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Chemical composition of Meridiani Planum sediments and precursor material: Measurements by the APXS onboard the Mars Exploration Rover Opportunity

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The Alpha Particle X-Ray Spectrometer (APXS) is onboard the NASA Mars Exploration Rover Opportunity, which landed in Meridiani Planum at January 2004. Since this time the rover travelled more than 11 kilometres and investigated over 130 samples with the APXS. Compared to other landing sites, Meridiani provides a completely different geochemical scenario. The sediments, generally covered by thick layers of soil, are accessible, wherever impact craters exposed the underlying material. The high S concentrations of the sedimentary rocks range from 4 to almost 12 weight percent. Several elements are anti-correlated with S, which indicates a clear dilution by increasing S contents making S a major element itself. This and other observations suggest a two-component mixing model for the formation of the sediments. A siliciclastic component provides rock-forming minerals and a wet component contributes sulphates and salts. A strong negative correlation with S is seen for Na, Al, Si, K, and Ti. In these cases, their original concentration in the siliciclastic component can easily be derived by extrapolating to zero or low S contents. Fe concentrations are weakly diluted by S pointing to the addition of ferric sulphates, as confirmed by the discovery of jarosite by the Mössbauer Spectrometer. A weak positive correlation with S is observed for Mg and Ca indicating admixture as sulphates. Using the extrapolated concentrations of all major and several minor elements, the original siliciclastic composition can be reconstructed. The resulting composition is not ‘pure’ basaltic as represented by the Adirondack class rocks in Gusev crater, but altered material, as found around a layered plateau in Gusev, called Home Plate. The precursor of the Meridiani sediments

seems to contain material equivalent to other sites on Mars. To produce the observed sediment compositions, which are spread out over many kilometres, a (probably) wind driven siliciclastic component is mixed with an acid solution loaded with sulphates.