Initial Observations by the Mars Exploration Rover Opportunity at Cape York, Meridiani Planum

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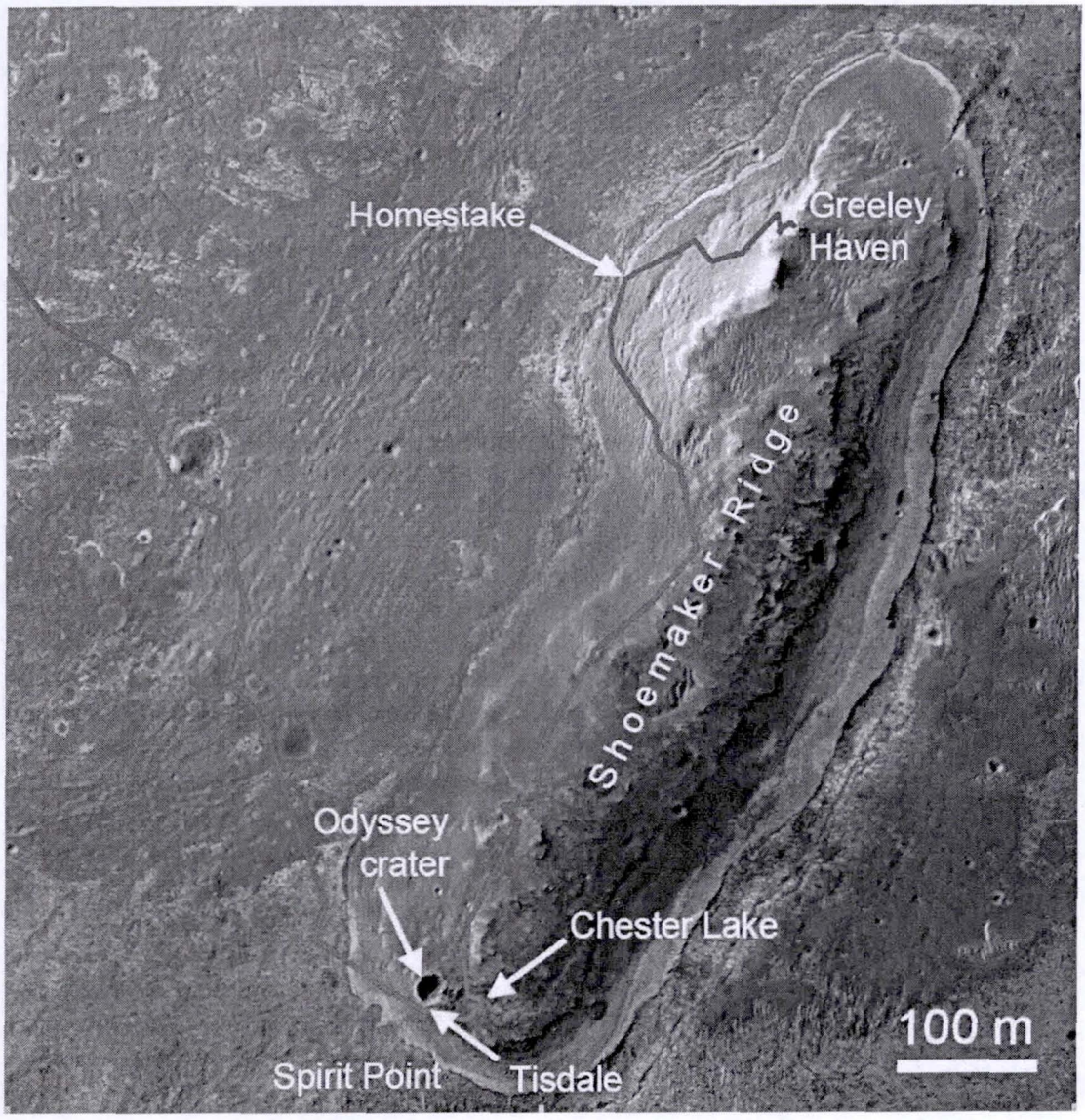
Since the beginning of its mission, the MER rover Opportunity has visited a sequence of progressively larger impact craters in order to characterize rocks that represent an ever-broader stratigraphic range. Endeavour Crater is by far the largest crater that this rover has visited, therefore the crater rim provides materials from strata that are much deeper and older than any materials yet sampled. Indeed, the Mars Reconnaissance Orbiter CRISM instrument detected spectral signatures of hydrated phyllosilicates in several rim segments, consistent with a Noachian provenance. In addition, the crater rim might have recorded the effects of the original impact as well as the thermal processes that occurred in its aftermath. This report summarizes initial observations of geologic structures and the fabrics, chemistry and mineralogy of rocks. Cape York is an N/NE - S/SW-trending segment of crater rim that is bounded by rim segments that are more deeply eroded, forming embayments. Opportunity drove onto the southwest margin of Cape York and has traversed across the Cape to a ridge near its northern end. The rim of Endeavour Crater was severely degraded and then onlapped by Meridiani sulfate-rich deposits, indicating that Cape York deposits experienced extensive erosion prior to the deposition of Meridiani Planum sulfate-rich sediments. Cape York consists of impact-uplifted rocks that are surrounded by a younger bedrock bench that might represent sediments shed from Cape York. The uplifted rock "Tisdale-2," located near the southern end of Cape York, is a polymict lithic breccia. Its elemental composition resembles a mixture of basalt plus bedrock encountered previously at Meridiani Planum, and it is relatively enriched in Ni, Zn, P, characteristic of hydrothermal fluids. "Chester Lake" and "Greeley Haven" are bedrock surfaces located near the southern and northern ends of Cape York, respectively, and they exhibit fabrics reminiscent of suevites. The rocks that were analyzed so far are quite different from any rocks previously encountered by Opportunity and Spirit. Several light-toned vein deposits (~1 cm) were discovered in the bench that borders the western flanks of Cape York. The vein "Homestake" is rich in Ca and S, and it exhibits a spectral feature near 1000 nm caused by hydration, indicating that "Homestake" consists substantially of gypsum. The relationship(s) between these veins and the sulfate-rich layered deposits at Meridiani Planum remains uncertain. The veins might have been deposited by sulfate-rich fluids perhaps either in the immediate aftermath of the impact that formed Endeavour Crater or at some later time. Current uncertainties notwithstanding, the novel lithologies at Cape York are significantly older than the sulfate-rich sedimentary rocks at Meridiani Planum, and these lithologies have recorded episodes of aqueous activity from earlier epochs, perhaps during the Noachian. The author acknowledges the contributions of the Athena Science Team, the MER engineering team, JPL and NASA.


Homestake
Greeley
Haven
Shoemaker Ridge
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crater
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Spirit Point
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100 m