

Petrochronology 2.0

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U-Th-Pb petrochronology is based on the fact that Pb* diffusion is slower than major element diffusion. Pseudosections only make sense when they are not modified by diffusive re-equilibration. Multi-element maps [1] demonstrate the tight correspondence between U-Th-Pb ages and patchy textures, requiring that fluid-induced dissolution/ reprecipitation is the principal cause of Pb* mobility, as retrograde reaction rates are faster than Pb* diffusion. Petrologic disequilibrium monitors retrogression and hinders accurate dating. Only documentation of genuine bell-shaped diffusion profiles can be used to claim diffusion, which happens only exceptionally [2]. True diffusion profiles are just as rare in the K-Ar and Rb-Sr systems. The tight link between petrology, microtextures, chemical composition and geochronology is also observed in micas and feldspars. Overdetermined multi-mineral Rb-Sr isochrons with excess scatter, and spatially resolved/stepwise release ³⁹Ar-⁴⁰Ar results, demonstrate ubiquitous correspondence between relict phases and isotopic inheritance [3]. Minerals are highly retentive of Sr and Ar, unless obliterated by retrograde reactions. What Rb-Sr and K-Ar ages carry is hydrochronological information, just as do U-Th-Pb ages [4]. Dating complex parageneses of unequilibrated rocks is labor-intensive: (i) qualitative identification of relicts, retrogression reactions, and chemically open systems by imaging techniques (cathodoluminescence, element maps.); (ii) μm -scale microchemical analyses of disequilibrium phases to assign them to a P-T-A-X segment; (iii) spatially resolved/stepwise release, relating the chemical signature of the analyzed mineral to its age. K-Ar and Rb-Sr provide a different perspective on the P-T evolution of a rock than does U-Th-Pb, as K-Rb-rich minerals (phyllosilicates and especially feldspars) mostly form later and react/dissolve faster in the retrograde path than U-rich accessory phases.

[1] *Ann Rev Earth Plan Sci* 35, 137 - [2] *Chem Geol* 420, 1 - [3] *Am Mineral* 102, 2422 - [4] *Terra Nova* 23, 390