Eclogite thermobarometry: a comparison between conventional thermobarometry and phase equilibrium modeling

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Eclogite thermobarometry is crucial for constraining the depths and temperatures to which oceanic and continental crust subduct. However, eclogite thermobarometry is complex, as eclogites commonly display high-variance mineral assemblages, and the mineral compositions only vary slightly with pressure and temperature (*P*–*T*). Phase equilibrium modeling has been raised as an alternative for thermobarometry, yet the complications associated to eclogite-facies thermobarometry also affect such an approach. In this contribution, we present a comparison between these two independent approaches: conventional thermobarometry and phase equilibrium modeling. First, we calculated phase equilibria and associated mineral compositions using commonly used thermodynamic datasets (Holland and Powell 2011). We then used mineral compositions retrieved from phase-equilibrium modeling as inputs for the grt–ph–cpx barometer (Krogh Ravna & Terry, 2004) and grt–cpx thermometer (Ravna, 2000) and compared the resulting *P*–*T* estimates. Our preliminary result show that the grt–ph–cpx barometer results in pressure estimates ~0.1–0.9 GPa (average dP = ~0.3 GPa) of the corresponding mineral compositions from the phase equilibrium modeling. The grt–cpx thermometer yields temperatures within ~1–105°C (average dT = ~30 °C) of the corresponding mineral compositions from the phase equilibrium modeling. The largest differences between *P*–*T* conditions of mineral compositions calculated by phase equilibrium modeling and the thermobarometers (up to ~105 °C lower temperature from the grt–cpx thermometer) are associated with amphibole-bearing assemblages in the phase-equilibrium models. Thermobarometry of amphibole-free medium- and high-temperature eclogites generally agree well – within a mean of 0.2 GPa and 23 °C – between the two methods.

Holland, T. J. B., & Powell, R., 2011. An improved and extended internally consistent thermodynamic dataset for phases of petrological interest, involving a new equation of state for solids. *Journal of metamorphic Geology*, 29(3), 333-383.

Krogh Ravna, E. J., & Terry, M. P., 2004. Geothermobarometry of UHP and HP eclogites and schists–an evaluation of equilibria among garnet–clinopyroxene–kyanite–phengite–coesite/quartz. *Journal of metamorphic Geology*, 22(6), 579-592.

Ravna, K., 2000. The garnet–clinopyroxene Fe^{2+}–Mg geothermometer: an updated calibration. *Journal of metamorphic Geology*, 18(2), 211-219.