



September 16th, 2021

Patrick Wruck, Commission Secretary
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Subject: British Columbia Utilities Commission (“BCUC”) – Inquiry into the Regulation of Safety
Intervener Evidence Addressing Stage 1

Dear Mr. Wruck,

In compliance with Appendix A-8 to Order G-209-21, Borealis GeoPower Inc. provides to the panel its Intervener Evidence Addressing Stage 1.

Please find Borealis GeoPower Inc.’s comments attached.

Warm Regards,

A handwritten signature in black ink that reads 'Alison Thompson'.

Alison Thompson
CEO
Borealis GeoPower Inc.

Borealis GeoPower Inc. – Intervener Evidence Addressing Stage 1

About Borealis

Founded in 2007, Borealis GeoPower Inc. is a small clean technology enterprise focused on developing geothermal energy projects throughout Canada. Our portfolio includes projects with exploration permits as well as a diverse collection of consulting assignments across Canada. We work closely with our host communities and First Nations partners to enable energy projects that support local jobs, a diversified economy, zero-emission power and heat production, and participation in the international natural resources sector via rare earth elements in geothermal brines.

Framing the Discussion

Borealis GeoPower Inc. (Borealis) is an intervener in this proceeding with the overarching goal of encouraging the development of safe and reliable geothermal energy systems, including those that may be classified as Indigenous Utilities or Municipal Utilities. It is Borealis' view that the prevention of over-regulation, be it in scope or complexity, is crucial to the encouragement of geothermal energy system development. In this proceeding, Borealis is also representing the Canadian Geothermal Energy Association (CanGEA) and Kitselas Geothermal Inc. (KGI). Further, Borealis is also partnered with the Village of Valemount on a district heating project.

Borealis thanks the Panel for agreeing that the safety of the environment could be included in the Stage 1 Sub Issues. We anticipate addressing this issue during the Intervenor Final Argument stage and regret that due to the COVID situation, we did not have time to proactively detail that information in this submission.

Geothermal energy systems have proliferated around the world over the last 125 years and are characterized by their benign operating and safety history. Borealis looks forward to receiving Information Requests about the safety record of the international geothermal district heating (and cooling) industry and regrets that due to the COVID situation, we did not have time to proactively detail that information in this submission. Instead, we have prioritized our time towards an issue we first raised in our November 12, 2020 submission.

To excerpt our November 12, 2020 submission:

“It is Borealis's understanding that the pipeline facilities of a geothermal energy system that uses a geothermal resource of less than 80 °C are regulated by the BCUC and TSBC. In this scenario, there is no standard prescribed for the regulation of these facilities. As such, Borealis is concerned that the standards applied, out of an abundance of caution, may be those designed for oil and gas activities.

“It is Borealis’s understanding that the pipeline facilities of a geothermal energy system that uses a geothermal resource of 80 °C or greater are regulated by the BC OGC and TSBC. In this scenario, the standards for safety are presumed to default to oil and gas standards.

“In British Columbia, geothermal energy systems that derive water from a Hot Sedimentary Aquifer (HSA) may warrant the application of oil and gas regulations, (at any temperature – this parentheses comment added in the September 15, 2021 submission)). For example, the Clarke Lake project in NE British Columbia, while planning to produce geothermal resources, will be operating in an area where natural gas is known to exist, and natural gas has been historically produced. It must be noted that HSAs can produce waters that are less than 80 °C.

“Other potential geothermal energy systems, such as those hosted outside of sedimentary basins, do not bear any relation to oil and gas, no matter their temperature. These systems operate at low pressure, are not flammable, **and the fluids are less corrosive** (emphasis added in the September 16, 2021 submission). These systems do not pose the same safety risks as an oil and gas related system and the application of oil and gas standards to these systems will overregulate and discourage development.

“Borealis is seeking the development of a set of safety standards tailored for non-sedimentary basin geothermal pipeline facilities to fill the legislative vacuum, providing safety and certainty to the development and operation standards of geothermal energy systems.

“Given that Borealis (or its partners – this parentheses comment added in the September 15, 2021 submission) and KGI will likely be coming before relevant government bodies seeking a permit for geothermal pipelines in the near-future, Borealis, KGI, and CanGEA would welcome an opportunity to provide pre-emptive advice and global case studies to such relevant government bodies for the creation of this new set of standards.”

In response to our November 12, 2020 submission, the BC Oil and Gas Commissions provided a Letter of Comment (Exhibit E-5) to the BCUC on February 11, 2021. An excerpt from that letter follows:

“Under the *Geothermal Resources Act (GRA)*, the Commission is the regulatory responsible for overseeing environmental and public safety risks from geothermal operations in British Columbia.”

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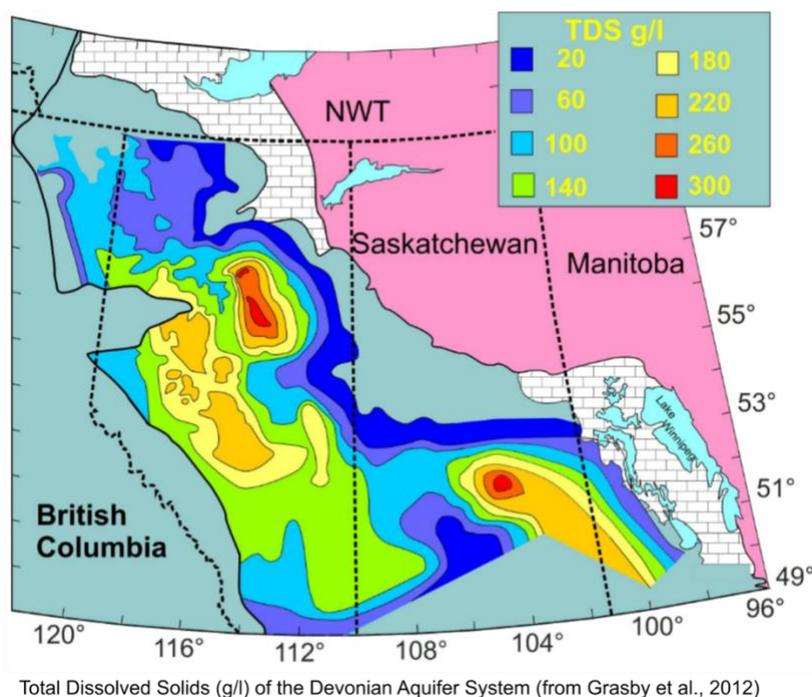
“The *Geothermal Operations Regulation* is specific to geothermal activity and does not apply oil and gas standards to the regulation of geothermal wells, regardless of whether the well derives water from a hot sedimentary aquifer, except in the instance of pipelines. (Emphasis added by Borealis in the September 15, 2021 submission).

...

“Geothermal pipelines fall under OGAA, and are regulated by the Commission, including requirements to follow relevant sections of CSA Z662¹ (a national standard). This is consistent with the approach to pipelines for water produced as a by-product during oil and gas extraction.” (Emphasis added by Borealis in the September 15, 2021 submission.)

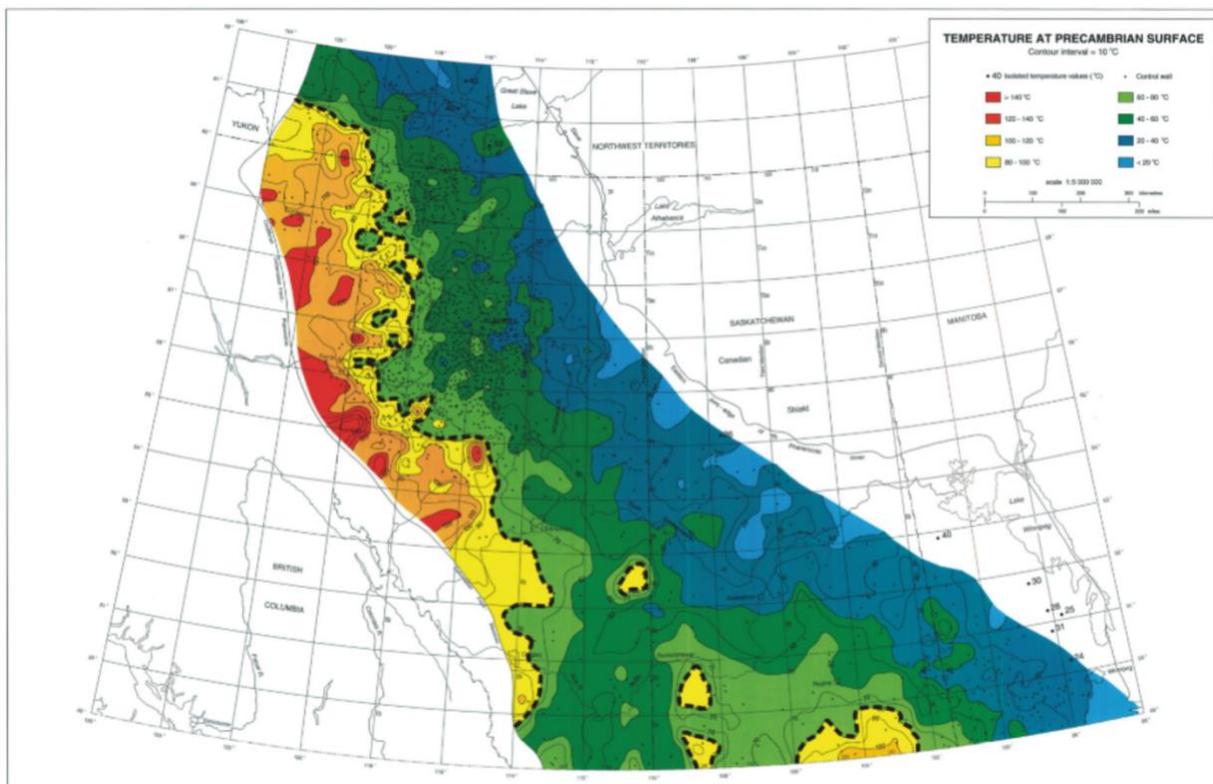
On April 16, 2021, Borealis responded to Exhibit E-5 and we encourage this Inquiry’s participants to review that response again. We further wish to add the following information to highlight the operating safety differences between water derived from Hot Sedimentary Aquifers, regardless of if the temperature is above or below 80 °C, and geothermal waters from convective reservoir systems. Borealis thanks both the BCUC and OGC for the time spent building their internal capacity on appropriate safety regulations for the geothermal energy industry.

Fluids entrapped in sedimentary formations that may be used for geothermal purposes are commonly highly saline and may contain hydrogen sulphide, or sour gas. This high salinity is due to extended contact between the fluid and host rocks lasting for millennia, thereby allowing for the accumulation of dissolved compounds in the fluid, in addition to remnant salinity from connate waters (deposited with the sediments). The distribution of salinity in a sedimentary basin will thus be the product of connate water salinity, rock composition and thermal history, and hydrologic parameters. While salinity commonly increases with depth as the fluids have been entrapped for a longer period of time, other hydrologic processes may affect the formations. As an example, below is a map of the salinity distribution in Devonian Aquifers of the Western Canada Sedimentary Basin (from Grasby et al., 2012). This aquifer has undergone glacial recharge and dilution of its waters in its western edge, but most areas in central Alberta remain saturated in Total Dissolved Solids (TDS).



¹ Canadian Standards Association Standard CSA Z662, Oil and Gas Pipeline Systems, as amended from time to time.

The salinity of a sedimentary brine is also independent of the temperature of the fluid, as evidenced by the high salinity values from brines from central Alberta (e.g., Swan Hills area), despite their relatively low temperatures (60-80°C). The map below shows the temperature at the base of the sedimentary basin, representing the maximum temperature of brines across the basin.

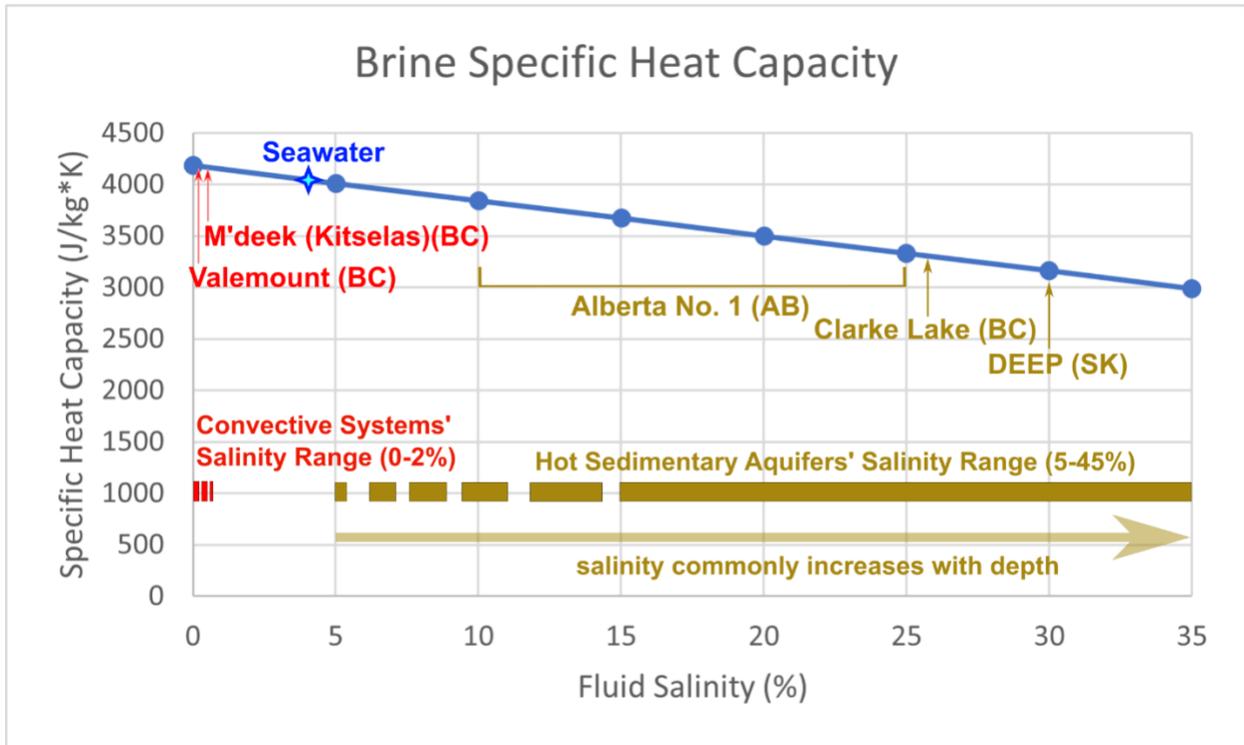


Temperature at the base of the Western Canada Sedimentary Basin (Precambrian surface) (from Grasby et al., 2012)

On average, both salinity and temperature increase with depth, and the salinity of Hot Sedimentary Aquifers displays a wide range of values.

In contrast, convective geothermal fluids are primarily sourced from the recent infiltration of meteoric waters, which are actively circulating through the system preventing extended accumulation times in the host rocks. The meteoric origin and reduced contact time with the host rocks result in very low salinities for convective geothermal fluids, and vastly different compositions than sedimentary brines. In addition, hydrocarbon compounds or hydrogen sulphide are not found in significant quantities in convective geothermal fluids, having concentrations of several orders of magnitude less than those seen in sedimentary brines, and thus do not pose the same corrosion and safety risks.

The graphic below illustrates the ranges of salinities common to each type of geothermal system in relation to the specific heat capacity of the solution.



Salinity assumed as derived entirely from NaCl (880 J/kg*K) (from Borealis GeoPower, 2021).

Our excerpt from our April 16th, 2021 submission still holds as our conclusion:

“Borealis continues to respectfully submit to the BCUC and OGC that a different standard must be accepted as the default standard for non-HSA geothermal pipelines. As Borealis has stated before, while the geothermal energy industry is new to BC and Canada, it is not new to the world. Many suitable international standards already exist for modification and adoption.”

Sincere Regards,

Tim Thompson
 Chair
 Borealis GeoPower Inc.