

★ Hot springs

- Cenozoic plutons (<64 Ma)
- Late Cretaceous plutons (82-64 Ma)
- Mid-Cretaceous plutons (115-90 Ma)
- Early Cretaceous plutons (125-115 Ma)
- Triassic - Jurassic plutons (230-160 Ma)
- late Paleozoic plutons (320-252 Ma)
- mid-Paleozoic plutons (370-340 Ma)

- Radiogenic heat production A (μW/m³)**
- <2.5
  - 2.5 - 4.0
  - 4.0 - 6.0
  - 6.0 - 8.0
  - 8.0 - 10.0
  - >10.0
- Values >4.0 are labelled on the map

**RECOMMENDED CITATION**

COLPRON M., 2019. Potential radiogenic heat production from granitoid plutons in Yukon, Yukon Geological Survey, Open File 2019-16.

This map supersedes Yukon Geological Survey, Open File 2017-60 by M. Friend and M. Colpron.

Data compilation by Melissa Friend, Justin Emberley and Maurice Colpron; digital cartography and drafting by Maurice Colpron, Yukon Geological Survey. Any revisions or additional geological information known to the user would be welcomed by the Yukon Geological Survey.

This map and supporting digital data can be downloaded free of charge from the Yukon Geological Survey website: [yukon.ca/science-and-natural-resources/geology](http://yukon.ca/science-and-natural-resources/geology).

Paper copies of this map may be obtained from the Yukon Geological Survey, Energy, Mines and Resources, Yukon government, P.O. Box 2703 (K-102), Whitehorse, Yukon, Y1A 2C6. Email: [geology@gov.yk.ca](mailto:geology@gov.yk.ca).

**NOTES**

This map presents results for calculations of the potential for radiogenic heat from granitoid plutons to produce radiogenic heat. The calculations are performed using U, Th, and K concentrations from whole rock geochemical data compiled from various sources in the Yukon Geological Survey lithochemical database. The objective of this exercise was to identify plutons with anomalously high potential for radiogenic heat production to use as a targeting tool for geothermal resource exploration.

**Background:** More than 80% of the heat produced in the Earth's crust comes from granitoid rocks. When granitoid rocks form they naturally concentrate radioactive elements such as U, Th, and K, and the radiogenic decay of these elements is an exothermic reaction. The radioactive decay of these elements within a granitoid body may generate local heat anomalies and elevated geothermal gradient at relatively shallow crustal levels. In combination with other local rock properties (e.g., porosity, permeability, thermal conductivity), radiogenic heat has the potential to generate a geothermal resource.

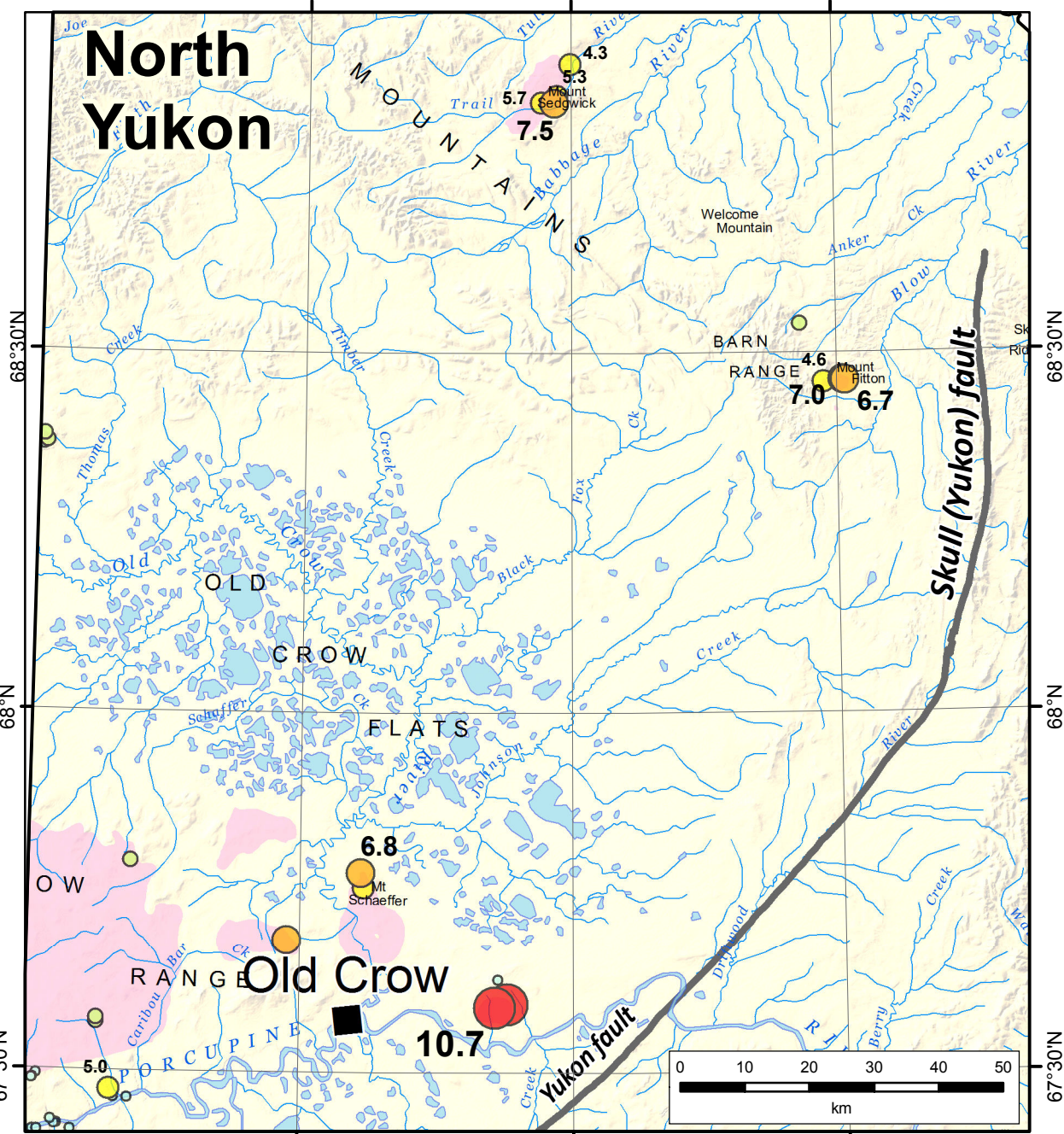
The decay of radioactive elements converts mass into radiation energy, which in turn gets converted to heat. While all naturally radioactive isotopes generate some heat, significant heat generation only occurs from the decay of <sup>238</sup>U, <sup>235</sup>U, Th and <sup>40</sup>K. Therefore, potential heat production is governed by the concentrations of U, Th and K in the rock. In igneous rocks, radiogenic heat production is dependent on the bulk chemistry of the rock and decreases from acidic (e.g., granite) through basic to ultrabasic rock types. Therefore, granites with anomalously high concentrations of U, Th and K are targets for calculating potential radiogenic heat production.

Potential radiogenic heat production (A) from plutonic rocks can be calculated using this equation:

$$A (\mu W/m^3) = 10^{-9} P (9.52c_U + 2.56c_K + 3.48c_{Th})$$

where c is the concentration of radioactive elements U and Th in ppm, and K in %; and P is the rock density. Heat production constants of the natural radio-elements U, Th, K are 9.525 · 10<sup>-9</sup>, 2.561 · 10<sup>-9</sup> and 3.477 · 10<sup>-9</sup> W/kg, respectively.

**Data and Methods:** Geochemical data from ~1760 samples of plutonic rocks from Yukon are used to calculate potential heat production. The calculated values for radiogenic heat production (A) are plotted over the mapped distribution of Paleozoic and younger plutonic rocks and major crustal faults are also shown for reference.



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Energy, Mines and Resources  
Government of Yukon

Open File 2019-16

**Potential radiogenic heat production from granitoid plutons in Yukon**

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