THE DARK SIDE OF THE CI CHONDRITE ORGUEIL

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Introduction: The reflectance spectra of carbonaceous chondrites show low reflectance levels in the visible, the CI Orgueil being one of the most extreme cases. These meteorites are usually associated to C- and D- type asteroids as well as cometary nuclei [1,2], that all present very low geometric albedos (<0.08). If one wants to obtain compositional information from the reflectance spectra of small bodies, an accurate understanding of the optical properties of meteorites is a prerequisite. Here, we will try to understand the reflectance spectra of Orgueil, from 0.5 to 4 µm, by using laboratory measurements of coals, their laboratory mixture with minerals phases, as well as measurements of the reflectance spectra of carbonaceous chondrites with contrasted parent body histories.

Methods: Reflectance spectra were measured using the spectro-gonio-radiometer available at IPAG. This instrument has typical accuracy on reflectance level of 0.25 % [3]. In the case of carbonaceous chondrites, reflectance spectra were measured using an environmental chamber **(**primary vacuum and heating at T=60°C) to minimize contamination by adsorbed water [4-5]. The series of standard coals was obtained from the the Coal Sample Bank (Penn State University USA) . For mixing experiments, synthetic calibrated alumina spheres (25 and 80 µm), powdered pyrite provided by the MNHN (Paris), dunite powder (5-10 µm) as well as a Réunion island basalt were used. For most samples, the impact of observation geometry was also investigated in the principal plane, for 3 incidence angles (0°,30°, 60°) and typically 13 emergence angles (spaced by 10°)

Results and discussion: The coals studied have a very low reflectance level in the visible up to 1-µm (<0.03). The behavior at higher wavelength is quite different and depends on the maturation degree of the coal. At 2-µm, with increasing maturation, coals range from having a high reflectance factor (0.4) to very low (0.03). This evolution was documented in previous studies on bitumen and coals [6-7]. In term of bulk C, H and O composition [8], the insoluble organic matter of Orgueil is close to the less mature coals, and therefore highly reflective in the NIR. The reflectance spectra of Orgueil, which is flat from 0.5 to 2.5 µm, with a reflectance factor of about 0.06, is however more similar in shape to that of mature coals. Such an observation is paradoxical if organic compounds control the reflectance spectrum of Orgueil. In order to see if multiphase mixing solves this paradox, reflectance spectra of mixtures were undertaken. These data sets show that given the fine-grained nature of Orgueil, a few weight percents of carbon might only cause very minor darkening. Rather, we will suggest that other opaque phases are mostly responsible for the low albedo of Orgueil.

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