

## **Transformation in the Gypsum-Syngenite-Polyhalite system to describe their formation on Mars**

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The presence of the some compounds in Mars can be crucial to know what type of processes happened millions of years ago. Calcium sulfates have been identified on Mars with different states of hydration. They were found in veins of stones in different locations of the Red Planet [1]. However together with gypsum, others salts such as polyhalite ( $\text{K}_2\text{MgCa}_2(\text{SO}_4)_4 \cdot 2\text{H}_2\text{O}$ ) and syngenite ( $\text{K}_2\text{Ca}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ ), which are of the most abundant mineral rock salt formations, could also be found in the new landing sites Jezero crater (Mars2020) and Oxia Planum (Exomars2020) because sulphates have been detected from orbiters.

Depending on the conditions of formation to obtain these minerals, the processes leading to their formation would have been different. Such different formation conditions to obtain polyhalite and/or syngenite have been simulated using thermodynamic calculations through the MEDUSA software. According to the conditions required to obtain such salts, it would be possible to describe their formation on Mars.

Several chemical parameters have been varied in order to obtain the thermodynamically stable polyhalite and syngenite establishing the elemental concentration required at normal conditions (25°C). However, although polyhalite and/or syngenite were the thermodynamically stable mineral(s) supposed to be obtained, the identified mineral was pure gypsum. This is due to a faster formation of gypsum at normal conditions. Therefore, in old Mars having K, Ca, Mg and sulfates at the concentration required for obtaining the polyhalite and/or syngenite at 25°C, the final mineral would be gypsum. Having these ions in the proper conditions is not enough to justify these minerals formation. Thus, hydrothermal conditions must be required to favour the thermodynamically stable minerals (polyhalite and syngenite) in comparison to the fast formation of gypsum. The different simulations and results obtained will be discussed.

[1] W. Rapin *et al.*. Hydration state of calcium sulfates in Gale crater, Mars: identification of bassanite veins. *Earth and Planetary Science Letters* 452 (2016) 197- 205.