

Quantitative CO₂ analysis of cordierite and its applications for petrogenesis: preliminary report

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Fluids in lower crust are regarded to play an important role on mineral assemblage and chemistry of high-grade metamorphic rocks. A common occurrence of deep crustal CO₂ has been reported from various granulite terranes in the world. Although most of the fluids have already escaped from the rock, some are still preserved in the system as hydrous or carbonate minerals, fluid inclusions, and possibly along grain boundary of minerals.

Cordierite (Mg₂Al₄Si₅O₁₈) is a common mineral in pelitic rocks that underwent amphibolite- to granulite-facies metamorphism. The analytical total of cordierite is generally less than 100% by 2-3 wt.%, suggesting the presence of channel-filling volatiles such as CO₂ and/or H₂O. As the volatile content of cordierite is regarded to be controlled by fluid composition during metamorphism, quantitative analysis of CO₂ in cordierite channel is an important clue to infer composition of fluids. Although such quantitative analysis of CO₂ and H₂O in cordierite has been done by SIMS, it is not a convenient method for many petrologists without the instrument. In this study, we therefore adopted electron microprobe for quantitative CO₂ analysis in cordierite. The analysis has been done at low accelerating voltage (12.5 keV) and high sample current using Al-coated thin sections.

Two types of cordierite in pelitic granulite from the Limpopo Belt (southern Africa) have been analyzed; coarse-grained porphyroblastic mineral in migmatite and retrograde phase around poikiloblastic garnet. Analysis of migmatitic cordierite yielded K-value of 12.9 to 13.1, which is higher than that of symplectitic cordierite (12.8-12.9). The preliminary analysis therefore suggests that migmatitic cordierite has higher CO₂ content than that of symplectitic phase from the same area. The result is consistent with common occurrence of CO₂-rich fluid inclusions trapped as primary phase in peak metamorphic minerals.