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ChemCam analyses of the Pahrump Hills sediments in the context of other sediments analysed by the Curiosity Rover

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Abstract

We report the results of ChemCam observations at the location of Pahrump Hills, analysed by the rover during the end of 2014 and beginning of 2015. Although Pahrump Hills sediment compositions are overall close to that of the coarser conglomerates analysed earlier by the rover, these observations show a strong variability in texture and composition, suggesting variations in source material and a complex aqueous history.

Chemistry of sediments analysed by ChemCam before Pahrump

The Curiosity rover has encountered a diversity of sedimentary rocks, which have displayed significant variations in both texture and composition. Early observations by the Curiosity rover in Gale crater revealed isolated outcrops of cemented pebbles and sand grains with textures typical of fluvial sedimentary conglomerates [1]. Conglomerates observed by Curiosity contain clasts with a strong diversity in albedo and textures indicating multiple sources on the Gale crater rims. Sandstones and mudstones observed at Yellowknife Bay were interpreted as having been deposited in a fluvio-lacustrine environment [2]. More stratified sandstones have been observed in the second and third terrestrial years of investigation in the outcrops named Cooperstown and Kimberley. These outcrops show a different composition than those previously analysed, with enhanced K interpreted as being due to the presence of alkali feldspars, also correlated to high proportions of fluorine and lithium [3, 4].

The chemistry of Pahrump Hills

Pahrump Hills likely correspond to the lower part of Mt Sharp/Aeolis Mons based on orbital images. Their facies is interpreted as fluvio-lacustrine sediments [5]. The Pahrump Hills sediments have major element chemistry close to that of the conglomerates, suggesting a genetic relationship through the deposition of fluvial sediments from a similar source, likely the Gale crater rim. Nevertheless, Pahrump sediments display subtle variations in major elements connected to variations in facies. There is an enhanced Mg content in resistant layers, which is correlated with a depletion in Fe and enhanced Al/Si ratios as well as enhanced hydrogen emission.

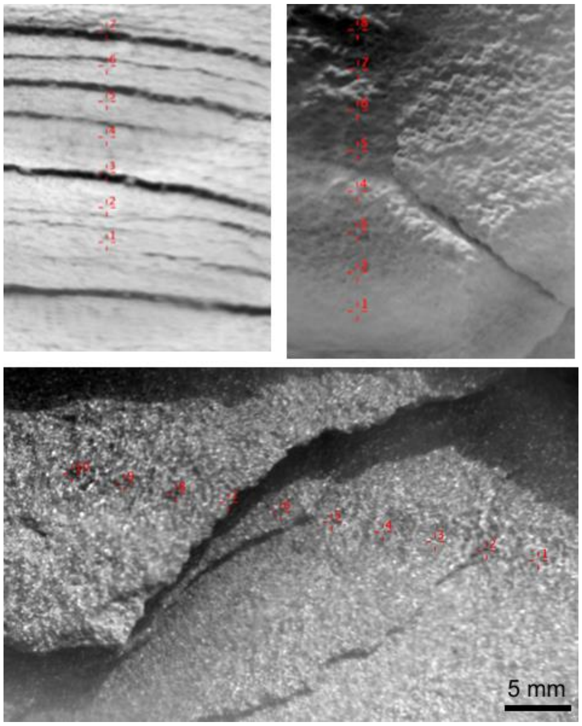

Fig. 1: Various sedimentary facies observed by ChemCam RMI images. Top left: Laminated facies. Top right: Resistant facies with lamination barely visible. Bottom: Upper unit with light-toned minerals inside darker toned matrix.

These resistant layers have also a higher CIA (Chemical Index of Alteration) compared to the sediments previously encountered, suggesting alteration occurred. Laminated facies transitioning laterally into indurated facies suggest the role of cementation, in an early diagenetic phase (Fig. 1). Diagenetic features include concretions with enhanced sulfur and nickel, and calcium sulfate veins crossing all layers late [5]. The upper layers show deposits with high calcium and titanium with interesting light-toned mineral pseudomorphs (Fig. 1). These observations point towards a complex setting with deposition in an aqueous context and alteration during deposition and/or diagenesis during cementation in these sediments.

References

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