K-Ar constraints on fluid-rock interaction and dissolution-precipitation events within the actively creeping shear zones from SAFOD cores

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The San Andreas Fault Observatory at Depth (SAFOD) was drilled to study the physical and chemical processes responsible for faulting and earthquake generation along an active, plate-bounding fault at depth. SAFOD drill cores show multiple zones of alteration and deformation due to fluid-rock interaction in the fault rocks(Schleicher et al. 2008). In context of fluid studies in the SAFZ, noble gas and potassium measurements were performed on solid samples of sedimentary rocks obtained from drill cores across the fault (3050-4000m-MD). We used a combination of 40Ar/39Ar and K-Ar methods on crushed samples of mudrock with variable amounts of visible slickensides to constrain the degree of resetting of the K-Ar system across the San Andreas Fault zone. 40Ar/39Ar was analyzed from small fragments (sand sized grains) while K-Ar was measured in crushed bulk rock samples (100-250 mg for Ar, and 5-10 mg for K analyses). The apparent 40Ar/39Ar ages based on single step laser fusion of small fragments corresponding to the detrital component in the coarse fraction, show varying ages ranging from the provenance age to <13Ma. Although more data are needed to make detailed comparisons, the apparent K-Ar ages of bulk samples in the fault zone are biased toward authigenic materials contained in the fine fraction, similar to the 40Ar/39Ar ages reported for mineralogical separates from very fine size fractions of samples obtained from 3065.98m-MD and 3294.89m-MD (Schleicher et al., submitted to Geology). The small samples measured for 40Ar/39Ar show scatter in the apparent ages, generally bracketing the bulk ages. However they are picked from sieved portions of the samples, and it is likely that there may be a loss of the younger (finer) material. Detrital provenance ages appear to be 50-60Ma in the Pacific Plate, and 100Ma in the North American Plate. 40Ar/39Ar ages within the SAFZ, as defined by geophysical logs (3200-3400m MD), are dominated by apparent detrital ages of ~100Ma. More work is needed to test whether this is a real provenance age, or if there could be some systematic process that could lead to age bias towards older values. We observe nearly complete resetting of K-Ar ages, indicating that the K content is dominated by newly formed authigenic minerals as a result of fluid rock interaction in the SAFZ. Because the authigenic minerals are subject to successive

dissolution-precipitation events over a range of time (3 to 0 Ma) and because the detrital component may not be fully reset, the K-Ar apparent ages (<300,000 years) in the SAFZ provide a maximum age on the resetting event. Similar trends of relatively young ages across the SAFZ compared to the surrounding country rock in the Pacific and North American Plates are also observed in the apparent fluid 'ages', corresponding to the fluid event responsible for the fluid-rock interaction in the fault (Ali et al. this session).

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