## Iron-rich carbonates as the potential source of evolved CO<sub>2</sub> detected by the Sample Analysis at Mars (SAM) instrument in Gale Crater.

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The Sample Analysis at Mars (SAM) instrument detected at least 4 distinct CO<sub>2</sub> release during the pyrolysis of a sample scooped from the Rocknest (RN) eolian deposit. The highest peak CO<sub>2</sub> release temperature (478-502°C) has been attributed to either a Fe-rich carbonate or nanophase Mg-carbonate. The objective of this experimental study was to evaluate the thermal evolved gas analysis (T/EGA) characteristics of a series of terrestrial Fe-rich carbonates under analog SAM operating conditions to compare with the RN CO2 releases. Natural Fe-rich carbonates (<53um) with varying Fe amounts (Fe0.66X0.34- to Fe0.99X0.01-CO3, where X refers to Mg and/or Mn) were selected for T/EGA. The carbonates were heated from 25 to 715°C (35°C min<sup>-1</sup>) and evolved CO<sub>2</sub> was measured as a function of temperature. The highest Fe containing carbonates (e.g., Fe<sub>0.99</sub>X<sub>0.01</sub>-CO<sub>3</sub>) yielded CO<sub>2</sub> peak temperatures between 466-487°C, which is consistent with the high temperature RN CO<sub>2</sub> release. The lower Fe-bearing carbonates (e.g., Fe<sub>0.66</sub>X<sub>0.34</sub>CO<sub>3</sub>) did not have peak CO<sub>2</sub> release temperatures that matched the RN peak CO<sub>2</sub> temperatures; however, their entire CO<sub>2</sub> releases did occur within RN temperature range of the high temperature CO<sub>2</sub> release. Results from this laboratory analog analysis demonstrate that the high temperature RN CO<sub>2</sub> release is consistent with Fe-rich carbonate (~0.7 to 1 wt.% FeCO<sub>3</sub>). The similar RN geochemistry with other materials in Gale Crater and elsewhere on Mars (e.g., Gusev Crater, Meridiani) suggests that up to 1 wt. % Fe-rich carbonate may occur throughout the Gale Crater region and could be widespread on Mars. The Rocknest Fe-carbonate may have formed from the interaction of reduced Fe phases (e.g., Fe<sup>2+</sup> bearing olivine) with atmospheric CO<sub>2</sub> and transient water. Alternatively, the Rocknest Fe-carbonate could be derived by eolian processes that have eroded distally exposed deep crustal material that possesses Fe-carbonate that may have formed through metamorphic and/or metasomatic processes.