

**EXPERIMENTS ON THE PRESSURE STABILITY OF MG-CORDIERITE AT
CONTROLLED CO₂ - H₂O - Na⁺ - CONDITIONS BETWEEN 600 AND 800°C**

by

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Introduction

Cordierite $Mg_2Al_4Si_5O_{18} \cdot n(Na^+, H_2O, CO_2, Ar, \text{etc.})$ is a common mineral in highgrade metapelitic rocks and aluminous magmatites. Its petrological significance is based on a number of pressure and temperature sensitive reactions which cordierite is involved in. The influence of Na^+ , H_2O , CO_2 etc. has been studied in several investigations (cf. SCHREYER, 1985; VRY et al., 1990). The pressure stability of Na-Cordierite has been investigated in two pilot studies so far (MIRWALD & LE BRETON, 1985; MIRWALD & KNOP, 1995). This work presents preliminary results of an experimental investigation on the pressure stability of Mg-Cordierite at constant fluid composition, containing CO_2 , H_2O and Na^+ .

Experimental Methods

The cordierite-starting-material was synthesized by melting and crystallisation of an oxide mixture. The breakdown reaction assemblages have been obtained from the breakdown products of cordierite. The experiments with sodium were performed with a fluid-composition of $CO_2 : H_2O : Na^+ = 1 : 1 : 0.125$. The experiments without sodium were performed at a fluid-composition of $CO_2 : H_2O = 1 : 1$. The ratio of total fluid: Mg-Cordierite was 4 : 1.

The experiments with sodium-containing fluid were performed as double capsule experiments with one capsule containing albite glass and the other with sodium oxalate as sodium donor. The total dissociation of sodium oxalate ensured a defined amount of sodium in the sample (0.5 atoms Na^+ pfu Mg cordierite). As CO_2 source silver oxalate and sodium oxalate have been used. The experiments were performed in a piston cylinder apparatus with sodium chloride cells and gold capsules.

The samples were quenched from 650°C - 800°C below 300°C within 15 seconds and within 40 seconds below 100°C. Optical microscopy, X-ray powder diffractometry, electron microprobe analysis and scanning electron microscopy served for the characterization of the run-products.

Results

The upper pressure stability boundary of Mg-Cordierite without sodium at a $\text{CO}_2 : \text{H}_2\text{O}$ ratio of 1 : 1 is shown in fig. 1. The dP/dT -slope of the stability boundary is -0.67 MPa/K . The stability boundary with sodium is reduced by some 0.35 GPa between 650°C and 800°C . The dP/dT -slope is close to zero, thus indicating an almost temperature independent course. Both, albite glass and sodium oxalate containing samples, yielded the same results. Talc, aluminosilicate, quartz, (clino)enstatite and corundum could be identified as breakdown products of Mg-cordierite without sodium. The presence of carbonates has not been confirmed. The reaction products of the experiments with sodium showed typical X-ray reflections of the sodium bearing talc-like mineral saponite (SCHREYER et al, 1980). The occurrence of this phase may indicate that the exchange vector $\text{Na} + \text{Al}^{[4]} \Rightarrow \text{Si}^{[4]}$ is active in the sheetsilicates. Albite has been identified as a crystalline phase in all experiments in which albite glass was employed.

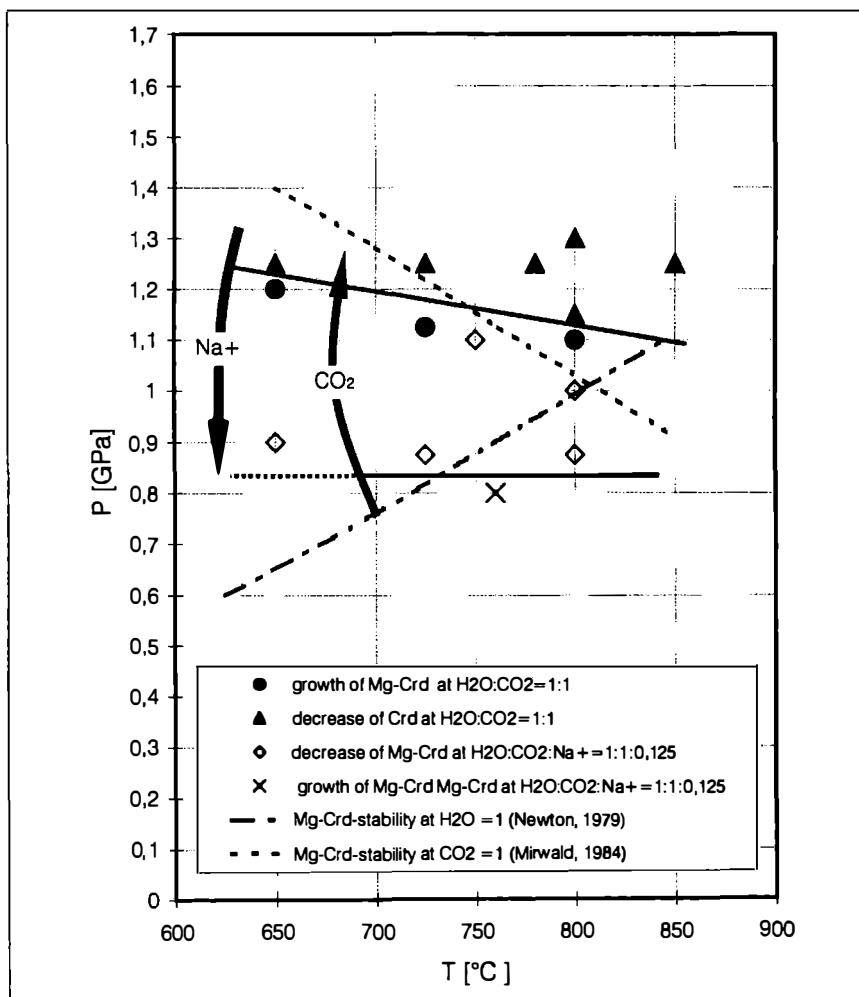


Fig. 1
P-T stabilities of Mg-Cordierite at different fluid-compositions.

The comparison with the results of the pilot study of MIRWALD & LE BRETON (1985) in which NaOH was used as sodium source, shows that our stability boundary is located at a pressure which is 0.1 GPa lower. This could be explained by the specific behavior of NaOH, which possibly influences the ratio of CO₂ / H₂O and/or the activity of Na⁺ in an unknown manner. Our stability boundary without sodium lies about 0.05 GPa higher than that one of MIRWALD & LE BRETON (1985). This small difference may be due to slightly differing fluid-composition in the experiments.

References

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