

Estimation of Minimum Fe-Mg content for Plagioclase-Cordierite replacement

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Conventional studies suggested that chemical compositions of metamorphic fluid consist of C-H-O-S system, and other elements such as Na, Ca, and Si are not transported with the fluid. These elements, however, do dissolve in the fluid in some instances, as exemplified by quartz-filled vein and as demonstrated by various studies of fluid inclusions. For example, in tonalitic granulite in Sri Lanka, plagioclase was substituted locally by cordierite.

We attempt to obtain the essential data about the element transport within the metamorphic fluid, by experimentally reproducing the chemical reactions that are responsible for element inflow and outflow. They include the solubility of mineral to the fluid, the chemical composition and concentration of the fluid, and their change in the pressure and temperature conditions. By utilizing this information, we should be able to limit the range of the chemical composition and concentration, and the P-T values.

This study has determined the minimum ratio of Mg/(Fe+Mg) and the minimum concentration of (Mg, Fe)Cl₂ for the plagioclase-cordierite replacement, by utilizing hydrothermal experiments. Because the ample amount of tonalitic-granulite specimen in Sri Lanka for this experiment is not available, we have used powdered specimens of anorthosite from the Natal region, South Africa, and chloride solution of Mg and Fe. These materials were sealed into gold capsule with or without CO₂ and were held at a pressure of 100 MPa and a temperature of 600 °C in autoclave for 130-400 hours. We have obtained the following results:

The minimum concentration of MgCl₂ for the plagioclase-cordierite replacement is approximately 0.08 mol/kg.

The minimum ratio of Mg/(Fe+Mg) for the plagioclase-cordierite replacement is approximately 0.2. These minimum values derived above are not influenced by the presence of CO₂.

It is estimated that the Mg/(Fe+Mg) ratio of the fluid responsible for the plagioclase-cordierite replacement in the tonalitic granulite in Sri Lanka is approximately 0.2.