Testing the Gefion family as a possible parent body for the L-chondrite meteorites. J. R. Blagen[1,2,3], M. J. Gaffey[1,2,4] and S. K. Fieber-Beyer[1,2], [1]Department of Space Studies, University of North Dakota, Clifford Hall, 4149 University Ave Stop 9008 Grand Forks, ND 58202. [2]Visiting astronomer at the IRTF under contract from NASA, which is operated by the Univ. of Hawai'i, Mauna Kea, HI 96720. [3]jessica.blagen@my.und.edu, [4]gaffey@space.edu.

Introduction: The ordinary chondrites, at around 80%, are the most abundant types of meteorites falling to Earth [1-3]. Based on Antarctic meteorite collections, this prevalence has been maintained for at least the past million years [4]. The ordinary chondrites are subdivided into three groups based on the ratio of metallic iron to oxidized iron. The L-chondrite meteorites are intermediate between the H- and LL-chondrites in both abundance of NiFe metal, mafic mineral composition, and redox state. L-chondrites are the most abundant ordinary chondrite falls, comprising ~38% of all meteorite falls [1-3].

Identifying the parent bodies for the ordinary chondrites has been an important goal of asteroid science for more than thirty years [e.g., 5,6]. Linking meteorites to an asteroid, or asteroid family, makes it possible to pinpoint particular isotopic and mineralogical compositions to a specific location within the asteroid belt, which allows for a more robust understanding of the thermal and compositional gradients present in the solar nebula [6].

An unambiguous determination of a genetic relationship will most likely require a sample return mission. However, probable or plausible parent bodies can be identified based on two main criteria. A plausible meteorite parent body will be an astertoid that either has a surface mineralogy compatible with that of the L-chondrite meteorites, or which is in an orbital location that can provide quantitative yields of the relevant amount of meteoroids to the Earth. A probable parent body will meet both criteria [6].

Evidence of the breakup event of the L-chondrite parent body has been established from shock ages of the L-chondrites [7] and from fossil meteorites and extraterrestrial chromite found in Middle Ordovician Orthoceratite Limestone in a number of Swedish quarries [7-13]. The strata reveal a pronounced increase in the influx of L-chondrite meteorites over a period of 1-2 Myr by up to two orders of magnitude compared to the flux today. [11] have further shown, using ^{40}Ar-^{39}Ar dating, that the breakup event occurred at 470±6 Myr. Information put forth by [14] allows for a relatively fast delivery of fragments from the L-chondrite breakup event via the 5:2 resonance with Jupiter [15] that could be as short as 100,000 years. This corresponds nicely with the revised geologic time scale [16] that dates the period of the L chondrite meteorite shower documented in the Swedish quarries at 467.3±1.6 Myr.

Based on dynamical models, [15] have recently proposed that the Gefion family of asteroids may be the source of the L-chondrite meteorites. The present study is using near-infrared spectral data gathered using the Spex instrument [17] on the NASA Infrared Telescope Facility at Mauna Kea Observatory to determine the mineralogy of members of the Gefion family. The CCD spectra of 132 members of the Gefion family taken from the SMASS database are S-type asteroids, compatible with, but not diagnostic of, the L-chondrites. This work, which is part of an ongoing larger study, will provide quantitative mineralogical characterization of two core Gefion family members, testing both the hypothesis that this family is a possible source of the L-chondrite meteorites, and whether the Gefion family is a true genetic family.

Preliminary data gathered on Gefion family member (2905) Plaskett places the range of the asteroid's measured band centers overlapping the L chondrite zone on the Band I versus Band II plot, as seen in figure 1.

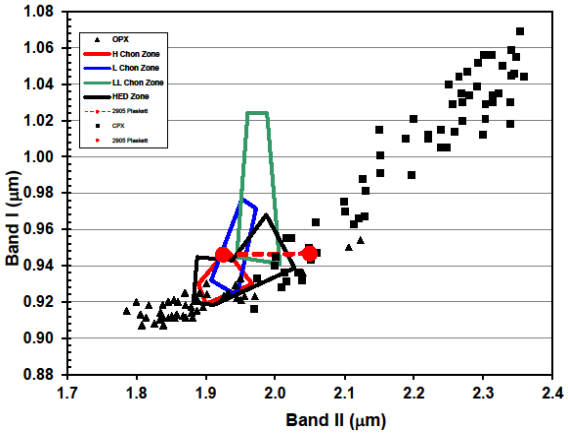

Figure 1. The spectral range of (2905) Plaskett appears to overlap the L chondrite zone.

However, on the Band I versus Band Area Ratio chart (figure 2), (2905) Plaskett plots outside the entire ordinary chondrite zone.

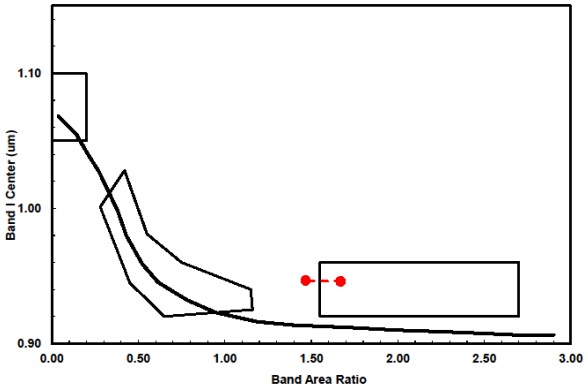

Figure 2. Gefion member (2905) Plaskett plots outside the ordinary chondrite zone (boot-shaped area in center).

This data precludes this asteroid from supporting the theory that the Gefion family is indeed the source of the L-chondrites. However, this study is in its infancy and (2905) Plaskett may prove to be an interloper within the Gefion family. More spectra are needed to validate this conclusion.

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References: [1] Wasson J. T. (1974) *Meteorites*. Springer-Verlag, New York, pp. 316. [2] Burbine T. H. et al. (2001) Meteorite Parent Bodies: Their Number and Identification. In Asteroids III (Bottke W. F. et al. Eds.) Univ. of Arizona Press, pp. 653-667. [3] *The Catalogue of Meteorites* (2012), Natural History Museum, London, http://www.nhm.ac.uk/research-curation/research/projects/metcat/ [4] Harvey R. (2003) The Origin and Significance of Antarctic Meteorites. *Chem. Erde* **63**, 93–147. [5] Chapman C.R. and Salisbury J. W. (1973) Comparisons of meteorite and asteroid spectral reflectivities. *Icarus* **19**, 507-522. [6] Gaffey M. J. (2011) Mineralogy of Asteroids. *XV Special Courses at the National Observatory of Rio de Janeiro* AIP Conf. Proc. 1386, 129-169. [7] Haack H. P. et al. (1996) Meteoritic, asteroidal, and theoretical constraints on the 500 Ma disruption of the L chondrite parent body. *Icarus* **119**, 182-191. [8] Schmitz B. et al. (2001) A rain of ordinary chondrite meteorites in the early Ordovician. *Earth and Planetary Science Letters* 6057:1-15. [9] Schmitz B. et al. (2003) Sediment-Dispersed Extraterrestrial Chromite Traces a Major Asteroid Disruption Event. *Science* 300:961-964. [10] Schmitz B. and Haggstrom T. (2006) Extraterrestrial chromite in Middle Ordovician marine limestone at Kinnkulle, southern Sweden-Traces of a major asteroid breakup event. *Meteoritics and Planetary Science* 41:455-466. [11] Korochantseva E. V. et al. (2007) L-chondrite ateroid breakup tied to Ordovician meteorite shower by multiple isochron ^{40}Ar-^{39}Ar dating. *Meteoritics and Planetary Science* 42:113-130. [12] Heck P. R. et al. (2008) Noble gases in fossil micrometeorites and meteorites from 470 Myr old sediments from southern Sweden, and new evidence for the L-chondrite parent body breakup event *Meteoritics & Planetary Science* **43**, 517–528. [13] Heck P. R. et al. (2010) A single asteroidal source for extraterrestrial Ordovician chromite grains from Sweden and China: High-precision oxygen three-isotope SIMS analysis. *Geochim. Cosmochim. Acta* **74**, 497–509. [14] Heck, P. R. et al. (2004) Fast delivery of meteorites to earth after a major asteroid collision. *Nature* 430:323–325. [15] Nesvorny D. et al. (2009) Asteroidal source of L chondrite meteorites. *Icarus* 200, 698-701. [16] Gradstein F.M. et al. (Eds.) (2004) A Geologic Time Scale. Cambridge University Press. pp 506. [17] Raynor J.T. et al. (2003) Spex: A medium-resolution 0.8-5.5 micron spectrograph and imager for the NASA Infrared Telescope Facility. In Publications of the Astronomical Society of the Pacific, 115:805, pp. 362-82.