Thermal stability of metalorganic compounds on volcanic olivine

Joanna Brau¹, Marco Matzka², Philippe Schmitt-Kopplin²-³, Norbert Hertkorn², Werner Ertel-Ingrisch¹, Bettina Scheu¹, and Donald B. Dingwell¹
¹Ludwig-Maximilians-Universität München, Germany; ²Helmholtz Zentrum München, Neuherberg, Germany, ³Technische Universität München, Freising, Germany

Context of the project
A previously unknown class of metalorganic compounds has been revealed in meteorites [1] and surfaces of silicate phases. The reaction of organic molecules with minerals lead to metal organic structures. They are stable under high temperature and pressure, and may have been involved in the emergence of life, since metals play an important role in living systems.

Aim of the project
- Profiling metalorganic compounds thermal signature, and understand their formation
- Investigate the mineral-molecular interaction
- Early Earth conditions

Experimental approach
We use a high temperature gas-mixing tube furnace, and perform experiments within the stability field of olivine [3] between 950 and 1350°C. A reduced atmosphere is created using a CO/CO₂ gas mixture. The olivine grains were held for dwell times of 1 to 8h, and quenched by vertical lifting out of the furnace and cooling down in air to room temperature.

Stability of Olivines
EPMA measurements
- Similar composition of major elements after heating

SEM mapping
- No diffusion of elements in olivine grains
- Melt phase different from olivine, composition associated to melted basalt attached

Preliminary results
The organic cargo was analysed using FT-ICR-MS. The olivines were crushed and the soluble organic matter was extracted with methanol.

FT-ICR-MS
- Systematic changes of organic molecular composition due to temperature and time of exposure (cf M. Matzka)

Raman spectroscopy
- Confirm thermal stability of olivines and composition
- Confirm the non crystal chemical structure of the melt phase and be taken into account in the rest of our study.

Conclusion
The preliminary results of this study show that under a reduced atmosphere and high temperatures (950-1350°C):
- Homogeneity and thermal stability of olivines from 1959 Kilauea eruption stay constant
- Metalorganic compound contents are influenced by heat
- Olivine phase appears to allow metalorganic compounds to evolve

References