HIGH-RESOLUTION 2.5–3.5 μM OBSERVATIONS OF C-, B- AND G-CLASS ASTEROIDS. A. S. Rivkin, *Department of Planetary Sciences, University of Arizona, Tucson AZ 85721-0092, USA, asrivkin@lpl.arizona.edu,* J. K. Davies, S. L. Ellison, *Joint Astronomy Centre, Hilo HI 96720, USA*, L. A. Lebofsky, *Department of Planetary Sciences, University of Arizona, Tucson AZ 85721-0092, USA*.

Surveys of asteroids performed in the 3-μm spectral region have given us great insights into the volatile inventories and alteration histories in the asteroid belt [1-3]. For the brightest asteroids, higher-resolution studies can give us better constrained band shapes. With these band shapes, we can better determine surface mineralogy for these bodies and gain further insight into the nature of asteroid surfaces and the origin of the hydrated minerals present. With improvements in detector technology over the past decade, observations of this type can be made with high signal-to-noise ratios on more bodies than previously possible.

We have obtained observations of six asteroids from the CGS4 instrument on UKIRT over two nights: three on 4 February 1996 (2 Pallas, 13 Egeria, and 51 Nemausa), and three on 10 July 1997 (1 Ceres, 19 Fortuna, and 106 Dione). The spectral classes observed (B, CU and G in 1996, three Gs in 1997) allow us to compare the band shapes present on several asteroids within the G class as well as compare them across several classes.

All of the asteroids observed except 1 Ceres have very similar band shapes. It has long been known that 1 Ceres and 2 Pallas looked quite different in this spectral range. These observations show that 2 Pallas is quite typical of the asteroids we have observed. The difference 1 Ceres shows cannot be due to something common to G-class asteroids, since those we have observed other than Ceres (13 Egeria and 19 Fortuna) have band shapes similar to 2 Pallas and 51 Nemausa.

A sub-feature near 3.07 μm within the broad hydration feature of 1 Ceres has been variously interpreted as water ice [1,4] and ammoniated silicates [5]. Our spectrum, with somewhat smaller uncertainties than those available early in the decade, supports the latter interpretation. We find the spectrum of an ammoniated Ca-Na montmorillonite taken by Trude King to provide an excellent match.

Although examination of the Pallas spectrum shows no features within the broad 3-μm feature, a feature is possibly present at the 1-σ level ($\sim$ 2–3 %) at 2.94 μm in Fortuna's spectrum. In Figure 1 this possible feature is seen as a shoulder in the spectrum of 13 Egeria, as well. Because both Fortuna and Egeria are G-class asteroids, it is possible that this feature is present on most of these asteroids, though it is not present on Ceres and the Dione spectrum is too noisy to identify any weak features. Inspection of Figure 2 shows a shoulder in the spectrum of 51 Nemausa, a CU (unusual C-class) asteroid at the same wavelength.

A feature at 2.94 μm can be found in several meteorite spectra published by Hiroi et al. (1996): PCA 91084, ALH 83100, EET 90043, Y794080, Y82162, and Y86720 [6]. All of these are thermally metamorphosed carbonaceous chondrites, for which the broad 2.9 μm H_2O absorption feature appears to have moved to be centered near 2.94 μm. Because Egeria's hydration feature is centered shortward of 2.85 μm, we know that these meteorites are likely an imperfect analog to its surface, but it is plausible that material similar to these meteorites is present in some amounts on Egeria and Fortuna's (and perhaps Nemausa's) surface. Once more I must caution, however, that a 2.94 μm feature is only tentatively identified, and because it is only 1-σ in depth, data with smaller uncertainties may find this to be merely noise. Because 2.94 μm is not far from the second overtone of an H_2O absorption, if confirmed, this feature suggests H_2O-bearing minerals are present on these asteroid surfaces. There is evidence in the meteorite collection for both H_2O-bearing and OH-only phyllosilicates [7].

Other than this possible feature at 2.94 μm, no other subfeatures are found in the spectra of the UKIRT spectra of these asteroids (excepting 1 Ceres). The general agreement of these spectra with each other argues that these asteroids all have similar hydrated minerals on their surfaces, and have undergone similar alteration and thermal histories (again excepting 1 Ceres). The spread in spectral properties is consistent with those found within a set of spectra from a single meteorite.

References: [1] Jones et al (1990) *Icarus* **88**, 172. [2] Lebofsky et al. (1990) *Icarus* **83**, 12. [3] Rivkin et al. (1995) *Icarus* **117**, 90. [4] Lebofsky et al. (1981) *Icarus* **48**, 453. [5] King et al. (1992) *Science* **255**, 1551. [6] Hiroi et al. (1996) *MAPS* **31**, 321. [7] Rubin (1997) *MAPS* **32**, 231.

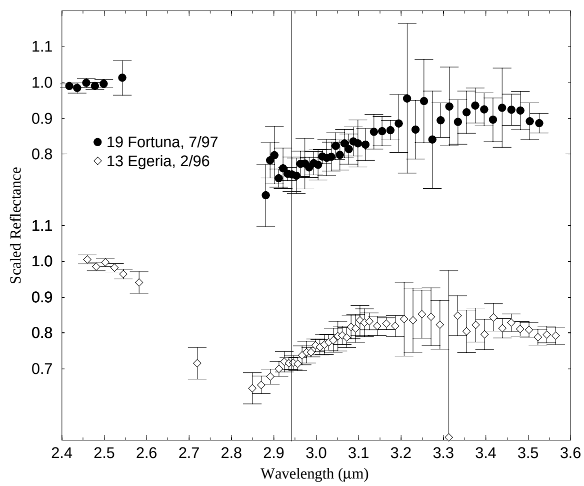

Figure 1: Comparison of the spectra of the G-class asteroid 19 Fortuna and the G-class asteroid 13 Egeria. Note that qualitatively their spectral behavior is the same, again, with a roughly linear increase with increasing wavelength, flattening out beyond 3.2 μm. This is evidence that the same, or similar, hydrated minerals are present on their surfaces. These asteroids also both show evidence for a feature near 2.94 μm, marked with a vertical line. Absorption features with minima near that wavelength are found in themally metamorphosed CI/CM chondrite spectra taken by Hiroi et al. (1996). While the fact that the spectral reflectance declines shortward of 2.9 μm means that OH-bearing minerals are present, a shoulder at 2.94 μm implies some H_2O-bearing minerals may be present as well.

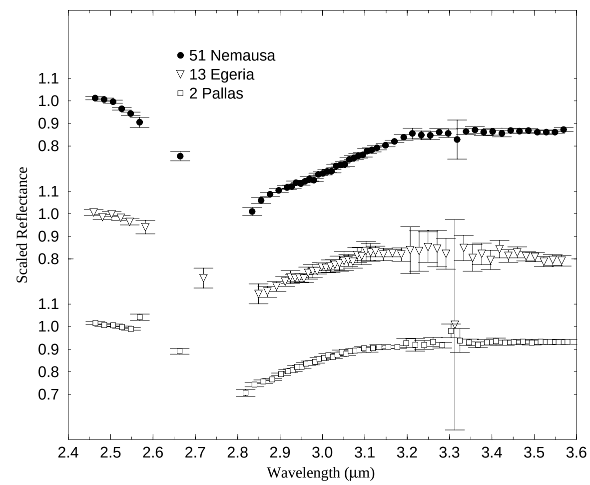

Figure 2: 2.4–3.6 μm spectra of three low-albedo asteroids, taken from UKIRT in February 1996. These asteroids have been thermally corrected using the Standard Thermal Model (see Lebofsky and Spencer (1989)).