

Aridification sequence and formation of sulfates in Aeolis Mons, Gale crater

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In Gale crater, the Curiosity rover is exploring the sulfate-bearing unit, a regional package hundreds of meters thick of yet mostly undefined origin. The terrains orbitally defined as part of the clay-sulfate transition and leading upward to the sulfate-bearing unit show multiple signs consistent with marked changes towards drier paleoenvironments both in the sedimentary and geochemical record. Bedrock in the basal section is marked by diverse diagenetic overprints where sedimentary structures are less visible. Further up, the rover imaged butte-forming outcrops and revealed a >100-m-thick interval with a transition into large-scale trough cross-bedded structures. Within the large-scale cross-bedded strata of most likely eolian origin, ChemCam revealed that sulfates occur in the form of diverse lithologies mostly related to nodular bedrock. The abundance of nodules and related sulfates is highly variable. Indicators of locally and intermittently wet environments, such as mudcracks in the basal section or lenses with wave ripple laminae have been identified in specific intervals. The surrounding dry eolian strata adjacent to these features are also marked by the enhanced occurrence of nodular lithologies. This association and the general stratigraphic control on the distribution of sulfate-enriched nodules is consistent with their formation within the sediments due to evaporation where a sulfate-rich water table reached or came close to the surface in a variably dry climate.

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