OPPORTUNITY RESULTS AT VICTORIA CRATER, MERIDIANI PLANUM. S. W. Squyres[1] and the Athena Science Team, 1. Department of Astronomy, Cornell University, Ithaca, NY.

Victoria crater is an impact crater about 800 meters in diameter that lies roughly 5 km south of the landing site of the Opportunity rover. After a drive of more than 900 sols, Opportunity has arrived at Victoria crater, and is now engaged in exploration of this, the largest impact crater encountered by either rover.

The shape of Victoria crater is unusual. The rim is characterized by a number of prominent alcoves that are U-shaped in plan view, separated by sharp promontories that project toward the crater interior. The alcoves are clearly sites of mass wasting, and this distinctive shape indicates that the crater has been enlarged significantly by mass wasting processes.

Orbital images also show that the crater is surrounded by a dark annulus about half a kilometer in width that has few of the prominent eolian ripples that characterized and often obstructed much of Opportunity's southward traverse.

A surprising finding upon reaching the annulus was that the soil there is rich in large (~4-6 mm) hematite rich concretions. Concretions in this size range had been abundant at the Opportunity landing site at Eagle crater, and also at Endurance crater. However, as the rover had progressed southward, the concretions in the bedrock along the route had become smaller, and in some areas were absent completely. Concretions and concretion fragments in the soil were also conspicuously smaller along much of the route than they were at Eagle and Endurance craters.

We suggest that the sudden increase the size of concretions in the soil upon entering Victoria's annulus is a consequence of the following sequence of events having taken place at the Opportunity site. (1) A sequence of flat-lying sulfate-rich sedimentary rocks is deposited. (2) There is an influx of groundwater to some level within the sequence, and hematite-rich concretions are precipitated from this groundwater. (3) The groundwater recedes, leaving the concretions within the rock. (4) Eolian erosion strips away surface materials, creating a surface that rises gently to the south. (There is evidence that Opportunity gained elevation during its southward traverse, moving slightly up-section from concretion-rich materials into concretion-poor materials.) (5) Victoria crater forms, excavating through concretion-poor materials into underlying concretion-rich materials, and depositing these concretion-rich materials into its ejecta blanket. (6) Continued eolian erosion strips away the highly friable sulfate-rich sedimentary materials in the ejecta blanket, leaving behind a lag deposit of concretions excavated from depth.

In this scenario, the edge of the annulus, where the large concretions first re-appeared, represents the edge of the crater's ejecta blanket. The scenario can be tested in the future when Opportunity enters Victoria crater, since it predicts that a traverse down the crater wall will move from upper concretion-poor bedrock into deeper concretion-rich bedrock.

Large eolian ripples dominated the surface along the portions of the traverse where concretions were small, but are generally absent in the concretion-rich annulus, as they were at the concretion-rich landing site. We suspect that the absence of ripples in the annulus is due to the effect that the surface roughness produced by large concretions has on sand saltation trajectories.

Since arriving at the crater's rim, Opportunity has been traversing along the rim imaging the stratigraphy exposed on the promontories. The promontories are quite steep, and most of them expose several to many meters of intact bedrock on near-vertical faces. Because Because Victoria crater is so large, by imaging these faces we can for the first time study lateral sedimentary facies variations at Meridiani over horizontal length scales of hundreds of meters. The objective of the traverse and the associated imaging is to create a "circumferential fence diagram" along the crater's perimeter that characterizes lateral facies variations in the exposed bedrock.

On most of the promontories, the uppermost unit is crater ejecta consisting a jumbled breccia of blocks up to a meter or more in size. The ejecta blanket is entirely dominated by blocks of sulfate-rich sandstone; no other material is evident in significant quantities.

The ejecta blanket overlies a zone in which sulfate bedrock is extensively fractured in place, with an abrupt contact that is clearly visible around most of the crater rim. We interpret this contact to represent the pre-impact surface. The fracturing below it may have occurred before the crater formed, created by the substantial volume loss that can be associated with dehydration of sulfate minerals. Alternatively, it may have taken place as a consequence of the impact itself.

Beneath the fractured zone lies intact bedrock. Mini-TES observations reveal this bedrock to be sulfate-rich over all depths observed to date.

Pancam observations of the bedrock show the promontories on the north side of Victoria crater to be dominated by eolian facies. No clasts are visible in Pancam images; evidently the grain size is too small everywhere to be revealed by Pancam, as is the case everywhere else at Meridiani. Bedding, however, is prominent. In several locations, most notably a promontory named Cape St. Mary, there is spectacular eolian cross stratification exposed on the cliff faces, with high-angle truncations indicative of former dune deposits. Elsewhere we see the subparallel bedding and low-angle truncations expected for eolian sand sheets. Generally, then, the stratigraphy at Victoria is consistent with what was observed at Endurance crater, although much better exposed over significantly larger vertical and horizontal scales.

At the time of this writing, Opportunity has entered a field of cobbles that are markedly different in composition from the sulfate-rich sandstone that is otherwise so dominant at Victoria. The cobbles lie well within the crater's annulus, and so may represent a minor fraction of the crater ejecta that is more resistant to wind erosion than the very friable sulfate-rich material, and hence better preserved. Incomplete compositional data obtained to date are consistent with the cobbles being either highly mafic martian rocks or stony meteoritic materials. We are investigating the possibility that the cobbles represent a previously unseen unit excavated from deep in the section, and also the likely alternative that they are meteoritic debris.

Our plan is to continue Opportunity's clockwise traverse around Victoria crater until lateral facies variations have been characterized well from the rim. This traverse will also allow us to search for routes into and out of the crater. With the changing martian seasons and the approach of southern hemisphere summer, illumination on south-facing slopes will improve, making conditions more favorable for the rover to enter the crater via such slopes. If the rover remains healthy, we plan to send it into Victoria crater, obtaining in-situ observations at deeper stratigraphic levels than possible anywhere else along Opportunity's traverse to date.