Evidence for slow slip in Mecca Hills, CA, from microstructural and (U-Th)/He analysis of heterogeneous hematite coatings on shallow fault surfaces

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1 Motivation
Why Mecca Hills?
- Faults in the Mecca Hills are subparallel to the San Andreas Fault (SAF) and exhumed basement rocks overlain by sediments. Studying exhumed fault zones may illuminate deformation processes that are ongoing within the SAF.
- Triggered slip events are observed on the SAF through Mecca Hills (e.g., Williams et al., 1988; Tymofyeyeva et al., 2019). Microearthquakes occur on the SAF at 3-4 km depth near Painted Canyon.
- Multi-scale microscopy and thermochronometry of exhumed upper crustal strike-slip fault rocks can inform the role that heterogeneous rheology plays in promoting slow slip events.

Why hematite?
- Hematite is a common mineral that precipitates in shallow fault zones and coats minor slip surfaces. It is also a stable mineral that can retain heat for long periods of time.
- Platy hematite resembles phyllosilicate minerals - Hematite is a ferric oxide (Fe₂O₃) mineral that often forms thin, plate-like crystals.

3 Hematite Occurrence

4 Hematite Morphologies

5 Comparison with Other Phases

6 (U-Th)/He Thermochronometry

7 Implications
Evidence for fluidization, episodic hematite precipitation, and subseismic deformation

8 Ongoing and Future Work
- Analyses of 47 new hematite (U-Th)/He aliquots in Fall 2020 at University of Arizona, depending on sample mineralogy, multiple surfaces from a single hand sample, one mirror-like surface, and a hematite sample from outside main PCF damage zone (whereapatite dates are against). All with 150 °C of (U-Th)/He dates.
- Field work in Fall 2020 - mapping fault rock alteration in relation to basement geology and hematite-coated slip surfaces and investigation of wet-related alteration and hematite mineralization. Petrography - providing greater context for hematite and co-occurring phases and identification of green and red-brown phyllosilicate minerals
- Continued SEM analyses - characterize hematite, clay, and silica

Transmission Electron Microscopy at University of Utah Nanofab Surface Analysis Lab to evaluate: (continued)
- Low-velocity shear experiments - can these textures and structures be reproduced at slower slip rates and can hematite display velocity strengthening behavior?