Ge enrichments in sedimentary rocks in Gale Crater, Mars

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Rocks enriched in Ge have been discovered in Gale Crater, Mars, by the Alpha-particle X-ray spectrometer (APXS) on the MSL rover, *Curiosity*. Ge is a useful tracer in planetary crusts because it is primarily lithophile and varies <20% in basalts (~1.6 ppm) [1]. Ge can be concentrated by alkaline, hydrothermal, and/or oxidizing fluids (10s – 1000s ppm), thus, the occurrence of Ge reflects the fluid chemistry [1]. Here, we examine Ge trends to constrain the timing of alteration of Gale rocks and the character of the protolith.

Ge in Gale sedimentary rocks varies widely from below the detection limit (20 ppm) up to 250±12 ppm (Figure 1). Ge does not correlate with Fe, S, or Si, consistent with the absence of widespread Fe oxide-, sulfide-, and silica-rich deposits along *Curiosity's* traverse. Excluding Kimberley, Ge correlates with Zn (R^2 = 0.5). In-situ mobilization of Fe, S, and Zn is evident, and appears to be independent of Ge.

The Ge discoveries in Gale (up to sol 833) are consistent with a sediment source that was enriched in Ge, likely by hydrothermal alteration. Erosion and transport of these materials into the crater floor (possibly mixing with less altered sediment) has obscured the primary Ge occurrence. In-situ weathering and diagenesis did not further enrich Ge or fractionate Ge from Si.

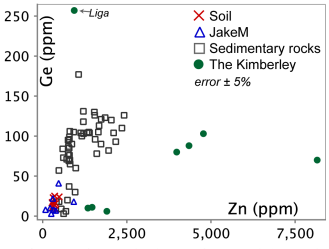

Figure 1: Variation of Ge with Zn in Gale Crater (sols 0-833).

[1] L. R. Bernstein, *Geochimica et Cosmochimica Acta*, vol. **49**, no. **11**, pp. 2409–2422, Nov. 1985.