

## Cordierite stability in the presence of H<sub>2</sub>O-NaCl brines

Manuel Scola, Peter W. Mirwald & Peter Tropper

Institut für Mineralogie und Petrologie, Universität Innsbruck, Innrain 52, A-6020 Innsbruck, Austria

Cordierite is a common mineral in high-grade metapelitic rocks whose stability strongly depends on the nature of the fluid components (Newton 1972; MIRWALD, 1984). In granulite-facies rocks, H<sub>2</sub>O-fluid inclusions show considerable amount of chloride species such as NaCl (Newton et al., 1998). Since the effects of salinity on the stability properties of hydrous phases are rarely investigated (e.g. Tropper & Manning, 2004), we carried out piston cylinder experiments on the cordierite breakdown reaction (1): 3 cordierite + 2 H<sub>2</sub>O = 6 kyanite + 2 talc + quartz at 700 - 750°C and 0.75 - 1.2 GPa, in the presence of H<sub>2</sub>O-NaCl fluids.

The experiments were performed in a piston cylinder apparatus with a conventional NaCl cell set up. As starting materials we used synthetic anhydrous Mg-cordierite and natural kyanite, talc and quartz. The experiments were performed in the presence of H<sub>2</sub>O-fluids with five different starting compositions: X(H<sub>2</sub>O) = 1.00, 0.90, 0.75, 0.57 and 0.35 which corresponds to activities of H<sub>2</sub>O, a(H<sub>2</sub>O) = 1.00, 0.80, 0.60, 0.40, 0.20, according to the ideal H<sub>2</sub>O-NaCl activity model of Aranovich and Newton (1996). Reaction progress was monitored by EPMA and SEM, thus checking the growth of either cordierite or its breakdown phases such as kyanite.

The first experimental investigations at a(H<sub>2</sub>O) = 0.6, and 700 °C yielded a reversal of reaction (1) lying between 0.85 and 0.95 GPa, which agrees with the results of Newton (1972) and Mirwald (1984), who showed the pressure stabilizing effect of H<sub>2</sub>O on Mg-cordierite. This reversal also agrees very well with the predicted position of reaction (1) when calculated with THERMOCALC v. 3.2 and the thermodynamic database of Holland and Powell (1998). Lowering the activity of H<sub>2</sub>O favours the formation of albite which occurred in all a(H<sub>2</sub>O) = 0.2 run ranging from 0.75 to 1.0 GPa and in all H<sub>2</sub>O-NaCl fluids-bearing assemblages above 1.1 GPa. Besides for the formation of albite, Na<sup>+</sup> is also incorporated in the channel structure of cordierite (Schreyer et al., 1979; Mirwald, 1983). EPMA analyses showed values of 0.9 wt % Na<sup>+</sup> which corresponds to 0.04 Na a.p.f.u at a(H<sub>2</sub>O) = 0.2 and 0.015 a.p.f.u at a(H<sub>2</sub>O) = 0.8. The influence of pressure on the Na content of cordierites has also been examined and indicates, possibly, a slight positive dependence. In terms of temperature-dependence of Na-incorporation, the proposed inverse correlation of Na-content versus temperature (Mirwald, 1986) could not be judged within the small temperature interval of 700°C–750°C.

These experiments confirm previous observation of the pressure stabilisation of cordierite by fluids and provide first information on the effect of variable H<sub>2</sub>O-activity of fluids on this mineral being a characteristic phase of granulite-facies metapelites and metagranites.

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