Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19942

Nitrates production by volcanic lightning during explosive eruptions and impact on life development

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High concentrations of nitrate have been measured in some volcanic deposits but their origin remains unclear. We assumed they can be produced by volcanic lightning taking place in some volcanic plumes during explosive eruptions. The high energy released by volcanic lightning can indeed break the chemical bonds of dinitrogen wich will subsequently undergo oxidation to produce NOx ($NO + NO_2$) then nitrate (HNO_3).

Our study focuses on the presence and origin of nitrates in other old volcanic samples. The study area is the Tecopa Basin, Califnornia, USA, where deposits of three supereruptions are preserved : Lava Creek Tuff (0,64Gy), Bishop Tuff (0,76Gy) and Huckleberry Ridge Tuff (2,04Gy). Our main objective is to measure i) the concentration of potential nitrates and sulphates in ashes and sediments and ii) the multi isotopic composition ($\delta^{18}O$, $\Delta^{17}O$, $\delta^{15}N$, $\delta^{34}S$, ...) of these species. $\Delta^{17}O$ values will help to identify the oxidation pathways involved in nitrates and sulphates formation and to highlight a potential production of nitrates in the upper atmosphere by ozone (ozone mean $\Delta^{17}O$ value = +32‰). A comparison between $\Delta^{17}O$ values of ashes and sediments leading to distinct isotopic signatures would support nitrates production by volcanic lightning during the eruption. This will emphasize the role of volcanic lightning as an important anaerobic process in nitrogen fixation, which is essential for life development in the early Earth.