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Fracture network modelling of a potential high-level nuclear waste repository site

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The potential host rock for the high-level nuclear waste repository of Hungary is the Boda Claystone Formation (BCF) located in SW Hungary, a homogeneous formation with a thickness of 1000 m. The BCF consists of well-compacted reddish-brown claystone, siltstone, and albitolite (authigenic albite >50%) with dolomite and sandstone intercalations. Fracture network modelling and hydrological assessment were performed in the BAF–2 well, which is over 900 m deep. The fracture network was modelled using a discrete fracture network (DFN) algorithm based on acoustic borehole televiewer (BHTV) images and core sample images. This modelling approach can be used to calculate the permeability and porosity of the fracture system if the hydrologic aperture of the fractures is known. Fracture aperture can be defined in several ways. In hydrodynamic processes, the hydraulic aperture should be used, which is defined as a theoretical conduit that produces the same flow rate as the real fracture. The hydraulic aperture was estimated using a calibration algorithm comparing the measured permeability values of the borehole to the modelled permeability values of the fracture system. Hydrological evaluation of the borehole was performed by calculating flow zone indices (FZI). This parameter is based on the covariation of porosity and permeability and is usually used to evaluate reservoir quality. FZI values denote hydraulic units within the rock column where the properties controlling flow are internally uniform. Based on the geometry of the fracture network and hydraulic flow units, most parts of the well behave uniformly, while three narrow zones exhibit different hydrologic characteristics. The first zone is located in the upper 100 m of the well and is likely formed by weathering and diagenetic processes. The second zone is at about 400 m, where a large-scale structural boundary is suspected. In the third zone at 700 m, coarsening of the host rock strongly affects the hydrological properties, but the influence of tectonic processes cannot be excluded either.