

GEOCHEMISTRY OF CHONDRULES : FRACTIONATION PROCESSES IN THE EARLY SOLAR SYSTEM.

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ABSTRACT

Chemical and petrological data on individual chondrules from a variety of chondrites reveal a remarkable number of processes having been active upon meteoritic matter early in the history of the Solar System. The most important of which are: (1) Alkali fractionation took place during a highly reduced pre-chondritic stage leading to the separation of K from Na probably into different sulfides. (2) Vapor fractionation was active repeatedly during heating events. Depending on the intensity of the heat source either highly volatiles only (rare gases), or volatiles (alkalis and halogenides), or even moderately refractory elements (Si, Mg, Ni) were lost. Vapor fractionation accounts for the formation of Ca-Al-rich objects and for the formation of normal refractory chondrules. (3) An(Ir, Au)-(Ni, Co) fractionation took place probably at the same time. Since Ir, a highly refractory element, and Au, a moderately refractory element, have been enriched simultaneously, a separation of (Ir, Au) from (Ni, Co Fe) must have taken place which could have been achieved under highly reducing conditions by separation of (Ni, Fe, Co) silicides and similar compounds from the metal. (4) Melting of highly reduced pre-chondritic matter took place under oxidizing conditions. The prevailing pO₂ could have established the final Fe⁰-FeO distribution. During that event also chondrules formed from fractionated pre-chondritic matter with or without mixing of the lithologies. (5) Metal-silicate fractionation was very effective during this melting event and led to severe depletions of siderophile elements in chondrules and igneous lithic

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agments. (6) Metal formed separate bodies (maybe chondrules) and subsequently was partially redeposited onto chondrule and fragment surfaces (coatings and rims). (7) on cooling S-saturated gas partially reacted with the metal and formed sulfides. (8) Agglomeration of the constituents to form a chondritic rock took place at still lower temperature.

One of the processes identified could also be responsible for the fractionations observed between different chondrite classes and different planets.

INTRODUCTION

Chondrites are by far the most common meteorites among