GEOTHERMAL ENERGY DEVELOPMENT IN CANADA

Carl A. OZYER[1] and Stephen E. GRASBY[1]
[1]Geological Survey of Canada, 3303 33rd St. NW, Calgary, Alberta, Canada

e-mail: carl.ozyer@canada.ca

ABSTRACT

Canada has enormous geothermal energy potential, with resource quality varying as a function of regional geology, ranging from high temperature volcanic belts and hot sedimentary basins to lower temperature shield regions. Despite known areas of high potential there is no electrical generation to date and only niche direct heat use. Full realization of geothermal energy potential in Canada is hindered by numerous barriers ranging from lack of geoscience knowledge to lack of effective regulatory environments that inhibits industry exploration. Policy objectives of transitioning to a clean energy economy is starting a resurgence of geothermal activity in Canada that holds great promise to see future power generation.

Keywords: geothermal energy, clean energy supply, reducing exploration risk

1. INTRODUCTION

Canada has enormous geothermal energy potential (Grasby et al., 2012). However, to date there has been no electrical generation and only niche direct heat use. Canada does have a significant development of heat exchange systems across the country (Raymond et al., 2015). Here we present an overview of geothermal energy in Canada and discuss the current status of exploration and development activities as well as address some of the barriers that has limited geothermal energy development to date.

2. CANADIAN GEOTHERMAL POTENTIAL

As the second largest country in the world, Canada has diverse geology and as such geothermal resource potential (Fig. 1). The western portion of Canada forms part of the Pacific Ring of Fire and has associated high temperature volcanic belts throughout the province of British Columbia as well as the Yukon Territory (Fig. 2). Previous exploration activity at the Mount Meager site demonstrated waters over 200 °C, however development of this site was hindered by low producability of fluids to surface. Western Canada is also underlain by thick sedimentary sequences with close to 1 million oil wells drilled. These wells provide a wealth of data allowing characterization of temperature and permeability of sedimentary sequences. High temperature resources (> 120 °C) with potential for electrical generation are known to occur in regions of northwestern Alberta, NE British Columbia, SW Northwest Territories, as well as southern Saskatchewan. Broad regions of western Canada and parts of the Saint Lawrence Lowlands of eastern Canada also show potential for direct heat use geothermal systems. Another intriguing potential for Canada is heat pump systems that utilize large volume but low temperature waters from abandoned mines for district heating. This has provided economic

opportunities for small mining communities post mine-closure, by attracting new industries with promise of low heating costs.

Unique opportunities exist in Canada to develop geothermal resources to support remote northern communities that are not connected to any regional power grid (Fig. 3). For these communities electricity is typically provided by diesel generators and heat for buildings is produced by consuming heating oil. These fuels have to be transported over large distances by truck and in many cases there is only land access through the short winter road season (i.e. road access is only possible when the land and lakes are frozen to sufficient depth to allow truck traffic). Development of geothermal resources in these regions can provide domestic energy supply that does not face disruption by events such as early season road melt. The low average air temperatures of northern communities can also provide unique benefits giving the higher temperature differential (ΔT).

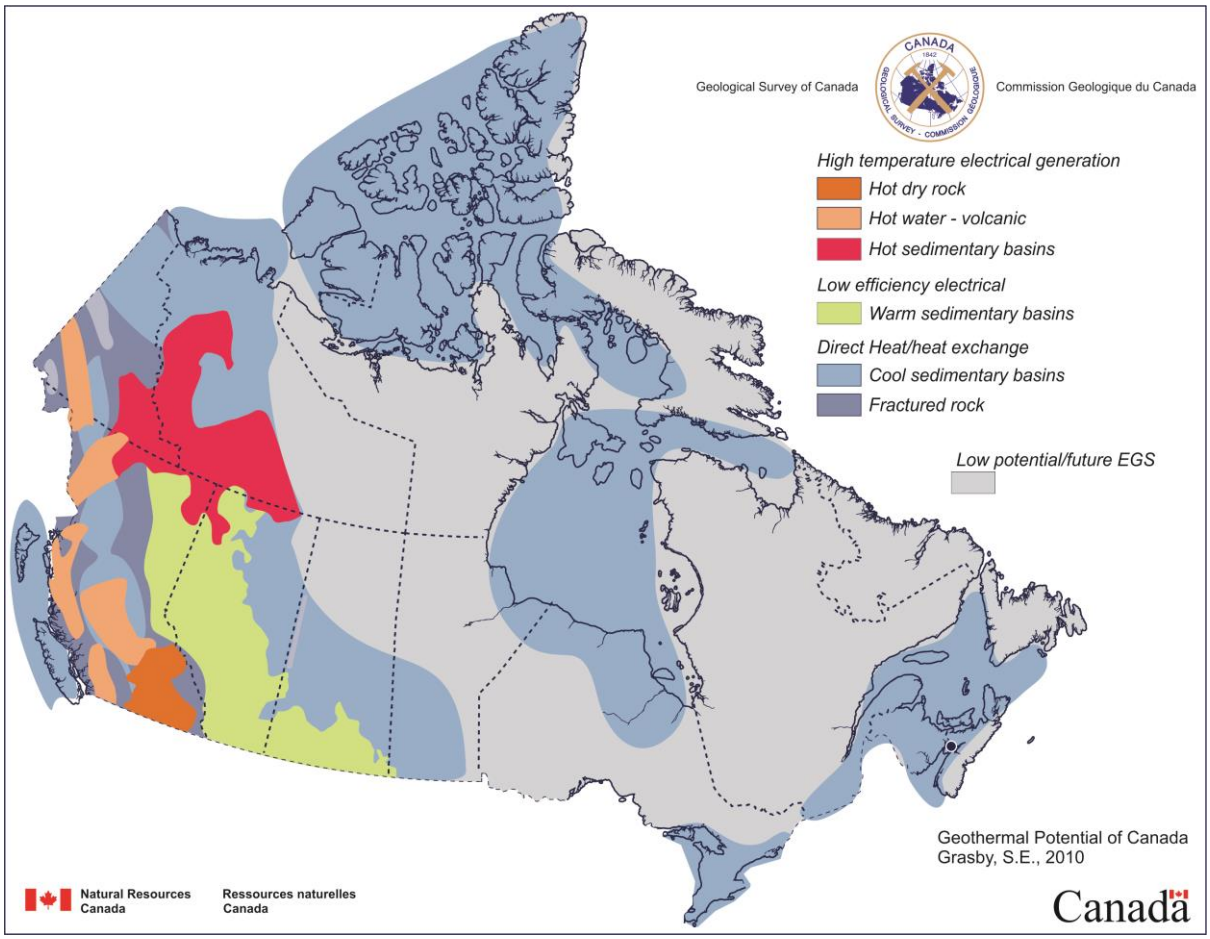

Fig. 1 Map showing geothermal energy potential of Canada.

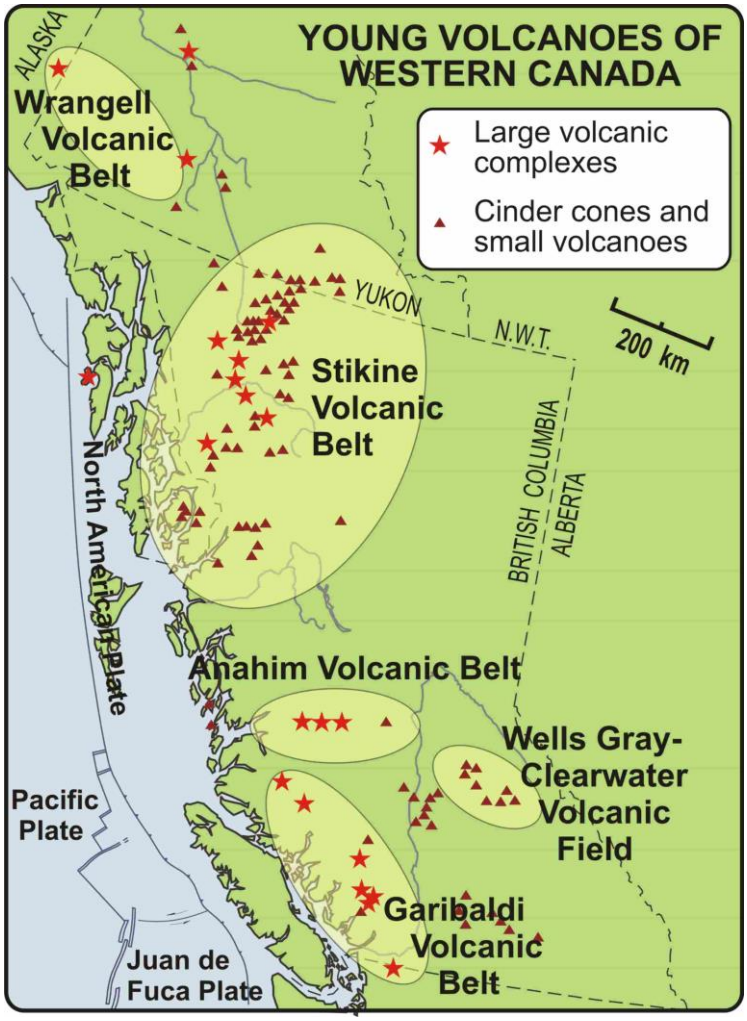

Fig. 2 Map showing young volcanic belts in western Canada.

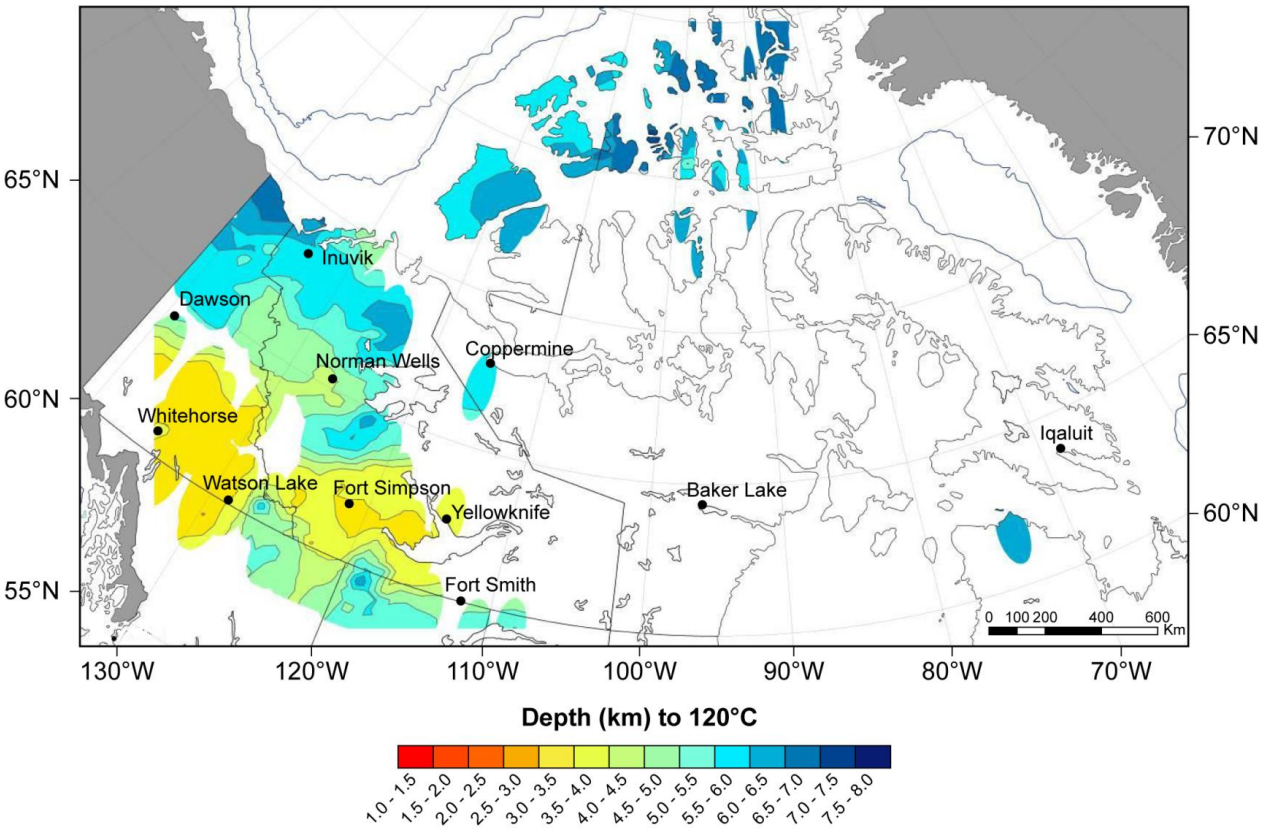

Fig. 3 Map showing estimated depth to reach temperatures sufficient for electrical generation relative to locations of northern communities. White areas represent regions with no data control.

3. GEOTHERMAL BARRIERS

Despite the potential in Canada, geothermal energy has been hindered from development due to several barriers that exist. A key one is the lack of regulatory systems in most jurisdictions in Canada that hinders industry investment in exploration. As there has been limited interest in geothermal development in the past, regulators have not considered geothermal potential, and therefore, there is no clear regulatory environment for industry to work under. For similar reasons, the geothermal industry was not mentioned in the tax code until recently. That limited access to the same tax incentives which other resource extraction industries had. In many jurisdictions, there are also barriers in establishing power purchase agreements which hinders the ability to sell geothermal power to the grid even if a resource is developed. Additionally, while there historically was a geothermal energy research program from 1975-1985, there has been very limited investment in geoscience research in geothermal energy in Canada for the last 30 years. Finally, there is a general lack of knowledge of geothermal energy and its potential as a clean energy supply. This has led to some instances of low public support for government investment in developments such as district heating systems. Similarly, governments have not included geothermal energy in programs meant provide incentives to enhance clean energy production.

4. SHARING THE OPPORTUNITY

Overall, the concept of geothermal energy for power generation or heating is well received in Canada and is seen as an acceptable option to aid Canada in reducing carbon emissions. However, geothermal energy needs to be located in proximity to populous areas or power grids. Additionally, it has to be of benefit to those who are paying for the energy to obtain buy-in.

As an example, the City of Yellowknife, Northwest Territories commissioned a study to utilize the former Con Mine site (a former gold mine) to produce geothermal heat for apartments, offices, schools, and other buildings in the core of the city (Ghomshei, 2007). The City sought the residents (taxpayers) permission to borrow $49,000,000 towards developing a $60,000,000 geothermal project through a plebiscite vote. In the subsequent vote, residents voted 1,362 to 997 against borrowing the funds.

In this example of opposition to the project, it wasn't necessarily the cost or the utilization of geothermal energy for heating, it was essentially that most residents would not benefit directly from the project and would likely mean an increase in their property taxes or possibly a reduction of services to pay for the project. This outcome demonstrates the critical importance for local communities to share some of the direct benefits of clean energy development in order to get stakeholder buy-in.

5. FINDNG THE RIGHT PURPOSE

Utilization of geothermal resources requires creativity as to how the resource can be used based on its proximity to consumption. The previous example of utilizing a former mine site to generate geothermal heat has also been successful in Canada. In Springhill, Nova Scotia for example, a former coal mine was flooded with water and the heated body of water now provides heat and cooling to several industrial operations on-site, such as a plastics and battery manufacturing facilities (Jessop et al. 1995).

Following the successful utilization of geothermal energy from the former coal mine, a new geothermal industrial park is being proposed in Springhill to attract new investments in the area. However, a better understanding of the mine water resource needs to be better communicated to potential investors, as there is large financial risk associated with the development of alternative energy.

6. CURRENT STATUS

There has been a recent upsurge in interest in geothermal energy in Canada, including several new companies engaged in active resource exploration, including renewed looks at potential of volcanic belts of Canada as well as hot sedimentary basins of the country. Several companies as well as governments are engaged in exploration activity including drilling of thermal gradient holes and in one case a test well for a potential geothermal development. New research and funding opportunities are also being explored for targeted research of geothermal energy potential to support remote northern communities (heat and/or electricity).

7. CONCLUSIONS

Canada has enormous geothermal energy potential. New interest in converting Canada's economy to one based on low carbon fuels has recently driven increased interest in geothermal as a clean energy supply. Concerted effort is required to reduce numerous barriers that have limited geothermal exploration in the country, including significant new investment in geoscience research. As well as reducing exploration risk, geoscience can aid development of a new effective regulatory environment to attract industry investment. Public outreach and education is also required to raise the overall awareness and acceptance of geothermal energy as part of the clean energy mix. Critical is to develop effective means to share direct benefits of geothermal development with communities.

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