Fluvial to Lacustrine Facies Transitions in Gale Crater, Mars

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Abstract Text:

NASA’s Curiosity rover has documented predominantly fluvial sedimentary rocks along its path from the landing site to the toe of the Peace Vallis alluvial fan (0.5 km to the east) and then along its 8 km traverse across Aeolis Palus to the base of Aeolis Mons (Mount Sharp). Lacustrine facies have been identified at the toe of the Peace Vallis fan and in the lowermost geological unit exposed on Aeolis Mons. These two depositional systems provide end members for martian fluvial/alluvial-lacustrine facies models. The Peace Vallis system consisted of an 80 km² alluvial fan with decimeter-thick, laterally continuous fluvial sandstones with few sedimentary structures. The thin lacustrine unit associated with the fan is interpreted as deposited in a small lake associated with fan runoff. In contrast, fluvial facies exposed over most of Curiosity’s traverse to Aeolis Mons consist of sandstones with common dune-scale cross stratification (including trough cross stratification), interbedded conglomerates, and rare paleochannels. Along the southwest portion of the traverse, sandstone facies include south-dipping meter-scale clinoforms that are interbedded with finer-grained mudstone facies, interpreted as lacustrine. Sedimentary structures in these deposits are consistent with deltaic deposits. Deltaic deposition is also suggested by the scale of fluvial to lacustrine facies transitions, which occur over >100 m laterally and >10 m vertically. The large scale of the transitions and the predicted thickness of lacustrine deposits based on orbital mapping require deposition in a substantial river-lake system over an extended interval of time. Thus, the lowermost, and oldest, sedimentary rocks in Gale Crater suggest the presence of substantial fluvial flow into a long-lived lake. In contrast, the Peace Vallis alluvial fan onlaps these older deposits and overlies a major unconformity. It is one of the youngest deposits in the crater, and requires only short-lived, transient flows.

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