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PETROGRAPHIC, MINERALOGICAL AND CHEMICAL CHARACTERISTICS OF BAUXITE FROM POSUŠJE DEPOSITS, BOSNIA AND HERZEGOVINA – AGEMERA PROJECT RESEARCH

PETROGRAFSKE, MINERALOŠKE I KEMIJSKE KARAKTERISTIKE BOKSITA IZ LEŽIŠTA U POSUŠJU, BOSNA I HERCEGOVINA – AGEMERA PROJEKT ISTRAŽIVANJA

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The exploitation of bauxite in the wider area of Posušje in Bosnia and Herzegovina has been known since the first half of the 20th century, and to date more than 1100 deposits or occurrences of various sizes and structures have been discovered. Bauxite deposits of Posušje represent typical karst bauxites, formed during the emersion phase between Upper Cretaceous rudist limestones in the footwall and various carbonate and clastic rocks of Paleocene/Eocene and Oligocene ages in the hanging wall. The most intensive mineralogical and geochemical bauxite research in these areas was carried out during the 70s and 80s. Afterwards, despite numerous newly discovered deposits, no petrographic, mineralogical and geochemical analysis on the bauxites has been published. The present study is focused on recently discovered bauxite deposits in Posušje and their petrographic and mineralogical description. The bauxites show ooidic to pelitomorphic, but in places also clastic textures. Micro-ooids and spheroids are mostly smaller than 0.1 mm, and in places fragments of the former ooid can be found. In some bauxites, pebbles of resedimented bauxite prevail, mostly larger than 2 mm but sometimes larger than 1 cm, which define their conglomerate texture. Gibbsite and boehmite are the main Al-bearing minerals of the bauxites, and diaspore has not been observed. The ratio of gibbsite to boehmite varies between deposits, and in some deposits boehmite is the only aluminium phase present. Where present, the gibbsite is developed into relatively large hypidiomorphic crystals larger than 0.25 mm, with clearly defined polysynthetic lamellae. Hematite is the dominant Fe-phase in all deposits. Although rarely, goethite-rich bauxites can be found in the form of isolated layers, with just traces or no hematite. Zircon, apatite and calcite are minor and ac-

cessory minerals, and X-ray analysis indicated significant amounts of anatase and rutile. Kaolinite was detected in only one sample. Chemical analyses indicate a negative correlation of Al and Fe content. The Al_2O_3 content ranges from 53.4 to 63.9 wt.%, and Fe_2O_3 from 22.5 to 35.2 wt.%. The SiO_2 and TiO_2 content varies from 1.6 to 5.6 wt.% and 3.5 to 4.6 wt.%, respectively. The chemical composition of the analysed samples defines them as ferrous bauxites. A change in the chemical composition was observed in relation to the footwall distance. The relatively high content of Zn (up to 627 ppm) gradually decreases towards host carbonates of the footwall, and a similar trend is observed in the Fe, Cr and Zr content, while Al, P, Ca and Ti, on the other hand, increase closer to the footwall. Mineralogical, petrological and chemical studies of the recently opened bauxite mines in Posušje revels heterogenic properties and indicate a complex genesis of the deposits, with possibly diverse source material.

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SEA WATER IMPACT ON THE COASTAL KARSTIC AQUIFER BOKANJAC-POLIČNIK
UTJECAJ MORA NA PRIOBALNI KRŠKI VODONOSNIK BOKANJAC-POLIČNIK

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Ključne riječi: *utjecaj mora, priobalni krški vodonosnik, Bokanjac-Poličnik, Zadar*

Izvori i kopani bunari u zaleđu grada Zadra od velikog su značaja za vodoopskrbu grada Zadra jer su dugi niz godina bili jedini izvori vodoopskrbe za potrebe grada, a i danas se koriste za vodoopskrbu uz dovod vode s rijeke Zrmanje. Na slivnom području nalazi se više vodnih objekata uključenih u vodoopskrbni sustav grada Zadra. To su: Bokanjac, Boljkovac, Golubinka, Jezerce i Oko.

Tijekom dugih sušnih razdoblja, dio tih vodoopskrbnih objekata je povremeno pod utjecajem mora, iako su neki od njih udaljeni i nekoliko kilometara od morske obale. To ukazuje na duboke prodore zaslanjene morske vode u slatkovodni vodonosnik, odnosno na postojanje slane vode ispod slatkovodnog sustava i konusno izdizanje slane vode zbog prekomjernog crpljenja.

Golubinka je priobalni krški izvor koji ima problema sa zaslanjivanjem tijekom svakog ljetnog sušnog razdoblja u potpuno prirodnim uvjetima te se za vodoopskrbu koristi samo izvan tih razdoblja. Ostali vodoopskrbni objekti u slivu su kopani bunari, od kojih Boljkovac i Jezerce imaju povremeni problem zaslanjivanja, dok je kod Bokanjca to najmanje izraženo. Vodocrpilište Oko se trenutno ne koristi za potrebe vodoopskrbe, ali na njemu nije zabilježeno zaslanjenje.

Za potrebe Plana upravljanja vodnim područjima 2016. – 2021. (NN br. 66, 2016) sliv je proglašen tijelom podzemne vode na kojem su u skladu s nacionalnom metodologijom za ocjenu kemijskog stanja podzemnih voda krških vodonosnika, provedena klasifikacijska ispitivanja. Klasifikacijskim ispitivanjima ovo tijelo podzemne vode ocijenjeno je „u lošem stanju" i „u riziku" te su propisane mjere i operativni monitoring (BIONDIĆ *et al.*, 2016).

Operativni monitoring je započeo krajem 2017. godine izvođenjem četiri duboke bušotine i postavljanjem automatskih senzora električne vodljivosti, temperature i razine podzemne vode po dubini bušotina. U svaku bušotinu postavljeni su automatski senzori na svakih 10 m dubine koji su mjerili razinu podzemnih voda, temperaturu i električnu vodljivost svakih 10 minuta. Monitoring je završio krajem 2019. godine čime je cijeli vodonosnik praćen po dubini kroz dvije hidrološke godine, odnosno dva sušna kritična razdoblja. Tijekom toga razdoblja, zdenci vodocrpilišta Bokanjac nisu zaslanjivali, ali se vrijednost električne vodljivosti kretala u rasponu od 0,590 do 0,985 mS/cm što je malo povišena vrijednost u odnosu na prosječnu u tom vodonosniku. Na vodocrpilištu Jezerce, koje je bliže moru od vodocrpilišta Bokanjac, električna vodljivost se kretala u rasponu od 0,850 do 1,084 mS/cm. Na vodocrpilištu Boljkovac električna vodljivost se tijekom kišnog kretala oko 3,5 mS/cm, tijekom sušnih razdoblja se spuštala na oko 1 mS/cm, dok su u proljetnom razdoblju 2019. godine izmjerena dva maksimuma 5,27 mS/cm (6. 2. 2019.) i 4,89 mS/cm (16. 4. 2019.). Od studenoga 2018. do lipnja 2019. godine crpilište nije bilo aktivno (BIONDIĆ *et al.*, 2019).

Monitoring je nastavljen kroz provođenje projekta: Upravljanje krškim vodonosnicima ugroženima klimatskim promjenama (UKV) (KK.05.1.1.02.0022) od svibnja