

Seminar 9 (to follow Lecture 11)

- 1) **“Zircon thermometer reveals minimum melting conditions on earliest earth”** by Watson and Harrison, *Science*, 308, 841-844, 2005.
- 2) **“Crystallization thermometers for zircon and rutile”** by Watson et al., *Contrib. Mineral. Petrol.*, 151, 413-433, 2006.

As shown in Lecture 3, partition coefficients are expected to vary with temperature; however, there are very few examples of trace element partition coefficients that have been used to infer equilibration temperatures. These papers on Zr incorporation into rutile (TiO_2) and Ti incorporation into zircon (ZrSiO_4) have useful applications in the petrogenesis of crustal rocks that commonly contain these accessory minerals.

- 3) **“The effect of temperature on the equilibrium distribution of trace elements between clinopyroxene, orthopyroxene, olivine and spinel in upper mantle peridotite”** by Witt Eickschen and O’Neill, *Chem. Geol.*, 221, 5-101, 2005.

Mantle peridotites exposed in the crust are metamorphic rocks. The simplest and common interpretation of their bulk-rock composition is that they represent residues created by variable extents of melting. A common interpretation is to use cpx/melt partition coefficients combined with incompatible trace element abundances in clinopyroxene, commonly determined by ion-microprobe, to infer the trace element contents of the coexisting melt, e.g. see Johnson et al. in seminar 8. A problem with this approach is that these mantle peridotites have recrystallized at sub-solidus temperatures, typically $<1100^\circ\text{C}$. If cpx/opx partitioning is sensitive to temperature, the measured trace element contents of the recrystallized CPX do not accurately reflect its TE concentrations during partial melting. This paper determines that for many elements cpx/opx and cpx/ol partition coefficients decrease with increasing temperature. The determination of the temperature dependence of cpx/opx and cpx/ol partition coefficients can be used to reconstruct trace element abundances in clinopyroxene at melting temperatures, thereby enabling accurate estimates of the trace element contents in the equilibrium melts, providing that reliable cpx/melt partition coefficients are available.