High heat production Mount Douglas Granite and potential for geothermal energy resources in southwestern New Brunswick, Canada

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The radiogenic heat production of the Mount Douglas Granite was examined to determine potential for Hot Dry Rock (HDR) geothermal resources in this area. The highly fractionated Mount Douglas Granite, which is located in southwestern New Brunswick, has characteristic features of high heat production (HHP) granites, in which the granites have elevated concentrations of K_2O, Rb, LREE, U, and Th. They produce anomalous heat generated by radiogenic decay of unstable isotopes, such as ^{238}U, ^{232}Th, and ^{40}K. The uraniferous nature of the granite is well established by a number of criteria, including whole-rock geochemical data, displaying high U and Th contents (≤ 22 ppm U; ≤ 71 ppm Th), which are significantly higher than the average continental crust (Th = 10.5 ppm; U = 2.7 ppm). The presence of U-, Th-, and REE-bearing minerals (e.g., monazite, zircon, xenotime, thorite, bastnaesite, and uraninite) and significant U and Th anomalies in some oxide and sulfide minerals (e.g., wolframite, hematite, and martite) support the uraniferous nature of the granite, along with previous airborne radiometric surveys and a recent gamma-ray spectrometry survey.

Assuming a density of 2.61 g/cm^3, the calculated average weighted mean radiogenic heat production of the granite is 5.9 µW/m^3 (14.1 HGU). This ranges from 2.2 µW/m^3 in the least evolved unit, Dmd1, up to 10.1 µW/m^3 in the most fractionated unit, Dmd3. They both are significantly higher than the average upper continental crust (1.65 µW/ m^3). The high radiogenic heat production of the Mount Douglas Granite, accompanied by a high estimated heat flow of 70 mW/m^2, identifies the granite as a "hot crust" (>7 HGU) HHP granite and highlights its potential for geothermal energy exploration. This could be a local, renewable and clean energy source associated with deep, hot crystalline rocks having temperatures generally higher than 150 ºC. Such high heat production is expected to result in local heat flow anomalies for the area, although further investigation, such as airborne radiometric surveys, seismic data, and satellite magnetic data, are required. The surface heat flow (a function of radioactive element content), the latest thermal event, and the intensity of tectonic activity are other important parameters that should be considered when evaluating potential geothermal resources.

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