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Numerical modeling of the evolution of Mars' climate; a tool the the accounting of volatile inventories.

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The broad goal of our research is to explain the transition from the early and presumably thick martian atmosphere ($>\sim$0.5 bar), to the present thin atmosphere and small surface CO_2 ice cap (about 10 mbars). I report on progress with our 1-D^+ evolutionary model of the atmosphere and climate of Mars. We summarize results from Manning et al. (Icarus 2006, **80**, 38-59) on the evolution of the reservoirs of CO_2 on Mars, and present new results from more recent studies. In recent work, we adapted our evolutionary model to include nitrogen, an important element for biotic life. Our research suggests that a substantial reservoir of nitrates exists, formed as a consequence of asteroidal shock-heating of the early atmosphere. We also present results from a project modeling the Hesperian climate to determine the minimal partial pressures of CO_2 required to explain activated dendritic drainage basins that have recently been observed on late Noachian and Hesperian terrain. Two models are compared; one, a climate in thermal equilibrium, and the other thermally perturbed. In thermal equilibrium, the seasonal melting of showpack and ground ice at high latitudes in the early Hesperian are possible when CO_2 partial pressures are of order 350 mbars and obliquities are high. Another mechanism for producing drainage basins is an impact-generated water-based greenhouse atmosphere. The ability to produce fluvial features with impacts depends on two factors, the partial thermal blanketing of the atmosphere by water vapor in equilibrium with (elevated) surface temperatures, and the availability of surface water at low latitudes.

Evolutionary modeling holds forth the promise that the knowledge of different epochs of Mars' history can be integrated into a "standard model" with many points of contact between model predictions and geological observations.