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Metamorphic mineral growth in subduction complex: an example of zircon and phengite in Nagasaki metamorphic complex, western Kyushu, Japan

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Low-T and high-P metamorphism takes places in subduction zone. The metamorphism causes change of mineral assemblages, modification of chemical composition of minerals, release of fluids, exotherm and endotherm. These elementary steps affect progress of subduction orogenesis, arc volcanism, and subduction seismicity. However, duration of metamorphism (metamorphic reactions) of individual rock in subduction zone is not fully understood. Here, we apply the interface-controlled reaction kinetics to metamorphic mineral growth in subduction zone. The formulation of the interface-controlled kinetics is applied to growths of nearly insoluble zircon and soluble phengite. The formulation predicts that Ostwald ripening is dominant for fine-grained zircon and dissolution-precipitation between non-hydrostatic stressed phengite and hydrostatic stressed phengite is dominant for phengite growth. These different modes of growth are attributed to large differences in reaction kinetic constant between two minerals. Using the formulation and radiometric ages of zircon and phengite, we obtained duration of a low-T and high-P subduction metamorphism of the Nishisonogi unit of the Nagasaki metamorphic complex, western Kyushu, southwest Japan. We will discuss the validity of interface-controlled kinetics, the obtained kinetic constant for sluggish growth of metamorphic zircon, and prolonged duration of the high-P metamorphism in the subduction zone.