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Introduction to the Michael J. Holdaway commemorative issue

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This special issue of the *American Mineralogist* is dedicated to Michael J. Holdaway in honor of his nearly 40 years of contributions to the geosciences community. Metamorphic petrology has grown from a discipline based on field observation and interpretation to a quantitative discipline where experimental determinations on mineral stabilities provide a framework for quantitative petrogenetic grids and derivative tectonic interpretations, and theoretical activity modeling of detailed crystal chemistry establishes the link back to the real rocks.

Michael J. Holdaway has made fundamental contributions to each of these areas over his academic career. Mike was born down under in Canberra, Australia. He moved to the U.S. where he later undertook his university education. After receiving a bachelor's degree from Yale in 1958, he moved to the University of California at Berkeley. There he studied with Francis Turner, as an NSF fellow, and received his Ph.D. four years later. He was trained in the classical traditions of metamorphic petrology; with a solid background in thermodynamics, a penchant for careful observation of field relations and a facility for detailed analysis of mineral chemistry, all of which he continued to apply throughout his career.

His Ph.D. studies, focused on mafic metamorphic rocks in the Klamath Mountains of California, lead to one of his first publications in 1965, in the *American Mineralogist*. In this paper he established his meticulous nature by reporting carefully measured modes and optical properties of the minerals. To obtain chemical compositions on amphiboles, he methodically crushed the rocks and separated the amphiboles using the isodynamic separator and heavy liquids. These early studies foreshadowed the detailed and careful methods that would characterize his career and would be the cornerstone for his groundbreaking studies on the H contents of staurolite nearly 20 years later.

Upon finishing his Ph.D., Mike accepted a position at Southern Methodist University in Dallas, Texas, where he has spent nearly 40 years in academia. During that time, he began pioneering work in experimental petrology, an interest initially sparked by Bill Fyfe at Berkeley. Painstaking, slow, and tedious hydrothermal experiments were undertaken that still remain fundamental to our understanding of the stabilities of many metamorphic minerals. His first experimental paper, published in 1966, was on the stability of clinozoisite plus quartz. Five years later he completed one of the most carefully crafted experimental studies on a group of recalcitrant minerals: the Al-silicates. Developing techniques to measure small changes in andalusite weight gain and loss, he determined the position of the andalusite-sillimanite phase boundary and constructed the Al-silicate phase diagram that remains widely used today. Published in 1971, this landmark paper has been cited over 1100 times, indicating the clarity and durability of his timeless studies. He went on to other mineral systems and published papers on experimentally determined *P-T* stabilities for pyrophyllite, Fe-Mg-Al silicates, cordierite, and staurolite.

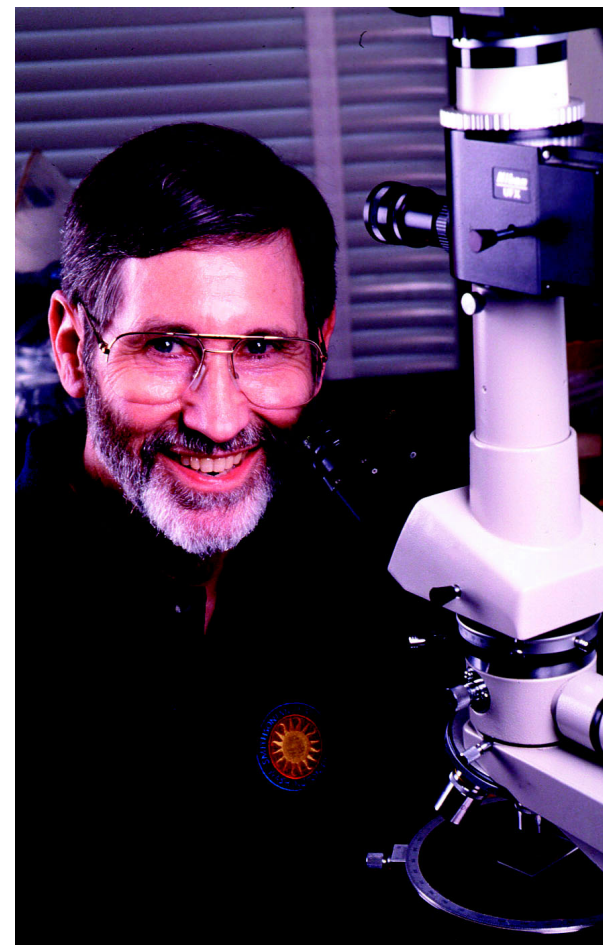

Photo courtesy of Sorena Sorensen and The Smithsonian Institution.

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This expert experimental work has been guided by, and intimately associated with, detailed field observations. Perhaps feeling the need to escape the Dallas summers, Mike's field areas have included the Picuris Range of New Mexico and the cooler climates of western Maine. His studies of rocks from Maine, together with C.V. Guidotti, elucidated the polymetamorphic nature of the Acadian orogeny in New England.

He appreciated the influence of variable mineral chemistry on phase relationships and the importance of activity models in accurately determining *P-T* conditions of metamorphism. His field studies served as a basis for detailed mineral chemical and theoretical analyses of minerals to more accurately quantify pressures and temperatures of metamorphic terranes. Recently, his work has been closely allied to the theoretical formulation of geothermobarometers.

He was also one of the first to demonstrate quantitatively the importance of light-elements in affecting mineral stabilities, after the widespread use of the electron microprobe effectively eliminated these elements from consideration in many mineral-chemical investigations. These studies led to the discovery that the metamorphic index mineral staurolite represents a major reservoir for Li in the middle crust. In addition, he and his students demonstrated that staurolite, once assumed to have a constant amount of H, in fact did not. This finding employed the painstaking techniques of mineral separation and manometric measurements of water content. Mike demonstrated that this variability in H content must be taken into account when deriving thermodynamic properties, thus providing a partial resolution to the staurolite enigma.

In addition to his distinguished research career, Mike promoted and nurtured the field of metamorphic petrology through the training of undergraduate and graduate students. He was generous with his time and facilities; opening his experimental lab to colleagues and, in some cases, doing the experiments for them and asking only for a simple thank you.

He also gave his time for active participation in, and advancement of, the profession. Most notably, he served as Vice-President, President (1992) and Past President of the Mineralogical Society of America. Twenty years after publishing his first paper in the *American Mineralogist*, he served as the sole Editor of the journal from 1980 to 1985. At that time, there was a single editor and one could walk by his office and admire the meter-high pile of neatly stacked manuscripts.

Even today, he inspires. At the Smithsonian Institution, a video of Mike revisiting his aluminosilicate experiments is shown hundreds of times per day, everyday, except for Christmas. It is viewed by millions of visitors. As Sorena Sorensen notes, "He tells people about the essential role experimental petrology plays in understanding how the Earth works, in what is arguably the largest outreach program of any petrologist in the world."

Clearly M.J. Holdaway is a leader in metamorphic petrology, linking experimental petrology to field occurrences and to the complex mineral chemistry of rocks. To celebrate the career of Mike on the occasion of his retirement, we are pleased to publish this collection of papers. As one of Mike's former students, it was a pleasure to convene the special Holdaway session at the 2000 GSA annual meeting and to serve as a Guest Associate Editor for this special issue of the *American Mineralogist*. I thank Darby Dyar for co-chairing the GSA symposium with me, Darrell Henry for serving as an additional Guest Associate Editor, Editor Bob Dymek, and Managing Editor Rachel Russell for their assistance and the authors for contributing quality papers to the theme session and to this volume.