Mapping He distribution in zircon

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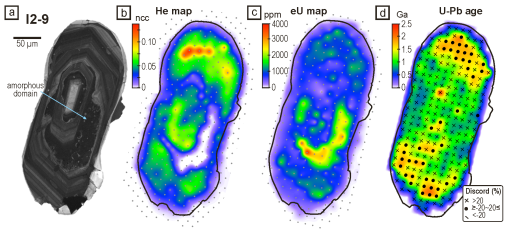
Zircon (U-Th)/He thermochronometry is an established radiometric dating technique used to place temporal constraints on a range of thermally sensitive geological events. Isotopic, crystallographic, and/or mineralogical heterogeneities within analyzed grains can result in dispersed or anomalous ages. We provide the first two-dimensional, grain-scale zircon RESOchron He “maps” and quantify intragrain He distribution [1]. These maps illustrate the complexity of intracrystalline He distribution in natural zircon and, combined with a correlated quantification of parent nuclide (U and Th) distribution, provide an opportunity to assess a number of crystal chemistry processes that can generate anomalous zircon (U-Th)/He ages. The results suggest that fluid inclusions are potential traps for radiogenic He and confirm the effect of heterogeneity in parent-daughter isotope distribution and metamictization on (U-Th)/He systematics. Finally, we present a new inversion method where He, U, and Th mapping data can be used to constrain the high- and low-temperature history of a single zircon crystal.



CL image (a), He distribution map (b), eU map (c) and U-Pb age map (d) of a zircon with an amorphous domain enriched in U but depleted in He.

[1] Danisik, McInnes, Kirkland, McDonald, Evans, Becker (2017), Science Advances 3, e1601121.