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Aqueous Alteration of Endeavour Crater Rim Apron Rocks

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Mars Exploration Rover Opportunity is exploring Noachian age rocks of the rim of 22 km diameter Endeavour crater. Overlying the pre-impact lithologies and rim breccias is a thin apron of fine-grained sediments, the Grasberg fm, forming annuli on the lower slopes of rim segments. Hesperian Burns fm sandstones overly the Grasberg fm. Grasberg rocks have major element compositions that are distinct from Burns fm sandstones, especially when comparing interior compositions exposed by the Rock Abrasion Tool. Grasberg rocks are also different from Endeavour rim breccias, but have general compositional similarities to them. Grasberg sediments are plausibly fine-grained materials derived from the impact breccias. Veins of $CaSO_4$ transect Grasberg fm rocks demonstrating post-formation aqueous alteration. Minor/trace elements show variations consistent with mobilization by aqueous fluids. Grasberg fm rocks have low Mn and high Fe/Mn ratios compared to the other lithologies. Manganese likely was mobilized and removed from the Grasberg host rock by redox reactions. We posit that Fe^{2+} from acidic solutions associated with formation of the Burns sulfate-rich sandstones acted as an electron donor to reduce more oxidized Mn to Mn^{2+}. The Fe contents of Grasberg rocks are slightly higher than in other rocks suggesting precipitation of Fe phases in Grasberg materials. Pancam spectra show that Grasberg rocks have a higher fraction of ferric oxide minerals than other Endeavour rim rocks. Solutions transported Mn^{2+} into the Endeavour rim materials and oxidized and/or precipitated it in them. Grasberg has higher contents of the mobile elements K, Zn, Cl, and Br compared to the rim materials. Similar enrichments of mobile elements were measured by the Spirit APXS on West Spur and around Home Plate in Gusev crater. Enhancements in these elements are attributed to interactions of hydrothermal acidic fluids with the host rocks. Interactions of fluids with the Grasberg fm postdate the genesis of the Endeavour rim phyllosilicates. The aqueous alteration history of Endeavour rim rocks is complicated by different styles of alteration that have spanned the Noachian and Hesperian. Late stage acidic aqueous alteration of Grasberg fm materials is likely penecontemporaneous with the diagenesis of the sulfate-rich sediments of Meridiani Planum.