METEORITE IDENTIFICATION AND CLASSIFICATION USING MAGNETIC SUSCEPTIBILITY. A. ElkShoulder[1], J. Franklin[1], O. Yawea[2], K. Gchachu[2], J. Simmons[2], B. A. Cohen[2], and H. E.Newsom[2], [1]Southwestern Indian Polytechnic Institute, Albuquerque, NM 87120, USA (http//:www.sipi.bia.edu), [2]University of New Mexico, Albuquerque NM 87131.

Introduction: The purpose of this project is to distinguish between meteorites and earth rocks. This is done both for scientific knowledge and as a service to the public. Another purpose is providing research experience for Native American students from the Southwestern Indian Polytechnic Institute. The presence of iron-nickel metal is an important characteristic of most meteorites. Magnetic susceptibility is an excellent method to measure the metal content without destroying the integrity of the meteorite sample, or ruining a nice display specimen. The metal content is also an important aspect of meteorite classification.

Procedure: Magnetic susceptibility measures how the sample responds to a magnetic field. The higher the metal content of the meteorite, the higher the magnetic susceptibility value. We can use this method to test suspect meteorite samples and to identify the type of meteorite, because different varieties of meteorites have different amounts of metal. Rochette et al. [1] and other papers [2, 3] established the range in magnetic susceptibility for various meteorite groups.

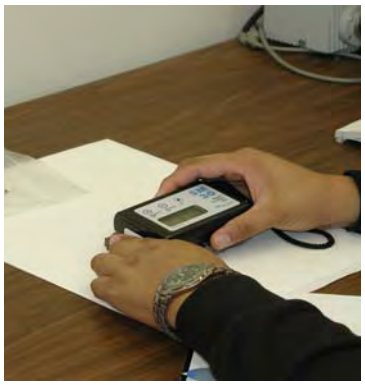

Fig. 1a. Sample of the "Chico" meteorite being measured on contact with SM-30 susceptibility meter over a wooden table.

The instrument used for the measurements is the SM-30 Magnetic Susceptibility Meter, (TERRAPLUS USA INC. 625 Valley Road Littleton, Colorado 80124). It operates at a frequency of 9 kHz with measurement times of 5s for basic mode and 8s for drift correction modes. The meter contains an oscillator with a pickup coil. The frequency of the oscillator depends on the distance of the meter from rock. The change in frequency is proportional to the amount of susceptibility of the rock. To find out the change it is necessary to measure the oscillator frequency twice. The pick-up step or first measurement is held near the rock. The compensation step or second measurement is carried out when the meter is held away from the rock (free air measurement).

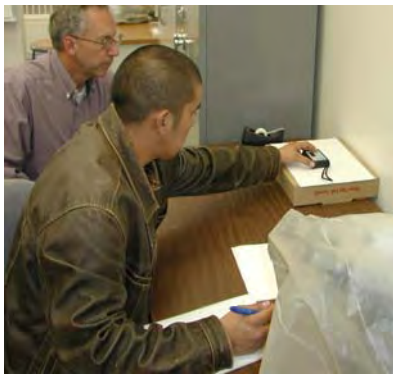

Fig. 1b Joey Franklin and Professor Horton Newsom taking a background measurement.

After the completion of the measurement steps, the values are subtracted and displayed. A correction is also needed for density. The terrestrial samples are considerably lower in density than the meteorite samples. The density correction is applied as part of the calculations performed be the spreadsheet provided by P. Rochette.

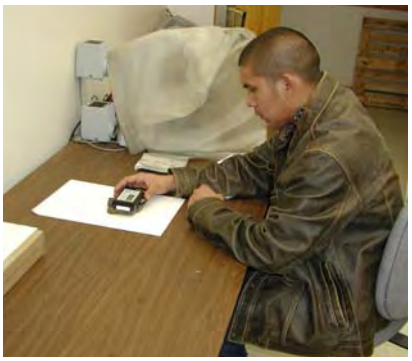

Fig. 1c. Joey Franklin measuring a meteorite sample with the magnetic susceptibility meter.

Results: The results of the SM-30 measurements on 8 different meteorite samples are shown in Figure 2. The log X for the samples are consistent with the presence of metal and overlap the ranges for metal-bearing meteorites as shown by Rochette et al. [1] (Figure 2). For example, the ability of the magnetic susceptibility measurements to reflect the meteorite classification can be seen by detailed comparisons between the results in figure 2 and the literature data in figure 3. For example, "El Hammami" which is classified as an H meteorite has log X values between 5 and 5.5 (Figure 2). These values fall in the range of values for H chondrites measured by Rochette et al, (Figure 3). This

shows that the "El Hammami" meteorite has a classification consistent with values established by earlier measurements [1]. Another example is "Bison, Kansas" which falls in the range transitioning between 3.5 and 4.5, consistent with the classification of this meteorite as an LL class meteorite.

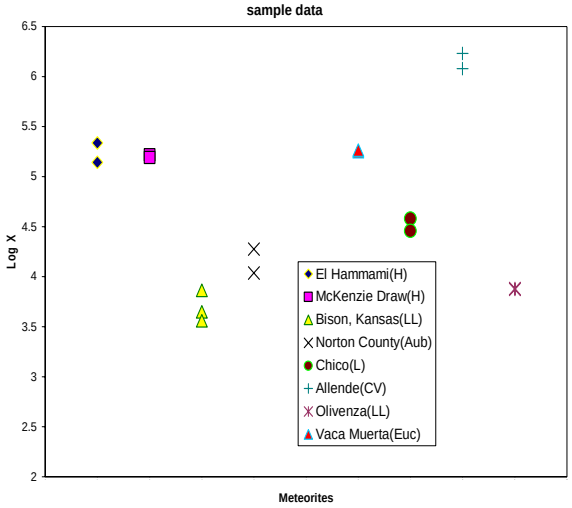

Fig. 2. Samples of 8 meteorite specimens measured by SM-30 susceptibility meter at the University of New Mexico.

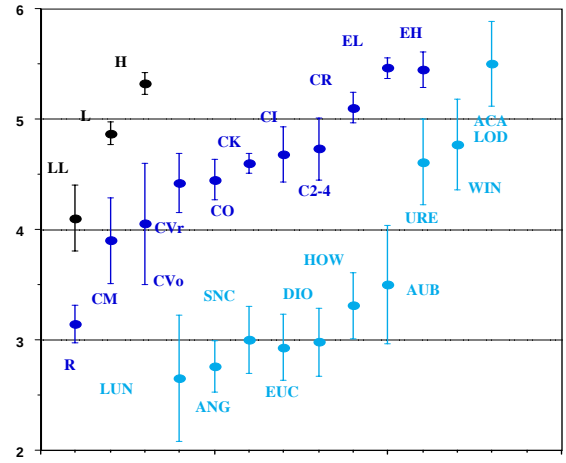

Fig. 3. Susceptibility mean value chart from Rochette et al. [1, 2].

Future work: Magnetic susceptibility can also be used to determine the distribution of metal nuggets in larger meteorites. Of particular interests to us is the Institute of Meteoritics' large sample of the Norton County aubrite. Aubrites are differentiated stone meteorites with small amounts of metal. Previous studies have suggested that aubrites formed though partial segregation of metal, leaving sizable metal nodules inhomogeneously trapped in a silicate mantle [4, 5]. Using the SM-30 to study the distribution of metal in Norton County and other large, intact meteorite specimens will be an important project for understanding the distribution of metal in chondritic meteorites, and metal-silicate fractionation during differentiation of meteorite parent bodies.

Educational outreach support and goals: This student research project is part of a program at the Southwestern Indian Polytechnic Institute (SIPI) in collaboration with the University of New Mexico entitled "Stars on Earth, Space Science Research Experience and College Preparation for Underrepresented Secondary Students". Fugnding for the program is provided by the NASA-EOSS, OEOP, program entitled "Minority University Education and Research Partnership Initiative in Space Science" (MUCERPI). This program provides under-represented high school students and college students with research experience in space science and technology-based academic preparation in math, science, engineering and technology (MSET). SIPI college students also benefit from the establishment of new courses in Earth and Planetary Science and astronomy, and the opportunity to be involved in related research projects at the University of New Mexico. The research activities include a meteorite identification program, and research on martian impact craters and analog materials.

Conclusion: The positive results of our magnetic susceptibility meter measurements confirm the usefulness of this technique for meteorite identification and classification. We plan to continue with additional in-depth studies of samples from the collections of the Institute of Meteoritics as well as characterize suspect meteorites using this technique.

References: [1] Rochette P. et al., (2003) *MAPS* 38, 251-268 [2] Rochette P. et al, (2004) *LPS XXXV*, Abstract # 1132. [3] Gattacceca J. et al, (2004) *Geophys. J Int. 58*, 42-49, [4] Casanova I., et al. (1993), *Geochimica et Cosmochimica Acta 57*, 675-682 [5] Casanova I. et al. (1993) *LPS XXIV*, 259-260.
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