Canadian Space Agency (ASTRO) Report

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Under the supervision of Dr. Desmond Moser, at Western University, my summer research covered a broad spectrum of Earth & Planetary–related activities. Working on numerous samples, including some from well-known impact structures such as Vredefort and Sudbury, I focused mainly on collecting, processing as well as imaging and analyzing individual grains.

In order to properly analyze the samples, they had to first be carefully processed. Processing techniques that I learned included Wilfley table hydro-separation, Frantz magnetic separation, heavy liquid separation (with LST), grain picking and mounting (both on carbon tape and in epoxy), and carbon coating. These techniques made it easier to analyze the samples. Perhaps the most interesting processing technique that I learned over the summer was using the Electric-Pulse Disaggregator (EPD). This machine is one-of-a-kind in Canada, and is used to separate a whole rock into its individual grains. This technique is a substitute for mechanical crushing, which is time consuming and can possibly affect the microstructures in grains. I took part in the testing of the EPD, and at the end of the summer we had it running to its full potential. Analysis of the grains separated by the EPD did not seem to show any form of EPD-induced 'trauma,' meaning that the EPD will be available as a more efficient alternative to mechanical crushing in the future.

Once the samples had been properly processed, I analyzed hundreds of grains using the Hitachi SU6600 FEG-SEM and the Hitachi S2500 SEM. The underlying theme of the summer was to gain familiarity of microstructures in minerals such as zircon, monazite and apatite from known impact sites such as Vredefort and Sudbury, with the eventual goal of identifying possible features in samples of Nuvvuagittuq greenstone belt in northern Quebec. The Nuvvuagittuq belt holds some of the world's oldest crust, possibly as old as 4.3 billion years. Using various imaging and analytical techniques, including Back Scatter Electron (BSE), Secondary Electron (SE), Electron Back Scatter Diffraction (EBSD), Energy Dispersive X-Ray Spectroscopy (EDS), and Cathodoluminescence (CL), I put together a database of microstructures (approximately 600 images) from known shock environments. These images can be used in the future for comparison when looking for definitive impact microstructures in other minerals such as apatite, zircon, or monazite. Some of the microstructures that I saw included Planar Deformation Features (PDF's), Planar Features (PF's), and Curviplanar Features (CF's).

In a supporting project, I worked with Dr. Roberta Flemming, in hopes of obtaining a unit cell for monazite that would work for Electron Back-Scatter Diffraction (EBSD), as all prior attempts at doing EBSD on monazite had been failures. Using a single grain of monazite from the Vredefort Impact Structure and analyzing it under the Micro-XRD at Western, I was able to refine the unit cell. After more failed attempts at EBSD work, we finally decided that it wasn't the unit cell that was the problem, but rather something else within the software. Once we figure out the problem, this will lead to further work with EBSD on monazite in order to visually map impact microstructures on the grains.

As a result of the experience I gained in the laboratory this summer, I will be able to further my investigation into impact microstructures and Earth & Planetary-related research. This summer has allowed me to gain familiarity and knowledge that will be useful and applicable to my undergraduate thesis this coming Fall/Winter, under the supervision of Desmond Moser as well. Hopefully this will include further work on Nuvvuagittuq samples, as they are an important potential mineral archive of the Late Heavy Bombardment purported to have affected the inner solar system.

ASTRO Cluster Program

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