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Report Summary

My research this summer, under the supervision of Dr. Christopher Herd, was conducted on the University of Alberta's sample of Tissint, a Martian meteorite which fell to Earth in the summer of 2011. Tissint is only the 5th Martian meteorite fall in history the first samples of which were collected in October 2011 in the Oued Drâa area of southern Morocco near the Algerian border, SSW of the village of Tissint for which the meteorite is named. Of the roughly 17 kg of material recovered, the U of A purchased a single piece with a mass of 58.247 g, which was accessioned to the University of Alberta Meteorite Collection as MET11640. My work involved sample processing, oxygen fugacity calculations, bulk compositional analysis and production of a synthetic 'Tissint-like' composition for conducting crystallization experiments.

The first step in sample processing was to produce a 3D digital scan of the original sample in its entirety. This was done so as to both preserve an accurate visual model of the meteorite prior to cutting it, and provide a simple means by which to measure its volume for the purpose of calculating the meteorite's density. Following this the sample was cut into a number of different pieces using a special low-speed saw purchased specifically for the purpose of cutting meteorites. All cutting on the meteorite was done dry (i.e. without any form of lubricant) so as to avoid contaminating or altering the sample, and all cuttings in the form of dust and small fragments jarred loose by the action of the saw were collected for further analysis. Cuttings were sent to the University of Alberta SLOWPOKE nuclear reactor facility for Instrumental Neutron Activation Analysis (INAA) in order to determine the bulk composition of Tissint. A sample of quartz cuttings which had been produced by cutting with the same saw blade as was used on

Tissint were also analyzed in order to quantify contaminates introduced by the saw blade in the cutting process.

Several of the sections cut from Tissint were further processed into thin sections which I was able to look at both with a petrographic microscope, and an SEM. This allowed me to produce a brief petrographic description, and take a number of high magnification images of the textures found in the shock melt pockets which are present throughout the meteorite, sometimes in very large abundance. The thin sections were also intended to be used for Electron Microprobe analysis, in order to determine the composition of the various mineral phases and from those calculate the oxygen fugacity under which the meteorite crystallized. However, I was unable to carry out these analyses as the U of A's EMP was under repairs for much of the summer research period. Preliminary fO_2 calculations were made using published data, which unfortunately proved insufficient to accurately constrain the oxygen fugacity, although highlighting the need for more detailed studies.

Based on preliminary results from the INAA and published ICP-MS compositional data, we were able to synthesize a bulk composition modeling that of the Tissint parental melt from oxide powders. By the end of my summer research term this synthetic composition had been homogenized by several rounds of melting, and quenching and I had carried out phase modeling with the alphaMELTS program to determine liquidus temperatures and phase relationships during crystallization. As such, I was able to complete work that will form the basis of other research to complete in future.