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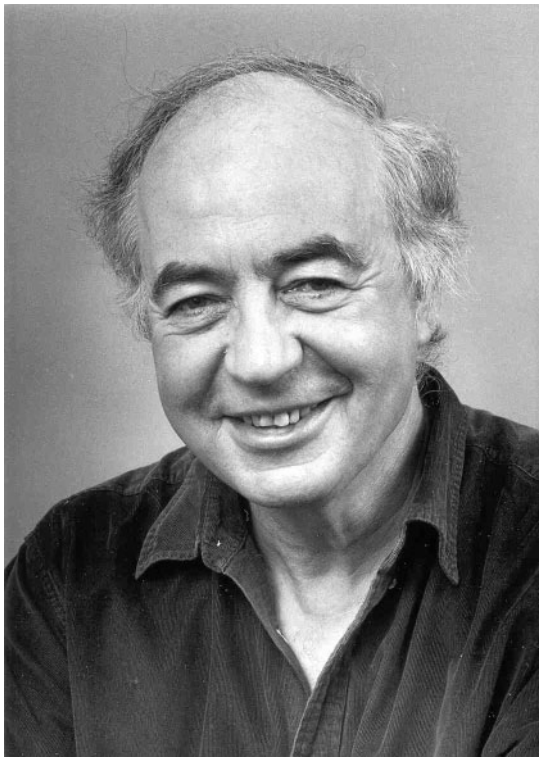
Foreword
Magma generation and evolution in the Earth



A VOLUME IN HONOUR OF THE WORK OF MICHAEL J. O'HARA, ON THE OCCASION OF HIS 70TH BIRTHDAY

The 20th century was eventful in all areas of Earth Science. Continental drift and sea-floor spreading became embodied in the theory of plate tectonics, isotopically heterogeneous mantle was recognized as a by-product of plate tectonics, large igneous provinces were identified as possibly originating from mantle plumes - the list goes on. One thing these revolutions have in common is the process of scientific debate - which Mike O'Hara has stimulated vigorously in the field of the petrology and geochemistry of igneous and metamorphic rocks on the Earth and its Moon in over 150 scientific publications since 1960. Part of this body of work is now acknowledged as fundamental truth, whilst some aspects remain controversial [e.g., O'Hara (2000), *Flood Basalts, Basalt Floods or Topless Bushvelds? Lunar Petrogenesis Revisited*, Journal of Petrology 41, 1545-1651].

Mike's discoveries in igneous petrology and geochemistry have fundamentally altered the way geoscientists study igneous rocks. In his famous 1968 paper "*Are ocean floor basalts primary magmas?*" [O'Hara (1968) *Nature* **220**, 683–686], he demonstrated for the first time that erupted basalts from the mid-ocean ridges cannot be primary magmas from the mantle, a minority point of view at the time. This conclusion is now universally accepted as true and this classic paper still continues to be cited. In another paper that same year "*The bearing of phase equilibria studies in synthetic and natural systems on the origin of basic and ultrabasic rocks*" [O'Hara (1968) *Earth Science Reviews* **4**, 69–133], Mike showed how liquidus crystallization phase diagrams can be used as a tool to distinguish the products of partial melting from the products of partial crystallization in igneous petrogenesis. He invented the CMAS projection technique for analysis and description of crystallization and melting paths, and for the representation of the geochemistry of basaltic rocks. This projection method has been used ever since in various modified forms. He showed that crystallization of magmas in nature follows phase equilibrium systematics that can be approximated by phase diagrams in simple 4-component systems; this also holds, to a lesser extent, for partial melting. In this way, O'Hara became peerlessly the principal successor to N.L. Bowen, and was recognized for this achievement with the Bowen Award of the American Geophysical Union in 1984.

One of the major tasks in volcanology-petrology-geochemistry is to distinguish between the effects of partial melting and partial crystallization in the geochemistry of erupted magmas. Although Mike first recognized it 35 years ago and despite recent advances in computational procedures for simulating crystallization and melting, this problem persists. Indeed, it is so complex that petrologists continue to debate interpretations about the P-T conditions of mantle melting based on basalt chemistry which, quite often, reflects the effects of fractional crystallization and mantle source compositional variability!

From 1977 onwards, Mike continued to investigate the processes of partial melting and partial crystallization of magmas through theoretical modelling of mineral-melt trace element partitioning. This body of work forms a sequel to the seminal papers of Gast and Shaw. He explored the consequences of magma mixing, crustal contamination and fractional crystallization in

open system, high-level magma chambers, as well as magma generation processes that involve melt integration over 3-dimensional regions within the mantle. In more recent years, Mike has also worked on global geodynamic problems such as subduction initiation and the origin of mantle plumes.

On February 22nd, 2003 Mike O'Hara celebrated his 70th birthday; that year also marked the 35th anniversary of two of his classic 1968 papers cited above. The first joint assembly of the European Geophysical Society (EGS), the American Geophysical Union (AGU) and the European Union of Geosciences (EUG) in Nice, France, in April 2003 provided a unique opportunity to celebrate both his scientific contributions to the field of igneous petrology and his 70th birthday. A dedicated symposium, at which he was *Guest of Honour*, brought together scientists from all parts of the world to discuss their new research on magma petrogenesis in the Earth and the terrestrial planets.

The papers published in this volume of *Journal of Petrology* represent a collection of topical studies by a range of authors, many of whom gave oral presentations in Nice. All of the authors have been influenced in some way by Mike's work; a number of them were his former students; all have been touched in different ways by his generosity in sharing his scientific ideas freely with the community.

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