The objectives of this work are to (1) assess the onset temperature and (2) enthalpy of calcite decomposition at TEGA pressures (30 mbar). Results of this work will enhance the ability to assess the true onset temperature and enthalpy of calcite decomposition in the TEGA data sets.

Materials and Methods: Iceland Spar calcite was examined in this work. Differential scanning calorimetry analysis was performed with a Setaram Ligne 96. Ten mg samples were heated from 30 to 1100°C at heating rate of 20°C min⁻¹ at pressure of 30 mbar. All analyses were purged with research grade N₂ at a rate of 4.5 sccm.

Results and Discussion: Calcite decomposition onset temperature was 677°C at 30 mbar which is lower than the onset temperatures at 1000 mbar (815°C) (Fig. 1). Calcite decomposition results in CO₂ release, thus lower pressures cause a greater pressure difference between the inner calcite crystal and the surface which facilitates CO₂ diffusion through the calcite lattice [8]. This could have the effect of lowering the temperature required to decompose calcite.

The enthalpy for calcite decomposition was calculated to be 2000 J/g and 1575 J/g at 30 and 1000 mbar, respectively. The enthalpy of calcite decomposition at 30 mbar is much higher than that at 1000 mbar. The higher enthalpy at reduced pressure may be attributed to adiabatically expanding gas that cools the sample holder which results in more heat required to maintain the sample temperature [6]. The higher enthalpy at lower pressure relative to the lower enthalpy determined at higher pressure is important because this affects the calculated concentration of calcite in the Mars soil based on the enthalpy measured by TEGA.

The amount of calcite (g) in the Phoenix soils is estimated by dividing the measured TEGA enthalpy (J) by the enthalpy (2000 J/g) measured at 30 mb in the testbed. Calcite concentrations will be overestimated if the enthalpies (e.g., 1575 J/g) measured at 1000 mb are used to calculate the amount in Phoenix soils. Thus, it is critical that the higher enthalpy determined at reduced pressure be utilized in calculating calcite concentration in the Mars soil.
Fig. 1. Differential scanning calorimetry of calcite at 30 and 1000 mb N$_2$ pressure. Calcite onset decomposition at 30 mb was 677°C while the 1000 mb onset temperature was 815°C

**Conclusions:** Results of this work demonstrate the need to evaluate calcite thermal properties at pressure conditions representative of TEGA operating conditions. Future work will mix calcite with other Mars analog material (e.g., Mars JSC-1) to assess any effects that other materials may have on the thermal properties of calcite. More importantly, calcite will be run in the TEGA engineering qualification model (EQM) to provide the most accurate assessment of thermal properties of calcite as determined by a TEGA-like instrument. Additional work is also required to evaluate the effect of a lower TEGA N$_2$ purge flow rate (~ 1 sccm) on the onset temperature and enthalpy of calcite decomposition.

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**References:**