Dinnyeberki uranium ore deposit – new exploration results and current status

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1. Location

The Dinnyeberki uranium ore deposit is located in South Hungary, in the western part of Baranya County, at approx. 0.75 km to the southwest from the village Dinnyeberki (*Fig. 1.*), in the eastern side of a valley, close to its bottom. The site can be accessed from Dinnyeberki on a dirt road. The terrain is hilly, generally covered by forests and meadows, with more or less N-W striking valleys.

Figure 1. Location of the Dinnyeberki uranium ore deposit

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2. History of discovery, exploration and uranium production

Although the Mecsek Ore Mining Co., the former Hungarian uranium ore mining company performed significant exploration in the region, the uranium ore deposit was discovered by a mapping drilling of the Hungarian Geological Institute in 1982, as a big anomaly on the gamma-ray log. Considering the very small size of the deposit (see next chapter), it's not surprising that the discovery was accidental.

In the subsequent years, the Mecsek Ore Mining Co. explored an 160 × 180 m area in a very detailed way, some parts were drilled with 20 m spacing. Later the exploration was extended to a significantly larger area in the surroundings, but no other ore deposit was found.

Considering the mineralization is hosted by relatively loose sediments at a small depth, the company decided to perform an experimental in situ leaching (ISL) exploitation. At that time this was a rather new technology and the Dinnyeberki ore deposit was the target of the first trial in Hungary to adopt it. The first attempt was done with linear arranged wells already in 1983, but after the failure of this method the company tried the hexagonal arrangement started in 1987. In both phases, the leaching agent was sulfuric acid of 10-30 g/l concentration, since at that time this was the predominating technology and the environmental considerations had minor importance. Between and in the course of these two phases, numerous hydrogeological tests were performed, including permeability and groundwater flow tests with clear or salty water.

Even the new, hexagonal well system produced bad results considering the uranium production, which was a consequence of the poor host rock permeability. Therefore, in 1989 the company abandoned the attempts, simultaneously with the first Government intention to abandon the entire uranium ore mining in Hungary. The ISL experiment was terminated from one day to another and environmental remediation wasn't performed. Finally, the remediation was started in 1999 and completed in 2002 through leaching the rocks with water, done by the legal successor of the former uranium ore mining company.

In 2006, WildHorse Energy Hungary Ltd., the subsidiary of WildHorse Energy (Australia) has got uranium ore exploration right for the area around the Dinnyeberki deposit. In March 2008, WildHorse drilled a hole to reveal the aftermath of the former ISL experiment and the current status of the ore deposit.

3. Deposit characterization

3.1. Stratigraphy

The Dinnyeberki mineralization of Early Miocene age is hosted by a poorly sorted, clastic sedimentary rock formation deposited in a trench in an aquiclude dacitic tuff bed, filling a valley of the pre-Tertiary basement, both in the new and the historic drillholes.

3.2. Lithology

According to the historic exploration, there are four types of rock of the pre-Tertiary basement: granite, Lower Permian Korpád Sandstone Formation and Gyűrűfű Rhyolite Formation ("quartz porphyry"), and Upper Permian Cserdi Formation (sandstone, conglomerate).

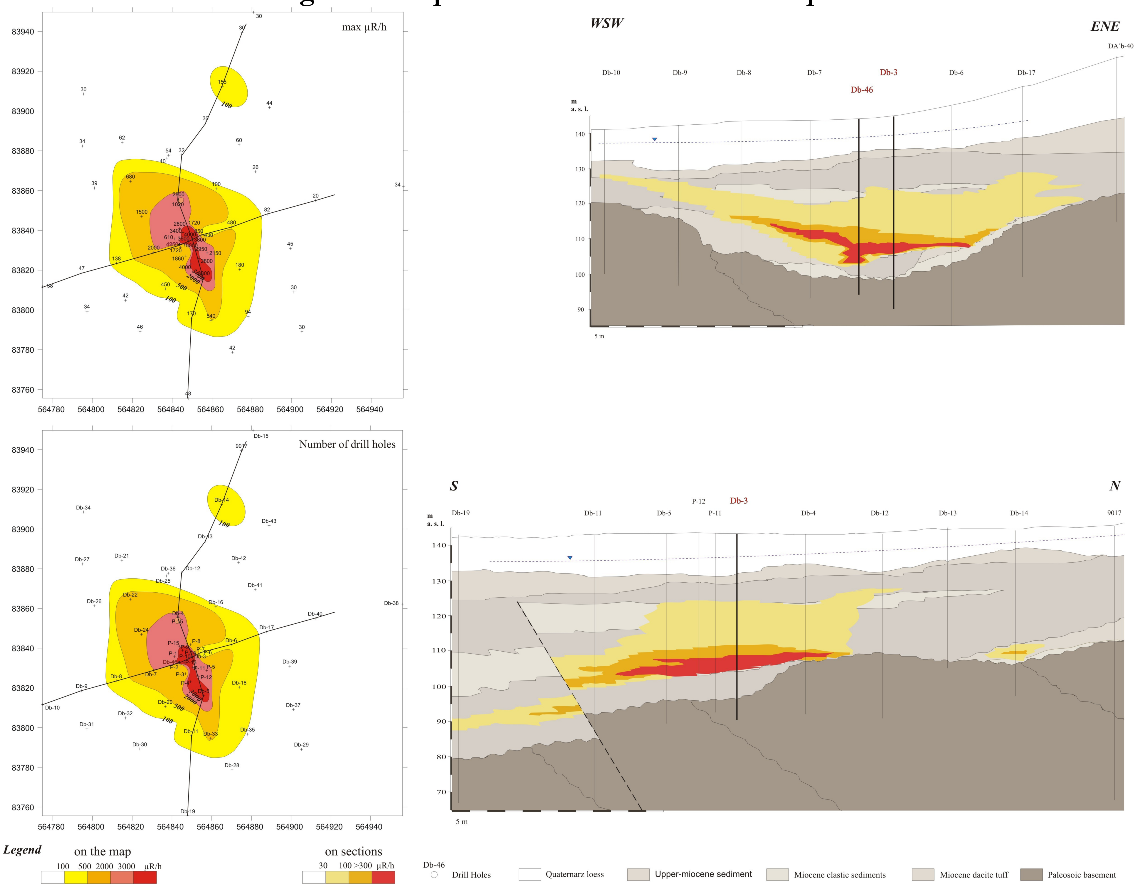
The oldest Miocene beds overlying the basement on some spots consist of clay and pebbly clay, with various organic matter content. These – or the basement in the lack of the previous rocks – are overlain by green dacitic tuff of several meter thickness. In the dacitic tuff a trench developed in the same direction like the valley of the basement surface, filled by younger Miocene sediments. There are alternating, matrix supported conglomerate, pebbly clay, clayey sand beds. Within the lower part of this sequence there is the dark grey, pebbly, clayey sand with high organic matter content, which hosts the mineralization. The Miocene clastic sedimentary rocks are overlain by Upper Pannonian yellow sand, then by Quaternary clayey silt (loess).

3.3. Deposit parameters

The deposit size is very small, the axes of the elliptical ore body are 60 and 90 m, outlined by the 300 ppm cut-off grade (*Fig. 2.*). The depth is from 36 to 42 m below the surface. The host rocks for the mineralization are: 1) organic matter containing formation right above the dacitic tuff, 2) the lower several decimeters of the dacitic tuff, 3) organic matter containing formation below the dacitic tuff, and 4) clay infilling of the basement faults. From among them, only the rocks above the dacitic tuff contain mineable amount of uranium.

The typical host rock is loose, poorly cemented, pebbly sandstone, with high organic matter content. The mineralization is characterized by strongly oxidized uranium oxides and hydroxides, which refers to the current mobility of uranium. According to the lead isotopic age determination, the age of mineralization is 20 million years, with a considerable re-mobilization and enrichment between 11-15 million years before present (MATUZ-BOKOR 1986).

Figure 2. Map and cross-sections of the deposit



Source: after KONRÁD, amended

The average ore thickness is 0.4 meter, but varies between 0.2 and 4 meter. The historic exploration found the uranium content between 20 and 6780 ppm with the average of 310 ppm, but the new drilling of WildHorse has revealed even higher grades (see next chapter). The reserve is 13 305.7 tons of ore with 18 408.8 kg uranium content (HARSÁNYINÉ 1988). The mineralization is generally in the radioactive equilibrium state, but there is slight radium surplus in the mineralized pebbles. The probable source of uranium is the nearby Permian uranium ore deposit, but the granite and the Gyűrűfű Rhyolite Formation can be source rocks, too.

4. Results of the new exploration

In the second half of March 2008, WildHorse Energy Hungary completed a drillhole named Dinnyeberki-46 (Db-46) within the area of the uranium ore deposit. It's purpose was to confirm the historic data and study the current status of the mineralization, after several years of acid leaching, then 3 years of remediation attempts. The bottom depth of the hole was 45 m.

The Db-46 is located very close to the old Dinnyeberki-3 (Db-3) drillhole, so it has been chosen for comparison, but all of the historic holes have very similar bed sequence and mineralization character.

The table below summarizes the results of the Db-46 drillhole, in comparison with the historic data from the hole Db-3.

Table 1. Comparison of the results of the historic drilling Db-3 and the new drilling Db-46.

Drillhole	Db-46 interval #I	Db-46 interval #II	-
Comparable historic drillhole	-	-	Db-3
Depth of anomalous interval below surface (m)	36.0 - 41.0		34.2 - 40.3
Depth of ore interval below surface (m)	37.6 -39.1	39.8 - 40.8	36.5 - 40.2
Thickness of mineralized interval (m)	1.5	1	3.74
GT (% U × m thickness)	0.0669	0.3292	*1.066*
Average grade (ppm U)	446	3 292	*2850 (from gamma-log)*
Peak U content (ppm)	969	20 600	*6450 (from gamma-log)*
Lithology	coarse-grain sandstone with small pebbles, clay with dacitic tuff and small pebbles, clayey dacitic tuff with small pebbles and rock clasts, conglomerate with quartz porphyry and metamorphic rock pebbles	clay with dacitic tuff, rock clasts and small pebbles, clayey dacitic tuff with small pebbles, weathered clayey sandstone and sand, weathered dacitic tuff with organic matter, conglomerate with quartz porphyry and metamorphic rock pebbles	*silt with coarse-grain sand, dacitic tuff, carbonaceous clay, clay with dacitic tuff and rock clasts, conglomerate and sandstone with quartz porphyry and metamorphic rock pebbles*

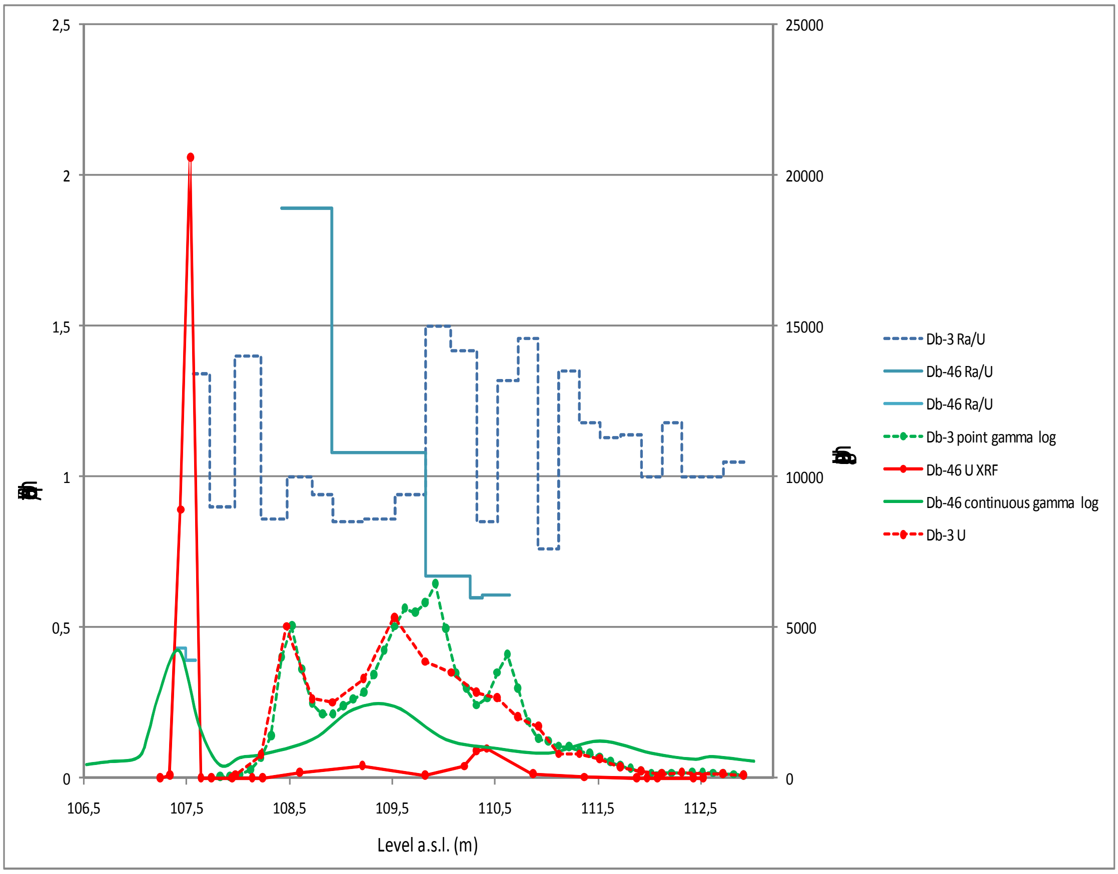
grade values are from assays unless other is specified

The above table data can be summarized that while there was one, rather thick mineralization in the historic drillhole, the new drillhole contains two, separate and thinner mineralized horizons. The lithology of the ore is the same in both holes.

5. Current deposit conditions and status of the environment

Figure 3 summarizes and visualizes the drillhole logging and core sample test results that are the most relevant from point of view of the current deposit conditions.

Figure 3. Gamma-ray logs and drill core laboratory test results from drill holes Db-3 and Db-46.



The first thing one can realize is the misalignment of the laboratory assay and the gamma-ray log plots in drillhole Db-46. There is about 10 cm difference between the two peaks at the level of 107.5 m – it's not significant, but the other peak on the higher level (at 110.4 m on the XRF assay plot and about 109.4 m on the gamma log) shows already 1 meter difference. The reason of this misalignment can be the poor drill core recovery percentage (which was only 35% in some intervals) and the careless handling of the core by the drilling rig crew. Obviously, the right positions of the peaks are surely the levels shown by the gamma log plot.

Although the Db-3 and Db-46 drillholes are very close to each other (the distance is 6.8 m), there are significant differences regarding the character of mineralization in the two holes. In Db-46, about 1 m of waste and another 1 m poorly mineralized sections are between the two ore zones, while the ore interval is uninterrupted through 3.7 m in Db-3. In addition, the lower ore zone in Db-46 is located at such a depth where mineralization couldn't be found in the historic Db-3 drillhole.

In the lower ore section of the drillhole Db-46, the core sample assays have produced significantly higher grades than had been expected from the point gamma logs (2869 μR/h maximum vs. 20,600 ppm U). The spectral gamma-ray tests showed strong positive radioactive disequilibrium in this zone ($Ra_{Ueq}/U = 0.39$). However, the Ra_{Ueq} is 7602 ppm in the highest grade sample of this interval, significantly higher than the gamma log peak value, although these should be the same. It probably means that even the point gamma log can "smear" the very high peaks of narrow zones, maybe the increase of measuring time on a given logging point can eliminate this effect in the future.

Based on the gamma-ray log and the XRF assays, in the upper ore section of the drillhole Db-46 the situation seems to be the opposite of the previous one, i.e. the assay results refer to negative disequilibrium (1840 μR/h maximum vs. 969 ppm U). However, the gamma spectrometry has not confirmed this observation, the Ra_{Ueq}/U ratio is positive again, around 0.6. Probably the depth misalignment problem causes this virtual conflict.

The GSP tests show very strong negative disequilibrium between the two ore zones of drillhole Db-46. The Ra_{Ueq}/U ratio reaches even 1.89. This data is from a less mineralized, or rather only anomalous interval.

The historic studies from the 80s reported both positive and negative radioactive disequilibrium conditions in the deposit, although not so extreme ones like in Db-46. In the ore zone of Db-3, the Ra_{Ueq}/U values are between 0.76 and 1.5 and there is no such consequent rule of disequilibrium like in Db-46, the Ra_{Ueq}/U values fluctuate randomly through the mineralized interval.

The possible explanation of the current situation is in connection with the former experimental ISL production. It can be concluded from the report about the ISL site remediation (KONRÁD et al. 2005) that the deposit was left under acidic conditions for a decade long (groundwater pH = 1-4). After the remediation had started, the pH was successfully increased, but slight acidity (pH = 5-6) remained following to the completion of remediation actions. The more than 20 years of acidity in combination with the limited, but effective groundwater flow resulted in the rearrangement of uranium mineralization.

Drillhole Db-46 is located within the impact zone of the one-time experimental ISL area. Uranium has been removed from the middle part of the original ore body, partly in the course of the ISL production, but partly later, owing to the transportation by groundwater in the acidic environment. Fortunately, the movement was mainly downward, and the clay and sand of high organic matter content in the lower ore zone of Db-46 captured the uranium again and bound it. This is the reason of the negative disequilibrium in the middle (uranium loss, radium surplus) and the positive disequilibrium (uranium surplus) below.

6. REFERENCES

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