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The hydraulic structure of Late Carboniferous fault zones in the Scottish Midland Valley applied to hydrogeological modelling of the Strathden Group aquifers of Fife, Scotland

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It is becoming increasingly common in regions with shallow geothermal gradients, such as the UK, for Hot Sedimentary Aquifers (HSAs) to be exploited to generate domestic heating. Within Scotland, a particularly promising site for this use includes the aquifers of the Upper Devonian/Lower Carboniferous Strathden Group below Guardbridge, Fife.

A 2016 feasibility study by Robinson and co-workers (2016) into the geothermal production of these aquifers used a finite element numerical model to simulate groundwater flow. A key feature of the proposed hydrogeological model was the Dura Den fault, a regional normal fault striking parallel to the Highland Boundary Fault. However, due to a dearth of field data, it was not possible to accurately model the architecture, and thus permeability structure, of the fault zone.

The proposed study intends to constrain the architecture of the Dura Den fault and comprable structures elsewhere in the Scottish Midland valley. These other faults will be selected by their similarity with the Dura Den fault, i.e. orientation, offset and cutting Carboniferous or Devonian strata. Possible candidates include the West and East Ochil, Abbey Craig, Campsie and Rosyth Faults, with all of the aforementioned structures having formed roughly contemporaneously with the Dura Den fault in the Late Carboniferous. Field analyses will be carried out using a 1-D & circular scan-lines, 3-D photogrammetry and large-scale fracture mapping to create a statistically useful dataset of fault zone characteristics.

A numerical hydrogeological model of the Guardbridge aquifers will then be constructed using an OpenGeoSys finite element platform, applying field data from the Dura Den fault and analogous structures. This is intended to provide a more detailed insight into the effect of fault characteristics and fracture permeability on subsurface hydrodynamics and heat output from the geothermal extraction system proposed by Robinson and co-workers (2016).

Reference:
Robinson, R.A.J.; Townsend, P.; Steen, P.; Barron, H.; Abesser, C.A.; Muschamp, H.; McGrath, I.; Todd, I., 2016. Geothermal Energy Challenge Fund: the Guardbridge Geothermal Technology Project, s.l.: St. Andrews University.