closer to failure. East of the 1999 fault ruptures, seismic activity is very low because of the stress shadow generated by the ultimate earthquake sequence. Seismic activity is slightly higher on the eastern most segments that have not yet fully ruptured.

The conjugate East Anatolian Fault extends over 600 km linking the North Anatolian Fault to the Dead Sea Fault. Little information is presently available on this fault system. Present-day strain accumulation is about 11 mm/yr. Historical seismicity suggests that like the North Anatolian Fault it has ruptured in sequences of clustered earthquakes, the last one having occurred during the 19th century. Present-day seismicity is low but higher than on the central NAF indicating that stresses have started to accumulate. Most seismic activity is located near large scale fault asperities.

The last ground rupturing earthquake sequences on the North and East Anatolian faults suggest a possible transfer in seismic activity between these two faults. This hypothesis that has not yet been verified because of the lack of paleoseismic data concerning on the East Anatolian Fault. The sediments of the Lake Hazar, located in the central part of the East Anatolian Fault, provided a long-term seismic record and a means to further test the seeming correlation between the seismicity of the North Anatolian Fault and of the East Anatolian Fault systems.