WHAT LURKS IN THE MARTIAN ROCKS AND SOIL? INVESTIGATIONS OF SULFATES, PHOSPHATES, AND PERCHLORATES

Mössbauer parameters of iron in phosphate minerals: Implications for interpretation of martian data‡

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ABSTRACT

Phosphate minerals, while relatively rare, show a broad range of crystal structure types with linkages among PO_4 tetrahedra mimicking the hierarchy of polymerization of SiO_4 tetrahedra seen in silicate minerals. To augment previous Mössbauer studies of individual phosphate species and groups of species, this paper presents new Mössbauer data on 63 different phosphate samples, and integrates them with data on more than 37 phosphate species in 62 other studies from the literature. Variations in Mössbauer parameters of different sites in each mineral are then related to both the local polyhedral environment around the Fe cations and the overall structural characteristics of each species. The entire aggregated Mössbauer data set on phosphate minerals is juxtaposed against parameters obtained for spectra from the MIMOS spectrometers on Mars. This comparison demonstrates that signatures from many different phosphate or sulfate mineral species could also be contributing to Mars Mössbauer spectra. Results underscore the conclusion that unique mineral identifications are generally not possible from Mössbauer data alone, particularly for paramagnetic phases, although combining Mössbauer results with other data sets enables a greater level of confidence in constraining mineralogy. This study provides a wealth of new data on Fe-bearing phosphate minerals to bolster future analyses of Mössbauer spectra acquired on Mars.

Keywords: Mossbauer, Mars, phosphates, alluaudite, arrojadite, vivianite, triphylite