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Deep geothermal energy from the Cornubian Batholith: preliminary lithological and heat flow insights from the United Downs Deep Geothermal Power Project.

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SW England is the most prospective region in the UK for the development of deep geothermal energy as it has highest heat flow values (c. 120 mW m^{-2}) and predicted temperatures greater than 190 ^{o}C at 5 km depth. The United Downs Deep Geothermal Project (UDDGP), situated near Redruth in Cornwall, is the first deep geothermal power project to commence in the UK. Two deviated geothermal wells, UD-1 (5058 m TVD) and UD-2 (2214 m TVD), were completed in 2019 and intersect the NNW-SSE-trending Porthtowan Fault Zone (PTFZ) within the Early Permian Cornubian Batholith.

The Cornubian Batholith is composite and can be divided into five granite types that were formed by variable source melting and fractionation [1]. These processes were the primary control on the heterogeneous distribution of U, Th and K that underpins heat production in the granite. Previous high resolution airborne gamma-ray data has demonstrated the spatial variation of near-surface granite heat production [2], and the CSM Hot Dry Rock Project (1977-1991) provided U, Th and K distributions to depths of 2600 m in the Carnmenellis Granite [3]. However, uncertainties in: (i) U, Th and K content in the deeper batholith, (ii) thermal conductivity are still challenges to modelling the high heat flow.

Preliminary evaluation of UD-1 downhole spectral gamma data (900-5057 m) indicates the presence of three major granite types on the basis of contrasting U and Th characteristics. QEMSCAN mineralogical analysis of cuttings (720 – 5057 m) demonstrates the overwhelming dominance of two mica (G1) and muscovite (G2) granites and little expression of biotite (G3) granites. U- and Th- bearing accessory minerals include monazite, zircon and apatite, with the appearance of allanite and titanite in the deeper granites. Representivity analysis between various cutting fractions show no systematic bias in the major mineral components.

There is a substantial increase in Th below 3000 m that indicates the deeper parts of the batholith are likely to contribute substantially to overall heat production. Monazite is the primary source for Th and has a close association with micas. Mineralogical, mineral chemical, whole-rock geochemical and coupled thermal conductivity analysis is ongoing to improve understanding of

the construction of this part of the Cornubian Batholith and its implications for the regional thermal resource and sub-surface temperature evaluation.

References:
[1]Simons B et al. (2016) Lithos, 260: 76-94
[2]Beamish D and Busby J (2016) Geothermal Energy, 4.1:4
[3]Parker R (1989) Pergamon, 621.44