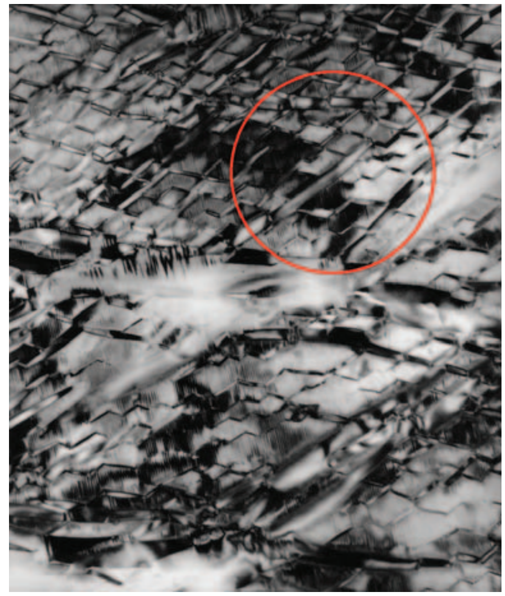
Ian Parsons

Now you see it, now you don't

This issue of *Elements* tells the story of how tiny, rare crystals can give amazing insights into the history of rocks and the earliest days of our planet. The zircon on our cover is all of a third of a millimetre long yet contains evidence of several stages of growth, all of which could be individually dated using the U–Pb method. We can unravel the conditions of growth and crustal residence from isotopes of the common element oxygen and the rare element hafnium, more than a million times less abundant. Zircon provides a perfect marriage of mineralogy with geochemistry – a showcase for the brilliance of modern imaging and analytical methods.

Using the very small to understand the very large is a recurrent theme in Earth sciences and one that has always fascinated me. I haven't been bold enough to make contributions on a planetary scale, but looking back I get enormous satisfaction from having been a member of a team involved in the production of some primary geological maps. So, I've looked closely at parts of the Earth on a scale of 100 km (10^5 m) using a hammer, a hand lens, a tent, and most fun of all, a helicopter. More unusually, I've also spent many hours, in near-complete darkness, with expert electron microscopists, producing images of mineral textures that can go down to the scale of the crystal lattice, say 1 nm (10^{-9} m). That's a range of 14 orders of magnitude. From the textures I see with these high-resolution microscopes, using the extremely short wavelength of electrons, I can make deductions about the cooling history of the rock, identify phases of fluid–rock interaction, and make progress in understanding the mechanisms by which such reactions occur.

This brings me to the main point of this editorial. Our cover picture is an optical micrograph of a zircon grain mounted between crossed polarizers, a technique invented in 1828 by William Nicol, right here in the University of Edinburgh – a beautiful example of a classic mineralogical image. But what is so special about images taken with a light microscope? Readers who have signed up for MSA's electronic discussion forum will have seen, a few months ago, a flurry of messages bemoaning pressures inside US universities to reduce the time spent teaching optical mineralogy. Similar pressures exist in the UK and no doubt elsewhere in Europe. In our August issue we ran an article by Dan Kile, of the US Geological Survey, who made a strong case for continuing to teach formal crystal optics in first-degree courses. It may surprise readers to learn that when the editors of *Elements* discussed Dan's article (by e-mail) we all agreed that long courses of formal instruction in optics were *not* now necessary for a useful career in Earth sciences. They should not be retained if the price is exclusion of other imaging methods. We respected Dan's viewpoint, and as



Now you see it. Apart from a few inclusions of apatite, this alkali feldspar crystal appears completely featureless in thin section in an optical microscope, both in plane polarized light and between crossed polarizers. The red circle is 1 μm in diameter, about the size of the smallest object visible in a light microscope. Diffraction of electrons in the transmission electron microscope (photo) reveals a complex, self-organized intergrowth of sodium and potassium feldspars, and several types of twins.

we often point out, *Elements* is *your* magazine, but if push came to shove, your editors would not shed many tears if formal optics took a lesser role. We should use the time to introduce students to the huge range of imaging techniques now available, from the mind-boggling atomic force microscope to expensive techniques like isotopic mapping using an ion probe.

Of course, thin-section work is a vital ingredient in any geologist's training. It is cheap, quick and particularly good at revealing textural relationships between grains. Without it students would never get a feel for what the Earth is made of and what rocks actually are. But in the UK it is still common to find students dragged early on through a mighty crystal optics course – Fletcher's indicatrix, determination of optic orientation, pleochroic schemes, interference figures and so on. Is all this really necessary to make routine use of a polarizing microscope? I personally think not. I'd go further. By hitting the unformed student mind early on with crystal optics as the ultimate technique, several generations of petrologists and geochemists have been implanted with the belief that if you can't see an object under high power in an optical microscope, it isn't there! I'm reminded of the notice that appears on the mirrors of American cars – 'Objects in mirror are closer than they appear'. Perhaps lab microscopes should have, engraved around their ocular(s), 'Objects less than 1/1000 of a mm across will be invisible'.

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INTRODUCING SUSAN STIPP

It is with great pleasure that the *Elements* editorial staff welcomes Professor Susan Stipp, Geological Institute, Copenhagen University, Denmark, as our next principal editor. Her term began officially on January 1, 2007. She replaces outgoing editor Michael Hochella. Susan brings a wealth of scientific and international experience to her new role. A Canadian by birth, she obtained her BS and MS degrees from the University of Waterloo, where she did graduate work in hydrogeology in one of the most famous natural water science groups in the world. Her PhD, which focused on mineral surface processes relevant to groundwater remediation, was obtained from Stanford University in 1989. Since that time, she has carried out research and taught at the University of Geneva and ETH of Lausanne, Switzerland. Since 1995, she has been on the faculty of Copenhagen University, where she founded and leads the NanoGeoScience Laboratory. She is currently director of the Nano-Chalk High Tech Fund, a new and very large research effort funded by the Mærsk Oil and Gas Venture. She is a member of the Danish Parliament Technology Advisory Panel. In 2004, she organized and ran the international Goldschmidt Conference at her university. Professor Stipp's vast research, publishing, and editorial experience in low-temperature water–rock interaction, biogeochemistry, and hydrogeology will complement the editorial team nicely. We welcome her to the *Elements* editorial team!

A WORD FROM SUSAN

I am honored to be joining the *Elements* team. When Rod Ewing described the goals of a new publication to the board members of the European Association for Geochemistry and the Geochemical Society at Goldschmidt 2002 in Davos, he dreamed of creating a colourful periodical that would unite mineralogists, petrologists and geochemists and put attractive and understandable information about our work into the hands of people in industry and government. The aim was to show the size and breadth of our community and the power of the research we do. This would strengthen our profile and would provide information for industrial applications, policy making and decisions about research funding.

In its two years of publication, *Elements* has come a long way. It is already uniting our community. Its scientific quality is high. It is now included in the citation index and is doing very well. People outside our field are beginning to know of its existence and ask for it, and it has already become a teaching tool in upper-level undergraduate and graduate courses. During my term on the team of principal editors, I hope to help *Elements* become a means for encouraging links between academics and industry *through applied research*. I hope to help create thematic issues that will allow government officials to understand some of today's important scientific topics and to see that funding *basic research* is fundamental to national economic well-being. These goals are not contradictory. Through better communication, academics, industry and government will have a better understanding of geoscience topics and will be able to see the benefits for society of *both types of research*. *Elements* can be a key player in this communication.

Susan L.S. Stipp

WELCOMING FIVE NEW SOCIETIES

We are thrilled to welcome five new societies to the *Elements* family as of January 2007: the Association of Applied Geochemists, the Deutsche Mineralogische Gesellschaft, the Società Italiana di Mineralogia e Petrologia, the International Association of Geoanalysts, and the Polskie Towarzystwo Mineralogiczne (Mineralogical Society of Poland). This translates into about 2000 new readers. We look forward to their contribution.

ADVERTISERS IN 2007

Our 2006 regular advertisers—RockWare, Rigaku, PANalytical, Meiji, Excalibur, Materials Data, Actlabs, CrystalMaker—all booked advertising again in 2007. We are thankful for their continued business. We also welcome new advertisers in this issue: among others, Thermo Scientific, Australian Scientific Instruments, and Bayerisches Geoinstitut. *Elements* puts our advertisers' messages in the hands of more than 9,000 mineral scientists, and the income generated from advertising goes a long way towards printing the magazine. This is a mutually beneficial partnership. Currently, advertising content is about 10% of the magazine. One way you, our readers, can help us with advertising is by telling our advertisers you have noticed their ads in *Elements*.

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Now you see it, now you don't

A cubic micron of a typical silicate contains around a billion unit cells, each composed of several tens of atoms – plenty of space for all manner of defects, dislocations, twins, exsolution textures, zoning, subgrains, solid inclusions, fluid inclusions... For routine petrography these sub-optical features may not matter at all, but if we determine properties like diffusion coefficients using supposedly 'perfect' gem-quality crystals, whose perfection has often been judged only by optical microscopy, we may be on very shaky ground indeed. And the 'ordinary' crystals to which we later apply these coefficients are each likely to be replete with an inventory of sub-optical features which may or may not be relevant. New devices are on the horizon, such as cheap, miniaturized Raman spectrometers, that will make the identification of many minerals semi-automatic. Optical microscopy will remain the method of choice for petrography, but we should trade the time that students often now spend on optical theory for at least a superficial introduction to the whole wonderful world of imaging techniques that the 21st century provides.

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WELCOMING 2000 NEW READERS

If you receive an issue of *Elements* for the first time, you have either just joined one of *Elements* founding Societies or you belong to one of the five societies that joined as of January 2007.

MEMBERS OF THE FOLLOWING SOCIETIES RECEIVE *ELEMENTS* AS A MEMBER BENEFIT.

European Association for Geochemistry • Geochemical Society • International Association of GeoChemistry • Mineralogical Association of Canada • Mineralogical Society of America • Mineralogical Society of Great Britain and Ireland • Societé Française de Minéralogie et Cristallographie • The Clay Minerals Society

NEW SOCIETIES AS OF JANUARY 2007

Association of Applied Geochemists • Deutsche Mineralogische Gesellschaft • Società Italiana di Mineralogia e Petrologia • International Association of Geoanalysts • Polskie Towarzystwo Mineralogiczne (Mineralogical Society of Poland)

SUBSCRIBERS TO THE FOLLOWING JOURNALS ALSO RECEIVE ONE COPY OF *ELEMENTS*

American Mineralogist • *Clay Minerals* • *Clays and Clay Minerals* • *MINABS Online* • *Mineralogical Magazine* • *The Canadian Mineralogist*