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Resetting parameters from Ar diffusion experiments for earthquake illite thermochronology

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Earthquake dating presents a challenge because even the largest earthquakes produce only a small amount of new material at the fault surface. Dating techniques have mostly focused on using either thermal resetting of thermochronometers in existing minerals in the rock near the fault surface, or on deconvolution of mixtures of old minerals in the rock and new minerals produced on the fault surface. However, the potassium-rich clay minerals present in the disturbed rocks in many fault environments likely represent a complicated mixture of multiple generations of detrital and authigenic minerals, all of which may be partially or fully reset by the geometrically complex heating imposed by major earthquakes. We present the framework of a new model for using XRD, K-Ar measurements, and biomarkers to obtain earthquake age information from complex illite K-Ar datasets, and diffusion data from rapid heating experiments on illite and on bulk fault rocks that directly simulate earthquake conditions in the laboratory. We show that earthquakes are capable of fully resetting the K-Ar system in illite in fault rocks, and that paired biomarker data help constrain the earthquake history behind these resetting signals. Tectonic histories represent non-unique solutions that nevertheless hold valuable information about the degree of seismic hazard in the fault zone from which these rocks are derived.