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Award

2004 Leonard Medal for Michael J. Drake

Two hundred years ago, British chemist William Henry argued that the behavior of an element at high dilution varies in proportion to its concentration. Henry's Law, as it came to be known, offers a fair approximation for the partitioning of trace elements but, in many geochemical systems, element behavior depends on other factors such as temperature, pressure, bonding, and so forth. Experimentally determined partitioning of trace elements provides the means of understanding these factors, but carrying out such difficult experiments would strain the technical ability and wither the resolve of most of us. Mike Drake has spent his career measuring how trace elements behave in crystallizing magmas, in minerals located deep within planetary interiors, and in solids and liquids under various cosmochemical conditions.

Like Henry, Mike Drake grew up in England. As a graduate student with Dan Weill at the University of Oregon, Mike began his studies of trace element partitioning by developing an electron probe technique for rare earth element (REE) analysis. At the time, there were no ion probes, so this constituted a major advance over the REE analyses of bulk rocks or mineral separates that were then possible. Mike focused especially on REE partitioning in plagioclase, which has proved so important in understanding the formation of the feldspathic lunar crust. After a postdoc year with John Wood studying lunar petrology, Mike migrated to the University of Arizona, where he has remained. REE analyses were central to Mike and Guy Consolmagno's classic paper on the composition and identity of the HED meteorite parent body. He also determined REE partitioning among the minerals of refractory inclusions, as well as quantifying the preferences of other lithophile trace elements (Sr, Ba, Y, Rb, Cs, Ni) among minerals crystallizing from magmas under various conditions.

Mike and his students have also measured the solubilities of noble gases (Ne, Ar, Kr, Xe) in magmas, to understand how their abundances constrain outgassing and the various planetary reservoirs for volatile elements.

But Mike's best known studies focus on the partitioning of elements with affinities for metal or sulfide phases (Ga, Ge, P, V, Cr, Ru, Rh, Pd, Ag, Mo, Sn, Co, W). Some of his experiments are carried out at very high pressures to simulate fractionation during core formation. These very difficult experiments provide critical data for assessing the accretion and differentiation histories of the Earth, the Moon, the terrestrial planets, and their meteorite building blocks.

Mike's careful experiments have had a profound effect because he has used the results with great insight to understand the geochemical processes that happen as planets evolve. He is a master at synthesizing diverse constraints and constructing a coherent picture of events of huge scale. Some examples are his models for lunar basalt petrogenesis, magma ocean crystallization on the Earth, Mars, and Vesta, and the impact origin of the Moon. Without this body of published work, our understanding of the formation, differentiation, solidification, and outgassing of planetesimals and planets would be limited, indeed.

In recognition of his significant contributions to planetary geochemistry, Michael J. Drake has been selected as the recipient of this year's Leonard Medal.

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