Geophysical Research Abstracts
Vol. 14, EGU2012-10904, 2012
EGU General Assembly 2012

Observation of micron to centimetre scale argon in alkali feldspars: implications for 40Ar/39Ar thermochronology

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New data from gem quality K-feldspar from Itrongay, Madagascar indicates that such crystals behave as a single diffusion domain for Ar diffusion. A study of such a grain allows us to measure natural Ar diffusion from micron to centimetre scales in gem quality feldspars. UV-laserprobe 40Ar/39Ar ages from single gem quality grains indicate that the natural crystal surface acted as the main diffusion domain boundary.
UV-Laser ablation 40Ar/39Ar dating of 1 cm whole crystal of gem quality K-feldspar was undertaken at a range of length scales. Micron scale UV laser depth profiling was used to determine Ar diffusion adjacent to the natural crystal surface (presumed to have formed as the pegmatite crystalised). UV laser spot dating was used to measure the age variations on a length scales of 10s of microns to mm and even cm. The high potassium content and age of the Itrongay sample make it possible to measure natural argon diffusion at high precision and high spatial resolution, to address some of the issues surrounding Ar diffusion, at a scale that can be imaged in the laboratory.
The analysis reveals the presence of age gradients in the Itrongay feldspar spanning more than 50Ma - between 420 and 470 Ma. As previous work on Itrongay feldspar has tended to be carried out on mm-sized fragments without knowledge of the original crystal boundaries, the variation in radiometric ages in the published literature is likely due to these internal age variations. These gradients are interpreted as diffusion profiles caused by the diffusion loss of 40Ar from the crystal and we have modeled the likely differences between slow cooling/storage at elevated temperature, episodic loss, or different diffusion mechanisms. The age gradients appear to be in agreement with previous thermochronology in the area.