Deep Ocean Exploration Institute
Final Project Report

Project Title: ***Microtomography Of Fluid Distribution In Subducted Sediments: A New Experimental Approach To Constraining H2o Cycling In Subduction Zones***

PIs: Glenn Gaetani (G&G) & Véronique Le Roux (G&G)

What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

Large amounts of water are carried into the deep Earth via subduction (downward movement of the edge of an oceanic plate). A major open question is how much of this subducted water is released from the plate and brought up to the surface with magmas, and how much remains trapped into the plate and is carried deeper into the Earth. This is a key question to understand the cycling of volatiles and volcanism on Earth.

What have you discovered or learned that you didn't know before you started this work?

This is the first study that has investigated the 3-D distribution of water in experimental analogs of oceanic rocks. We found that the selected rock analogs that constitute the oceanic plates can retain different amounts of water (ranging from 0.5 % to 1.5 %; see figure 1 for an example), which may eventually be recycled in the deep Earth.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

The results are exciting because we show that it is possible to quantify by 3-D image processing how much water may be retained in subducted rocks if water escape by porous flow. This has never been done before.

What were the greatest challenges and difficulties?

From making the samples in the laboratory to imaging it at a national photo source facility, there were several critical steps where the sample could have been lost. Thus, a significant challenge was to be able to preserve the experimental sample. One of the other challenges was to get familiar with the 3-D image processing software which none of the PIs had used before. This has been very successful, resulting in the purchase of the software and possible independent use by a guest student (trained under the guidance of the PIs). Technical challenges have given us new ideas to improve the experiments in the future.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

This investigation was conducted from 2011 to 2013, using the experimental laboratory of G. Gaetani at WHOI (to make the samples), the Argonne National Laboratory for microtomography data (to image the samples in 3-D), and the commercial software Avizo to process the 3-D data (available in Le Roux’s laboratory).

Is this research part of a larger project or program?

This research has given the PIs the opportunity to obtain exciting preliminary results. A full proposal is now pending at NSF. The work has been presented at Goldschmidt in summer 2013 by PI Gaetani and will be presented at AGU by PI Le Roux this Fall.

Please provide photographs, illustrations, tables/charts, and web links that can help illustrate your research.

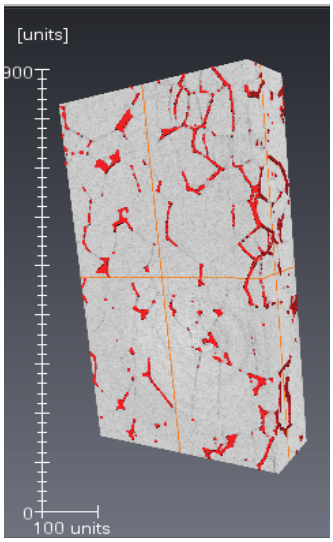

Figure 1: grey is carbonate, red is pore space (former water network). The experimental sample is about 700 x 300 x 100 µm. The processing software provides information on the connectivity of the water network, i.e. the capability of the water to escape from the system (analog of subducted oceanic plate). Here the carbonate contained approximately 1.5 % of water, 30 % of which was trapped in the system.