Constraining the temperature conditions of fossil subduction plate interfaces: Combining petrology and geodynamics

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Pressure-temperature (*P-T*) estimates from exhumed metamorphic rocks, including eclogites and blueschists, are often used to constrain the thermal conditions of fossil subduction zone plate interfaces. However, the exhumed rock record on average indicates temperatures 200-300°C warmer than those predicted by geodynamic models for modern subduction zones. To elucidate the difference in the fossil and modern subduction zone thermal structures, we compare newly acquired *P-T* estimates from petrologic data to newly constructed geodynamic models of the regional tectonics at selected fossil subduction localities. We evaluate the *P-T* history of these terranes using quartz-in-garnet and zircon-in-garnet elastic thermobarometry combined with Zr-in-rutile thermometry. This permits us to test assumptions about chemical equilibrium thermobarometers that are commonly utilized to reconstruct *P-T* paths. The geodynamic models are 2-D coupled kinematic-dynamic models that use the fossil subduction parameters, such as convergence velocity and plate age, and are constrained by global plate reconstruction models and regional geological and petrological studies. We compare the model-predicted subduction thermal structures with the *P-T* conditions that are estimated from exhumed rock record to assess the key factors that contribute to the apparent disparity between fossil and active subduction systems.