**Interesting Objects Near *(6) Hebe*.** S. K. Fieber-Beyer[1,2] [1]Dept. of Space Studies, Box 9008, Univ. North Dakota, Grand Forks, ND 58202. [2]Visitiing Astronomer at the IRTF under contract from the NASA, which is operated by the Univ. of Hawaii Mauna Kea, HI 97620. sherryfieb@hotmail.com

**Introduction:** The Kirkwood Gaps are severely depleted zones in the asteroid belt located at proper motion resonances with Jupiter. The secular resonances are orbital resonances between two bodies with synchronized precessional frequencies, which helps to move objects in/out of the resonances. For example, objects near either of these resonances are subjected to excited eccentricities (e) and repeated planetary encounters, which ultimately remove asteroids and asteroidal fragments from these resonances. As such, theoretical models indicate the majority of main belt material delivered to the inner solar system, particularly to the Earth, originates from the 3:1 Kirkwood Gap and the $\nu_6$ secular resonance [1-8]. Changes in (e), (i), and (a) due to gravitational encounters with planets, as well as non-gravitational forces such as collisions with other asteroids and Yarkovsky effects can deliver nearby meter-kilometers scale objects into the chaotic zones of the 3:1 Kirkwood Gap and the $\nu_6$ secular resonance [9-18]. These objects are rapidly transferred to Earth- and Mars-crossing orbits making these particular resonances perfect hunting grounds for the source of meteorites and NEAs [19-23]. Since the 3:1 Kirkwood Gap and the $\nu_6$ secular resonance are not dominated by any one particular assemblage, observation and characterization of individual objects are necessary to test for a variety of meteorite affinities [24-28].

While focusing on the intersection of the 3:1 Kirkwood Gap and the $\nu_6$ secular resonance, a number of objects were observed to determine whether asteroid (*6*) *Hebe* has a family or not. Although *(6) Hebe* does in fact have an old, disbursed family [29], eight of the nearby asteroids observed exhibit rare spectral features.

**Observations and Data Reduction:** Near-infrared spectra of eight asteroids: *(172) Baucis*, *(186) Celuta*, *(432) Pythia*, *(584) Semiramis*, *(855) Newcombia*, *(1504) Lappeenranta*, *(1937) Locarno*, and *(4904) Makio* were obtained using the NASA IRTF SpeX instrument [30] in low resolution mode (0.68-2.54-μm) throughout the years 2015-2017. Asteroid and standard star observations were interspersed within the same airmass range to allow for modeling of atmospheric extinction. Data reduction was done using previously outlined procedures [24-29].

**Analysis:** This particular subset of asteroids have absorption features located near the 1- and 2- μm regions in the near-infrared wavelength range; however, it should be noted that two asteroids have a single absorption feature (Figure 1), while the remaining six exhibit two absorption features (Figure 2).

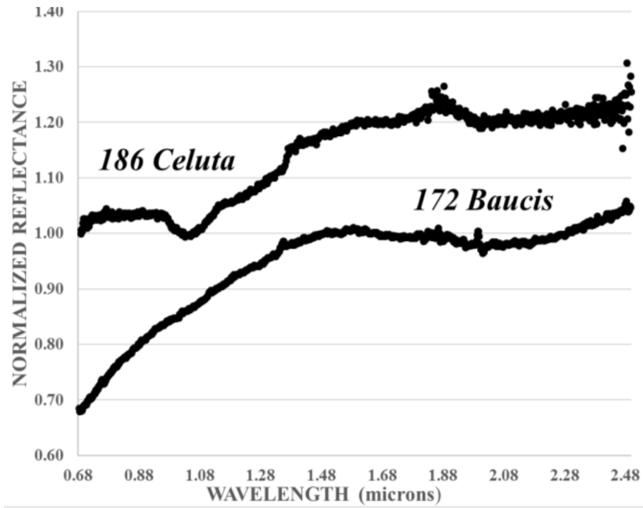


**Figure 1:** Spectra of the 1-μm absorption band asteroids discussed in this paper. The spectra were normalized and offset for clarity.

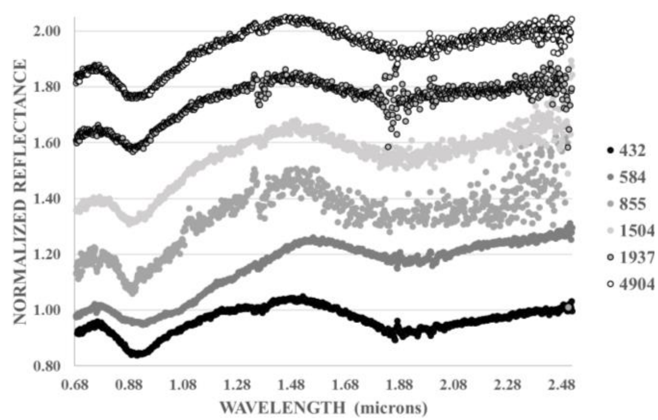


**Figure 2:** Spectra of the 2-μm absorption band asteroids discussed in this paper. The spectra were normalized and offset for clarity.

I have completed the parametric band analysis on the eight targets, i.e. band centers and band area ratios (BAR). The temperature corrected BI, BII, and BAR are diagnostic of the abundance and composition of the mafic silicates [e.g., 31-39]. The uncertainty was estimated using several polynomial fits and sampling different ranges of points within the BI and BII spectral intervals to yield the standard deviation. After initial measurement, the asteroids were plotted on the S-asteroid subplot [40] (Figure 3), and then the appropriate temperature corrections [41, 42] were applied before the chemistry was calculated. If the asteroid plotted in/near the BA, S (VI), or S (VII) zones, then the pyroxene chemistry was calculated using [37, 38]'s equations. If the asteroid plotted in/near the S (III) or S (IV) zones, then the pyroxene chemistry was calculated using [39]'s equations. See Table 1.

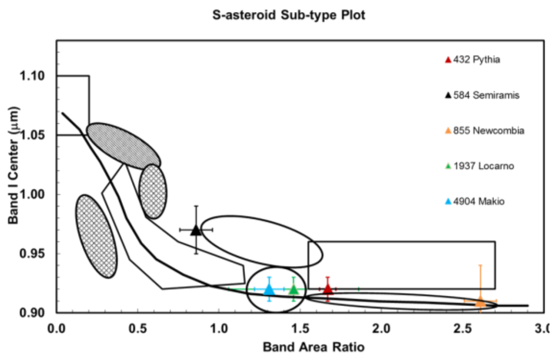


**Figure 3:** S-Asteroid sub-type plot of asteroids *(432)*, *(584)*, *(855)*, *(1937)*, and *(4904)* as derived by [40].The BAR for asteroid *(1504)* is 3.01, which falls to the right of the x-axis, indicating a pyroxene end-member.

***Table 1: Band Values and Mafic Chemistries***

| Object | Band I (µm) | Band II (µm) | BAR | ol/ (ol+opx)[a] | Fa[b] | Fs[b,c] | Wo[c] |
|---|---|---|---|---|---|---|---|
| 172 Baucis | NA | 2.12 ±0.03 | NA | NA | NA | NA | |
| 186 Celuta | 1.05 ±0.02 | NA | NA | NA | NA | NA | |
| 432 Pythia | 0.92 ±0.01 | 1.89 ±0.02 | 1.67 ±0.05 | 0.33 | NA | $28.3_{\pm3}$[c] | $4.1_{\pm3}$[c] |
| 584 Semiramis | 0.97 ±0.02 | 1.91 ±0.02 | 0.86 ±0.10 | 0.57 | $25.5_{\pm1.3}$[b] | $21.3_{\pm1.4}$[b] | NA |
| 855 Newcombia | 0.91 ±0.03 | 2.01 ±0.03 | 2.61 ±0.10 | 0.17 | NA | $33.4_{\pm3}$[c] | $4.1_{\pm3}$[c] |
| 1504 Lappeenranta | 0.91 ±0.01 | 1.89 ±0.02 | 3.10 ±0.23 | 0.06 | NA | $21.1_{\pm3}$[c] | $1.1_{\pm3}$[c] |
| 1937 Locarno | 0.92 ±0.01 | 1.88 ±0.03 | 1.46 ±0.40 | 0.43 | NA | $27.3_{\pm3}$[c] | $3.7_{\pm3}$[c] |
| 4904 Makio | 0.92 ±0.01 | 1.90 ±0.02 | 1.31 ±0.09 | 0.46 | NA | $27.3_{\pm3}$[c] | $3.7_{\pm3}$[c] |

The values reported in Table 1 were calculated using the equations derived by: [31][a], [39][b], [37,38][c]

**Results:** Initial results indicate a robust, yet unique plethora of meteoritic material all confined to a narrow inclination (10-12°) vs. semi-major axis space (2.241 – 2.399 AU). For example, *(172) Baucis* contains a spectrally dominant phase of spinel, while *(186) Celuta* is dominated by olivine. In addition, *(432) Pythia*, *(584) Semiramis*, *(855) Newcombia*, *(1504) Lappeenranta*, *(1937) Locarno*, and *(4904) Makio* have mineralogies ranging from olivine-pyroxene mixtures to pure pyroxene end-members. The meteorite affinities will be presented at conference.

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