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The mechanics of the North Anatolian Fault propagation

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Elastic-Plastic Fracture Mechanics concepts are used to model the set-up and the localisation of finite deformation caused by the propagation of a strike-slip fault in the continental lithosphere. The North Anatolian Fault (NAF) is a 1600 km long strike-slip fault, which nucleated in eastern Turkey around 10 Ma and has grown by propagation as a result of the Arabia-Eurasia collision. Around 5 Ma, the NAF penetrates the Aegean, a large Process Zone (400-600 km) develops at the tip of the NAF due to interaction with the Aegean back-arc extension and with the Hellenic subduction zone. Both the length of the NAF and the size of the Process Zone incresase during the propagation process until the NAF be effectivelly connected to the Hellenic subduction zone. Around 1-2 Ma the plate-kinematic circuit is closed around Anatolia and the propagation of the NAF stops. In this study the NAF is modelled as a simple shear crack in elastic lithosphere, loaded by the Arabia-Eurasia convergence to the east and by the Aegean back arc extension to the west. The stress concentration at the western tip of the NAF causes plastic deformation in the process zone of the strike-slip fault. The process zone of the NAF is modelled as a zone of constant yield shear stress, which develops in the plane of the NAF at the tip of the fault (Dugdale approach). Our model is constrained by finite offsets and by the timing of the fault propagation deduced from the geology and is compatible with the present-day behavior of the NAF deduced from GPS and tectonic observations. We show that continental lithosphere can resist up toa 3% elastic shear strain and that more than 12% shear strain have been relaxed plastically by the Aegean lithosphere since 3 Ma.