



furnace. It has been found that the presence of a graphite-tube furnace in a pressure medium makes the pressure transmission inefficient by nearly 10% to a tube-less assemblage for the pressure calibration at the room temperature and in the pressure range up to the Ba I-II transition. This inefficiency would hold true in higher pressure region. On the other hand, it is believed that at temperature higher than 1000°C the pressure medium would soften and pressure would be transmitted more efficiently [Boyd and England, 1963]. Thus, the working pressures would be increased several per cent higher than the values estimated from the calibrations at room temperature. In the phase diagrams presented by Akimoto and Fujisawa [1967] (see Figures 1 and 5 (except olivine solvus 5)), these effects are not considered. Putting all accounts together, it could be said that there is a possibility of decreasing the transition pressure shown in Figures 1 and 5 by a few per cent.

There are two sources of error in the temperature estimation. First, the simple error coming from stability of furnace temperature; this error does not exceed  $\pm 20^\circ\text{C}$  in the experiment. Second, the pressure effect on the emf of thermocouples must be considered. Accurate estimation of this effect is very difficult, because there are no quantitative results available for the range of pressures and temperatures considered here. Direct measurement of this effect has made only up to  $100^\circ\text{C}$  under relatively lower pressure [Bridgman, 1918; Bundy, 1961]. Hanneman and Strong [1965, 1966] estimated indirectly the pressure effect up to 50 kb and to  $1300^\circ\text{C}$  with Pt|Pt-10Rh, C|A, and Pt|Pt-13Rh thermocouples. If their results are true in higher-pressure range, the temperatures indicated in the phase diagrams of Figures 1 and 5 (except olivine solvus 5), which were determined with the Pt|Pt-13Rh thermocouple, must be corrected by nearly  $+100^\circ\text{C}$ , since in the experiment no correction was made for this kind of error. This indirect method of determining the pressure effect has not yet been justified by any other evidence. We tentatively adopt the value of  $+100^\circ\text{C}$  as the maximum amount of correction needed.

Now we will try to estimate the temperature at the top of the transition layer in two limiting cases. From the preceding discussions, we will

use in this attempt the assumed parameters: (1) the Fe/Mg ratio in mantle minerals is 1:9, and (2) the depth at which olivine-spinel transition begins is at about 370 km ( $\approx 125$  kb).

*Lower limit of the temperature at 370-km depth.* We will assume that (1) the pressure transmission is not affected by the existence of a graphite-tube furnace, and (2) the pressure effect on the emf of thermocouple can be considered negligible. In this case the phase relations indicated in Figure 5 can be used without corrections, and the temperature at the depth of 370 km is estimated to be  $1150^\circ\text{C}$  from olivine solvus 1 in this figure.

*Upper limit of the temperature at 370-km depth.* We will assume that (1) the existence of a graphite-tube furnace results in a 10% reduction of the pressures previously estimated, and (2) the pressure-induced correction for the emf of thermocouple reaches nearly  $100^\circ\text{C}$ . In this case the phase relation shown in Figure 5 must be modified as shown in the curve for olivine solvus 5, and the estimated temperature at the 370-km depth reaches about  $1530^\circ\text{C}$ .

Thus the temperature at the depth of about 370 km would be limited in the range

$$1150^\circ\text{C} \leq T_{370 \text{ km}} \leq 1530^\circ\text{C}$$

as long as the model of Kanamori or Johnson is considered. The temperature distributions given by Rikitake [1952] and Verhoogen [1954] fall in this range of temperatures. Extrapolated value from Ringwood's [1966b] geotherm would exceed even the highest limit of the present estimation at the 370-km depth, and Gilvarry's [1957] distribution gives lower temperature values than are given by the present estimation at that depth.

The temperature at that point will be lowered (to  $800^\circ\text{C}$  at the 320-km depth, in the lowest case, with CIT 11CS3) if other recent models referred to in the former section are taken into account, since in all these models the rapid rise of velocity around the 350-km depth always begins at a shallower depth than in the model of Kanamori or Johnson.

The temperature distribution in the olivine-spinel transition region cannot be determined strictly, since the correlation between the observed thickness of the transition region and the width of the two-phase region in the olivine-spinel transition has not yet been established