INTRODUCTION

This book is an outgrowth of a workshop on teaching mineralogy held at Smith College in June 1996 and sponsored by a grant from the Division of Undergraduate Education, National Science Foundation (DUE-9554635). Seventy participants, from diverse institutional settings and from all academic ranks, met to explore common interests in improving instruction in mineralogy. At the workshop, participants took part as both instructors and as students. They had the opportunity to explore a variety of new instructional methods and materials and also to observe their colleagues as instructors. All were encouraged to test these activities in their own classrooms, to evaluate their effectiveness, to suggest changes to the authors, and to develop new and complementary exercises. The sourcebook before you is the product of this group effort.

Teaching mineralogy is both challenging and rewarding. Mineralogy is typically taught as the first pre-professional course in an undergraduate geology curriculum. The large amount of information and abstract nature of much of the content presents formidable barriers to learning for many students. In recent years, educational scholars have discovered a great deal about the ways in which students learn. Indeed, much of the discussion at the workshop was on student learning rather than on faculty teaching. Many felt we need to be more concerned about what students can do as scientists rather than just evaluating their performance on exams.

Mineralogy, like all sciences, is a changing and expanding field. As our knowledge base continues to grow, it is appropriate to reexamine regularly what we teach and how we teach in mineralogy courses. Exciting new advances in mineralogical research, stronger connections to cognate disciplines (e.g. geochemistry, geophysics, materials science), and increasing relevance of mineralogy to society (e.g. environmental geology, resource utilization) all must be effectively incorportated into modern mineralogy courses. Our search has lead us to believe that there is a convergence of the way we conduct our science and the way we teach it—and the common theme is discovery-based exercises.

There is a national mandate to reform all science education (e.g. *Shaping the Future, New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology*; NSF 96-139) and many in the mineralogical community are responding. New goals for science education identified in *Shaping the Future* call for coursework that is more meaningful and relevant for students in their professional training; opportunities for students to "be" scientific by simulating, replicating, or engaging true research activities; and for providing students with life-long learning skills for creative problem-solving, quantitative reasoning, clear writing and speaking, and information and data gathering. To achieve these goals, while teaching the underlying principles and knowledge base of mineralogy, is the challenge we face. New teaching approaches that may help include collaborative learning, peer instruction, alternative assessments, and especially, use of discovery- and inquiry-based exercises. We can emphasize the relevance of our course material by showing connections with sub-disciplines in geology, cognate disciplines, and society in general.

Within this volume you will find numerous exercises that can be applied in the teaching of mineralogy and related courses. There are hands-on, experimental, theoretical, and analytical exercises. All have been written with the hope of optimizing student learning. At the workshop there was little interest in developing a "prescriptive" approach to mineralogy by making recommendations on a specific content that might be universally applied in mineralogy courses and curricula. We recognize that every student population will have different needs, every faculty

member will have her or his own areas expertise, every department will have its own curricular needs, every institution will have its own resources, and every geographic setting will provide unique educational opportunities. The exercises in this volume provide examples of innovative ways that mineralogy can be taught using a variety of materials and teaching techniques. We encourage you to use these activities in whatever ways will best serve your students. You may freely photocopy the exercises for class use, adopt these materials or adapt them to meet the special needs of your own course, and use these activities as models to help you develop your own new exercises.

However you use this book, please share your experiences with your colleagues and with the authors of the exercises. Being an effective teacher is not easy and we can all benefit from the experiences of others. If you would like to join an electronic mail list server discussion of mineralogy teaching, send a subscription request to jbrady@science.smith.edu.

We hope that the exercises in this volume will help you find ways to make your mineralogy teaching more successful. If we prompt you to modify your classes so that your students not only learn and retain more, but also have fun in the process, we will have achieved our goals.

John Brady, Dave Mogk, Dexter Perkins
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