2005; melanterite, McLennan et al. 2005; starkeyite, Peterson et al. 2007) or triclinic (pentahydrite, meridianiite; Peterson and Wang 2006).

Meridianiite ($MgSO_4 \cdot 11H_2O$) was experimentally synthesized, and recognized from natural samples found at terrestrial locales with environmental conditions consistent with the solid's phase diagram (Peterson and Wang 2006; Peterson et al. 2007). The crystallographic parameters of natural terrestrial meridianiite (a = 6.7459 Å, b = 6.8173 Å, c = 17.280 Å, α = 88.137°, β = 89.481°, γ = 62.719°) (Peterson et al. 2007) include $a \approx b$ (within ~1%) and $\alpha \approx \beta$, (both <2° from perpendicular). Thus, the unit cell geometry of meridianiite is very close to monoclinic. If the interpretation that the mineral removed to form the crystal molds observed at Meridiani Planum is meridianiite (Peterson and Wang 2006; Peterson et al. 2007) is correct, then the earlier interpretation that the crystal molds at Meridiani Planum represent a monoclinic mineral can be accounted for. Measurements from the MI images would not have easily distinguished between triclinic morphology with α and β so near 90° and monoclinic crystal morphology.

Images from Mars of crystal morphology have evoked the pioneering role of morphological crystallography in the mineral sciences. Whereas morphological crystallography dominated terrestrial mineralogy for more than a century before the X-ray diffraction revolution, XRD arrived on Mars within a decade after the few tantalizing images of crystal morphology. Although imagery from other rovers will continue to support tentative identifications of minerals based on morphological crystallography, Curiosity's CheMin XRD data enable greatly expanded understanding of mineral structures and chemical compositions on Mars.

MSL rover Curiosity and its CheMin instrument are acquiring XRD data of primary minerals and products of aqueous alteration in unconsolidated wind-blown sediments and fluvial, deltaic, lacustrine, and aeolian sandstones, mudstones, and conglomerates at Gale Crater. Among the signature findings uniquely enabled by CheMin, Treiman et al. (2016) used CheMin data to determine compositions of alkali feldspar in sandstones at one sampling site, from their unit cell parameters. Their results yield compositions strongly supporting the hypothesis that potassic alkaline igneous rocks, a rock type for which evidence has "been indirect or speculative until recently" (Treiman et al., 2016, p.98) on Mars, existed in the source area of the sampled sandstones.

Morrison et al. (2018a) refine previously acquired CheMin data for plagioclase, sanidine, clinopyroxenes, orthopyroxene, olivine, spinel, and minerals of the alunite-jarosite group. Using each sample's own plagioclase as an internal standard, Morrison et al. (2018a) correct for each sample cell's offset (<80 μm in all cases), its effect on the sample-cell-to-detector distance and where the diffracted beam intersects the detector, and the consequences for Bragg's Law interpretation of the detected 2θ angles for all of that sample's other minerals. The corrections result in different values of unit cell parameters than previously reported for these samples (e.g., by up to 0.02 Å for olivine), which are in turn extremely important to the subsequent usefulness of the unit cell parameters as indicators of mineral composition.

Morrison et al. (2018a) invoke regression relationships, that they establish in a companion paper (Morrison et al. 2018b), between unit cell parameters and crystal chemical compositions from published data for each relevant mineral group. Combining the improved unit cell parameters and the crystallography-composition regression algorithms, they revise the minerals' inferred chemical compositions. The combined effects of sample-cell offset and the regression algorithms result in compositions that differ subtly for some minerals, and appreciably for others, relative to previously published compositions for the same minerals estimated from the pre-correction CheMin data. For example, olivine compositions from sandstone sample Windjana were first reported to be Fe-forsterite, ~$Fo_{59\pm06}$ (Treiman et al., 2016); correction for sample-cell offset yields improved unit cell parameters corresponding to $Fo_{67.5}$ (Morrison et al., 2018a).

At the present state of NASA's Mars Exploration Program planning, the mineral abundances and compositions determined from MSL Curiosity CheMin data complete the only full mineralogical data set for Mars surface materials until a Mars Sample Return mission (MSR), which is still at least a decade away. The XRD data, acquired with Curiosity's unique CheMin instrument and corrected for small sample-stage offsets by Morrison et al. (2018a), enabled a major expansion from and improvement upon all previous identifications of rock-forming minerals from Mars mission data, all of which were based on observations that did not include crystallography. The refined unit-cell parameters and the updated mineral compositions derived from them by Morrison et al. (2018a) provide a firm new foundation for future interpretations of igneous-mineral and -rock formation conditions, sediment provenance, pre-depositional and diagenetic chemical alteration, and habitability assessment on Mars.

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