EGU2020-19028
https://doi.org/10.5194/egusphere-egu2020-19028
EGU General Assembly 2020

Unravelling pre-eruptive P-T conditions by machine learning

Maurizio Petrelli[1], Luca Caricchi[2], and Diego Perugini[1]
[1]University of Perugia, Department of Physics and Geology, Perugia, Italy (maurizio.petrelli@unipg.it)
[2]University of Geneva, Department of Earth Sciences, Geneva, Switzerland

Clinopyroxene based thermometers and barometers are widely used tools for estimating temperature and pressure conditions under which magmas are stored before eruptions.

Several studies reported the development and the application of Clinopyroxene–liquid geothermobarometers in many different volcanic environments, also warning on the potential pitfall in using overly complex models [e.g., 1 and references therein]. The main drawback in the use of models with a large number of parameters is the potential overfitting of the calibration data, yielding a poor accuracy in real-world applications. On the other hand, simpler models cannot account for the complexity of natural magmatic systems, requiring different calibrations for different magma chemistries [e.g., 2, 3].

In the present study, we report on the development of Clinopyroxene and Clinopyroxene-liquid thermometers and barometers in a wide range of P-T-X conditions using Machine Learning (ML) algorithms. To avoid overfitting and demonstrate the robustness of the different methods, we randomly split the dataset into training and validation portions and repeating this procedure up to 10000 times to trace the performance of each of the used algorithms. We compared the performance of ML algorithms with classical and established Clinopyroxene and Clinopyroxene-liquid thermometers and barometers using local and global calibrations. Finally, we applied the obtained thermometers and barometers to real study cases.

[1] K. D. Putirka, Thermometers and barometers for volcanic systems, Minerals, Inclusions and Volcanic Processes, 69. 61–120, 2008.

[2] D. A. Neave, K. D. Putirka, Am. Mineral., 2017, DOI:10.2138/am-2017-5968.

[3] M. Masotta, S. Mollo, C. Freda, M. Gaeta, G. Moore, Contrib. to Mineral. Petrol., 2013, DOI:10.1007/s00410-013-0927-9.