DETERMINING THE PARTIAL PRESSURE OF OXYGEN (P\textsubscript{O\textsubscript{2}}) IN SOLUTIONS ON MARS. P. L. King
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The current martian atmosphere has log (P\textsubscript{O\textsubscript{2}}) = -5, but martian mantle estimates are below the quartz-fayalite-magnetite (QFM) buffer ([1,2]; recalculated as log (P\textsubscript{O\textsubscript{2}}) < -79 at 25°C using data from [3]). Also, it is likely that early Mars had relatively low P\textsubscript{O\textsubscript{2}} conditions, analogous with those proposed for the early Earth [4]. Here, I examine the martian P\textsubscript{O\textsubscript{2}} evolution using phase equilibria, S\textsuperscript{2-}/S\textsuperscript{6+} and Fe\textsuperscript{3+}/Fe\textsuperscript{2+} minerals or species in surface solutions on Mars.

P\textsubscript{O\textsubscript{2}} of martian solutions

The primordial solutions on Mars likely contained C-O-H-S-N-halogen species (similar to Earth [4]). Such reactive solutions may have leached the martian surface materials (sulfides-Fe-Mg minerals-plagioclase-glass) to produce saline solutions [5]. Since pyrite is the most easily leached mineral, we can model the leaching solutions in the Fe-O-S-H system. At low P\textsubscript{O\textsubscript{2}}, H\textsubscript{2}S and HS\textsuperscript{-} -bearing solutions are predicted as a function of pH (Fig.). It is probable that log(P\textsubscript{O\textsubscript{2}}) > -69 because Fe\textsuperscript{3+} (hydrous) oxides, (e.g. hematite) are found on the martian surface [6] (Fig.).

To further constrain P\textsubscript{O\textsubscript{2}} on the martian surface it is possible to examine the stability of phases in the K-Fe-C-O-S-H system. This system is chosen because jarosite is proposed to exist on Mars [7]. Stability limits of Fe-bearing phases relative to pH and P\textsubscript{O\textsubscript{2}} in the K-Fe-O-S-H system at 25 °C and ~105 Pa. At lower martian temperatures the P\textsubscript{O\textsubscript{2}} values will be lowered [9,15] and there may be effects due to the anion content [15], therefore the data should be assessed with reference to displacement from the buffer reactions.

Possible method to increase P\textsubscript{O\textsubscript{2}} on Mars

On Mars, H\textsubscript{2}-loss is indicated by the high D/H value of the martian atmosphere relative to the martian mantle [16]. Hydrogen-loss may drive up oxygen fugacity [17] via reactions such as dehydrogenation of the atmosphere (H\textsubscript{2}O = H\textsubscript{2} + 0.5O\textsubscript{2}), which in turn may promote oxidation of Fe in solids (e.g., martian amphiboles [18]).

References