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Revisiting the Geothermal Potential of the Dehcho Region in NWT, Canada

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Summary

The Dehcho Region is located in Canada's Northwest Territories (NWT). The region consists of ten small communities of under 1000 people (2022 total population of 7,174) (Figure 1). This represents 16% of the population of NWT, but it should be noted that almost 50% (2022: 21,720) of the population live in the capital City of Yellowknife (2022). Presently, the electricity needs of the Dehcho region communities are supplied by diesel generators. The thermal needs of the communities are provided by heating oil fired furnaces, hydronic systems in larger buildings, and combustion of wood in individual residences. The southern NWT region was identified several decades ago as having a high potential for geothermal energy, due to the high bottom-hole temperatures discovered during exploration drilling for gas and oil (Grasby et al. 2013). To increase energy stability and sustainability, as well as reducing the carbon emissions of the Dehcho region, geothermal energy is being evaluated for both heat and power generation. The first detailed evaluation carried out by Terrapin Geothermics was in the community of Nahanni Butte, NWT (Hickson et al. 2023). The examination of geothermal energy potential at Nahanni Butte encouraged the Dehcho First Nation to begin investigations into the geothermal energy potential of the entire Dehcho Region.

The initial focus of this study was the collection of new data from wells being decommissioned at Cameron Hills (Smejkal et al. 2023). Analysis of newly collected data and archived regional data resulted in a revision of the understanding of the geothermal potential of the Dehcho region.

By utilizing the data from existing hydrocarbon wells in the Dehcho region, an individual geothermal gradient was calculated for each of the communities (Figure 1 and Table 1). The data from the hydrocarbon wells was also used to estimate the depth of the sedimentary basin at each community and the presence of potential geothermal reservoirs. This data is intended to provide each community with more information about the geothermal potential at their location. With this information, it is possible to investigate the possibility of deploying geothermal energy technologies appropriate for their location, infrastructure and load requirements.

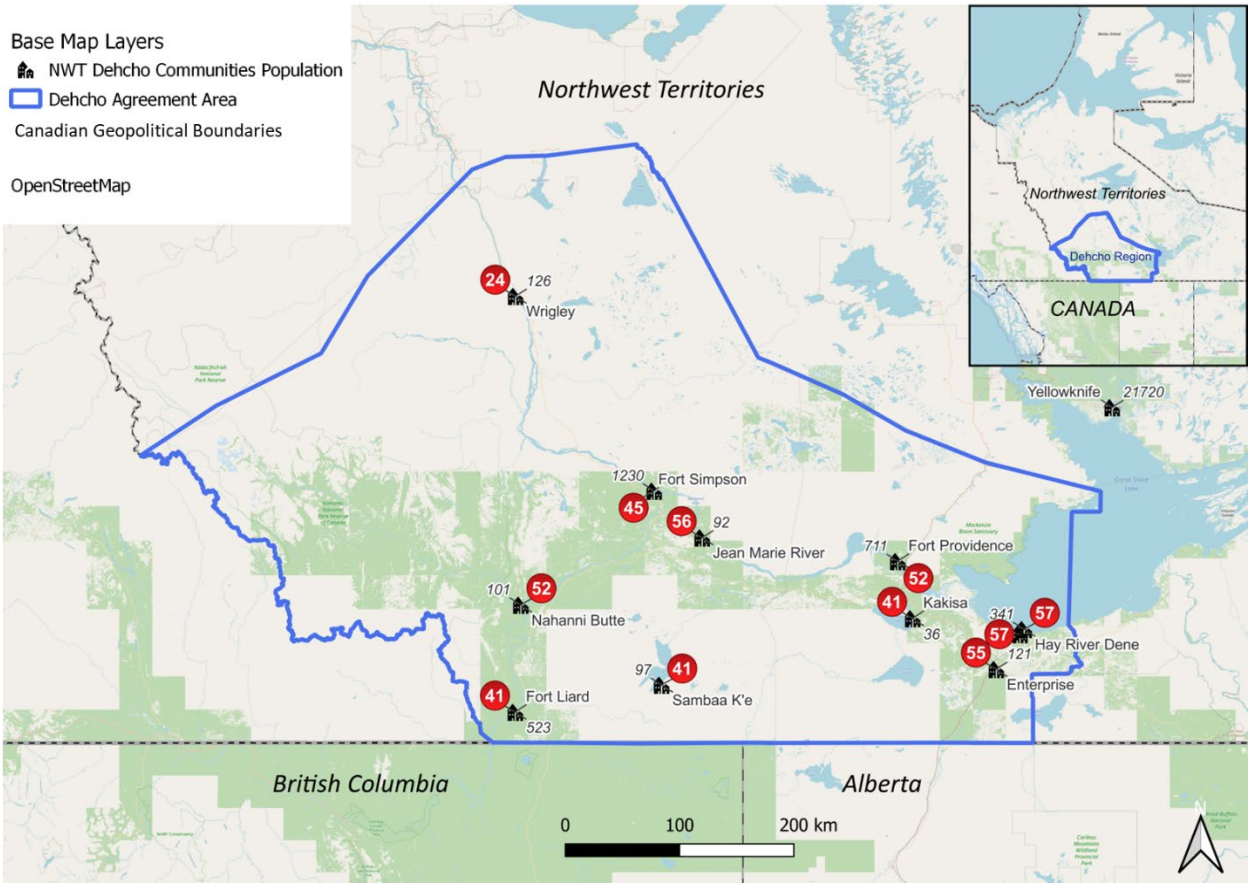

Figure 1: The Dehcho Region of Northwest Territories (NWT), Canada, showing the communities, their populations and the geothermal gradient calculated from preexisting hydrocarbon data.

Table 1: The calculated geothermal gradient for each community in the Dehcho Region, NWT. Also included is the depth to the top of the Precambrian crystalline basement, the temperature at the top of the Precambrian and the meter of Precambrian that would need to be drilled in order to access 60°C (geothermal heat) and 120°C (geothermal power).

Community	Population (2022)	Geothermal Gradient (°C/km)	Depth to Precambrian (mTVD)	Temperature at Precambrian Top (°C)	Depth (m) to 60°C	Depth (m) to 120°C	Meters of Precambrian to Drill to 60°C	Meters of Precambiran to Drill to 120°C
Kakisa	36	40.63	761.25	30.93	1476.74	2953.48	715.49	2192.23
Hay River	3796	57.28	614.60	35.20	1047.49	2094.97	432.89	1480.37
Enterprise	121	55.39	720.43	39.90	1083.23	2166.46	362.79	1446.02
Fort Providence	711	52.07	589.15	30.68	1152.29	2304.59	563.14	1715.44
Nahanni Butte	101	51.51	1200.00	61.81	1164.82	2329.64	0.00	1129.64
Fort Liard	523	40.71	5000.00	203.55	1473.84	2947.68	0.00	0.00
Jean Marie River	92	55.81	683.70	38.16	1075.08	2150.15	391.38	1466.45
Sambaa Ke	97	41.16	1993.34	82.05	1457.73	2915.45	0.00	922.11
Wrigley	126	24.32	1718.90	41.80	2467.11	4934.21	748.21	3215.31
Fort Simpson	1230	44.96	755.90	33.99	1334.52	2669.04	578.62	1913.14
Cameron Hills 2023 Data	0	41.05	1577.05	64.74	1461.63	2923.26	0.00	1346.21
Cameron Hills Historical Data	0	34.99	1577.05	55.18	1714.78	3429.55	137.73	1852.50

Results, Observations, Conclusions

The geothermal potential of the Dehcho region is among the highest in Canada, but sparse population, great distances and lack of infrastructure make utilization of the resource challenging. The technology implemented needs to be “right sized” by considering the community’s needs and future development plans to find the best application of renewal energy solutions (Hickson et al. 2023, Smejkal et al. 2023). This may include geothermal technology, or hybrid systems such as waste heat recovery from existing diesel generation, and lower cost thermal systems providing base-load heating on a multidecadal time frame (Dehghani-Sanij et al. 2023). Small scale hybrid geoexchange/geothermal systems should be investigated whenever new development is being contemplated by communities (Hickson et al. 2023). These systems will likely provide the longest sustainability at the lowest greenhouse gas expenditure and potentially the lowest operating costs with escalation in hydrocarbon prices. Enhanced and Advanced geothermal systems (Hickson et al. 2024) are potential technologies that could be deployed in the Dehcho region but will require alternative funding structures as there is limited commercial basis to attract private sector

investment. Each community within the Dehcho will require an individualized plan for energy sustainability based on these findings. The gathering and analysis of the data from the Cameron Hills (Smejkal et al. 2023) has been instrumental in providing this updated perspective on the geothermal potential of the Dehcho region (Hickson et al. 2023).

Acknowledgements

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