Zircon microstructural and chemical responses to deformation

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Over the last few decades the mechanics of zircon grain deformation have come under new scrutiny in the fields of earth and planetary science. Micro- to nano-scale elements of deformation are now measurable using state –of- the- art techniques in mass spectrometry, x-ray diffraction and electron microscopy, and are beginning to be used to deduce and quantify the deformation events in various tectonic and impact environments.

A compilation of naturally- and experimentally-deformed zircon analyses will be presented. We attempt to reconcile the microstructural features and attendant chemical change in natural samples with well-known deformation regimes (e.g. [1]) and to set the boundaries on these regimes using experimental data. A useful application of this work is to observe the boundary between plasticity and creep, where the action of diffusion may lead to submicron heterogeneity of important trace elements, including radiogenic lead. Many of the zircon studies in the literature show typical features of creep by dislocation climb such as tilt walls. These grains belong to rocks deformed in upper amphibolite-facies to granulite-facies tectonism, and within impact structures where zircon homologous temperatures approach ~0.3. There is significant variation in the development of sub-boundaries due to the heterogeneous nature of deformation conditions within deformation zones, and due to conditions imposed by neighbouring grains. So far, the best evidence for elemental heterogeneity due to creep comes from impactogenic shear zones [2] with high effective stresses and strain rates suggesting a nuanced mechanism for element mobility.

[1] Frost, H & Ashby, M. (1982) Deformation Mechanism Maps. Pergamon Press, New York, NY. [2] Moser, D., Davis, W., Reddy, S., Flemming R. & Hart, R. (2009) *EPSL* 277 (1-2) 73-39