Ar diffusion in alkali feldspar from Shap granite (UK): linking topology of Arrhenius trajectories and texture modifications during step-heating experiments

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We investigate the mechanisms that dominate the redistribution and loss of radiogenic Ar from alkali feldspar. Several authors claim that thermally activated volume diffusion is predominantly responsible, and thus $^{40}Ar/^{39}Ar$ data collected by step-heating may be used to constrain the thermal histories of rocks (e.g. using multi-diffusion domain (MDD) theory; [1]). A plethora of assumptions is used to convert $^{40}Ar/^{39}Ar$ data to a time-temperature path, one of which is that boundaries which define diffusion domains in nature are also preserved during *in vacuo* laboratory step-heating. However, some researchers question the validity of this assumption (e.g. [2]). Here we attempt to identify diffusion domain boundaries and assess their stability by correlating Arrhenius trajectories with modifications of feldspar texture that occur in response to heating and cooling.

To adress the problem we have conducted two types of experiments. *In vacuo* repetitive step-heating experiments were used to obtain Arrhenius trajectories from fragments of alkali feldspar megacrysts from Shap granite (UK) with shortest dimension lengths of ~0.4, ~0.9, ~1.1, and ~1.3 mm. Heating of megacrysts in a muffle furnace, in air, was used to investigate modifications of feldspar texture that occur in response to heating and cooling.

Our preliminary results indicate that boundaries which define diffusion domains during laboratory step-heating may form during the step-heating itself, possibly by grain fracturing. In smaller ~0.4 mm feldspar fragments this seem to happen during the first heating step, and the Arrhenius trajectory for them is typical of alkali feldspars used for recovering thermal histories via MDD theory (e.g. [1]). In the larger ~0.9, ~1.1, and ~1.3 mm fragments boundary formation apparently occurs during several consecutive initial heating steps, and their Arrhenius trajectories are inconsitent with MDD modelling. Heating of feldspars in air revealed that their texture was significantly modified.

[1] Lovera et al. (1989) JGR:SE **94 (B12)**, 17917-17935. [2] Parsons et al. (2010) CMP **160 (2)**, 155–180.