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8. Assessing and mapping spatial distribution of the main lithological components of recent sediments in Fortuna lake, Danube Delta Biosphere Reserve, Romania

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Abstract: Main lithological components were determined in surface and core sediment samples collected in the Fortuna Lake to evaluate their concentration and spatial distribution. Fortuna Lake is one of the important freshwater lakes in the western part of the fluvial-delta plain, in terms of ecology, biodiversity, limnology, and hydrology. Like many other transitional lacustrine environments of the Danube Delta Biosphere Reserve, this lake is sensitive to both natural and human-induced changes. Particularly, this lake is threatened by the natural situation resulting from hydrological inputs and by the extensive growth of emergent vegetation in its catchment. In certain instances, these natural processes could be exacerbated by human activities. The main aim of this study was to gain a complete picture of the spatial distribution of the lithological components in Fortuna Lake bed-sediments. Therefore, 20 sampling sites were randomly distributed within the lake. The bed-sediment samples were analysed for their main lithological components by Loss on Drying, respectively Loss on Ignition Method, and a grain size analysis was performed. Analytical results were processed using Golden Surfer Mapping Software to show areas of prevalent organic/mineral content accumulation. Customary Kriging method was used to interpolate the spatial distribution of the investigated lithological components within the lake, providing the possibility to distinguish the sampling stations in relation to their geographical position and lithological content. Additionally, to bring to a better understanding related to the vertical (in-depth) distribution of the lithological components, 3 sediment short cores were retrieved from different sectors of the lake. The spatial and vertical distribution of the lithological components within the lake indicated that the highly organic-rich sediments are located in areas characterized by low energy conditions, whereas the mineral-rich sediments were identified in sectors marked by relatively higher energy conditions. The total organic matter was the most enriched component in the lake sediments due to *autochthonous* input derived from *in-situ* basin processes and biological production. Poor water circulation or under low-flow condition are additional factors influencing organic matter accumulation in sediments. The grain size results revealed sediments specific to the lacustrine environment *i.e.,* muds consist predominantly of siltic fraction with a subordinate sand content. In terms of the natural evolution related to Fortuna L. the general tendency is of a progressive natural siltation enhanced by low water circulation and vegetation growth.
Keywords: bed-sediment, core-sediment, physical-chemical characteristics, organic matter, grain size lacustrine, transitional environment

Abbreviations: C – Canal/Channel; CAR - Total Carbonates; DDBR - Danube Delta Biosphere Reserve; DM - Dry Matter; GPS - Global Positioning System; ha - Hectares; L- Lake; LOD - Loss On Drying; LOI - Loss On Ignition; SIL - Siliciclastic Fraction; TOM - Total Organic Matter; WC - Water Content;

INTRODUCTION

Fortuna Lake belongs to a river-sea transition zone *i.e.,* Danube Delta Biosphere Reserve (DDBR) which is situated in the south-east of Romania, where the Danube flows into the Black Sea (Gâștescu, 2007). DDBR has a triple international conservation assignment *i.e., World Cultural and Natural Heritage,* a *Biosphere Nature Reserve,* and *Wetland of International Importance* (Ramsar Convention, 1987). Over the past several decades, it has been impacted by different types of natural and anthropogenic factors as changes in the hydrological patterns due to hydro-technical works, creation of man-made channels or meander cut, eutrophication (Humborg *et al.,* 1997; Panin *et al.,* 2016) or, by changes in water and sediment quality (Vosniakos *et al.,* 2008; Teodorof *et al.,* 2009; Gati *et al.,* 2016). The sediments of the aquatic environment act as a major reservoir for both natural and anthropic materials, being used as records on past environmental conditions or human related activities (Cohen, 2003; Finsinger *et al.,* 2006; Smol, 2008). Accordingly, changes in sediment quantity and quality can have a significant impact on environmental systems, posing many negative direct and indirect consequences on water quality and/or aquatic biodiversity (Alabaster and Lloyd, 1982; Wood and Armitage, 1997; Harrison *et al.,* 2007; Bilotta and Brazier, 2008).

In general terms, sediments are solid particles, originates from rocks and minerals, as well as vegetal and animal organic debris that are carried by wind, water and mass wasting and deposited in a new sink area. Aquatic sediments (*i.e.,* porous, soft or lithified) incorporates three major components (*i.e.,* carbonate, siliciclastic sediment and organic matter) representing their solid fraction (Ricken, 1993). The prevalence of organic/mineral fractions may be related to *allochthonous* sources (high rates of fluvial sediment supply, discharges from upstream origins, aeolian transport, climate conditions etc.), or *autochthonous* sources (geological age substrate of the depositional environment, in-situ biological, chemical, physical and geological processes etc.). The spatial distribution of the main lithological components is important to assess the effects of their potential source *i.e., allochthonous* or *autochthonous* on recent sedimentation pattern and to delimitate sectors based on the type of sediment found within the lake. The aim of this paper was to assess and investigate the spatial and distribution of the main physical-chemical parameters (*i.e.,* organic matter, carbonates and siliclastic fraction, including sand, silt and clay) in Fortuna Lake sediments. Analytical results were processed using Golden Surfer Mapping Software to show areas of prevalent organic/mineral content accumulation. Customary Kriging method was used to interpolate the spatial distribution on the investigated physical-chemical parameters within the lake, providing the possibility to distinguish the sampling stations in relation to their geographical position and lithological content. In addition, three sediment short cores were evaluated for their vertical main lithological fractions.

MATERIALS AND METHODS

Study area. Fortuna Lake (977.5 ha) is located in the Sireasa Şontea-Fortuna hydro-morphological unit (Latitude: 45°12'54"N, Longitude: 29°07'30"E), part of the fluvial delta plain, belonging to the DDBR area (Fig. 1-A), (Gâștescu and Știucă, 2008). The structure, function and the evolution of the deltaic ecosystems are controlled by the fluvial inputs of the Danube River. Significant amounts of terrigenous materials brought by the Danube River, from its upstream reaches, to the Black Sea (Panin and Jipa, 2002) are partially dissipated throughout the hydrographic networks including as well, fluvial-lacustrine reservoirs. The aquatic landscape of this shallow lake is characterised by a series of inlet and outlet streams, *i.e.,* Fortuna 1 Canal/Șontea C. (East), Fortuna 2 C. (North), Fortuna 3 C. (North), Şontea Stream (the northern limit of Fortuna L.), Mitchina Canal (West) and Crânjală C. (South). Fortuna L. has direct connections with both Sulina's Branch *via* canal Crânjală and with Șontea stream, as well. It is interesting to mention that in the southern part of the lake a micro-delta was evolving (Rădan *et al.,* 2013) (Fig. 1-B) that was fed by the sedimentary input of the Crânjală C. *via* direct connection with the Sulina Branch – one of the three main branches which form the Danube Delta. Crânjală C. played a significant role throughout the time regarding the alluvial supply of the lake from the Danube River. After the end of the World War II, this channel was dug and the stone bridge that blocked the circulation of water *via* the Old Danube was removed (Motoc, 2016). Then, in the ‘80s, the specific hidrosedimentary intense activity of the Crânjală C. contributed to the creation of a micro-delta in the canal mouth area, providing a progressive silting of the lake. Later on, in the ‘90s, when the canal was closed, the organic content of the sediment prevailed as a result of the hidrosedimentary regime changes, and the lake is now being fed by a northern connection canal *via* Șontea Stream (Rădan *et al.,* 2013). The environmental imprints of natural factors as hydrological inputs, geological background, sediment characteristics and excessive vegetation development in its catchment area, can lead in time to the phenomenon of siltation. Therefore, the role of sediment and sediment dynamics in the aquatic environment is important to be deciphered.

Field activities. A number of twenty geo-referenced (Garmin Montana 680) bed-sediment samples were gathered using a Van-Veen Grab Sampler, including three sediment short cores that were extracted from different sectors of the lake (Fig. 1-B). The field activities took place on board the RV ”Istros” and from smaller boats, during September 2019. Approximately 100 grams of sub-samples were taken from the upper layers of bed sediments. The sediment cores were split and processed on board. All these sediment samples were described, transferred in sterile plastic containers, labelled and stored until further analysis. Sediments of Fortuna L. were abundant in fine-medium and sporadically coarser triturated vegetal particles, incorporated, generally, into cohesive/non-cohesive muddy silts. The colour of the muds varies from dark green to dark grey and up to blackish grey. At the top of the organic-rich layer (top 1 cm) there was a yellowish-brown oxidation film (probably microbial or chemical oxidation). Within the interlayered mud-silts the predominant constituent was of organic origin, as vegetal remains of reed, decomposed leaves, as well as friable and de-pigmented shell debris. The macrobenthic fauna was abundant and representative for fresh waters ecosystems *i.e., Viviparus, Dreissena, Unio, Anodonta, Planorbis, Limnaea, Valvata*, *Radix* along with *Chironomidae and Oligochaeta*.

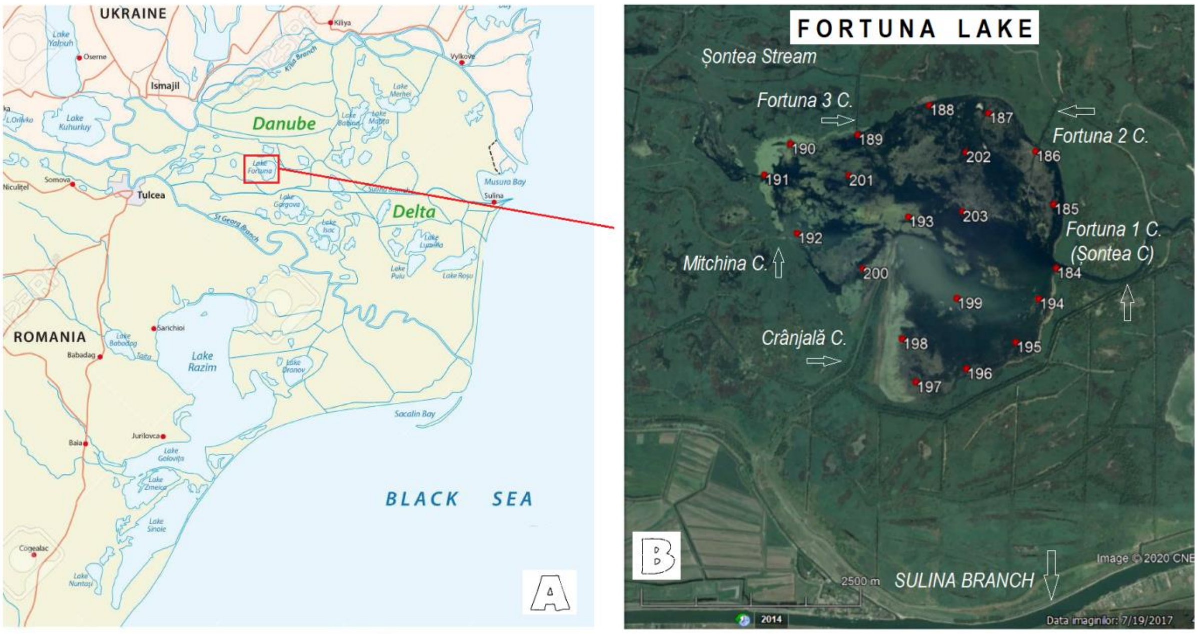

Fig. 1. Geographical location of the study area within the DDBR area, (A) (Base map: https://www.123rf.com/), and (B) map of the GPS coordinates for each sample collected from Fortuna L. (Base map: https://www.google.com/intl/ro/earth/)

Lithological analysis. Laboratory testing comprised both lithological and grain size analysis. The surficial and core sediment samples were analysed for their main lithological components *i.e.,* water content - WC%, dry matter - DM%, total organic matter - TOM%, total carbonates - CAR% and siliciclastic fraction -SIL%, by Loss on Drying (LOD), respectively Loss on Ignition Method (LOI). In this study, the natural water content refers to the water content of a field-moist state and was assessed by using undisturbed sediment material. Therefore, gravimetrically, WC% and DM% were determined by the common LOD method (Smith and Mullins, 2000; ASTM-D2216, 2010), which involves successive weights of sediment material before and after drying at 105ºC. Water content was obtained as the difference between wet and dry weights, and the data were expressed as the percentage of the total field-moist state mass (%). Next, the standard sequential weight LOI method (Dearing 1986; Heiri et al. 2001) based on calcination technique (Dean, 1974; Santisteban *et al.,* 2004) was employed to estimate the percentage content of TOM%, CAR% and SIL%. Sequential weight loss is measured after heating and superheating the samples (by high-temperature electric furnace SNOL 8.2/1100 LHM01) at 105ºC to remove water, at 550ºC to remove organic matter (Bengtsson and Enell, 1986), and at 950º-1000ºC to remove carbonates (Digerfeldt *et al.,* 2000). The calculation of the carbonate content was done according to the agreed laboratory procedures (https://www.geog.cam.ac.uk/). The weight of the residue remaining after 950º-1000ºC, as a percentage of the total initial dry sample is expressed as the SIL% fraction. In the final analysis, customary Kriging method of gridding was used to interpolate the obtained data as distribution maps, using Surfer software - Golden Software, Inc., 2010.

Grain size analysis. Particle size analyses were undertaken using a Mastersizer 2000E Ver.5.20 (Malvern Instruments Ltd.-Malvern, UK) that identifies the percentages of particles belonging to different dimensional categories from 0.10 µ to 1000 µ (1 mm), with an accuracy of 1% and a reproducibility of 99%. Samples were initially suspended in distilled water and sonicated for 10 minutes in an ultrasonic bath. Particles greater than 2 mm (*e.g.,* gravel and stones), were removed by sieving on fractions, weighed and reported to the percentages obtained by diffractometry. Textural classification *i.e.,* gravel, sand, silt, clays was performed according to the Udden-Wentworth grain-size scale (Udden, 1914;

Wentworth, 1922), completed with three subdivisions at 1φ intervals in the range of clay. The classification of sediments was related to diagram proposed by Shepard (1954). Basic statistical grain-size parameters as the median (Md = φ50), mean grain size (Mz), the standard deviation (σ), the asymmetry coefficient (Sk_I) and kurtosis (K_G) were calculated using the logarithmic original formulas (Folk and Ward, 1957).

RESULTS AND DISCUSSIONS

Spatial distribution of the main lithological components in lacustrine bed-sediments. A quantitative assessment of the major lithological composition of sediments was related to the percentages by weight in reference to WC%, DM%, TOM%, CAR% and SIL% content, estimated from the total weight of the dry residue sample. Analytical results were processed using Golden Surfer Mapping Software to show areas of prevalent organic/mineral content accumulation. Kriging was used to estimate and interpolate values related to the spatial distribution of the investigated lithological components within the lake, providing the possibility to distinguish the sampling stations in relation to their geographical position and lithological content. The concentrations of the main lithological components from both surface and core sediment samples are summarized in Table 1.

Table 1. Concentration of the main lithological parameters in surficial and core sediments

Fortuna bed-sediment samples (n =20)	***Value***	**WC (%)**	**DM (%)**	**TOM (%)**	**CAR (%)**	**SIL (%)**
	min	6,92	70,39	38,06	2,55	9,52
	max	29,61	93,08	81,52	20,33	52,89
	mean	13,21	86,79	67,33	10,98	21,69
DD-19-187 core (n =29)	*min*	8,63	74,07	13,02	5,75	5,80
	max	25,93	91,37	87,32	31,70	70,29
	mean	17,02	82,98	51,82	13,72	34,46
DD-19-190 core (n =27)	*min*	11,34	63,29	30,83	2,41	9,20
	max	36,71	88,66	88,29	11,06	59,84
	mean	23,08	76,92	62,71	6,36	30,93
DD-19-193 core (n =18)	*min*	10,46	70,39	45,35	7,60	21,23
	max	29,61	89,54	68,87	14,89	44,12
	mean	20,95	79,05	56,40	11,21	32,40

Water content. Generally, sediment samples have natural variable water content that is influenced by structural and textural characteristics of sediments (*i.e.,* degree of compaction and saturation, particle size, geochemical composition, mineralogy, organic content etc.). The distribution of water content was synthesized as saturated (> 25%), intermediate or transitional (5–25%), and dry (< 5%), (Namikas *et al.,* 2010). In this study, the natural WC% was considerably variable within each sample, and equally the magnitude and variation increased with the amount of dry matter residue content existing in the measured sample. The obtained mean values of a WC % (Table 1) indicated that both surficial and core sediments are categorized as intermediate or transitional (5–25%). The data showed a very strong negative correlation between WC% and DM% (r = -1) in all tested samples of both superficial and core sediments. In our case the moisture content may be associated with water level fluctuations (as a result of the local hydrographic network that supplies the lake) and climatic characteristics (*e.g.,* temperature, evaporation, precipitations etc.). The obtained results are displayed as a contour map showing WC% variations (Fig. 2-A). According to the distribution map, the largest sector characterized by a high WC% content (≈ 17-29%) was identified in the eastern area of the lake in the closeness of the Șontea C. mouth. Probably, this sector comprises more water saturated sediments due to the constant influx of water. The other sectors of the lake were characterized by lower WC% values and may be associated to the seasonal climate conditions of the sampling period (September 2019), after several consecutive months of scarcity of precipitation, higher temperatures (https://www.accuweather.com/ro/ro/tulcea/) or low flow rates in rivers and streams. Danube River was particularly affected by significant low water levels (mean value = 51.18 cm), in comparison to normal reference quota (180-200cm) at Tulcea Port station - km 71.3 (https://www.afdj.ro/ro/cotele-dunarii). All these combined factors can lead to a high rate of evaporation, implicitly in decreasing the sediment moisture in the investigated sectors of the lakes.

Total organic matter. Organic matter is an inconsistent but important fraction of recent bottom sediments acting as an environmental indicator on the potential input of both *allochthonous* and *autochthonous* sources in relation to their origin within a depositional environment. In concordance with several previous scientific studies, there are two main sources of organic matter accumulated in sediments: *allochthonous* (high rates of fluvial sediment supply, discharges from upstream origins, aeolian transport, climate conditions etc) and *autochthonous* (geological *age* substrate of the depositional environment, in-situ biological, chemical, physical and geological processes etc.) (Volkman and Tanoue, 2002; Mash *et al.,* 2004; Tesi *et al.,* 2007; Cresson *et al.,* 2012). In the absence of a harmonized classification concerning the organic matter content in aquatic sediments, our results were compared according to the soil organic matter literature (Perrin, 1974; Tate, 1987; Van der Veer, 2006) in which two simple types were conceptualized in terms of: mineral sediments (≤15-30% organic matter), and organic sediment (≥15-30% organic matter). Acquired results are displayed as a contour map showing TOM% variations (Fig. 2-B). The TOM% distribution map showed that the most dominant class interval has values over 50% of the total weight of dry residue. TOM% was the dominant sediment fraction all over the lake, excepting the inner stations (≤50%) of the western shore of the lake (in the closeness of the Mitchina C. mouth), as well as middle and southern inner lake stations (on the Crânjală C. flow direction). Most of the high values obtained (≥60-80%) are the result of the in-lake productivity processes that significantly, contribute to the accumulation of organic matter. The minimum of 38.06% (DD19-192) was identified in the western part of the lake. The sample location was near the MitchinaC., where the irregular dynamics of flow/inflow are relatively rapid and, probably, may obstruct the accumulation of organic matter. Instead, the maximum of 81.52% (DD19-190) was recorded in the northwestern part of the lake, a relatively sheltered sector characterized by excessive development of emergent and submerged vegetation and slightly disturbed by bottom water currents. These conditions can promote excessive *autochthonous* accumulation of organic material.

Total carbonates. The carbonate content within aquatic sediments is attributable to organic (*i.e.,* humus, plant remains, biofenic debris) and inorganic forms (*i.e.,* calcite, aragonite) (Kennedy and Woods, 2013). The sedimentary carbonate content can be used as paleoenvironmental and depositional biogeochemical indicators (Clayton and Degens, 1959; Lapointe *et al.,* 1992; Zhao *et al.,* 2016). For comparison, our results were correlated in accordance with the weight percentage of the carbonate content (De Bakker and Schelling, 1989), where the sediment samples were grouped as: *non-carbonate sediments* (≤0.5% of the total weight of dry sediment) *low carbonated sediments* (0.5 - 1%), and *carbonated sediments* (≥1%).Obtained results are shown as contour map showing CAR% variations (Fig. 2-C). In terms of CAR% content, the surficial sediment samples were characterized by higher CAR% content values (over 1% of the total weight of dry residue) encountered in all samples. The CAR% distribution map revealed a significant variation from a minimum value of 2.55% (DD19-189) encountered in the northern part of the lake (in the closeness of the Fortuna 3 C. mouth) to a maximum value of 20.33% (DD19-197) occurred in the southern part. Lake sites with notably higher content of CAR (≥10%) were found predominantly in the south-eastern half of the lake (Fig. 2-C). The carbonate-rich sediment samples may have probably an additional amount of shell debris, strongly incorporated into the sediment mass, which cannot be removed during sample preparation. Probably, this area offers favourable conditions for the proper development of the benthic communities (so as, on a very long-term interval of time, these organisms can become a significant part source of authigenic carbonates). Moreover, the authigenic origin of carbonates may be related to the chemical precipitation and recristalization or, due to the mechanical abrasion of *autochthonous* or *allochthonous* skeletal or non-skeletal carbonate elements existent in the catchment area.

Siliclastic fraction. The siliciclastic content, i.e., the minerogenic matter/mineral residue/inorganic non-carbonate fraction is an indicator related to *allochthonous* sedimentary particles' origin (supplied *via* fluvial or aeolian inputs, volcanic and hydrothermal activities etc.) or, to *autochthonous* provenience (geoechemical background, erosion, etc.). The obtained results are shown as a contour map showing SIL% variations (Fig. 2-D). According to the distribution map, the inter-comparison between investigated sampling sites exhibited both minimal and maximal values of SIL% content (≤50% of the total weight of dry residue). Range of variation is relatively narrow, fluctuating from 9.52% (DD19-187) to a maximum value of 52.89% (DD19-192). The maximal value occurred in the closeness of the Mitchina C., there were a lower content of TOM% had already been registered. Generally, there is a a very strong negative correlation between the SIL% and the TOM% (r = -0.908115). The overall obtained results are also strengthened by ternary diagrams with the distribution of the investigated components (Fig. 3-A).

Sediment grain size and surface textural observations in lacustrine bed-sediments. In this study, we synthetically report the sediment grain size parameters and general surface textural observations. Firstly, it is worth mentioning that the abundant and decomposed biogenic materials (*i.e.,* unctuos black muds and strongly putrid odorous) have interfered with the particle size analysis by laser diffractometry.

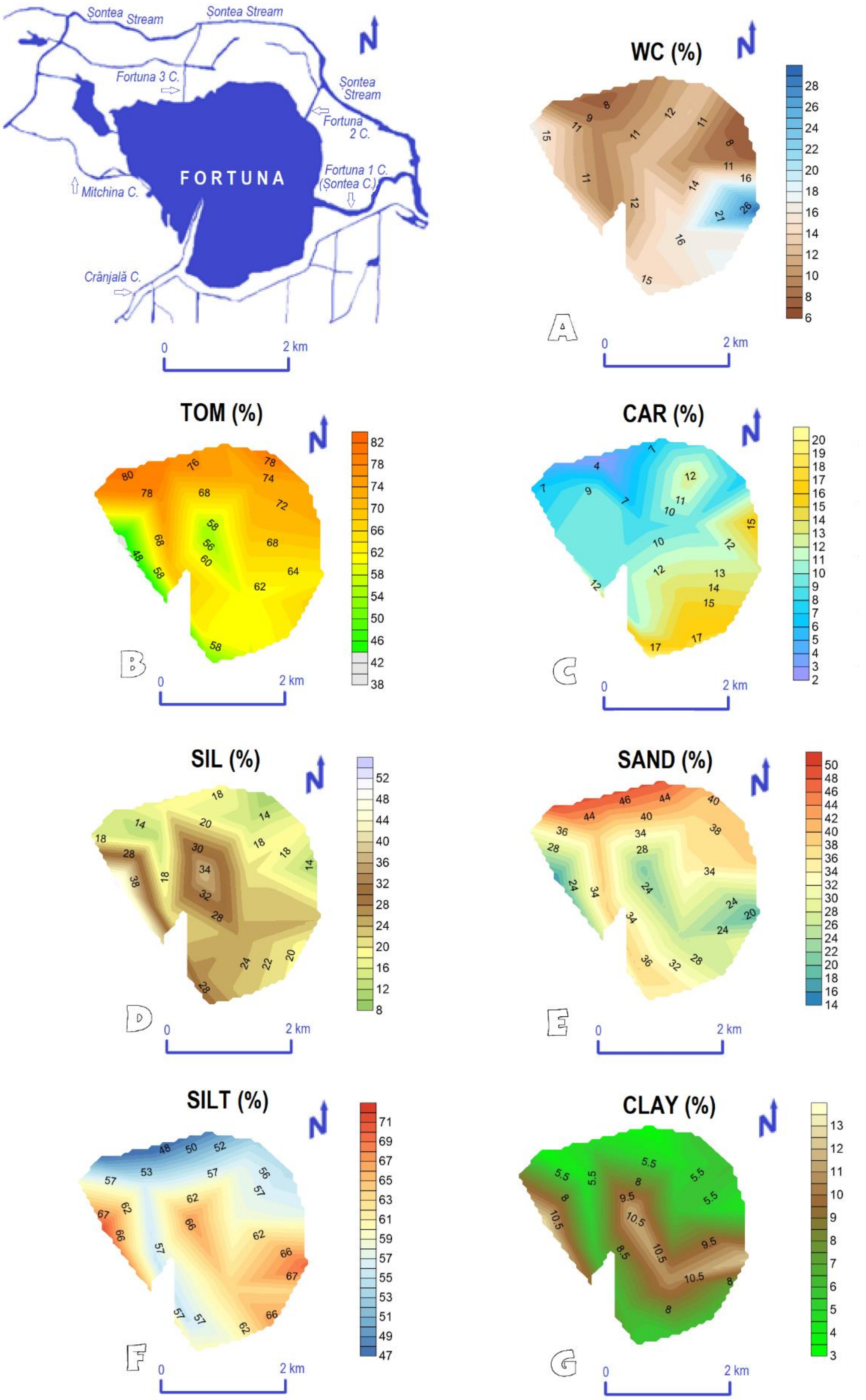

Fig. 2. Spatial variation of the main lithological parameters and main grain size fractions in bed-sediments from Fortuna L.

Acquired results are displayed as a contour map showing SAND, SILT and CLAY% variations (Fig. 2-E, F, G). Generally, the obtained results revealed sediments specific to the lacustrine environment, composed of muds, with the predominant siltic fraction (Fig. 2-F, Fig. 3-B) and with a subordinate sand content (greater than one-third distribution) (Fig. 2-E). An exception was given by two samples (DD19-188 and DD19-190), gathered from the northern side of Fortuna L., in which the sandy fraction slightly exceeds the siltic one. Concerning the muds, the most representative sub-fractions were constituted of coarse and medium silt categories. Apart from the inorganic material, there is also an organogenic content, generally composed of shells, biogenic fragments and plant residues. In most cases, the mean grain-size (Mz) and the median (Md) have values between 4.05 and 5.77Φ. Overall, the standard deviation (σ) in relation to the sorting degree indicated a trend from a poorly sorted to a very poorly sorted particles, the asymmetry index (Sk_I) showed a symmetrical distribution, and the normal distribution curve is mesokurtic.

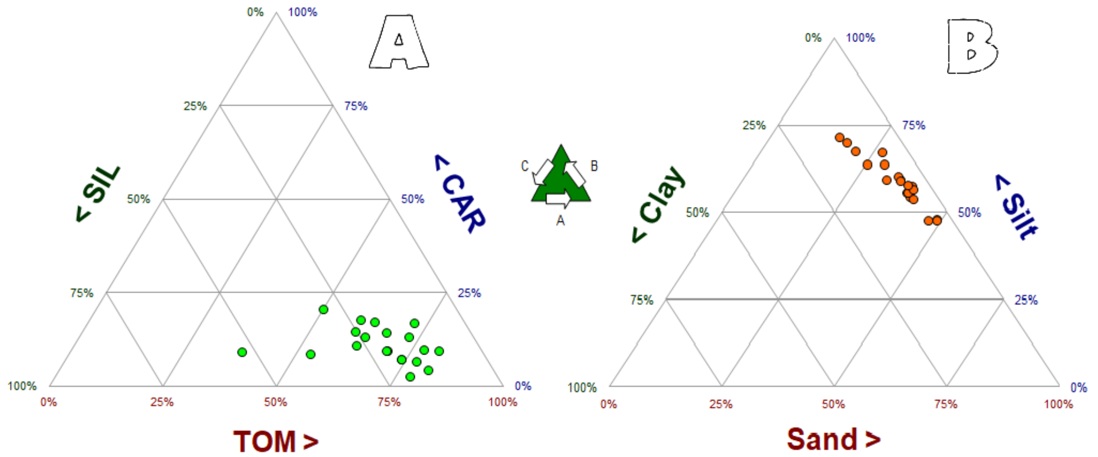

Fig. 3. Ternary diagram showing the distribution of investigated parameters within the bed-sediments

Vertical distribution of the main lithological components in lacustrine core-sediments. The vertical (in-depth) distribution of the main lithological components was evaluated in three short cores extracted from different sectors of Fortuna L., *i.e.*,: DD19–187 (59 cm) and DD19–190 (54 cm) from the northern side, as well as DD19–193 (37 cm) from the central part of the lake (Fig. 4).

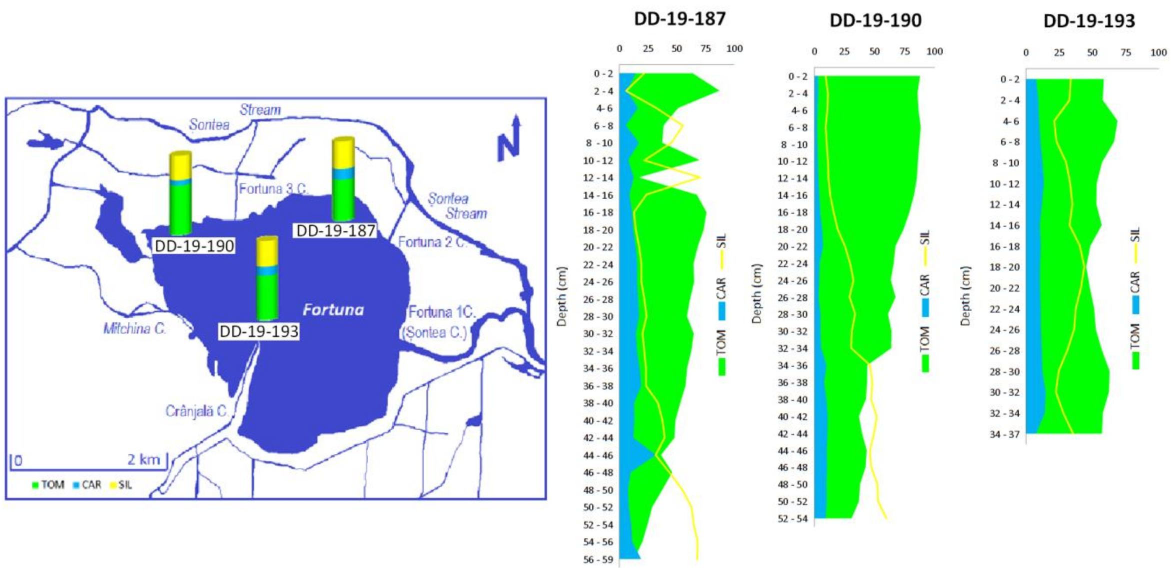

Fig. 4. Vertical variation of the main lithological parameters in core-sediments from Fortuna L.

The lithological analyzes performed on the core sediment samples showed quite comparatively significant variations of the main lithological components: TOM, CAR and SIL% (Table 1). Acquired results are displayed as variation diagrams showing TOM, CAR and SIL% fluctuations. Generally, the TOM% distribution diagram showed that the average values calculated for all short cores have values over 50% of the total weight of dry residue. As well, CAR% fraction has higher average values, over 1%

of the total weight of dry residue occurred in all cores. Average values of SIL% fraction were under 50% of the total weight of dry residue.
The overall results for both bed- and core-sediments indicated a mixed lithology between organic-rich, moderate carbonate and low siliciclastic sediments.

Statistical analysis. In order to evaluate the possible associations between all investigated parameters through sediment physical-chemical characteristics a simple linear correlation analysis was performed by calculating correlation coefficients (r). The bed-sediment results showed both positive and negative relationships between investigated components within the bed-sediments. So, a *strong positive correlation* occurred for TOM *vs* SAND, r = 0.755662; TOM *vs* SILT, r = 0.755662; SIL *vs* SILT, r = 0.610902; SIL *vs* CLAY, r = 0.725468; WC *vs* SILT, r = 0.685299; WC *vs* CLAY, r = 0.601542; DM *vs* SAND, r = 0.690116, a *moderate positive correlation* was noticed for WC *vs* CAR, r = 0.431034; CAR *vs* SILT, r = 0.502416. As well, were found insignificant relationships as *low positive correlation i.e.,* WC *vs* SIL, r = 0.23759; DM *vs* TOM, r = 0.39086 and a *very low positive correlation* for CAR *vs* SIL, r = 0.058571 and CAR *vs* CLAY r = 0.040007.Opossitely, the (r) values were significantly negative for several parameters. Thus, it was observed a very *strong negative correlation* for TOM *vs* SIL, r = -0.908115 and WC *vs* DM, r = -1, then, a *strong negative correlation* in favour of TOM *vs* CLAY, r = - 0.65792; SIL *vs* SAND, r = - 0.67411; WC *vs* SAND, r = - 0.69012; DM *vs* SILT, r = - 0.6853; DM *vs* CLAY, r = - 0.60154 and a *moderate negative correlation* about TOM *vs* CAR, r = - 0.47119; DM *vs* CAR, r = - 0.43103. Also, a *low negative correlation* occurred for WC *vs* TOM, r = - 0.39086; CAR *vs* SAND, r = - 0.38124; DM *vs* SIL, r = - 0.23759.

Overall, congruent with mixed energy conditions prevalent in the Fortuna L., the spatial distribution of the lithological components (TOM, CAR, SIL) (%) within the bed- and core-sediments showed the existence of different types of accumulation related mainly to local hydrodynamic conditions. Results revealed a mixed lithology between organic-rich, moderate carbonate and low siliciclastic sediments. The organic-rich sediments were prevalent in areas dominated by quiet-water conditions and low energy setting, while the mineral-rich sediments were found in areas dominated by high hydrodynamic energy conditions (at the outermost station near the Mitchina C., as well, in the mouth area of the Crânjală C.). Accumulation of fine sediments is impeded in areas with persistent bottom currents. Our results are consistent with previous research findings related to lithological data on recent lacustrine sediments from the Danube Delta (Rădan and Rădan, 2007; Rădan *et al.,* 2014; Rădan *et al.,* 2016;), or adjacent to Fortuna L. (Rădan *et al.,* 2013; Catianis *et al.,* 2013; Catianis *et al.,* 2016).

CONCLUSIONS

In our case the sedimentary accumulation is conditioned by the local factors such as the environmental conditions specific to the transitional (deltaic/ lacustrine) environment. The main physical processes that influence the sediment deposition within Fortuna Lake are mainly related to sediment transport *via* the Danube River (through the secondary hydrographic network), climatic conditions and hydrodynamic environmental variables within its catchment areas. The evolution of the lacustrine ecosystems within the Danube Delta depends mainly on the Danube River alluvial input. In terms of the natural evolution related to Fortuna L. the general tendency is of progressive siltation manifested as a result of several cumulative factors. Under several favourable premises, as its geographical position within the Danube Delta, the relatively high alluvial content, the phases of the hydrological regime, the morpho-hydrographic conditions and the abundant aquatic vegetation place this lacustrine in the category of lakes susceptible to progressive natural siltation.

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