Gale Crater – why are we there and what do we hope to learn ?

Carlton Allen

Astromaterials Research and Exploration Science, NASA Johnson Space Center, Houston, TX USA

The Mars Science Laboratory Rover Curiosity is commencing a two-year investigation of Gale crater and Mt. Sharp, the crater's prominent central mound. Gale is a 155 km, late Noachian / early Hesperian impact crater located near the dichotomy boundary separating the southern highlands from the northern plains. The central mound is composed of layered sedimentary rock, with upper and lower mound units separated by a prominent erosional unconformity. The lower mound is of particular interest, as it contains secondary minerals indicative of a striking shift from water-rich to water-poor conditions on early Mars. A key unknown in the history of Gale is the relationship between the sedimentary units in the mound and sedimentary sequences in the surrounding region.

We employed orbital remote sensing data to determine if areas within a 1,000 km radius of Gale match the characteristics of sedimentary units in Mt. Sharp. Regions of interest were defined based on: the mound's inferred age, altitude range, and THEMIS nighttime brightness (a proxy for thermal inertia). Using orbital CTX, MOC and HiRISE images we examined all areas within our regions of interest for analogous geomorphic units in the same altitude ranges as the corresponding units in Mt. Sharp.

The results are consistent with the hypothesis that sedimentary units in both the upper and lower sections of the Gale mound are related to nearby regional units located along the dichotomy boundary. This relationship supports an inferred geologic history that includes several episodes of widespread sedimentary deposition and erosion in the martian mid-latitudes. In this model Mt. Sharp is the remnant of regional sedimentary deposits that partially or completely filled the crater, became lithified, and were subsequently deeply eroded. Key questions that will be addressed by Curiosity include the compositions of the sediments, the modes of deposition, the mechanisms of lithification, and the nature of the erosion.