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Numerical modeling of continental subduction and UHP rocks exhumation: implications for the Sulu UHP terrane in eastern China

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Abstract:

Ultrahigh-pressure (UHP) rocks commonly form and exhume during the early continental collision, with the protoliths mainly of the subducted passive continental margin. Sulu UHP terrane in eastern China is one of the largest and the best preserved UHP belt in the world, with lots of detailed geological, petrological, and geophysical data, which can be used to test and quantify the numerical modeling of UHP rocks' formation and exhumation. We conduct 2D high-resolution thermomechanical numerical experiments to investigate the conditions and tectonic processes of continental subduction and UHP rocks exhumation with different geometrical configurations and numerical model parameters, such as width of the continental margin, convergence velocity, sedimentation and erosion rates, etc. Our modeling results can not only be comparable with the "physical models" of continental subduction and exhumation, but also have many similar characteristics with Sulu UHP terrane, such as "Mixed rock types; dome structure and thin nappe stacks; partial melting at the base of the dome; etc."

The passive continental margin, which has relatively thin crust (24 km thickness compared to 35km of the ordinary continental crust) with significant (8-10 km thick) sed-

imentary layer, plays an important role in the continental subduction and UHP rocks exhumation. If the width of the transient "margin" is not big enough, there will not be enough time for the exhumation processes before the absolute continental collision. The convergence rate of the continental plates affects the numerical models into three different scenarios: (1) too-early exhumation processes of the subducted rocks without reaching UHP depth, under lower convergence velocity (1.25 cm/y); (2) Sulu-like subduction-exhumation scenarios with the formation and exhumation of UHP rocks, under intermediate convergence velocity (2.5 cm/y); (3) tectonic underplating of the subducted rocks into the overriding lithosphere mantle, under higher convergence velocity (5 cm/y). The sedimentation and erosion rates also influence the numerical models notably, especially in term of size and geometry of partially molten area formed at the base of the dome, with smaller sizes under low sedimentation rate and/or high erosion rate, and larger sizes under high sedimentation rate and/or low erosion rate.

Key words: numerical modeling, subduction, UHP, Sulu, convergence velocity, sedimentation and erosion rate