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Influence of mantle redox state on the atmospheric composition of rocky planets

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The mantle redox state is a crucial parameter to investigate the volatile composition during volcanic outgassing and to demonstrate the connection between the mantle and the atmosphere. We investigate the volatile transition from the interior to the atmosphere during the early Earth history as well as for rocky planets with different sizes. We simulate: the mantle-melt volatile partitioning, the gas chemical speciation during degassing and the outgassed atmospheric composition. Starting from the mantle-melt volatile partitioning, our results show that the CO_3^{2-} partitioning is inhibited in reducing states while the carbonate partitioning is favored in oxidising conditions. Once the melt reaches the surface, we simulate the gas chemical speciation. According to the volatile content of the melt, under reducing conditions the main outgassed species are CO, H_2 and H_2O while H_2O and CO_2 dominate the oxidising case. Lastly, calculating the atmosphere composition, we show that a reducing scenario generates lower atmospheric pressure and larger atmospheric thickness compared to an oxidised redox state.

Cite abstract as:
Ortenzi, G., Noack, L., Sohl, F. (2019) Influence of mantle redox state on the atmospheric composition of rocky planets. Paneth Kolloquium, Nördlingen (Germany), abstract URL: http://www.paneth.eu/PanethKolloquium/2019/0026.pdf (abstract #0026).