COSMOCHEMISTRY AND GEOCHEMISTRY

Dr. Michael Drake directs a geochemistry research group whose major goal is the investigation of igneous rocks from various planets in an attempt to understand planetary evolution. The approach is to use igneous rocks (particularly basalts) as "remote sensing chemical probes" of the otherwise inaccessible interiors of planets. In favorable cases it is possible to calculate the average composition of the entire planet. This approach has been particularly successful when applied to meteoritic basalts, and has led to the suggestion that the third largest asteroid, Vesta, is the source of many of these meteorites.

Other ongoing areas of research include investigations of the early differentiation events in the history of the Moon, Mars and meteorites. The geochemistry group also carries out a program investigating the behavior of elements during crystallization and melting events, with a view to mathematically predicting the outcome of a given igneous process.

Dr. William Boynton recently established a research group concerned with understanding the various physical and chemical processes that may have occurred during the very early stages of the formation of the solar system. The work can be divided into three general areas. The first is concerned with studying the process of condensation of elements from the gaseous solar nebula to form solid grains. Work is about equally divided between theoretical calculations using thermodynamics and elemental abundance measurements using a new, high-precision neutron activation analysis technique.

The second area is concerned with identifying extinct radionuclides that may have been present at the time the solar system formed. Currently evidence for ^{247}Cm, which will provide insights into the time scale of nucleosynthesis, is being sought by searching for variations in the amount of its daughter, ^{235}U. In addition, the possibility that superheavy elements may have been synthesized is being examined by looking for rare-earth element fission fragments in iron meteorites.

The third area is concerned with the question of whether a supernova may have been involved in the formation of our solar system. Recent evidence from this laboratory and elsewhere suggests that certain inclusions found in meteorites may have been produced in other stars that predate the formation of the solar system.