Canadian Expertise and Financing in Global Geothermal Exploration and Development

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ABSTRACT

Canadian companies and Canadian experts have made a mark in the global exploration and development of all types of mineral and hydrocarbon resources including geothermal energy. Most of the worlds exploration funds are raised on the Toronto Stock Exchange (TSX and TSX-V) that fuels the global search for mineral wealth. This is also true of the geothermal sector. But Canada's global ambitions came after focus on Canadian geothermal resources starting in 1975. The early 1970's worldwide oil crisis spurred increased interest in geothermal resources globally. The crises fostered an increased interest in both the USA and Canada, major oil producing nations, in geothermal resources. In 1973, a small group of energy professionals, scientists and academics came together in California to explore potential synergies and research projects that might help their countries combat the coming fuel shortages with another way to produce power. This was the nascent beginnings of the US-based Geothermal Resources Council (now Geothermal Rising). Several Canadians attended that meeting and upon returning to Canada, established the Canadian Geothermal Association as a not-for-profit technical association to bring together Canadians interested in geothermal energy both domestically and globally. The association is still active today, 50 years later, after rebranding as Geothermal Canada in 2018. During these 50 years Canadians have been active globally in all aspects of geothermal development from green-field exploration to brown-field development, to building and operating plants, to reservoir management. Canadian drilling expertise was also sought after based on the drilling of 1000's of wells since the early 1940s. Canadian drillers and engineers found themselves involved in geothermal exploration projects in Japan, USA and elsewhere. Research also included exploration technologies such as the development of electromagnetic geophysical methods. These methods were developed and first used in Canada at Mount Meager, supported by funding from Canada's Federal Government Natural Resources Canada (Geological Survey of Canada and the Earth Physics Branch).

1. Introduction

Canadians first became interested in geothermal energy resources in the early 1970's when a global oil crisis spurred increased interest in geothermal resources globally (Figure 1). The crises fostered an increased interest in both the USA and Canada (Hintz 2023). In 1973, a small group of energy professionals, scientists and academics came together in California to explore potential synergies and research projects that might help their countries combat the coming fuel shortages with another way to produce power. This was the nascent beginnings of the US-based Geothermal Resources Council, now known as Geothermal Rising.

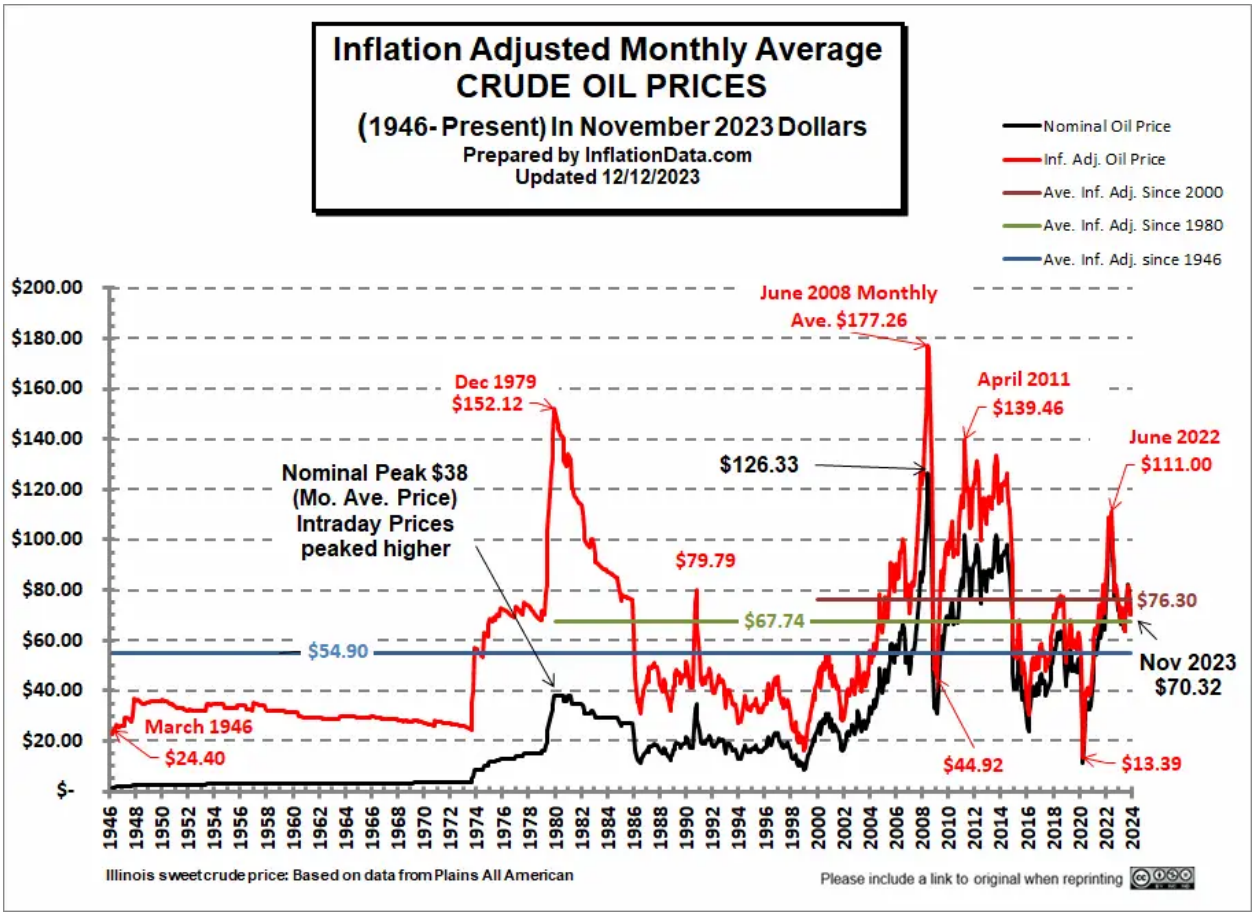

Figure 1: Inflation adjusted crude oil prices (https://inflationdata.com/articles/inflation-adjusted-prices/historical-oil-prices-chart/), showing the rise and fall of crude oil prices that fueled and cooled geothermal investments globally.

Three Canadians attended that meeting, Dr. Jack Souther, Geological Survey of Canada, Tim Sadlier Brown, and Andrew Nevin, both from Nevin-Sadlier Brown-Groodbrand and Associates. Upon returning to Canada, they established the Canadian Geothermal Association as a not-for-profit technical association to bring together Canadians interested in geothermal energy both domestically and globally. The association is still active today, 50 years later, after rebranding as Geothermal Canada in 2018. During these 50 years Canadians have been active globally in all aspects of geothermal development.

Canadians have been involved in everything from green-field exploration to brown-field development, to building and operating plants, to reservoir management. For more details on the efforts by Canadians in Canada see Jessop (2008) and Jessop et al. (2024). These papers chronical the significant investment made by the Canada Government between 1975 and 1985, to support geothermal research and development in Canada. In addition to the efforts at home in the 1980s and 1990's Canadian drilling expertise was sought after globally. Canadian drillers, well known from oil and gas exploration in the Western Canada Basin where 1000's of wells had been drilled since the early 1940s, found themselves involved in geothermal exploration projects in Japan, USA and elsewhere.

Canadian expertise in mineral exploration using geophysical methods was directed at the exploration for geothermal resources in the mid-1070's. Early R&D efforts by Greg Shore, Premier Geophysics, in the use of electromagnetic methods for exploration of high temperature systems, were first used in Canada at Mount Meager, supported by funding from Canada's Federal Government, Dept of Natural Resources (Shore 1978). These methods were soon being tested and deployed globally.

It was these early efforts and the training of a cadre of young geologists, geophysicists and engineers that led to expansion of the involvement of Canadian's in geothermal development efforts globally. Throughout the decades these investments have been largely financed by the Toronto Stock Exchange (TSX) and TSX Venture Exchange (TSX-V). These exchanges are home to 42% of the world's public mining companies. In 2021, 203 mining firms were listed on the TSX and 967 firms listed on the TSX-V. These firms had a combined market capitalization of $558 billion and raised $10 billion in equity capital in 2021.

2. Global Efforts

In the early 1980's Toronto based Polaris Renewable Energy became active in Nicaragua, developing an operating asset there (Tiffer et al. 1988). In Nevada, Vancouver based Nevada Geothermal explored and developed the Blue Mountain Geothermal field (Fairbank et al. 1999, Fairbank 2024). The mid-2000's saw several Canadian companies entering the scene, among these Western Geothermal, Siera Geothermal, and Magma Energy Corp. The capital investment in these companies was bolstered by the steady rise in crude oil prices noted from the early 2000s to the 2008 financial crises (Figure 1) (Helleiner 2011).

Western Geothermal focused on assets in Canada such as Meager Mountain, and Siera Geothermal was involved in exploration in Canada and the USA. In 2007 Magma Energy Corp was formed and commenced a global exploration program as well as purchasing operating assets in Nevada (Soda Lake) USA and Iceland (HS Orka Svartsengi and Reykjanes). Headquarters were in Vancouver, Canada in addition to offices in Lima, Peru; Reno, Nevada; Santiago, Chile; Sienna, Italy; and Keflavik, Iceland, they also established additional subsidiary companies in Chile (Hickson 2011), Italy, Nicaragua, and Peru. The company merged in 2011 with Plutonic Power Corp, becoming Alterra Power Corp. Eventually the company was bought by Innergex Renewable Energy, who continues developing renewable energy projects, but is no longer actively engaged in geothermal development, despite holding key geothermal assets in Italy and Chile.

The 2008 financial crises left many companies struggling to raise capital. Publicly traded Magma Energy Corp. was the first Canadian company of any type to go to the markets post-crises with an

"initial public offering." In June 2009, they raised just over $CDN120MM on the TSX. By 2013, many geothermal companies were again challenged to raise capital as crude oil prices fell (Figure 1) and the geothermal value proposition for electrical generation vs natural gas declined.

By the early 2020s, most of the financial and development emphasis for Canadians was on home grown projects (Huang et al 2023). With time the focus in Canada has shifted from low-cost Natural Gas and coal power generation to renewable energy projects, geothermal energy for power production is slowly gaining momentum in Canada (Huang and Hickson 2024). However, wind, solar and run-of-river hydro, still make up the bulk of renewable electricity projects in Canada.

Of note, is the 2023 achievement of Calgary based, Futera Energy Corp to produce the first geothermal electrons in their co-production facility in the Swan Hills of Alberta (https://www.globenewswire.com/news-release/2023/03/22/2632687/0/en/Canada-s-First-Co-Produced-Geothermal-Power-Project-is-Operational.html) , 40 years after the 250 kw generator produced power at Mount Meager, British Columbia in 1983. Additionally, Parex Resources Inc, based in Calgary, Alberta and operating in the Llanos Basin, Colombia, installed and operates two ORC units powered by a high temperature water cut from their hydrocarbon operations (Figure 2). Generation began in 2021, as the second only geothermal power plant operating in South America. Polaris continues to develop the geothermal resources of Nicaragua and has also expanded into solar and hydro projects in Latin America.

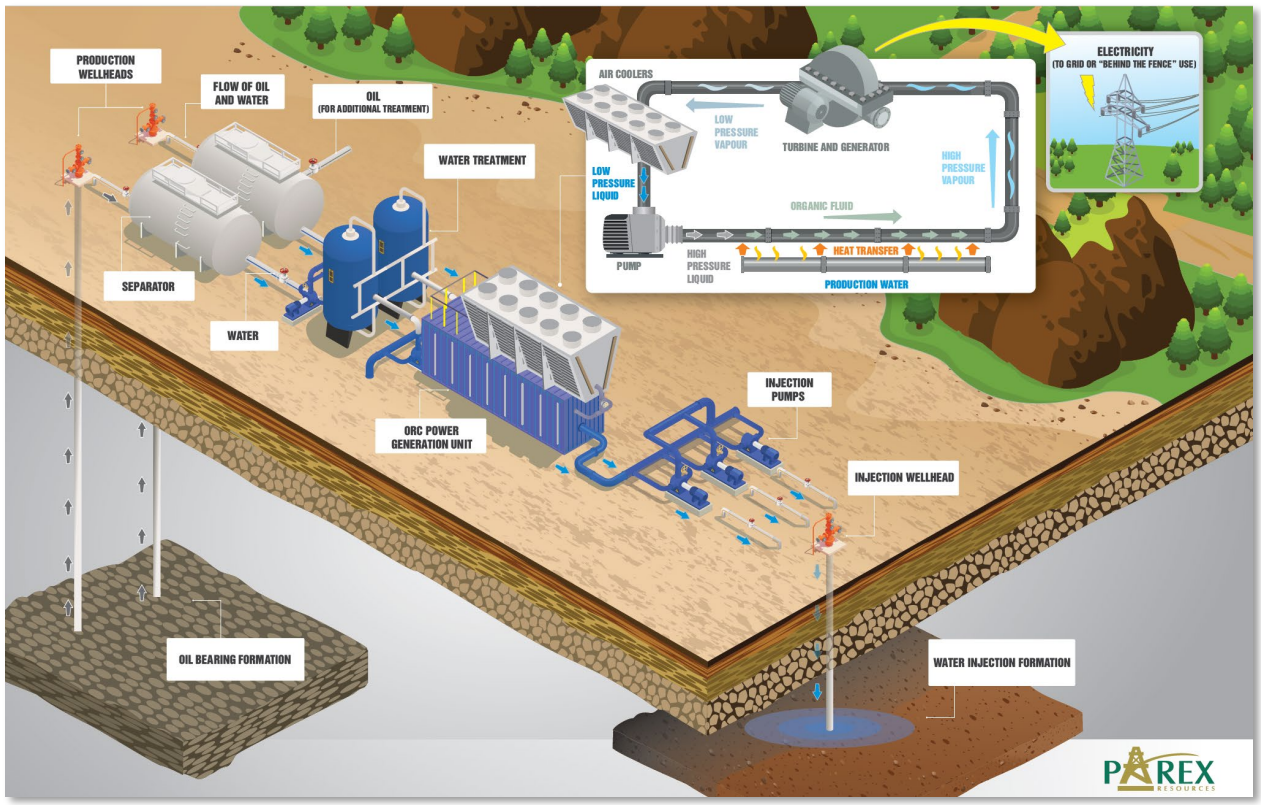

Figure 2: Parex Resources Ltd. operating ORC unit in the Llanos Basin, Colombia, utilizes a high temperature water cut to produce electricity then used in the field operations.

Acknowledgement

The Canadian pioneers who laid the groundwork for the current cohort of geothermal geoscientists and engineers are thanked for their perseverance and fortitude. Innovation and advances in the oil and gas sector have fueled new ways of looking at geothermal development, these pioneers are thanked for their contributions over the decades. The authors apologize for projects and developments where Canadian's have been instrumental and have been missed in this brief review. The mention of any specific project is not an endorsement of that project or the development team. We welcome updates and additions.

REFERENCES

Fairbank, B. P. Blue Mountain "Faulkner 1" 49.5 MW Geothermal Power Plant, Humbolt County, Nevada – A Canadian Story. GeoConvention, Calgary, AB. (2024)

Fairbank, B. and H. Ross. "Geology and Temperature Gradient Surveys - Blue Mountain Geothermal Discovery, Humboldt County, Nevada." TRANSACTIONS-GEOTHERMAL RESOURCES COUNCIL: 513-518. (1999)

Gutiérrez-Negrín, C.A. "Evolution of worldwide geothermal power 2020–2023." Geothermal Energy (2024) 12:14 https://doi.org/10.1186/s40517-024-00290-w (2023)

Helleiner, Eric. "Understanding the 2007 – 2008 Global Financial Crises: Lessons for Scholars of International Political Economy." Annual Review of Political Science, Volume 14:67-98 https://doi.org/10.1146/annurev-polisci-050409-112539 (2011)

Hickson, C. J. F., F.; Rodriquez, C.; Sielfeld, G.; Henriquez, R.; Gislason, T.; Selters, J.; Benoit, D.; White, P.; Southon, J.; Ussher, G.; Charroy J.; Smith, A.; Lovelock, B.; Lawless, J.; Quinliven, P.; Smith, L.; Yehia, R. "The Mariposa Geothermal System, Chile." Geothermal Resources Council Annual Meeting, San Diego, CA, GRC. (2011)

Hintz, E. "Looking Back on the 1973 Oil Crisis, New Perspectives on Energy Innovation." Lemelson Center for the Study of Invention and Innovation. (2023)

Huang, K and Hickson, C.J. "Geothermal Energy Solutions for Canada's Geological Provinces" GRC Transactions, Vol 48 (2024).

Huang, K., Dehghani-Sanij, A., Hickson, C., Grasby, S.E., Smejkal, E., Miranda, M.M., Raymond, J., Fraser, D., Harbottle, K., Torres, D.A. "Canada's Geothermal Energy Update in 2023." *Energies*, 17, (2024), 1807.

Jessop, A. "Review of National Geothermal Energy Program, Phase 2 – geothermal potential of the Cordillera." Geological Survey of Canada, Open File 5906, (2008), 86.

Jessop, A., S. Grasby and C. J. Hickson. "The history of geothermal research in Canada." GeoConvention, Calgary, AB, CEGA. (2024)

Shore, G. Meager Creek Geothermal System, British Columbia, Part III: Resistivity Methods and Results. Geothermal Resources Council Annual Meeting. 2: 593-596. (1978)

Tiffer, E. M., R. A. Lacayo and G. Sabatino. "Geothermal development in Nicaragua." Geothermics 17(2): 333-354. (1988)