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NATURAL GAS IN THE EMERGING GLOBAL ENERGY LANDSCAPE



Patricia M. Dove

Energy was not on the mind of Heraclitus of Ephesus (circa 500 BCE) when he wrote “The only constant is change.” However, his words ring true as you read this issue of *Elements*. Within a decade, the energy world has witnessed a tectonic shift that is roiling the international economic, political, and environmental landscapes. Technological advances, made largely by the Canadian and United States oil and gas industries, have converted North America from a gas-importing to a gas-exporting continent. Had the “shale boom” never happened, the US would currently be importing more than 280 million cubic meters of natural gas per day (*New York Times*, April 2014). Today, the US is poised to export an equal amount as liquefied natural gas (LNG).

This new abundance of “unconventional” energy, and the recent technologies that made it possible, are giving rise to a global energy market with a complex web of implications for regions, nations, and indeed, entire continents. The most obvious of these implications concerns energy pricing and the energy dependence of nations. Western Europe is the largest energy importer in the world with increasing needs as one travels eastward. While natural gas prices in the US are near unprecedented lows, recent tensions between Russia and Ukraine are threatening to further increase energy costs throughout the European Union. Incredibly, the price of electricity in Europe is already approximately triple that of the US. This has leaders of the EU pushing to restart the stalled negotiations regarding Russia-Ukraine gas pricing (*Moscow Times*, June 2014), redoubling their efforts to diversify the EU’s energy portfolio (Reuters, May 2014), and in some cases, moving hydrocarbon-based chemical industries abroad (*Wall Street Journal*, May 2014).

For decades, energy security has been an important issue for Europe. Many favor developing local sources as a way to diversify their energy portfolios. Indeed, European efforts to increase the proportion of renewable energy sources are the envy of the world. But can renewable energy keep up with demand? For some, the potential for developing shale gas within Europe offers a local tap that is tempting. According to a 2013 US Energy Information Association report, there are significant resources in Poland (4 trillion cubic meters), France (3.8 trillion cubic meters), the UK (0.7 trillion cubic meters), and Germany (0.5 trillion cubic meters) (*Wall Street Journal*, March 2014). Those are impressive energy assets when one considers that the average yearly per capita consumption of natural gas in France and Germany is 758 and 1224 m³, respectively (EIA, 2012).

But wait, not so fast! The circumstances that gave rise to the growth of natural gas production in North America are different from the situation in Europe. Europe lacks some of the natural advantages found in North America, with a higher population density that limits the space available for large gas-production facilities, geologic formations that are more costly to develop, and the fact that European landowners are not entitled to profit from gas extracted beneath their own property. Additional impediments include water availability and environmental concerns. These issues led France to ban hydraulic fracturing for gas and oil despite the belief by some analysts that France sits atop potentially highly productive natural gas fields (*Le Monde*, June 2013). There is similar widespread resistance to shale development in the UK.

Meaningful solutions to energy needs will take time. For example, the Canadian government desires new markets for shale gas exported as LNG. However, in recent bilateral discussions, German Chancellor Merkel and Canadian Prime Minister Harper reiterated that significant infrastructure will be required to make this a reality (Canadian Press, May 2014). New pipelines, gas conversion plants, and shipping terminals will be necessary to export from the Canadian east coast. Each of these facilities is a massive and costly project that typically requires 6–8 years to complete. Similar export challenges are unfolding in the US, Australia, Africa, and the Middle East. For example, the first LNG export terminal in the US will finally be fully functioning in 2015, and that gas is already spoken for. Half of that gas has been contracted by India and South Korea, while the rest will go to British and Spanish

suppliers (*New York Times*, April 2014). This is another reminder that energy is transitioning to a globalized commodity and the demand is high.

Nevertheless, the energy industry is currently unconvinced there is sufficient economic incentive to justify such large new investments. How is that possible, you ask? Well, it is important to remember that the government of Nation X doesn’t ship gas to the government of Nation Y. Private companies sell gas to private companies that buy gas. This economic reality check also raises the issue that shipping LNG to Europe is a two-point problem. That is, receiving LNG requires similarly enormous investments in regasification terminals and distribution systems. While two European terminals are scheduled for completion within a few months and six more are currently under construction, many more will be needed to significantly reduce natural gas costs and satisfy regional demands.

Current events suggest that more transformations in the energy market are on the horizon. The energy conversation, traditionally focused on the distribution of resources from the Middle East, is

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THIS ISSUE

We now have the capacity to exploit economically gas and oil shale, oil sands, and heavy oil in spite of additional technology, energy, and cost requirements. Guest editors David Cole and Michael Arthur and the authors of this issue address the geological and geochemical nature of these resources and their impact on global socioeconomics and the environment. Rounding out the issue are two Perspective articles, on shale gas exploitation and the need for geoscientists to become involved, and Patricia Dove's editorial, which reflects on the global political context.

While working on this issue, I received the following e-mail: "Your next issue, 'Unconventional Hydrocarbons,' sounds terrifying. The environmental devastation caused by 'fracking,' 'tar sands,' and other processes is off the scale. We should be moving away from hydrocarbons and looking towards a carbon-free future...it is entirely possible." This comment illustrates well one side of the polarized debate surrounding unconventional oil and gas. In Quebec, legislation was tabled in 2013 to put a moratorium on exploration and exploitation for shale gas, but the bill died when the government called an election. But even exploration for conventional resources is controversial in some areas. Recently, aboriginal groups in Canada made an official request for a moratorium on oil and gas exploration in the Gulf of St. Lawrence "until a comprehensive environmental assessment is done." The St. Lawrence coalition, made up of environmental groups, First Nations, and fishery representatives from five provinces, is also pushing for a moratorium on exploration for oil and gas in this area because "too little is known about the possible effects of oil and gas projects on the gulf's fragile ecosystem to proceed with them in its waters." Exploration for any resource can no longer be made in isolation. Companies need to earn a "social license" to operate, and that can only be done by informing and involving the local populations and working closely with regulatory agencies.

COPYEDITOR FOR *ELEMENTS* MAGAZINE

We seek a copyeditor to join the editorial team of *Elements* magazine as it heads into its second decade. *Elements*, published six times yearly, is a joint publication of 17 international societies covering the fields of mineralogy, petrology, and geochemistry (MPG). Each issue comprises six peer-reviewed, thematic articles geared to the technical MPG nonspecialist, as well as nonthematic content. Reporting to the executive editor, the copyeditor helps ensure that the magazine's editorial matter conforms to *Elements'* high editorial standards. The copyeditor has the following tasks (among others): ensure that the editorial content is clearly expressed and free of grammar, spelling, and punctuation errors; ensure that the content conforms to *Elements'* established editorial style; check that all mineral names, mineral formulas, and geographical names are correct; ensure that mathematical style conventions are rigorously followed; check that figures are clear and correctly cited in the text; ensure that the reference list is complete and correct; check and correct the prepublication proofs.

This position will appeal to those who delight in well-written English and have an eye for detail. The position allows for creativity and is ideal for those interested in helping to make difficult science subjects accessible to the nonspecialist reader. There are no geographic restrictions on the location of the copyeditor, but there must be ready access to the Internet.

Required qualifications: A BSc in Earth science or a related scientific field, or equivalent experience. Fluency in both written and spoken English is essential. A minimum of 3 years of copyediting experience is needed, preferably copyediting for a general geoscience publication. The candidate will be able to use standard software (Microsoft® Word, Adobe® Acrobat) for manipulating and treating texts.

This is a position subject to annual contract renewal. Start date is 1 January 2015 with a time commitment of approximately 80 hours every 2 months. For additional information about *Elements*, see www.elementsmagazine.org.

Applications should include a cover letter clearly addressing the required qualifications, a CV, and the names of three referees. Applications and/or questions should be sent electronically to: Pierrette Tremblay, Executive Editor *Elements* (pierrette.tremblay@ete.inrs.ca). Applications will be reviewed starting Monday, 13 October 2014, and the position will remain open until filled.

EDITORIAL MEETING

We welcomed Jodi Rosso, incoming executive editor, and Bernie Wood, incoming principal editor, to our day-long annual meeting, held prior to the Goldschmidt Conference. We reviewed thematic issues currently in preparation, proposals received for potential inclusion in the 2016 lineup, and various editorial questions. Founding Editor Rod Ewing and Dan Frost, member of the Executive Committee standing in for Chair Barb Dutrow, joined us for a brainstorming session during which we discussed open access, how to make *Elements* even more relevant, and online and social media presence.



At Goldschmidt, we celebrated *Elements'* first ten years with the union session "Elements: 10 Years Old (see page 313), and a dinner with past and principal editors and members of the Executive Committee was held at Cafeteria 15L.

PETER ROEDER

Many of us mourn the passing of Peter Roeder (see obituary, page 298). Peter was my MSc supervisor. He was a great scientist, but he will be remembered even more for his kindness and gentle ways. He and his wife Claire welcomed countless students to their home. I remember well some of the grad parties at their house, with Claire's wonderful cooking. After we left Queen's, my husband and I would stop by every few years to show off our growing children, and we were always welcomed like family. Peter also had a great influence on my career: In 1994 while he was president of the Mineralogical Association of Canada, he asked me to join its outreach committee. This invitation was the beginning of my long involvement with MAC, which eventually brought me to *Elements*.

Pierrette Tremblay, Executive Editor

EDITORIAL *Cont'd from page 243*

pausing to hear the tummy rumble of energy-hungry China. Eager to wean its economy from energy imports and coal, Beijing has set an ambitious target of producing 60–100 billion cubic meters of gas per year by 2020 (*Wall Street Journal*, March 2014). It is quite possible that China will become an energy producer, with early estimates projecting that the Sichuan and Tarim basins contain massive gas reserves on the same order as those of the Marcellus Shale (US EIA report). Because water supply will be a major challenge, Chinese national companies are partnering with Royal Dutch Shell and US firms to adopt new low-water-use technologies. These events suggest the possibility of another tectonic shift, with the emergence of new Far East energy giants.

With the prospect of a truly globalized energy economy comes the reminder that we must consider environmental impacts. History seems to repeat itself, with the drive to frantically mine Earth resources and then leave behind environmental legacies with tremendous societal and ecological costs. Can it be different this time? As we rush forward to develop unconventional energy sources, can new technologies evolve in the "right" ways? We have an opportunity to write a new energy legacy that includes more environmental wisdom and foresight than before. In the bigger picture, such a change in mindset could also guide us toward solving other complex issues, with far-reaching benefits for humankind.

Patricia M. Dove

Principal Editor in charge of this issue