

Dating brittle deformation of the Söderström Fault, Stockholm, central Sweden

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In Sweden, timing of brittle deformation of many important faults remains poorly constrained, as only very few studies providing absolute geochronological constraints exist. Here, we new although preliminary results aiming to better define the age of brittle deformation accommodated by the Söderström Fault (Stockholm area) by dating authigenic and synkinematic illite separated from the fault rocks using K-Ar dating. The fault transects Svecofennian (2.0-1.8 Ga) migmatites of sedimentary and granitoid origin previously deformed in the ductile regime. The Söderström Fault is recognized as a key brittle deformation zone that strikes east-west through Söderström, a water body that separates the capital suburbs Gamla Stan and Södermalm in central Stockholm. Relatively little is known about this fault, but there are indications for still active dextral strike-slip motion along the fault. Reverse S-side-up movement of up to several hundreds of meters has been reported. Samples from this fault were obtained from a drill core that cross-cut the fault and preserve clay-rich gouge. Sample preparation allowed separation of clay minerals in five different size fractions ($<0.1\ \mu\text{m}$, $0.1\text{-}0.4\ \mu\text{m}$, $0.4\text{-}2\ \mu\text{m}$, $2\text{-}6\ \mu\text{m}$ and $6\text{-}10\ \mu\text{m}$). Dating of two samples (SGL18-0001A and SGL18-0003A) shows a range of ages from ca 360 to 660 Ma and ca 450 to 760 Ma, whereby the younger ages are from the finer- and the older ages from the coarser size fractions. The younger sample (SGL18-0001A) yields distinct ages in the two finest grain size fractions, <0.1 and $0.1\text{-}0.4\ \mu\text{m}$, at ca 360 Ma and ca 390 Ma, respectively. SGL18-0001A also exhibits similar ages in the coarsest grain size fractions, $2\text{-}6$ and $6\text{-}10\ \mu\text{m}$, with ca 650 Ma to ca 660 Ma, respectively. Similarly, sample SGL18-0003A yields consistent ages in the two coarsest grain size fractions, with ages of ca 790 Ma and ca 760 Ma, whereas the three smaller grain size fractions yield gradually younger ages, from ca 670 Ma to ca 550 Ma and ca 450 Ma. A detailed study of the identification of the clay mineral fractions is still ongoing, and it will help constrain the actual amount of authigenic illite in the finest fraction as well as the polytypism of the clay crystallites. These preliminary dates indicate a protracted brittle deformation history of the Söderström Fault. Gouge formation postdates the Sveconorwegian orogeny (1.1 -0.9 Ga), and is more likely related to extensional events during the opening of the Iapetus Ocean. The youngest ages coincide broadly with the age of the Caledonian orogeny and may represent the influence of the far-field orogenic stress. A similar timing of brittle deformation has also been observed by Alm et al. (2004) and Drake et al. (2009) in eastern and northern Sweden, and in southeastern Sweden, respectively, by dating specific mineral growth events.

References

Alm, E., Sundblad, K., Huhma, H. (2004), Sm-Nd isotope determinations of low-temperature fluorite-calcite-galena mineralization in the margins of the Fennoscandian Shield, SKB Report R-05-66, 58 pp.

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