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Investigating petrological processes through the integration of crystallographic and microstructural analyses

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Collecting crystallographic orientation datasets for complex polyphase samples is now rapid and routine thanks to the growing availability of Electron Backscattered Diffraction (EBSD) systems. Likewise, many of the tools and methods developed to interrogate orientation datasets are widely available and open-source. Integrating the emerging wealth of orientation data with other forms of microstructural analyses is proving to be a valuable approach to understanding key petrological processes in metamorphic and magmatic systems alike.

To date, most EBSD studies have focused on crystal lattice deformation. However, crystal orientation data is a valuable tool for decoding a wide range of microstructures where lattice deformation is absent. Ongoing studies highlight the following petrological processes as examples that lend themselves to an integrated crystallographic and microstructural approach:
1) Patterns in the orientation relationships of crystals sharing a grain boundary may shed light on the role of epitaxy and heterogeneous nucleation; a process that can generate chemical ordering and coupled reaction behaviour in both magmatic and metamorphic systems.
2) Shape preferred orientations of non-equant crystals in magmatic systems may preserve a record of particle flow, offering snapshots of evolving magmatic dynamics and crystallisation regimes, characteristic of certain magmatic systems.
3) The crystallographic orientation relationships within glomerocrysts may preserve a record of the mechanisms responsible for crystal synneusis. The combination of textural and microstructural data of glomerocrysts can be used to understand the fluid dynamical behaviour of crystallising magmatic systems.

This work demonstrates that through the integration of crystallographic and microstructural analyses there are many new avenues to explore in the study of petrological process.