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Geothermal potential of Caledonian granites in Ireland and the Isle of Man: Implications from hydrothermal alteration

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Ordovician to Devonian (Caledonian) granites are common in the Iapetus Suture Zone (ISZ) in Ireland and Britain. Some of these, e.g., the buried Kentstown and Glenamaddy granites, are situated beneath Upper Palaeozoic sedimentary basins, and hence are potential geothermal targets.
Numerous granites of similar age and related origin (Fritschle et al., 2014) are exposed astride the ISZ. They are considered to be analogous to the buried ones, and their geochemical characteristics are used as a proxy for the buried granites as samples from deep drilling are naturally limited.
The whole-rock geochemistry of nine granite intrusions (71 samples, including both hydrothermally altered and unaltered samples) varies significantly, but with no obvious geographical control. The granites are S- and I-Types with ASI (Aluminium Saturation Index) between 0.7 – 1.4. Average heat production rates range from 1.4 μW/m^3 for the Leinster Granite to 4.9 μW/m^3 for the Drogheda Granite (Fritschle et al., 2015).
The heat-producing elements uranium (U), thorium (Th) and potassium (K) and calculated heat production rates generally correlate positively with niobium and rubidium concentrations. However, S-Type compared to I-Type granites show elevated abundances in rubidium (>130 ppm) and usually have a lower Th/U ratio. Altered samples tend to have a higher Th/U ratio compared to unaltered ones.
Within individual plutons trends of decreasing heat production rates with increasing Th/U ratios were observed. This trend is attributed to the hydrothermal redistribution of the mobile heat-producing element uranium. This is also implied by uranium-enrichment in hydrothermally generated Ca and Si-veinlets.
Metasomatic processes such as hydrothermal alteration appear capable of significantly redistributing mobile elements such as uranium. Hence, these processes may act as a major mechanism controlling the granite's heat production budget, often shaping a pluton's geothermal exploitation potential.

Fritschle, T., Daly, J.S., Whitehouse, M.J., Buhre, S., McConnell, B., 2015. Geothermal potential of Caledonian granites astride the Iapetus Suture Zone in Ireland and the Isle of Man – Implications for EGS prospectivity. Proceedings World Geothermal Congress 2015, in press.
Fritschle, T., Daly, J.S., Whitehouse, M.J., McConnell, B., Buhre, S., 2014. Zircon geochronology and Hf-O isotope geochemistry from granites in the Iapetus Suture Zone in Ireland and the Isle of Man. Geophysical Research Abstracts 16, EGU-2014-801.