NATIONAL RADIOACTIVE WASTE REPOSITORY 2011-2012: CONSTRUCTION OF THE FIRST TWO DISPOSAL GALLERIES

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1. Introduction

The Bataapáti site was selected for the storage of the low and intermediate level radioactive waste on the basis of a multilateral consideration. The site and its sorroundings geographically belong to the Geresd Hills and geologically to the Mórágy Granite Pluton. In the northwest part it spreads over the East Mecsek. The site is located in the centre of this region.

The surface exploration phase was completed in 2003 [1]. On the basis of the results the specialised authority agreed on geological suitability within the boundaries of the polygon appointed in the exploration area. The construction of the inclined shafts (serving as access tunnels) meant the subsurface exploration phase, which, in accordance with the approved plan, was launched in late 2004 and was completed in mid-2008 [2].

The final report of the underground exploration program [2] was prepared during the excavation of the last section of the inclined shafts. It confirmed that the subsurface exploration had achieved its task objective and proved that the natural conditions of the Bátaapáti site are suitable for a low and intermediate level radioactive waste repository [3].

Phase I (the so-called "small loop" tunnel system) of the construction of the National Radioactive Waste Repository (NRWR) in Bátaapáti was carried out between 2008 and 2009 [9]. The first and second stages (construction of the "large loop" tunnel system and the subsurface areas of final water treatment system) of Phase II were basically completed in June 2010 [17]. The operating systems of the NRWR and the first two disposal galleries of the No. 1 chamber field (I-K1 and I-K2) were constructed (completed by the end of September, 2011) within the third stage of the second phase [18], [21], [22].

After the completion of the small-loop tunnel system a summarising geological evaluation was prepared [15]. An expert summary [13] was made in 2010 with consideration of the data available as of 31 May 2010. These reports were followed by the disposal gallery preliminary design [16] in May, 2011 and the recently prepared geological summary [19], which are based on data collected before the date of 24 April 2012. The Pécs District Mines Inspectorate received the geological summary [20] about the construction phases of the NRWR between 2008 and 2012 in early June 2012. Zoltán Balla was responsible for the small-scale geological modeling [4], [5], [6] and Gyula Maros mainly for the structural-tectonic synthesis [11], [12].

1. Geological setting

The Bátaapáti site has been established in the 338-million-year-old rocks [10], [8] of the Mórágy Granite Pluton at the southeastern edge of the East Mecsek, south of the Mecsekalja Dislocation Zone, which consists of paleozoic metamorphic rocks. The Mórágy Granite consists dominantly of granitic, less dioritic intrusive rocks. It also contains acidic dykes, which are genetically attached to them. The subvolcanic alkali basalt dykes

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characterised by diverse composition and classified among the Lower-Cretaceous Rozsdásserpenyői stratigraphic unit are a rare type of rocks, but in connection with the repository are very significant (due to their correlation with high transmissivity). In the granitic rocks of the Mórágy Granite the dioritic rocks compose downward-widening, dominantly steeply dipping lens-like, NE-SW trending bands, which are parallel to the strike of the Mecsekalja Dislocation Zone. Between the rocks characterized by different chemical composition, transitional, hybrid rock-types were formed [2].

The tectonic evolution of the above-mentioned rocks formed diverse structures, showing a series of multiple renewal characterized by variable filling, usually along its strike too. The structure has significantly higher impact on the hydrogeological and geotechnical conditions than does the mineralogical composition [15]. The distributional principles of the most significant structures determine the tectonic and hydrogeological feature of the site.

The presence of strike-slip type, braided-sigmoidal structures whose sizes range from macro to micro-scale is the most basic feature of the tectonic character of this area. These form a complex conductive channel system because of their inner structure.

The site is divided into hydrogeological blocks by E-W striking non-conductive and NE-SW, NNW-SSE striking conductive structures. The structures which are parallel to the strike of the Mecsekalja Dislocation Zone are significant both hydrogeologically and geotechnically, as the highest transmissivity values and the thickest weakened zones are associated with this direction.

Despite the favourable lithological composition, significant base-metal, radioactive ore indications or regional hydrothermal alteration accompanied with ore mineralization have not been exposed during the performed work [14].

In the scale of the subsurface geological the hydro-geological modeling is based on a pattern consisting of the combination of geological bands and hydro-geological stripes, which is divided into units (blocks) by non-conductive zones [7].

2. Characterisation of the No.1 chamber field

The No. 1 chamber field is located in the tectonic/hydro-geological unit which is delineated by the "Péter" and "Zoltán" fault, as non-conductive zones. This area is traversed by the "Patrik" fault. Well conductive strips run along both its northern and southern margin while at its eastern and western side so-called hydro-geological boundary structures – zones – can be traced [7].

In the area of the No. 1 chamber field the most important geological feature is the banded geological structure and the stripe-zone-like hydrogeological character, which is the result of NE-SW and NNW-SSE striking tectonics (Figure 1). We have distinguished three NE-SW bands on the basis of their lithology: the northern, middle and southern bands.

The *northern monzonitic band* comprises of dioritic rocks (monzonite, hybrid monzonite) and a NE-SW striking alkali basalt dyke which intersects the dioritic rocks. This dyke has average dip direction of 318º/72º and is 0.60-1.90 m thick. It is intersected by NE-SW and NW-SE striking faults and fractures, along which the offset can be several meters. Sometimes the dyke along these faults and fractures can be brecciated and shows argillitization of varying degrees. The main plane of the dyke is uneven tectonically segmented. The monzonitic rocks of the northern band are mostly intact, slightly jointed and have favourable geotechnical features. The occasional highly conductive 20-NE-SW structure runs along the alkali–dyke, but open fractures of the monzonitic rocks are also characterized by high transmissivity.

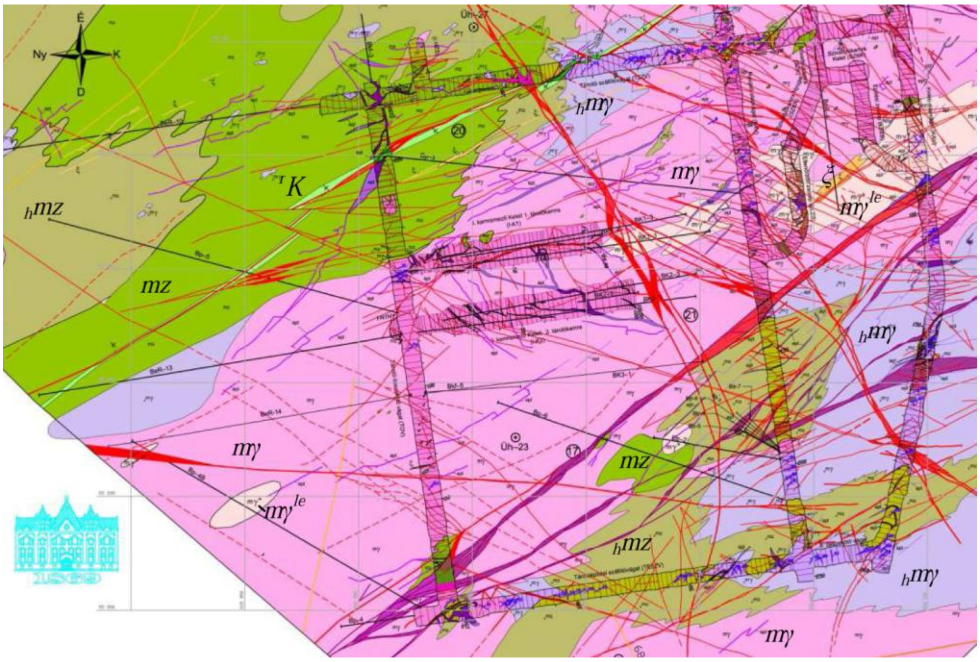

Figure 1. Geological map of the No. 1 chamber field (from [20], by MÁFI [12])
Legend: $m\gamma$ – monzogranite, $m\gamma^{le}$ – leucocratic monzogranite, $_h m\gamma$ – hybride monzogranite, $_h mz$ – hybride monzonite, mz – monzonite, ξ – syenite, ^rK – alkali basalt

The northern band is gradually connected to the *middle monzogranitic band*, mostly built up by monzogranite with some minor leucocratic monzogranites. The middle band appears in the NW part, with gradual transitions from the monzonites through hybrid rock types (hybrid monzonite, hybrid monzogranite). Elongated syenite bodies with thickness of a few meters are also characteristic to these transition zones. The Patrik fault forms the southeastern limit of the middle band. The southeastern part of the middle band is homogenous, dry, while to the northwest the fracturation increases gradually, and seepage appears. The geotechnical characteristics of the “TOV” drift near the Patrik fault gradually improve from the south. Between 50 and 120 meters of the drift the geotechnical features are favourable. The fractured middle quality (category III) rock masses are become more frequent approaching the northwestern limit of the band. The geotechnical characteristics are similar in the “NAV” drift around the Patrik fault, but with a much wider transition zone. The first two repository chambers are located in the middle, monzogranitic lithological unit (band).

The *Patrik fault (17-NE-SW)* separates the middle band from the southern band. This is a fault zone of primary importance: it is 10–15 m wide with variable internal structure. It

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has a braided-sigmoidal morphology, and it is built up from carbonatized monzogranite boudins and several-meter-wide clayey core zones. The core zones mostly have a flaky, lentil or brecciated structure with clayey, carbonatic, polimictic breccia filling. The Patrik fault has NE-SW strike, and a steep dip to the SE, but planes dipping to NW can also occur. In its internal structure loose, brecciated, open, SW dipping, and NW-SE striking structures are found. The Patrik fault (17-NE-SW) is by far the most dominant geotechnical element of the "large-loop" drift system. The Patrik fault is traversed by the "NAV" and "TOV" drifts exposed (category V) rocks of 15 m length, with a clay bearing fault zone more than 10 meters thick.

The *southern hybrid lithological band* is made up of various types of rocks, from monzogranite in the NW through hybrid monzogranite, hybrid monzonite intruded by leucoratic monzogranite (based on the Btr-2 hole) to the SE direction. Because none of the occurring lithology types could be considered dominant, petrologically the rocks were labeled hybrid. The geotechnical characteristics of these rocks are usually favourable, but they frequently contain open fractures with very good water conductivity properties. This band contains several important high water conductivity, NE-SW striking structures, from which those with higher water influx were given individual names (18-NE-SW, 19-NE-SW). From the observations derived from the "Btr" holes tests, the water conducting channel system is variable. The good water conductivity channels are frequently connected to monzonite bodies.

The 21-NNW-SSE significant structure stretches in the eastern wing of the chamber field, while the 22-NNW-SSE structure is in the western flank. The latter was defined mostly by hydro-geological data.

3. Conclusions

The Bátaapáti repository is intended for the final disposal of low and intermediate level radioactive wastes (L/ILW).

Surface-based geological investigations of the Bátaapáti L/ILW repository site were conducted between 1997 and 2003. Underground investigations were carried out during the excavation of the access tunnels (2005-2008). The forming of the 1st and 2nd repository chambers and the installation of the operational systems were carried out in 2011-2012, within the construction of the II/3 construction phase of the National Radioactive Waste Repository. Geological, hydro-geological and geotechnical investigations were performed within the investigation programme of the National Radioactive Waste Repository in Bátaapáti and were financed by the Hungarian Agency for Radioactive Waste Management (PURAM).

The host rock of the repository is monzonite and monzogranite of the Mórágy Granite Formation of Early Carboniferous age. Crystalline rocks are intersected by Lower Cretaceous alkali volcanic dykes. Hydro-geological and geotechnical properties are strongly influenced by large-scale tectonic zones with complex inner structure and extensive development of fault gouge and breccia. The first two repository chambers are located in the middle, monzogranitic litological unit (band). This unit offers the most favourable properties for the further chamber construction.

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