

## Expanding-Contracting Earth

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Since the birth of the Earth by giant impact at 4.56 Ga, the Earth has been regarded to be cooled, hence shrunk over geologic time. However, if the Earth was double-layered in convection, the story must have been different with a peak of expanding during a uni-directional cooling. Using the thermal evolution model of Breuyer and Spohn (1995), we calculated expanding-contracting effect, using the First Principle Calculation. The result shows ca.60km in radius larger Earth right after the consolidation of magma-ocean on the surface shrunk 50km in radius within ca. 10 m.y., and gradually expanded 11km in radius due to radiogenic heating in the lower mantle in spite of cooling in upper mantle in the Archean. This was due to double-layered convection in the Archean with final collapse of overturn, presumably by the end of Archean. Since then, the Earth has been gradually cooled down to reduce its radius 12km up to now.

Geologic evidences support the late Archean mantle overturn ca. 2.6Ga, e.g., the global distribution of super-liquidus flood basalts on nearly all cratonic fragments >35 examples. If this is correct, the surface environment of the Earth must have suffered from extensive volcanism and emergence of local landmasses, because of thin ocean cover 3-5km thickness. Global unconformity appeared for each cratonic fragment with stromatolite back to 2.9Ga with a peak at 2.6Ga. The global magmatism brought extensive crustal melting to yield explosive felsic volcanism to transport volcanic ash into stratosphere during the catastrophic mantle overturn. This event seems to be recorded by sulfur mass-independent fractionation (SMIF) at 2.6Ga. During the mantle overturn, numbers of mantle plume penetrated into upper mantle and caused local doming ca. 2-3km upward to lead local landmasses above sea-level. This led the rapid increase of atmospheric oxygen enabling life from Prokaryotes to Eukaryotes by 2.1Ga or much earlier.