Data Article

Geochemical dataset of the Danube Delta sediments

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A R T I C L E   I N F O

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A B S T R A C T

We present geochemical analyses (major, such as CaCO₃, TOC, Fe₂O₃, and minors such as MnO and TiO₂) and trace elements, as well as some trace elements with genetic significance (Rb, Sr, Zr) or toxic and potentially affected by anthropic influences (Cu, pb, Zn, Cd, Cr, V, Ni, Co) of the superficial bed sediments of the St. George distributary which is the most sinuous and morphologically dynamic branch of the Danube River. Bed sediment samples were collected onboard of R.V. Istros, in June 2017. The dataset is useful to evaluate the distribution of the sediment along the fluvial channel, the present ecological state of the environment and, the effects of artificial intervention on the fluvial channel (the cut-off of the natural channels by navigational canals between 1984 and 1988). The data are presented as tabular format.

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Specifications Table

| Subject                      | Geochemistry                      |
|------------------------------|-----------------------------------|
| Specific subject area        | Geochemical analyses of the superficial bed sediments |
| Type of data                 | Table                             |
|                              | Chart                             |
|                              | Figure                            |

How data were acquired
Surface sediment samples were collected with a grab sampler “Van Veen” type. Sediments were oven dried and homogenized using a mortar grinder RM 200 (Retsch, Germany) and sieved with a 250-μm stainless steel sieve. The total organic carbon (TOC) and CaCO₃ concentrations were determined in accordance with WakleyBlack titration method modified by Black [1] and Gaudette et al. [2], respectively.

Fe₂O₃ (total), TiO₂, Rb, Sr, Zr and V have been analyzed by X-ray fluorescence spectroscopy, using a VRA-30 sequential spectrometer, on compacted powders; Mn, Co, Ni, Cu, Zn, Cr and Pb have been determined by flame, AAS and Cd – by graphite furnace AAS on an ATI UNICAM 939E AA spectrometer, after digestion of the samples with boiling HNO₃.

Data format
Raw Analysed

Parameters for data collection
Sediment samples were collected during a geological survey in June 2017 using a research vessel RV Istrros, equipped with a grab sampler “Van Veen” type. The water discharge of the St. George distributary was 2170 m³.s⁻¹ at the entrance in the study area (A1) (Fig. 1).

Description of data collection
Sediments were sampled in the Danube Delta (on St. George branch), along three cutoff meander reaches (the Mahmudia, Dunavăt de Sus and Dunavăt de Jos meanders, named here as M1, M2 and M3 respectively), in June 2017. Bed sediment samples (14 samples) were collected from the main channel of the St. George branch (Fig. 1). Two samples are located on the lateral canals (Perivolovca and Dunavăt canals) and one sample on the Uzlină Lake.

Data source location
Institution: The National Institute for Research and Development on Marine Geology and Geo-Ecology – GeoEcoMar
City: Bucharest
Country: Romania
The southern distributary of the Danube River, the St. George branch:
Geographical borders of the survey area: UTM 35 N WGS84
Upstream bifurcation: 45°11′18.29″ N / 28°53′13.03″ E
Distributary mouth: 44°52′45.33″ N / 29°37′04.26″ E

Data accessibility
Data are presented with the article

Value of the Data

- Geochemistry of river sediments are controlled by the physical and chemical weathering of parent rocks, but also by factors such as climatic, hydrological, morphological and anthropogenic pressures in the basin.
- The presented data could be used by hydrologists, sedimentologists and geochemists for the research planning, sediment sampling, and specific analyses protocol.
- Evaluating post effects of the anthropogenic pressures in a natural environment can provide important comprehension of other similar cases worldwide.
- The data advance knowledge about actual ecological state of the Danube Delta sediments.

1. Data Description

This data presented consists of geochemical data acquired along the St. George branch in June 2017. The spatial distribution of the geochemical sampling stations is presented in Fig. 1. The sediments were sampled in medium to high water stage, at a daily discharge of 2170 m³.s⁻¹ (measured at the entrance in the study reach, A1) (Fig. 1). Surface sediment samples were collected with a grab sampler from 17 locations distributed along the branch, on the main channel
Fig. 1. Location of the sediment sampled position. The map was obtained using Global Mapper 16 software.

Table 1
Location of the samples, site description and water depth.

| Sample | Latitude (°'"") | Longitude (°'"") | Site Description | Depth |
|--------|----------------|-----------------|------------------|-------|
| G1-01  | 45° 02' 45.8962" N | 29° 11' 24.4993" E | Downstream confluence of M1 | 8.8 |
| G3-04  | 45° 02' 57.6957" N | 29° 10' 56.4003" E | Artificial canal at the confluence of M1 | 20.4 |
| A3-05  | 45° 04' 06.2048" N | 29° 08' 28.2991" E | Artificial canal at the bifurcation of M1 | 17.4 |
| A1-06  | 45° 04' 17.8985" N | 29° 07' 49.5995" E | Upstream bifurcation of M1 | 10.1 |
| A2-10  | 45° 04' 21.9034" N | 29° 08' 26.6989" E | Downstream bifurcation of M1 | 1.5 |
| G2-14  | 45° 03' 07.2065" N | 29° 11' 15.9008" E | Upstream confluence on M1 | 2.3 |
| D-17   | 45° 06' 21.0997" N | 29° 11' 02.0997" E | M1 natural course | 4.5 |
| LU-22  | 45° 05' 33.5043" N | 29° 16' 00.0003" E | Uzлина Lake | 1.0 |
| I3-28  | 45° 02' 03.1964" N | 29° 15' 47.1994" E | Downstream bifurcation on artificial canal of M2 | 4.4 |
| I2-29  | 45° 02' 14.9058" N | 29° 15' 53.2002" E | Downstream bifurcation on M2 | 9.0 |
| J-30   | 45° 02' 18.8989" N | 29° 16' 41.6988" E | Apex of M2 | 15.8 |
| K3-32  | 45° 01' 32.1961" N | 29° 16' 09.3996" E | Upstream confluence on artificial canal of M2 | 7.8 |
| CD2-35 | 45° 00' 21.5053" N | 29° 16' 05.9015" E | Dunavat Canal | 5.6 |
| M-38   | 45° 01' 18.5980" N | 29° 18' 05.3013" E | M3 natural course | 3.1 |
| CP2-40 | 45° 01' 13.0000" N | 29° 18' 41.2000" E | Perivolovaca Canal | 3.0 |
| N1-42  | 44° 59' 55.3972" N | 29° 17' 21.5997" E | Downstream confluence of M3 | 12.5 |
| N3-43  | 45° 00' 25.3967" N | 29° 17' 06.7008" E | Upstream confluence of M3 on artificial canal | 21.8 |

and former meanders (Mahmudia, Dunavăt de Sus (Upper) and Dunavăt de Jos (Lower)). Information on the sampling stations (coordinates, water depth and site characteristics) are provided in Table 1.

Order 161/2006 [3] sets Romanian quality criteria for a number of chemical compounds, organic and inorganic, in sediments: these include a number of heavy metals analysed in sediment samples (Table 2).
Table 2
Quality criteria for heavy metals in sediments (Order 161/2006).

| Metal                  | UM    | Ord. 161/2006 |
|------------------------|-------|---------------|
| Total chromium \((\text{Cr}^{3+}+\text{Cr}^{6+})\) | μg/g  | 100           |
| Copper                 | μg/g  | 40            |
| Lead                   | μg/g  | 85            |
| Zinc                   | μg/g  | 150           |
| Nickel                 | μg/g  | 35            |

The geochemical parameters analysed on bed sediments of the three studied meanders during the field campaign from June 2017 are shown in Table 3. The Table 4 show the descriptive statistics for the concentrations of the studied variables. Table 5 present the correlation matrix (Pearson) for the major constituents, minor constituents and heavy metals.

The linear regression analysis and the calculation of the prediction interval for the relationship \(\text{Fe}_2\text{O}_3 - \text{Ni}, \text{Fe}_2\text{O}_3 - \text{Cr}, \text{Fe}_2\text{O}_3 - \text{Zn} \) and \(\text{Fe}_2\text{O}_3 - \text{Cu}\) are represented in the Figs. 2–5.

2. Experimental Design, Materials and Methods

Prior to geochemical analysis the sediment samples were oven dried (24–48 h/105°C), ground, and homogenized using a mortar grinder RM 200 (Retsch, Germany) and sieved with a 250-μm stainless steel sieve. The total organic carbon (TOC) and CaCO\(_3\) concentrations were determined in accordance with WakleyBlack titration method modified by [1] and [2], respectively. The concentrations of \(\text{Fe}_2\text{O}_3, \text{TiO}_2, \text{MnO}, \text{Zr}, \text{Cr}, \text{V}, \text{Zn}, \text{Cu}, \text{Ni}, \text{As}, \) and \(\text{Pb}\) were measured.
Table 3
Results of geochemical analyses on bed sediments of the three studied meanders during the field campaign from June 2017 to estimate the geochemical properties of bottom sediments and characterize the variation of major and trace elements.

| Sample | CaCO₃, % | TOC, % | Fe₂O₃, % | TiO₂, % | Zr, μg/g | Sr, μg/g | Rb, μg/g | Zn, μg/g | Ni, μg/g | MnO, % | Cr, μg/g | V, μg/g | Co, μg/g | Pb, μg/g | Cu, μg/g | Cd, μg/g |
|--------|---------|--------|-----------|---------|----------|---------|---------|---------|---------|--------|---------|---------|---------|---------|----------|
| G1-01  | 7.22    | 0.07   | 2.30      | 0.48    | 98       | 185     | 55      | 24.54   | 23.9    | 0.024  | 31.5    | 46      | 6.83    | 9.717   | 4.367    | 0.07     |
| G3-04  | 8.23    | 0.04   | 2.80      | 0.59    | 112      | 186     | 53      | 20.83   | 18.1    | 0.021  | 30.4    | 44      | 4.64    | 8.762   | 3.86     | 0.071    |
| A3-05  | 11.41   | 0.02   | 2.60      | 0.42    | 92       | 199     | 48      | 26.07   | 23.0    | 0.033  | 31.7    | 66      | 7.38    | 10.81   | 4.211    | 0.073    |
| A1-06  | 7.66    | 0.05   | 2.44      | 0.51    | 94       | 189     | 51      | 18.81   | 17.7    | 0.019  | 28.6    | 43      | 3.88    | 9.019   | 2.934    | 0.056    |
| A2-10  | 10.64   | 0.07   | 2.73      | 1.13    | 192     | 190     | 47      | 19.22   | 14.9    | 0.021  | 14.0    | 77      | 3.25    | 8.62    | 4.064    | 0.064    |
| G2-14  | 10.16   | 0.95   | 6.09      | 0.98    | 272     | 196     | 109     | 103.40  | 50.7    | 0.107  | 89.7    | 114     | 12.60   | 24.2    | 44.84    | 0.296    |
| D-17   | 9.67    | 1.15   | 7.54      | 1.01    | 187     | 185     | 134     | 151.10  | 73.9    | 0.111  | 127.0   | 144     | 16.28   | 38.18   | 69.80    | 0.427    |
| LU-22  | 21.18   | 2.60   | 5.18      | 0.45    | 103     | 290     | 91      | 119.10  | 51.4    | 0.133  | 55.6    | 64      | 11.81   | 38.06   | 69.62    | 0.571    |
| I3-28  | 9.14    | 0.01   | 3.17      | 0.93    | 117     | 176     | 37      | 16.12   | 14.0    | 0.019  | 19.2    | 89      | 3.31    | 7.529   | 3.00     | 0.048    |
| I2-29  | 8.96    | 0.06   | 2.83      | 0.63    | 99      | 187     | 49      | 21.88   | 19.5    | 0.020  | 18.0    | 43      | 5.46    | 7.968   | 3.02     | 0.079    |
| J-30   | 12.13   | 0.24   | 4.11      | 0.80    | 292     | 194     | 75      | 37.78   | 28.2    | 0.050  | 48.4    | 64      | 6.44    | 11.8    | 11.01    | 0.125    |
| K3-32  | 13.20   | 0.72   | 6.01      | 1.02    | 285     | 183     | 104     | 73.82   | 51.8    | 0.090  | 75.2    | 88      | 12.37   | 22.52   | 26.37    | 0.182    |
| CD2-35 | 12.13   | 0.53   | 5.34      | 0.93    | 347     | 210     | 106     | 74.98   | 42.9    | 0.069  | 57.7    | 110     | 11.24   | 16.68   | 28.75    | 0.281    |
| M-38   | 10.20   | 0.06   | 2.65      | 0.71    | 143     | 203     | 54      | 23.47   | 18.8    | 0.015  | 19.4    | 69      | 4.68    | 8.368   | 4.21     | 0.079    |
| CP2-40 | 10.52   | 0.86   | 5.61      | 0.95    | 316     | 190     | 103     | 96.26   | 46.2    | 0.085  | 70.7    | 99      | 10.87   | 20.44   | 41.81    | 0.325    |
| N1-42  | 6.95    | 0.06   | 2.34      | 0.62    | 137     | 191     | 54      | 19.90   | 17.8    | 0.020  | 22.1    | 76      | 4.09    | 8.585   | 3.64     | 0.058    |
| N3-43  | 11.38   | 0.72   | 5.84      | 0.83    | 244     | 189     | 105     | 68.63   | 51.5    | 0.075  | 59.9    | 104     | 11.59   | 20.35   | 27.37    | 0.177    |

(2021)
Table 4
Descriptive statistics for the concentrations of the studied variables of the collected sediment samples.

|          | CaCO$_3$ % | TOC % | Fe$_2$O$_3$ % | TiO$_2$ % | Zr $\mu$g/g | Sr $\mu$g/g | Rb $\mu$g/g | Zn $\mu$g/g | Ni $\mu$g/g | MnO % | Cr $\mu$g/g | V $\mu$g/g | Co $\mu$g/g | Pb $\mu$g/g | Cu $\mu$g/g | Cd $\mu$g/g |
|----------|------------|-------|---------------|-----------|--------------|-------------|-------------|--------------|-------------|--------|------------|------------|------------|------------|------------|------------|
| Mean     | 10.634     | 0.484 | 4.092         | 0.764     | 184.117      | 196.647     | 75          | 53.877       | 33.191      | 0.0536 | 47.002     | 78.823     | 8.042      | 15.976     | 20.757     | 0.175      |
| Median   | 10.2       | 0.074 | 3.17          | 0.8       | 143          | 190         | 55          | 26.07        | 23.86       | 0.032  | 31.734     | 76         | 6.826      | 10.81      | 4.367      | 0.079      |
| St. Dev. | 3.256      | 0.669 | 1.712         | 0.228     | 89.646       | 25.340      | 29.952      | 42.544       | 18.131      | 0.0395 | 30.725     | 28.782     | 4.067      | 10.051     | 23.279     | 0.153      |
| Minimum  | 6.95       | 0.014 | 2.3           | 0.42      | 92           | 176         | 37          | 16.12        | 13.98       | 0.0150 | 13.953     | 43         | 3.248      | 7.529      | 2.934      | 0.048      |
| Maximum  | 21.18      | 2.602 | 7.54          | 1.13      | 347          | 290         | 134         | 151.1        | 73.92       | 0.132  | 126.957    | 144        | 16.28      | 38.18      | 69.8       | 0.571      |
| C$_5$, % | 30.62      | 138.28| 41.85         | 29.91     | 48.69        | 12.89       | 39.94       | 78.97        | 54.63       | 73.71  | 65.37      | 36.51      | 50.58      | 62.91      | 112.15     | 87.65      |
| Count    | 17         | 17    | 17            | 17        | 17           | 17          | 17          | 17           | 17          | 17     | 17         | 17         | 17         | 17         | 17         | 17         |
Table 5
Matrix (Pearson) of linear correlation coefficients for the major constituents, minor constituents and heavy metals \( r_{17, 0.05; 95} = 0.482 \).

|        | CaCO3 % | TOC %  | Fe2O3 % | TiO2 % | Zr μg/g | Sr μg/g | Rb μg/g | Zn μg/g | Ni μg/g | MnO % | Cr μg/g corr | V μg/g | Co μg/g | Pb μg/g | Cu μg/g | Cd μg/g |
|--------|---------|--------|---------|--------|---------|---------|---------|---------|---------|-------|-------------|--------|---------|---------|---------|---------|
| CaCO3 %| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| TOC %  | 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Fe2O3 %| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| TiO2 % | 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Zr μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Sr μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Rb μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Zn μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Ni μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| MnO %  | 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Cr, μg/g corr| 1 | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| V μg/g | 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Co μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Pb μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Cu μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
| Cd μg/g| 1       | 0.817  | 0.434   | -0.021 | 0.191   | 0.854   | 0.381   | 0.517   | 0.457   | 0.675  | 0.262       | 0.610  | 0.120   | 0.458   | 0.637   | 0.707   |
Fig. 3. Linear regression diagram Fe$_2$O$_3$-Cr, with the prediction interval ($C_{\text{Cr}}=16.818\times\text{Fe}_2\text{O}_3-21.831$, $r^2=0.879$).

Fig. 4. Linear regression diagram Fe$_2$O$_3$-Zn, with the prediction interval ($C_{\text{Zn}}=23.007\times\text{Fe}_2\text{O}_3-40.289$, $r^2=0.858$).

by X-ray fluorescence spectroscopy using a VRA-30 sequential spectrometer, on compacted powders; Mn, Co, Ni, Cu, Zn, Cr and Pb have been determined by flame AAS and Cd – by graphite furnace AAS on an ATI UNICAM 939E AA spectrometer, after digestion of the samples with boiling HNO$_3$. Accuracy and precision of AAS and XRF analyses were checked with several SRMs from US Geological Survey, NIST and IAEA.
Fig. 5. Linear regression diagram Fe$_2$O$_3$-Cu, with the prediction interval ($C_{Cu}=11.826C_{Fe2O3}-27.644$, $r^2=0.757$).

Ethics Statement

None.

CRediT Author Statement

Laura Duțu: Conceptualization, Writing – review & editing; Dan Secrieru: Geochemical analysis, Writing – review & editing; Florin Duțu: Writing – review & editing, Data acquisition; Naliana Lupașcu: Geochemical analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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