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Numerical modeling of intraoceanic subduction: from the initial stage of subduction to the crust formation.

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We have created a new coupled geochemical-petrological-thermomechanical numerical model of retreating intraoceanic subduction associated with volcanic arc development. The model includes spontaneous slab bending, subducted crust dehydration, aqueous fluid transport, mantle wedge melting, and melt extraction resulting in crustal growth. Each of these processes is characterized also by geochemical features tracking by markers. Model allows us to investigate the dynamics of subduction, mantle wedge plumes development and magmatic arc growth and displacement. Study of evolution of uranium series isotopes from the initial distribution in subducted oceanic crust and mantle through the dehydration and melting processes to the crust formation provides a tool to reconstruct a development of natural arcs.

Our numerical experiments show that subduction rate varies strongly with time and plays a crucial role in a plume development and consequent arc growth. Composition of magmatic arc and the rate of its generation strongly depend on the velocity of subduction. Newly formed arc crust is composed of rocks that are derived by melting of hydrated mantle and subducted crustal lithologies. Crust formed by mantle melting is predominant in the intraoceanic magmatic arc in all numerical experiments. The contribution from melting of subducted crust is only significant after the cessation of subduction, which allows thermal relaxation and melting of the slab. In several numerical experiments with slowing subduction an intra-arc extension which leads to

the splitting of previously formed crust and favors continuation of subduction process is observed. Rate of crust production correlates positively with subduction velocity. The loci of magmatic activity and intensity of crustal growth is strongly dependent on the dynamics of hydrous partially molten upwellings (cold plumes) rising from the slab. The volume of crust produced in the course of subduction process depends on both the efficiency of melt extraction and the slab age.