Sulfur in Gale Crater, Mars: Results from the APXS on *Curiosity*

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Sulfur is a major component (1-45 wt% SO_3) of nearly every in situ measurement acquired by the Alpha Particle X-ray Spectrometer (APXS) on the MSL rover *Curiosity* over its >18 km traverse in Gale Crater on Mars. Here, we review the occurrence and geochemical associations of S discovered by the APXS in Gale Crater.

Airfall dust that settled on *Curiosity* hardware was analyzed by the APXS and found to be soil-like, but enriched in SO_3 (~8 wt%) and Cl (~1 wt%). The pervasive dust is a constituent of globally uniform basaltic soils [1], which have consistent Zn (325±40 ppm) and molar S:Cl ~3.

A prominent occurrence of S in Gale is in white veins (sub-mm up to several cm width) that crosscut all units (but not all rock types). Rasters of the APXS over veins show a precise 1:1 molar variation of Ca:S [2], consistent with pure Ca-sulfate, an interpretation confirmed by CheMin XRD detections of gypsum, bassanite, and anhydrite [3].

Other localized sulfates have been discovered. Mg-sulfate concretions (~1 cm) occur in the Murray fm., as evident in APXS rasters with 1:1 molar variation of Mg:S [2]. Most of the concretions are highly enriched in Ni (3000-4000 ppm). Unlike the Ca-sulfate veins, the Mg-sulfate concretions are not pure; they are a mixture of salt and sediment. The K-Fe-sulfate, jarosite, was also detected (1-3 wt%) in Murray fm. samples by CheMin XRD [4], but it has not been definitively detected by the APXS.

Sulfates are widespread, indicating a significant reservoir in the S cycle. The mobilization of cations required for this is reflected in the apparent depletion (via alteration) of Fe (-15%), Mg (-35%), and Ca (-10%) in average Murray fm. bedrock. Diversity in the sulfates suggests evolving brines, different fluid conditions over time, and/or spatially heterogeneous salt deposits.

[1] Yen et al. (2013) LPSC. [2] VanBommel et al. (2016, 2017) X-Ray Spectrom. [3] Vaniman et al. (2017) LPSC. [4] Rampe et al. (2017) EPSL.