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Editorial

Readers may have noticed that the February publication date of this first issue of volume 60 is one month earlier than usual. The reason for this is that the *Mineralogical Magazine* is moving from quarterly publication to six issues per year, bringing it into line with the major learned society mineralogical journals published in north America and the continent of Europe. The numbers of papers recommended for publication by our panel of referees is such that the publication delays have long been a matter of concern to the editors. We hope that the extra two issues each year will speed the publication of many suitable papers.

The *Mineralogical Magazine* also publishes from time to time groups of papers presented at the Society's scientific meetings, thereby reflecting the active programme of activities in the Society and its specialist groups. This first issue of 1996 includes papers given at the 1995 Winter Conference on magmatic processes and the associated Hallimond Lecture.

These extra issues are being published without an immediate increase in subscription rate to Society members or subscribers and represents very good value for money.

A. M. CLARK

Magmatic processes: do the answers lie in the rocks?

Introduction

WHEN Council of the Mineralogical Society decided that the 1994/95 Winter meeting should be held in Sheffield with the theme of Magmatic Processes it was appreciated that, as so often in recent years, there was likely to be a clash with the Geological Society's Volcanic Studies Group's main annual 'Research in Progress' meeting. However, during the 1993/94 Winter Conference in Glasgow discussions between the organisers of the Sheffield meeting and representatives of V.S.G. presented an opportunity for this to be avoided by holding a 3-day combined meeting of the Mineralogical Society and the Volcanic Studies Group in Sheffield from the 4th–6th January 1995.

The format adopted was two days of thematic sessions, during which the Hallimond Lecture, seven invited talks and fifteen offered talks were presented, followed by one day in which seventeen oral presentations were given on 'research in progress'. Concurrent with these was a 3-day session in which 36 posters and two other exhibits were displayed. The experiment in combining the meetings proved highly successful, attracting a record attendance of over 170 (including delegates from South Africa, Canada, U.S.A. and six European countries) and setting a precedent which is to be repeated in Bristol in 1996.

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Thirteen papers arising from material presented at the Sheffield meeting were accepted for publication in the *Mineralogical Magazine*. These are collected into the thematic set which follows this introduction.

The highlight of the meeting and first in the set is the 1994 Hallimond Lecture on *Solidification fronts and magmatic evolution* by Professor **Bruce D. Marsh** of The Johns Hopkins University. The fundamental importance of solidification fronts and the pre-intrusive/extrusive phenocryst contents of magmas is demonstrated through their effects on a wide range of igneous processes from differentiation and layering to the evolution of granophyric and pegmatitic segregations from basaltic magmas. Many of the concepts discussed are illustrated by schematic diagrams of exceptional clarity. Possible natural examples of the magmatic processes are presented ranging from large basic sills in Antarctica through Hawaiian lavas to mid-ocean ridge systems. The enthusiasm and charisma with which this '*tour de force*' was presented as a lecture comes over even in the printed version.

Two papers on the Honningsvåg Intrusive Suite of Northern Norway by **Tegner *et al.*** and by **Tegner and Robins** follow the Hallimond Lecture. The first of these describes wedge-shaped layers of mafic and ultramafic cumulates in which the mineral chemistry varies systematically both vertically and laterally. The geometrical relationships are such that it is clear that cumulates of different compositions must have been crystallizing simultaneously in different parts of the same magma chamber and a petrogenetic model is presented based on the evolution of a zoned magma chamber in which there were numerous thin double-diffusive convective layers. The second paper describes ultramafic sheets intruded into the upper part of the cumulate sequence in the same layered intrusion and presents evidence that the mineral assemblages in these resulted from reactions between the original cumulus minerals and infiltrating picritic magmas.

The paper on the Shiant Isles main sill by **Gibb and Henderson** presents details of the internal structure and mineralogy of what has hitherto been regarded as a strongly differentiated sill. It is shown that the large-scale 'differentiation' is due mainly to multiple intrusion and physical processes operating during and/or after emplacement, while extreme local/small-scale differentiation occurred through almost perfect *in-situ* fractional crystallization.

Tait and Jaupart review the physical principles of crystallization stressing the importance of the thermal structure of crystallizing magmatic boundary layers. The reasons for the existence of mush layers in magma chambers are discussed and how the amounts and compositions of interstitial liquids vary within them. These are considered likely to lead to the onset of compositional convection and the production of both chemically stratified and adcumulate rocks. The theme of compositional convection is continued in the next paper by **Seedhouse and Donaldson** which reports the results of a series of isothermal experiments in which olivine crystals are grown from a synthetic basaltic melt in which Fe is replaced by Co to minimise redox problems. Analysis of the products provides evidence for the occurrence of compositional convection in the melt surrounding the growing crystals.

There then follow two papers on the Bushveld Complex. In the first of these **Cawthorn** presents evidence that the Merensky Reef formed from a more evolved magma than the 100 m of layered Critical Zone rocks immediately below it. He also shows that key chemical parameters such as the enstatite content of orthopyroxene and whole-rock Mg/(Mg+Fe) ratio are dependent primarily on rock type (mafic rocks having higher values than anorthosites) and argues that the observed variations within the uppermost Critical Zone are attributable to reactions with trapped liquid rather than fractionation and/or infiltration metasomatism. In the second paper **Mitchell** focuses on a pyroxenitic layer from the Main Zone within which there are five cycles of upward enrichment in Mg and Cr in pyroxenes and Ca in plagioclase. He ascribes these cryptic variations to repeated influxes of magma.

The paper by **Bryon *et al.*** reports on porosity occlusion in a granodiorite from the Peruvian Coastal Batholith. Alkali feldspar in small interstitial 'pockets' is interpreted as nucleation and growth of new crystals in pores which had become isolated during the last stages of crystallization and involving the last 3–4% of liquid.

Hole and Saunders use the major and trace element geochemistry and isotope systematics of small-volume alkali basalts erupted following ridge-crest trench collisions to argue that these arose as a result of asthenospheric upwelling through 'windows' in the subducted slab. The conditions under which these small melt fractions were produced and the implications of them as precursors to the generation of MOR tholeiites are discussed. **Edwards and Malpas** describe core from the crust–mantle transition zone of part of the East Pacific Rise. The relationships between harzburgite, dunite and associated gabbros are examined and it is concluded that refractory harzburgite has reacted with basaltic melts to produce gabbroic rocks by way of intermediate dunites.

Metasomatic redistribution of *REE* in syenites and their host rocks (granite gneiss and quartzite) from S. Greenland is described by **Rae *et al.*** The effects are seen most conspicuously in apatites where the episodic metasomatism has produced complex

zoning patterns – in some cases by modification of pre-existing apatite and in others by promoting new crystal growth. The final paper in the set, by **Canning *et al.***, examines the Caledonian minettes of northern Britain and reveals that those from NW of the Great Glen Fault have a distinctive trace element chemistry. This is attributed to compositional differences in the mantle sources of the minettes, the clear implication being that the sub-continental lithospheric mantle is different on either side of the Great Glen Fault.

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