(1.) EXPERIMENTAL INVESTIGATION OF HYDROUS MELTING OF THE EARTH'S UPPER MANTLE, AND

(2.) OLIVINE ABUNDANCES AND COMPOSITIONS IN HAWAIIAN LAVAS.

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ABSTRACT

(1)

The presence of small amounts of water dissolved within nominally-anhydrous minerals in the earth has significant effects on the chemistry of melting in the mantle. Upwelling rock containing water will melt at greater depths than the same rock would if it were volatile-free, and the chemistry of these hydrous melts is expected to be quite different from that of anhydrous melts. We have developed new experimental techniques and applied them to melting under pressures where hydrous melting is of the greatest natural importance. We have also controlled the content of carbon, another volatile element, to produce melts from a range of compositions not previously sampled experimentally.

The liquid composition shows a number of interesting properties. Compared to anhydrous melts from the same pressure, it shows decreased modal olivine and increased silica content. Compared to carbon-containing experiments, it suggests that carbon interacts with water when both volatiles are present, and may act to oppose the effects of water. The presence of a hydrous liquid also has an important effect on the coexisting solid chemistry. High-aluminum clinopyroxenes are commonly observed at this pressure in anhydrous systems. However, in all of our volatile-containing experiments, the clinopyroxenes show a substantial decrease in aluminum content and an increase in calcium content. Many elements, including water, enter into the clinopyroxene structure by coupled substitution with aluminum, and thus reduced clinopyroxene aluminum content during natural melting will decrease the partitioning of these elements during melting.

(2)

Variations in the modal abundance of olivine are the main mineralogical differences amongst typical Hawaiian lavas. A large quantity of olivine must crystallize from the Hawaiian parental liquids prior to eruption to produce the erupted lavas. The chemistry and abundance of these olivines reflects the behavior of the magmatic system in a number of

ways. We have used the chemistry of these olivines and lavas to estimate the parental liquid compositions in Hawaiian volcanoes, to infer the relationship between the olivines and the lavas that host them, and to probe the evolution of Hawaiian volcanoes over time.

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