OPENING THE MID-IR WINDOW ON ASTEROID PHYSICAL PROPERTIES. P. Vernazza[1], P. L. King[2], M. R. M. Izawa[3], A. Maturilli[4], J. Helbert[4], D. Cruikshank[5], R. Brunetto[6], F. Marchis[7], R. P. Binzel[8], R. L. Flemming[3]. [1]Laboratoire d'Astrophysique de Marseille, France (pierre.vernazza@oamp.fr), [2]Institute for Meteoritics, Univ. New Mexico, Albuquerque NM 87131 USA, [3]Univ. of Western Ontario, [4]DLR, [5]NASA Ames, [6]IAS, [7]SETI Institute & UC-Berkeley, [8]MIT.

Introduction: Determining both the linkages between meteorites and their parent bodies and the surface composition of asteroids is a critical goal of planetary studies. Spectroscopy in the visible near-infrared range (VNIR, 0.4–2.5 micron) has proven to be a powerful tool for constraining the surface composition of certain asteroid taxonomic classes (e.g., A-, S- and V-classes), and has also allowed researchers to determine the linkages between a few meteorite classes and their parent bodies (e.g., HEDs and V-types, OCs and S-types). For many asteroid classes that are featureless in this wavelength range, however, (e.g., the B-, C-, and D-classes), VNIR spectroscopy is currently facing its limits, because some important minerals do not have features in this spectral region.

For these compositional groups, mid-infrared spectroscopy has long been considered as the solution. Most major mineral groups and silicate glasses (such as the plagioclase feldspars) that lack useful diagnostic features at visible to near-IR wavelengths do produce diagnostic mid-infrared features. It has recently been shown, however, that in the case of asteroids, even if the main surface minerals are well known from the VNIR range, spectral deconvolution using existing mid-infrared spectral libaries do not indicate their presence nor constrain their relative abundance [1]. This implies that the current approach in terms of sample preparation (i.e. pressed powder on a pellet) may not reproduce well the actual properties of asteroid regolith. Otherwise, the laboratory and asteroid spectra would match.

New method: Here we test a different sample preparation method that has previously been applied on enstatite chondrite meteorites [2].

By suspending enstatite chondrite powder (<30 µm) in infrared-transparent KBr powder, Izawa et al. [2] produced very different mid-IR reflectance spectra from pure EC powders of equivalent grain size (referred as the classical sample preparation method). Interestingly, enstatite chondrite meteorites which have been linked to asteroid 21 Lutetia [3], display similar mid-infrared spectral properties to those of 21 Lutetia only when they are diluted in KBr powder (see Figure 1). This may indicate that scattering from the regolith of 21 Lutetia is a mixture of transmission and reflectance. The most probable explanation for the correspondence of KBr-diluted spectra is that scattering from the regolith is dominated by the fine-grained component and that the regolith is loosely consolidated, both properties that can enhance transmission of incident light: such material allows many photons to pass entirely through one or more particles before reaching the detector. Although there are almost certainly larger particles in the regolith, most of the scattering (volumetrically) is likely to be from small particles. This is in accord with previous studies indicating that the regolith of many asteroids is dominated by very fine-grained material (e.g., [4]).

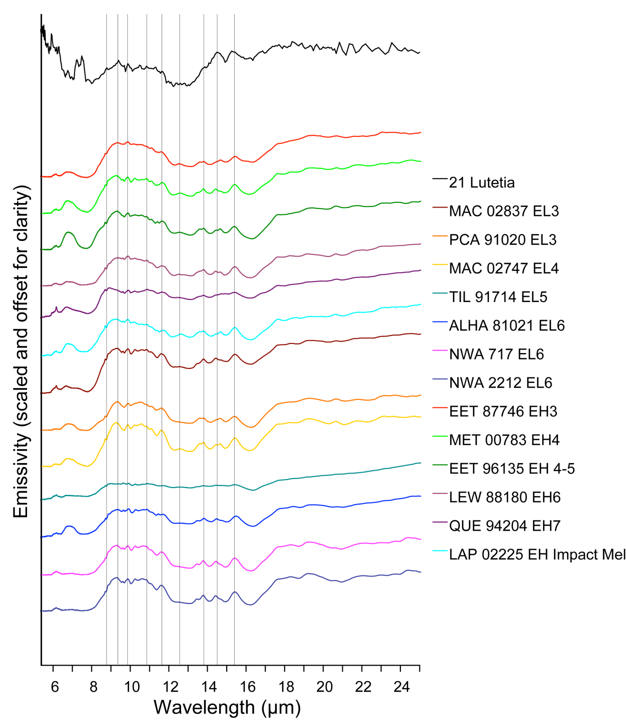

Figure 1: Comparison between KBr-diluted EC spectra with the mid-infrared spectrum of 21 Lutetia. Spectral features of 21 Lutetia in the are

strikingly similar to those of KBr-diluted EC, notably in the ~8-25 µm region dominated by silicate fundamental vibrations. The Christensen feature of enstatite near ~8.3 µm in the non-diluted EC spectra is conspicuously absent from the 21 Lutetia spectrum. The discrepancy near ~6 µm is likely due to the presence of hydrated terrestrial weathering products in the EC samples investigated by [2].

However, because there is an ongoing controversy on the true nature of Lutetia's composition, we tested this new sample preparation method on a 'well-known' asteroid-meteorite association, namely the so-called S-type asteroids and the ordinary chondrite meteorites (OCs). A good match between KBr-diluted OC spectra and S-type spectra would definitively open the mid-IR window to advanced asteroid science.

Results: We will present a comparison of both KBr-diluted OC spectra and non KBr-diluted OC spectra with Spitzer S-type asteroid spectra (e.g., Vernazza et al. 2010). The OC sample includes the H (H3 Dhajala, H4 Kabo, H6 Chiang Khan), L (L3 Mezö-Madaras, L4 Rio Negro, L6 Kyushu), and LL (LL3 Semarkona and Bishunpur, LL4 Greenwell Springs, LL6 Bandong and Saint-Séverin) chondrites. The S-type sample will cover different compositions (in terms of olivine to pyroxene abundance) as inferred from the VNIR range.

Specifically, we will test if applying the new sample preparation method, one can use the mid-infrared range to link an OC subclass (e.g., LL class) to a given S-type asteroid as can be done in the VNIR range (e.g., [5,6]). Said differently, we will investigate how precisely the surface composition of an asteroid can be determined from the mid-infrared range.

References: [1] Vernazza P. et al. (2010) *Icarus, 207,* 800-809. [2] Izawa M. R. M. et al. (2010) *JGR, 115*. [3] Vernazza P. et al. (2009) *Icarus, 202,* 477-486. [4] Emery J. et al. (2006) *Icarus, 182,* 496-512. [5] Vernazza P. et al. (2008) *Nature, 454,* 858-860. [6] Binzel R. P. et al. (2009) *Icarus, 200,* 480-485.