Providing Resources for Future Generations — Technical and Human Challenges

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Earth is a remarkable planet, providing us with a comfortable place to live and the energy, minerals and water to sustain our societies. Geoscientists understand the dynamic processes within and at the surface of our rocky planet that shape our unique home. Plate tectonics and related processes have operated throughout much of Earth's history, leading to repeated amalgamation and breakup of supercontinents; the building and erosion of mountain ranges thousands of kilometers long; the constant delivery of massive quantities of sediment from the continents into adjacent sedimentary basins; and disruptive and hazardous events such as earthquakes, volcanic eruptions and violent storms. These and other geological processes have moved and concentrated metals, minerals, hydrocarbons and water. The resulting concentrations of natural resources were so obvious that ancient humans recognized and exploited them beginning more than 10,000 years ago.

To continue developing resources responsibly in the future — as will be necessary to further human progress — we need to understand Earth in all its complexity, our relationship to the planet, and the role that humans will play in maintaining supplies of critical resources while also exploiting them more cleanly for the benefit of all. Geoscientists are essential in this process. In June 2018, geoscientists and engineers from around the world, in academia, government and industry, along with indigenous people, policy experts, members of civil society and young people — students and early career professionals — will meet in Vancouver, Canada, for the Resources for Future Generations conference (rfg2018.org). The conference seeks broad engagement to fully examine the nature of Earth, the distribution and discovery of resources, and the important sustainability issues related to resource extraction. Come join us!

RFG 2018
RESOURCES FOR FUTURE GENERATIONS

The ultimate purpose of the conference is to build the understanding of natural resources and develop ideas about how we can meet the resource demands of the future. First and foremost, we have to discover new natural resources containing the elements, materials and commodities that society needs with sufficient concentrations and characteristics to permit clean, economic extraction. Over the last several decades, extraction of many natural resources has become more difficult; for example, many current mines have lower concentrations or grades of metals and minerals than in the recent past, and hydrocarbons are extracted from more complex, lower-permeability host rocks. As a result, we expend more energy, use more water and disturb more land per unit of production than in the past.

The discovery of new high-quality, high-value deposits can reverse this trend, allowing increased efficiency of extraction per unit of commodity, although making such quality discoveries is challenging. The odds are improved, however, when we better understand the critical earth processes that work separately and collectively to form and concentrate resources of different types. The concentration of resources into economic zones, such as mineral deposits and petroleum reservoirs, resulted from numerous large-scale global processes: plate tectonics, magmatism, formation of sedimentary basins, the presence of water at the surface and deep within the crust, microbiological activity, and the composition of the atmosphere. Other, local-scale factors and processes — such as rock structure and permeability, pressure and temperature, fluid-rock and mineral interactions, and erosion rates — controlled the distribution of resources.

Quantifying the roles of these complex processes requires comprehensive research in fundamental geoscience, and the application of new approaches, techniques and models to decipher the information and data we already have on known resources, and hence predict the locations of new discoveries. Many aspects of geoscience are needed to tackle this daunting task, and while many researchers do not work on resource issues, it is important for all to communicate the necessity of broad geoscientific research and to identify potential applications even when the connection to resources may seem unlikely.

Discovering new natural resources is vital, but equally important is how we extract the contained commodities. Historically, extractive industries have not been viewed well by the public. This is hardly surprising given past examples of poor practices, environmental damage and limited distribution of benefits. These industries, however, have changed significantly over the last 30 to 40 years, and will continue to advance by using more efficient technologies, reducing energy

consumption and recycling water. Such improvements are welcome and necessary in the effort to design and maintain responsible extraction practices. Over the long term, these practices will require a profound understanding of Earth, including surface processes, water, climate and biodiversity. Geoscience and geoscientists play major roles in understanding global change, as well as assessing the local and regional landscapes. We need the geoscience community to apply this knowledge to identify and mitigate negative consequences from resource extraction.

Geoscience clearly offers the technical underpinning for delivering natural resources for the future. But technical advances have limited potential if the people who are most at risk from resource extraction see few of the benefits. Indigenous peoples have relationships with the land and associated resources that have evolved over a period vastly exceeding post-industrial resource demand. Understanding indigenous knowledge and community needs is a prerequisite for responsible resource extraction. Other affected communities also have valid concerns that must be heard. Successful engagement requires expertise from social and political science as well as geoscience and engineering. Many technically minded people are uncomfortable bridging the gap to social science, and yet building collaboration across this interface is critical for future resource development that is designed to meet global sustainability goals.

Today, technology is everywhere, from healthcare to space travel to global communications and the shared economy. Perhaps the most exciting applications of technology involve innovations intended to create a cleaner and greener planet and redress the unintended consequences of accelerating population growth and resource extraction. The two most cited examples of major innovations related to reducing our reliance on fossil fuels are renewable energy and electric vehicles. These sectors, however, require abundant natural resources such as copper for electric motors and turbines, lithium and cobalt for batteries, and silicon, gallium, indium and tellurium for solar panels; and it will take considerable amounts of these resources to get us through the emerging sustainability revolution. Recycling will play an increasingly important role, but a serious resource gap needs to be filled before recycling alone can meet the long-term needs of a growing population. A cleaner, greener planet is the primary target, but in achieving this, we also have to address the basic needs of the up to 3 billion people who lack clean water, sanitation, nutrition, heat or electricity.

These issues and many more will be discussed at the RFG2018 conference next year, which will include numerous sessions covering the major technical themes — Earth, Energy, Minerals and Water — as well as nontechnical themes, including Resources and Society, and Education and Knowledge. Complex and challenging issues will be debated, efforts will be made to draw delegates across the boundaries among the themes and disciplines, and indigenous people will demonstrate their leadership in the resource debate. Considerable focus will be given to young people – early career and students - who represent "Future Generations." This will include pop-up pitch sessions, career workshops, mentoring opportunities and focus group discussions, as well as opportunities to speak in broad thematic and specific technical sessions.

Earth supports life, obviously including humans, but geological processes also concentrated natural resources that have aided human development for more than 10,000 years, and especially in the last 250 years. To meet the needs of future generations, geoscientists must work with many others to find and responsibly develop the resources that we will need. Most importantly, we must work collectively to empower future generations to take on the natural resource challenge in all its aspects.

Credit: Anne Thompson

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In 2013, the International Union of Geological Sciences (IUGS) launched an initiative — Resourcing Future Generations — to address concerns related to the future supply of natural resources that are necessary in the modern world. In 2015, a group of Canadian geoscientific and resource associations agreed to partner to deliver a conference on this theme under the auspices of IUGS. This is the first IUGS conference organized between their International Geological Congress (IGC) events held in different parts of the world every four years.

Resources for Future Generations (RFG2018) has grown into a major international conference based on earth science and focused on the broad technical and nontechnical issues related to natural resources and our ability to provide these critical ingredients for future generations.

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