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C.J. Renggli, P.L. King, R.W. Henley, M.D. Norman

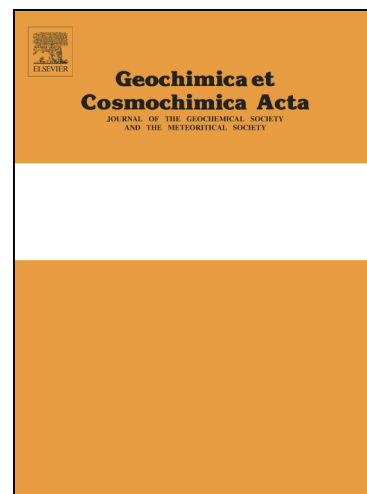
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## Volcanic gas composition, metal dispersion and deposition during explosive volcanic eruptions on the Moon

C. J. Renggli<sup>1\*</sup>, P. L. King<sup>1</sup>, R. W. Henley<sup>1</sup> and M. D. Norman<sup>1</sup>

<sup>1</sup>Research School of Earth Sciences, Australian National University, ACT 2601, Australia

\* (christian.renggli@anu.edu.au).

### Abstract

Transport of metals in volcanic gases on the Moon differs greatly from their transport on the Earth because metal speciation depends largely on gas composition, temperature, pressure and oxidation state. We present a new thermochemical model for the major and trace element composition of lunar volcanic gas during pyroclastic eruptions of picritic magmas calculated at 200-1500 °C and over  $10^{-9}$ - $10^3$  bar. Using published volatile component concentrations in picritic lunar glasses, we have calculated the speciation of major elements (H, O, C, Cl, S and F) in the coexisting volcanic gas as the eruption proceeds. The most abundant gases are CO, H<sub>2</sub>, H<sub>2</sub>S, COS and S<sub>2</sub>, with a transition from predominantly triatomic gases to diatomic gases with increasing temperatures and decreasing pressures. Hydrogen occurs as H<sub>2</sub>, H<sub>2</sub>S, H<sub>2</sub>S<sub>2</sub>, HCl, and HF, with H<sub>2</sub> making up 0.5 to 0.8 mole fractions of the total H. Water (H<sub>2</sub>O) concentrations are at trace levels, which implies that H-species other than H<sub>2</sub>O need to be considered in lunar melts and estimates of the bulk lunar composition. The Cl and S contents of the gas control metal chloride gas species, and sulfide gas and precipitated solid species. We calculate the speciation of trace metals (Zn, Ga, Cu, Pb, Ni, Fe) in the gas phase, and also the pressure and temperature conditions at which solids form from the gas. During initial stages of the eruption, elemental gases are the dominant metal species. As the gas loses heat,

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