**Magnetic properties of primitive achondritic meteorites GRA 06128 and GRA 06129.** J. Geissman[1] and C.K. Shearer[2]. [1]Dept. of Earth and Planetary Sciences, Univ. of NM, Albuquerque, NM 87131 (jgeiss@unm.edu), [2] Institute of Meteoritics and Dept. of Earth and Planetary Sciences, Univ. of NM, Albuquerque, NM 87131.

**Introduction:** Newly discovered achondritic meteorites GRA 06128 and 06129 (GRA) are somewhat unusual meteorites that contain a high percentage of sodic feldspar (~ $An_{15}$) with Fe-rich silicates (olivine, high-Ca and low-Ca pyroxene), two phosphates, oxides, sulfides, and Fe,Ni-metal [1,2,3,4,5]. $^{26}$Al-$^{26}$Mg isotope measurements and a variety of chemical-mineralogical characteristics indicate that these meteorites represent products of very early planetesimal melting (4565.9 ± 0.3 Ma) of an unsampled geochemical reservoir from an asteroid that has characteristics similar to the brachinite parent body [1]. Superimposed upon the initial crystallization event are several other events that represent subsolidus reequilibration-metamorphism and fluid interaction. Our intent in this abstract is to examine the magnetic properties of GRA 06128 to gain insights into its evolving mineral assemblage and the environment under which GRA obtained its magnetism.

**Analytical approach:** Magnetic properties of GRA were measured at the University of New Mexico using a DC-SQUID based superconducting rock magnetometer (2G Enterprises), housed in a low magnetic induction space. The specimen mass used for all magnetic measurements was about 120 mg. First, the specimen was subjected to repeated measurements of the natural remanent magnetization (NRM) to test for viscous remanent magnetization (VRM) acquisition. Alternating field (AF) demagnetization was utilized to a peak field of 120 mT, to examine the character of the remanence carried by relatively low coercivity phases. An anhysteretic remanent magnetization (ARM) was acquired in a DC field of 0.1 mT and a peak AF of 98 mT. Acquisition of an isothermal remanent magnetization (IRM) to near saturation (SIRM) utilized a pulse DC impulse magnet to about 3.0 T. Backfield pulse DC demagnetization of near saturation IRM was conducted until IRM changed sign. AF demagnetization of IRM imparted in a pulse DC field of 98 mT was carried out to 100 mT. The specimen was subsequently mounted in pure alumina cement to make a thermally resistant specimen of cubic shape, and subjected to progressive thermal demagnetization to over 670ºC of three-component IRM, acquired in orthogonal fields of 3.0 T, 0.3 T, and 0.03 T, following the method of Lowrie [6].

**Results:** The natural remanent magnetization (NRM) moment of the UNM specimen is 1.94 x $10^{-6}$ emu (intensity of 16.08 x $10^{-6}$ $Am^2/kg$) (Figure 1). Progressive alternating field demagnetization of the GRA specimen measured indicates that the meteorite NRM may contain at least two components. Alternating-field (AF) demagnetization to 95 mT randomizes less than 50 percent of the NRM; at higher peak fields demagnetization behavior is more erratic. A possible higher coercivity component only partially responds to AF demagnetization and thermal demagnetization of NRM. Intensity of anhysteretic remanent magnetization (ARM) is about 81.0 x $10^{-6}$ $Am^2/kg$ and over a factor of 6 higher than NRM. The intensity of ARM as well as AF demagnetization response to ARM indicates that a considerable fraction of moderate coercivity phases is present that does not contribute to the NRM (Figure 2). Acquisition of an isothermal remanent magnetization shows nearly complete saturation at about 3.0T, and backfield DC demagnetization of near-saturation IRM yields an estimate of coercivity of remanence of about 280 mT. The near saturation IRM intensity is about 2970 x $10^{-6}$ $Am^2/kg$, and yields an ARM/SIRM ratio of approximately 0.027. Comparison of AF demagnetization of ARM and near-saturation IRM suggests the presence of fine, single domain to pseudo single domain ferrimagnetic particles in the specimen (Figures 2 and 3). In addition, the very low crossover value ($R < 0.1$) for IRM acquisition and AF demagnetization of near saturation IRM at least suggests the possibility of strongly interacting magnetic phases [7,8]. Thermal demagnetization of three component IRM suggests that the magnetization is carried by high-coercivity phases with laboratory unblocking temperature intervals that center on ~350°C, ~ 570°C, and ~675°C that are likely pentlandite, a Fe-Ni metal, and hematite, respectively (Figure 4). Thermal demagnetization of both the high (>3.0 T) and intermediate ($0.3< H<3.0$T) coercivity components also suggests the possibility of the thermal destruction of iron hydroxide phases between about 100 and 200°C. The intermediate and lowest field (coercivity) (< 0.03T) components show a ~complete unblocking below about 570°C, and this response is consistent with the observed occurrence of Fe,Ni metal. Notably, the response to thermal demagnetization of three component IRM does not suggest the generation of abundant new magnetic phases that could be reflected in an increase in the intensity of one of the components during progressive heating.

**Discussion:** Based on the available rock magnetic and demagnetization data for GRA 06129, the origin of the remanence present in this sample is difficult to determine with confidence. The available data are not inconsistent with the remanence being a weak field thermoremanent magnetization (TRM) blocked over a range of temperatures below about 680ºC. Progressive thermal demagnetization of NRM, on a separate sample, is required to more adequately evaluate this hypothesis. Alternatively, the remanence could be an elevated temperature chemical remanent magnetization (TCRM). The paragenesis of the remanence carrying magnetic phases is critical in assessing this possibility.

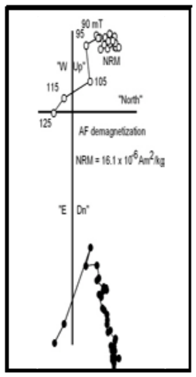


Figure 1. Response to progressive alternating field demagnetization of the natural remanent magnetization (NRM). Orthogonal demagnetization diagram, where the "horizontal" component of the remanence is projected onto the "N"-"E" plan and the "vertical" component of the magnetization is projected onto the "N"-"Up/Dn" plane. Peak demagnetizing fields in mT given along some vertical projection data points.

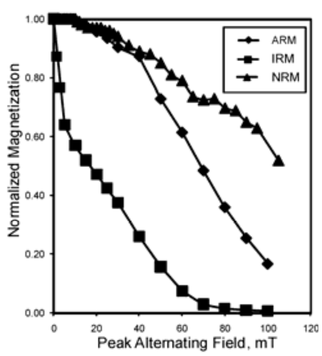


Figure 2. Plot of normalized magnetization intensity vs. peak alternating field strength, in mT, showing response of natural remanent magnetization (NRM), isothermal remanent magnetization (IRM) acquired at 98 mT, and anhysteretic remanent magnetization (ARM) acquired with a DC field of 0.1 mT and a peak alternating field of 98 mT.

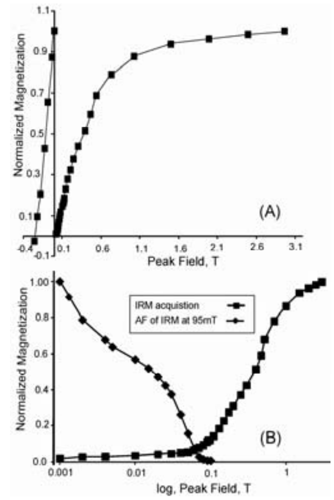


Figure 3. (A) Normalized acquisition of isothermal remanent magnetization (IRM) to a peak field of 3.0 T, and backfield direct field demagnetization. (B) Semi-log plot of normalized IRM acquisition and alternating field demagnetization of IRM acquired at 95 mT.

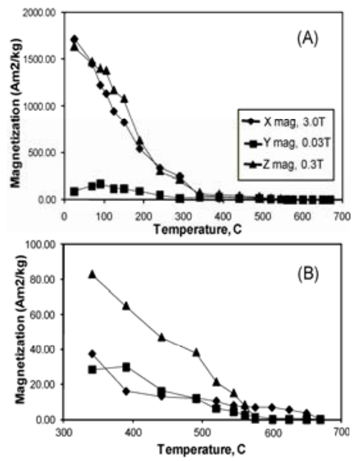


Figure 4. (A) Results of progressive thermal demagnetization of three-component isothermal remanent magnetization (IRM) acquired in fields of 3.0 T, 0.3T, and 0.03T. (B) Same, but showing detail at 340C and higher demagnetization temperatures.

**References:** [1] Shearer et al. (2008) Am. Mineral. 93, 1937-1940. [2] Shearer et al. (2010) GCA 74, in press. [3] Trieman et al (2008) LPSC XXXIX, abst.# 2215, [4] Ash et al. (2008) et al (2008) LPSC XXXIX, abst.# 2271, [5] Zeigler et al (2008) LPSC XXXIX, abst.# 2456, [6] Day et al. (2009) Nature 457, 179–183. [7] Lowrie (1980) Geophyes. Lett. 17, 159–162. [8] Cisowski (1981) Phys. Earth Planet.Int. 26, 56–62. [9] Moskowitz et al., (1993) Earth Planet. Sci. Lett. 120, 283–300.