

Advancing Greener Economy: Insights from Studies on Bauxite Deposits in Bosnia-Herzegovina (Jajce and Posušje) and Porphyry Copper System in Bulgaria (Assarel)

Marko Holma^{1, 2, 3}, Šime Bilić⁴, Ivica Pavičić⁴, Franjo Šumanovac⁴, Gordana Deljak⁵, Ivan Grubišić⁶, Irena Peytcheva⁷, Stoyan Georgiev⁷, Elitsa Stefanova⁷, Dimitrina Dimitrova⁷, Atanas Hikov⁷, Desislav Ivanov⁸, Ivaylo Vasilev⁸, Pasi Kuusiniemi^{14, 3}, Timo Enqvist^{14, 3}, Gergely Surányi¹⁵, László Bálazs¹⁵, Sandór Demők¹⁵, Jarmo Korteniemi^{16, 3}, Giulio Casini⁹, Eduard Saura^{9, 11}, David Martí^{9, 12}, Helena Seivane¹³, Martin Schimmel¹³, Markku Pirttijärvi¹⁰

1. Kerttu Saalasti Institute, University of Oulu, Oulu, Finland, 2. Muon Solutions Oy Ltd, Rovaniemi, Finland, 3. International Virtual Muography Institute, Tokyo, Japan, 4. University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia, 5. Rudnici boksita Jajce d.d., Jajce, Bosnia and Herzegovina, 6. Rudnici boksita d.o.o. Posušje, Posušje, Bosnia and Herzegovina, 7. Geological Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria, 8. Assarel-Medet JSC, Panagyurishte, Bulgaria, 9. Lithica SCCL, Girona, Spain, 10. Radai Oy Ltd, Oulu, Finland, 11. Universitat Autònoma, Barcelona, Spain, 12. IGME, CSIC, Madrid, Spain, 13. Geo3BCN, CSIC, Barcelona, Spain, 14. Muon Solutions Oy Ltd, Pyhäjärvi, Finland, 15. Muon Solutions Oy Ltd, Budapest, Hungary, 16. Muon Solutions Oy Ltd, Turku, Finland

A transition towards sustainable energy sources requires the exploration and development of minerals critical to electronics and energy storage and delivery systems. Funded under Horizon Europe (Grant Agreement N°101058178), the AGEMERA project is a three-year initiative addressing critical raw materials (CRMs), including their exploration and extraction. The conventional methods applied in the project encompass structural geological fieldwork and modeling, mineralogical studies, trace element geochemistry, and geochronology. The innovative exploration methods include drone geophysics, passive seismic surveys, and cosmic-ray muography, occasionally combined with other geophysical techniques. These methods are applied in varying combinations across different areas, depending on technical capabilities and specific needs.

The deposit types studied for their CRM content or potential include orogenic gold with atypical metal associations, sediment-hosted stratiform copper, karst bauxite, porphyry copper, epithermal gold, polymetallic veins, volcanic-hosted massive sulfide, and iron oxide-copper-gold. The countries involved in the geological studies are Bosnia-Herzegovina, Bulgaria, Finland, Germany, Poland, Spain, and Zambia.

This abstract focuses on the bauxite deposits in the regions of Jajce and Posušje, Bosnia-Herzegovina, and the porphyry copper system in Assarel, Bulgaria. The Late Cretaceous Jajce bauxites are predominantly boehmitic in composition, with rare diasporite in some localities. Hematite is the dominant Fe mineral. These deposits locally exhibit up to 1,353 ppm of REEs. The Early Eocene Posušje bauxites chronologically align with the Paleocene–Eocene Thermal Maximum (PETM) around 56 million years ago. Boehmite is their primary Al-bearing mineral, jointly with gibbsite at some localities. Hematite remains the dominant Fe phase, and the total REEs vary between 357 and 1,112 ppm. Our preliminary studies on the CRM potential of the Assarel porphyry deposit reveal high concentrations of several CRMs in some ore and alteration minerals. For example, enriched Te, Co, Ag, Ge, and Bi contents were defined in a high-sulfidation mineral association.