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Spectroscopy and photometry of CAI-rich asteroids

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Abstract

Asteroids that are classified as L-type in the classification that includes the Near-Infrared, are known to be a peculiar category of objects. They are named "Barbarians" from the first discovered (234 Barbara) and exhibit an anomalous high percentage of Calcium-Aluminum-rich-Inclusions (CAIs), responsible of a spinel absorption feature in the near infrared (around 2.1-2.2 μm). They also seem to have unusually high rotation periods, and large amplitude light curves. We started a campaign of NIR spectroscopy, photometry and polarimetry to shed a light on such properties and found a large variety of CAI abundances.

1. Observational campaign

The goal of our campaign was to obtain a the most complete physical characterization possible, concerning rotation periods, shapes, new polarimetric measurements, visible and NIR spectroscopy.

Polarimetry is an essential aspect, as Barbarians have a strong polarization parallel to the scattering plane at small phase angles, and a transition to perpendicular polarization at unusually high phase angles. Results obtained on this specific aspect will be introduced by Cellino et al. in the special session "Interpretation of observational data using spectro-polarimetric techniques" of EPSC2017.

Here we will focus mostly on the results by the other techniques.

We were able to coordinate a network of 15 telescopes around the world, to perform asteroid photometry of 16 targets, obtaining (or refining) their rotation period and determining an overall shape. [1][2]

We also obtained visible and NIR spectra for 15 asteroids [3]. Archive data were exploited to complete our sample.

Some of the asteroids in our sample belong to the Klumpkea and the Watsonia families. Others, to the scattered Henan group, probably a scattered collisional family that cannot be found by traditional clustering techniques based on dynamical properties [4].

2. Main results

Our photometric campaign shows that the anomalous distribution of rotation period, favoring long periods, is confirmed. We searched for the evidence of a widespread presence of possible concavities, on the example of 234 Barbara [3] but our results are not conclusive in this respect.

The most original results is provided by combining polarimetry and composition, showing that (1) there is a large variety of CAI abundance in our sample of L-type asteroids, ranging from negligible, to anomalously high, and (2) that this abundance is correlated to the variation of polarization rate with phase angle.

We also find a consistent behavior of the polarization related to the change in refraction angle of the spinel contained in the CAIs. Our study thus finds a strict link between the presence of spinel and the polarimetric anomaly of L-types.

References

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[4] Milani, A., et al. 2014, Icarus, 46, 239