PRECISE REFLECTANCE SPECTRA OF ORDINARY CHONDRITES IN THE VISIBLE AND UV: EXPLORING THE VARIABILITY OF S-CLASS ASTEROIDAL SPECTRA. J. M. Trigo-Rodríguez[1], J. Llorca[2], J.M. Madiedo[3], A. S. Rivkin[4], J. de León[5], and N. Pinilla-Alonso[6]. [1]Institute of Space Sciences (CSIC-IEEC). Campus UAB, Facultat de Ciències, Torre C5-p2. 08193 Bellaterra, Spain. [2]Institute of Energy Technologies and Center for Research in Nanoengineering, Universitat Politècnica de Catalunya, Diagonal 647, ed. ETSEIB. 08028 Barcelona, Spain. [3]Facultad de Ciencias Experimentales, Universidad de Huelva, Huelva, Spain. [4]John Hopkins Applied Physics Laboratory [5]Instituto de Astrofísica de Andalucía (CSIC), PO Box 3004, 18080 Granada. [6]NASA post-doctoral program at Ames Research Center, CA, USA.

Introduction: Narrow-band spectrophotometry programs for the study of asteroids were initiated in the 1960s [1,2], which were able to identify clear absorption bands in the UV and visible, that were used later on in order to develop the first asteroid taxonomy [3]. A step forward was to remotely obtain reflectance spectra of asteroids to establish the existence of families [4, 5, 6], and to place meteorites broadly within these families based on their own spectra. This approach is imperfect due to space weathering, that together with the presence of regolith, intrinsic roughness, etc., alters the reflectance spectra to be compared with spectra of meteorites in our laboratories. Currently there are several comprehensive spectral catalogue of meteorites [7-8], but we wish to explore the capacities of current spectrographs to obtain reflectivities in those extreme regions of the electromagnetic spectrum where data is poor (typically below 0.4 microns and over 2.4 microns). Additionally we wish to explore the importance of roughness as the reason for the diverse mineralogy observed for S-class asteroids that are linked to the ordinary chondrites [9].

Methods: We have used a Shimadzu UV3600 UV-Vis-NIR spectrometer. This instrument allows the measurement of the transmission, absorbance and reflectance for powder, solid, or liquid samples. The standard stage for the spectrometer is an Intregrating Sphere (ISR) with a working range of 220 to 2,600 nm. The spectrometer uses multiple lamps, detectors and diffraction grates to work over a wide range of wavelengths. The light originates at one of two lamps, passes through a variable slit, is filtered to select the desired wavelength with a diffraction grating, and is then split into two alternating but identical beams with a chopper. The sample beam interacts with the sample and is routed to one of two or three detectors (depending on the sample stage). The reference beam interacts with the reference material and then goes to the same detector. The inside of the ISR is coated with a reflecting polymer called duraflect. For calibration of the detector a standard baseline was created using a conventional $BaSO_4$ substrate. The samples analyzed were several sections of H and L ordinary chondrites (Table 1). The area sampled during the measurements correspond to a slot of 2.5×1 cm^2.

Meteorite	Group	Notes
Gao Guenie	H5	fall
Gold Basin	L4	found
Nulles	H6	fall
Olmedilla de Alarcón	H5	fall

Table 1. Meteorites analyzed in this study.

Results and discussion: The meteorites' reflectance spectra were measured several times in different areas to get an average value for the reflectance in each wavelength. The error was estimated from the scattering in the measurements, and estimated to be in general lower than 3%. The reflectance curves are shown in Fig. 1a,b where the different meteorites are labeled. On Fig. 2 is shown the reflectance curve for a same section of Gao Guenie H5 chondrite, but using a polished, and a rough face. Similar differences are observed for other chondrites. These preliminary results motivate us to keep exploring the role of roughness and grain size for regolith-rich asteroids. Limited data is available in spectral regions below 0.4 microns and over 1.4 microns, although the RELAB comprehensive database typically reaches 2.5 microns [8]. We note that below 0.4 microns the reflectivity of the samples tends to converge into a 5 to 10% range. Longward of 2.4 microns the reflectivity diversifies from 15 to 35%., but rising for all analysed chondrites (Fig. 1b).

Conclusions: Reflectance spectra for the selected meteorites are consistent with the averaged values for the S-class of asteroids. However, intrinsic differences among the chondrites point towards differences in mineralogy that we will continue exploring in future experiments.

References: [1] McCord T.B., Adams J.B., and Johnson T.V. 1970 *Science* **168**, 1445-1447. [2] Chapman C.R., Johnson T.V. and McCord T.B. 1971 In *Physical studies of minor planets* (T.Gehrels ed.) pp.51-65. NASA SP267, Washington, DC. [3] Chapman C.R., Morrison D., and Zellner B. 1975 *Icarus* **25**, 104-130. [4] Gaffey M.J. 1976, *J. Geophys. Res.* **81**, 905-920. [5] Tholen D.J. (1984) *Ph.D. Thesis.* Univ. Arizona, Tucson. [6] Bus S. J. and Binzel R. P. 2002 *Icarus* **158**, 106-145. [7] Pieters C.M., and Hiroi T., 2004 *LPS XXXV*, abstract#1720. [8] Brown Univ. Keck/NASA RELAB spectra catalog. [9] Gaffey M.J. et al. (1993) *Icarus* **106**, 573-602.

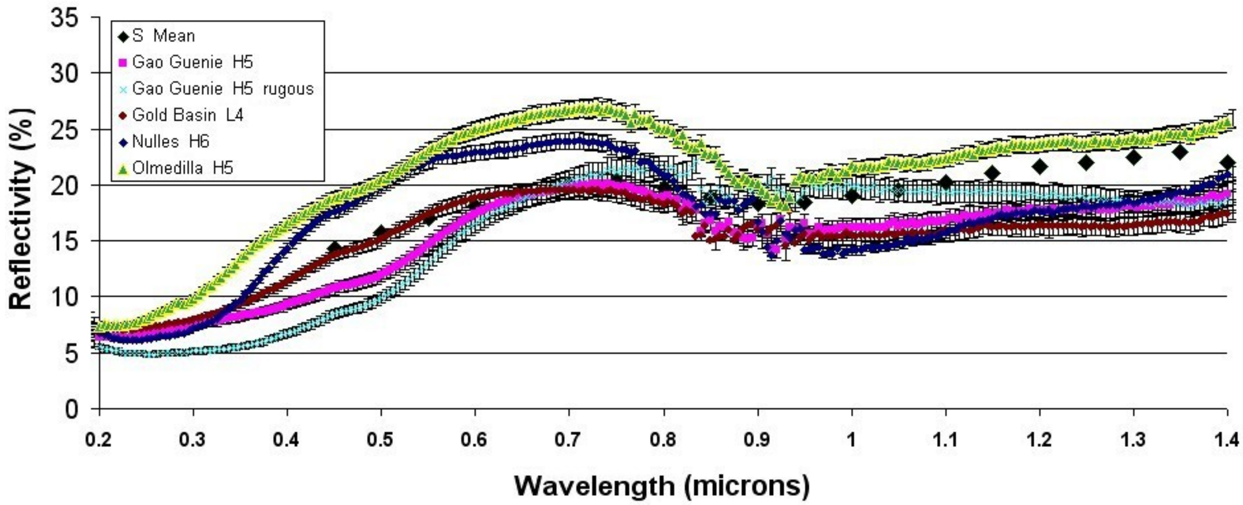

Figure 1a. UV-visible-near IR spectra of ordinary chondrites analyzed in this study in the 0.2 to 1.4 μm range (see Table 1 for additional details). 1σ error bars are included to take into account the scattering among the measurements.

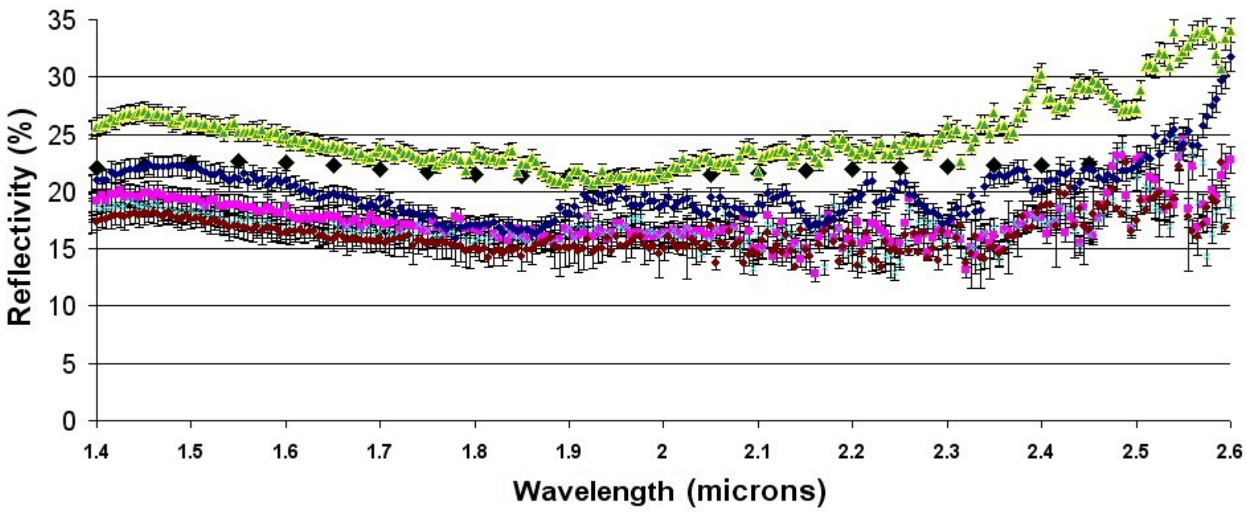

Figure 1b. Spectra of ordinary chondrites in the 1.4 to 2.6 μm range (see Fig. 1a caption for additional details).

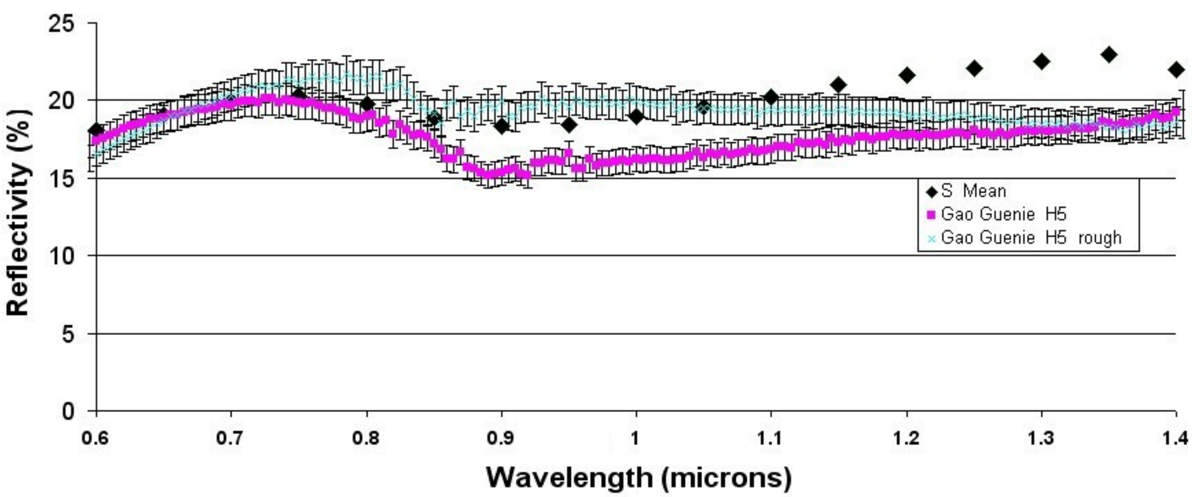

Figure 2. Main differences in the reflectance spectrum of the H5 ordinary chondrite Gao Guenie for a polished and a rugous section in the 0.6 to 1.4 microns range. Note that the rough sample tends to fit better the S mean spectrum below 1.1 μm.