# A numerical thermodynamic/thermokinematic investigation of metamorphic processes in subduction zones

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Understanding the relationships between metamorphism and spatio-thermal variations at convergent plate boundaries is important for deciphering the present-day dynamics of subduction zones. In particular, the interaction between densification due to mineralogical phase transitions and slab pull forces is subject to ongoing investigations. We have therefore developed the tool THERIAK_D (*www.min.uni-kiel.de/~ed/theriakd*), which combines thermodynamic equilibrium computations and geodynamic models. Here, we present a 2D-subduction zone model that shows how the hydration, dehydration, partial melting and fractionation processes of rocks all influence the metamorphic density of the lithospheric and crustal parts of subduction zone. In this manner, we gain knowledge about the driving, metamorphic processes in a subduction zone like the eclogitization or release of fluids. Our model demonstrates that the initiation of eclogitization of the slab is not the only significant process that makes the descending slab denser and is responsible for the slab pull force. Instead, the densification of the lithospheric mantle of the sinking slab starts earlier than eclogitization and contributes significantly to slab pull in the early stages of subduction, where eclogitization does not occur. The mantle densification can also be seen in geophysical tomography. Thermodynamically modeled seismic velocities are in good agreement with geophysical observations. Hence, combined thermodynamic and numerical geodynamic models may help interpreting tomography imaging and enhance our understanding of metamorphic processes in subduction zones. Consequently, our approach shows that the evolution of subduction zones can only be assessed reliably if metamorphic processes are taken into account.

**Further Reading**: Duesterhoeft, Quinteros, Oberhänsli, Bousquet, De Capitani (2014), *Tectonophysics, 637, 20-29*.