

Volcanic Gas Speciation in the C-H-O-N-S System on Terrestrial Planets

CAROLINE BRACHMANN¹, LENA NOACK² AND FRANK SOHL³

¹German Aerospace Center

²Freie Universität Berlin

³German Aerospace Center, Institute of Planetary Research

Presenting Author: caroline.brachmann@dlr.de

Understanding the gas chemical speciation during magma ascent and degassing is crucial when trying to explain the build-up of secondary atmospheres on young planets.

We simulate the gas chemical speciation in the C-H-O-N-S system since C-H-O-S volatiles can be stored in significant amounts in basaltic magmas and therefore make up about 95 % of the magmatic gases released by volcanoes on earth. Because of its important role in the terrestrial atmosphere Nitrogen was added to our calculations as well.

In consideration of the solubility of each phase in the magma temperature, pressure, oxygen fugacity and melt composition were varied and fitted to conditions present on early Earth and Mars.

We show that oxygen fugacity has a major influence on the gas composition during degassing due to its important influence not just on the speciation of all volatiles but also on the solubility of Nitrogen and Sulfur in the magma. According to the volatile content of the melt, under reducing conditions H₂, CO, H₂S, S₂ and NH₃ are the main outgassed species, while H₂O, CO₂ and SO₂ and N₂ dominate in the oxidizing case.

We furthermore show that the temperature and pressure conditions of the source region in which the magma is formed and the chemical composition of the magma itself also play a key role in the chemical composition of volcanic gasses.