Seismic rupture evidences preserved in a serpentinite massif along the Middle Branch of the North Anatolian Fault, Turkey

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Résumé

Serpentinites, formed by the hydration of peridotites, are associated with aseismic creep due to their frictional properties (Moore and Rymer, 2007; Hirth and Guillot, 2013) along the intracontinental faults. However, recent studies suggest that serpentinite-bearing shear zones may also host dynamic ruptures (Tarling et al., 2018).
Here we describe the very first observation of seismic rupture in a serpentinite-bearing fault zone along the Middle branch of the North Anatolian Fault (MNAF). Although the MNAF lacks evidence of instrumentally recorded earthquakes, historical, paleoseismological and geomorphic studies testify surface-rupturing events have occurred along it (Benjelloun et al., 2021).

Field and petrographic observations reveal the presence of a serpentinite outcrop containing rodingite veins, where the crustal fault is crosscutting the massif. Geochemical analysis of rodingites-interpreted as metasomatized gabbros-combined with petrographic observations in the serpentinite, suggests that the ultramafic body corresponds to a remnant of the Tethyan oceanic lithosphere obducted during closure of the Intra-Pontide Ocean, later overprinted by the strike-slip fault.

In addition, a slickenside within the serpentinite massif was sampled. It exhibits uncommon cockade structures-angular ultramafic clasts and rounded carbonate clasts, both rimmed by carbonate concentric rims (Frenzel and Woodcok, 2014). These structures are interpreted as the result of dynamic fracturing (Berger and Herwegh, 2019). Optical microscopy, SEM and Raman reveal a gouge zone where the interface of rupture took place associated to the cockade texture that presents rounded small element with concentric growth rims, supporting fluid injection during the mainshocks, with high porosity around these elements. This cockade structure suggests that brittle failure in serpentinite is possible thanks to fluid overpressure, due to serpentinite dehydration during the rupture.
Our results provide evidence for the first time of rupture in serpentinite fault that changes the paradigm that associated serpentinite to aseismic slip along major strike-slip faults.

Mots-Clés: North Anatolian Fault, Serpentinite, Coockade structure, Seismic rupture

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