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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Granite is a main component in upper continental crust of the Earth. Owing to the presence of water, granite is characteristically found on the Earth, while rare in the other planets in our solar system. Granites have abundant radiogenic elements (K, Th, and U), thus could be a heat source when subducted into mantle by plate tectonics. Also, high concentration of phosphorus in granite provides important nutrient of life through continental weathering. Therefore, granite play an important role in both biological evolution and thermal history of solid Earth.

Nonetheless, petrogenesis of granite has not been fully understood. Large amount of granitic magma have been suggested to form under hydrous condition by partial melting of basaltic rocks in subduction zone. The parent basaltic rock is still uncertain, though oceanic crust of subducted slab (slab melting) or continental lower-crust (lower-crustal melting) has been proposed as a candidate. Depletion of heavy rare earth element (HREE) in granite is recognized as an indicator of slab melting under high pressure condition where garnet is stable. However, this geochemical indicator is not sufficient to distinguish slab melting and lower-crustal melting because depletion of HREE in rocks is also shown by melting of thick continental lower-crust, and even slab melting does not result in depletion of HREE when it occur at lower pressure. Other new geochemical indicator irrespective to pressure is necessary for constraining formation mechanism of granite,

Oxygen isotope ratio could be a potential indicator, because oceanic crust and continental lower-crust possibly have different oxygen isotope ratio. In common, oceanic crust have

higher oxygen isotope ratio ($\delta^{18}O_{SMOW}$: from +7 to +15‰) than mantle value (+5.5 ± 0.2‰), while mafic continental lower crust have similar or slightly higher ratio (from +5 to +6‰). Therefore, oxygen isotope ratio in granite may provide critical information to identify formation process of the granite. I focus oxygen isotope ratio in zircons from granite. Zircon can be preserved in not only granite, but also sedimentary rocks with little compositional alteration even after deposition and metamorphism. Furthermore, oxygen isotopic ratio of zircon is not susceptible to fractional crystallization and surface alteration even when whole rock oxygen isotopic ratio was changed by these processes. Thus, oxygen isotope ratio of zircon provides more reliable and direct information of protolith of granite compared to those of whole rock.

On the other hand, melting of clastic sediments could be an additional source of granitic magma, and cannot be distinguished by oxygen isotopes alone, because sedimentary rocks generally exhibit high oxygen isotope ratio (from +7 to +25‰) that is similar to altered basalts in oceanic crust. Therefore, contamination of pre-existing continental rocks especially sediments have to be considered by using other indicator than oxygen isotopes. Trace element compositions in zircons could be a useful tracer for evaluating influence of sediment into granitic magma.

In order to establish new indicator for discriminating formation process of granite, it is important to investigate modern granitoid bodies where tectonic setting is well constrained. In this thesis, I selected the Tanzawa Tonalite (4-9 Ma) and the Taitao Granitoid (4-5 Ma), because these two represent granites which was formed by arc lower-crustal melting and slab melting, respectively, based on seismic observation, whole rock composition and high-pressure melting experiments.

The Tanzawa Tonalite is the best target for this study, because it emplaced at middle crust of oceanic island arc, where influence of sedimentary contamination is extremely low. I analyzed oxygen isotope ratio and trace element composition in the zircons from Tanzawa Tonalite. The oxygen isotopic ratios in the Tanzawa zircons show slightly lower value than

the mantle zircon value. The results imply that lower oxygen isotope ratio compared to mantle value could be an indicator of the zircons from granite formed by arc lower-crustal melting.

The Taitao Granitoids contain small amount of sedimentary component up to 15% based on Sr and Nd isotope ratios of whole rocks. Trace element composition in zircons from the Taitao Granitoids show slightly higher Sm/Yb ratio than those from the Tanzawa Tonalite. Combining with trace element data in zircons from S-type granites, correlation between Ce/Ce* and Sm/Yb ratios is observed. The correlation probably reflect mixing of sedimentary component. These trace element compositions can be useful to distinguish influence of sedimentary and basaltic components.

The results in this study demonstrate that the oxygen isotope ratio combined with trace element composition in zircons provide more comprehensive understanding of the formation process and protolith of granite.