UPDATE ON TESTING THE GEFION DYNAMICAL FAMILY AS A POSSIBLE SOURCE OF THE L-CHONDRITES. R. Roberts[1] and M. J. Gaffey[2], Space Studies Department, John D. Odegard School of Aerospace Sciences, Box 9008, Uuniversity of North Dakota, Grand Forks, ND 58202. [1]momenttensor@gmail.com [2]gaffey@space.edu

Introduction: The ordinary chondrites comprise approximately 80% of meteorite falls [1, 2]. Antarctic meteorite finds show that this abundance has been consistent for the past million years [3]. Due to their high percentage among falls, identifying probable parent bodies for the ordinary chondrites has been a priority for some time [4]. Fossil L-chondrites have been observed in Middle Ordovician sediments in Sweden, China, and other locations [5-7]. Chromite isotopes, shock features, and ^{40}Ar-^{39}Ar isochrons from Ordovician L-chondrites match those from current L-chondrites which indicates both a catastrophic breakup of the L-chondrite parent body and a short interval from the event to Earth impact [5-8]. This indicates that an influx of L-chondrites above the normal rate was occurring during the Middle Ordovician which places an age limit of the catastrophic event which formed the asteroid family that may be the source of these meteorites [5-7]. The Gefion dynamical family has been proposed as a source for the L-chondrites due to its location close to a fast acting mean motion resonance, the age of the family as determined by numerical modelling, and the dominant taxonomy of its members as ordinary chondrites fall in the S(IV) subtype of the S taxonomic class [9- 11].

To date, reflectance spectra have been taken for 14 asteroids, 11 of which are of useable quality for analysis; spectra for 4182 Mount Locke was taken twice due to the poor observing conditions for the first observations. Reflectance spectra for this ongoing project are obtained using the SpeX instrument on the NASA IRTF 3 meter telescope at Mauna Kea Observatory. Asteroids observed and the observing dates (UT) are:

527 Eyryanthe (10/5/13)
1433 Geramtina (7/18-20/11)
1839 Ragazza (10/5/13)
2372 Immo (7/26/13)
2521 Heidi (7/26/13)
2905 Plaskett (6/4/11)
2911 Miahelena (5/7/13)
3788 Steyaert (5/7/13)
3910 Liszt (7/18-20/11)
4182 Mount Locke (6/4/12 & 10/5/13)
7272 Darbydyar (6/18/13)
7735 Scorzelli (6/4/11)
12275 Marcelgoffin (12/2/13) [12]
17109 1999 JF52 (6/18/13)

Observations of nearby standard stars were interspersed with the asteroid observations to derive atmospheric extinction corrections. Where available, these local standard stars were type G2V. If G2V stars are not available in close proximity to the asteroid, well calibrated solar analogs are used along with standard stars [18,19]. Spectra are taken in low resolution/asteroid mode, in two channels A and B, and are stored as Flexible Image Transport System (FITS) files. IRAF is used for the initial data reduction in which read noise and dark current are removed and the background sky is removed by subtracting one channel from the other; to produce a one deminsional array which was subsequently processed using the SpecPR routines [11]. Wavelength calibration is obtained from the spectra taken of the argon lamp (taken each observation night); the channel positions of emission lines are recorded, input into Excel and a polynomial is fitted. If absorption features are present, the final corrected averaged asteroid spectrum is normalized in SpecPR for a chosen set of intervals and band areas/centers are obtained [11]. The band areas and positions obtained will indicate the subtype, the position on the Ca pyroxene trend, and are the variables for a set of equations which both provide ferrosilite (Fs) and Wollastonite (Wo) percentages and test if the mineralogy falls within permissible ranges for H, L, or LL chondrites [11,12].

Because the Gefion Family is located in a relatively dense region of the asteroid belt, distinguishing between family members and background objects can be challenging. The initial test of the Gefion Family as the source of the L-type chondrites would be satisfied if family members or objects in the family region are shown to commonly exhibit L-type mineralogies, as distinct from the background population lying outside the designated bounds of the family.

All asteroids observed to date are from the Nesvorny et al HCM asteroid families V2.0 216 Gefion – Nesvorny analytical family number [13]. Analysis has been completed for 2905 Plaskett, 3910 Liszt, 1433 Geramtina, 2911 Miahelena, 3788 Steyaert [14-16]. Figures 1 and 2 show the locations of the aforementioned asteroids along with new analysis for 2521 Heidi in relation to the L-chondrite region (Figure 1), and the S(IV) region (Figure 2). Analysis for October 5 2013 UT observations of 4182 Mount Locke and July 28 2013 observations of 1839 Ragazza are currently underway at this time with 4182 Mount Locke final

spectra exhibiting Band 1 and Band 2 absorptions. Preliminary analysis for spectra of asteroids 17109 1999 JF52 and 527 Euryanthe show that these two objects are not related to ordinary chondrites though 17109 1999JF52 has an SDSS taxonomy of S [17].

Excluding 527 and 17109, the Gefion family objects analyzed so far cluster around the general ordinary chondrite region, but do not clearly concentrate in the L-chondrite region. At this time, the number of characterized Gefion dynamical family members is still insufficient to reliably determine the dominant composition. And the possibility of interlopers within the sampled population cannot be excluded at this time.

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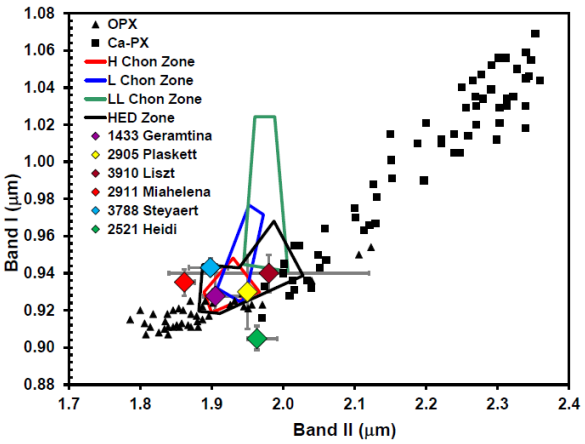

Figure 1: Band 1/Band 2 plot for Gefion family asteroids analyzed to date. 2905 Plaskett and 3910 Liszt values are from Blagen [14], 1433 Geramtina values from Roberts et al [15], 3788 Steyaert and 2911 Miahelena are from Roberts et al [16], and 2521 Heidi is new. 3910 Liszt and 1433 Geramtina plot closest to the L-chondrite zone.

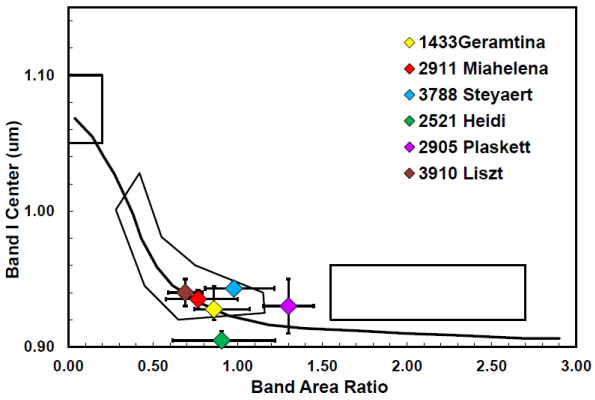

Figure 2: BAR/B1 plot for the same asteroids as in figure 1. Note that 2905 Plaskett and 2521 Heidi fall outside of the S(IV) region.