**Introduction**

- Hydrous sulfates (Ca-, Mg-, Fe-sulfates and recently Al-sulfates), as markers of aqueous processes on Mars, have been observed on a variety of locations on Mars.
- This set of six experiments studies the dehydration processes and dehydration rates of a Al-sulfate (Alunogen, $\text{Al}_2(\text{SO}_4)_{17}\text{H}_2\text{O}$) and a Fe$^{2+}$-sulfate (Melanterite, $\text{FeSO}_4\cdot 7\text{H}_2\text{O}$).
- The dehydration rate of hydrous sulfates is a function of environment pressure ($P$), temperature ($T$), and partial water pressure ($P_{\text{H}_2\text{O}}$). Our experiments were conducted at Mars relevant $P$, $P_{\text{H}_2\text{O}}$, and at three $T$s.
- We compared our results with those from previous experiments on Mg-sulfate (Epsomite, $\text{MgSO}_4\cdot 7\text{H}_2\text{O}$);
- Our goal is to understand the potential hydration degrees of these sulfates within Mars subsurface and the current water budget of Mars.

**Samples & Experiments**

Samples are prepared to make sure:
1. Within the same grain size range;
2. At the highest dehydration degree (RH buffer tech.)
3. With confirmed ID and homogeneity (laser Raman 100-point check).

**Experimental design:**

- The P and $P_{\text{H}_2\text{O}}$ in our experiments are relevant to general Mars P and $P_{\text{H}_2\text{O}}$.
- Two sets of experiments (for alunogen and melanterite) are conducted at 3 temperatures: 25°C, 0°C, and -12°C, which are within the $T$ range at Mars surface.

**Experiment Results**

Among the 6 dehydration experiments, alunogen dehydrated from 17 $\text{H}_2\text{O}$ to 12.53 $\text{H}_2\text{O}$ at 21°C. Melanterite dehydrated from 7 $\text{H}_2\text{O}$ to 2.72 $\text{H}_2\text{O}$ at 21°C.

**Comparison -- three dehydration paths**

- **Under very similar $P$, $T$, $P_{\text{H}_2\text{O}}$ conditions:**
  - All three dehydrations are strongly $T$ dependent.
  - With very different dehydration pathways:
    - Alunogen – fast at beginning, then stable at ~ 12w.
    - Melanterite – experience three stages;

**Conclusion**

- A comparison of the dehydration processes of alunogen, melanterite, and epsomite reveals:
  - The dehydration rates of all three processes are strong temperature dependent. At low $T$, all three dehydrations invariably go very slow;
  - Under the similar $P$, $T$, $P_{\text{H}_2\text{O}}$ conditions, the pathways of dehydration of three hydrous sulfates are very different: alunogen lost only the hydrogen bonded $\text{H}_2\text{O}$; melanterite went through three steps in which crystalline structures were maintained during almost entire duration; epsomite lost first hydrogen bonded $\text{H}_2\text{O}$ and then became amorphous during almost entire duration. The differences in the bonding strength are the causes for their different dehydration pathways.
  - Under the similar $P$, $T$, $P_{\text{H}_2\text{O}}$ conditions, the dehydration of epsomite goes faster than that of melanterite, the dehydration of melanterite goes faster than that of alunogen.

**Acknowledgement**

This work was partially supported by NASA Mars Fundamental Research Project NNX10AM89G (AW) and by the Chinese Scholarship Council (YHZ). We want to thank the help given by Ms. Y. L. Lu and Mr. Paul Carpenter in Raman, IR, and XRD laboratories.

**References**