Project EARTH-16-LH1: A new method for high-strain deformation of rocks in the laboratory: Equal-channel angular pressing at high temperatures

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A variety of large-scale geodynamic processes rely on feedbacks and instabilities that occur during large deformations of rocks. For instance, the formation of new tectonic plate boundaries requires deformation to localize into narrow high-strain shear zones. This localization is thought to result from the microstructural evolution that occurs during deformation: grain-size reduction, mineral phase segregation or mixing, and fabric development. Unfortunately, our understanding of the interplay among these phenomena is hindered by the difficulty in recreating large, complicated deformations in the laboratory.

This project aims to develop a new technique for exploring large deformations in laboratory experiments. Equal-channel angular pressing (ECAP) is a technique that has been developed in the Materials Sciences for large deformations of metals at room temperature. Importantly, this technique allows a single sample to undergo multistage strain histories to large deformations. However, it has not yet been applied to materials like rocks that are brittle at room temperature. The student will develop this technique for application to rocks at high temperatures (~1400ºC), and experiments will be conducted to test models of microstructural evolution during complicated strain paths.

Methods will include laboratory-based synthesis of synthetic rocks, experimental apparatus design, high-resolution electron microscopy (EBSD), and numerical modelling of microstructural evolution.