New authigenic illite age and hydrogen isotope data to constrain the geochronological and geochemical framework of brittle faulting within the Nojima fault zone, Japan.

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Numerous recent case studies have successfully constrained the timeframe of brittle faulting through dating of clay-size fault gouge fractions. However, the involved fluids sources are not well constrained. K-Ar dating of fault rocks coupled with hydrogen isotope analysis allows to both constraining the timing of brittle faulting and to constrain the influx of variable fluids sources into such fault systems. We present a novel application of hydrogen isotope-based analyses that explores the hydrogen isotope values of fluid sources in Paleocene to Miocene clay gouge-bearing faults from outcrops and drill core samples from the Nojima fault (Awaji island, Japan; [1]). K–Ar ages provide have an age range from 63.4 ±1.3 Ma (Early Palaeocene) to 42.2±1.0 (Palaeogene–Middle Eocene). Several <0.1 and <0.4 μm fractions in proximity to a pseudotachylyte zone are thermally influenced with loss of radiogenic Ar. The illite age data support a model that the Nojima fault zone was initiated ~ 55 Ma ago by ZFTA data [2]. Hydrogen isotope (δ D) values of –119 to –97 for fault gouges and cataclasite zones and document meteoric fluids infiltrating the upper crustal brittle fault zones. The data document elevated temperatures and a heterogeneous thermal history within the study area and influence of a secondary thermal heating event probably caused by circulation of hot fluids within the fault zone about 31–38 Ma ago and even a potential influence of Quaternary faulting.

[1] Zwingmann et al., 2010. Chemical Geology doi:10.1016/j.chemgeo.2010.05.006
[2] Murakami and Tagami, 2004. GRL 31. doi:10.1029/2004GL020211.

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