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Recent Mineralogical Discoveries in Gale Crater, Mars from the CheMin XRD Instrument, Demonstrating a Watery Past.

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Curiosity landed in Gale crater August 2012 and has traversed (~27 km) sedimentary rocks that comprise a ~5 km-high mound, informally known as Mount Sharp, to investigate depositional/diagenetic environments and potential habitability. VSWIR spectra revealed the lowermost slopes of Mount Sharp contain mineral assemblages that are indicative of water-rock interactions [1-3], with sulfate-bearing units overlying phyllosilicate-bearing units. This mineralogical succession may mark the beginning of the transition from a relatively wet/warm to a very dry/cold Mars (e.g., 1, 4).

Thirty-four powdered rock samples have been analyzed by the CheMin XRD instrument and mineralogical results from the first 6 years of the mission are reviewed in [5]. Here we describe the mineralogical diversity observed over the most recent 4 years. Sediments in the Vera Rubin Ridge (VRR) and Glen Torridon (GT) region were deposited in a lacustrine-fluvial environment and are syndepositional. The mineralogy suggests post-depositional fluid-rock interaction. Differences in mineralogy could have been the result of silica-poor, briny groundwater that destabilized smectite and precipitated hematite in VRR [6]. Other hypotheses include lake water-groundwater mixing [7] or diagenesis driven by deeply sourced fluids altering smectite to precipitate hematite and amorphous silica [8-9].

Preserved bedforms in the clay-sulfate transition region indicate a change from lacustrine-fluvial to aeolian depositional environments. Mineralogical changes include the identification of goethite along with the disappearance of phyllosilicate. The absence of crystalline Mg-sulfate in drilled samples from this transition region may mean that: 1) Sulfates are concentrated in secondary concretions not sampled by *Curiosity's* drill, or 2) Sulfate components are either X-ray amorphous or if crystalline, became amorphous in the relatively low-humidity environment of the rover [10]. Continued exploration of sulfate-rich rocks will elucidate this environmental transition above the phyllosilicate-rich sediments.

[1] Milliken et al., (2010) *Geophys. Res.* [2] Fraeman et al., (2013) *Geology*. [3] Fraeman et al., (2016) *J. Geophys. Res*. [4] Bibring et al., (2006) *Science*. [5] Rampe et al., (2020) *Geochemistry*. [6] Bristow et al., (2021) *Science*. [7] Thorpe et al., (2020) *LPSC LI.* [8] Rampe, et al., (2020) *JGR*. [9] Rampe et al., (2020) *LPSC LI*. [10] Rampe et al., (2022) *LPSC LIII.*