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VIS-IR spectroscopy of Alais CI chondrite by using the SPectral IMager (SPIM).

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Abstract

In the last years increasing attention on the composition of asteroids is being payed. In fact, aside the scientific missions (Dawn for Vesta and Ceres, Osiris Rex for Bennu) other projects aim to study NEA (Near Earth Asteroids) compositional properties for monitoring, warning and defence purposes. The study of the spectral properties of the CC chondrites is important to provide new data for the interpretation of remote sensed data from class B, C and G types asteroids. The Alais meteorite is a CI chondrite that is believed to have C-G type asteroid as parent body. In this abstract we show preliminary interpretation of data collected by the Spectral Imager (SPIM) in the VIS-IR (0.45-5μm) range on powders of the Alais meteorite.

1. Introduction

The Alais meteorite is a CI chondrite that is believed to have C-G type asteroid as parent body. In this abstract we show preliminary results related to the spectral features of Alais, in the VIS-IR to support observations on C-type asteroids. Data were collected by means of SPIM SPectral Imager in the range from 0.45 to 5 μm to analyze the spectral contribution of different components of this meteorite sample thanks to the high spatial resolution (40 micrometers).
From the mineralogical point of view the Alais chondrite consists largely of a phyllosilicates matrix, mainly saponite with subordinate serpentine [1]. The composition of phyllosilicates in Alais ranges between serpentine and smectite [2]. Other phases such as carbonates, Ca-sulfate, and Mg-sulfate (epsomite and hexahydrite), do occur in veins [3,4]. Thermomagnetic analysis indicates that magnetite content is 8.9 ± 0.9 wt.%, [5]. Bulk C content is about 5.40 wt.% [6]. Recently the Alais meteorite was studied in the VNIR range by [7].

2. Experiment set up

The imaging spectrometer installed in SPIM is a spare of the spectrometer on Dawn spacecraft. It works in the 0.22-5.05 μm spectral range, with a spatial resolution of 38x38 μm on the target [8]. The analyzed samples were in the form of powders. The analyses of the absorptions were carried out on the mean spectrum of the powder and then on each pixel spectrum.

3. Results

The average spectrum of the powder is shown in fig.1. It is characterized by a blue slope in the NIR range, 1.04-2.4 μm.
It is featured by an absorption centered at 0.5 μm and around 1.16 μm. At 1.97 μm the H_2O band appears. Moving towards the IR range another weak absorption around 2.2 μm appears. The IR range show a deep absorption at 2.88 μm related to O-H stretching. Two little absorptions appear located at 3.39 and 3.49 μm that could be related to carbonates and/or to C-H contamination. The absorption near 4.26 is due to atmospheric CO_2.
The band at 4.75 μm is currently under investigation.

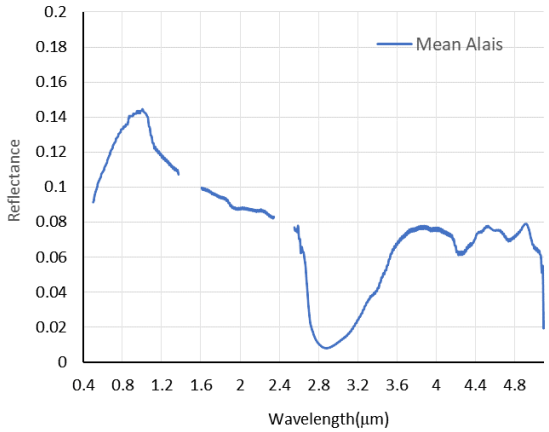

Fig. 1 Mean spectrum of powders of Alais chondrite.

Preliminary results of the analyses pixel by pixel are shown in fig.2.

The 0.49 and 1.16 μm absorptions in almost all the spectra can be assigned to magnetite: the first due to spin-forbidden Fe^{3+} absorption band transitions and the second to crystal field in octahedrally coordinated Fe^{2+}[7]. In some spectra (coordinates of pixel: x249y9; x189y9) the 1.94 μm feature appears. It is related to H_2O in hydrated phases like some sulfates and phyllosilicates. The absorptions at 2.18-2.20 μm is related to the metal-OH stretching in the phyllosilicates.

In the range between 2.7-5 μm, the spectra show higher variability in the absorption features. They are overall characterized by strong H_2O features 2.7-3 μm. Moreover, they display typical absorptions and spectral profiles of sulfates, carbonates, phyllosilicates.

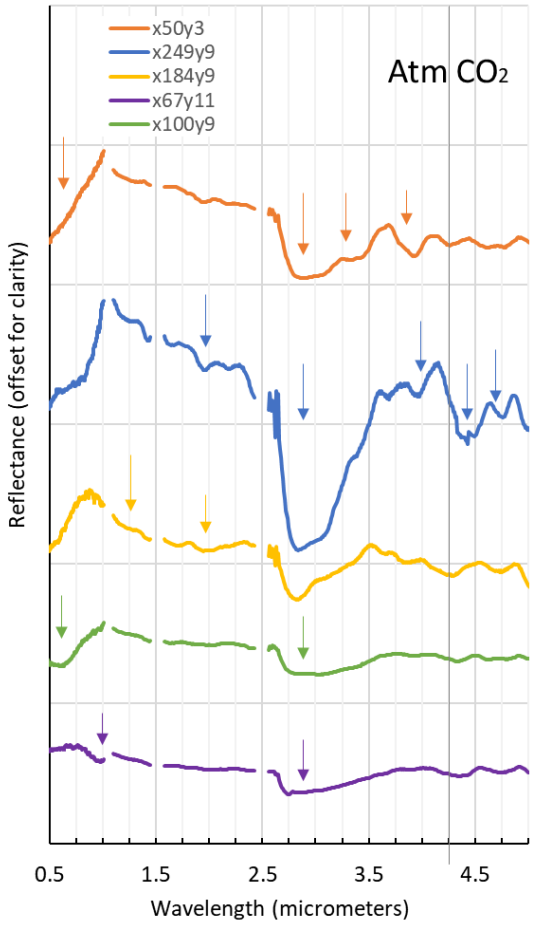

Fig. 2 Spectra of some single pixels of the Alais powder. x,y represent the coordinates of each considered pixel

For example, the spectrum related to pixel x50y3 is featured by a 3.27-3.43 μm doublet and 3.79-3.95 μm absorptions, (data around 1.5 and 2.5 μm were removed because of instrumental artifacts).

After the continuum removal these bands closest match to Mg-carbonates than Ca carbonates.

4. Summary and Conclusions

In this abstract we show some spectral properties in the VIS-IR range of powder of Alais carbonaceous chondrite. The average spectrum shows features that can be ascribed to different mineralogical groups. This first observation was confirmed by analyses of single pixels that shows the persistent occurrence of Fe-bearing minerals in the range 0.45-1.2. All the spectra investigated however show a subpixel mixing of absorptions attributable to phyllosilicates, carbonates, sulphates. Further investigations are on course with the aim to unmix the mean spectrum, quantifying each spectral phase and evaluating implications on the spectral properties of carbonaceous chondrites parent bodies.

Acknowledgements

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