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Mapping the geothermal potential of fault zones in the sedimentary basins of the Belgian and Netherlands border region.

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Faults often determine the success or failure of low enthalpy geothermal projects. This is due to their prevalence throughout the subsurface and capacity to behave as significant fluid flow pathways or baffles (or both simultaneously). Here we present the methodology and results of an assessment of the capacity of faults in the Belgium and Netherlands border region to impact geothermal potential. This work was completed as part of a crossborder project in the European INTERREG Iva program Flanders-The Netherlands.

The geothermal potential of reservoirs and fault zones was mapped across the Belgian provinces of Limburg and Antwerpen, and Dutch provinces of Limburg and Noord-Brabant. The Roer Valley Graben (RVG) and the Campine Basin are the main structural elements within this region. The four most significant reservoir intervals were correlated across the border. These comprise Upper Cretaceous chalk, Lower Triassic sandstones, Upper Carboniferous sandstones and Lower Carboniferous limestones. Mapped faults cutting these intervals were also correlated. Regional-scale maps have been created indicating the likelihood of fault zones to improve geothermal potential in these intervals.

The capacity of faults to improve geothermal potential was determined from factors known to increase or decrease fault permeability. Lithology was a primary consideration: Carbonate rocks tend to fracture along fault zones, creating breccia or joints, resulting in an increased permeability. Permeability can be further increased by karst processes, as evidenced at the Venlo geothermal project, Netherlands. Therefore areas with faults in the carbonate reservoirs were considered to have possible potential. Conversely, permeability is likely to decrease in the clastic reservoir units as cataclastic processes dominate. Such faults were not considered to have additional geothermal potential.
The timing of fault activity was considered another key variable. Recently deformed faults are more likely to be permeable as fractures tend to be cemented and effectively re-sealed over time. Permeability can increase each time the fault is re-activated and pre-existing or new fractures open. Recent fault activity was identified where faults have been mapped cutting Quaternary layers and from recorded earthquake locations. Fault activity was also used to indicate critically stressed faults (optimally oriented to the stress field) which are more likely to be permeable.

Regions of predicted higher geothermal fault potential in the chalk and limestone reservoir intervals are located along the flanks of the RVG, and to the south in Dutch and Flemish Limburg Provinces. Areas with medium fault potential flank the regions of higher potential in the RVG. There is possible fault potential across much of the remaining area.

The results of this study provide a provisional assessment of geothermal potential of fault zones but detailed analyses will be required for each new geothermal project. The maps will be validated as geothermal projects develop in the region. However, the region of higher geothermal potential of fault zones encompasses the Venlo geothermal site in which a fault has been shown to have good transmissivity.