# What can fault-related opals tell us about brittle fault behavior?

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The preservation of fault-filling material allows for the reconstruction of the deformational history of a specific structure. We examined fault-related opals from three different fault zones within the Eastern California Shear Zone: Camp Rock, Cady, and the Cave Mountain fault systems. Fault-core samples are taken from different fault splays within a wide damage zone (~500 m). We combine microstructural, geochemical and geochronological methodologies to study the absolute and relative timing and the formation mechanisms of fault-related opals in order to provide a unique record of long-term fault activity.

We distinguish between two main types of fault-filling material: (1) post-tectonic material, occurring as undisturbed massive or reworked material, mainly of opal mineralogy, but also containing various proportions of clay, carbonate soil, and other detrital components; and (2) syn-tectonic authigenic opal, occurring as cementation of sheared sigmoidal or breccia structures and as filling of injection or syn-deformational veins. For opal samples with high U concentrations (>50 ppm), multiple SHRIMP-RG (Sensitive High Resolution Ion Microprobe – Reverse Geometry) spot analyses allow the construction of Tera-Wasserburg concordia age. The combined microstructural, geochemical and geochronological results indicate that post-tectonic material accumulated in the fault zone by prolonged fluid infiltration and evaporation processes, as evident by the high U + REE concentrations and the very slow growth rates (0.5 mm/Myr). In contrast, syn-tectonic opals precipitated relatively fast (10 mm/Myr) by localization of pressure solution on fault surfaces and/or associated with high fluid-pressure. Crosscutting relationships and relative ages indicate multiple deformation phases within a single sample. The deformation history established in this study supports the interpretation of highly localized slip zones (< 5 cm wide), characterized by 2 to 3 distinct events reoccurring within a specific structure. The longevity of the seismic zone can be estimated by the range of ages for a specific structure; thus far, longevity varies from 2.5 to 8.8 Myr.