"Little-t, meet big-T"

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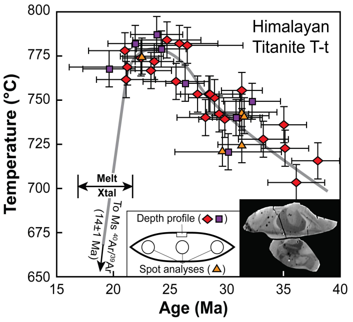
Geochronologic applications to petrology and tectonics commonly attempt to correlate age (t) with temperature (T) or pressure (P). Four primary methods are used: (1) Textural correlation – e.g. deformed vs. undeformed grains, spatial distributions of inclusions, etc. This method assumes that P-T conditions of deformation or host mineral growth are known. (2) Chemical correlation to mineral growth events – e.g. Y zoning in monazite, REE patterns in zircon. Normally this method assumes that the whole-rock is reactive and that P-T conditions of key mineral reactions (e.g. melting and crystallization, feldspar breakdown) are known. (3) Diffusion zoning. This method returns rates rather than absolute age, and assumes we know diffusion rates and boundary conditions precisely. (4) Concurrent measurement of age and T-sensitive trace elements, e.g. U-Pb dating plus Zr- or Ti-thermometry. This method assumes Ti and Zr equilibration.

Methods 1-3 are applied regularly, but raise difficult questions, e.g.: Are reactions overstepped? Do REE uniformly equilibrate? What drives zircon growth? Simultaneous U-Th-Pb geochronology plus trace element thermometry in accessory minerals may yield better precision and accuracy. Applications to zircon and titanite show promise, but sometimes conflict with petrologic constraints or experiments. For example, in the Himalaya, old titanite ages correspond with high Zr-in-Ttn T's (≥700 °C; figure to left, [1]), whereas experiments suggest Pb should reequilibrate to c. 600 °C and record only young ages. Similarly, zircons that span a large age range return low Ti-in-Zrc T's (600-750 °C) that are consistent with low Zrc-saturation T's, but not high petrologic T's (≥800 °C). These discrepancies may point to unresolved issues in experimental calibrations (U-Pb closure in titanite), equilibration lengths (trace element thermometers), and/or petrologically inferred reaction temperatures. Correlating t with P remains highly inferential. Raman spectroscopy on mineral inclusions ("thermoba-Raman-try") offers a possible solution, although fluorescence in accessory minerals can pose an analytical challenge.



[1] Kohn & Corrie (2011) *EPSL* **311**, 136-143