THE HAWLEY MEDAL FOR 2001 TO ADRIENNE C.L. LAROCQUE, JAMES A. STIMAC, JEFFREY D. KEITH AND MICHELLE A.E. HUMINICKI

The Hawley Medal is awarded for the best paper to appear in *The Canadian Mineralogist* in 2000. The selection this year was, as usual, especially difficult because there were a large number of excellent papers. The Hawley committee, consisting of Penny King, Maya Kopylova and Tony Peterson, had a difficult time selecting among a short list of eight papers. After several e-mail discussions, they reached a consensus. The best paper this year is entitled "Evidence for open-system behavior in immiscible Fe–S–O liquids in silicate magmas: implications for contributions of metals and sulfur to ore-forming fluids", published in *The Canadian Mineralogist*, volume 38, pages 1233-1249 (2000). The authors are Adrienne C.L. Larocque, James A. Stimac, Jeffrey D. Keith and Michelle A.E. Huminicki. Two of the authors are in the Philippines, and could not make the journey to St. John's for this ceremony. Jeff Keith and Michelle Huminicki were present to accept the awards.

The paper is based on extensive study of sulfide inclusions from a variety of volcanic rocks from several localities. The rock types range from rhyolite to basalts, and the localities include active, dormant, and extinct volcanoes, as well as rocks from porphyry copper districts. Samples were examined with an SEM, and phases in the rocks were analyzed with the electron microprobe. Concentrations of Au in sulfide and Fe-oxide were established with an ion microprobe.

The paper is extremely well illustrated, meticulously organized, and clearly written. The authors based their interpretations on close observations of textures and a thermodynamic approach. This led to a clear exposition of the criteria that can be used to determine the origin of sulfides in volcanic rocks. This paper also has implications for ore formation and exploration.

Fellow mineralogists, it gives me great pleasure to introduce Jeffrey Keith and Michelle Huminicki, co-authors of the Hawley Medal winning paper for 2000.

Brian Fryer, President

Mr. President, Fellow Members of the Mineralogical Association of Canada, and Guests,

In addition to being my research colleague and co-recipient of the Hawley Medal, Jim Stimac is also my husband. Shortly before our son was born in 1998, Jim's company posted him to work in the Philippines. Since his birth, Cameron and I have commuted regularly between Winnipeg and Metro Manila. It has been difficult and draining, and many times I have wondered whether or not it is worth it. Being awarded the distinguished Hawley Medal is an incredible honor, and I mean that in the sense that I still cannot quite believe it, but it also represents an affirmation of some of the choices that I have asked my family to make, and for that I am *deeply* grateful. I have always thought that Jim deserves a medal for his unflinching support of my professional goals and aspirations, and now he has one!

When I recall the papers that have previously been awarded the Hawley Medal, I am humbled that our paper about funny little globules in volcanic rocks is to join their ranks. I came rather late to the study of these oxide–sulfide globules: Jim Stimac and Jeff Keith noticed them as early as the late 1980s. Jeff observed ragged remnants of magmatic sulfides in rocks from Bingham and Tintic districts in Utah, and interpreted them as products of oxidation, and later, degassing. More difficult to interpret are Fe-oxide globules in volcanic rocks from Clear Lake, California; Jim attributed their formation to immiscibility of an Fe-oxide liquid. When he started looking for them in other suites of rocks, Jim discovered that oxide and oxide–sulfide globules are anything but rare. When I undertook to characterize the globules, I was amazed at the wide variety of textures and compositions that they display. However, all of this variation appears to be controlled by a few fundamental processes – immiscibility, degassing, and oxidation – and their timing relative to crystallization of the host magma.

While the subjects of our study are perhaps humble, their economic and environmental implications are important. Magmatic sulfides play a critical role in storing and releasing metals and sulfur to a magmatic volatile phase. It is not a new idea, but we now have excellent evidence that the process occurs. The volatile phase may be entrained into a magmatic-hydrothermal ore-forming fluid, giving rise to porphyry-type and related mineralization. Alternatively, metals and sulfur may be emitted to the atmosphere through volcanic degassing. The destabilization of magmatic sulfides may explain, in part, the problem of excess sulfur degassing from volcanoes.

I was working on separate collaborative projects with Jim and Jeff when I became obsessed with the idea of writing this paper. My colleagues were very patient in allowing me to be sidetracked, and were always forthcoming with information, discussions, and samples. Michelle Huminicki worked for me as a summer student, and she was fearless in finding, documenting, and analyzing globules in samples from many locations worldwide. My intention in writing the paper was twofold: (i) to encourage others to look for and document similar features in their rocks, and (ii) to inspire someone to do the necessary experiments to really understand the processes. I see our paper as the beginning, rather than the end, of a quest.

We are fortunate in Geological Sciences at the University of Manitoba to have a superior crew of support staff to assist us. In particular, I appreciate electron-microprobe technician Ron Chapman for always being willing to find a way to analyze phases that are too small or too "frothy" or non-stoichiometric. SEM technician Sergio Mejia has always gone above and beyond the call of duty in enthusiastically and capably helping me to obtain exactly the type of data that I need. I am grateful to my Department for supporting my decision to spend large amounts of time in the Philippines so that I could balance family and professional obligations. Similarly, I am grateful to NSERC for continuing to fund me in spite of my vagabond lifestyle. I could not begin to make the commute work without the assistance and tolerance of many people, but in particular, I wish to thank my mother, Judith Larocque, for looking after Cameron when I was in Winnipeg and looking after my house when I was not.

It has been said many times before, but at the risk of being redundant, I wish to thank Bob Martin for the outstanding job that he does as editor of *The Canadian Mineralogist*. The excellent quality and high degree of relevance of the papers that appear in the journal are a testament to his hard work, his broad geological knowledge, and his commitment to the mineralogical sciences and the MAC. I am grateful to the reviewers of our paper, especially the anonymous one, for making me work so hard to revise the manuscript. And finally, I wish to express my deep appreciation to the Hawley Medal Committee for their recognition of our work.

Adrienne Larocque

Mr. President, Ladies and Gentlement,

Along with my coauthors, I am very happy to receive this honor. I think we are all surprised and humbled to be given this award. Iron-oxide globules first caught my eye while I was studying metal partitioning in immiscible sulfide globules in young volcanic rocks in the early 1990s. Some of this work was reported at a conference on giant ore deposits at Queen's University in 1995. I'm proud that, although that investigation involved recent analytical innovations, the basic observations and ideas all came from detailed petrography. I firmly believe that there is still an important place for basic, descriptive work in science, and I encourage young scientists to hone their skills in fundamental methods before moving on to the latest rage in analytica.

The paper describes research that was a team effort spanning nearly a decade. Each of us brought different perspectives and skills to the work that ultimately led to a more integrated understanding. Adrienne picked up work started by Jeff and me and extended it to new rock suites. She kept our interest up, as we drifted to other endeavors, and carried things further than we could have on our own. We eagerly await experimental evidence that will further our understanding of the sulfide – oxide – silicate system under open-system conditions.

I especially cherish this award because I share it with my best friend and partner.

Jim Stimac

ADRIENNE C.L. LAROCQUE AND JAMES A. STIMAC

Mr. President, Ladies and Gentlement,

I wholeheartedly concur with Adrienne's and Jim's sentiments of gratitude and surprise at being awarded this honor; I also am deeply appreciative and honored by this award. Let me just add a few comments to theirs.

Jim notes that detailed petrography was and is the key to deciphering the origin and degassing history of magmatic sulfides. I can second that notion and reluctantly admit that my first discovery of magmatic sulfides in volcanic rocks happened quite by accident, while probing pyroxenes in a sample that had about 1000 ppm of magmatic sulfide globules. But, that was probably the last time I failed to do reflected light petrography prior to probe work.

Among those I wish to acknowledge, first and foremost would be Jim Whitney, my department chair, mentor, and friend while I was at the University of Georgia in the late 1980s. His prior work with magmatic sulfides from the Fish Canyon Tuff and experimental work on sulfides reassured me that sulfide degassing was the correct interpretation for the textures that I observed.

Although I did not overlap with Jim and Adrienne in our time at Queen's University, the Queen's connection ultimately brought the three of us together, for which I am grateful. This is not the final chapter of this collaboration; our work in progress will more fully document how dramatically sulfide abundances may change depending upon the cooling and degassing history of the magma.

For me, the best part of this collaboration has been the opportunity to get to know and work with Adrienne and Jim – they are both so capable, dedicated, and easy to work with! It has been very rewarding. Finally, there should be no mistake that it is largely Adrienne Larocque's hard work and perseverance that are at the heart of this paper. I salute her for this exceptional effort.

Jeff Keith

JEFFREY D. KEITH

Mr. President, Members of the Mineralogical Association of Canada, and Guests,

I would like to extend my thanks to my co-authors for allowing and trusting me to get involved in this research. Initially I was brought into this project as a summer student working on an NSERC study award. I was recruited by Adrienne to find and document these "funny little Fe-oxide and Fe-sulfide globules" that had a "frothy" appearance. I was intrigued that these textures might be an indication of S degassing of sulfides occurring prior to final crystallization of a magmatic system. After getting an eye for these textures came the hard part: trying to analyze these micrometer-sized globules with very irregular textures. As a result of the unusual characteristics of these oxides and sulfides, it made sense that atypical and variable micro-analytical results became one of the criteria for identifying them. Hopefully, others will undertake experimental work in order to document the range in conditions responsible for producing these degassed sulfides.

When I was first introduced to geology five years ago, I felt so lucky to have found my true calling, and my experience ever since has been phenomenal. It is the incredible scientists in this field who continue to do an excellent job teaching new students that are truly inspiring to me. I feel so lucky that I was given the opportunity to work in such a great research environment at the University of Manitoba, which allowed me to express my academic opinions and grow as a researcher. I hope in the future that I will be able to teach, assist, and pass on research experience and knowledge to my peers, colleagues, and those who follow, as my mentors have for me. In particular, Dr. Adrienne Larocque, in addition to being first author and introducing me to this work, was my undergraduate advisor, professor, employer, and mentor, but more importantly, she was an inspiration and a true friend.

I want to extend my warmest thanks to MAC for recognition of this paper and to Bob Martin who continues to do an excellent job as editor of *The Canadian Mineralogist*. I would also like to thank the Natural Sciences and Engineering Research Council of Canada for their support.

Michelle Huminicki

MICHELLE A.E. HUMINICKI