

Fe-Mg COMPOSITION AND MODAL ABUNDANCE OF MARTIAN SILICATES BY MÖSSBAUER SPECTROSCOPY.

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Introduction: Mössbauer spectrometers form part of the science payload on 3 upcoming Mars missions. Beagle 2 will land on Mars in late December 2003. The Mars Exploration Rovers (MER), carrying the Athena Science Payload, will land later the following month. All three landers will carry Mössbauer spectrometers to investigate the Fe-bearing mineralogy of Martian soils and rocks. In this work we explore how data from different instrument geometries correlate, and whether, in addition to valence state information, Mössbauer can provide data on the Fe-Mg composition of silicates and their modal abundance.

Mössbauer spectrometers on Mars will operate in backscatter mode [1]. Typically, ⁵⁷Fe Mössbauer spectra are collected in transmission mode: a powdered sample is introduced between a vibrationally modulated ⁵⁷Co source and a detector. Operating in backscatter geometry dispenses with sample preparation. Mössbauer will provide data on the Fe valence state of Martian rocks and soils, and identify Fe-bearing phases within those samples. If overall Fe wt% in a sample is also measured, and the phase is of known composition, then the intensity of a component in a Mössbauer spectrum may be used to estimate the modal abundance of that component in the rock (e.g. [2]). On Mars, Fe wt% in the bulk rock will be determined by alpha particle X-ray spectrometry or X-ray fluorescence spectrometry, but there is no method on any lander to determine the composition of individual phases. Thus, if (say) hematite is detected (a phase with distinctive Mössbauer parameters and simple chemistry), modal abundance could be estimated, but for phases with more variable chemistry (olivine, pyroxene etc), it could not.

Methodology: Menzies et al. [3,4] have recently shown that the Mössbauer parameter *quadrupole splitting* (QS) varies consistently with Fe-Mg over the olivine solid solution series. In addition to natural samples, a suite of synthetic olivine standards were made that help to define the trend over the whole compositional range. The linear relationship between QS and Fe-Mg in olivine allows Mg# to be determined to within ~10 molar units. A similar correlation appears to hold for En-Fs in pyroxene [4]. We are extending this study using natural and synthetic samples to more clearly define the relationship between QS and composition in both silicates. In addition, comparative backscatter/transmission Mössbauer studies will allow us to use our database of transmission Mössbauer parameters in interpreting backscatter Mössbauer from Mars.

Conclusions: The work of Menzies et al. [3,4] has provided a means of determining Mg# in Martian ferromagnesian silicates. This compositional information will also allow modal abundance of those phases to be estimated. The data will be extremely valuable in interpreting the geological history of Martian materials.

References: [1] Klingelhöfer G. et al. (2000) *Workshop on Concepts and Approaches for Mars Exploration*, July 18-20, Houston, Texas, #6103. [2] Bland P. A. et al. (2000) *Meteorit. Planet. Sci.*, 35, A28. [3] Menzies O. N. et al. (2001) *LPS XXXII*, 1622. [4] Menzies O. N. et al. (2003) *Meteorit. Planet. Sci.*, 38, (in prep.).