New studies of clay formation provide clues about early Martian climate

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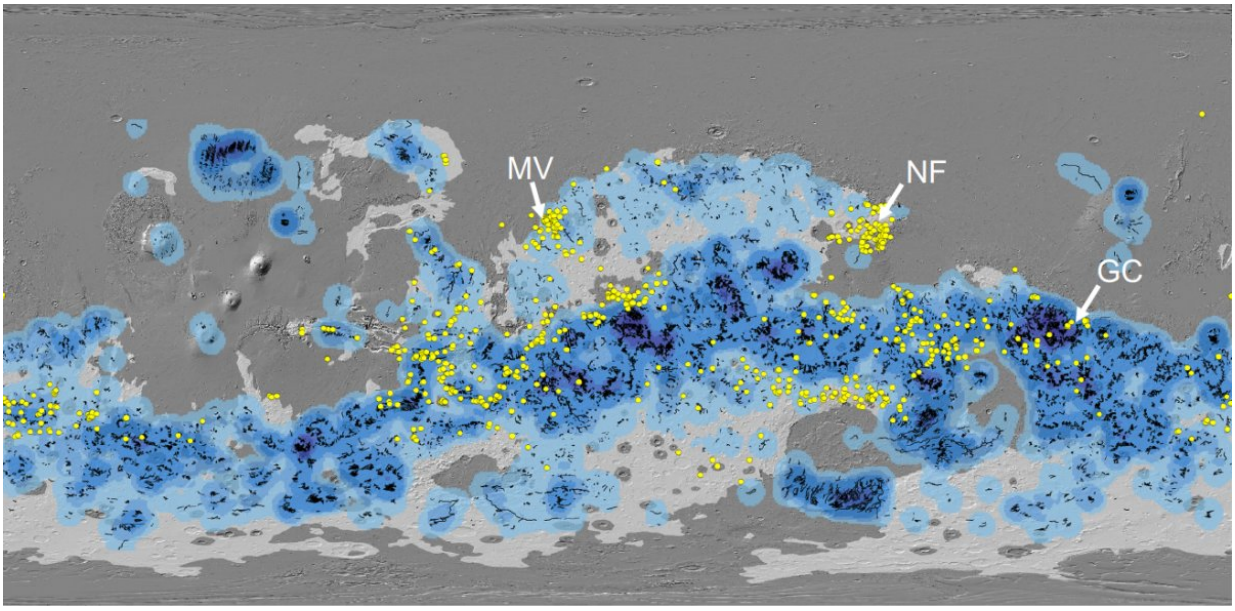

Ancient Noachian rocks on Mars are mapped in light gray with valley networks colored in blue tones and surface clays marked in yellow. Two locations with abundant smectite clays formed in surface environments include Mawrth Vallis (MV) and Nili Fossae (NF). The Mars Science Laboratory (MSL) rover is currently at Gale Crater (GC) where smectite clays have also been found. Credit: SETI Institute

New research published in *Nature Astronomy* seeks to understand how surface clay was formed on Mars despite its cold climate.

The climate on early Mars has presented an enigma for planetary scientists because surface features such as valley networks indicate abundant liquid water was present and the clay minerals found in most ancient surface rocks need even warmer temperatures to form, while atmospheric models generally support a cold climate on early Mars. This new study led by Janice Bishop of the SETI Institute and NASA's Ames Research Center in Silicon Valley has addressed this question by investigating the conditions needed for the formation of the ancient surface clays.

Part of this early Martian climate puzzle comes down to how "warm" is warm. Currently Mars' temperature is below freezing, but we know it must once have been warm enough for liquid water to carve out features on the surface. However, cold water is not warm enough for surface clays to form. "We realized that in order to better constrain the early Martian climate, we needed to understand the formation conditions of Martian clays," said Bishop.

This study evaluated the types of clays present in ancient, altered rocks on Mars and separated these into 3 categories: 1) Mg-rich clays formed at high temperatures (100-400 °C) below surface (e.g. mixtures of saponite, serpentine, chlorite, talc, and carbonate), 2) clays formed at warm temperatures (20-50 °C) in lakes, streams or rainy environments (dioctahedral Fe-rich or Al-rich smectites), and 3) poorly crystalline aluminosilicates such as allophane formed at cold temperatures (