

minimum were a cusp at the boundary of the field, but future work may indicate the need for modification of this feature of the diagram. The temperature and composition of this point are 1480°C and 71 weight per cent anorthite. At atmospheric pressure this point lies at 1274°C and 43 weight per cent anorthite.

The complex relations at high pressures found in the systems diopside-anorthite and anorthite-silica continue into the triangle of figure 7. The fields adjacent to the anorthite composition have not yet been fully delineated. There must be a field of sillimanite, one of corundum, probably one of " β alumina," and, near the piercing point, one of anorthite itself. Although pyroxene, anorthite, and quartz are the solid phases present at the piercing point, the relationship there is not ternary. There is a melting interval of about 30°C. This point contains about 10 weight per cent more anorthite than its counterpart at atmospheric pressure, and its temperature is raised about 125°C by 20 kb. This is somewhat less than the increase in the minima in the diopside-anorthite and anorthite-silica systems.

That pyroxenes grown in this system at 20 kb do not lie on the join diopside-lime Tschermak's molecule is shown by the failure of compositions, as determined by X rays, to bear the relations to each other demanded by principles of phase equilibria, and by the fact that different parameters of the unit cell have values that would correspond to different amounts of lime Tschermak's molecule in solid solution. Correction for enstatite in solid solution, determined from β , improves the internal consistency of the data, but the remaining discrepancies are probably large enough to be considered real. Presumably there is also magnesian Tschermak's molecule (or corundum) in solid solution in the pyroxene.

These results should dispel any doubts that pressure, even in the absence of volatile constituents, can profoundly affect phase diagrams. In part of the range of compositions, the system at 20

kb is not even qualitatively similar to the system at atmospheric pressure, and quantitative differences in melting behavior occur at all compositions. The most striking new features caused by pressure are the incongruent melting of anorthite, the appearance of sillimanite on the liquidus, the appearance of quartz on the liquidus above 1000°C, and extensive solid solution in the pyroxene. None of these effects occurs at atmospheric pressure, and none of them could have been inferred without high-pressure experimentation.

There is an interesting possible geological consequence of the shift in composition of the piercing point with pressure. If a small amount of liquid were formed by fractional fusion at 20 kb in this system, it would have the approximate composition diopside₂₂-lime Tschermak's molecule₄₂-quartz₃₆. If this liquid were then decompressed suddenly, perhaps by rapid upward intrusion, it would arrive in a superheated condition and the composition of the liquid would be well inside the anorthite field at low pressure. The liquid would crystallize large quantities of feldspar before other solid phases appeared, which suggests a mechanism for the origin of anorthosites. It is to be expected that in the system albite-diopside-silica the piercing point will behave in a similar way because of solid solution of jadeite in the pyroxene and the eventual disappearance of albite from the liquidus. An important unexplored question is the behavior of intermediate plagioclases; it is not yet known whether the mechanism outlined can produce feldspars of the compositions found in anorthosites.

The System $MgSiO_3$ - $CaMgSi_2O_6$

F. R. Boyd, Jr., and J. F. Schairer

Mineral assemblages containing two pyroxenes are of almost ubiquitous occurrence in mafic and ultramafic igneous rocks. The two pyroxenes are usually a calciferous pyroxene, augite or ferro-