Instrumental Neutron Activation Analysis of River Sediments of Danube (Romania), Nile (Egypt) and Zarafshon (Tajikistan): A Comparative Investigation

Octavian G. Duliu[1,2], Lucretia Dinescu[3], Wael Badawy[4], Daler Abdusamadzoda[4], Otilia Culicov[4], Marina Frontasyeva[4], Inga Zinicovscaia[4], Tatjana Trtić-Petrović[5]

[1]*University of Bucharest, Faculty of Physics, Department of Structure of Matter, Earth and Atmospheric Physics, Astrophysics, 405, Atomistilor str. 077125, Magurele (Ifov), Romania*
[2]*Geological Institute of Romania, 1, Caransebes str. 1, 012772 Bucharest, Romania*
[3]*Institute of Physics and Nuclear Engineering, Mãgurele, PO Box Mg-06, RO-76900, Bucharest, Romania*
[4]*Joint Institute for Nuclear Research, IIO, Joliot-Curie 6, 141980 Dubna*
[5]*Vinča Institute of Nuclear Sciences, National Institute of the Republic of Serbia, University of Belgrade, P.O. Box 522, Belgrade 11001, Serbia*

The Instrumental Neutron Activation Analysis (INAA) proved to be one of the most sensitive elemental analytical technique that permit the determination of mass fraction of more than 40 elements with an accuracy of the order of mg/kg and less. Moreover, INAA does need any preliminary processing of investigated material, avoiding in this way any systematic errors inherent to any sample digestion procedure, as the case of ICP-MS, -AES or OAS.

Beside the major, rock forming elements Na, Mg, Al, Si, K, Ca, Ti, Mn and Fe, INAA gives excellent results in determining the mass fraction of the most important incompatible elements such as the High-field-strength elements (HFSE) Sc, Zr, eight Rare Earth Elements (REE), Hf, Ta, W, Th and U. Although different from HFSE, a large category of trace elements closely related to the human activity, better known as Presumably Contaminating Elements (PCE) which includes V, Co, Cr, Ni, Cu, Zn, As, Se, Sn, Sb represents excellent proxies for any anthropogenic contamination.

As a direct consequence of this fact, INAA can simultaneously furnish confident data to be used on one hand in elucidating the nature of investigated material which can be equally sediments, soils, a wide variety of rocks or, in quantifying the degree of local contamination.

Given the great volume of date, only an appropriate multivariate statistical analysis can derive confident conclusions. Accordingly, cluster, principal component or discriminant analysis together with a variety of graphic bi- and ternary plots were systematical used in investigating soil and sediments from different geological formation located on three continents, e.g. Nile Valley and Delta of north-east Africa, Danube river and delta, eastern Europe or Zarafshon river, central Asia.

Our investigation allowed evidencing a close similarity between soil and sediments collected along the Nile sector between Aswan lake and Mediterranean Sea, or along entire Zarafshon river. In this regard is wort mentioning the presence of mafic components in Nile sediments and soils, peculiarity well explained by the High Ethiopian Plateau origin of Blue Nile which transports about 80% of the Nile water. Opposite to this was the situation of Danube and Zarafshon river sediments and soil of which mineral material is almost felsic, in concordance with the Neogene orogeny of their catchment basins.

At the same time, given the reduced industrial activity along Nile and Zarafshon rivers, excepting some local contaminated hotspots, the rest of river seemed less or almost uncontaminated with PCE. A similar situation was noticed in the case of Danube river and specially in the Danube Delta, there the vertical profile of some PCE presented a certain tendance of diminishing towards the sediment surface, a consequence of the active measure taken by the EU state to reduce the environmental contamination.