

Negative growth of the continental crust at present: Significance of tectonic erosion and arc subduction

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Conventional views suggest that continental crust has gradually grown through the geologic time and finally reached the present volume. However, the thermal evolution of the earth proposes that huge amount of continental crust should be formed in the early Earth. This is the continental crust paradox.

Subduction and recycling of differentiated material into the mantle are of significance not only for creating mantle heterogeneities but for continental growth models. Continental crust is returned to the mantle through sediment subduction, tectonic erosion and continental subduction. Oceanic arcs, primary form of continental crust, have been thought to be entirely accreted during arc-collision due to its buoyant nature. Modern oceanic arcs are, however, mostly subducted into the mantle. The best examples of arc subduction are observed around the Japan islands. Among the more than 15 examples of arc-arc collision in the western Pacific, arc-arc amalgamation is possible only in the case of parallel collision. Parallel collision of two arcs is rather rare case, compared to the normal arc-arc collision, therefore these observation imply that the predominant subduction of arc crust is in general and that a majority of the intra-oceanic arc in the Earth history must have been subducted into the mantle.

Over the past three decades, marine geophysicists and geologists have documented tectonic erosion as a more common process than the formation of an accretional complex in subduction zones, and speculate that a large volume of the continental crust is subducted into the mantle at both accretionary and erosive convergent margins. Comprehensive studies on the rate of continental reduction versus production suggest a balance, resulting in no growth of continental crust at present. However, these estimates do not take into account the amount of arc subduction. Considering direct subduction of oceanic arcs into the mantle, we conclude negative growth of the continental crust on the Earth at present.

Keywords: continental growth, tectonic erosion, sediment subduction, arc subduction