17th Castle Meeting

New Trends on Paleo,
Rock and Enviromentral Magnetism

Castle Trakošćan - Croatia

28 AUGUST - 3 SEPTEMBER 2022

17th "Castle Meeting" on Palaeo, Rock and Environmental Magnetism

BOOK OF ABSTRACTS

Edited by

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Organized by
Ruđer Bošković Institute
Zagreb
Croatia

ISBN 978-953-7941-44-4

Editorial Office:
Ruđer Bošković Institute
Bijenička cesta 54
10000 Zagreb
Croatia

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Magnetic properties as indicators of toxic elements pollution in surface sediments of the Vlasina River (Serbia) and Kupa River (Croatia)

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Keywords: magnetic susceptibility; toxic elements; statistical methods; Vlasina River; Kupa River

The relationships between magnetic susceptibility (MS) and elemental variations have been the focus of considerable study in the fields of environmental assessment. The aim of this study was to apply a rapid and inexpensive, low-field magnetic susceptibility method to stream sediments from Vlasina (Serbia) and Kupa (Croatia) river basins, and discuss the relationships between MS and content of 26 studied elements using statistical approaches.

In this research, magnetic susceptibility was measured using SM30, a small magnetic susceptibility meter with a very high sensitivity of 1×10^{-7} SI. Inductively Coupled Plasma Optical Emission Spectroscopy was used to determine the concentration of the studied elements, after sequential extraction procedure (Sakan et al., 2016). Total concentrations of each element were determined as the sum of concentrations determined in each fraction.

The Kupa River basin, occupies the west-central part of Croatia and is shared by two neighboring countries (Slovenia, Bosnia and Herzegovina). The Kupa itself is a tributary to the Sava River and meets the latter at Sisak after traversing a distance of 294 km. The river basin is one of the most significant water resources in Croatia (Frančišković-Bilinski et al., 2012).

Vlasina River Basin covers an area of 1061.72 km² and covers the south eastern part of Serbia. The total length of Vlasina River is 65.9 km. The largest part of the geological base of the Vlasina River Basin belongs to the Serbo-Macedonian mass, formed in the Palaeozoic (Carbon-Perm) (Durlević et al., 2019).

Correlation analysis was performed to reveal statistical correlations between MS and 26 elements analyzed by ICP-OES in Kupa sediment samples. Ten of them showed negative correlation (As, B, Ba, Fe, K, Li, Mg, Na, P, S), while other elements showed positive. Chromium showed excellent correlation with MS (0.91) and is element with the highest correlation to MS, what could indicate its anthropogenic origin. Element with strongest correlation to MS after Cr is vanadium (0.62), followed by Mn (0.52), Al (0.52) and Cd (0.50). All other elements have rather weak correlation with MS, among which highest are those of Sr (0.45), Zn (0.35), Be (0.28), Co (0.27), Pb (0.27) and Ti (0.26). Measured MS values in Vlasina samples are mostly very low, with several locations where values are a bit higher; they range from 0.02×10^{-3} to 1.113×10^{-3} SI units. The strongest correlation was observed with Mo (0.43), then with Ag (0.29). Correlations > 0.10 are determined between MS and following elements: Zn (0.17); Cu (0.12); Pb (0.17); Ba (0.13); Mn (0.10); Ti (0.20); V (0.21); In (0.16); Sn (0.16); Tm (0.10); Lu (0.12); Hg (0.16); Bi (0.13); Th (0.15) and U (0.24). Correlation analysis between MS and measured chemical elements has shown that strong correlations do not exist. From that it could be concluded that in Vlasina samples there is no significant anthropogenic influence.

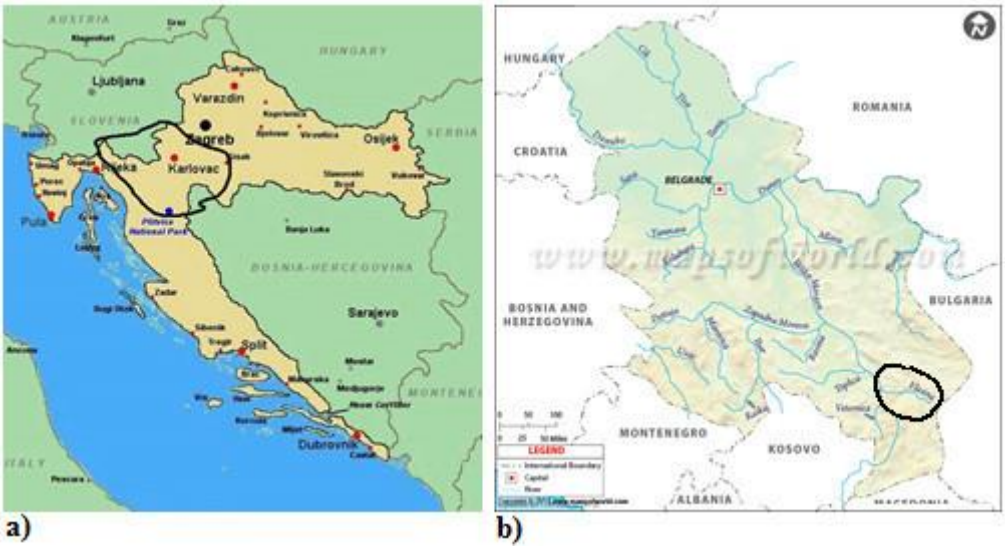

Fig. 1: Position of **a)** Kupa River drainage basin in Croatia, and **b)** Vlasina River drainage basin in Serbia.

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The authors would like to thank the Ministry of Education, Science and Technological Development of Republic of Serbia (Grant No: 451-03-68/2022-14/200026) for financial support.