Estimate of subduction rate of island arcs to the deep mantle

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Evolution of life on the Earth is strongly related to the oceans and the continents, both of which are unique to the Earth. Continental materials contain a large amount of incompatible and radiogenic elements, which may affect terrestrial thermal history and chemical evolution, as well as the Earth's surface environment. Geological studies have revealed that continental materials are subducted from the Earth's surface via the following three mechanisms (e.g. Yamamoto et al., 2009): tectonic erosion, sediment subduction, and direct subduction of immature oceanic arcs, which are found, for example, in the western Pacific. In the first two processes, the continental materials are conveyed through subduction channels of thickness of 2-3km just above the subducting slabs, and therefore considerable amount of continental materials reaches 270 km depth (Ichikawa et al., 2013, 2014), below which the continental materials are denser than the surrounding mantle materials due to coesite-stishovite transition. Here, in order to estimate the subduction rate of continental materials of oceanic arcs to the deep mantle, we have conducted numerical simulations of subduction of arcs based on the finite element method, using relevant rheology models. The results show that the subduction rate highly depends on temperature profiles of the subducting slabs and the geometry of the arcs.

Keywords: island arc, subduction, numerical simulation

