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KINETICS OF MINERAL CONDENSATION IN THE SOLAR NEBULA

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A natural extension of the type of gas-mineral-melt condensation experiments described elsewhere in this report (Mysen, Crystal-Liquid-Vapor. . .) is to study the gas-mineral-melt reaction process by controlling the reaction times of appropriate gas compositions with silicate materials. In a condensing and vaporizing gas-solid system, important processes that could influence the composition of and speciation in the gas phase are the kinetics of vaporization of components from silicate crystals and melts. The high vacuum attainable in the space station would provide a unique environment for studying these processes at gas pressures much lower than those obtainable in experimental devices operated at terrestrial conditions. Initial experiments would be carried out under static conditions in which the gas phase and mineral or melt would be allowed to come to exchange equilibrium. Further experiments would be carried out at variable gas flow rates to simulate disequilibrium vapor fractionation.

In this type of experiment it is desirable to analyze directly the species in the gas phase in equilibrium with the condensed silicate material. This analytical method would provide a direct determination of the species present in the gas phase. Currently, our notion of the gas speciation is based on calculations from thermodynamic data. These calculated equilibria have not been verified by experiment, and model

condensation sequences in the solar nebula make untested assumptions concerning the speciation in the gas phase at various pressures and temperatures. Mass spectroscopic determination of composition and partial pressure in the gas phase would provide this information.

The proposed experiments require similar furnace designs and use similar experimental starting compositions, pressures, and temperatures as those described by Mysen (Crystal-Liquid-Vapor, this report). The proposed experiments are essentially a natural extension of those proposed by Mysen.