OLIVINES ON VESTA-LIKE ASTEROIDS. L. Golubeva[1], L. McFadden[2], D. Shestopalov[1], V. Khomenko[3], L. Gasanova[1]. [1]Shemakha Astrophysical Observatory, Shemakha, Azerbaijan, AZ-3243 (land@azdata.net), [2]Department of Astronomy, University of Maryland, College Park, MD 20742-2421 (mcfadden@astro.umd.edu), [3]Institute of Geochemistry, Mineralogy and Ore Formation, Palladin pr., 34, Kiev, Ukraine, 252142 (vladkhom@hotmail.com)

Reflectance spectra of some Vesta-like asteroids contain a faint isolated absorption band near 600 nm. Center position of this band varies in the range of ~ 590 – 640 nm in various spectra of the vestoids. Looking over reflectance spectra of orthopyroxenes and achondrites, we found that some spectra of enstatites, bronzites, hypersthenes, and HED meteorites do contain a faint feature centered in the range of ~ 590 – 620 nm. At the same time, we could not find any absorptions centered longward of 620 nm in the spectra of the specified sample.

One of the probable cause of origin of this feature in the vestoid spectra is spectral contribution of olivine component of the vestoid rocks. Considering this supposition, we did not overlook, of course, the conclusion about low abundance of the olivine on vestoid surfaces [1].

It is known the reflectance olivine spectra contain a wide absorption near 600 nm. We estimated center position of this band for the olivine spectra obtained in [2].

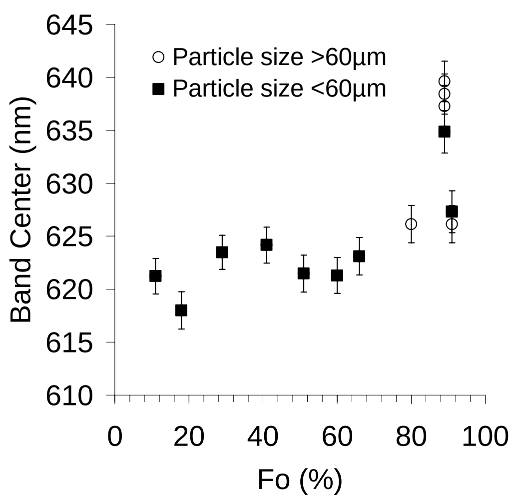

Fig.1. Correlation between center position of the 600-nm absorption band in the olivine reflectance spectra and forsterite content.

In accordance with Figure 1, the band center position depends weakly on both forsterite content and particle sizes of the olivine samples. Sensibility of the band position to the particle sizes says apparently that the feature has a complicated contour combining several spin-forbidden transitions of Fe^{2+} in olivines.

To estimate contribution of the 600-nm olivine band we calculated reflectance spectra of the intimate pyroxene-olivine mixtures using the model [3]. The results of the calculation are presented in Figure 2. The center positions of the 600-nm band in the spectra of the terrestrial orthopyroxenes, eucrites and howardites are represented by the ovals situated at Ol = 0 vol. %. Notably, the 600-nm band center in the spectra of the achondrites is shifted to shorter wavelengths with respect to that of the orthopyroxene spectra. This shift, as we suppose, could be caused by the spin-forbidden band of Mn^{2+} near 590 nm. In result, the 600-nm band in the achondrite spectra has more extensive short-wave wing than in the orthopyroxene spectra.

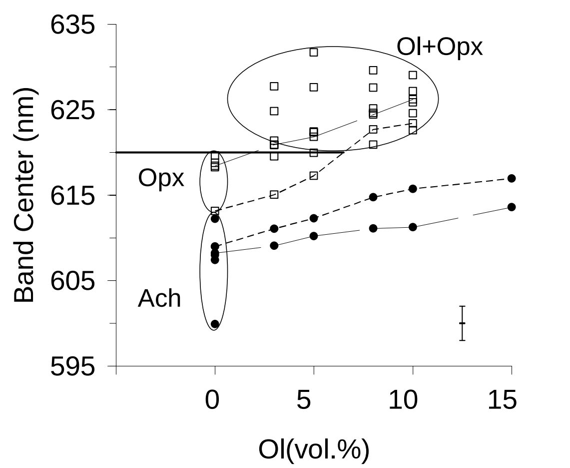

Fig.2. The shift of the 600-nm band center in the reflectance spectra of olivine-pyroxene mixtures depending on olivine content.

As can be seen from Figure 2 the center of the 600-nm band in the spectra of the pyroxene and pyroxene-rich samples lies in the range from 600 to 620 nm. When olivine content increases in the two-component mixture, the resulting band is shifted towards long-wavelength side. Some tracks, describing this process, are also shown in Figure 2 for clarity. We can say for low content of olivine on the investigated surface only if the discussed band center is situated longer than 620 nm. However, if the band center is between 600 and 620 nm, then assertion on presence of olivine on the tested surface may be incorrect. As the calculations show, there are no any other spectroscopic signs of such a low content of olivine in the pyroxene-olivine mixture (i.e. the band near 950 nm, and maximum in reflectance near 750 nm do not show a noticeable shift to the red and blue side, respectively).

The Table lists V-asteroids from [1, 4, 5, 6] in whose spectra the faint isolate absorption near 600 nm was found. In accordance with the above discussion olivine appears to be (< 10 vol. %) on the surface of 2468 Repin, 2640 Hallstrom, 4188 Kitezh, and 4993 Cossard. Unfortunately, we cannot test this conclusion by the Repin's spectrum from [1] since all the faint absorptions are lost in the noise in that spectrum. In the spectra of other vestoids, listed in the Table, the discussed band is located shortward of 620 nm and, consequently, is the attribute of the pyroxene and/or other minerals, for example, chromites. The same conclusion is valid for the vestoids from SMASS1 [7] since the band position in their spectra is ~600 nm but not longer then 620 nm [8].

Table. Position of the isolated absorption near 600 nm in the spectra of the vestoids.

Vestoids	Band near 600 nm	Olivine (<10 vol. %)
956 Elisa	597±1	not observed
1946 Walraven	603±1	not observed
2045 Peking	609±1	not observed
2468 Repin	624±2	may be
2566 Kirghizia	605±2	not observed
2579 Spartacus	586±2	not observed
2640 Hallstrom	636±2	may be
3155 Lee	598±2	not observed
3536 Schleicher	578±3	not observed
3900 Knezevic	600±2	not observed
4188 Kitezh	638±2	may be
4993 Cossard	641±2	may be
5240 Kwasan	609±2	not observed
7148 Reinholdbien	617±1	not observed

Those four asteroids whose spectra have the discussed absorption make only 7% of a list of the processed vestoid spectra. Apparently, olivine is rare component of the vestoid surfaces.

So, the olivine feature centered longward of 620 nm helps to detect small amount of this mineral (several percents) in the pyroxene-olivine mixture, whereas the 950-nm band and reflectance maximum near 750 nm keep as yet proper “pyroxene” wavelength position. In this connection one can recall the asteroid 4 Vesta. If an olivine-bearing region really exists near Vesta's equator [9] then spectral observation across the asteroid surface in the range of the 600-nm olivine band can be a good test for this supposition.

Acknowledgements: Reflectance spectra of the minerals and meteorites discussed here were measured at RELAB and USGS Digital Spectral Library.

References: [1] Duffard R. et al. (2004) *Icarus*, *171*, 120–132. [2] King T. V. V. and Ridley W. I. (1987) *JGR*, *92*, 11457–11469. [3] Shkuratov Yu. G. et al. (1999) *Icarus*, *137*, 235–246. [4] Bus, S.J., Binzel, R.P. (2002) *Icarus*, *158*, 106–145. [5] Lazzaro D. et al. (2004) *Icarus*, *172*, 179–200. [6] Alvarez-Candal A. (2007) *Astronomy & Astroph.*, *459*, 969–976. [7] Xu Sh. et al, (1995) *Icarus*, *115*, 1–35. [8] Shestopalov et al, (2007) *Icarus* (in press). [9] Gaffey M.J. (1997) *Icarus*, *127*, 130–157.