Compositions of Diverse Noachian Lithologies at Marathon Valley, Endeavour Crater Rim, Mars
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Mars Exploration Rover Opportunity has been exploring Meridiani Planum for 11+ years, and is presently investigating the geology of rim segments of 22 km diameter, Noachian-aged Endeavour crater. The Alpha Particle X-ray Spectrometer has determined the compositions of a pre-impact lithology and impact breccias representing ejecta from the crater. Opportunity is now investigating the head (higher elevation, western end) of Marathon Valley. This valley cuts eastward through the central portion of the Cape Tribulation rim segment and provides a window into the lower stratigraphic record of the rim. At the head of Marathon Valley is a shallow (few 10s of cm), ovoid depression ~27×36 m in size, named Spirit of Saint Louis, that is surrounded by a ~20-30 cm wide zone of more reddish rocks (red zone). Opportunity has just entered a region of Marathon Valley that shows evidence for Fe-Mg smectite in Compact Reconnaissance Imaging Spectrometer for Mars spectra indicating areally extensive and distinct lithologic units and/or styles of aqueous alteration.

Rocks at the head of Marathon Valley and within Spirit of Saint Louis are breccias (valley-head rocks). In some areas, layering inside Spirit of Saint Louis appears continuous with the rocks outside. The valley-head rocks are of similar, generally basaltic composition. The continuity in composition, texture and layering suggest the valley-head rocks are coeval breccias, likely from the Endeavour impact. These local breccias are similar in non-volatile-element composition to breccias investigated elsewhere on the rim.

Rocks within the red zone are like those on either side in texture, but have higher Al, Si and Ge, and lower S, Mn, Fe, Ni and Zn as compared to rocks on either side. The valley-head rocks have

higher S than most Endeavour rim breccias, while red zone rocks are like those latter breccias in S. Patches within the rocks outside Spirit of Saint Louis have higher Al, Si and Ge indicating red-zone-style alteration extended beyond the narrow red zone. Rocks on either side of the red zone and patches within it have the multispectral signature (determined by Panoramic Camera) of red hematite indicating an oxidizing environment. The red zone appears to be a thin alteration zone marking the border of Spirit of Saint Louis, but the origin of this morphologic feature remains obscure.