High surface porosity as the origin of emissivity features in asteroid spectra. P. Vernazza, M. Delbo, P. L. King, M.R.M. Izawa, J. Olofsson, P. Lamy, F. Cipriani, R. P. Binzel, F. Marchis, B. Merin, A. Tamanai. 1 European Southern Observatory, K. Schwarzschild-Str. 2, 85748 Garching, Germany (pvernazz@eso.org). 2 UNS-CNRS-Observatoire de la Côte d’Azur, Laboratoire Cassiopée, BP 4229, 06304 Nice cedex 04, France. 3 Australian National University, Research School of Earth Sciences, Acton ACT 0200, Australia. 4 Department of Earth Sciences, University of Western Ontario, London, Ontario, Canada. 5 Max Planck Institute for Astronomy, Königstuhl 17, 69117 Heidelberg, Germany. 6 Laboratoire d’Astrophysique de Marseille, UMR 7326, CNRS/Université d’Aix-Marseille, 38 rue Frédéric Joliot-Curie, 13388, Marseille Cedex 13, France. 7 Research and Scientific Support Department, European Space Agency, Keplerlaan 1, 2201 AZ Noordwijk, The Netherlands. 8 Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA. 9 SETI Institute, 515 N. Whisman Road, Mountain View, CA 94043, USA. 10 Herschel Science Centre, SRE-SDH, ESA PO Box 78, 28691 Villanueva de la Cañada, Madrid, Spain. 11 Kirchhoff-Institut für Physik, D-69120 Heidelberg, Germany.

Abstract: Emission features in the mid-IR domain (7-25 µm) are quite ubiquitous among large asteroids and therefore offer the potential to uncover their surface composition. However, when comparing these spectra with the actual laboratory spectra of both minerals and meteorites, they do not necessarily match. Here, we show that by modifying the sample preparation – typically by suspending meteorite and/or mineral powder (<30 µm) in IR-transparent KBr (potassium bromide) powder - we are able to reproduce the spectral behaviour of those main-belt asteroids with emissivity features. This resulting good match between KBr-diluted meteorite spectra and asteroid spectra suggests an important surface porosity (>90 %) for the first millimeter for our asteroid sample. It therefore appears that mid-IR emission spectra of asteroids do not only carry information about their surface composition but they can also help us constraining their surface structure (under-dense versus compact surface structure). The large surface porosity inferred from the mid-IR spectra of certain asteroids is also implied by two other independent measurements, namely their thermal inertia and their radar albedo. We further clarify how much compositional information can be retrieved from the mid-IR range by focusing our analysis on a single object, 624 Hektor. We show that the mid-IR range provides critical constraints i) on its origin and of that of the red Trojans that we locate in the Kuiper belt region, and ii) on the primordial composition of the dust present in the outer region (>10AU) of the Solar System’s protoplanetary disk. Future investigations should focus on finding the mechanism responsible for creating such high surface porosity.