Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11706

# High-resolution crystal and melt geochemistry: Decoding magma storage and eruption

**TERESA UBIDE**

The University of Queensland

Presenting Author: t.ubide@uq.edu.au

Understanding the architecture and dynamics of volcano feeder systems is essential to inform volcano monitoring efforts and understand crustal evolution and the development of magmatic ore deposits. Over the last decades, conceptual models for magma storage have evolved from the classic balloon-shaped, liquid-dominated chamber to a succession of crystal-rich, mushy storage regions that can transect Earth's crust and upper mantle. Within this new paradigm, magmatic crystals and melts hold key information on the mechanisms driving the growth and evolution of magma bodies, and the potential switch from deep storage to sudden remobilisation and eruption.

This keynote explores crystal and melt records as independent, yet complementary archives of magmatic histories from source to surface, in a variety of tectonic settings. High-resolution geochemistry is now able to resolve variations in major and trace elements and even isotope ratios at the crystal scale. This informs on the sequence of processes preceding eruption, as well as unveiling compositional patterns of crystal growth. Combined, complex crystal records represent powerful tools to reconstruct magmatic histories, eruption triggers and ascent rates. The preservation of chemical zoning is diffusion-dependent; different elements can reflect distinct processes in a given host. Diffusion modelling can determine the timescales of such processes, and inform volcano monitoring efforts.

Carrier melts provide a means to explore erupted liquid compositions, and their variation with time or setting. When isolated from the crystal cargo, matrix geochemistry can provide outstanding insights into the nature of melts reaching the surface, and the physical and chemical processes that filter them within the plumbing system. Additionally, early constraints come from snapshots of melts trapped as melt inclusions. And because most magmas do not actually erupt, plutonic enclaves and fossilised chambers can provide valuable insights into the growth and evolution of magma bodies.

Together, high-resolution geochemical approaches make it possible to unveil previously hidden information in the rock record, and statistical analysis of magmatic datasets provide an exciting outlook for the study of magma transport and storage, aiming to constrain the behaviour of plumbing systems and help forecast future volcanic activity.