AQUEOUS ALTERATION IN LOW ALBEDO ASTEROIDS. E. S. Howell, *NAIC/Cornell University, Arecibo PR 00612, USA, (ehowell@naic.edu)*, A. S. Rivkin, *MIT, Boston MA ,(asrivkin@mit.edu)*, F. Vilas, *Johnson Space Center, Houston TX 77058-1113, USA (faith.vilas1@jsc.nasa.gov)*, A. M. Soderberg, *Cambridge University, Cambridge, UK*.

Many low-albedo asteroids have undergone aqueous alteration. Evidence both from meteorite mineralogy and texture (e.g. Scott et al. 1989 and references therein), and spectral observations of H_2O/OH at 3 μm indicate the presence of hydrated silicates, which seems to require contact with liquid water for some length of time. Additional Fe^{2+}–Fe^{3+} charge transfer bands near 0.7 μm also are associated with hydrated silicates (e.g. Vilas et al. 1994), although this band is not always concurrent with the 3 μm band. In order to better understand this relationship, and to understand the hydration process itself, we obtained rotationally resolved visible spectra of a number of asteroids which did not have concurrent bands at 3 μm and 0.7 μm. Several possibilities could account for these bands not being concurrent: If the hydrated silicates are unevenly distributed across the asteroid surface, then perhaps rotational variability explains the discrepancy. Only Fe-bearing hydrated silicates exhibit the 0.7μm band, so the presence of the 3 μm band alone might occur on Fe-poor objects. The 3 μm band is stronger, so is can be detected on some low-albedo objects in cases where the weaker 0.7 μm band cannot be seen. However, the 0.7μm band should not be present when 3 μm band is absent, unless it can also arise from anhydrous minerals. This does not seem to be the case. All but one asteroid which shows only the 0.7μm feature, also shows rotational variability which accounts for the lack of a 3 μm feature. So we are confident that the the 0.7μm band is a reliable indicator of Fe-bearing hydrated silicates.

We obtained spectra of 14 asteroids at 3 or more rotational phases. We find that 7 objects have variable visible spectra at different rotational phases. These objects, however, were not chosen at random. Most of them were previously suspected to be variable based on data at other wavelengths. Five of these asteroids have a 0.7μm band at some phases, and not at others. The other two do not have a 0.7μm band at any phase but show spectral shape changes at different rotational phases. Among those asteroids whose spectra are constant with rotation, two have a 0.7 μm band, 3 do not, and two others have a consistent 0.7 μm band at the 2 different phases measured.

We have compiled data on C,B,F and G class asteroids: 55 objects at 3 μm, and 39 objects at 0.7 μm. Below are histograms where the hatched area represents objects with the indicated band, and the unhatched area above does not show the band. While the numbers are not very large, there is a consistent trend where about 50% of the objects 50–150 km diameter are hydrated, about 66% of the objects 150-250 km are hydrated, and very large objects (of these classes) nearly all show the 3μm band. This trend is consistent with that seen by other authors, Jones et al. (1990), Vilas and Sykes (1996) and seen also among hydrated M (W) class asteroids by Rivkin et al. (2000). The trend for the 0.7μm band is similar, but the band disappears again for larger objects, where perhaps the temperatures were high enough to eliminate this band, that is, greater than 700 K (Hiroi et al., 1996). Below some size, aqueous alteration would not take place. However, smaller objects are mixed with collisional remnants of larger, possibly hydrated parents. Currently, we do not have a sufficient sample of objects smaller than 50 km to look at their hydration distribution.

From these observations, we can draw several conclusions:

- Rotational variation is fairly common, and is a likely explanation of previous inconsistent observations at different times.
- No clear cases of the 0.7 μm occurring when the 3 μm band was absent were found, supporting the interpretation of this band as resulting only from Fe-bearing hydrated silicates. However, many objects which show a 3 μm band do not also have a 0.7 μm band, so the absence of this band does not indicate a lack of hydrated silicates.
- We see a size-dependent distribution of objects with hydration bands, which supports a trend of increasing degrees of thermal alteration at larger sizes. Together, the 3 μm and 0.7 μm bands can be used to indicate the extent and intensity of the thermal heating the object has experienced.

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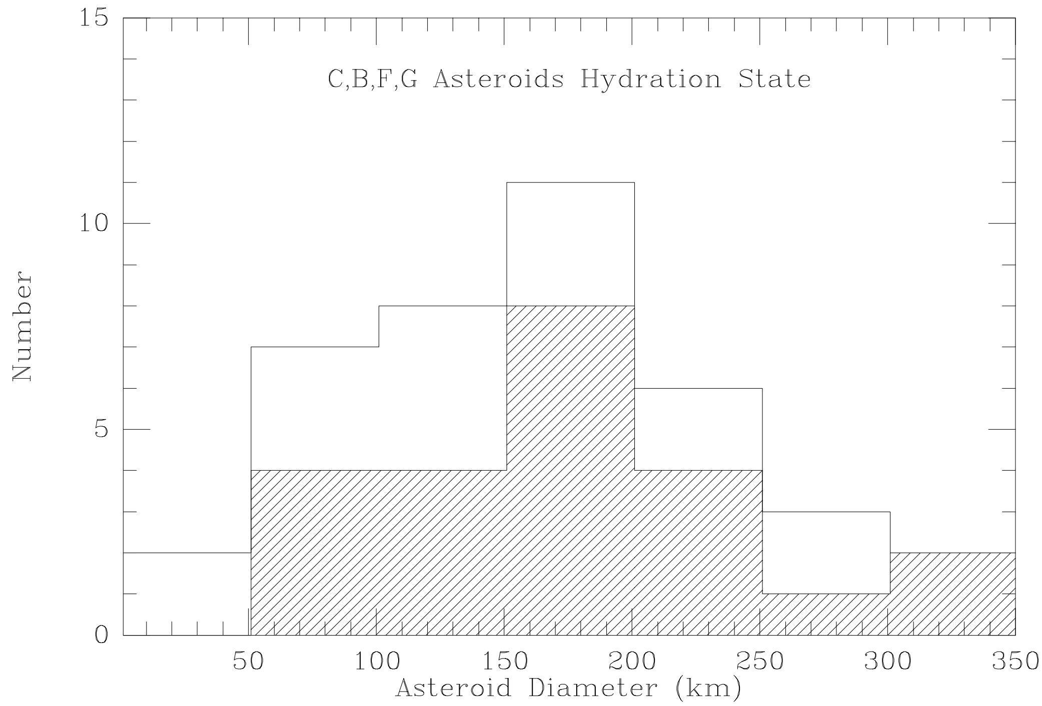

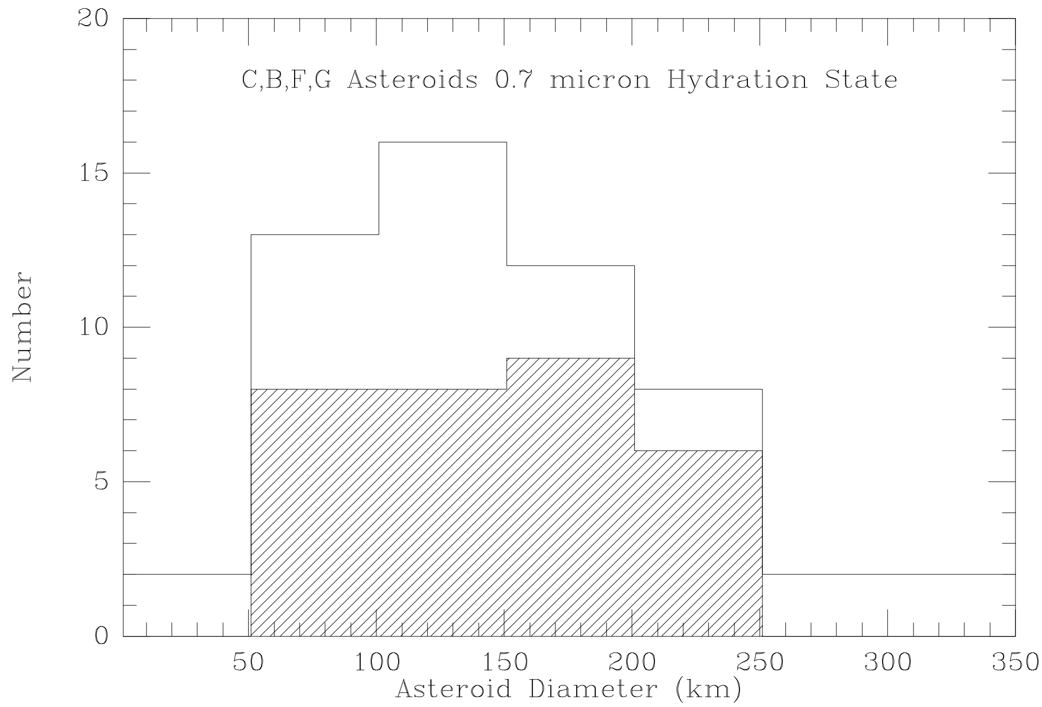

Figure 1: Histogram of 0.3μm band data on C, F, B, and G class asteroids is shown in the top figure, 0.7μm band is shown in the bottom figure. The hatched areas are objects with the band, the unhatched areas above, show objects with no band. Diameters are taken from the IRAS measurements (Tedesco et al. 1992).