Bassanite formation on Mars

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Detection of hydrated salts provides strong evidence for past aqueous activity on the surface of Mars. Bassanite ($CaSO_4 \times 0.5H_2O$) has been detected in a number of locations [1,2], and in some cases it forms laterally extensive deposits [1]. Given that gypsum ($CaSO_4 \times 2H_2O$) is the stable calcium sulfate under Mars surface conditions, the finding of bassanite is surprising. Rehydration of desiccated gypsum in the presence of ice results in the formation of bassanite [3], as does humidity-driven cation exchange reactions between Ca-smectites and Mg-sulfates [4]. However, complete desiccation of gypsum under Mars surface conditions is difficult to achieve, and smectite-sulfate assemblages are not often observed on Mars.

We investigated two additional potential bassanite formation pathways: *i)* low-pressure- and low-humidity-driven dehydration of gypsum, and *ii)* dry oxidation of the Ca-sulfite hannebachite ($CaSO_3 \times 0.5H_2O$) by gaseous oxidants produced in the martian atmosphere. The latter of these is motivated by the suggestion that volcanic emission of SO_2 may have resulted in the precipiattion of sulfite salts at the expense of carbonates [5]. Neither gypsum dehydration nor exposure of hannebachite to dry O_2 resulted in bassanite formation. Oxidation of hannebachite by O_3 and H_2O_2, however, yielded essentially pure bassanite (Fig. 1), suggesting a potential role for hannebachite oxidation in the formation of bassanite on Mars with implications for the planet's climatic and volcanic history.

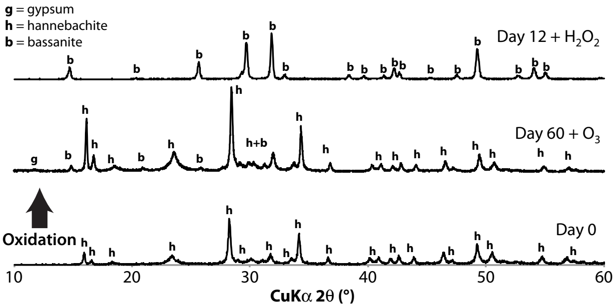

Figure 1: Hannebachite oxidation products.

[1] Wray *et al* (2010), *Icarus* **209**. [2] Vaniman *et al* (2014), *Science* **343**. [3] Vaniman *et al* (2009), *LPS* **XL**. [4] Wilson & Bish (2011), *JGR-Planets* **116**. [5] Halevy & Schrag (2009), *GRL* **36**.