Development of a fine-grained sediment un-mixing tool for $^{40}Ar/^{39}Ar$ dating of multi-age component samples

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Typically $^{40}Ar/^{39}Ar$ dating is restricted to dating of isolated mineral phases or phenocryst-free groundmass from igneous and metamorphic rocks. The targeting of sediments by adopting a bulk-sampling approach does not yield much geological significance because the date(s) recovered average contributions from a variety of detrital materials with differents compositions and ages. However, if an approach could be developed that could un-mix the different age signals averaged in a high-resolution $^{40}Ar/^{39}Ar$ step-heating experiment, then bulk dating of sediments could be used as a tool to reconstruct provenance and proceses such as deposition, authigenesis and weathering. Such a technique would have application to both the terrstrial sciences and solar system exploration.

Vanlangingham and Mark (2011) showed that *a priori* simplistic modelling of high-resolution $^{40}Ar/^{39}Ar$ step-heating data has the potential to 'un-mix' the sample, returning apparent ages that approach the true ages of the end member components. This contribution will show how further complex modelling adopting, for example, a MDD approach has potential to provide further clarity in unmixing. Un-mixing was possible as we know the starting compositions and ages of the end members. Our work aims to construct an inverted model that can resolve the age and compositions of end members from just the step-heating spectra. The inverted model will (1) interrogate Ar diffusion kinetics recovered from careful temprature controlled step-heating, and (2) subsequently deconvolute the mixed age spectra producing the age of each end member. The 'un-mixing' model could potentially be used as a provenance solution for bulk-grain sediments constraining the geological evolution of a region.

[1] VanLaningham, S. and Mark, D.F., 2011. *Geochimica et Cosmochimica Acta*, *75*(9), pp.2324-2335.