Chemical & Physical Sciences
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THE EARLY AQUEOUS ENVIRONMENT OF MARS INFERRED FROM MISSION LIFETIME RESULTS BY THE CURIOSITY ROVER AT GALE CRATER, MARS

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The Mars Science Laboratory Mission's Curiosity rover landed at Gale crater, Mars, on August 6, 2012. For the past ~9 years Curiosity has been exploring a lacustrine deposit exposed in dissected terrain of crater-interior central mountain. The lacustrine deposit (Murray fm., >300m thick, early Hesperian age) overlies and is laterally equivalent to fluvial-deltaic deposits of the Bradbury group that Curiosity explored earlier in the mission. These rocks are unconformably overlain by the Stimson formation, an eolian sandstone that was deposited above a surface representing significant denudation of crater-filling strata. The Murray contains one major depositional facies – laminated mudstone – deposited in a lake; and minor additional facies – ripple cross laminated and trough cross bedded sandstones – representing subaqueous delta foreslope, fluvial, or eolian environments. The persistence of fine lamination, locally with scour and drape truncation surfaces, and general absence of desiccation cracks, prism cracks, intraclasts, displacive evaporite crystals and nodules, or bedded evaporites, all suggest a perennial lake with depths great enough to avoid seasonal desiccation. Intercalated thin sandstones, of potentially eolian or fluvial origin, might indicate base-level lowering during longer-term lake level oscillations or a period of normal regression. The mineralogy and chemistry of the lower Murray formation are explained by variations in the composition of fine clastic detritus delivered to the lake via marginal sediment plumes, coupled with redox oscillations in the composition of authigenic minerals precipitated from the lake. Stratigraphically higher members of the Murray, including those leading up to and comprising Vera Rubin Ridge and Glen Torridon regions, record elemental mobility during later diagenesis due to chemical weathering in an increasingly temperate paleoclimate as shown by feldspar alteration and phyllosilicate mineralogies. The early Hesperian environment at Gale crater is inferred to have recorded a persistently aqueous environment characterized by mild salinity and acidity. In that regard, Mars increasingly seems similar to Earth, where spatial variability in regional/global environments is as important to understand as temporal variability.

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