Estimation of sedimentation rate and sediment origin by natural radionuclides and ^{137}Cs in the Vrana Lake, Croatia

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The objective of the study was to investigate the Vrana lake sediments and to provide information about their mineralogical composition and sedimentation rate. Additional objectives were to determine whether the sedimentation rates are uniform in the whole Lake and to establish the relationship between the materials deposited in the Lake and the surrounding carbonate and flysch rocks.

To carry out this study, we retrieved three 30-cm long sediment cores from the Vrana Lake, the largest natural lake in Croatia. The cores were cut into smaller sub-samples of 2 cm in thickness, and prepare for further analyses. The following parameters were measured: ^{137}Cs, ^{40}K and ^{232}Th activities, carbonate content and mineralogy. The surroundings of the lake are made of limestone (Cretaceous and Eocene) and Eocene flysch, while the lake bottom and karst poljes are filled with Quaternary deposits.

Sedimentation rate were estimated by ^{137}Cs measurements and calculation. Sedimentation rates are not uniform in the whole lake. In the NW part of the lake, sedimentation rates of $10mm.y^{-1}$, $4.1mm.y^{-1}$ and $5.0mm.y^{-1}$ were estimated for 1954–1964, 1964–1986 and 1986–2010 time periods, respectively. In the SE part, sedimentation rates for the same three periods were as follows: $8.0mm.y^{-1}$, $2.3mm.y^{-1}$ and $2.5mm.y^{-1}$. Average sedimentation rates were $6.4mm.y^{-1}$ for the NW part of the lake, and $4.2mm.y^{-1}$ for the SE part.

Massic activities of ^{40}K and ^{232}Th were used as sediment source tracers. ^{40}K massic activities ranged around 31–$166Bq.kg^{-1}$, 232Th ranged around 3.1–$18Bq.kg^{-1}$ and ^{137}Cs ranged around 0.3–$68Bq.kg^{-1}$. Correlations between radionuclides massic activities are positive. All three radionuclides are indicators of the silicate material influence.

Carbonate component predominates in the sediment composition, where $CaCO_3$ mass fractions range between 72 and 94% and with mean values around 82–88%.

All analysed sediment samples (23) were classified as sandy silt, with a mean grain size of 20-56μm. Such classification can indicate a uniform sedimentation. The phase analysis showed the presence of the calcite, quartz, micas and pyrite. $CaCO_3$ mass fractions and the radionuclides massic activities are negatively correlated, indicating that all studied radionuclides are transported into the lake mainly in particulate form, connected with the silicate material influence.

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