

Establishment of new index of sediment input into granitic magma using trace element composition in zircon

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Understanding of formation process of granitic magma is one of the important issues to unveil evolution of Earth history. Evaluating amounts of sediment incorporation into granitic rocks is necessary to comprehend formation process of granite. Sedimentary components in granite have been estimated from whole rock geochemistry such as alumina saturation index and radiogenic Sr isotopic ratio. However, these whole-rock values do not necessarily reflect original magma composition, because chemical composition of the magma changes with magma evolution process (e.g. Griffin et al., 2002; Belousova et al., 2006).

Trace element compositions in zircon could be a useful tracer for evaluating amounts of sediment contamination into granitic magma (e.g. Belousova et al., 2006). In order to establish a new indicator for estimating quantity of sedimentary components in granite, we focus on modern granitic belts where tectonic settings are well constrained. We conducted in-situ analyses of trace element compositions in 188 zircon grains from the Tanzawa Tonalite (4-9 Ma; Tani et al., 2010) and 210 zircon grains from the Taitao Granitoid (4-5 Ma; Anma et al., 2009) with LA-ICP-MS. The Tanzawa Tonalite is the best target for this study, because it emplaced at middle crust of immature oceanic island arc where influence of sedimentary contamination is extremely low. On the other hand, the Taitao Granitoids contain small amount of sedimentary components because the granitoid were intruded into Jurassic accretionary complex.

Zircons from the Tanzawa Tonalite and the Taitao Granitoid show enrichment of HREE, negative Eu anomaly and positive Ce anomaly, which are typical characteristics of those in most granites. Trace element compositions in zircons from the Taitao Granitoids show lower Yb/Sm ratios than those from the Tanzawa Tonalite. As combined with previous trace element data in zircons from oceanic plagiogranite, S-type granite and I-type granite, a clear correlation can be observed between $\ln(\text{Ce}/\text{Ce}^*)$ and $\ln(\text{Yb}/\text{Sm})$. Higher Ce/Ce* and Yb/Sm ratios in the Tanzawa Tonalite are consistent with little sedimentary component deduced from its tectonic setting. In addition, results from principal component analysis using these trace element data show strong correlations among $\ln(\text{La}/\text{Sm})$, $\ln(\text{Pr}/\text{Sm})$ and $\ln(\text{Nd}/\text{Sm})$ values in zircons. Cross-plots of these values exhibit that trace element compositions in zircons from the Tanzawa Tonalite and oceanic plagiogranite are plotted on different fields from those from S-type granites. High La/Sm, Pr/Sm and Nd/Sm ratios in zircons from the S-type granite probably reflect high LREE concentration in sediments. Therefore, these trace element compositions can be useful to evaluate influence of sedimentary components into granite. The results in this study demonstrate that trace element composition in zircons has a possibility to provide more detail information for protolith of granite.

Keywords: Zircon, Trace element composition, LA-ICP-MS, Tanzawa Tonalite, Taitao Granite, Sediment contamination