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# Spatio-temporal evolution of brittle normal faulting and fluid infiltration in detachment fault systems - a case study from the Menderes Massif, western Turkey

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K-Ar dating of fault rocks coupled with hydrogen isotope analysis allows constraining the timing of brittle faulting and the influx of meteoric fluids into such fault systems. We applied this approach to resolve the spatio-temporal activity of three detachment-fault systems in western Turkey and to evaluate how deep meteoric fluids infiltrated these fault systems (Hetzel et al., Tectonics, in revision). K-Ar ages of cataclasites and gouges from two detachment fault systems that accomplished the bivergent extension of the central Menderes Massif suggest diachronous brittle deformation. The Büyük Menderes detachment in the south was already active at ∼22 Ma, whereas the earliest brittle deformation recorded at the Gediz fault system in the north occurred at ∼9 Ma. K-Ar ages of secondary and splay faults indicate that both fault systems continued to be active until 4–3 Ma – consistent with rapid Pliocene cooling inferred from published thermochronological data. In the northern Menderes Massif, the boundary fault of the Simav graben became active at 17–16 Ma, after the end of faulting on the Simav detachment. Hydrogen isotope ($\delta$D) values of –109 to –87 ‰ for fault gouge, cataclasite, and mylonites document that meteoric fluids infiltrated the upper crustal normal faults and penetrated into the detachments and the uppermost levels of their mylonitic footwalls. This explains the ubiquitous retrogression of biotite to chlorite in extensional shear zones and the growth of chlorite in detachment-related cataclasites. Our results document that brittle normal faults were active over ∼20 Ma of the extensional history and provided effective pathways for meteoric fluids.

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