Thermal models and the exhumed rock record: of apples and oranges?

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Since the recognition that many exhumed HP blueschists and eclogites were related to past subduction of oceanic crust it has been common to compare maximum (P, T) conditions constrained by the rock record to estimates from subduction zone thermal models. I myself am guilty of this (and will again in this presentation). While this has become a relatively simple exercise given the abundance of databases containing rock (P, T) data and the increasing availability of thermal models, it is important to question whether this approach could obscure rather than enlighten subduction and exhumation processes. The common observation that HP rocks appear to have experienced warmer conditions than most thermal models predict (*e.g.*, Denniston-Dorland *et al.*, 2015) may reflect an artefact caused by the simplicity of this comparison.

One significant issue is that many of the available thermal models assume (near) steady-state subduction. This ignores the actual exhumation processes or the observation that a significant number of HP rocks seem to be exhumed during subduction initiation or termination (Agar *et al.*, 2009). A second issue is that the rock (P, T) conditions are frequently compared to predicted slab top temperatures only, which is rather imprecise especially when shear heating along the plate interface is assumed since rocks get exhumed from the crust and mantle that is below the slab top, they stay cooler than the slab top (van Keken *et al.*, 2018). In addition, models of present-day subduction may not closely reflect the conditions in paleo-subduction zones. Finally, subduction is a dynamic process and various important processes such as slab tearing, trench migration, and development of flat slab segments are clearly not modeled by the near steady-state kinematic models. Combined, the frequently used thermal models may be the proverbial apples to the HPT rock oranges. We clearly have our work cut out for us to make sense of this fruit bowl!

I will discuss a few approaches that require collaboration between petrologists and geodynamicists but that can make the comparison more robust and fruitful. I will also highlight examples from the literature that provide inspiration for such continued collaboration.

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