An examination of fractionation on a planetary scale: examples from meteorites

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Carbonaceous chondrites are a type of meteorite that are thought to be the most primitive and undifferentiated material in our solar system, and therefore can provide a better understanding of the early history and evolution of our solar system. Geologists have extensively studied the carbonaceous chondrite Allende CV3 since its observed fall in 1969, providing a foundation of geochemical and petrologic data. Chondrites are defined by small spherical aggregates of minerals called chondrules. Many questions about the formation of chondrites and chondrules remain unanswered, and the genetic relationship between meteorites and other bodies such as planets are only speculated. Planets such as the moon are achondrites, formed by partial melting and are considered to be differentiated material. This research will attempt to show a relationship between chondrules in Allende CV3 meteorite to that of lunar samples and komatiite samples from Earth using distribution coefficients and phase distributions. Chondrules within Allende are treated as individual rocks, which can be grouped based on mineral constituents. Phase distribution maps are created using the electron microprobe and determine bulk composition of 8 different chondrules in Allende. The spectra of major elements in chondrules are overlapped to give a visual representation of phase distribution. Distribution coefficients or more simply the ratio of element concentration in a single mineral to the concentration of the element in the whole rock will be calculated using weight percent of specific elements in olivine, pyroxene and plagioclase in the meteorite, Lunar and Earth samples. Distribution coefficients for major, minor, and trace elements will show trends in fractionation providing an evolution of material from primitive chondrites to earth-like material. Chondrules from Allende will be analyzed and compared to known petrologic types on earth, to better understand chondrule formation and processes. A genetic relationship between chondrites and achondrites could be formed using distribution coefficients. Comparing the geochemistry of chondrules in Allende to that of known rock types on Earth and the moon could provide insight into the early history of our solar system and the formation of chondrules and chondrites.

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