POSSIBLE EXPLANATIONS FOR THE 506 nm FEATURE IN TELESCOPIC SPECTRA OF VESTA, VESTOIDS AND HED METEORITES. L. Kaletzke[1], E. Cloutis[1], M. Craig[1,] K. McCormack[1], and L. Stewart[1], Department of Geography, University of Winnipeg, 515 Portage Avenue, Winnipeg, Manitoba, Canada R3B 2E9, l.hemminger@uwinnipeg.ca

Introduction: Telescopic spectra of Vesta, vestoids and HED meteorites show a 506 nm absorption feature whose wavelength position varies for different Vestoids, howardites vs eucrites vs diogenites, and across the surface of Vesta [1, 2, 3]. [1] believe that the shift is due to the change in composition of pyroxenes, specifically that increases in calcium content are correlated with increases in the wavelength position of this band., as postulated in [2]. In an extensive examination of pyroxene reflectance spectra, we only observe the 505 nm feature in orthopyroxene spectra (Fig. 1), but not in clinopyroxene spectra (Fig. 2). Therefore we believe that the band shift seen in HEDs, Vesta, and vestoids may be due to another mechanism.

Experimental Procedure: Reflectance spectra of 50 pyroxene samples (45-90 µm grain size) were measured with an Ocean Optics S-2000 spectrometer, covering the wavelength range 200-600 nm with ~0.3 nm spectral resolution. A total of 300 spectra (30 msec/spectrum) were averaged to improve signal to noise ratio for each sample. The spectra were measured at i=0°, e=45° relative to halon. Halon's reflectance begins to decline shortwards of ~250 nm, thus spectral slopes in this range are not reliable. In addition, spectral acquisition was optimized for the 400-600 nm range, and data shortward of 400 nm are increasingly noisy. Continuum removal applied to the spectra involved division of a straight line tangent to the reflectance spectrum on either side of the feature of interest.

Results: Our high resolution orthopyroxene spectra display two bands at 504.5 nm and 508.0 nm (Figs. 1 and 2). These bands do not shift with changes in Fe^{2+} content, but the depth of the 508 nm band appears to increase with increasing Fe^{2+} content. Given these observations it appears that shifts in 505 nm region band minima seen across the surface of Vesta, between different vestoids, and between HED meteorites [1, 2] are not attributable to changes in either Fe^{2+} or Ca content in pyroxenes.

In transmission spectra of lunar samples [2] see a doublet in low calcium pyroxene and pigeonite spectra, and a singlet in high calcium pyroxene spectra in the 505-510 nm region. We believe this is because the lunar samples may be exsolved into calcium-rich and calcium-poor regions. The 505 nm feature in these spectra is likely attributable to the calcium-poor regions. We see a doublet in all of our low calcium pyroxene spectra, but it is easy to miss the second band at 507 nm in some of the spectra because it can be extremely weak (Fig. 2), particularly in the lowest Fe^{2+} content sample spectra.

For spectra of Vesta, [1] saw variations on the order of 1 nm in the position of the 506 nm feature for different parts of the asteroid's surface as well as variations in the width of this feature. Given the differences in pyroxene composition within the HED groups and the probable link between Vesta and HED meteorites, we believe that the shift in band position for different parts of Vesta is too large to be explained by changes in pyroxene composition across Vesta. In addition, we do not see a broadening of the 506 nm band in our low calcium pyroxene spectra as a function of Fe^{2+} content. The shift also cannot be attributable to calcium content variations since our clinopyroxene spectra do not exhibit a 506 nm absorption feature (Fig. 3).

Discussion: For the HED meteorites [3] shows the 506 nm feature for diogenites (which are composed almost exclusively of orthopyroxene), occurring at the shortest wavelengths, with a shift to longer wavelengths for eucrites (which are composed largely of clinopyroxene and plagioclase), as well as a broadening of this feature. They attributed the shift to changes in pyroxene calcium content. Our alternative interpretation is that the shift is due to increasing plagioclase feldspar content.

A number of plagioclase feldspar spectra (which do not contain any additional phases either optically or by X-ray diffraction) exhibit an absorption feature in the 510 nm region. Thus we can infer that the band is feldspar related and not from an unknown phase in our sample. This absorption band is wider than in pyroxenes and occurs at longer wavelengths (510-520 nm) (Figs. 4 and 5). The cause of this band in the feldspar is unknown to us at this time

An explanation for both the 1 nm shift and the widening of the 506 nm band could be the addition of feldspars. This is consistent with the mineralogy of the HED meteorites because eucrites (narrowest and shortest wavelength 506 nm band) contain feldspar and diogenites (widest and longest wavelength 506 nm band) do not. Therefore the increasing feldspar content can explain the shift to longer wavelengths and the widening since we see it occurring in our feldspar data.

References: [1] Vilas F. et al. (2000) *Icarus, 147*, 119-128. [2] Hazen R.M. et al. (1978) *Proc. Lunar Planet. Sci. Conf. 9th*., 2919-2934. [3] Hiroi T. et al. (2001) *Earth Planets Space, 53*, 1071-1075.

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Figure 1. 300-600 nm reflectance spectra of three orthopyroxenes and one pigeonite.

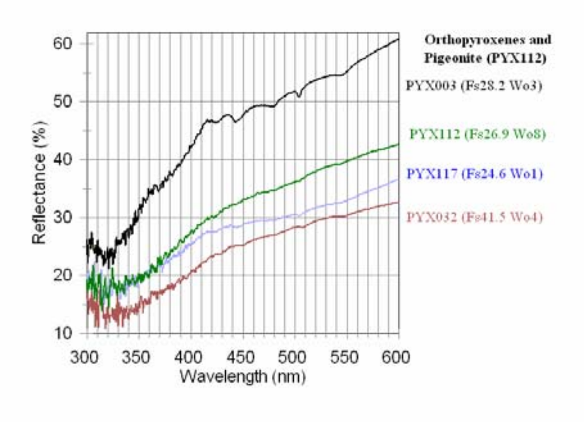

Figure 2. The same spectra as in Fig. 1 but after removal of a straight line continuum.

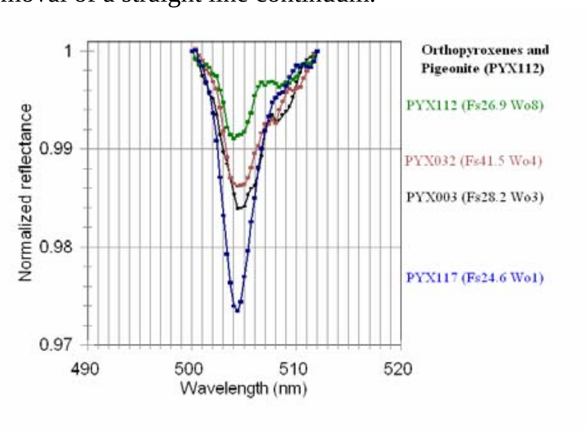

Figure 3. 300-600 nm reflectance spectra of four representative clinopyroxenes.

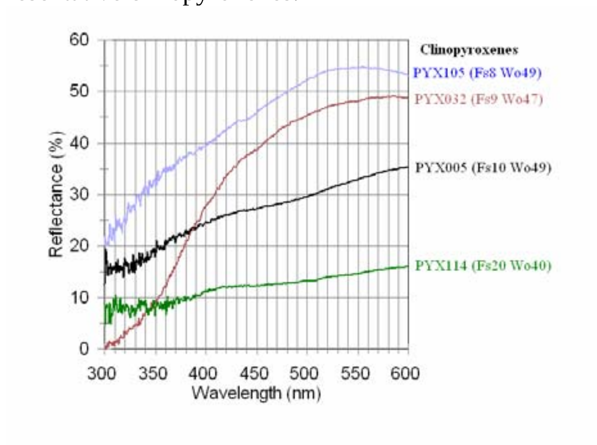

Figure 4. 300-600 nm reflectance spectra of three plagioclase feldspars showing evidence of an absorption band in the 510 nm region.

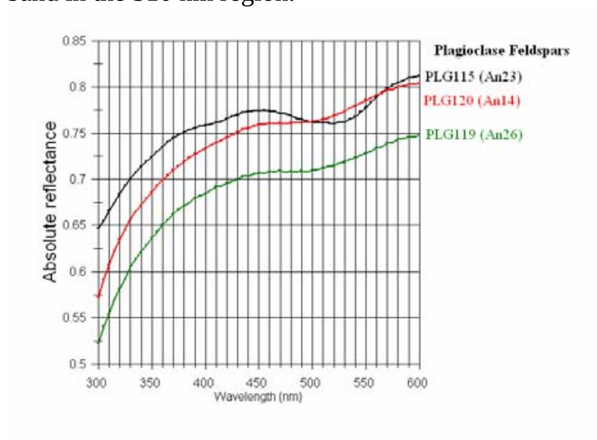

Figure 5. The same spectra as in Fig. 4 but after removal of a straight line continuum.