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Machine learning Thermo-Chemo-Barometry in volcanic systems

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Determining the temperatures and pressures at which different igneous phases crystallized is fundamental for understanding the pre-eruptive dynamics in volcanic plumbing systems. Constraining P-T conditions also helps to reconstruct the architecture and distribution of the different magma bodies underneath the volcanoes, which is also very important for risk assessment at active volcanoes.

In the last decade, Machine-Learning (ML) has been applied to geothermobarometry [1–3]. The use of ML regression strategies has proven useful. However, it also comes with some limitations when applying to real natural study cases as the assessment of uncertainty requires careful evaluation, together with the impact of biases for estimates at the boundaries of the compositional, pressure and temperature space.

Here, we present a new calibration strategy for ML-based thermometers, barometers and chemometers that accounts for the individual error associated with single estimates. Additionally, and following the methodology proposed by [4], we used different approaches to address the bias related to the intrinsic nature of the three-based ensembles algorithms. Finally, we apply our approach to a study case.

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