AN ENVIRONMENTAL MAGNETO-LITHOGENETIC STUDY IN THE LAKES OF THE GORGOVA – UZLINA DEPRESSION (DANUBE DELTA, ROMANIA). I. INSIGHTS FROM SHORT SEDIMENT CORES

Sorin - Corneliu RĂDAN[1], **Silviu RĂDAN**[2], **Irina CATIANIS**[2], **Dumitru GROSU**[2], **Albert SCRIECIU**[2], **Iulian POJAR**[2]

[1]*Geological Institute of Romania, 1 Caransebeş St., RO-012271 Bucharest, Romania*
[2]*National Institute of Marine Geology and Geo-Ecology (GeoEcoMar), 23-25 Dimitrie Onciul St., 024053 Bucharest, Romania*
e-mail: sc.radan@yahoo.com; radan@geoecomar.ro; irina.catianis@geoecomar.ro; dan.grosu@geoecomar.ro; albert.scrieciu@geoecomar.ro; pojariulian@geoecomar.ro

Abstract. Magnetic susceptibility (**MS**) represents a high resolution environmental and lithological (**LITHO**) proxy tool, which is successfully used for the study of recent sediments in freshwater or marine aquatic environments. The studies that we have achieved in the last 40 years in the Danube – Danube Delta – Black Sea hydrosedimentary system have revealed strong connections between the characteristics of sedimentary environment, sediment quality and their magnetic properties. In the present paper are discussed results concerning several lakes from *Gorgova – Uzlina Depression (Danube Delta)*, which are added to the lately published magneto-lithological data for sedimentary environments of *Meşteru – Fortuna* and *Matiţa – Merhei* depressions. This work, which represents the first part of a composite paper, is particularly focused on the sediment cores collected in the lakes *Gorgova*, *Cuibeda, Uzlina* and *Isacova*. Their **MS** characterization, not neglecting the lithological support, defined by the three main components, namely the **SIL**iciclastic/ minerogenic fraction – **SIL**, **T**otal **O**rganic **M**atter – **TOM** and **CAR**bonates – **CAR**, is approached. Several lithological units are identified, based upon the macroscopic characteristics, magnetic properties and lithological composition. It is interesting to note that although the study area is included in the fluvial delta plain, the recent lacustrine sediments are very thin in some sectors and the short cores (under 60 cm) stop at a level of marine clays (L. Cuibeda). The second part of this study, regarding the surficial sediments from the above-mentioned lakes, and more other ones is published inside of a similar magneto-lithogenetic context. All these data give new evidences for demonstrating the availabilities of the method used to identify the environmental influences on the magnetic susceptibility of lake sediments, and hence to assess the geoecological state of the deltaic area under attention.

Key words: environmental magnetism, lake sediments, magnetic susceptibility, lithology, sediment cores, Danube Delta.

1. INTRODUCTION – STUDY AREA

The magnetic susceptibility tool, which we are using in lacustrine areas since 1977, *„offers the possibility of a fast and non-destructive characterization of sediments“* (Egli, 2003), and our **MS** database, accumulated during such a long time period, accounts for a consistent contribution to the development of *„so-called magnetic proxies for the reconstruction of the environmental history“* (Egli, 2003), particularly relating to the *Danube Delta*. In order to develop a *proxy* method of recovering and deciphering of the enviromagnetic and sedimentological records archived inside of the lake sediments, we have begun, two years ago, to carry out reviews of data having been gathered by us for the *Danube Delta* (*DD*) ecosystems, particularly since 2010. In two previous published papers, we performed synopses relating to the lakes and channels from the *Meşteru – Fortuna* (**I**, in Fig. 1) (Rădan *et al.*, 2013) and *Matiţa – Merhei Depressions* (**II**, in Fig. 1) (Rădan *et al.*, 2014a). These are two deltaic units located in the northern *DD* wing, which encompasses the area between the *Chilia* and *Sulina Branches* (Fig. 1).

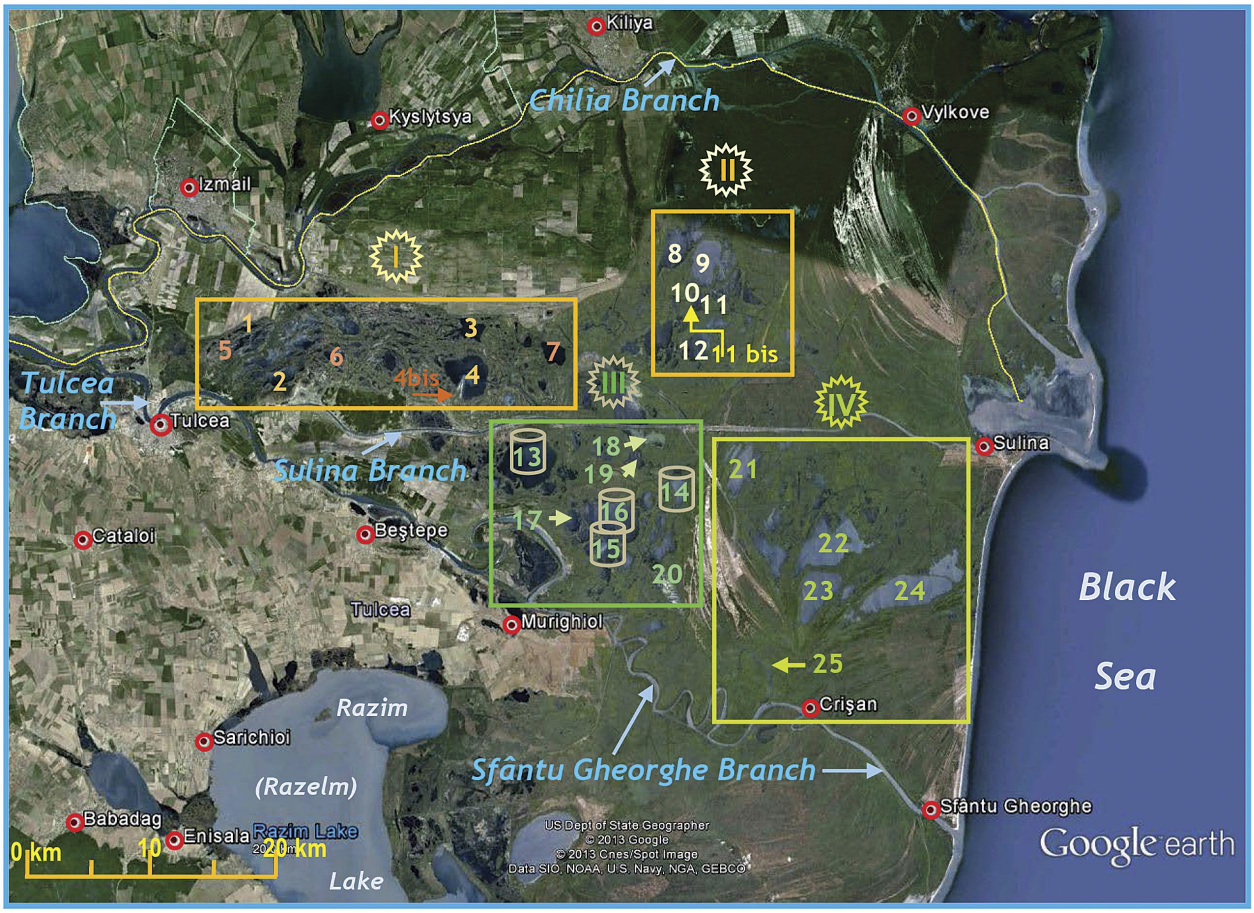

Fig. 1. Location of the major interdistributary depressions in the Danube Delta and position of the main water bodies studied during 2010 – 2015 time period. **I**. *Meşteru - Fortuna Depression*: **1** – Cuteţchi Lake; **2** – Tătaru Lake; **3** – Băclăneşti Lake; **4** – Fortuna Lake; **4bis** – Crânjală Canal; **5** – Trofilca Lake; **6** – Belâi Lake; **7** – Lideanca Lake. **II**. *Matiţa – Merhei Depression*: **8** – Babina Lake; **9** – Matiţa Lake; **10** – Polideanca - Lopatna Swamp; **11** – Polideanca Lake; **11bis** – Lopatna - Polideanca Channel; **12** – Bogdaproste Lake. **III**. *Gorgova – Uzlina Depression*: **13** – Gorgova Lake; **14** – Cuibeda Lake; **15** – Uzlina Lake; **16** – Isacova Lake (**13** ÷ **16** – lakes under study in the present paper: *Part* **I** focused on sediment cores); **17** – Isăcel Lake; **18** – Obretinu Mic Lake; **19** – Obretinciuc Lake; **20** – Gorgoştel Lake (**17** ÷ **20** – lakes added to preceding ones in the paper's *Part* **II** focused on surficial sediments). **IV**. *Lumina – Roşu Depression*: **21** – Iacub Lake; **22** – Lumina Lake; **23** – Puiu Lake; **24** – Roşu Lake; **25** – Erenciuc Lake. *Notes*: **I** – Area with published data (Rădan *et al*., 2013); **5**, **6**, **7** – lakes from where 4 cores were collected in 2014 and 2015, and consequently, the achieved results are not included in the cited paper; **II** – Area with published data (Rădan *et al*., 2014); **III** – Area under attention in the present paper; **IV** – Deltaic area for which the results are to be next published.

The study area approached in this article is situated within the southern DD wing, which is bordered by the *Sulina* and *Sfântu Gheorghe Branches*, and includes the lakes and channels of the *Gorgova – Uzlina Depression* (**III**, in Fig. 1). This deltaic unit is placed in the western part of the Danube Delta, having as an eastern border the *Caraorman Sand Ridge* (Fig. 1), hence, it is also positioned in the fluvial delta plain area, like the above-mentioned previously investigated two depressions.

Magnetic susceptibility (**MS**) has proved to be a high resolution environmental and lithological (**LITHO**) proxy tool, being successfully used in lacustrine areas, wherefrom the composite signatures archived inside of surficial sediments and cores are recovered and deciphered in laboratory. The great number of sample collections investigated during the last 40 years in the *Danube Delta* (*DD*) gave a clear evidence of *„magnetisability"* of the *DD* lake sediments, particularly concerning the environmental influences on the parameter that measures this geophysical property and the appropriate geoecological response. Consequently, by **MS** and **LITHO** characterization of recent sediments, sampled at different time intervals in the same lakes, the changed or unchanged environmental state of deltaic geoecosystems (the anthropogenically modified ones included) has been accurately established by means of a quantitative indicator assessment, complemented by other information, as well.

The magneto-lithological data obtained for nine short sediment cores, collected during the period 2010 ÷ 2014 from four lakes (*Gorgova*, *Uzlina*, *Isacova* and *Cuibeda*; Figs. 1 and 2), are analysed in this article, as a first part

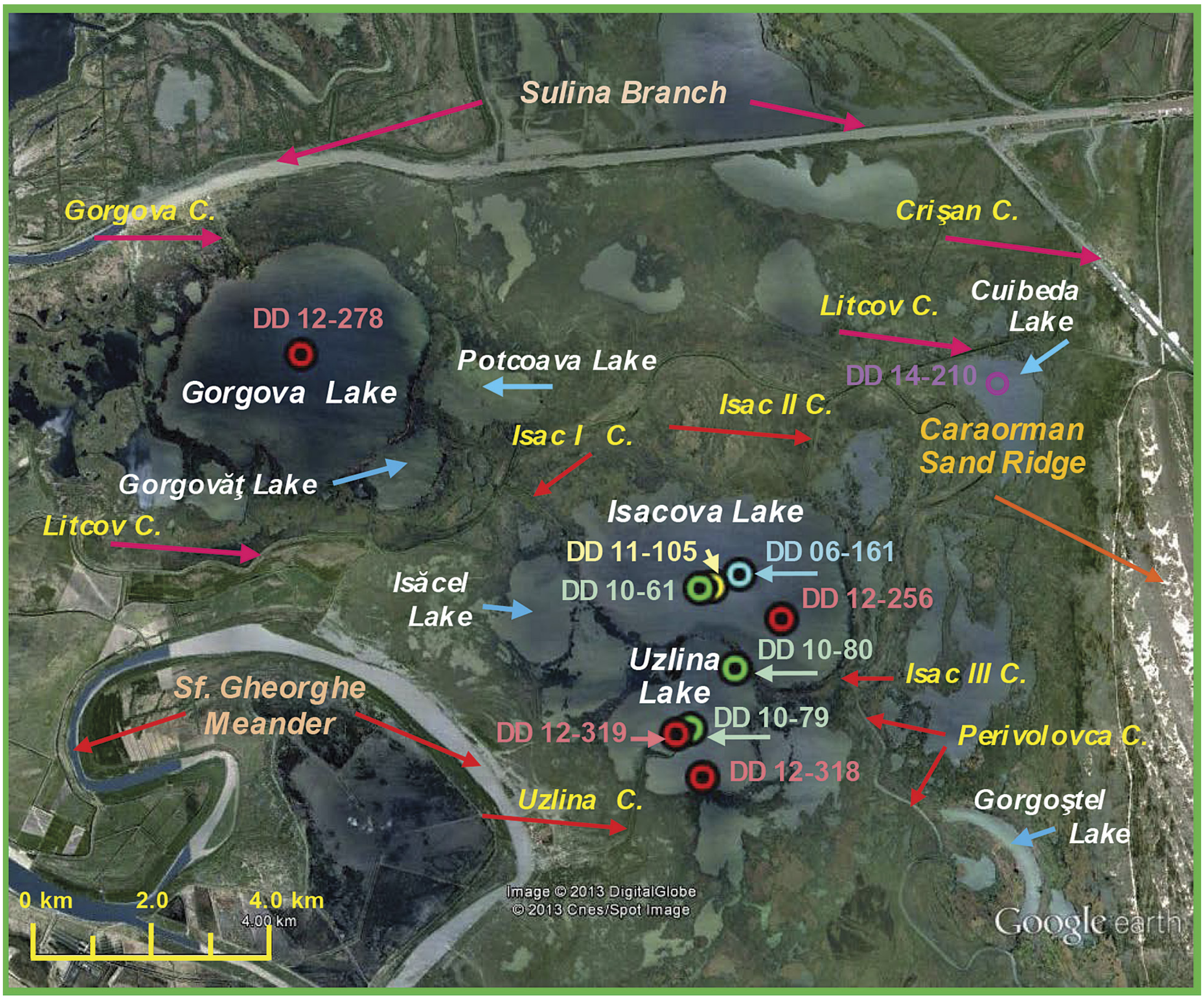

Fig. 2. Locations of the cores taken out in the *Gorgova – Uzlina Depression*, during 2010 – 2014 period, and which are analysed in the paper. *Note*: The results obtained for the *Core DD 06-161* (*Isacova Lake*), sampled in 2006, have been previously published/presented (Rădan *et al*., 2010a,b).

of a composite paper. This integrated study concerns the vertical distribution of the *magnetic susceptibility* (**MS**; **k**) and of the main lithological (**LITHO**) components (**SIL** – *Siliciclastic/detrital/mineral fraction*, **TOM** – *Total Organic Matter*, and **CAR** – *Carbonate fraction*). The areal distribution of the **magnetic** and **LITHO** parameters measured for the surficial sediments of all 9 investigated lakes from the *Gorgova – Uzlina Depression* (the *Obretinu Mic*, *Gorgovăţ*, *Obretinciuc*, *Isăcel* and *Gorgoştel lakes* are added to the four above-specified lakes; Figs. 1 and 2), will be discussed in the second part of the paper.

Some of the magneto-susceptibilimetric and lithological/sedimentological data, achieved along the way, have been previously published, *e.g.*, Rădan & Rădan (2011, and the references therein), Rădan *et al*. (2013, 2014a,b,c,d), and/or were presented at international symposia, *e.g.*, Rădan & Rădan (2007b,c, 2010b), Rădan *et al*. (2014b, 2015).

2. GEOMATERIALS AND METHODS

The field works were performed by GeoEcoMar, aboard the fluvial research vessel "*Istros*", in the framework of the Core Program, Contract no. PN 09-41 03 04. The nine sediment cores have been taken with a *Hydro-Bios corer*, using a transparent tube of 60 cm length. The thickness of the sedimentary sequences recovered in the cores was 25 - 53 cm. The cores were collected during the period 2010 ÷ 2014 from four lakes: *Gorgova* (*DD 12-278*), *Uzlina* (*DD 10-80*, *DD 10-79*, *DD 12-319* and *DD 12-318*), *Isacova* (*DD 10-61*, *DD 11-105* and *DD 12-256*), and *Cuibeda* (*DD 14-210*) (Figs. 1 and 2). Albeit the cores are short, the **MS** and **LITHO** variations which were recorded reveal interesting profiles for interpretation in magneto-sedimentological terms. The sediment cores were opened aboard the R/V "*Istros*" and they were sampled in 1, 2 or 3 cm thick slices ; several sediment sub-samples (ranging between 9 - 23 slices) were obtained from each core and, subsequently, they have been directed to different laboratories for specific analyses (*e.g.*, lithological composition, magnetic susceptibility *etc.*).

The magnetic susceptibility measurements were executed with a *KLY-2 Kappabridge,* in the *laboratory of environmental magnetism* of the *Geological Institute of Romania*. Details concerning the methodology for measuring the magnetic susceptibility (**MS**; **k**) on lake sediments with this equipment were given in numerous unpublished research reports and in several previously published papers (cited in Rădan & Rădan, 2011). The **k** values were reported to the *classes* of a "magnetic susceptibility scale" (Rădan & Rădan, 2007a), so that a **MS** calibration of the lake sediments has become feasible.

As regards the determination of the lithological composition of the lake sediments, this was carried out in a dedicated laboratory of GeoEcoMar. The *Loss on Ignition method* (*LOI*) was applied, by using the sequential heating at 550°C and 950°C, into a SNOL lab furnace (Dean, 1974; Catianis *et al*., 2013, 2014). Hence, the contents (in percents) of three lithological components were established, following the order **TOM** (**T***otal* **O***rganic* **M***atter*), **CAR** (**CAR***bonates*), and **SIL** (**SIL***iciclastic/minerogenic/detrital* fraction).

The strength of the relationship between the magnetic and lithological parameters was assessed (**SIL** *versus* **MS**, **TOM** *vs*. **MS** and **CAR** *vs*. **MS**), the achieved correlation coefficients (**r**) being referred to a scale with 6 ranges spanning the interval from (-1) to (+1) (Rădan *et al*., 2014a).

3. RESULTS AND DISCUSSION

The results are presented following the order (Fig. 1) *Gorgova* (**13**), *Cuibeda* (**14**), *Uzlina* (**15**) and *Isacova* (**16**).

The vertical distribution profiles of the **MS** values (in **10-6 SI**) and of the **SIL**, **TOM** and **CAR** contents (in **%**), which were recorded along the *Cores DD 12-278*, *DD 14*-210, *DD 10-79*, *DD 12-319*, *DD 12-318*, *DD 10-80*, *DD 10-61*, *DD 11-105* and *DD 12-256*, are supported by several **MS** - **LITHO** diagrams, all together constituting magneto-lithological models assigned to the nine cores.

3.1. Gorgova Lake (13, in Fig. 1)

Located in the central part of the *Gorgova - Uzlina Depression* (Fig. 1), the *Gorgova Lake* was investigated during the expedition carried out by GeoEcoMar during 20 July – 2 August 2012. Besides of the surficial sediments which were sampled from 33 stations, a HydroBios sediment core (*DD 12-278*) of 44 cm length was collected from the central zone of the lake (Fig. 2). After slicing the core at intervals of 2.0 cm, 23 samples have resulted, which have been then directed for investigation towards different laboratories.

The sedimentary sequence crossed by the *Core DD 12-278* shows a change, from soft *organic* muds at the upper part to *organo-mineral* sediments downwards, associated with a slight *carbonate* increase trend to the base, reflecting the lithological variations in time, during more or less recent evolution of the lake.

The study of this core shows up a series of magnetic susceptibility variations (Fig. 3a), starting from the lowest **k** value (20.6×10^{-6} SI) measured on the first (top) sediment slice (0 - 2 cm), marked by **1** ("blue triangle", in Fig. 3), and reaching the highest value (102.35×10^{-6} SI) for the sample collected in the middle of the core (depth interval 22.0 - 24.0 cm), element indicated by **I** in Fig. 3 ("red triangle"). Actually, a large **MS** maximum anomaly is recorded in the central zone of the core, which is extended along ca. 30 cm, up and down of the median ax, above specified. Along the last 6 cm of the core (its base), an enhancement trend is observed, the **k** values increasing from 61.49×10^{-6} SI – which marks a minimum zone (denoted by **2**/ "blue triangle", in Fig. 3) – up to 87.94×10^{-6} SI (at the core base; 42 - 44 cm), **k** value signalized by a "red triangle" (**III**). There is another higher **k** value (100.34×10^{-6} SI), measured on a sample sliced from the central **MS** maximum area (interval 28 - 30 cm), a point denoted by **II** ("red triangle"). All these elements identified within the **MS** 3D bar-chart carried out for the *Core DD 12-278* are correlated in Fig. 3 with the corresponding levels from the **MS** 2D line-chart (**c**) and from the **SIL** 3D bar-chart (**f**), respectively. We add the observation that the **MS** characterization of the core is based on two **k** *classes* only: **II** (36 %) and **III** (64 %) (Fig. 3b); moreover, for 71 % of the samples calibrated to *class* **III** were measured **k** values within the lowest zone of the *class* **III** definition interval ($75\times10^{-6} \div 175\times10^{-6}$ SI), particularly situated between $75\times10^{-6} \div 95\times10^{-6}$ SI (Fig. 3a), the rest of 29 % being **k** values placed between $95\times10^{-6} \div 105\times10^{-6}$ SI (Fig. 3a), *i.e*., also within the first third of the interval. As regards the contents of the *siliciclastic* component (**SIL**) determined for the *muds* sampled from the above remarked levels (**1** and **2** – related to the lower/minimum values; **I**, **II** and **III** – related to the higher/maximum values), identified along the sediment core, they are as follows: **1** – 11.36 %; **2** – 33.36 %; **I** – 45.54 %; **II** – 41.69 %; **III** – 49.00 %. The calculated correlation coefficients **r** (Fig. 3,i,j,k,l), which indicate high values (given below), confirm the above observations with regard to the interconnection between the magnetic and the lithological parameters (particularly, **SIL** and **TOM**):

- **SIL** *versus* **k** ➢ **r** = 0.89 (Fig. 3i)
- **TOM** *vs*. **k** ➢ **r** = - 0.81 (Fig. 3j)
- **CAR** *vs*. **k** ➢ **r** is lower, but positive: **r** = 0.41 (Fig. 3k)

The positive correlation **CAR** *vs*. **k** is confirmed by the **CAR** *vs.* **SIL** correlation, both suggesting a detrital origin of the carbonates in the sediments of the Lake Gorgova:

- **CAR** *vs*. **SIL** ➢ **r** = 0.72 (Fig. 3l)

The **TOM** 3D bar-chart (Fig. 3g) reflects "in mirror image" the **SIL** 3D bar-chart (Fig. 3f), while the **CAR** 3D bar-chart (Fig. 3h) shows a relatively similar pattern to **SIL** diagram and a general increasing trend of the *carbonate* contents, starting with the lowest value (3.22 %) obtained on the first *mud* slice (0 - 1 cm), and reaching the highest one (15.64 %) at the core base (depth interval 42 - 44 cm); a slight minimum zone is visible around the median part of the core, the lowest **CAR** content (4.23 %) being given by the *mud* sample taken from the

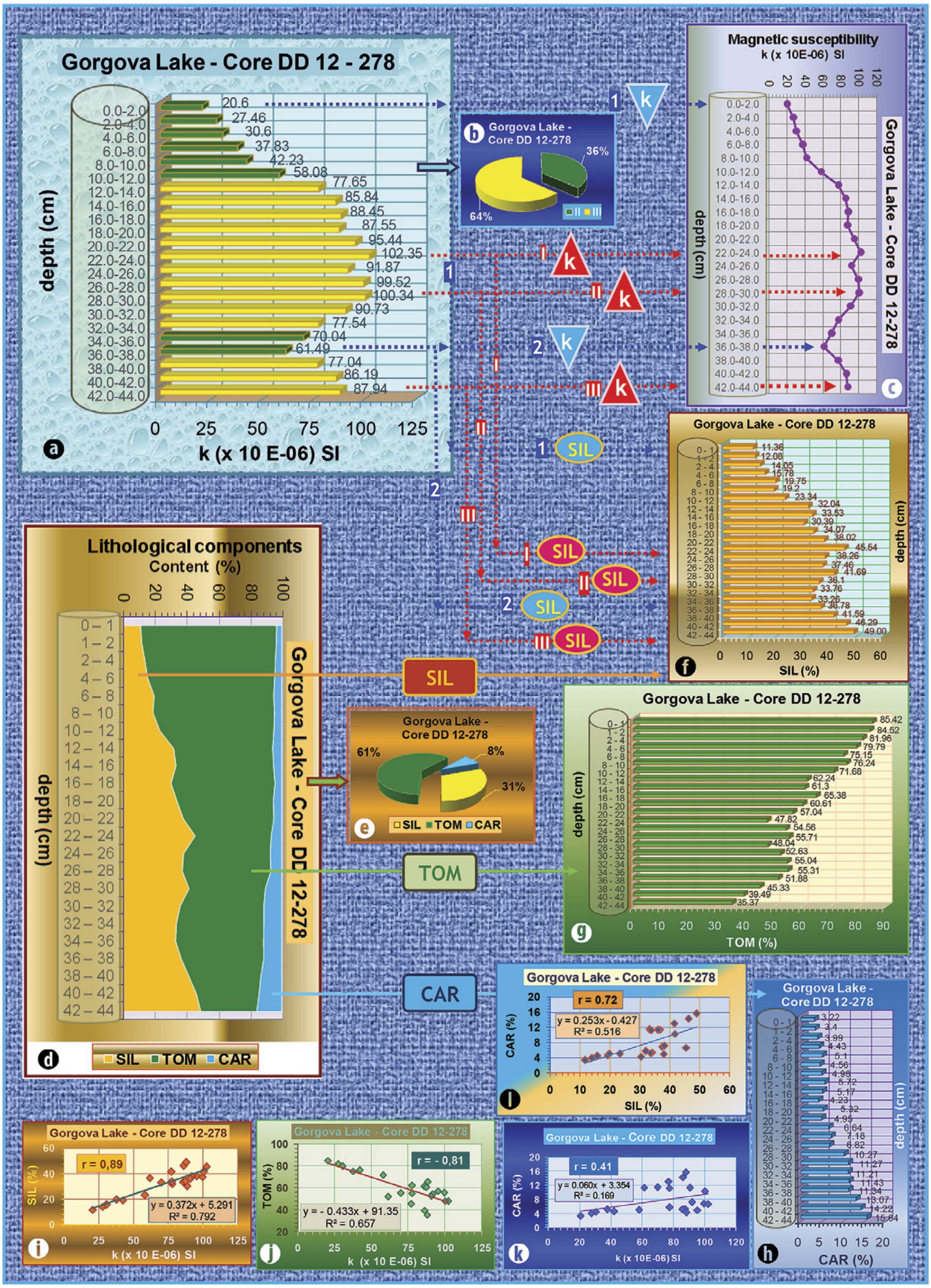

Fig. 3. Magneto-lithological model for the *Core DD 12-278* (*Gorgova Lake*). **a)** Downcore variations of magnetic susceptibility values (**MS**; **k**); the bars, representing **MS** values, are coloured according to **k** scale classes (Rădan and Rădan, 2007a); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents; **i)** Scatter plot for **SIL** *versus* **k**; **j)** Scatter plot for **TOM** *vs*. **k**; **k)** Scatter plot for **CAR** *vs*. **k**; **l)** Scatter plot for **CAR** *vs*. **SIL**.
Notes: *1*. **MS** (**k**) values are expressed in 10^{-6} SI; *2*. **SIL**, **TOM** and **CAR** contents are expressed in %.

depth interval 16 - 18 cm. The simultaneous vertical distribution of the three lithological components along the *sediment core DD 12-278* is best represented by the "area-chart" from Fig. 3d, and the average weights in which they participate to defining the core lithological composition are illustrated by the the diagram of Fig. 3e. So, 61 % are assigned to the organic matter (**TOM**), 31 % to the siliciclastic fraction (**SIL**), while the carbonate component (**CAR**) takes up the remaining 8 % (Fig. 3e).

The magnetic susceptibility variations (Fig. 3a), correlated with the values of the lithological component contents (Fig. 3f,g,h), illustrate an interesting alternance of finer and coarser episodes, which correspond to the temporal variations of the sedimentary supplies. The sediments are quite coarser, more siliciclastic in depth, as compared with the surficial ones, although they remain predominantly of *organo-mineral* type and are calibrated to **k** *classes* **II** and **III**.

In the absence of dating information, there are not reliable correlations with known events, but some assumptions in the context, only. Thus, we can consider the maximum **MS** values recorded at the core base could be correlated with the time period when the *Gorgova Canal*, located in north, was active. After its closing, in 1982, the sedimentation has become finer and richer in organic material, followed by a new increase with the apex within the depth interval 22 - 30 cm, which corresponds to the active period of the *Gârla Filatului Canal*; again, a diminishing of the detrital supplies has occurred, after cutting off the *Mahmudia Meander*, and then, after the temporary closing of the *G. Filatului*.

3.2. Cuibeda Lake (14, in Fig. 1)

The eastern boundary of the *Gorgova - Uzlina Depression* – as regards the studied lakes – is constituted just by the *Cuibeda Lake* (**14**, in Fig. 1; see also Fig. 2), investigated by GeoEcoMar during the expedition carried out in the timeframe 25 April ÷ 7 May 2014.

The surficial sediments were sampled from a network of 14 stations, and a short core of 38 cm length (Fig. 4) was taken from the central zone of this lake (Fig. 2), namely from the *DD 14-210* sampling station. The core was sampled by extrusion and cutting of sediment slices 2 cm thick; the 19 samples obtained have been analysed for the lithological composition and magnetic susceptibility.

The upper half of the core (0 - 20 cm) consists of grey yellowish muds, fluffy on top and more compact downcore, containing few shell debris (Gastropoda) and some vegetal material (reed fragments). In the next 5 cm, the sediments become coarser and show a peaty aspect. After a thin transition zone (25 - 28), represented by grey clayey to dark grey clayey-silty muds, containing few wood fragments (1 - 3 cm long), the core displays a last sequence (28 - 38 cm), represented by a dark grey silty clay, with a rather plastic consistency, similar to the marine clays identified in cores from *Matița - Merhei Depression* (Rădan et al., 2014a).

The average contents of the main lithological components (Fig. 4e) are in agreement with the above macroscopic core description, the *Total Organic Matter* (**TOM**) predominating (69 %) within the sediments, followed by the *silicilastic/mineral fraction* (**SIL**; 26 %), and the *carbonates* (**CAR**; 5 %). The *proxy* parameter magnetic susceptibility confirms this lithological composition of the core sediments, as 63 % of the **MS** values are represented by the lowest **k** *classes* – **I** (47 %) and **II** (16 %) –, followed by the *class* **IV** (21 %), and *class* **III** (16 %) (Fig. 4b).

Very suggestive are the **MS** line chart (Fig. 4c) and the **LITHO** area chart (Fig. 4d), as well as the 3D bar-charts (Fig. 4a,f,g), illustrating the vertical distribution of the **MS**, **SIL** and **TOM** parameters along the *core DD 14-210*. A first general remark is that the downcore gradual increase of the magnetic susceptibility values (Fig. 4a,c) and of the siliciclastic (**SIL**) content (Fig. 4f), together with the corresponding decrease of the organic matter (**TOM**) content (Fig. 4g) follow, accurately, the *core* macroscopic lithological description: the sediments are changing from the *fluffy, non-cohesive muds* (with vegetal material and shell fragments inside) towards *a bit more compact muds* ➔ *relatively compact muds* ➔ *clayey muds* ➔ *clayey siltic muds* ➔ *relatively plastic coarse clays* ➔ *plastic marine clays*. The lithological composition of the core sediments is clearly presented by the area-chart (Fig. 4d), which illustrates, simultaneously, the composite vertical distribution of the three **LITHO** components. This diagram is supported by three bar-charts performed for the respective components (Fig. 4f,g,h), which present the vertical distribution of their contents. So, regarding the *siliciclastic fraction* (**SIL**; Fig. 4f), the increasing trend from the top of the core up to its base is defined by the range 8.01 % ÷ 69.28 %, whose ends come from the first/top sample, a *fluffy mud* (0 - 2 cm depth), and respectively, from the last/base slice, a *marine clay* (36 - 38 cm). As concerns the *organic matter* (**TOM**; Fig. 4g), also, going downwards, the decreasing trend is defined by the content range 90.24 % ÷ 24.8 %, its ends being given by the same sediment samples as in the **SIL** case. The *carbonates* (**CAR**; Fig. 4h) are defined by the contents interval 1.76 % ÷ 11.51 %, the lowest value being obtained for two samples of *muds* (0 - 2 cm, and 16 - 18 cm depth intervals), while the highest one is achieved for a *marine clay* sample taken out from the 32 - 34 cm depth level.

Therefore, the **SIL** and **TOM** diagrams (Fig. 4f,g) illustrate – so, graphically – the quantification of the lithological evolution (above specified) that has been intercepted by the short sediment core of 38 cm length only, extracted from the *Cuibeda Lake* central zone.

Coming now to the *enviromagnetic* parameter – the *magnetic susceptibility*, this one confirms again its quality of *proxy* lithological parameter concerning the *lake sediments*.

So, the **MS** record shows the lowest level of the **k** values, having been defined even a „diamagnetic behaviour" for the muds sampled from the top first 14 cm, which have provided

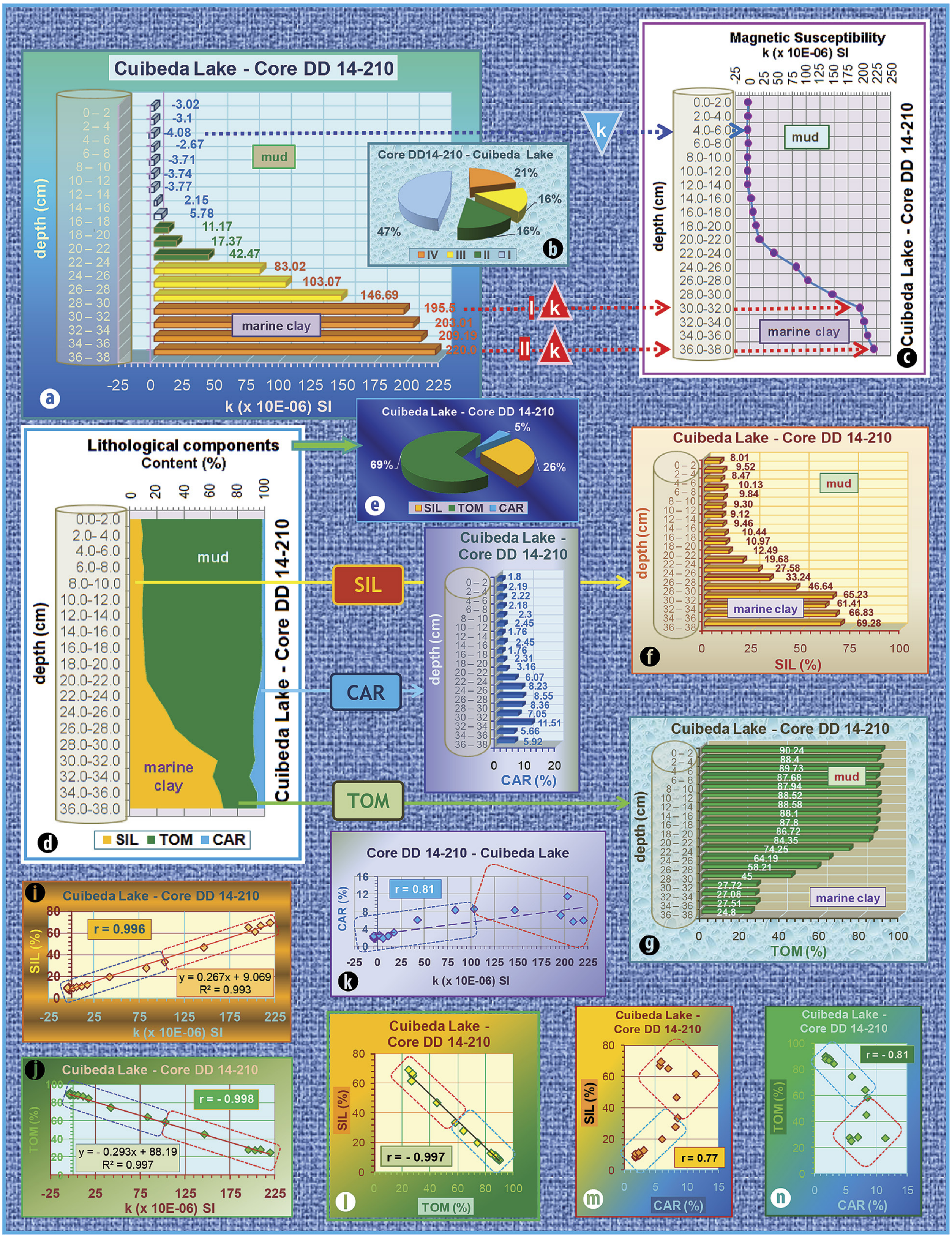

Fig. 4. Magneto-lithological model for the *Core DD 14-210* (*Cuibeda Lake*). **a)** Downcore variations of magnetic susceptibility values (**MS**; **k**); **b)** **MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents; **i)** Scatter plot for **SIL** *versus* **k**; **j)** Scatter plot for **TOM** *vs*. **k**; **k)** Scatter plot for **CAR** *vs*. **k**; **l)** Scatter plot for **SIL** *vs*. **TOM**; **m)** Scatter plot for **SIL** *vs*. **CAR**; **n)** Scatter plot for **TOM** *vs*. **CAR**. *Notes 1* and *2*: the same as in Fig. 3.

values between $(-4.08)\times10^{-6} \div (-2.67)\times10^{-6}$ SI (Fig. 4a). The **k** values are progressively increasing, but up to the depth of 24 cm they remain inside of the lower ranges of the **MS** scale, *i.e.* the *classes* **I** and **II**. The fact that at the base of the sample sliced from the level 24 - 26 cm it has been intercepted a boundary with a *clayey mud* and a transition zone (up to cm 28) is directly marked out by the magneto-susceptibilimetric parameter, which records an increasing trend, passing to the **k** *class* **III** (the measured value: 83.02×10^{-6} SI and 103.07×10^{-6} SI ; Fig. 4a). Going downwards, along the core, the **MS** values are progressively increasing, ranging between 146.69×10^{-6} (*class* **III**) $\div$ 220.00×10^{-6} SI (*class* **IV**). Consequently, the *marine clays* sampled in the lowest part of the *Core DD 14-210*, rather inside of the depth interval 30 - 38 cm, are calibrated to *class* **IV**, relieving the highest **k** values measured for the sediments of this core: between $195.50\times10^{-6} \div 220.00\times10^{-6}$ SI. This interval is well denoted by two "red triangles" in Fig. 4a➔c, while the lowest **k** value [$(-4.08)\times10^{-6}$ SI], recorded on a *fluffy mud* (4 - 6 cm depth), is also marked out, but by a „blue triangle" with an inverse position (as compared with the red ones) (Fig. 4a➔c).

The relationship of the lithological components with the enviromagnetic parameter/ magnetic susceptibility is remarkable as time as the correlation coefficients are **r** = 0.996 for **SIL** *versus* **k** (Fig. 4i) and **r** = - 0.998 for **TOM** *vs*. **k** (Fig. 4j). As a consequence, certainly, the **r** coefficient is very high, close to 1.0, in the case of **SIL** *versus* **TOM** correlation: **r** = - 0.994 (Fig. 4l). Also, a strong correlation is remarked for **CAR** *vs*. **k** (**r** = 0.81; Fig. 4j), which, usually, does not indicate such a high degree of interconnection. Moreover, as the correlation is positive in this case, it is suggested a genetic signification, namely, the *carbonates* are dominantly of detrital origin, these being brought along with the *siliciclastic material*. This assumption is consistent with the quite strong and positive correlation (**r** = 0.77) between *mineral/detrital* fraction (**SIL**) and *carbonates* (**CAR**) (Fig. 4m), as the strong negative correlation (**r** = - 0.81) of *organic matter* (**TOM**) with *carbonates* (**CAR**) (Fig. 4n). However, a closer analysis of the graphs shows that samples belonging to the level of *marine clays* are exempted from this rule, the corresponding cloud of points showing a slight reverse trend line, which would indicate a rather biochemical origin for carbonates associated with these clays.

3.3. Uzlina Lake (15, in Fig. 1)

The vertical distribution of the **MS** values and of the contents of the **LITHO** components **SIL**, **TOM** and **CAR** will be further presented, firstly for the cores from the underwater fan area of the *Uzlina Canal* (*DD 10-79*, *DD 12-319*), and then, for the two cores sampled from the southern and the northern extremities of the lake, *i.e.*, *DD 12-318*, and *DD 10-80*, respectively (location, in Fig. 2).

a) Core DD 10-79

The *Core DD 10-79* was collected in front of *Uzlina Canal*, at about 230 m from the canal mouth, within the area influenced by the Danubian water and sediment supplies (Fig. 2). From the lithological point of view, at the upper part of the core occurs a yellowish-grey oxidized, coarse silty *mud*, with sand traces, characteristic to the underwater discharge channel area. The mud is passing downwards to a darker coloured mud, more compact and very cohesive, keeping relatively unchanged up to the core base (48 cm beneath the water/sediment interface), where a cm-scale bedding, as revealed by colour, was observed . Along the whole column, from place to place, *Dreissena* fragments and rare *Viviparus* and *Unio* shells occur. The profile is typical for the zone of influence of a water input channel.

The magneto-lithological model carried out for the *core DD 10-79*, given in Fig. 5, shows that **MS** vertical variation is well correlated with the above macroscopic description. The **k** values are very high, ranging between 188.76×10^{-6} SI (*class* **IV**) – measured on the lowest sediment slice (45 - 48 cm depth interval), sampled from a finer intercalation, and 441.94×10^{-6} SI (*class* **Va**) – measured on a sample got from a zone of high **k** values (34 - 38 cm depth interval), corresponding to the coarser sediments (Fig. 5a), usually present in the discharge areas of the channels. Actually, these two *classes* only characterize this sediment core (Fig. 5b), 75 % of the samples being calibrated to **k** *class* **Va**, and the remaining 25 % to **k** *class* **IV**. The general image of the **MS** profile shows an increasing trend of the **k** values towards the deeper core part, followed by a decrease towards the base. The line-chart from Fig. 5c better illustrates the most significant features recorded by the **MS** profile, so that two maximum zones are clearly set and defined by the pair of **k** values marked by **I** and **II** ("red triangles"), and respectively, by **III** and **IV** ("red triangles"). At the same time, the minimum **MS** zone located between these two maxima, and the ends (*top* and *base*) of the two decreasing arms composing the *Core DD 10-79* **k** profile are marked by **2**, **1** (*top*) and **3** (*base*) ("blue triangles"), respectively (Fig. 5c).

As regards the lithological (**LITHO**) constitution of the core sediments, the area-chart from Fig. 5d presents the composite vertical distribution of the three lithological components: **SIL** (*silicilastic/mineral/detrital* fraction), **TOM** (*total organic matter*), and **CAR** (*carbonates*). The average lithological composition of the whole core sediments shows a very high **SIL** content (88 %), the other 12 % being equally divided between the **TOM** and **CAR** components (Fig. 5e). Actually, the *siliciclastic fraction* content determined along the core is quite constant, ranging within a narrow interval, *i.e.*, 84.2 % ÷ 91.1 % (Fig. 5f). The same characteristic is revealed by the *carbonates* (5.5 % ÷ 6.7 %; Fig. 5h), and by the *organic matter* content (Fig. 5g), the latter being defined within the interval 2.9 % ÷ 9.2 %, yet, excluding these two extreme values, the variation domain is 4.6 % ÷ 6.5 %.

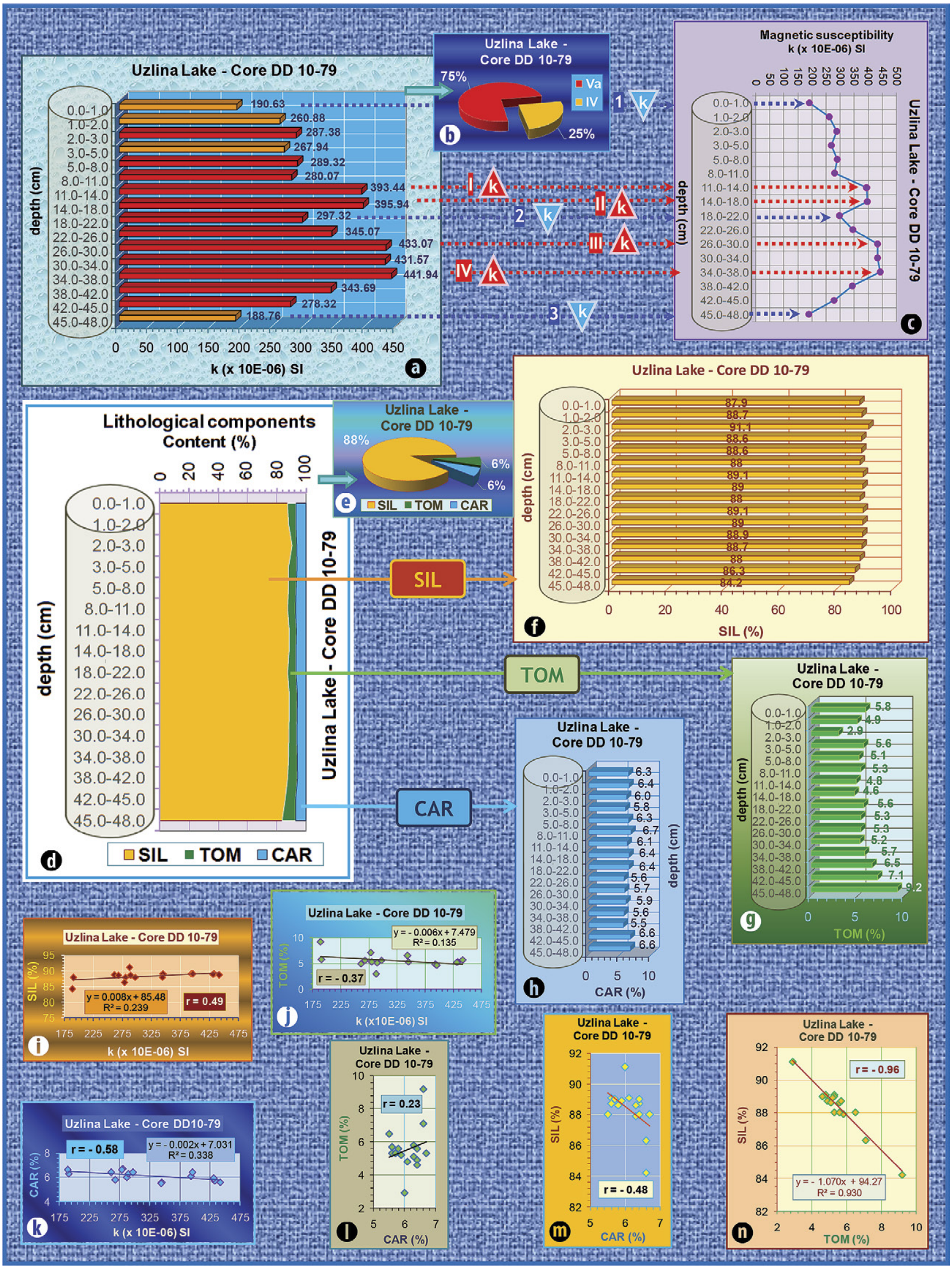

Fig. 5. Magneto-lithological model for the *Core DD 10-79* (*Uzlina Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents; **i)** Scatter plot for **SIL** *versus* **k**; **j)** Scatter plot for **TOM** *vs*. **k**; **k)** Scatter plot for **CAR** *vs*. **k**; **l)** Scatter plot for **TOM** vs. **CAR**; **m)** Scatter plot for **SIL** *vs*. **CAR**; **n)** Scatter plot for **SIL** *vs*. **TOM**. *Notes 1* and *2*: the same as in Fig. 3. *Note 3*: **1**, **2**, **3** and **I**, **II**, **III**, **IV** – see text.

In conclusion, the three components **SIL**, **TOM** and **CAR** have quite constant contents along the core (Fig. 5d), very high for the *mineral fraction* (an average value of 88.33 %; Fig. 5f), and very low for the *organic matter* (an average value of 5.56 %; Fig. 5g). As regards the *carbonates*, the mean content is 6.12 % (Fig. 5h), very close to the **TOM** content, but a bit higher. Some slight inflexions, that are clearly highlighted by the **MS** graphs (Fig. 5a,c), but also, by the **SIL**, **TOM** and **CAR** charts (Fig. 5f,g,h), suggest an alternation of coarser and finer sediment inflows, characteristic to the areas that are strongly and directly influenced by the *Danubian* supplies.

Related to the correlations between the *lithological components* and the *enviromagnetic parameter*, respectively between pairs of lithological components, the coefficient **r** records lower values as compared with those which we have usually presented in our studies. So, with the exception of the extreme cases, particularly for **TOM** *vs*. **CAR** (Fig. 5l), for which the correlation is *positive* and very *weak* (**r** = 0.23), and **SIL** *vs*. **TOM** (Fig. 5n), for which the correlation is *negative* and *strong* (**r** = - 0.96), in all the other cases taken into consideration the correlations are *moderate*, namely: **SIL** *vs*. **k** (**r** = 0.49; so, *positive* correlation; Fig. 5i), **TOM** *vs*. **k** (**r** = - 0.37; *negative*; Fig. 5j), **CAR** *vs*. **k** (**r** = - 0.58; *negative*; Fig. 5k), and **SIL** *vs*. **CAR** (**r** = - 0.48; *negative*; Fig. 5m), respectively. The relatively weak correlation **SIL** *vs.* **k** reflects the effect of the possible different grain sizes and, maybe, of the heavy mineral content variation within a dominantly siliciclastic sedimentary sequence.

b) Core DD 12-319

After two years, a short sediment core (*DD 12-319*; 33 cm length) has been taken out at a very small distance (160 m southwest) of *Core DD 10-79*, apparently closer to the *Uzlina Canal* mouth (160 m), but at 100 m northwest away from the channel axis (Fig. 2). The magneto-lithological model performed for this core is illustrated in Fig. 6.

This position explains why the vertical distribution of the magnetic susceptibility points out higher levels of the **k** values (Fig. 6a), as compared to the *Core DD 10-79*, characterized by the **MS** *classes* **III**, **IV**, **Va** and **Vb**; 78 % of the sediment samples sliced from the core are calibrated to *class* **Va**, and 6 % to class **Vb** (Fig. 6b). Thus, at the core base, is recorded the highest **k** value (636.75×10^{-6} SI, assigned to **k** *class* **Vb**; Fig. 6a,c) that was measured on the short cores collected from the deltaic lakes during the last time period. The **k** values are increasing with the depth, passing successively through the **k** *classes* **III**, **IV**, **Va** and **Vb**; the range in which the **MS** is defined is $170.66\times10^{-6} \div 636.75\times10^{-6}$ SI (Fig. 6a). This magneto-susceptibilimetric regime is due to the influence area created by the *Uzlina Canal,* which is carrying a detrital material supply from the *Danube River*, particularly from the *Sf. Gheorghe Branch*. The location of this core, on the underwater alluvial fan, closer to the channel (Fig. 2) could explain the higher **k** values measured at the 30 - 32 cm and 32 - 34 cm depth levels (Fig. 6a), whose mean **k** value is 603.5×10^{-6} SI (*class* **Vb**), as compared with 431.57×10^{-6} SI (**k** *class* **Va**), which was recorded for a similar thick slice (30 - 34 cm) cut from the core (*DD 10-79*; Fig. 5a), previously analysed. As the *Core DD 12-319* is shorter than *DD 10-79* (33 cm *versus* 48 cm; Figs. 6a and 5a), the finer sediment horizon (fluffy mud), identified at the lower part of the core taken in 2010, characterized by the decreasing **k** values measured within the depth interval 34 - 48 cm (Fig. 5a), has not been intercepted by the core taken in 2012, so that the **MS** profile is ended with the highest **k** value recorded along the *Core DD 12-319* (Fig. 6a).

As regards the lithological composition of the sediments of this core, the area-chart from Fig. 6d marks out a "sawtooth" shape of the vertical distribution of the main components **SIL** and **TOM** (supported, of course, by the **SIL** and **TOM** 3D bar-charts, drawn in Fig. 6f,g). This represents a different, even a contrasting pattern compared to the features denoting steadiness which are revealed by the *Core DD 10-79* **LITHO** area-chart (Fig. 5d). Still the **MS** profile recorded for the *Core DD 12-319* (Fig. 6a,c) shows a shape which does not follow the particular way of the two main **LITHO** components. The difference between the vertical distribution patterns of the lithological components in the two cores could be explained by their different positions in relation to *Uzlina Canal*: the *Core DD 10-79* is located in the axis of the channel, under the direct and continuous influence of river supplies, and the *Core DD 12-319* is placed in a lateral position, which records more accurately the periodic inflows of water and sediments brought by floods. As regards the **LITHO** content weights (given in Fig. 6d), it can be mentioned that the contents of the *carbonates* (**CAR**) from the *Core DD 10-79* are close to those determined for the *Core DD 12-319*: 6.12 % *versus* 6.26 % (mean values; **CAR** vertical profiles, in Figs. 5h and 6h), while for the **SIL** and **TOM** components (vertical profiles, in Figs. 5f,g and 6f,g), the comparative analysis results in 88.33 % *vs*. 73.17 % (**SIL**), and 5.56 % *vs*. 20.54 % (**TOM**). It can be concluded, the levels of the **LITHO** contents relating to the *Cores DD 10-79* and *DD 12-319*, sampled very close one another, look alike, with almost equal **CAR** contents, and a ca. 15 % difference between the siliciclastic and organic matter contents, particularly, a slight higher **SIL** content, and corresponding, a slight lower **TOM** content assigned to the *Core DD 10-79*.

The particularities of distribution patterns of various parameters observed in the two neighbouring cores could be explained through the role played by yet unmeasured factors, as grain size, heavy minerals in siliciclastic fraction, or the occurrence of greigite within the black organic muds.

c) Core DD 12-318

The *sediment core DD 12-318*, having a length of 30 cm only (Fig. 7), was collected during the 2012 summer campaign from the southern extremity of the *Uzlina Lake*, approximately at the half distance between the *Uzlina Canal* mouth, entering the lake, and its eastern boundary (Fig. 2).

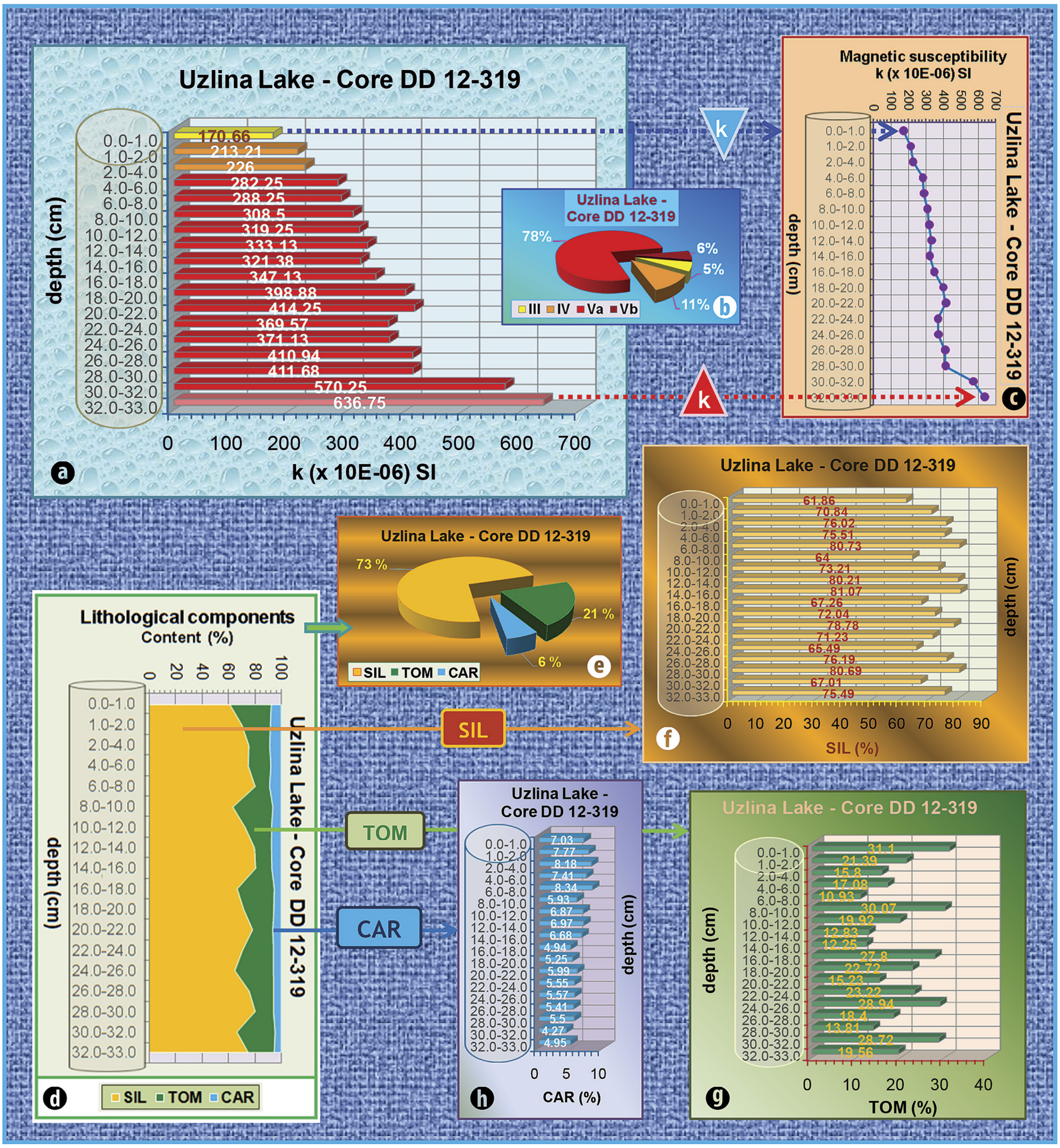

Fig. 6. Magneto-lithological model for the *Core DD 12-319* (*Uzlina Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents. *Notes 1* and *2*: the same as in Fig. 3. *Note 3*: **1** and **I** – see text.

The magnetic susceptibility vertical distribution (Fig. 7a), based on 16 sediment slices cut from the core, shows a general increase of the **k** values with the depth, followed by a decreasing trend observed along the last 8 cm towards the core base (interval 22 - 30 cm). Actually, at 22 cm depth, the blackish grey *mud*, rich in bioturbations, identified from the top core up to this level, becomes more soft and plastic. As compared with the cores *DD 10-79* and *DD 12-319*, taken not far from the mouth of the channel entering the lake (Fig. 6a), in the case of the *Core DD 12-318*, the **k** values are generally lower, passing, successively – from top core to 30 cm depth beneath the water/sediment interface – through the **MS** *classes* **III**, **IV** and **Va**, not reaching the *class* **Vb** (Fig. 7a,b), corresponding to a magnetic susceptibility range between 121.36×10^{-6} (*class* **III**) ÷ 429.00×10^{-6} SI (*class* **Va**). For the present analysed core, the most sediment samples (62 %)

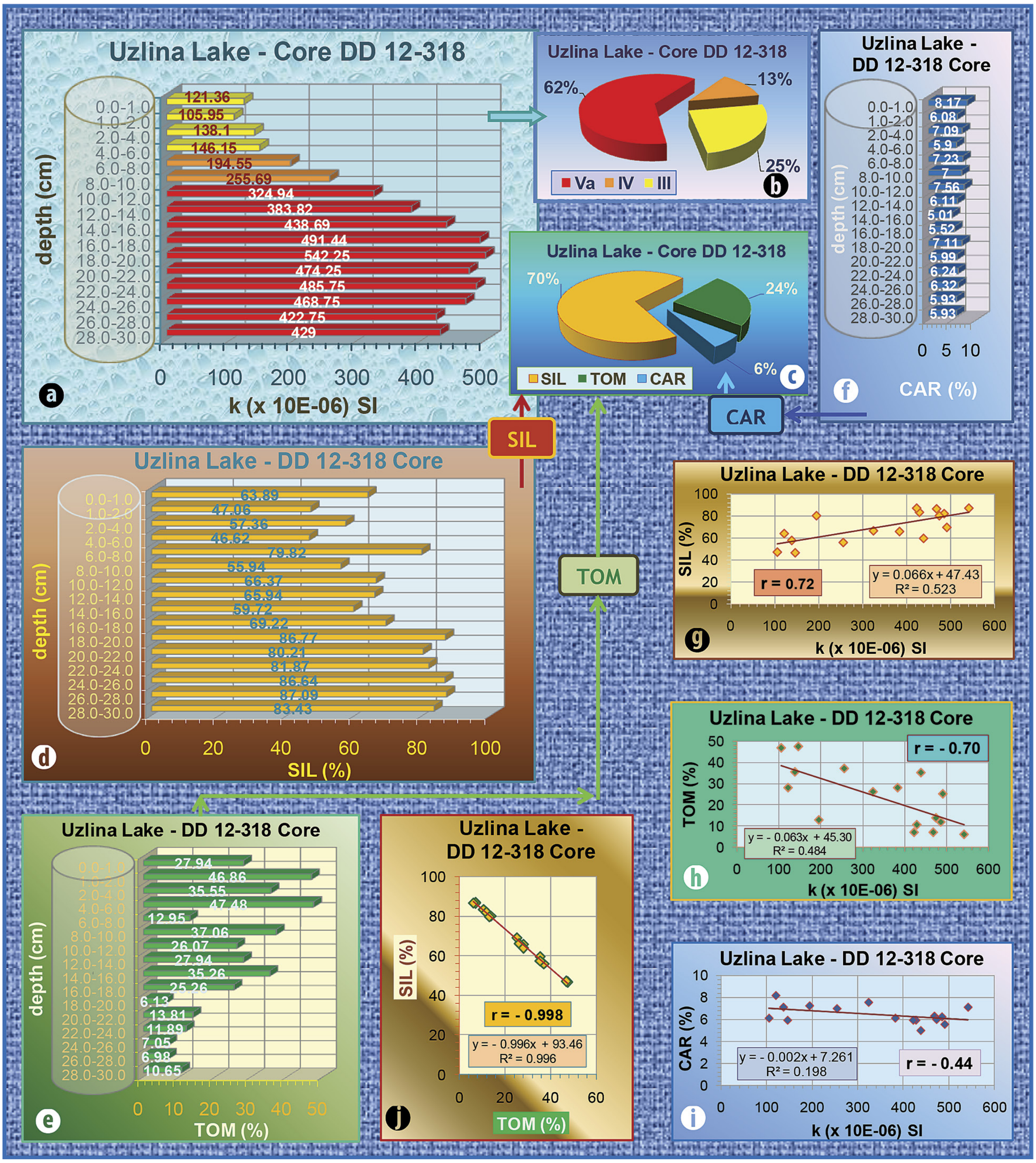

Fig. 7. Magneto-lithological model for the *Core DD 12-318* (*Uzlina Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Average lithological composition of the core sediments; **d)** Downcore variation of **SIL** contents; **e)** Downcore variation of **TOM** contents; **f)** Downcore variation of **CAR** contents; **g)** Scatter plot for **SIL** *versus* **k**; **h)** Scatter plot for **TOM** *vs*. **k**; **i)** Scatter plot for **CAR** *vs*. **k**; **j)** Scatter plot for **SIL** *vs*. **TOM** . *Notes 1* and *2*: the same as in Fig. 3.

are calibrated to **k** *class* **Va**, but the following weights (in size), *i.e.*, 25 % and 13 %, belong to **k** *classes* **III** and **IV**, respectively (Fig. 7b).

The lithological composition of the core sediments (Fig. 7c) indicates that the *siliciclastic/detrital component* (**SIL**) is predominant (70 %) over the *organic matter fraction* (24 %) and the *carbonates* (6 %). The **SIL** contents show a general increasing trend with depth (similar to the **k** vertical distribution), in this case up to the last two centimeters from the lower part of the core (Fig. 7d); yet, this dominant feature of the **SIL** profile is interrupted by two higher contents determined at the depth levels 0 - 1 cm and 6 - 8 cm, and by two lower contents which were reached for the sediment slices cut at the 4 - 6 cm and 14 - 16 cm depth levels (Fig. 7d). The macroscopic description of the samples performed aboard the "*Istros*" vessel does not explain these divergences from the general trend of the **SIL** profile, which are more visibly if we compare them with the magnetic susceptibility record (Fig. 7a), a *proxy* lithological parameter tested on thousands of lake sediment samples. Anyway, the correlation coefficient calculated for **SIL** *versus* **k** (**r** = 0.72) indicates a strong positive correlation (Fig. 7g), according to the scale presented by Rădan & Rădan (2014a). The same evidences, including the exceptions, offer the 3D bar-chart performed for the *total organic matter* component contents (Fig. 7e), but the general feature of the **TOM** profile remarks, as usually, a reversed behaviour (as compared with that of the **SIL** component), *i.e.* a decreasing trend downcore. Nevertheless, the correlation **TOM** *versus* **k** is a strong negative one, attested by **r** = - 0.70 (Fig. 7h). As regards the *carbonates* (**CAR**), the contents are defined within a quite narrow range, between 5.01 % ÷ 8.17 % (Fig. 7f). Like in other cases, the correlation coefficient for **CAR** *versus* **k** is relatively lower (**r** = - 0.44), and shows a moderate negative/reversed correlation (Fig. 7i). As usual, a very strong negative correlation (**r** = - 0.998) was determined for **SIL** *versus* **TOM** (Fig. 7j).

A version of the magneto-lithological model concerning the *Core DD 12-318* was firstly included – together with other several short sediment cores – inside of a poster-paper dedicated to the enviromagnetic signatures and their lithological support, in relation with the geoecological context associated with the *Gorgova – Uzlina* aquatic area (Rădan *et al*., 2015).

d) Core DD 10-80

The *Core DD 10-80*, a very short one (25 cm length), was collected during the 2010 summer campaign from the northeastern extremity of the *Uzlina Lake*, 50 - 60 m before entering into the output canal *Isac II*, through which the water is discharged from *Isacova Lake* in *Litcov Canal* (Fig. 2). The sediments are completely changing. Due to the core position in a more distal zone in regard to the *Danubian* supplies, the grain size of the cored sequence is finer than those of the above described cores; the **MS** values are lower, ranging between 32.1×10^{-6} SI (*class* **II**; minimum marked by a "blue triangle" in Fig. 8a➔c) and 138.07×10^{-6} SI (*class* **III**; maximum marked by a „red triangle" in Fig. 8a➔c). The core samples calibrated to *class* **II** represent 60 %, and the other 40 % belong to the *class* **III** (Fig. 8b). The sediments contain reed fragments and a rather poor fauna (some gastropods and a fragment of *Anodonta*). At 13 - 17 cm depth level, a more compact sediment was identified, having the consistence of a soil; this is remarked by the highest content of the *siliciclastic/mineral fraction* (78.9 %; Fig. 8f), and correspondingly, by the highest measured magnetic susceptibilitiy value (138.07×10^{-6} SI; Fig. 8a). This zone of *maximum*, defined by both the magnetic and the lithological parameters (Fig. 8a,c,f), could be explained by the intervention, at a moment, of a major flooding. The **SIL** 3D-bar chart (Fig. 8f) shows quite constant contents, ranging between 71.9 % ÷ 78.9 %. The decreasing trend illustrated by both the **MS** and **SIL** vertical distribution diagrams within the depth interval 17 - 25 cm (Fig. 8a,f) is generated by the relatively soft and fine mud intercepted towards the core base. Actually, the lowest magnetic susceptibility and the lowest **SIL** content were determined at the core bottom, for the last sediment slice (21 - 25 cm). Opposite to this, the highest organic matter (**TOM**) content (25.0 %) was shown by the same core interval (Fig. 8h), as compared with the lowest one (13.0 %), which characterizes the uppermost sediment core slice (interval 0 - 1 cm). It can be remarked the general increasing trend of the **TOM** contents along the *Core DD 10-80*, from top downwards (Fig. 8g). A general very slight reversed trend is observed for the *carbonates* of this core (Fig. 8h), the **CAR** profile indicating a content of 12.8 % for the sediment slice 1 - 2 cm, and around 3 % for the muds from the core lower part (13 - 25 cm). The **CAR** profile similarity to that of the *siliciclastic material* suggests a detrital origin of the *carbonates*. The **LITHO** area-chart (Fig. 8d) illustrates the composite vertical distribution of the three main components **SIL**, **TOM** and **CAR** along the *Core DD 10-80*. On the other hand, the diagram of Fig. 8e remarks the clear preponderance of the *siliciclastic fraction* (74 %), while the *organic matter* (**TOM**) represents 17 %, and the *carbonates* (**CAR**) – the rest of 9 %.

We add to this presentation of the **LITHO** profiles an interesting observation with regard to the decreasing trend of the *carbonate* material downwards the core (**CAR**, in Fig. 8h), in opposition with the *organic* component (**TOM**, in Fig. 8g), which exhibits an increasing trend from the water/sediment interface towards the core base. This situation seems to be atypical, the *organic matter* usually having a decreasing trend towards the deeper zones of the sediments. In reality, the *Core DD 10-80* not being too long, the level relatively rich in organic matter is a normal one for the northern zone of the lake, the covering sediment being influenced by the stronger supplies of sediments, of fluviatile origin, which have frequently been present in the last years and which prevail in the *Uzlina Lake*.

Regarding the relationship between the lithological components and the magnetic parameter **MS**, only the correlation **SIL** *versus* **k** (Fig. 8i) is characterized by a very high coefficient **r** (= 0.92), which argues a strong positive correlation, while for **TOM** *vs*. **k** (Fig. 8k) and **CAR** *vs*. **k** (Fig. 8l) – according to the **MS** scale (Rădan and Rădan, 2007a) – the correlations are weak and negative: **r** = - 0.24, and **r** = - 0.19, respectively (Fig. 8k,l). Certainly, if we test the correlation of the contents of these two lithological components together (**TOM** + **CAR**) *versus* the corresponding magnetic susceptibility values (**MS**; **k**) (Fig. 8j), the correlation coefficient is *very high* and *negative*, namely **r** = - 0.92, opposite to the case of **SIL** *vs*. **k** (**r** = 0.92), mentioned above.

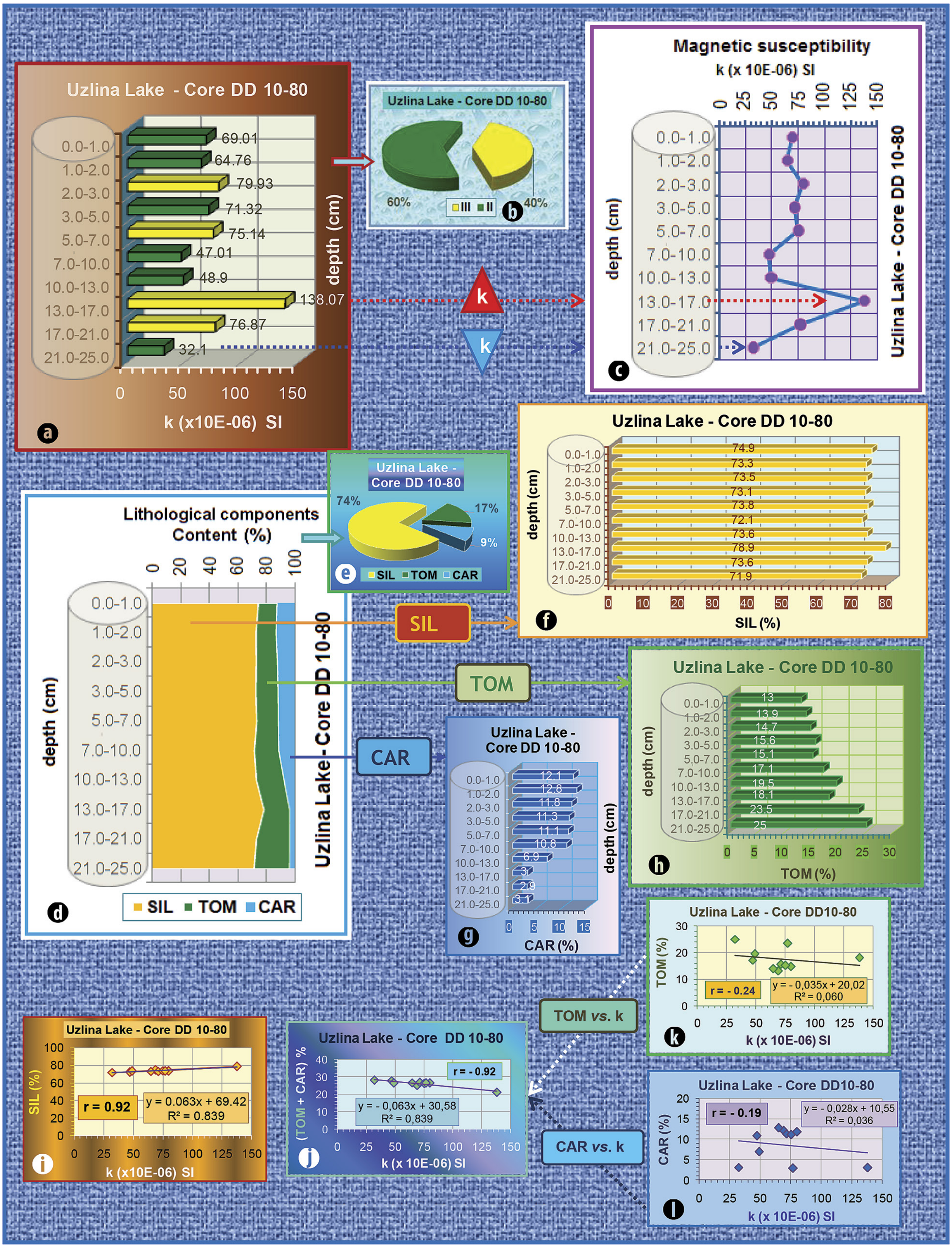

Fig. 8. Magneto-lithological model for the *Core DD 10-80* (*Uzlina Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents; i) Scatter plot for **SIL** *versus* **k**; **j)** Scatter plot for (**TOM** + **CAR**) *vs*. **k**; **k)** Scatter plot for **TOM** *vs*. **k**; **l)** Scatter plot for **CAR** *vs*. **k**. *Notes 1* and *2*: the same as in Fig. 3.

3.4. Isacova Lake (16, in Fig. 1)

During the period 2010 ÷ 2012, three sediment cores were sampled, one in 2010 (*DD 10-61*), the second in 2011 (*DD 11-105*), and the third in 2012 (*DD 12-256)* (location in Fig. 2). Actually, there is another core, *DD 06-161*, taken from the central zone of the lake (Fig. 2), but in 2006, the magnetic susceptibility profile being analysed or shortly commented in some previously published articles (*e.g.*, Rădan & Rădan, 2010a,b).

a) Core DD 10-61

The *Core DD 10-61* was sampled from the *Isacova Lake* central zone (Fig. 2), during the expedition that was carried out during 16 ÷ 30 June 2010. The core has a length of 50 cm. Normally, the sediments from this lake are finer and richer in organic matter than those from the *Uzlina Lake*. These characteristics are preserved in the core to the depth of 10 cm beneath the water/sediment interface. The organic, non-cohesive muds from this upper part of the core (first 6 slices, up to 9 cm depth) are characterized by very low magnetic susceptibility values, ranging between $14.11\times10^{-6} \div 35.57\times10^{-6}$ SI (Fig. 9a). The *siliciclastic/mineral fraction* (**SIL**) and the *organic matter* (**TOM**) support the enviromagnetic indication, recording within this depth interval the lowest contents (45.5 % ÷ 68.6 %; Fig. 9d), and respectively, the highest ones (13.3 % ÷ 38.5 %; Fig. 9e) that were measured for the sediments of this core. Starting with the core slice cut from the depth level 9 - 11 cm, the lithological composition is changing, the muds become coarse silty and take the aspect of a *compact soil* or *clay*, having a clearly different texture related to the typical lacustrine sediments. The magnetic susceptibility confirms its *proxy* quality, and records – going downwards along the core – a stepwise increasing, the **MS** values passing through **k** *classes* **III**, **IV** and **Va** (Fig. 9a), to reach the highest level (292.32×10^{-6} SI) at depth 24 - 27 cm (Fig. 9a), where a coarse silty mud has been intercepted. Yet, as the core is constituted of such sediments up to its base, the high level of the magnetic susceptibility is actually characteristic for more than a half of the core. Along the depth interval 19 - 50 cm/core base, the **k** values are ranging between 270.69×10^{-6} (very close to the upper limit of *class* **IV**) and 292.32×10^{-6} SI (*class* **Va**) (Fig. 9a). There is an exception – the slice cut from the level 21 - 24 cm –, which is characterized by a slightly lower **k** value, *i.e.*, 233.26×10^{-6} SI (marked by a „blue triangle" in Fig. 9a), so, also belonging to *class* **IV**. It is useful to highlight at this point of the analysis that this sample has also shown anomalous **SIL** and **CAR** contents, namely a minimum for the *siliciclastic/mineral fraction*, *i.e.*, 69.7 % (marked by a „blue triangle" in Fig. 9d), and a maximum for the *carbonate* component, *i.e.*, 26.7 % (marked by a „red triangle" in Fig. 9f). The unusual *carbonate* content is due, almost certainly, to a fragment of shell included accidentally within the mud sample (usually, the observable shell fragments are removed from the samples before performing analyses). This magneto-lithological anomaly, occurred at the depth level 21 - 24 cm, is very well illustrated by the profiles **MS** (Fig. 10a) and **CAR** (Fig. 10c), as well as by the area-chart (**SIL**, **TOM**, **CAR**) from Fig. 10b; the *minimum* **MS**, *minimum* **SIL** and the *maximum* **CAR** are correlated by a blue dotted line relating to the interconnection **MS ➔ SIL**, and further, by a red dotted line, for the connection with the **CAR** record (Fig. 10a➔b➔c). It can also be seen in Fig.10, at the 3 - 5 cm depth level, where it has been sampled a grey-dark yellowish organic non-cohesive mud (with rare shell fragments), a dotted blue line which correlates the minima **MS** and **SIL** (Fig. 10a➔b), in fact the lowest **k** value (16.07×10^{-6} SI; *class* **I**) and the lowest **SIL** content (45.5 %), respectively, which were recorded relating to the whole sediment core.

Looking to the 3D bar-charts performed for the three lithological components (Fig. 9d,e,f), in the upper core part, that is along the first 15 cm, we can observe, as a general characteristic – corresponding to the *magnetic susceptibility* profile –, the *siliciclastic fraction* records lower contents (Fig. 9d), while the *organic matter* (Fig. 9e) and the *carbonates* (Fig. 9f) are defined by higher contents.

The general trends indicated by the four profiles associated with the *Core DD 10-61* point out a downcore increasing of *magnetic susceptibility* (Figs. 9a and 10a), and of the *siliciclastic component* content (Figs. 9d and 10b), in parallel with a decreasing of the *organic matter* (Figs. 9e and 10b) and of the *carbonate fraction* (Figs. 9f and 10b,c) contents. It is considered, in the lower half of the core, the sediment sequence is a coarser and more compact mud, which often contains carbonaceous material, small peat fragments and plant remains, suggesting an old littoral lake facies. The sequence is defined by these characteristics: **k** values higher than 270×10^{-6} SI, **SIL** contents higher than 87.9 %, and **TOM** contents lower than 3.9 %; Fig. 9a,d,e).

The asserted trends could be explained by the diminishing of the detrital supplies in this zone in the last three decades, by cutting of the *Mahmudia Meander*, and afterwards, by the temporary closing of the *Uzlina Channel*. Albeit the dam from this channel has been moved away, the turbidity of the supplies coming from the *Mahmudia Meander* is lower than that of the channel which is shortening it.

Anyway, related to the lithological composition of the core sediments (Fig. 9c), the predominance of the *siliciclastic* fraction is clearly argued by the **SIL** content (77 %), while the *organic matter* (**TOM**) and the *carbonates* (**CAR**) represent 10 %, and 13 %, respectively. The magnetic susceptibility characterization of the *Core DD 10-61* supports this distribution of the lithological components within the core sediments, 70 % of the investigated samples being calibrated to *classes* **III** (15 %) + **IV** (20 %) + **Va** (35 %), and the remaining 30 % are assigned to the lower *class* **II** (Fig. 9b).

The general trends, comparable concerning the four characteristics of the core sediments, could anticipate the level of their correlations. So, as regards the connection of the **LITHO** components with the enviromagnetic parameter, the correlations are *strong* and *positive* for **SIL** *vs*. **k** (**r** = 0.88; Fig. 9h),

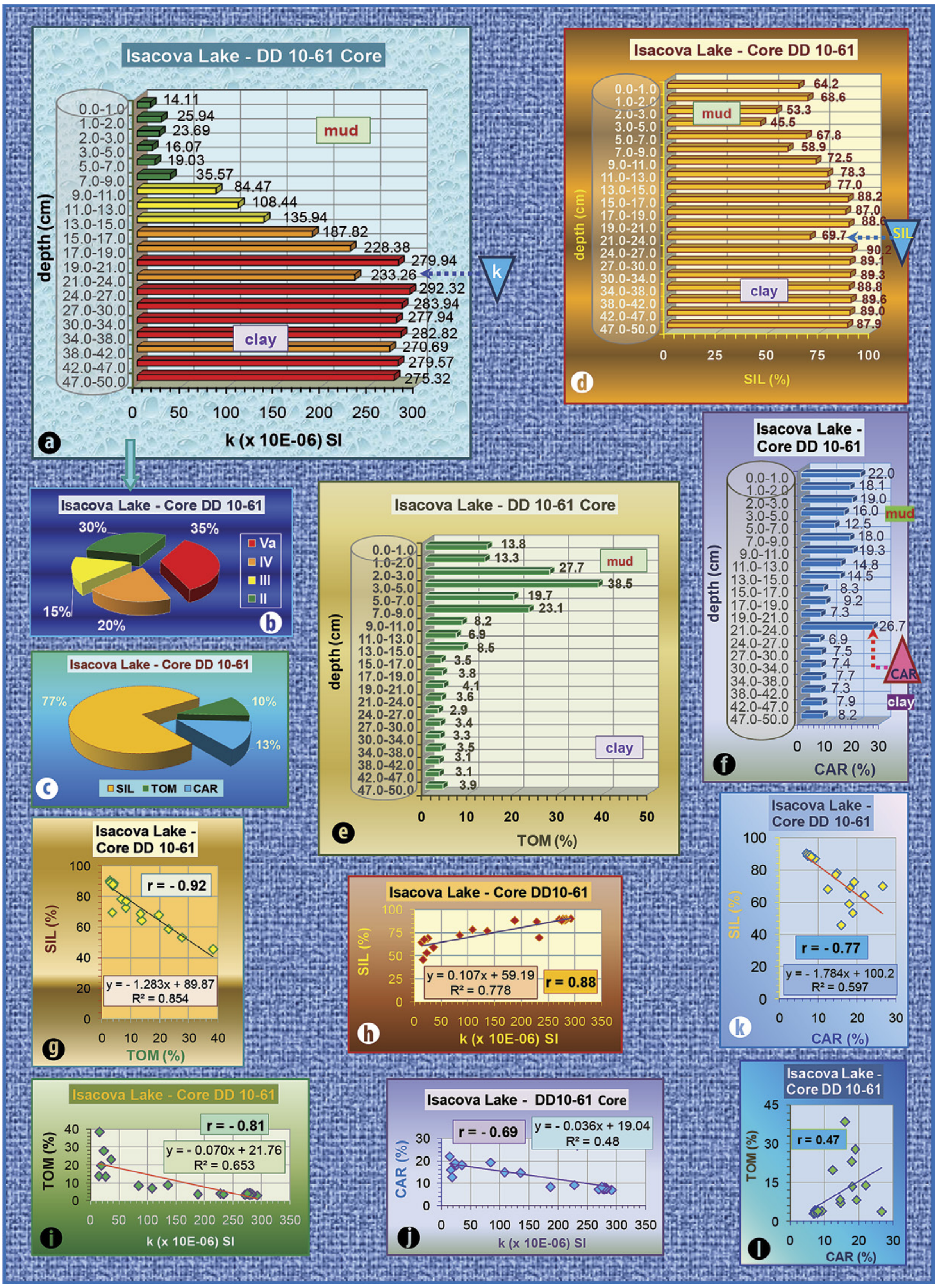

Fig. 9. Magneto-lithological model for the *Core DD 10-61*. Part I (*Isacova Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Average lithological composition of the core sediments; **d)** Downcore variation of **SIL** contents; **e)** Downcore variation of **TOM** contents; **f)** Downcore variation of **CAR** contents; **g)** Scatter plot for **SIL** *vs*. **TOM**; **h)** Scatter plot for **SIL** *versus* **k**; **i)** Scatter plot for **TOM** *vs*. **k**; **j)** Scatter plot for **CAR** *vs*. **k**; **k)** Scatter plot for **SIL** *vs*. **CAR**; **l)** Scatter plot for **TOM** *vs*. **CAR**. *Notes 1* and *2*: the same as in Fig. 3.

and *strong* and *negative* for **TOM** *vs*. **k** (**r** = - 0.81; Fig. 9i), and for **CAR** *vs*. **k** (**r** = - 0.69; Fig. 9j). We have also tested the correlations between pairs of lithological components, and the highest correlation coefficient (**r**) was obtained – as it is the case in the great majority of the studied cases – for **SIL** *vs*. **TOM** (**r** = - 0.92; Fig. 9g); a *strong negative* correlation for **SIL** *vs*. **CAR** (**r** = - 0.77; Fig. 9k) was determined, as well. It is not the case of the relationship of the *organic matter* with the *carbonates*, the correlation **TOM** *vs*. **CAR** being *moderate* and *positive* (**r** = 0.47; Fig. 9l), the latter characteristic not being frequently determined in our studies.

b) Core DD 11-105

The *Core DD 11-105* was collected from the *Isacova Lake* central zone (Fig. 2), at about 150 m east from the *Core DD 10-61*, during the expedition carried out in April 2011. The core has a length of 53 cm. As concerns the lithological composition, it has been observed an upper mud sequence of ca. 20 cm, blackish-grey at its upper part, and yellowish-grey at the lower one, fluffy on top, generally soft, non-cohesive, bioturbated, with a slight smell of H_2S, and with rare depigmented and very brittle shells. The muddy sediments are passing quite rapidly downwards to a more and more compact and plastic clay, showing a grey to dark grey colour, coarse silty to fine sandy, with frequent carbonized vegetal remains. The sedimentary succession and the lithological composition of the cored sequence are quite similar to those of the Core *DD 10-61*.

The magneto-lithological pattern presented in Fig. 11 illustrates – by the *magnetic susceptibility* (**MS**) record, and at the same time, by the parallel *siliciclastic* (**SIL**), *organic matter* (**TOM**) and *carbonate* (**CAR**) profiles – the above macroscopic description.

The vertical distribution of the **MS** (**k**) values measured along the core marks out the two types of sediments, the transition between them being a short one (Fig. 11a). So, the muds from the upper 21 cm are calibrated to **MS** *class* **II**, the **k** values ranging between $20.16 \times 10^{-6} \div 45.43 \times 10^{-6}$ SI (Fig. 11a), followed, downwards, up to 33 cm depth level, by a sequence of coarse silty muds, calibrated to **MS** *class* **III**, specifically with **k** values within the interval $80.00 \times 10^{-6} \div 133.37 \times 10^{-6}$ SI. This could be considered the transition zone between the two clearly different categories of sediments. The following and at the same time the last 20 cm of the *Core DD 11-105*, *i.e*. from 33 cm depth up to the core base (53 cm), constituted of coarse silty-clayey sediments, passing to coarse silty to sandy clays along the last 7 cm, are characterized by the highest **k** values, belonging to the **MS** *classes* **IV** and **Va**: the range is defined by 216.21×10^{-6} (*class* **IV**) $\div$ 287.68×10^{-6} SI (*class* **Va**) (Fig. 11a). The highest **k** value was measured for the sample collected from the 43 - 46 cm depth interval, a sample of mixed clayey, coarse silty and sandy sediment. A general remark, provided by this detailed magneto-susceptibility analysis, regards the stepwise passing from top core downwards, along 40 cm, through **k** *classes* **II**, **III**, **IV** and **Va**. In the last 13 cm, where a sequence of clayey (+ sandy) sediments and clays has been intercepted, the *class* **IV** is the characteristic **MS** range for 4 of 5 slices, excepting, thence, the highest **k** value that has just been above discussed. The weights in which the four **k** *classes* occur are as follows: **II** – 37 %; **III** – 21 %; **IV** – 32 %; **Va** – 10 % (Fig. 11b).

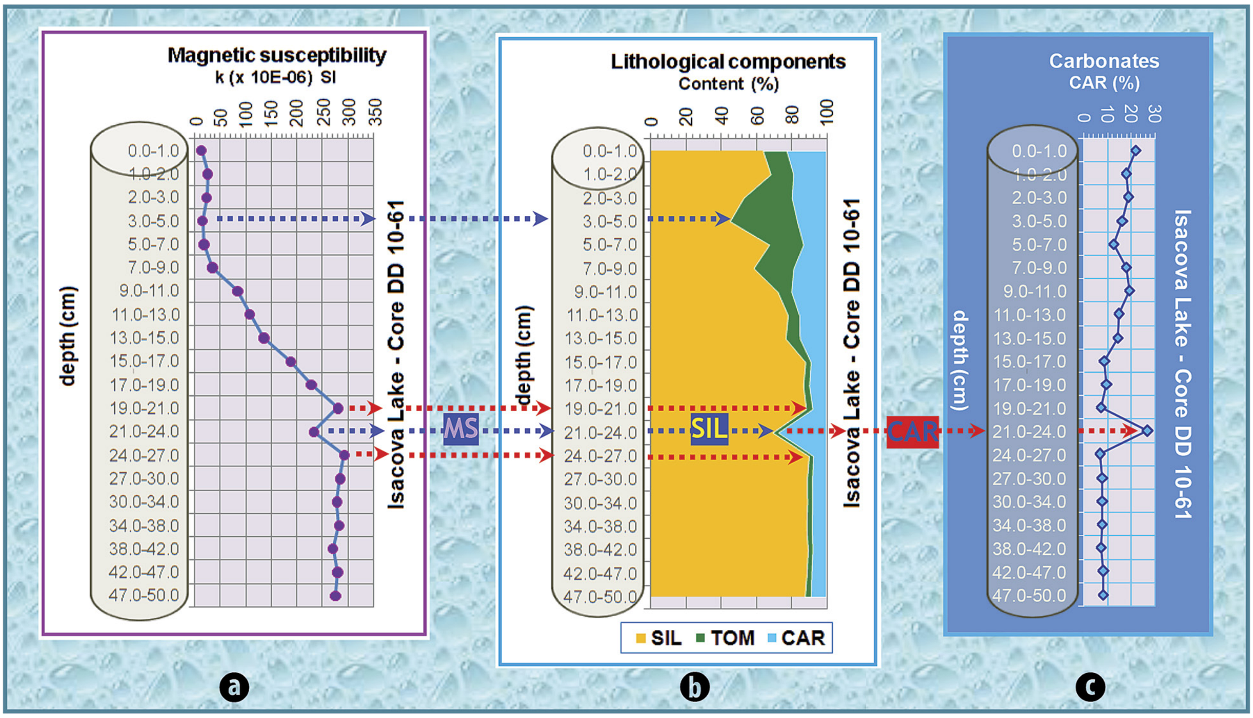

Fig. 10. Magneto-lithological model for the *Core DD 10-61*. Part II (*Isacova Lake*). **a)** Downcore **MS** variation curve; **b)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **c)** Downcore variation of **CAR** contents. *Note*: "red" and "blue" dotted lines – see text.

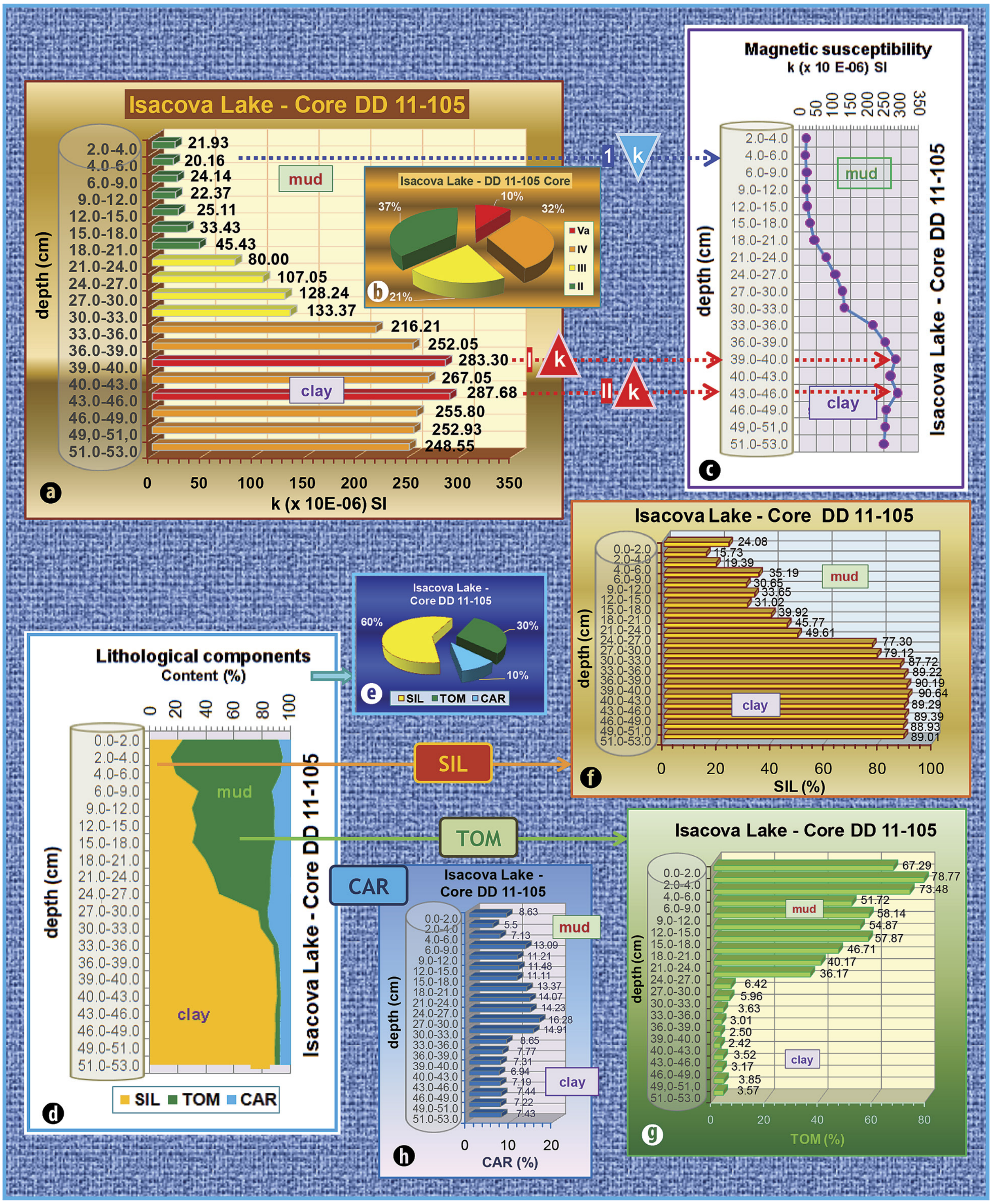

Fig. 11. Magneto-lithological model for the *Core DD 11-105*. Part I (*Isacova Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore **MS** variation curve; **d)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents); **e)** Average lithological composition of the core sediments; **f)** Downcore variation of **SIL** contents; **g)** Downcore variation of **TOM** contents; **h)** Downcore variation of **CAR** contents. *Notes 1* and *2*: the same as in Fig. 3.

The vertical distribution of the lithological components (Fig. 11d,f,g,h) support the magnetic susceptibility profile that is also illustrated in Fig. 11a,c. The **SIL** 3D bar-chart (Fig. 11f) marks out the two types of sediments composing the *Core DD 11-105*, and also a short transition zone, as it has previously been mentioned. We present further the characteristic zones in keeping with the groups shown by the **SIL**, **TOM**, **CAR** contents provided by the lithological analyses. So, the **SIL** contents within the upper mud sequence, more exactly, in this case, within the 0 - 18 cm depth interval, are ranging between 15.73 % ÷ 35.19 % (Fig. 11f). A short transition zone could be suggested by the **SIL** contents ranging between 39.92 % ÷ 49.61 %, which are assigned to the samples collected from the 18 - 27 cm depth interval. The coarse silty mud identified in the following two samples (27 - 30 cm and 30 - 33 cm) indicates higher **SIL** contents (77.30 % and 79.12 %, respectively), very close to those which are pointed out by the coarse silty clays, which were intercepted along the lowermost 20 cm. Therefore, the core sequence from 33 cm beneath the water/sediment interface up to the core base (53 cm) is characterized by the highest **SIL** contents, placed within the interval 87.72 % ÷ 90.64 % (Fig. 11f). This situation is in agreement with the magnetic susceptibility profile, namely the calibration of these sediments to the highest **k** *classes* of the **MS** scale, *i.e.*, **IV** and **V** (Fig. 11a). Of course, the vertical distribution of the organic matter fraction (**TOM**) (Fig. 11g) shows a reversed situation: high contents (51.72 % ÷ 78.77 %) for the muds from the first 18 cm of the core, followed by a transition zone defined by intermediary **TOM** contents, which decrease from 46.71 % (18 - 21 cm; a dark yellowish grey mud, without a H_2S smell, as it has been felt above it) up to 36.17 % (24 - 27 cm; a coarse silty mud). The next two samples (27 - 30 cm; 30 - 33 cm) show a sharp organic matter content decreasing, defined by 6.42 % and 5.96 %, respectively, very close to the following range of **TOM** contents (2.42 % ÷ 3.85 %), characterizing the coarse silty clays, crossed along the lowermost 20 cm of the core (33 - 53 cm) (Fig. 11g).

We can remark in this point of the analysis of the magneto-lithological characteristics the congruence of the diagrams from Fig. 12a,b. It is easily observed the very strong and positive correlation shown by **SIL** *vs*. **k** (**r** = 0.95), and, respectively, the very strong and negative correlation for **TOM** *vs*. **k** (**r** = - 0.92). As usual, the correlation between the two lithological components **SIL** and **TOM** is negative, in the present case reaching an extremely high degree: **r** = - 0.99 (Fig. 12c).

Referring to the third lithological component – the *carbonates*, it is interesting to note that the **CAR** profile (Fig. 11h) shows up two significant characteristics. Thus, in the first part, extending from the core top up to 33 cm beneath the water/sediment interface, the **CAR** contents indicate a general increasing trend (5.5 % ➔ 16.28 %), but with a few small deflections, that is quite similar with the corresponding interval from the **SIL** profile (Fig. 11f), and also from the **MS** record (Fig. 11a). It follows, downwards, from 33 cm depth up to the core base, a clearly lower level of the **CAR** contents, defined within a narrow range: 6.94 % ÷ 8.65 % (Fig. 11h), a characteristic indicated along this core fragment by the **TOM** profile, as well (Fig. 11g).

A general observation with regard to the *carbonate* profile reveals that the increasing trend of the **CAR** contents, in the first part of the *Core DD 11-105* (0 - 33 cm), is following up the lithological succession, starting from the upper sequence of muds with a H_2S smell, with rare depigmented and very brittle shells, and going towards the sequence of coarse silty muds; then it is recorded a sudden change, to a lower level of the **CAR** contents, from 33 cm depth up to the core base, where is intercepted the sequence of coarse silty clays (denoted as "*clay*" in the diagrams of Figs. 11 and 12).

This particular feature of the **CAR** profile recorded along the whole *Core DD 11-105* could support the *moderate correlation* that is indicated by the coefficient **r** = - 0.48 (Fig. 12d) for **CAR** *vs*. **k** (a *negative* correlation).

A more detailed analysis shows that the **CAR** *vs.* **MS** diagram of the upper mud sequence (0 - 33 cm) displays a clear strong positive correlation (**r** = 0.75; Fig. 12e), suggesting an association of carbonates with the siliciclastic fraction of sediments, which would indicate their predominantly detrital origin. The same type of chart obtained for the lower clay sequence (33 - 53 cm) presents, instead, a strong negative correlation (**r** = - 0.81; Fig. 12f), which highlights the lithological, and probably, a genetic difference between the two sequences.

The diagram of Fig. 11e reveals the preponderance of the *siliciclastic component* (60 %), followed by the *organic matter fraction* (30 %), and the *carbonates* (10 %). If we compare with the result of the calibration of the core sediments to the "**MS** scale" (Rădan & Rădan, 2007a), it appears a corresponding structure of the **MS** values distribution (Fig. 11b): the majority of the samples (63 %) are characterized by higher **k** *classes*, *i.e.*, 21 % (*class* **III**) + 32 % (*class* **IV**) + 10 % (*class* **Va**), while 30 % represent the core sediment slices to which the lower **k** *class* **II** is asserted.

Finally, we add that a composite **LITHO** image (a *2D* area-chart) is presented in Fig. 11d, and a line graph (Fig. 11c) illustrates the recorded **MS** profile (along the *Core DD 11-105*), in parallel with the **MS** bar-chart (Fig. 11a). The correlation of the **k** minimum value (*class* **II**), as well as of the highest two **k** values (*class* **Va**) from the **MS** bar diagram with the corresponding levels from the **MS** line-chart is illustrated in Fig. 11a➔c by the connection lines which are drawn out, particularly a blue line with a „blue triangle" (**1**) inserted, respectively by two red lines with a „red triangle" each inserted (**I** and **II**).

c) Core DD 12-256

The *DD 12-256 sediment core* was collected from the *Isacova Lake* southeastern area (Fig. 2), at about 1200 m north-east from the *Uzlina-Isacova Canal* mouth, in the 2012 summer campaign. With a length of 38 cm only (Fig. 13), this core has pro-

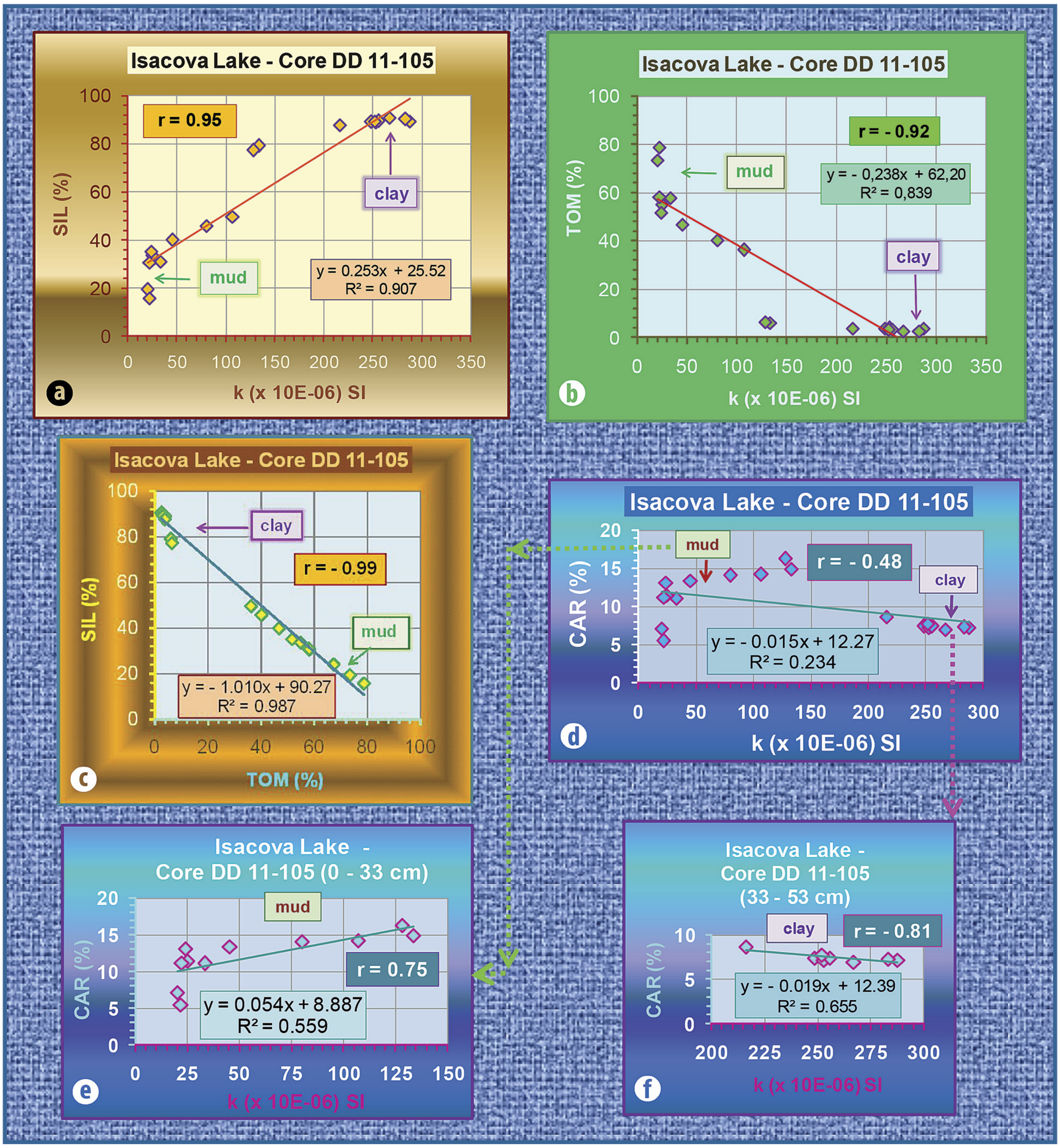

Fig. 12. Magneto-lithological model for the *Core DD 11-105*. Part II (*Isacova Lake*). Scatter plots showing the correlation between the **SIL**, **TOM** and **CAR** contents and the magnetic susceptibility (**MS**; **k**) values. **a) SIL** *versus* **k**; **b) TOM** *vs*. **k**; **c) SIL** *vs*. **TOM**; **d) CAR** *vs*. **k** (whole core); **e) CAR** *vs*. **k** (mud sequence: 0-33 cm); **f) CAR** *vs*. **k** (clay sequence: 33-53 cm).

vided very interesting magneto-lithogenetic characteristics. The core shows an upper sequence of ca. 26 cm, consisting of soft, blackish sediments, presenting a thin layer (2 cm) of fluffy oxidised *mud* on top, and passing downcore to a dark grey and dark yellowish grey compact *mud*. There are frequent bioturbations within the upper 18 cm, usually filled with a yellowish softer mud. Small fragments of shells and tiny gastropods are observed in divers places, but, also, a few larger shells can be found (*Viviparus* sp. at cm 6 – 8, *Dreissena* sp. at cm. 20 – 22).

From 26 cm depth beneath the water/sediment interface, downwards, the muds become more and more coarser and compact, turning into even silty-sandy muds or clays along the lowermost 4 cm (34 - 38 cm), where a small *Dreissena* shell was found.

The enviromagnetic parameter **MS** offers very clear quantitative proofs for the existence of two distinct sequences within the *Core DD 12-256* (Fig. 13a). The net boundary between them is located at 26 cm depth, as was inferred from the above

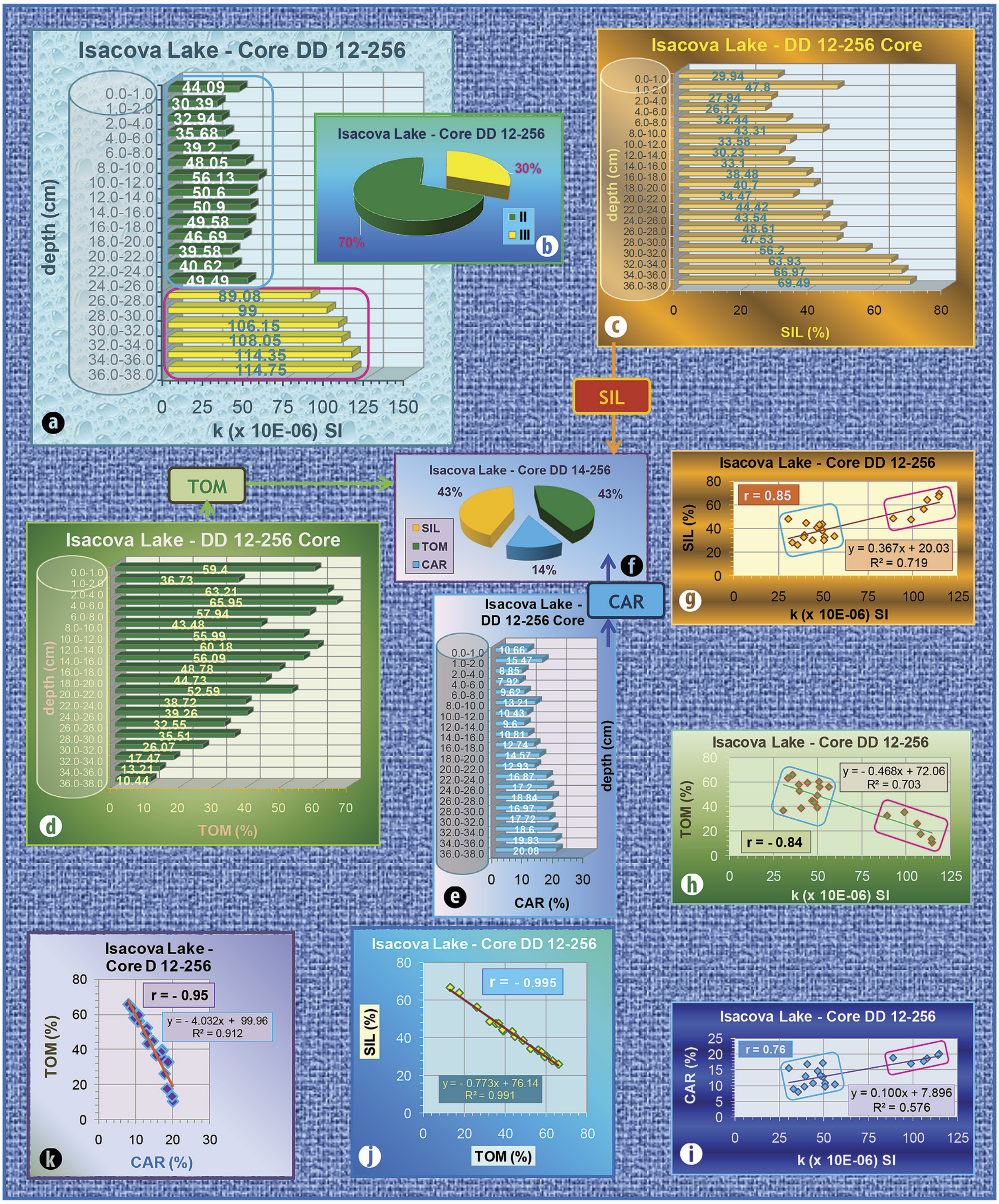

Fig. 13. Magneto-lithological model for the *Core DD 12-256*. Part I (*Isacova Lake*). **a)** Downcore variation of magnetic susceptibility values (**MS**; **k**); **b) MS** calibration of the core sediments, according to **k** classes; **c)** Downcore variation of **SIL** contents; **d)** Downcore variation of **TOM** contents; **e)** Downcore variation of **CAR** contents; **f)** Average lithological composition of the core sediments; **g)** Scatter plot for **SIL** *versus* **k**; **h)** Scatter plot for **TOM** *vs*. **k**; **i)** Scatter plot for **CAR** *vs*. **k**; **j)** Scatter plot for **SIL** *vs*. **TOM**; **k)** Scatter plot for **TOM** *vs*. **CAR**. *Notes 1* and *2*: the same as in Fig. 3.

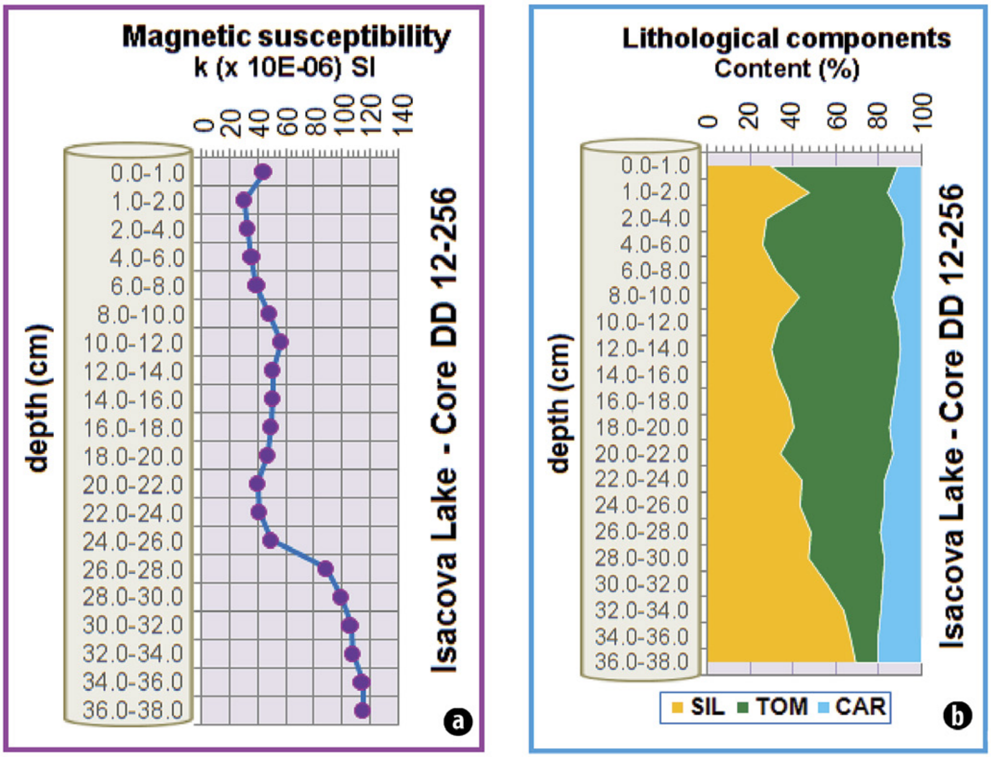

Fig. 14. Magneto-lithological model for the *Core DD 12-256*. Part II (*Isacova Lake*). **a)** Downcore **MS** variation curve; **b)** Downcore variation of lithological composition (**SIL**, **TOM** and **CAR** contents).

specified macrosopic description, which suggests a change of the lithological features, namely from the upper soft muds to the silty, coarse silty, and even fine sandy muds downcore. The vertical distribution of this *proxy* lithological parameter – *magnetic susceptibility* (**MS**) – shows an interesting profile of the upper sequence (Fig. 13a), particularly, a large maximum zone, with the appex (56.13×10^{-6} SI) centred on the sediment sample got from the 10 - 12 cm depth level, bordered by two zones of minimum; the upper one is centred on the mud slice cut from the 1 - 2 cm level interval (30.39×10^{-6} SI), while the underlying minimum zone is located on the mud sample deriving from the 20.0 - 22.0 cm level (39.58×10^{-6} SI). The **MS** record points out a sudden change of the magneto-susceptibilimetric regime, beginning with the silty mud sampled from 26 - 28 cm depth level, which is calibrated to the **MS** class **III**; the **k** values „jump" from 49.49×10^{-6} SI (class **II**), measured for the sample taken from the 24 - 26 cm level, to 89.08×10^{-6} SI (class **III**), value provided by the silty mud sampled from the 26 - 28 cm level (Fig. 13a). Hereinafter, the magnetic susceptibility profile remarks an increasing trend up to the core bottom (all **k** values assigned to class **III**), the last two slices – silty-sandy muds – generating the highest **k** values measured on the *Core DD 12-256*: 114.35×10^{-6} SI and 114.75×10^{-6} SI (Fig. 13a). The diagram of Fig. 13b illustrates the distribution of the *core sediments* according to the susceptibility scale: 70 % of samples – *class* **II**, and 30 % – *class* **III**. The *magnetic susceptibility* profile along the *Core DD 12-256* is also illustrated in Fig. 14a, where the characteristics outlined above are represented by the appropriate **MS** value markers. Next to this is drawn the **LITHO** area-chart (Fig. 14b), which brings together the **SIL**, **TOM** and **CAR** vertical profiles, showing, graphically, their different contents, which are in detail analysed below.

The main lithological components – *siliciclastic* and *organic matter* – indicate, correspondingly, a general increasing, and respectively, a decreasing trend of the contents with the depth, along the core (Fig. 13c,d), with a few exceptions, among which the most visible are the higher **SIL** contents, and the lower **TOM** contents, respectively, determined for the muds sliced from the 1 - 2 cm and 8 - 10 cm depth levels. It is also worth to remark that the highest **SIL** contents (66.97 % and 69.49 %) and the lowest **TOM** contents (13.21 % and 10.44 %) were obtained for the silty-sandy muds sampled from the core bottom (34 - 36 cm, and 36 - 38 cm, respectively; Fig. 13c,d). As regards the *carbonates*, it is remarked an increasing trend of their contents with the depth, with two more visible divergences generated by the same mud slices cut from the 1 - 2 cm and 8 - 10 cm levels (Fig. 13e). The **CAR** contents range between 7.92 % ÷ 20.08 %, the highest weights (19.83 % and 20.08 %) being provided by the two silty-sandy samples from the core bottom (Fig. 13e).

The average lithological composition of the cored sediments (Fig. 13f) reveals a balanced distribution of *siliciclastic* and *organic* components (43% and 43%), associated with a subordinate, but quite high content (as compared to all cores previously discussed) of *carbonates* (14%).

All the three lithological components (**SIL**, **TOM** and **CAR**) show interesting correlations with the *proxy* magnetic parameter (**MS**; **k**). Thus, for **SIL** *versus* **k**, the coefficient **r** shows a strong positive correlation (**r** = 0.85; Fig. 13g), and for **TOM** *versus* **k** – a strong negative/reversed correlation (**r** = - 0.84; Fig. 13h). It is interesting to remark a strong positive correlation for **CAR** *versus* **k** (**r** = 0.76), clearly expressed for the lower silty-sandy clay sequence, suggesting a detrital origin of the *carbonates* (Fig. 13i). We also checked the correlation of the lithological components in the cases **SIL** *versus* **TOM**, and **TOM** *versus* **CAR**, and we obtained very strong negative correlations in both situations: **r** = - 0.995 (Fig. 13j), and **r** = - 0.95 (Fig. 13k), respectively, the last one supporting, also, the detrital origin of the *carbonates*. In the same time, the diagrams of Fig. 13g,h,i highlight a clear distinction between the two lithological sequences described above. The two cluster groups, having distinct locations in the correlation diagrams, are associated with the *muds* (and marked on graphs by a "blue rectangle"), respectively with *the silty*, *coarse silty* and *silty-sandy muds* ("red rectangle").

4. CONCLUSIONS

The variety of the aquatic ecosystems and the diversity of the sediments deposited in different environments from the *Danube Delta* are well characterised by specific magnetic susceptibility (**MS**) fingerprints, recovered from surficial and core sediments sampled in the lakes of a series of deltaic depressions. Continuing this approach, this paper makes available a new magneto-lithological database – assigned to the *Gorgova - Uzlina Depression* –, which is added to another two important systematised series of results, previously published, relating to the *Meşteru - Fortuna* (Rădan *et al*., 2013) and *Matița - Merhei Depressions* (Rădan *et al*., 2014a).

The present article – as the first part of the paper concerning the aquatic unit above specified – is dealing with the *magnetosusceptibilimetric* (**MS**) and *lithological* (**LITHO**) *signatures* recovered from short cores only, the surficial sediments being the objective of the second part to be next fulfilled (Rădan *et al*., 2016; this volume).

The vertical distribution of the **MS** (**k**) values, recorded for nine sediment cores, collected from four deltaic lakes (*Gorgova*, *Cuibeda*, *Isacova* and *Uzlina*), reflects, accurately, the lithological variations, which sometimes are macroscopically less visible. Moreover, the integrated magneto-lithological study of the cores, taken out during the time period 2010 ÷ 2014, has resulted in the detection, in some investigated cases, of *marine deposits* located very close of the water/sediment interface (*Lake Cuibeda*). The presented data remark distinct magnetosusceptibility fingerprints recovered from the *muds* observed in the upper part of the cores, and from the *marine clays* or coarser shallow water deposits, respectively, intercepted towards the bottom of the cores. The main lithological components, particularly defined by the contents of *siliciclastic/mineral/detrital* (**SIL**) and of *total organic matter* (**TOM**) fractions, support the above mentioned **MS** signatures. More specifically, the intensity of the **MS** fingerprints recovered from *muds* (lacustrine deposits) is very low (*e.g*., **k** *classes* **I** and **II**), supported by low **SIL** and high **TOM** contents, while the **MS** fingerprints of *marine clays* and shallow water sediments (representing old marginal lacustrine or underwater fan deposits) show higher intensities (*e.g*., **k** classes **IV** and **Va**), supported by high **SIL** and low **TOM** contents. Therefore, the boundary between the recent *lacustrine* muds and the subiacent older, usually more compact and coarser deposits, observed by the macroscopic examination of sediment cores, was very clearly evidenced by the magnetosusceptibility (**MS**) and the lithogenetic (**SIL** , **TOM**) records.

These new proofs of identification of some *marine deposits* very close to the actual water/sediment interface, which are added to the previously published examples (*e.g.,* Rădan *et al*., 2014b), help to improve the deltaic system evolution knowledge, taking into consideration that the area under attention in the present study is located behind of the initial *Jibrieni – Letea – Caraorman* sand ridge, and thence older than this one. Besides, it is worth to point out that the cores in which it has been stated the existence of a *marine episode* at west of this *initial belt* were collected from lakes situated in the *Gorgova – Uzlina Depression*, which, at present, is a part of the *Fluvial Delta Plain*.

To clarify some aspects of the controversy relating to the development in time of the different events, which led to the deltaic edifice building up, some absolute dating information, complemented with fauna identification within some cores are needed.

Certainly, the presented magneto-lithological results give new proofs for demonstrating the availabilities of the method used to identify the environmental influences on the magnetic susceptibility of lake sediments, and hence to assess the geoecological state of the delta area.

This new case-study developed with regard to the lakes of the *Gorgova – Uzlina Depression* confirms that the magnetic susceptibility is a useful *sedimentogenetic*, *lithogenetic* and *environmental proxy* indicator, as well as a challenging *stratigraphic* tool (Rădan *et al*., 2014c). The obtained data are important in the context of deciphering the spatial and the temporal evolution of the deltaic geosystem.

An important direction that could be approached by comparing the profiles showing the vertical distribution of the magnetic susceptibility and of the lithological components, recorded along the sediment cores extracted from different lakes, is the *stratigraphic correlation* of the recent sediment sequences. Albeit the studied cores are short, some distinct features are seen in most of them. Even the use of the **MS** as a correlation tool is positively discussed in the literature, in a series of cases, to match the **k** peaks identified in some cores within a lake or in several cores from different lakes is difficult to really carry out (*e.g*., Trodahl, 2010, and references therein). In order to fulfill the *stratigraphic* goal, the **MS** records must be supplemented with data provided by other *proxy* parameters, including the radiometric dating.

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