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Machine Learning Thermo-Barometry for Volcanic Systems

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Estimating pre–eruptive temperatures and storage depths of magmas feeding active volcanoes is a fundamental topic in petrology and volcanology [1], [2]. As an example, accurate temperature estimations allow the proficient application of diffusion chronometry [3]. Also, an accurate definition of pre–eruptive storage depts is fundamental in the characterization of volcanic plumbing systems [4]. Several studies reported the development and the application of single crystal and liquid-crystal geothermobarometers in many different volcanic environments [1].

In the present study, we report on the development of single-phase 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 repeated this procedure using a Monte Carlo approach to trace the performance of every single phase (i.e., Olivine, Plagioclase, Clinopyroxene, Orthopyroxene, Amphibole, and Garnet). Finally, we applied the obtained thermometers and barometers to real study cases.

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