

PART 1

PHASE EQUILIBRIA
IN BASALTIC SYSTEMS

A TRIBUTE TO
PETER L. ROEDER

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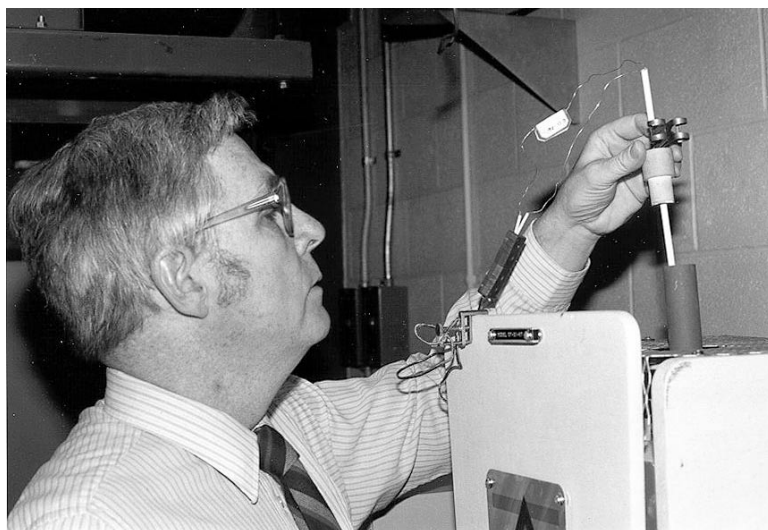
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Part 2

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PREFACE

In the early 1950's, during the Korean conflict, Peter Roeder was drafted into the US Army and stationed in San Francisco, where a local gentlemen's club allowed young soldiers to use its library. Peter, who had recently graduated from Tufts University with a B.Sc. in Geology, took advantage of this offer and it was there that he discovered Bowen's "The Evolution of the Igneous Rocks." Entranced by the rigor of Bowen's approach to fractional crystallization, he decided then and there to pursue graduate studies in experimental petrology at Pennsylvania State University. Professors O.F. Tuttle and E.F. Osborn at Pennsylvania State University had both worked with Bowen at the Geophysical Laboratory and Peter started experimental work on phase equilibrium in relatively simple systems under the supervision of E.F. Osborn.



DR. PETER L. ROEDER at work in his lab.

Before entering a career in science, Peter had briefly fancied a future as a professional bait-caster, and fishing has remained a lifelong hobby. His father, Kenneth D. Roeder, who was a world-famous biologist at Tufts, was a particularly influential role model, leading Peter to consider science as a career. Later, Bowen's book led him to experimental petrology, which has occupied the centre of his professional life. Several of his contributions to this field have changed the way we approach the subject. Igneous petrology has benefited enormously from this young soldier's recreational reading!

After graduating from Penn State in 1960, Peter held a postdoctoral fellowship at the New Mexico Institute of Technology, before joining the faculty at Queen's University in Kingston (Bowen's alma mater). Here he was able to satisfy his long-held ambition to experimentally investigate natural mafic rocks. His first Ph.D. student, Robin Hill, joined him in this pursuit. So as not to impinge on Robin's thesis, Peter began to consider the distribution pattern of Mg and Fe between olivine and basaltic liquids. Critical to the development of this research was the acquisition by Queen's of the first electron microprobe in a geology department in Canada, enabling Peter to analyze glass compositions as well as olivine and so quantify the well-known K_D equation. In the years that followed, Peter's scientific contributions (discussed below) developed rapidly, as did the esteem and affection in which he was held by his students and colleagues. He received a Golden Apple teaching award from the Queen's Engineering Society in 1982, and the Past President's Medal for Research Excellence from the Mineralogical Association of Canada in 1987. He was Vice-President of the MAC from 1990-92 and President from 1992-94.

Peter became a Professor Emeritus in 1996, but has continued active research and has several publications in progress. His colleagues at Queen's continue to benefit from the warmth, wisdom and good humour of his company. Peter's family has always been central to his life, and now he and his wife Claire have even more time to spend with their three adult children, David, Kathy and Tina, and four energetic grandchildren.

The contributions in this volume reflect the many areas in igneous petrology advanced by Peter Roeder's work over his career. These include phase equilibria in simple systems, crystal-liquid equilibria, activity-composition relations of melts, sulfur solubility, crystal buoyancy, magma redox and the use of chromian spinel as a petrogenetic indicator. Peter's seminal work published in 1970 with Ron Emslie on olivine-liquid equilibria [1] was a culmination of his previous work in simpler iron-bearing systems. It is probably the most oft-quoted paper in igneous petrology even 30 years after its publication (cited 220 times in the last five years). The K_D approach, laid out in that paper as a simple and elegant expression of the Fo-Fa melting loop in complex systems, provided a powerful tool to evaluate the origin and evolution of terrestrial and extraterrestrial basaltic magmas. This work led the way for the calibration and utilization of many other crystal-liquid K_D 's to unravel the compositional evolution of magmas in a quantitative and predictive way. Natural rock suites studied in this issue (Thorner, Morse, Russell and Hauksdóttir) echo the utility of olivine-liquid equilibrium to characterize the liquid line of descent and crystallization history of mafic magmas.

The geometric analysis of partial fusion in simple ternary systems was the starting point for understanding melt formation and crystallization in both the mantle and crust. Peter incorporated ternary solid solution into the approach [2]. A wonderful teaching tool in its own right, this work also relates to that presented by Yi-Hua Weng and Presnall in this issue on the phase equilibria in the system diopside-forsterite-enstatite, to provide a basis for the changing solidus relations with pressure observed for the complex natural system.

Peter's studies in the early 1960's under the tutelage of E.F. Osborn highlighted the profound role of fO_2 in the crystallization paths in simple iron-bearing systems, and the need to better understand and quantify this intensive variable in natural systems [3]. Quantitative oxygen barometry of magmas was soon to be born, and two new approaches to estimate fO_2 in both fresh and altered basaltic rock suites are presented here (Poustovetov and Roeder, Canil and Fedortchouk). Studies in the early 1970's by Roeder and coworkers on the importance of fO_2 and its relationship to iron redox equilibria in melts provided a simple, clear and quantitative understanding of the variables controlling olivine, chromite and sulfide saturation in mafic magmas [4-6]. This work established a more quantitative basis with which to understand the formation of layered intrusions and magmatic ore deposits. Papers in this issue by Paris and coworkers, and Brenan and Andrews touch on this facet of Peter's work.

As of this writing, Peter continues to study his favourite mineral chromite in nature and experiment. His many investigations into the world of this minute phase in mafic and ultramafic rocks opened our eyes once more to the utility of early crystallizing phases to a quantitative understanding of the crystallization history of magmas [7-14]. There is still much to be learned from the secrets locked in chromite, as shown in this issue by papers by Schulze, Pritchard and coworkers, and Roeder and coworkers. On this note, when told of the special session and issue in his honour, Peter expressed to us how he thought nobody would notice his retirement, such that he could "fade away into oblivion, still happy to analyze yet one more chromite grain". We hope he continues to analyze many more chromites, look forward to what he will tell us about them, and acknowledge with gratitude the many wonderful things he has already revealed to us about igneous rocks.

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