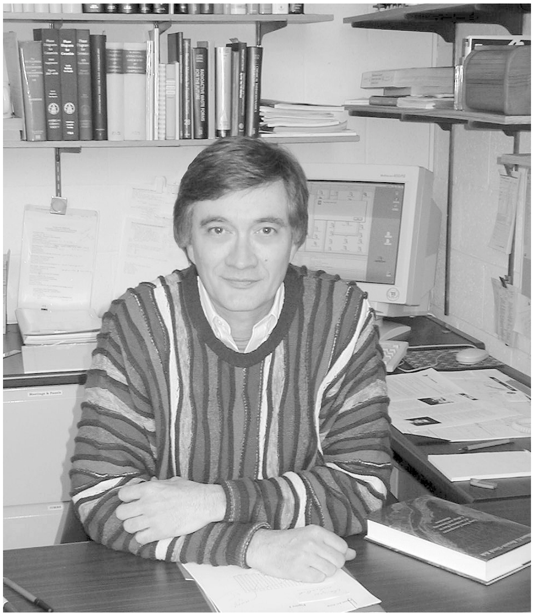
THE HAWLEY MEDAL FOR 2002 TO RODNEY C. EWING



RODNEY C. EWING

The Hawley Medalist for 2002 is Dr. Rodney C. Ewing. Dr Ewing is a Professor in the Departments of Nuclear Engineering and Radiological Sciences, Material Science and Engineering, and Geological Sciences at the University of Michigan. The Hawley Medal is awarded for the best paper to appear in *The Canadian Mineralogist* in the preceding year (2001). Dr. Ewing's paper, entitled "The Design and Evaluation of Nuclear-Waste Forms: Clues from Mineralogy", appeared in Volume 39, Part 3, pp. 697-715.

Dr. Ewing's paper was the only one selected by all three members of the Hawley Medal selection committee as one of the five best papers to appear the Volume 39 of *The Canadian Mineralogist*. The panel was composed of Charles V. Guidotti of the University of Maine, Encarnación Puga from the Instituto Andaluz de Ciencias de la Tierra in Granada, Spain, and Mavis Stout from the University of Calgary.

The committee described the paper as one that demonstrated an innovative application of mineralogy to an important modern-day problem. The paper was judged to be clearly written, impeccably documented, and the author emphasized the importance of the mineralogical sciences to modern science. Crystal-chemical data, information, and insights based on the study of naturally occurring, relatively common minerals, such as zircon and monazite, provide the key for assessing approaches to a crucial problem facing modern society: how to safely dispose of and store nuclear wastes for long periods of time. Only by studying minerals that have naturally stored radioactive elements for long periods of time can society learn how to attack this problem. The author of this paper shows once again that research done by academically oriented mineralogists can be of key relevance in addressing major technological questions. The selection of this paper for the Hawley Medal rewards research on a topic of scientific importance, but also a long and fruitful research program.

Norman M. Halden
President, MAC

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

An author is always pleased to have a paper recognized as a "best paper", and I am certainly no different; however, I acknowledge the very subjective process by which a "best" paper is selected. Other papers published during 2001 certainly reached a higher level of science or required greater effort and skill. Still, even with these humbling qualifications, I am particularly pleased that this paper was selected, because I think the subject, nuclear materials, is so critically important. The fate of nuclear materials, consumed and generated in nuclear reactors, will determine the future of nuclear power.

Twenty percent of the world's electricity is generated from approximately 400 nuclear reactors. The use of nuclear power as a replacement for carbon-based sources of energy reduces carbon emissions by an estimated 600 million metric tonnes per year. However, these same nuclear power plants, as well as reactors used to produce bomb materials, have left the world with a legacy of 150,000 tonnes of used nuclear fuel stored in 36 countries to varying degrees of care. The global production of used nuclear fuel is on the order of 10,000 tonnes per year, containing 100 tonnes of plutonium. The global inventory of plutonium is over 1,400 tonnes, of which approximately 450 tonnes have been separated by reprocessing (250 tonnes are used for weapons). The bare critical mass of ^{239}Pu is less than 10 kg. The fate of plutonium, and other fissile nuclides such as the much more abundant ^{235}U, is of critical environmental concern. Any significant increase in the use of nuclear power will result in substantial increases in the amount of spent nuclear fuel.

What is the role of geoscientists? If we consider the nuclear fuel cycle as the source term, then the geological repository is the intersection of the nuclear fuel cycle with geological cycles. The nuclear fuel cycle operates on a scale of tens of years, and the geochemical or hydrologic cycles operate on scales of hundreds to millions of years. From the nuclear engineering perspective, environmental impact can be lessened by careful design of the fuel cycle. From the geological perspective, the most important step is in the selection of a repository site. Once the site is selected, the principal geological means of protecting the environment will by a reduction in the release and transport rates combined with dilution. The science that supports the performance assessment of a site requires an analysis that couples atomic-scale processes, such as corrosion of spent fuel and waste packages, to crustal-scale processes, such as volcanic activity and climate change, that extend over temporal scales of thousands, if not tens of thousands, of years. The challenge for geoscientists is in modeling these complex, highly coupled, large-scale geological systems over extended periods.

Mineralogists can play an exceptionally important role in this process. On the nuclear side of the cycle, there is considerable interest in designing new fuels, inert matrix fuels that "burn up" excess actinides. This is just mineralogy plus neutrons. On the materials science side, the design, evaluation and selection of nuclear waste-forms are jobs tailor-made for mineralogists. Nuclear waste-forms of high chemical durability that are resistant to radiation damage provide the first and most important barrier against release to the environment. There is already considerable insight on the long-term behavior of such materials, many of them minerals, but much remains to be done in developing special waste-forms for specific waste-streams.

I believe that by recognizing this paper, the Mineralogical Association of Canada has focused the attention of the next generation of mineralogists on one of the major environmental issues of this century. Thank you for selecting this paper for the Hawley Medal.

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