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## Collaborative Research: Identifying Shallow Slow Slip using Hematite Tectures and (U-Th)/He Thermochnometry of Exhumed and Experimental faults

Alexis Ault

Utah State University, alexis.ault@gmail.com

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# DATA MANAGEMENT PLAN – UTAH STATE UNIVERSITY & BROWN UNIVERSITY

## Collaborative Research: Identifying shallow slow slip using hematite textures and (U-Th)/He thermochronometry of exhumed and experimental faults

This project will comply with the Division of Earth Sciences (EAR) National Science Foundation Data Sharing Policy.

### 1. Samples and data types

Field samples including hematite-coated fault surfaces, clay-coated slip surfaces and gouge, and crystalline bedrock will be collected for microstructural, petrological, geochemical, geochronological analysis. Hematite slip surfaces from Mecca Hills (from proposed field work and/or samples collected in January 2020) and the Wasatch fault zone (stored in Ault's M<sup>2</sup>SL lab; samples from McDermott et al., 2017; McDermott and Ault, in prep.), as well as a specular hematite boulder (Calzolari et al., 2020) will be used for rock deformation experiments. Each sample will be given a unique sample ID and information including location (collected with GPS using WGS84 and decimal degrees), lithology, field photographs, and a field description, all recorded in a field notebook. Fault surface samples will additionally include fault orientation data (e.g., strike, dip), slickenline orientation data (e.g., trend, plunge), and kinematic data (e.g., sense of slip, offset). Polished 1" round mounts and Cu-tape mounts of rough fault materials will be made from select samples for SEM and Raman analyses. Select surfaces will be dissected using the Nanofab's FIB-SEM to create lamella for S/TEM analyses.

Hematite aliquots, extracted from fault surfaces with fine-point tweezers, razor blade, and/or a Dremel tool, will be stored in labeled petri dishes and vials with appropriate sample ID information. Prior to (U-Th)/He analysis, hematite aliquots will be pre-screen via SEM for aliquot purity and target aliquots will be photographed with cameras attached to picking microscopes. Aliquot and crystal descriptions and grain size information where appropriate will be recorded in Microsoft Excel workbooks.

### 2. Data and metadata standards

Data will be compiled and stored in Microsoft Excel or ASCII format. Location information (GPS coordinates) will be compiled in decimal degrees using the World Geodetic System (WGS) 1984 datum. Unique sample IDs will be used for each sample location and sample type. A summary table will be generated that includes the unique Sample ID, the GPS location and information on the sample type, the types of analytical results available for these samples, date of analysis, and the laboratory where analysis was conducted. Table 1 presents examples of analytical data types and metadata acquired in this project.

**Table 1.** Analytical data and metadata for each analytical suite

Analysis	Categories
Every sample type or analytical suite	Project name Project scientist/collected by Unique sample ID Sample type Location (UTM or Lat, Long: using WGS 1984 datum), elevation (m) Laboratory and instrumentation Analytical method if applicable Comments
Rock deformation experiments	Sample ID Torque (Nm), Normal force (MPa) Normal and angular displacement, $\delta$ (mm) Surface temperature ( $^{\circ}$ C) Friction coefficient, $\mu_0$ , $\mu_w$
SEM, EBSD	Sample ID Analysis type and detector Operating conditions (e.g., magnification, accelerating voltage, beam size, vacuum pressure, working distance, dwell time) SEM images (BSE, SE); EDS images (counts) and spectra over image area EBSD phase maps, orientation data managed in Aztec software
S/TEM imaging and EDS	Sample ID Analysis type Operating conditions (e.g., magnification, accelerating voltage, beam size, vacuum pressure, working distance, dwell time)

	Image locations on wafer catalogued S/TEM images, bright field and darkfield; EDS images (counts) and spectra over image area TEM, HRTEM, FFT, and IFFT images, ronchigrams
Hematite (U-Th)/He analysis	Sample ID, UA ARHDL lab code $^4\text{He}/^3\text{He}$ ( $1\sigma$ error), He (ppm); line blanks, cold blanks, hot blanks, gas standards Isotope ratios (238/233, 238/235, 238/236, 232/229, 232/230, 152/147, 44/42; $1\sigma$ uncertainty); spike blanks, spike normals U, Th, (ng, $1\sigma$ error); U, Th, (ppm, $1\sigma$ error); calculated eU from grain morphology and Ca-based mass ( $1\sigma$ error) Date (Ma, $1\sigma$ error) – uncorrected as typically no FT correction is applied
Hematite $^4\text{He}/^3\text{He}$ analysis	Sample ID, UA ANGL lab code $^4\text{He}$ (atoms, $1\sigma$ error), $^3\text{He}$ (atoms, $1\sigma$ error); line blanks, cold blanks, hot blanks

### 3. Policies for Data Access and Sharing

The data and metadata generated from this project will be published in peer-reviewed, widely available scientific journals and through presentations at national conferences. All data from natural and experimental fault rocks will be made accessible in two ways. First, microscopy images and spectroscopy data, numerical data associated with the calculation of dates by (U-Th)/He,  $^4\text{He}/^3\text{He}$  diffusion data, and deformation experiment data and parameters (i.e., temperature, pressure, displacement, force, etc.) will be published either directly within these journals or as supplementary data tables and files in the journals' linked online databases.

Secondly, data will be made publicly available simultaneous with submitted manuscripts being accepted for publication. Microscopy and spectroscopy data will be made available through publications and USU's open access Digital Commons website (<http://digitalcommons.usu.edu/>). Digital Commons is managed through the USU Merrill-Crazier Library. This archive is organized by discipline (e.g., Earth Sciences) and sub discipline (e.g., Geochemistry, Tectonics) allowing for easy searching and data access. Thermochronology data acquired by USU personnel will be made available to users, free of charge, using the EarthChem database (Earthchem.org) using the (U-Th)/He templates or in Digital Commons. For experiments, will archive the run conditions, raw digital records of the data, purpose of experiment, and experimental assemblies used in the LabArchives data base in coordination with MIT for our collaborative effort: CORD – Coordinated Organizations for Rock Deformation.

### 4. Policies for Data Re-use and Redistribution

Publication of data in peer-reviewed scientific journals will occur during the project and at the end of the project. Data will be made available publicly through USU Digital Commons, EarthChem, and LabArchives once submitted manuscripts are accepted for publication, depending on the publication location and requirements. Data not published within 5 years of the end of the project will be made publicly available.

### 5. Plans for Archiving and Preservation of Samples

In addition to data products produced during this project, samples will require archiving. Hand samples, mineral separates, aliquot/sample mounts for SEM, and S/TEM wafers related to rock samples collected by project personnel will be archived in Ault's M<sup>2</sup>SL in the USU Department of Geosciences. Tables of GPS locations, lithology, and map units for each sample will be published in journal articles that present the project results, but will be archived at USU with each sample and be available upon request. Rock deformation experiment starting materials and end-products will be archived at USU and Brown University.