

Investigating the Origin of Garnet in Meta-Granite from Hoping, Hualien, Taiwan: Application of *in-situ* Geochemical Analyses

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Meta-granites from Hoping in eastern Taiwan belong to the Tailuko Belt, the orogenic belt that has undergone the highest-grade metamorphism in Taiwan: up to amphibolite facies. Based on the major element composition, the garnets in the meta-granites can be divided into two types: Type 1, enriched in Fe and Mg, and Type 2, richer in Ca and Mn. Petrographic analyses from this study and previous research show that Type 1 is almost free of inclusions and occurs only as a core surrounded by Type 2, whereas Type 2 contains abundant metamorphic inclusions such as epidote and may also occur as isolated grains. These observations suggest that Type 1 formed earlier and was overgrown by Type 2 during later metamorphic stages.

Trace element analysis is essential for further investigation, as the origin of Type 1 garnets remains uncertain, and major element composition alone is insufficient to distinguish garnet origins [1]. To address this, garnet major element composition was measured using an electron probe microanalyzer (EPMA), and a laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) method was developed to analyze the trace element composition of small (50–250 μm) and/or inclusion-rich garnets in our samples. Our aim is not only to better constrain the origin of Type 1 garnets, but also to identify reliable geochemical indicators of garnet origin by comparing our data with compiled geochemical data on garnets of different origins.

Trace element analysis reveals that Type 1 and Type 2 garnets exhibit variations in trace element concentrations, particularly in Cr, Zn, Y, Zr, middle rare earth elements (MREEs) and Hf, along with distinct REE patterns. Most Type 1 garnets show high Y (>500 ppm) and total heavy REE concentrations (>300 ppm), suggesting a magmatic origin based on the indicators proposed by Hong et al. (2020) [2]. Furthermore, we suggest that Y, MREE, the Eu anomaly (Eu/Eu^*), and the $\text{Gd}_\text{N}/\text{Yb}_\text{N}$ ratio are promising indicators for discriminating garnets from igneous, medium-grade, and high-grade metamorphic rocks.

[1] Krippner et al. (2014), *Sedimentary Geology* 306, 36-52.

[2] Hong et al. (2020), *Marine and Petroleum Geology* 116, 104316.