

LATE-STAGE WEATHERING AND CHLORAPATITE DISSOLUTION AS A POSSIBLE SOURCE FOR CHLORIDES ON THE MARTIAN SURFACE. M. Melwani Daswani¹ and E. S. Kite¹, Department of the Geophysical Sciences, University of Chicago (5734 S Ellis Ave., Chicago, IL 60637, melwani@uchicago.edu).

Introduction: Chlorides could potentially preserve biosignatures, and their presence in sediments indicates past aqueous activity. Local chloride-bearing deposits are widely distributed in the southern highlands on Mars [1]. Their formation is inferred from spectroscopy, topography and geological context to result from ponding surface fluids, and salt concentration by evaporation [e.g., 2]. Assuming the chlorides are NaCl, volumetric calculations of a chloride-bearing deposit and its paleolake near Miyamoto crater in Meridiani Planum were used to estimate a lake salinity of ~ 4 g/kg H₂O [2]. The source of chlorine for the deposits is unknown, but could be: 1) the martian soil, containing ~ 0.5 wt. % Cl [3] (possibly as perchlorates), 2) subsurface dissolution of previously deposited chlorides, or 3) from Cl-bearing igneous minerals leached by fluids.

Here we use mass balance calculations and one-dimensional (1D) reaction-transport fluid-rock geochemical modeling to constrain the mass of water and reactant rock required to produce the Meridiani Planum chloride deposit near Miyamoto crater studied by [2]. We also compute the composition of the dissolved reactant rock, secondary mineral precipitates and fluid composition along the reaction path. Fig. 1 represents the geological setting.

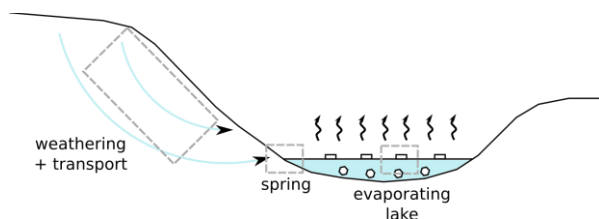


Figure 1 Schematic profile of the geological context of the possible chloride-bearing lake. We hypothesize that fluids permeate and alter the crust, producing secondary minerals (Figure 2), and spring at the lake bearing ions (Figure 3). The lake evaporates, precipitating evaporites.

Methods: Geochemical fluid-rock reaction modeling was carried out with CHIM-XPT, using modified Debye-Hückel theory to calculate mass balance, mineral, gas and liquid compositions at varying P-T conditions [4]. The composition of the basaltic clasts in Amazonian martian breccia meteorite Northwest Africa (NWA) 7034 was used as the host reactant rock in the 1D reaction model because of its similarity to martian

surface compositions [e.g., 5, 6]. Temperature was kept at 273 K, pCO₂ was 60 mbar (higher than the current atmosphere [e.g., 7], but lower than estimates for the Noachian [e.g., 8]), and total pressure was 1 bar.

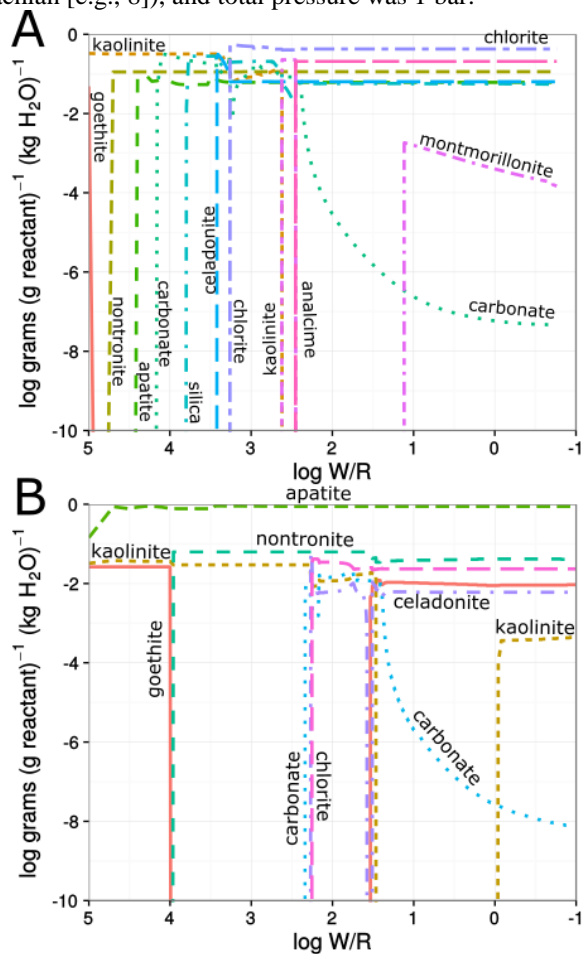


Figure 2 Secondary minerals precipitated along the weathering path leading to the lake (read from left to right, as fluid infiltrates further). A) Congruent weathering of NWA 7034 basalt clasts, and b) weathering 90 wt. % (F-Cl-OH) apatite + 10 wt. % NWA 7034 basalt clasts.

Chlorapatite as a reactant. Apatite in NWA 7034 (~ 6 wt. % of the basaltic clasts) is Cl-rich [e.g., 5], and its abundance in the reactant rock has an impact on the resulting fluid and secondary mineral composition. Apatite also dissolves more quickly than silicates like olivine and pyroxene [e.g., 9] and so the incongruent dissolution of the rock was approached by forward reaction-transport models with different initial apatite

