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Plate tectonics and the evolution and depletion of the mantle

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Today plate tectonics governs the thermal and compositional evolution of the Earth's mantle, but its role in the long-term evolution of the mantle composition is still unclear. In the opposite direction, the influence of the thermal and chemical evolution of the mantle on the operation of plate tectonics has been studied to some extent, but is far from completely understood.

In this work, we combine previous numerical models of mantle melting and depletion and subduction/plate tectonics to study the mantle evolution by means of numerical modeling of the plate tectonic cycle through the Earth's history. We adress the following questions:

- How did upper mantle depletion develop during the Earth's history? How important is the onset timing of plate tectonics in this?

- To what extent does the thermal and chemical evolution of the mantle influence the operation of plate tectonics, both at the production side (ridges) and the subduction side (trenches), the duration of the Wilson cycle, and the break-up of supercontinents?

- What is the influence of the 670-km discontinuity on the upper mantle evolution through time?

Our initial results show a significant sensitivity of the system to the potential mantle temperature, consistent with theoretical predictions, and therefore also to changing conditions during secular cooling of Earth.