SPECTRAL REFLECTANCE PROPERTIES OF MESOSIDERITES

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Introduction

Mesosiderites are stony-iron meteorites consisting of varying amounts of Fe-Ni metal and silicates [1]. The identity of any parent bodies in the main asteroid belt and among near-Earth asteroids is not well-constrained, due in part to the lack of laboratory spectral reflectance data for them. This is compounded by uncertainties about what their regolith physical properties may be, and the difficulty of preparing representative powdered samples.

A knowledge of the spectroscopic properties of mesosiderites is relevant to the composition of asteroid Psyche, the target of the upcoming Psyche mission [2], because of the discovery of possible weak mafic silicate absorption bands in telescopic spectra of Psyche [3] and other M/X-class asteroids [4] which may be consistent with a mesosiderite-like (pyroxene + metal) surface.

Methods:

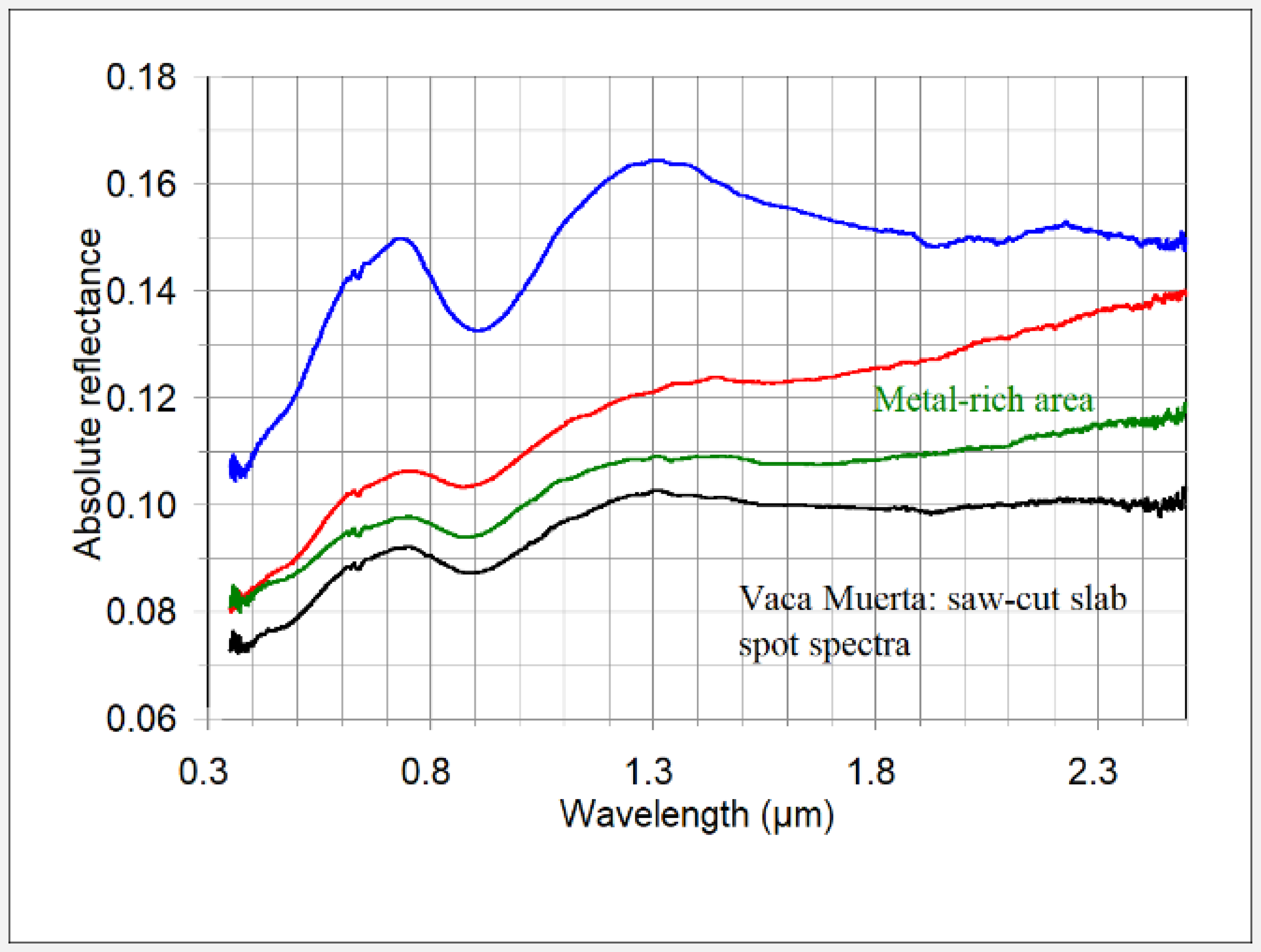
We measured spectral reflectance properties of a number of mesosiderites in a variety of forms, including saw-cut interior faces and saw-cut powders. The samples characterized to date include: Allan Hills A77219 (ALHA 77219), MacAlpine Hills 88102 (MAC 88102), Northwest Africa 2932 (NWA 2932), Northwest Africa 7132 (NWA 7132), Northwest Africa 10765 (NWA 10765), Northwest Africa 10882 (NWA 10882), Northwest Africa 11761 (NWA 11761), Queen Alexandra Range 86900 (QUE 86900), and Vaca Muerta.

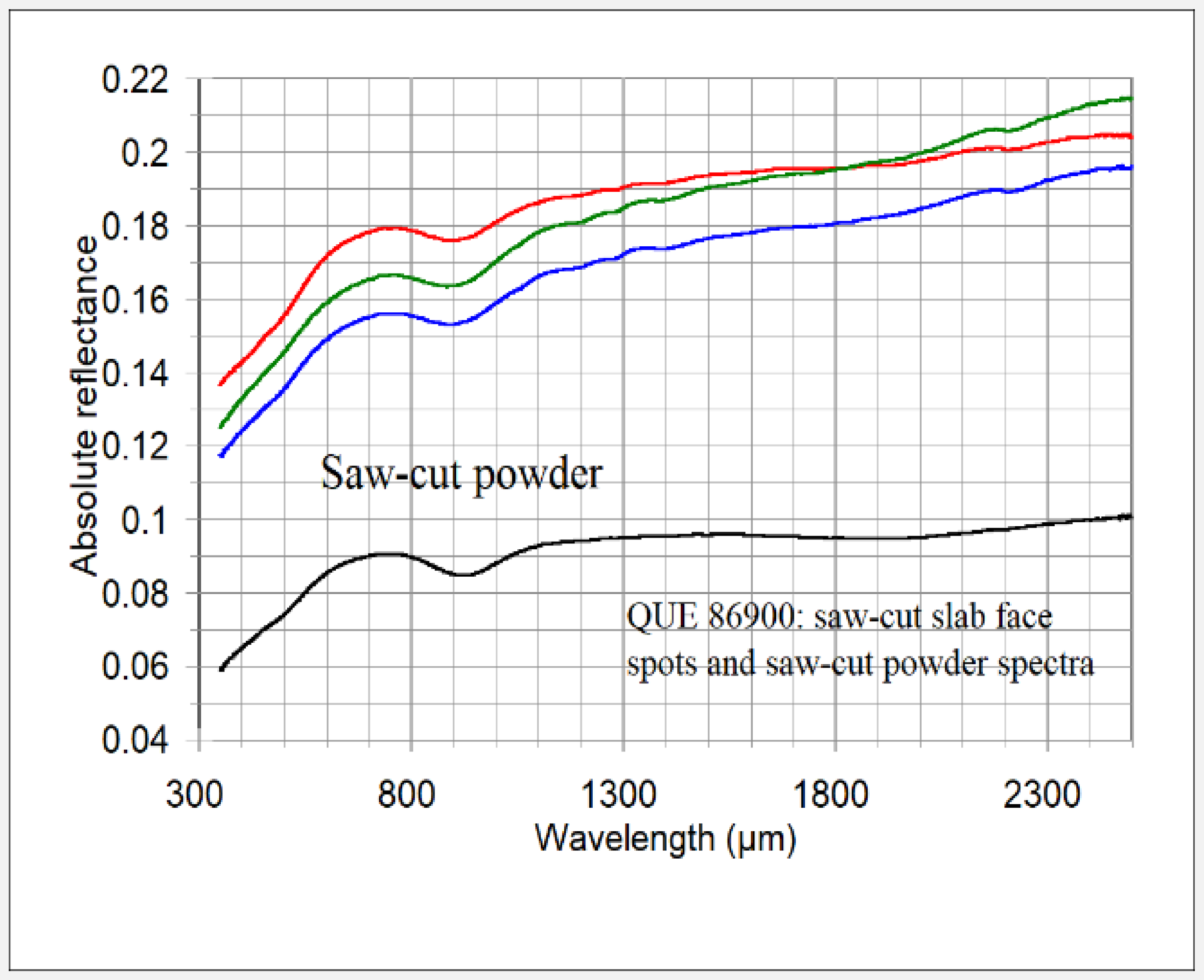
Reflectance spectra were measured using an ASD FieldSpec HR spectrometer between 350 and 2500 nm with between 2 and 7 nm spectral resolution, with a viewing geometry of *i*=30°, *e*=0° against a Spectralon reflectance standard, and corrected for dark current and irregularities in Spectralon's reflectance beyond ~2000 nm.

Results:

The spectral reflectance properties of the measured mesosiderites are diverse. This is due to two main factors: (1) the scale of roughness of the slabs strongly affects spectral slopes and albedo [5]; (2) the abundance of mafic silicates and metal viewed by the spectrometer on slabs. When mafic silicates are present in the field of view, they contribute to the reflectance spectrum. Pyroxene is the most obvious spectral contributor to the spectra. It will appear as a 1000 nm region absorption band and a weaker 2000 nm absorption band (Figures 2 and 3). Slab spectra can also be affected by polarization effects that cannot easily be corrected for.

Figure 1: View of unpolished surface of the Vaca Muerts mesosidierite.





Figures 2 and 3. Reflectance spectra of spots on a slab of the Vaca Muerta mesosiderite and saw cut powder and spots on a slab of the QUE 86900 mesosiderite.

Discussion:

As mesosiderite spot spectra and spectra of saw-cut powders are not well suited for assessing how metal and silicates contribute to the spectra, we have supplemented the mesosiderite spectra with reflectance spectra of powdered mixtures of pyroxene + meteoritic metal with known end member abundances. We have found that even at low abundances of pyroxene (<10 wt. %), pyroxene absorption bands are present in the reflectance spectra, albeit with greatly reduced band depths. Ongoing analysis of mesosiderite and silicate + metal spectra is allowing us to unravel the effects of physical properties (powders versus slabs), roughness of solid surfaces (slabs), and develeop methods to determine pyroxene-metal abundances, and how well pyroxene composition can be recovered from analysis of mesosiderite and mixture spectra.

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References: [1] Wiesberg M. K., et al. 2006. Systematics and Evaluation of Meteorite Classification. In: *Meteorites and the Early Solar System II*. [2] Oh D. Y. et al. 2016. *AIAA* 2016-4541. [3] Sanchez J. A. et al. 2017. *Astron. J.*, 153, 29. [4] *MaPS*, 46, 1910-1938. [5] Britt D. T. and Pieters C. M., 1988. *Proc. 18th LPSC*, 503-512.