Fluorine as seen by ChemCam in Gale Crater-Mars

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Introduction

Fluorine has been detected for the first time on Mars with the ChemCam Laser Induced Breakdown Spectroscopy (LIBS) instrument on board MSL-Curiosity [1]. This detection has been made possible through the identification of CaF molecular emissions that appear when recombination occurs in the cooling plasma [2]. These emission lines enable a much more sensitive detection of fluorine and halogens in general with respect to the usual atomic emissions.

Observations and Discussion

More than 20 ChemCam observations exhibiting the characteristic CaF molecular emission have been identified so far. These observations can be divided into two different sets. The first set is characterized by high Ca content. In some observations phosphorous can be also identified making fluor-apatite a straightforward candidate, but generally the F content is too high for apatite only and fluorite is also advocated. The second set, which is Al rich, is constituted by the conglomerates found early in the mission [3]. In this case the possible F-bearing phase could be topoaz or muscovite, since these targets are relatively enriched in K, Ba and Rb [4]. However fluorite cannot be discounted as a possible phase while apatite can because F/Ca ratios are too high. In all these observations no chlorine was found. Martian meteorites show evidence for high F concentrations in magmatic and secondary minerals. In detail [5,6] show that fluor-apatites are magmatic while chlor-apatites are metasomatic, suggesting a magmatic origin for our observation. The Al-rich fluorine bearing mineralogy encountered may possibly result from the alteration of granitic/rhyolitic melts [7]. Comparison with terrestrial systems shows that fluorite can also account for the elevated F-content in alkali-rich evolved rocks [8].

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