EXPERIMENTAL STUDY ON THE SYSTEM $MgSiO_3$-Al_2O_3-Cr_2O_3 BETWEEN 4 AND 6 GPA AT DIFFERENT TEMPERATURES WITH SPECIAL REFERENCE TO PYROPE-KNORRINGITE JOIN

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Phase equilibria study of the pyrope-knorringite join, which is a part of the $MgSiO_3$-Al_2O_3-Cr_2O_3 system has been made between 4 to 6 GPa and 1300 to 1500°C. The subsolidus assemblages in this join are as follows : 1) $garnet_{ss}$ 2) $garnet_{ss}$ + $orthoenstatite_{ss}$ + $corundum_{ss}$ and 3) $orthoenstatite_{ss}$ + $corundum_{ss}$. Spinel and quartz do not appear in this join in the same P-T range, as claimed by some investigators[1,2]. Present data rather confirm the observation of Malinovski et.al.[3], Turking et.al.[4] and Doroshev et.al.[5]. The solubility of knorringite in pyrope increases with pressure and is 59 mole% at 6 GPa and 1500°C. Such garnets have chemistry similar to natural chrome-pyropes found as inclusions within natural diamonds or within kimberlitic xenoliths. The maximum knorringite content in such natural pyropes has been reported to be 50 mole %, suggesting the P-T condition of equilibration of such garnets at a depth of 180-200 km.

Reaction of following phases crystallizing in the same system, $MgSiO_3$-Al_2O_3-Cr_2O_3 was considered :

$$\underset{\text{(pyrope)}}{Mg_3Al_2Si_3O_{12}} + \underset{\text{(eskolaite)}}{Cr_2O_3} \Leftrightarrow \underset{\text{(knorringite)}}{Mg_3Cr_2Si_3O_{12}} + \underset{\text{(corundum)}}{Al_2O_3}$$

Microprobe analyses of all the phases participating in the above reaction helped to determine activities of various components. These values together with the thermodynamic properties of pure pyrope, eskolaite and corundum helped to determine the standard entropy and enthalpy of formation of knorringite, which are as follows :

H^o_f (kJ/mol)	S^o_f (J/mol)	G^o_f (kJ/mol)
-5495.365	414.579	-5619.212
kJ/mol	J/mol.K	KJ/mol.

The topology of the solvus for the join Al_2O_3 has been established at 6 GPa. The critical composition (X_c) and critical temperature (T_c) for the solvus have been determined at 6 GPa, and are found to be $Cor_{55}Esk_{45}$ and 1063°C, respectively. The assemblages across the solvus boundary have been bracketed.