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One year of chemical diversity seen by ChemCam at Gale crater, Mars

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ChemCam, the chemistry remote camera, has observed more than 300 different targets (rocks and soils) over the course of the first 360 Sols on Mars. This presentation gives an overview of the chemical variations revealed by ChemCam onboard the rover Curiosity.

At the submillimeter scale, ChemCam identified two principal soil types: A fine-grained mafic type and a type made of coarse grains of diverse compositions [1]. The mafic soil component is similar to soils found at other landing sites, and may constitute a planet-wide reservoir. It possesses a ubiquitous hydration [2] in its amorphous phase, which may account for a significant fraction of the global hydration. The second soil component is made of pebbles, sometimes buried in the soil, and partly matches the diversity of chemical compositions found in the surrounding float rocks at the landing site [3]. The felsic end member appears to be specific to Gale crater, compared to other landing sites so far, and may be derived from coarse-grained intrusive rocks representing the ancient crust and transported from the crater rim [4].

Curiosity also came across many sedimentary rocks [5,6,7]. The 5 km deposits at the Yellowknife Bay formation testify prolonged aqueous activities relatively late in the history of early Mars, possibly in series of episodes: transport and sedimentation with little alteration, diagenesis partially into clays, and fluids circulation all along the unit formation through fractures, with a water activity more or less limited. Early diagenetic cracks in the lower most exposed unit appear to be filled with erosion-resistant raised ridges [8], that ChemCam has shown to be enriched in Mg- and Fe-rich clays [9]. The calcium sulfate veins (gypsum, bassanite) on the other hand are found all across the deposit and must have formed last [10].

In a large majority, rocks and coarse gravels encountered so far by Curiosity show little surface coatings but dust. However, some water-rock interaction evidences are provided by the discovery with ChemCam of three rocks with Mn-enriched coatings [11]. There are also some indications through the measurement of lithium abundance for a low level aqueous alteration pulling the alkalis out to the surface [12]. The influx of subsurface water must have been limited though otherwise the Li concentration in the soils should be higher than what ChemCam measured (first detection on Mars [12]).

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