THIN WAFER TRANSMISSION MÖSSBAUER SPECTRA OF FOUR SHERGOTTITES: IMPLICATIONS FOR MINERALOGY OF ROCKS AT MARS EXPLORATION ROVER SITES.
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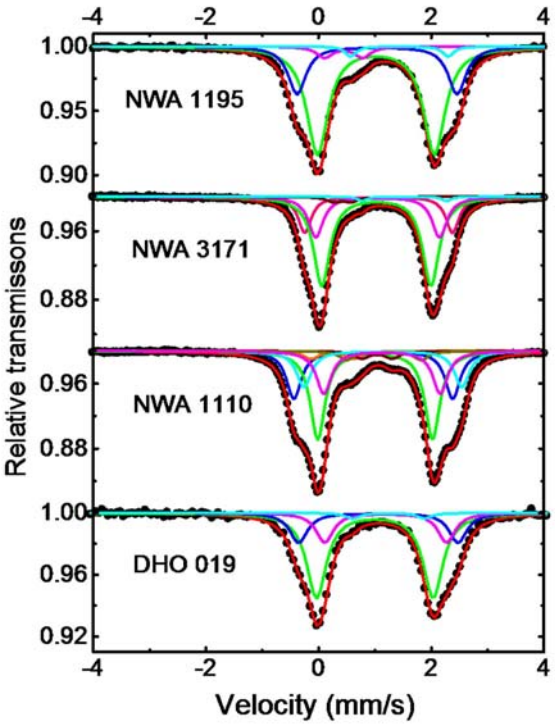
Introduction: We report here the preliminary results of a Mössbauer spectroscopy study of four different shergottite meteorites found in Northwest Africa and Oman, which span the known range of petrologic types. In contrast to traditional methods, we discovered that excellent spectra could be obtained in transmission mode from small (~15 mm diameter) and thin (~1mm) wafers of these specimens. This technique has advantages over traditional analysis of powdered samples since it is non-destructive, representative of the specimen, and permits subsequent studies to be performed on the intact samples. Our results may assist in the mineralogic interpretation of the back-scattered Mössbauer spectra obtained by the MER mission on rocks at the Spirit and Opportunity landing sites.

Specimens and Experimental Techniques: The specimens selected for study include olivine-orthopyroxene-phyric shergottite NWA 1195, olivine-phyric shergottite NWA 1110 (paired with NWA 1068), olivine-phyric shergottite Dhofar 019, and olivine-free basaltic shergottite NWA 3171. Petrological studies of these meteorites [1] have established their modal mineralogy and revealed complex chemical zoning within the mineral phases (as is typical of all shergottites and presumably also of their counterparts on Mars).

The wafers were irradiated using a ^{57}Co gamma source imbedded in rhodium matrix for two days to one week, and spectra were collected on a constant acceleration spectrometer in transmission mode. The spectra were analyzed using NORMOS software [2] assuming a Lorentzian line form.

Results: The transmission spectra shown in Figure 1 were fitted using the above line form. The drive velocity of the spectrometer was calibrated using metallic iron at room temperature. In order to obtain accurate hyperfine interaction parameters and avoid any line broadening due to sample thickness, we currently are implementing transmission integral analysis, which takes into account thickness effects and restricts positions and widths as much as is physically reasonable.



Discussion: As in previous studies [3], the spectra are consistent with the differing observed mineral assemblages in these samples, with prominent peaks from pyroxenes (green) and olivine (blue, except in NWA 3171). We are continuing to evaluate the results, especially with respect to accessory oxide phases such as chromite and ulvöspinel. A small but significant amount of Fe^{3+} was detected in all the samples, as was observed in Martian igneous rocks by the Spirit and Opportunity rovers [4], as well as in other meteorite samples.

References: [1] Taylor L. A. et al. (2002) *MAPS, 37*, 1107; Barrat J.-A. (2002) *GCA, 66*, 3505; Irving A. J. et al. (2002) *MAPS, 37*, A69; Goodrich C. A. et al. *LPS XXXIV*, #1266; Irving A. J. et al. (2004) *MAPS, 39*, A49. [2] Brand R. A., University of Duisburg, Wissel-Wissenschaftliche Electronik GmbH, Germany. [3] Vieira V. W. A. et al. (1986) *Phys. Scripta, 33*, 180; Dyar M. D. et al. (2003) *MAPS, 38*, 1733. [4] Morris R. V. et al. (2004) *Science 305*, 833; Klingelhöfer G. et al. (2004) *Science 306*, 1740.