85. *A High Pressure Hexagonal Form of $MgSiO_3$*

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The high-pressure and high-temperature state of $MgSiO_3$ has been studied in a spherical pressure vessel made up of two stages.[1] Chemically pure clinoenstatite is synthesised and charged into the vessel together with a platinum heater and Pt-Pt13%Rh thermocouple as shown in Fig. 1.

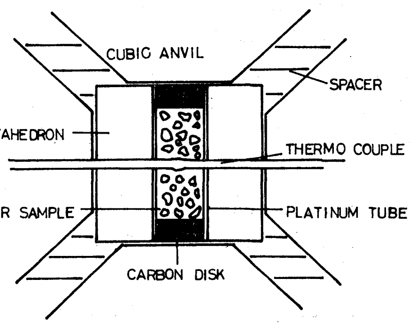

Fig. 1. Furnace assembly for quenching runs.

After the sample is compressed slowly up to the pressure higher than the metallic transition point of GaP (0.5 Mb), the electric current is driven through the heater, till the specimen temperature becomes 1000°C. Then, the P-T condition is kept constant for 10 hours. When the current is cut off, the sample is quenched, so that the specimen may be taken out of the vessel safely under the atmospheric pressure.

The quenched specimen is colourless aggregate of polycrystalline powder whose X-ray diffraction lines are given in Fig. 2. There appear more than 10 extra peakes in addition to those characteristic of γ-Mg_2SiO_4[3] and stishovite. They can be indexed on the basis of a hexagonal lattice as in the case of $MgGeO_3$ produced at 30 Kb by Ringwood and Seabrook[4] in 1962 (X-ray data are given in Table I).

Recently we have found[5] that clinoenstatite ($MgSiO_3$) breakes up at about 200 Kb into stishovite and β-Mg_2SiO_4, the latter being transformed further into γ-Mg_2SiO_4. The transformation is accompanied

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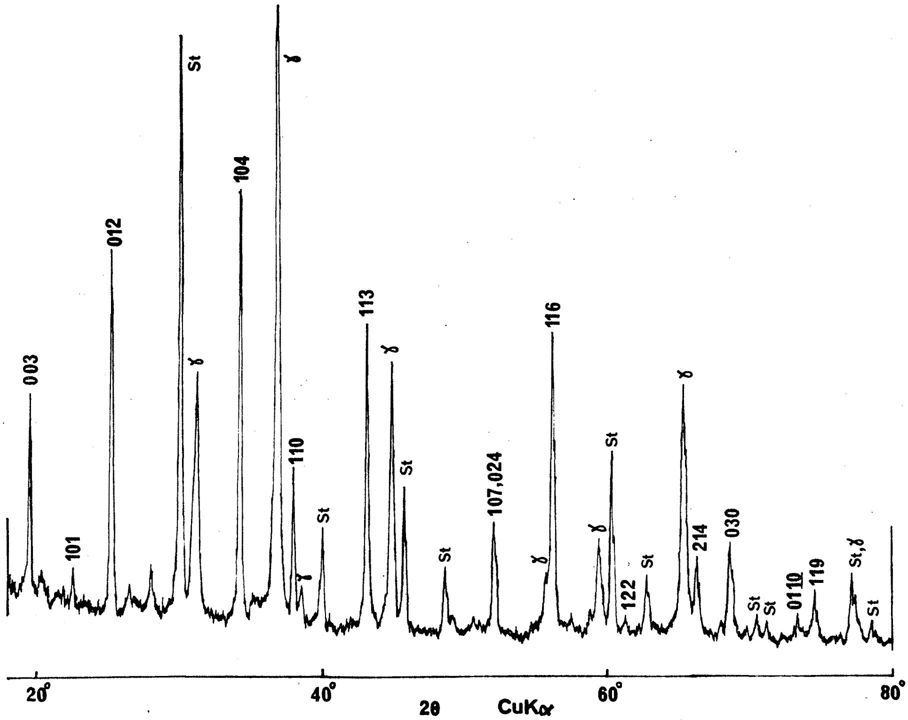

Fig. 2. Powder X-ray diffraction chart of the quenched sample.

Table I. Powder date for hexagonal $MgSiO_3$

h k l	d_{obs}	d_{calc}	Intensity
0 0 3	4.512 A	4.519 A	50
1 0 1	3.919	3.919	10
0 1 2	3.501	3.504	80
1 0 4	2.609	2.611	100
1 1 0	2.364	2.364	30
1 1 3	2.094	2.094	70
1 0 7	1.7521	1.7506	} 30
0 2 4	1.7521	1.7522	
1 1 6	1.6329	1.6332	70
1 2 2	1.5087	1.5086	<5
2 1 4	1.4076	1.4076	20
0 3 0	1.3647	1.3647	20
0 1 *10*	1.2867	1.2869	5
1 1 9	1.2703	1.2702	10

Hexagonal: $a = 4.727 \pm 0.001$Å, $c = 13.556 \pm 0.002$Å,
$V = 262.3 \pm 0.5$Å^3, Z 6, $\rho_{calc} = 3.81$ g/cm^3

by the contraction of volume of about 15%. The hexagonal $MgSiO_3$ obtained by us is 2% greater in density than the mixture of γ-Mg_2SiO_4

and stishovite above mentioned.

γ-Mg_2SiO_4 and stishovite, as we have found in the X-ray chart, coexisting with the hexagonal $MgSiO_3$ show that the reaction in our experiment for the new phase has been incomplete. The hexagonal metasilicate has not been found in nature. However, that it has been produced and is stable under a pressure less than 0.5 Mb would indicate its possible existence in the earth's mantle.

References

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