E

Fluids in the mantle and metasomatism

E1

AN EXPERIMENTAL AND THEORETICAL ANALYSIS OF PARTIAL MELTING IN THE SYSTEM KAISi0₄-CaO-MgO-SiO₂-CO₂: A MODEL FOR ALKALIC MAG-MA, CARBONATITE AND KIMBERLITE GENESIS.

R.F. WENDLANDT

Lunar and Planetary Inst., 3303 Nasa 1, Houston, TX 77058

The introduction of dolomite as a solidus phase in carbonated peridotite compositions at 25-30 kb coincides with a rapid increase in CO, solubility over a small pressure interval (several kb) and a profound depression of the solidus temperature (200°C). Partial melt compositions through this interval change rapidly from a silicate melt (alkalic near the solidus) at low P to a carbonatitic melt where dolomite is introduced as a solidus phase and back to a silicate melt (haplokimberlitic) at still higher P. The details of these transitions are important to the genesis of alkalic magmas, carbonatites and kimberlites, but are obscured by the small P interval over which large changes in melt composition occur, by several solidus reactions and melt composition occur, by several solidus reactions and melt compositions), and by the inability to rapidly quench and/or analyze partial melts generated by small degrees of partial melting. To understand better how the compositions of partial melting. To understand better how the hincreasing P, a combined experimental and theoretical analysis of melting relations involving ForDi+En+Carbonate+ Potassic phase (+CO) in the system KAISi0_4-CaO-MgO-Si0_2-CO_2 has been undertaken to about 50 kb.

Partial melts in equilibrium with Fo+Di+En+Potassic phase+CO, show increasing CaO and MgO, at constant CaO/MgO=0.7 (wt), and decreasing K_O, Al_O, and SiO, with increasing P to about 25 kb; kalsilite=component is stabilized while the diopside stability volume is depressed. Immediately above 25 kb, the CaO/MgO of partial melts increases to a value greater than I when dolomite is introduced as a solidus phase and the enstatite stability volume expands. Partial melts are never more MgO-rich than the kalsilite-dolomite-enstatite-CO, join at pressures below about 30 kb. At P>30 kb, K_O contents are low (-4 wt%); in the absence of H_O kalsilite fs the stable and refractory potassic phase. An analysis of all possible reaction topologies generated by the intersection of melting reactions (both CO₂-saturated and CO₂-undersaturated) with the subsolidus reactions En-Mag=Fo+Y and 'Di-Mag=En-Dol yield consistent conclusions: MgO and SiO, contents of partial melts increase and CaO, CO₂ and CaO/MgO decrease with increasing P.

Polybaric melt composition trends at P<25 kb mimic tabulated composition trends of strongly potassic, silica-undersaturated occurrences: Results of experiments in CaO-absent systems cannot duplicate the latter trends. The polybaric melt composition trend at P>30 kb ranges between calcite-rich and forsterite-rich extremes and is similar in this respect to differentiation trends for kimberlites. Melting reactions at the highest pressures considered in this study, involving dolomite and/or magnesite and peridotite minerals, can produce melt chemistries analogous to kimberlite compositions as cited in the literature.

E2

FUSION CURVES AND THE THERMODYNAMICS OF LIQUIDS TO HIGH PRESSURES

ART BOETTCHER

Institute of Geophysics and Planetary Physics and the Department of Earth and Space Sciences, University of California, Los Angeles, California 90024

Our determinations of anhydrous fusion curves of silicate and aluminosilicate minerals to high pressures reveal that marked structural and thermodynamic changes occur in the aluminosolicate liquids as functions of changing pressure and temperature. These changes prevent calculation of fusion curves from calorimetrically determined thermodynamic data; alternatively, thermodynamic data can be obtained from the fusion curves. Comparison of the solidi of albite with those of albite + quartz, sanidine, sanidine + quartz, anorthite, and diopside suggest that phase transformations in the crystalline phases have analogues in the liquids. This provides some basis for predicting the high-pressure structures of near-solidus liquids.

We have reinvestigated the systems quartz- H_2O-CO_2 , albite- H_2O-CO_2 , albite- H_2O-CO_2 , albite- H_2O , and albite- CO_2 to high pressures. These results permit calculation of activity coefficients for H_2O in the H_2O-CO_2 fluids. The albite- CO_2 solidus is the first determination of the effect of CO_2 on melting in an anhydrous, hydrogen-free environment, permitting us to determine the relationship between solubility and structure of the liquid.

Knowlegde of the nature of deep-seated liquids will enable us to better understand phenomena such as magma genesis and the distribution of elements.

E3

OXYGEN FUGACITY AND THE FLUID C-H-0 PHASE IN THE EARTH'S MANTLE.

E. WOERMANN¹, M. ROSENHAUER², ¹Institut für Kristallographie, Rehinisch Westfälische Technische Hochschule

Institut für Geochemie, Universität Frankfurt am Main, Germany

From experimental work it is deduced that CO_2 reacts with mantle silicates above 26 kb to form carbonates. With pressures increasing still further dolomite or magnesite are buffering mixed fluid phases to continuously lower CO_2 -activities.(Wyllie, 1978; Eggler,1978). In a similar way H₂O reacts to form hydrous phases - e.g. brucite- above about 90 kb, buffering the fluid phase to lower H₂O activities with increasing pressure. As a consequence a binary CO_2 -H₂O phase will disappear as soon as a hydrous and a carbonate phase coexist with mantle silicates. (Ellis & Wyllie, 1979,1980)

The absence of carbonates from typical mantle