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Mineralogical and photometric analysis of V-type asteroids

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Abstract

Most of the V-types that are known are located in the inner main belt and are members of the Vesta collisional family. The analysis of the photometric and spectroscopic properties of asteroids inside and outside the Vesta family, including V-types in the middle and outer main belt, can answer questions about the existence of differentiated bodies in the asteroid belt and consequently constrain the models of temperature radial extent and variability.

1. Introduction

Basaltic asteroids are taxonomically classified as V-types and their visible-to-near-infrared (VNIR) spectra show two deep absorption bands at 1 and 2 μm, associated with the presence of pyroxene. V-types VNIR spectra are similar to the spectra of HED meteorites and the most representative member of this type of asteroids is (4) Vesta. The majority of V-types are found in the inner asteroid belt as members of the Vesta collisional family, although several have been discovered far from the Vesta family, such as (1459) Magnya [1], showing differences in terms of mineralogy [2, 3]. The existence of such "outsiders" challenged the models of both temperature radial extent and variability during the early Solar System, which generally do not predict melting temperatures in the outer belt.

2. Objectives

The main objective of the present work is to investigate differences among V-types inside and outside Vesta family, using VNIR spectra and photometric phase curves. The spectra are of V-types identified as such using the (Y-J) vs. (J-Ks) color-color plot presented in the Moving Objects VISTA Survey (MOVIS) catalog [4]. The obtained spectra will allow us to confirm their classification as V-types and to infer their detailed mineralogical composition. The phase curves are of V-types classified as such by [5], and being members of diverse populations, in particular: members of the Vesta dynamical family, inner belt with low inclination [6], near-Earth asteroids and middle/outer main belt. The physical parameters obtained from the phase curves will allow to identify similarities and differences among the surface of V-types in different dynamical groups.

3. Methods

The VNIR spectra were obtained using the 2.5m Isaac Newton Telescope (INT) and the 3.6m Telescopio Nazionale Galileo (TNG), both located at El Roque de los Muchachos Observatory (La Palma, Spain), as well as the 3.0m NASA InfraRed Telescope Facility (IRTF), located at Mauna Kea Observatory (Hawaii). The photometric phase curves were obtained at the 1m telescope of the Observatório Astronômico do Sertão de Itaparica (OASI – Itacuruba-PE, Brazil) as part of IMPACTON. The analysis of the spectra allowed to derive several parameters that are diagnostic of mineralogical composition, like the centres and the depths of the absorption bands or the ratio of their areas (BAR), while the phase curves were used to derive the H-G parameters using the program $\text{MAGRED}_{\text{CF}}$.

4. Results

The obtained results seem to indicate that the composition of the asteroids outside the Vesta family is different from that of Vesta itself and from Vesta family members. Interestingly, a V-type asteroid located close to (1459) Magnya shows a significantly large value of the BAR parameter, similar to what is found for Magnya. Phase curves are still under reduction and preliminary results will be shown at the meeting.

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