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The evolution of Wilson cycles

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It is unlikely that today's plate tectonic mechanism operated in the same way during the Archaean. The Earth was likely to have seen a 100-300 K mantle temperature drop since the Archaean. So even if plate tectonics was operating during the bulk of the Earth's history, it is still likely that its appearance was showing secular changes, because rheology, crustal production, and volatile contents are all largely dependent on mantle temperature. In this work, we present numerical models of mantle melting and depletion and subduction / plate tectonics to study the mantle evolution by means of numerical modelling of the plate tectonic cycle through the Earth's history. We address the following questions: - How did the conditions for continental breakup change since the earliest appearance of plate tectonics? - How did continental formation and breakup influence the thermal and compositional history of the Earth's upper mantle? - 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 (super)continents? Our 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.