EPSC Abstracts
Vol. 6, EPSC-DPS2011-215, 2011
EPSC-DPS Joint Meeting 2011

New basaltic asteroids in the outer belt

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Abstract

New near-infrared reflectance spectra of putative V-type asteroids located in the outer asteroid belt have been obtained at the 3.6 m Telescopio Nazionale Galileo covering the spectral range 0.7 to 2.5 µm.
The majority of basaltic asteroids are found in the inner main belt, although a few have also been observed in the outer main belt. All of these distant asteroids may be basaltic bodies having no connection to (4) Vesta not only due to their dynamical characteristics but also to their spectra and derived mineralogies ([1],[2],[3],[4]). Therefore, it is important to understand if also other V-type candidates located in the outer belt show distinct mineralogy with respect to (4) Vesta and its family members. The discovery and analysis of basaltic asteroids independent of Vesta can provide insights into the early history of solar system formation.

1. Introduction

(4) Vesta is likely the smallest differentiated object of the Solar System. Its composition was studied in the past decades [1, 2, 3], revealing the presence of a basaltic crust. Most of the basaltic asteroids are associated to Vesta family , although a few have also been observed in the middle and outer main belt. Those objects with a > 2.5 AU, on the other side of the 3:1 mean motion resonance, are particularly interesting, because the strong resonance inhibits the cross-diffusion of asteroids from the Vesta family. So they are believed to be remnants of other igneous objects.
Other studies have found middle and outer main-belt basaltic asteroids, including 1459 [4], 21238 [5,6,7], 10537 [2], 7472 [2], and 40521 [7, 8].

Aiming to establish if other V-type asteroids might be found in the middle and outer belt, several methods have been developed and applied to photometric surveys, in particular the SDSS-Moving Object Catalog - MOC [9] to select candidate basaltic asteroids [10,11,12].

2. Results

Near Infrared spectra of two putative basaltic asteroids with a >2.5 AU (fig.1) have been acquired with the Telescopio Nazionale Galileo (TNG), in La Palma, on March 2010. We used the Near-Infrared Camera Spectrometer (NICS) equipped with the Amici grism, and a 2-arcsec slit. NICS offers a unique, high throughput, low resolution spectroscopic mode with an Amici grism disperser, which yields a complete 0.8–2.5 µm spectrum in one single acquisition. This large spectral range encompass the 1 and 2 µm bands giving the possibility to evaluate the nature of the observed asteroids.

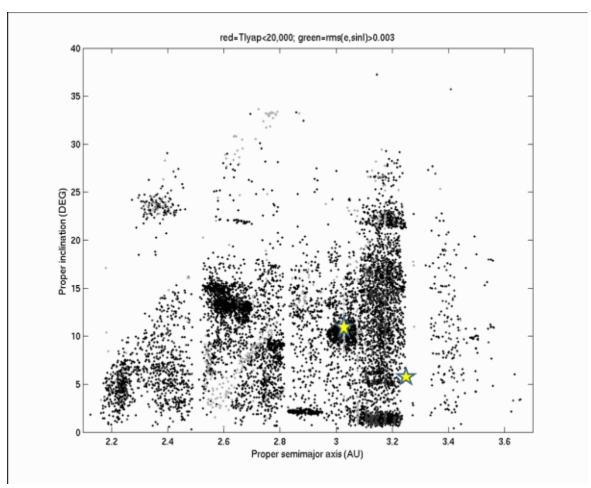

Figure1. The orbital location of the asteroids observed. The background asteroids are taken from astdys web site (http://hamilton.dm.unipi.it/astdys/).

The spectra of asteroids (14390) and (105041) are shown in fig. 2 and fig.3.

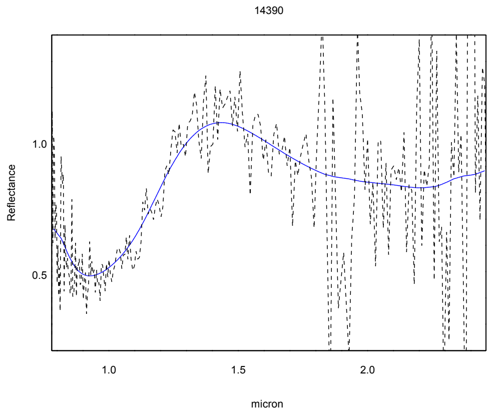

Figure 2. The reflectance spectrum of (14390) (dotted lines), with the smoothed spectrum overlain (blue line).

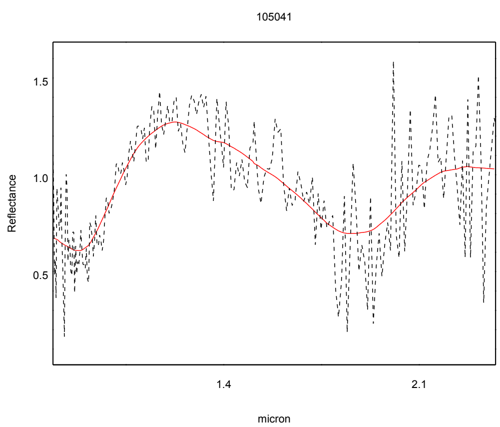

Figure 3. The reflectance spectrum of 105041 (2000 KO41) (dotted lines), with the smoothed spectrum overlain (red line).

The two asteroids show clearly two prominent absorption bands at 1 and 2 µm.

4. Conclusions

We found two asteroids located in the outer belt showing signatures typical of basaltic surface. Both asteroids are beyond the 3:1 resonance (~2.5 AU). Moreover (14390) has a very large semimajor axes (a= 3.24 AU). This asteroid is the most distant "basaltic" asteroids ever discovered.

However their spectra are quite different from those typical of V-type asteroids, posing the problem of the possibly different igneous process in the outer belt.

The above findings could have important implications to understand the origin of basaltic material in the Main Belt, though more data could confirm or refute the significance of these results.

Acknowledgements

These results were obtained with observations made at the Italian Telescopio Nazionale Galileo (TNG) operated on the island of La Palma by the Centro Galileo Galilei of the INAF (Istituto Nazionale di Astrofisica) at the Spanish Observatório del Roque de los Muchachos of the Instituto de Astrofisica de Canarias.

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