

Norman Levi Bowen and Igneous Rock Diversity

YOUNG, D.A. Department of Geology, Geography, and Environmental Studies, Calvin College, Grand Rapids, Michigan, USA.

By the beginning of the twentieth century, differentiation had emerged as the leading theory to explain the chemical and mineralogical diversity of igneous rocks. Soret diffusion, liquid immiscibility, compositional stratification of magma by gravity (Gouy-Chaparon effect), volatile transport, crystal settling, and other processes had been advocated as mechanisms of differentiation, but no consensus was achieved regarding a dominant mechanism.

During a career spent primarily at the Geophysical Laboratory, Norman Levi Bowen (1887-1956) initiated a new approach to petrology. On the basis of precise experimental studies of rock-forming silicates and sound physico-chemical principles, Bowen argued against the importance of the Soret diffusion, liquid immiscibility, volatile transport, and assimilation as major causes of diversity. He formulated a comprehensive theory of differentiation that emphasized the role of separation of crystals from liquid. He reasoned persuasively that rocks of the subalkaline igneous rock series, including granite, had been derived from parental basalt by crystal settling, filter pressing, or armoring of crystals.

Apart from its scientific merits, Bowen's achievement rested on personal, institutional, and technological factors that included his determination to dedicate virtually his entire career to solution of the problem of igneous rock diversity; his affiliation with the Geophysical Laboratory; and the prior development of the quenching method and the calibration of the temperature scale to very high temperatures.