

PRINCIPAL EDITORS

JAMES I. DREVER, University of Wyoming, USA
(drever@uwyo.edu)
GEORGES CALAS, IMPMC, France
(Georges.Calas@impmc.jussieu.fr)
JOHN W. VALLEY, University of Wisconsin,
USA (valley@geology.wisc.edu)

ADVISORY BOARD 2012

JOHN BRODHOLT, University College London, UK
NORBERT CLAUER, CNRS/UdS, Université de
Strasbourg, France
WILL P. GATES, SmecTech Research
Consulting, Australia
GEORGE E. HARLOW, American Museum
of Natural History, USA
JANUSZ JANECZEK, University of Silesia, Poland
HANS KEPPLER, Bayerisches Geoinstitut,
Germany
DAVID R. LENTZ, University of New Brunswick,
Canada
ANHUI LU, Peking University, China
ROBERT W. LUTH, University of Alberta, Canada
DAVID W. MOGK, Montana State University, USA
TAKASHI MURAKAMI, University of Tokyo, Japan
ROBERTA OBERTI, CNR Istituto di Geoscienze
e Georisorse, Pavia, Italy
TERRY PLANK, Lamont-Doherty Earth
Observatory, USA
XAVIER QUEROL, Spanish Research Council, Spain
MAURO ROSI, University of Pisa, Italy
BARBARA SHERWOOD LOLLAR, University of
Toronto, Canada
TORSTEN VENNEMANN, Université de
Lausanne, Switzerland
OLIVIER VIDAL, Université J. Fourier, France
MEENAKSHI WADHWA, Arizona State
University, USA
BERNARD WOOD, University of Oxford, UK
JON WOODHEAD, University of Melbourne,
Australia

EXECUTIVE COMMITTEE

CARLOS AYORA IBÁÑEZ, Sociedad Española
di Mineralogia
LIANE G. BENNING, European Association
of Geochemistry
THOMAS D. BULLEN, International Association
of Geochemistry
BERNARDO CESARE, Società Italiana di
Mineralogia e Petrologia
BARBARA L. DUTROW, Mineralogical
Society of America, Chair
W. CRAWFORD ELLIOTT, The Clay Minerals Society
MONICA M. GRADY, The Meteoritical Society
BERNARD GROBÉTY, Swiss Society of
Mineralogy and Petrology
GUY LIBOUREL, Société Française
de Minéralogie et de Cristallographie
MAREK MICHALIK, Mineralogical Society
of Poland
EJI OHTANI, Japan Association of
Mineralogical Sciences
IAIN M. SAMSON, Mineralogical Association
of Canada
EDWIN A. SCHAUBLE, Geochemical Society
CLIFFORD R. STANLEY, Association
of Applied Geochemists
PETER TRELOAR, Mineralogical Society
of Great Britain and Ireland
FRIEDHELM VON BLANCKENBURG,
Deutsche Mineralogische Gesellschaft
MICHAEL WIEDENBECK, International
Association of Geoanalysts

MANAGING EDITOR

PIERRETTE TREMBLAY, tremblpi@ete.inrs.ca

EDITORIAL OFFICE



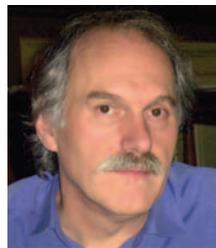
490, rue de la Couronne
Québec (Québec) G1K 9A9, Canada
Tel.: 418-654-2606 Fax: 418-653-0777

Layout: POULIOT GUAY GRAPHISTES
Copy editor: THOMAS CLARK
Proofreaders: THOMAS CLARK
and DOLORES DURANT
Printer: ALLEN PRESS

The publishers assume no responsibility for any statement of fact or opinion expressed in the published material. The appearance of advertising in this magazine does not constitute endorsement or approval of the quality or value of the products or of claims made for them.

www.elementsmagazine.org

TALES, TALES...



Georges Calas

The formation of ore deposits often appears to result from a “magic chain” made from a coherent succession of geological, geochemical, mineralogical, etc. processes that concentrate metallic elements. The efficiency of such element concentration is really extraordinary, as illustrated by elements such as gold, which is concentrated from the ppb level to nuggets weighing 70 kg. As a consequence, humankind has used for millennia these mineral resources, which have been central to technological progress since the Stone Age. And it is still the case. Rare earth elements do not take full advantage of this “magic chain.” The most abundant rare earth elements are indeed similar in crustal abundance to transition elements such as chromium or nickel. Despite this, ore deposits of the former are much rarer than those of the latter. Scandium, a transition element usually classified with the rare earths due to its geochemical properties, forms fewer than 10 rare or very rare and unique minerals. A geochemical invariant during weathering processes, exploited only as a by-product, scandium is a typical element not involved in the “magic chain.”

Rare earths minerals do not usually attract attention and are often put in a modest place in museum mineral collections. They are also sacrificed in mineralogy classes to leave time for more noble or “important” minerals. This reminds me of Andersen’s *Ugly Duckling*, a tale beloved around the world that shows an apparent transformation for the better. Indeed, despite rare earths being of prime importance in geochemistry, rare earth minerals remained, in the past, of minor importance for most mineralogists. However, recent events have put the spotlight on them, placing the rare earth resource in the forefront of present-day concerns. Modern societies are anxious to obtain this resource needed for many technological developments: once extracted, rare earths are desirable, although, in the past, they never attracted such attention and fame. The *Ugly Duckling* is now a noble swan.

In most countries, politicians and the media frequently question Earth science departments and organizations about rare earths, as our disciplines have always been involved in the exploration, mining and mineral processing of metallic resources. They are eager to hear from us about

the future evolution of the resource of strategic metals; the development of applications has been much faster than that of knowledge about how the resource might be increased to match this expansion. The names of the rare earth elements, such as ytterbium and europium, have become familiar to the public, because they are frequently heard on the radio, TV, and Internet. There is an emerging collective fear that we will run out of this resource. This is perfectly depicted in the cartoon reproduced below and published in December 2010 by the French satirical magazine *Le Canard Enchaîné*.

The first issue of *Elements*, guest edited by Robert Bodnar, was on the theme “Fluids in Planetary Systems.” Interestingly, the first article of the issue, written by Steve Kesler—and thus the first contributed article published in *Elements*—was entitled “Ore-Forming Fluids.” Since, *Elements* has published several articles dealing with ore-forming processes. However, the present issue on rare earth minerals and deposits is devoted only

to ore deposits. It perfectly illustrates how recent laboratory and field data provide clues to understanding the conditions of formation of rare earth deposits.

The “rare earth crisis” that occurred in 2010 underlined the importance of teaching ore deposits in the Earth science curriculum. This realization is affecting the positions and funding opportunities in many Earth science departments. For instance, Europe is creating a network on minerals resources, ERA-Min (www.era-min.eu.org), in order to strengthen a community that received less attention in the past. And new expertise will arrive in the field.

The *Beauty* was sleeping: it has been said that, during the emergence of China’s rare earth supremacy, most Western countries did not realize the perilous situation they now find themselves in, as if they were sleepwalking. The *Sleeping Beauty* is awaking. It is our hope that the present revival of interest in ore deposits in general and in rare earth deposits in particular, integrating sustainable development concepts and an active environmental conscience in the exploitation and utilization of mineral resources, will continue to help us find answers about the workings of the “magic chain.”

Georges Calas (georges.calas@upmc.fr)*
Université Pierre et Marie Curie, Paris



– What? A gram of dysprosium! You’ve gone overboard!

– We wanted to offer you lanthanum, but we didn’t find any!

(Cabu, *Le Canard Enchaîné*, 15/12/2010 – © Le Canard Enchaîné)

* Principal editor in charge of this issue