SEARCHING FOR A HIDDEN POPULATION OF IRON METEORITES BELOW THE ANTARCTIC ICE. William J. Oldroyd[1] and Jani Radebaugh[2], [1]Department of Physics and Astronomy, Brigham Young University, Provo, UT 84602 (will.oldroyd@gmail.com), [2]Department of Geological Sciences, Brigham Young University, Provo, UT 84602 (jani_radebaugh@byu.edu).

Introduction: Meteorites are essential tools for understanding the dynamics of our early solar system, its composition, and formation. The models used to study this synthesizing process rely not only on the composition of the meteorites themselves, but also on their relative abundances. It is suspected that the current percentage of iron meteorites discovered is significantly lower than the actual abundance due to a series of thermal processes which cause iron meteorites in Antarctica to melt down through the icy surface at depths on the order of tens of centimeters (Fig. 1) [1].

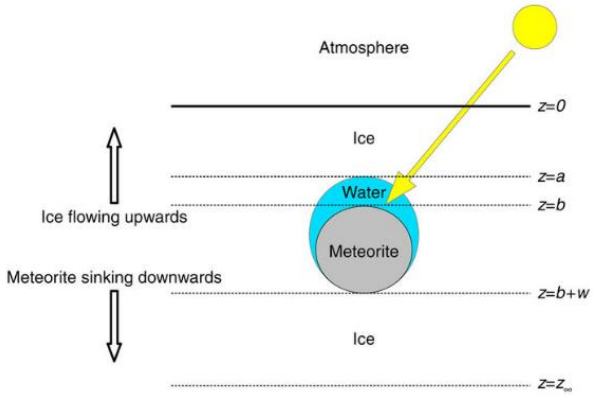

Figure 1. Zones of energy transfer in the meteorite ice system. Incoming solar flux penetrates the ice and warms the meteorite, which causes it to melt through the ice around it and sink. The ice sheet acts in opposition to this phenomenon allowing for an equilibrium depth to be reached. This diagram is not to scale. (This is figure 3 from Evatt et al., 2016 [1]).

Antarctic meteorite collection has been going on for more than 40 years. Because of ice sheet flow dynamics, meteorites migrate with the overall movement of the sheet and collect in pockets called meteorite collection zones. These meteorites may have fallen thousands of years ago; hence, this collection effort yields a representative sample of all the meteorites that fall on Earth. This is in contrast to the total number of meteorites found globally due to a strong bias towards iron-rich meteorites.

Nearly 70% of meteorites recovered worldwide are found in Antarctica [2]. Out of this large portion of discovered meteorites, only about 1% of Antarctic finds are iron meteorites. This is in contrast to the roughly 5% of observed worldwide falls that are iron meteorites (Fig 2.) [3]. Meteorite falls are believed to be representative of the actual population of meteorites present in the Solar System. This discrepancy in percentages supports the sinking meteorite hypothesis, which may be verified as these extraterrestrial treasures are excavated.

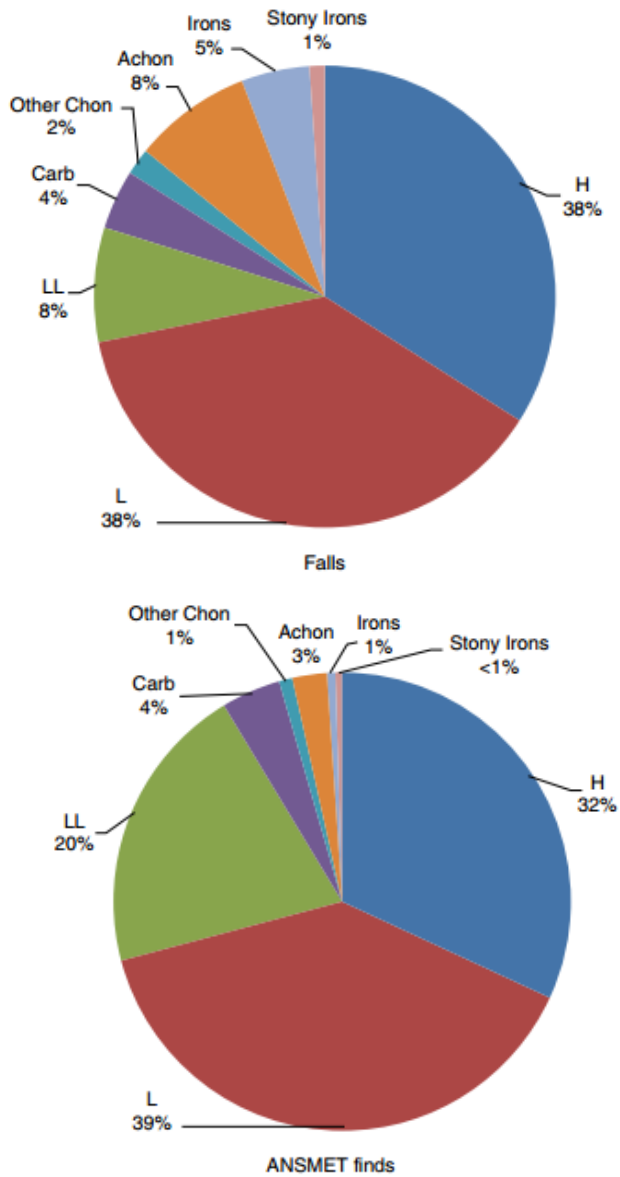

Figure 2. Distribution of meteorite type for worldwide falls (top) and meteorites found in The Antarctic Search for Meteorites (ANSMET) (bottom). (Modified from figure 10.6 from Corrigan et al., 2015 [3]).

Methodology: Using a pyronometer, the solar flux can be measured at varying depths and at different sites

in order to determine how much energy can be absorbed through the Antarctic glacial terrain. Dr. Jani Radebaugh is currently in Antarctica taking these data. Upon her return we will compare the data to laboratory analogues, such as man-made approximations to Antarctic conditions and corresponding local glacial features in the Rocky and Uinta Mountains. Using Matlab, we will write code that will model the thermodynamic interaction between meteorites and their surroundings accounting for a wide range of variable parameters including thermal conductivity, heat capacity, meteorite and ice densities, ice sheet heave velocity, incoming solar flux, air temperature, meteorite composition and size, as well as other factors. Comparison to past meteorite collection seasons may also prove useful in reaching conclusions. Our preliminary results will be presented at this conference. It is hoped that the result of the mathematical analysis will yield an estimate of the depth at which this population of iron-rich meteorites may be located.

Implications: Provided that the results are conclusive, they will pave the way for new meteorite collection techniques involving the recovery of these important astrophysical indicators. These extraterrestrial geological samples are extremely valuable because they formed early on and are one of the only remaining features of the early solar system. The relative abundances of iron and stony meteorites shape our understanding of what our solar system was made of and how all the pieces came together. The discovery of an additional population of iron meteorites would change our estimates of the iron/stony meteorite ratios and subsequently adjust our understanding of early solar system composition. The solar flux data we will take may also be used to help determine the environmental limit for photosynthetic extremophiles in icy habitats.

References: [1] Evatt G. W. et al. (2016) *Nat. Com., 7,* 10679. [2] *Meteoritical Bulletin Database* (2013). [3] Corrigan C. M. et al. (2015) *35 Seasons of U.S. Antarctic Meteorites (1976-2010),* 184, Print.