[Earth-Science Reviews](#)

Volume 232, September 2022, 104130

Mantle evolution and continental growth events

Uwe Walzer, Roland Hendel

Institut für Geowissenschaften, Friedrich-Schiller-Universität, Humboldtstrasse 11, 07743 Jena, Germany
u.walzer@uni-jena.de

https://doi.org/10.1016/j.earscirev.2022.104130

Highlights

- We solved the full set of physical balance equations for mantle-crust evolution.
- Computed timings of continental growth are similar to global detrital zircon ages.
- Continental growth was an episodic rather than steady state process.

Abstract

This paper presents the computational basis for the study of Walzer and Hendel (2022), who consider the relationships between continental growth, sedimentary geology, natural climate change, and ice ages. Here we solve the full set of balance equations for mass, energy, momentum, and angular momentum for a 3D spherical-shell mantle. The assumed radial distribution of viscosity is given in Appendix B. Furthermore, the modeled viscosity depends on temperature and water concentration. The modeled mantle is internally heated by the radioactive decay of ^{238}U, ^{235}U, ^{232}Th, and ^{40}K. The heat-producing elements are redistributed by chemical differentiation in spatial regions due to partial melting. Thus, in a simplified way, continental material is formed, which accumulates at the surface of a sphere, moves sideways in a non-prescribed way due to flow, and accretes to form continents. The growth curve of the total mass of continental crust resembles that of realistic geological models. We present in Appendix B the Grüneisen parameter, adiabatic temperature, thermal expansivity, and specific heat as a function of depth. The temporal distribution of juvenile additions to the continents, as obtained using our model, has a marked resemblance to global detrital zircon ages published by Puetz and Condie (2019, 2022). The results indicate the continental crust grew in an episodic manner rather than by steady state.