

TABLE 1

Details of experiments and chemical ranges of pyroxenes (number of analyses are shown in parentheses)

Run. No.	P (kbars)	T (°C)	Time (hours)	Starting composition	H <sub>2</sub> O	Products	Chemical range (CaMgSi <sub>2</sub> O <sub>6</sub> mole %)	
							orthopyroxene	clinopyroxene
1	40	1200	4	En <sub>50</sub> Di <sub>50</sub>	*	EnDi	2.6– 5.6 (14)	88.0– 89.4 (10)
2	30	1200	0.1	En <sub>50</sub> Di <sub>50</sub>	anhydrous	EnDi		
3	30	1200	0.75	En <sub>50</sub> Di <sub>50</sub>	anhydrous	EnDi	6.0–11.6 (4)	71.2– 77.0 (5)
4	30	1200	4	En <sub>50</sub> Di <sub>50</sub>	*	EnDi glass	4.8– 6.4 (10)	85.8– 88.4 (13)
5	30	1200 <sup>2</sup>	170	synthetic EnDi	*	EnDi glass	2.2– 6.2 (15)	84.2–100.0 (15)
6	10	1200	4	En <sub>50</sub> Di <sub>50</sub>	*	EnDi glass (tr)	7.4–10.0 (10)	78.6– 82.4 (10)
7	5	1200	4	En <sub>50</sub> Di <sub>50</sub>	*	EnDi glass Ol?	9.4–12.2 (10)	71.4– 77.6 (10)
8	5	1200	11	En <sub>50</sub> Di <sub>50</sub>	*	EnDi glass(tr)	9.6–12.6 (10)	74.8– 80.0 (10)
9	30	1500	2.5	En <sub>50</sub> Di <sub>50</sub>	*	clinopyroxene		45.6– 55.0 (12)
10	30	1200/1500	2.5/2.0	En <sub>50</sub> Di <sub>50</sub>	*	EnDi glass (tr)	6.4–10.2 (11)	55.4– 67.6 (16)
11	30	1500 <sup>2</sup>	3.2	En <sub>80</sub> Di <sub>20</sub>	anhydrous	EnDi Qz?	10.4–11.6 (10)	49.6– 57.6 (10)
12	30	1200/1500 <sup>2</sup>	2.1/4.2	En <sub>80</sub> Di <sub>20</sub>	anhydrous	EnDi	9.0–10.0 (6)	57.8– 68.2 (8)
13	30	900	23	En <sub>50</sub> Di <sub>50</sub>	a few %	EnDi Amph	1.6– 2.6 (12)	91.0– 92.8 (7)
14	30	900	214	synthetic EnDi	3% <sup>1</sup>	EnDi Amph (tr) magnesite (tr) Qz(tr)	0.2– 1.6 (5)	93.4– 99.8 (25)
15	10	900	72	En <sub>50</sub> Di <sub>50</sub>	a few %	EnDi	4.2– 6.4 (6)	76.4– 87.8 (15)
16	10	900	212	synthetic EnDi	4% <sup>1</sup>	EnDi Qz(tr)	1.4– 2.8 (9)	93.2– 98.8 (11)

\* Starting materials were slightly moistened by breathing.

<sup>1</sup> 22% silver oxalate was also added.<sup>2</sup> In the middle of the experiment indicated temperature decreased possibly due to chemical contamination of the thermocouple, and temperature was then controlled by maintaining power equal to the earlier condition. In run 5, an accidental "correction" of +70°C occurred for less than 1 hour after 100 hours of the experiment.

to single-phase clinopyroxene with composition similar to that of the starting glass, then nucleation of orthopyroxene and change of clinopyroxene towards the equilibrium composition, as in runs 2–4 and 7, 8 in Table 1. It is apparent that a glass with a composition within the pyroxene solvus crystallizes rapidly to form clinopyroxene of compositions similar to the glass composition, then or at the same time orthopyroxene nucleates, and the composition gap between

the two pyroxenes widens until the solvus limit is reached.

In contrast to glasses, starting material of synthetic diopside (CaMgSi<sub>2</sub>O<sub>6</sub>) and enstatite or clinoenstatite (Mg<sub>2</sub>Si<sub>2</sub>O<sub>6</sub>) react inwards until the solvus limits are reached. This is well demonstrated by the experiments in which layers of diopside and clinoenstatite were allowed to react across their boundary surface. In runs 5, 14 and 16, the CaMgSi<sub>2</sub>O<sub>6</sub> content of diopside

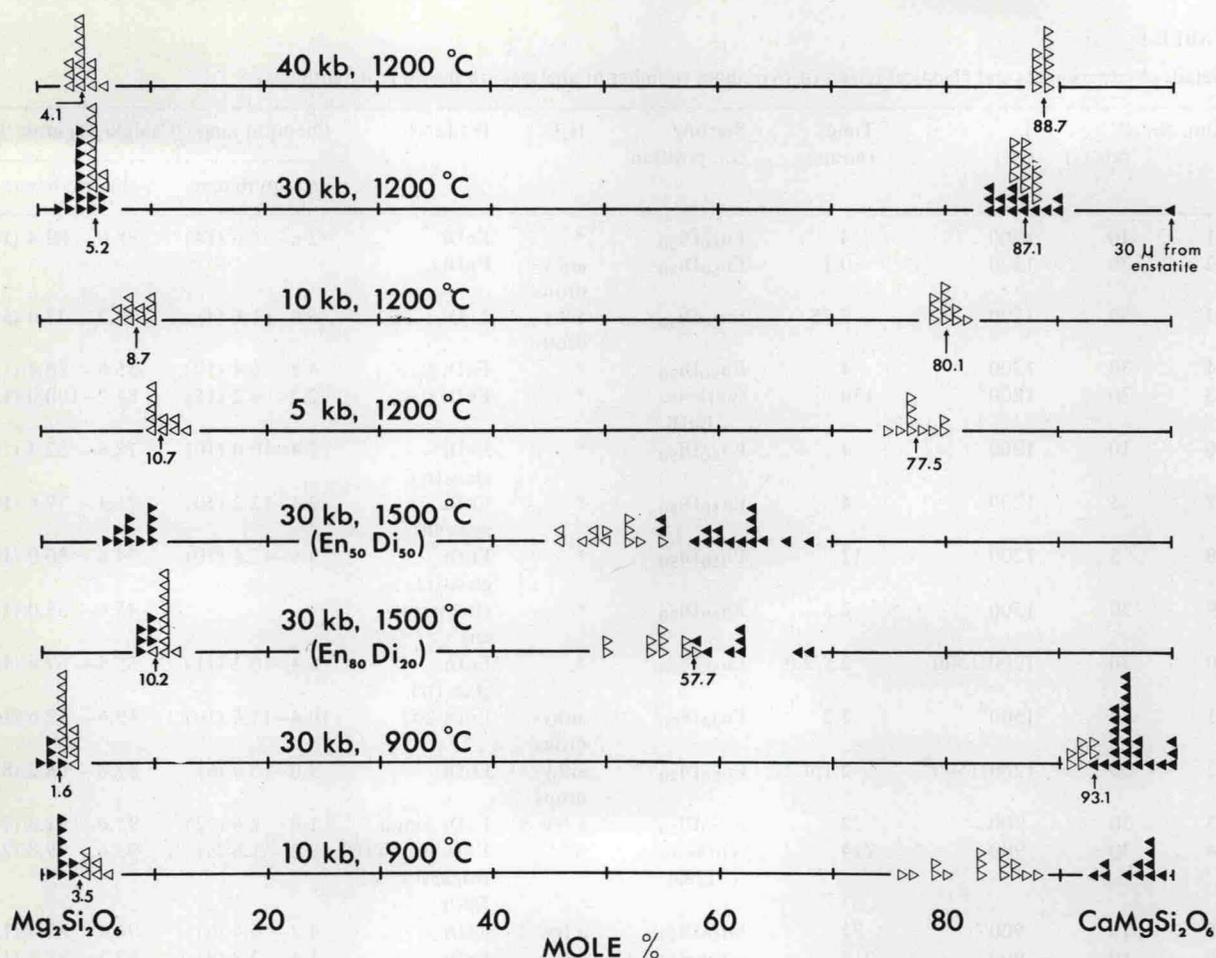


Fig. 1. Microprobe analyses of pyroxenes. Filled and open symbols are of homogenization and unmixing experiments, respectively. Decimal fractions in the raw data have been rounded to the nearest integer. Selected compositions are shown with arrows (see text).

30  $\mu\text{m}$  from the boundary was 100%, and rapidly decreased to the boundary zone (10  $\mu\text{m}$ ) in which orthopyroxene occurred. The  $\text{CaMgSi}_2\text{O}_6$  content of enstatite decreased away from the boundary zone and approached  $\text{Mg}_2\text{Si}_2\text{O}_6$  at the other end. Additional examples of the inward reaction of natural pyroxenes towards the solvus are found in Hensen [11].

Thus, a pair of unmixing and homogenization experiments establishes or limits the position of a solvus even if chemical hysteresis remains and the data in either of the experiments are themselves scattered between starting composition and equilibrium composition.

Both unmixing and homogenization experiments were done at 30 kbars and 1200°C, 30 kbars and

900°C, 10 kbars and 900°C, and 30 kbars and 1500°C (Fig. 1), the last of which is separately discussed in the next section. The pair of experiments at 30 kbars and 1200°C yielded an overlap of the data by two experiments (Fig. 1). At 30 and 10 kbars at 900°C, the data could limit positions of solvus within analytical error except for the clinopyroxene limb at 10 kbars and 900°C where either the unmixing or homogenization experiments (or both) did not reach solvus and its position was only bracketted between  $\text{En}_{12.2}\text{Di}_{87.8}$  and  $\text{En}_{6.8}\text{Di}_{93.2}$ .

At 40, 10 and 5 kbars at 1200°C, only unmixing experiments were made. Inferred solvus positions at these conditions are averages of the data.