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## Analysis of Experimentally Zoned Crystals to Investigate The Thermo-Chemical Evolution of Magma Reservoirs

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Magma reservoirs are characterized by thermal and chemical gradients producing large variations of the spatial distribution of the physical properties of the magma they contain. Understanding the pre-eruptive thermal, chemical and physical evolution of magma represents an important step to correctly interpret the signs of an impending eruption. In this framework, the chemical zoning of minerals, which provide us a record of these thermal and chemical perturbations, represents an important tool to reconstruct reservoir dynamics. We study the effect of the competition between changing intensive parameters, element diffusion and mineral growth on the chemical zoning of minerals. We grow chemical zoned minerals at the Petro-Volcanology Research Group of the University of Perugia, using tephra from 2002-03 Mt. Etna eruption as starting material. The zonation in minerals is been forced inside a high-temperature furnace by oscillating the temperature under three different conditions: static conditions, using a controlled deformation gradient (concentric cylinder apparatus) and using a chaotic mixing regime (Chaotic Magma Mixing Device – CMMD). We collect major and trace elements distribution maps on a large number of crystals using Electron Probe Micro Analyzer (EPMA) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS), respectively. The data will be analysed using a series of custom built machine learning algorithms to disentangle zoning related to variations of the thermodynamic conditions of crystal growth from the effects of the competition between diffusion and growth. Our data will help deciphering the zoning patterns observed in natural crystals, improve our understanding of magma reservoir dynamics and help the interpretation of monitoring signals in the period preceding a volcanic eruption.