MID-INFRARED SPECTROSCOPY OF CALCIUM-ALUMINIUM-RICH INCLUSIONS: A TOOL TO DETECT PRIMITIVE ASTEROIDS?

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Introduction: Current near-Earth asteroid (NEA) classification schemes are based on visible and near infrared (VNIR) reflectance spectroscopy of these bodies [e.g. 1]. Using mid infrared (MIR) spectra of NEAs acquired by the Spitzer Space Telescope, we explore whether MIR can be used to identify the primitive calcium-aluminium-rich inclusions (CAIs) found in carbonaceous chondrites, and whether we are able to detect primitive components in asteroids this way. High resolution MIR spectra for the Trojan asteroids [2], among others have been used to study their composition.

Methods: In-situ specular reflectance spectra of components forming CAIs in the carbonaceous chondrites Allende (CV3.3), Vigarano (CV3.3), and Ornans (CO3.3) were acquired with a Perkin Elmer AutoIMAGE Fourier Transform Infrared (FTIR) microscope at the Natural History Museum in London. Spectra were obtained in the range of 2.5 – 16 µm with a resolution of 4 cm^{-1}. Spectra were validated with the Johns Hopkins University Spectral Library and the RELAB Spectral Database.

Spectra for asteroids Cuyo, Mathilde, Ida, Isara, Bennu, Elisa, Gaspra, Toro and Apollo were acquired by the Infrared Spectrograph in 'staring mode' [3] on Spitzer, covering a range of ~ 5.3 – 36 µm. Data were reduced, cleaned and extracted with the SMART IDL package [4], IRSCLEAN, and the Advanced Optimal (AdOpt) extraction [5]. Asteroid physical parameters and emissivities were derived by fitting a NEA thermal model (NEATM [6]). Emissivities for the Trojans Aeneas, Agamemnon and Hektor were acquired from a previous study [2].

Results: We focus on the 8 – 16 µm range. All asteroid spectra generally display low signal-to-noise (S/N) relative to CAI lab spectra. Melilite in the interior of CAIs in Vigarano and Ornans has characteristic bands which are not definitively found in the asteroids sampled, with Cuyo being a possible exception. Pyroxene in the interior of Allende and Ornans CAIs has similar features to Hektor. Spinel (14 – 14.5 µm range in Vigarano CAI rims and Ornans CAI interiors, respectively) may be found in Bennu, and (somewhat shifted) in the Trojans.

Discussion: Mineralogical interpretation of the MIR spectra on asteroids based on the CAI lab spectra remains difficult. We have tentatively identified some of the phases of CAIs in the asteroids here, but remain cautious due to low S/N and possible effects of the irregular surface of asteroids on the spectra (e.g. band shifts and feature inversions [7]).

References: [1] Bus, S. J. and Binzel, R. P., 2002a. *Icarus* 158, 146–177. [2] Emery J. P. et al. 2006. *Icarus* 182, 496–512. [3] Houck, J. R. et al. 2004. *International Society for Optics and Photonics* 62–76. [4] Higdon S. J. U. et al. *Publications of the Astronomical Society of the Pacific* 116, 975–984. [5] Lebouteiller V. et al. 2010. *Publications of the Astronomical Society of the Pacific* 122, 231–240 [6] Harris, A. W. 1998. *Icarus* 131, 291–301. [7] Vernazza P. et al. 2010. *Icarus* 207, 800–809.