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on the north-western edge of Kaštela Bay is the formation of an alluvial fan (Divulje) dated to 18.8 ky BP, which covers the Eocene flysch deposits. Alluvial fans record climate-driven erosion and sediment-transport processes and therefore indicate that precipitation exerts (or ice melt in the hinterland) was the primary control on fan sedimentation during the Late Glacial. A robust morphologic analysis of shallow buried channel systems in the now submerged valley of the Jadro river has been made based on the interpretation of high-resolution seismic profiles.

The results indicate that the Pleistocene channel systems and floodplain was covered with only a thin Holocene sediment layer in Splitski channel during the period between 50 ky BP and 13 ky BP, when the area was subaerially exposed. It was then drowned and filled

during the sea level rise caused by Holocene transgression. This landscape and floodplain hosted both the Neanderthals (KARAVANIĆ *et al.*, 2022), and later the Epigravettian hunter-gatherers. The flooding of Kaštela Bay commenced after the formation of a short-lived early Holocene estuary in the paleochannel of the Jadro River. The study area exhibits the processes from fluvial and estuarine to fully marine.

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KARAVANIĆ, I., BANDA, M., RADOVIĆ, S., MIKO, S., VUKOSAVLJEVIĆ, N., RAZUM, I., SMITH, F.H. (2022): A palaeoecological view of the last Neanderthals at the crossroads of south-central Europe and the central Mediterranean: long-term stability or pronounced environmental change with human responses. *J. Quaternary Sci.*, 37, 194–203.

VUKOSAVLJEVIĆ, N., PERHOČ, Z. (2017): Lithic raw material procurement of the Late Epigravettian hunter-gatherers from Kopačina Cave (island of Brač, Dalmatia, Croatia). *Quaternary International*, 450, 164–185.

DEVELOPMENT OF OPEN EDUCATIONAL RESOURCES ON PERMANENT MAGNETS AND RARE EARTH ELEMENTS

RAZVOJ OTVORENIH EDUKACIJSKIH MATERIJALA O TRAJNIM MAGNETIMA I ELEMENTIMA RIJETKIH ZEMALJA

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Keywords: *Open Educational Resources (OER), Learning Management platform MoD, Digital Academic Archives and Repositories (Dabar), Rare Earth Elements (REE), permanent magnets*

In the frame of the EIT RawMaterials RECO2MAG project (<https://reco2mag.rgf.bg.ac.rs/>), which focus is on optimizing the manufacturing process of permanent magnet microstructures through novel grain boundary processing to produce resource-efficient sintered NdFeB PMs with lowered Dy content and improved energy products for use in novel electric motor designs, Open Educational Resources -OER (UNESCO, 2022) on permanent magnets and rare earth elements were developed.

Firstly, syllabi for two online courses: (1) “Green Deal and Circular Economy Challenges of Rare Earth-based Permanent Magnets with Technical Aspects”, and (2) “Rare Earth Elements Value Chain Gaps and Opportunities in the ADRIA Region” were designed.

The courses were aimed primarily at master’s and Ph.D. students, but also at researchers, policy-makers and raw material exploration and production experts worldwide, but with emphasis on RIS (Regional Innovation Scheme) countries, i.e. countries and regions in Europe where the pace of innovation is modest or moderate (<https://www.eitmanufacturing.eu/what-we-do/regional-innovation-scheme-ris/about-us/>). Syllabi included: courses information (title, description, and instructor information); courses objectives, courses outlines (topics to be covered); course agenda; required materials; grading policy; and learning activities.

Following the design of the syllabi, the online courses were successfully implemented in academic year 2022/23. Both courses had a shorter version consisting of six hours of lectures, panel discussions, and quizzes. Panel discussions and lectures were recorded. Successfully completed the long version of the course that included additional 24

hours of teamwork was awarded with one ECTS credit. For each course there were more than 100 applicants from more than 35 countries. Finally, short version of first and second workshop successfully passed 49 and 71 respectively.

To ensure the courses' sustainability, the learning materials and recorded lectures have been adapted as OER. These materials, including text, video, quizzes, and links to other open-source materials on the internet, are placed on the e-learning platform MoD (<https://mod.srce.hr/>) using course design. MoD is an e-learning system based on the open-source Moodle software system

established to support e-learning projects within the academic community. Copies of both e-courses have been placed in the Digital Academic Archives and Repositories (DABAR) of University of Zagreb Faculty of Mining, Geology and Petroleum Engineering (<https://repositorij.rgn.unizg.hr/>) under the CC0 license. This type of Creative Commons licence implies that the contents are freely available to the public and can be accessed, reused, repurposed, adapted, and redistributed by anyone without any cost. The developed OER serve as a free and self-sustainable platform for the dissemination of knowledge gained during the project's implementation.

UNESCO (2022): The 2019 UNESCO Recommendation on Open Educational Resources (OER): supporting universal access to information through quality open learning mate-

rials. Document code: CI-2022/WS/7 Rev. 16 p. (<https://unesdoc.unesco.org/ark:/48223/pf0000383205.locale=en>).

STRUCTURAL MODELLING OF WESTERN MARGIN OF MT. PAPUK AND MT. PETROVA GORA: THE CASE STUDIES OF THE DARUVAR AND TOPUSKO HYDROTHERMAL SYSTEMS

STRUKTURNO MODELIRANJE ZAPADNIH OBRONAKA PAPUKA I PETROVE GORE: ISTRAŽIVANJA HIDROTHERMALNIH SUSTAVA DARUVARA I TOPUSKOG

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Keywords: *SW Pannonian Basin, 2D/3D structural modelling, thermal aquifer, hydrothermal system, geothermal energy*

In the SW Pannonian Basin area, geothermal gradients and heat flow are higher than the world average (≥ 3 °C/100 m; JELIĆ *et al.*, 1995). This work presents the results of conducted structural investigations in the Daruvar and Topusko areas (MILEUSNIĆ, 2022; MIŠIĆ, 2022), which are parts of hydrothermal systems in the central part of the Republic of Croatia. Daruvar and Topusko hydrothermal systems are two out of three research areas investigated in the scope of the installation research project "Multidisciplinary approach to hydrothermal system modelling" (HyTheC) funded by the Croatian Science Foundation.

Regionally, Topusko hydrothermal system lies within the area of the Sava Suture Zone, i.e., the contact zone between the Adria microplate and the Tisza-Dacia mega-unit, while Daruvar hydrothermal system belongs to the Tisza-Dacia mega-unit. To understand the recharge

and discharge areas of the Daruvar and Topusko hydrothermal systems, we focused on structural modelling of subsurface conditions by defining lithofacies distribution and fault geometry, identifying the predominant fracture systems, potential reservoir rocks, and their hydrogeological parameters. Additionally, the principal objectives were to construct preliminary conceptual 3D models of Mt. Petrova Gora and the western slopes of Mt. Papuk. We conducted extensive structural-geological field observations, which were combined with available geological and geophysical data. Collected structural data of bedding, foliation and fracture system orientations were analyzed using stereographic projection. The principal stress axes and stress field were calculated for the mapped fault planes. At the same time, up to six geological cross sections were created for each preliminary conceptual 3D model of the studied areas. Results show that both Daruvar (Fig. 1a) and Topusko structural models (Fig. 1b), i.e., hydrothermal systems, were hosted by complex,