American Mineralogist, Volume 83, pages 491–500, 1998

Melting experiments in the systems CaO-MgO-Al_2O_3-SiO_2 and MgO-SiO_2 at 3 to 15 GPa

CLAUDE HERZBERG[1,*] **AND JIANZHONG ZHANG**[2]

[1]Department of Geological Sciences, Rutgers University, New Brunswick, New Jersey 08903, U.S.A.
[2]Center for High Pressure Research and Mineral Physics Institute, The State University of New York, Stony Brook, New York 11794, U.S.A.

ABSTRACT

The results of multi-anvil melting experiments are reported for a range of compositions in the system CaO-MgO-Al_2O_3-SiO_2. The liquidus crystallization fields for forsterite, orthopyroxene, clinopyroxene, and garnet have been mapped out at 10 GPa, as have their intersections at various cotectics. The composition of the liquid that is multiply saturated in forsterite, orthopyroxene, clinopyroxene, and garnet has been also determined to within $\pm$0.5–1.0 wt% (2σ), and the result is in excellent agreement with a previous estimate (Herzberg 1992). These experiments confirm that the effect of pressure is to reduce Al_2O_3 and increase MgO and SiO_2 in magmas formed by the melting of garnet lherzolite with increasing pressure (Herzberg 1992). Melting experiments in the system MgO-SiO_2 also have been performed to constrain how pressure affects the compositions of liquids that are saturated in harzburgite [L + Ol + Opx]. Experiments in both CaO-MgO-Al_2O_3-SiO_2 and MgO-SiO_2 demonstrate that there is a maximum normative olivine content to liquids formed by initial or advanced melting of peridotite in the upper mantle, and this occurs at 7 to 8 GPa. For most peridotites that undergo decompression melting in a plume, clinopyroxene and garnet are the first crystalline phases to melt out and, with a few important but rare exceptions, the experimentally constrained liquids are unlike most volcanic rocks. Advanced anhydrous melting will yield liquids with a residual harzburgite mineralogy [L + Ol + Opx], and these liquids are similar in composition to most komatiites with Cretaceous and 2700 Myr Archaean ages.