RESEARCH PAPER

CONTRIBUTION OF THE DIFFERENT SOURCES TO THE FORMATION OF ALLUVIAL SEDIMENTS IN THE SELENGA RIVER DELTA (EASTERN SIBERIA, RUSSIA)

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ABSTRACT. Unraveling sources of sediment supply, their temporal and spatial variability is of key importance to determine origin of deposits and to explore the formation mechanism of Selenga Delta landscape units. From an environmental point of view this solution would help to identify the particle-bound pollution sources. We used geochemical fingerprinting (the FingerPro R package), which is a modern quantitative implementation of the method of sedimentary provenance analysis. The main aim was to recognize the main patterns of sediment and associated particle-bound pollutants transport and deposition within the delta. At the old floodplain from 55% to 90% of sediments were delivered from the eroded floodplain and terrace banks upstream and only about 10-15% originates from the remote basin sources. Sedimentary environment in the Khlystov Zaton reveals a greater variety than on the floodplains. 40% of sediments from the upper 5 cm-layer originated from the flood, taking place in 2013, and 30% were the product of floodplain and terraces banks erosion. Nevertheless, analysis of the fine-grained component of suspended sediment sets the material from eroded floodplain banks as the dominant source of accumulation within the delta. This means that the self-absorption is the leading process in the Selenga delta at the moment. Heavy metals and metalloids accumulates in the lower reaches of the Selenga on the floodplain surface, deltaic lakes and oxbows during high floods. Runoff decrease during floods can lead to the release of pollutants into the Lake Baikal.

KEYWORDS: suspended sediment, sediment sources, sediment traps, fingerprinting, Selenga River delta

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INTRODUCTION

River deltas and estuaries are specific natural geographic objects at locations of river junctions with the receiving waterbody. Deltaic and estuarine geomorphic systems are formed by complex interaction of fluvial (including water and sediment runoff) coastal (waves, changes in the level of the receiving waterbody and surging) and, often, some other (aeolian, biogenic) processes. Such a complex nature and location within the most dynamic contact zone between lithosphere, hydrosphere and atmosphere determines distinctive morphodynamic features of these systems. The Selenga River delta occupies a unique position among all other river deltas, since it is the world's only fluvially dominated river delta formed at the confluence of the Selenga River with the ultra-fresh Baikal Lake (Hume & Herdendorf 1988).

The Selenga River delta region has been studied for nearly a hundred years. Since 2011, scientific research group from V.B.Sochava Institute of Geography SB RAS led by E.A. Ilicheva and M.V. Pavlov concentrated on the delta morphodynamics focusing mostly on the recent transformations of the subaerial deltaic surface. That group employed high-resolution remote sensing (RS) data (spring, 2011) and results of 2003–2013 fieldworks, including repeated geodetic leveling surveys (Ilicheva et al. 2015). Main results describe lateral shifts of the deltaic arms and branches and sedimentation rates at various geomorphic positions. For example, accumulation in the upper section of the Sorokoustnaya arm corresponds to about 1.0-1.5 m since 1986. However, previous study about sedimentation on the deltaic floodplain and oxbow lakes requires further research (Ilicheva et al. 2020).

Suspended sediment provenance data is important for the examination of sediment delivery and construction of catchment sediment budgets (Walling et al. 1984). FingerPro unmixing model allows to reveal potential sediment sources in drainage basins using a number of diagnostic physical or chemical characteristics of sediments (Lizaga et al. 2018). Each source has its own geochemical "fingerprint"- the ratio of heavy metals concentrations or other numeric parameters describing certain characteristics of fine-grained sediment fractions. It can be preliminary suggested that the main sources of floodplain, pools and oxbow lakes deposition include sediment delivery from the large drainage basin of upper and middle Selenga (watersheds and soil downslope washout), as well as bank erosion of sandy deposits of the Late-Pleistocene terraces and old floodplain, located in the lower reaches. Bank erosion sources, situated immediately upstream from the delta apex, have their own individual geochemical fingerprints, depending on the type of eroded material. Suspended sediments coming from basin sources are represented by mixture in which contribution of each individual source cannot be distinguished due to long travel distances and times similar to each other.

The main natural factors influencing the Selenga delta are fluctuations of the Baikal Lake water level, main river hydrological regime and the local landscape characteristics. The sources of suspended load include bank erosion in the main river lower reach, drainage area surface erosion and upstream channel erosion (Potemkina et al. 2019). The tentative hypothesis of this study states that the basin source prevails over others in contribution to sedimentation traps due to the widespread anthropogenic influence throughout the catchment (cultivation, grazing and mineral resources exploration), which enhances fluvial processes including soil, gully and river channel erosion (Bazhenova et al. 1979). However, there are certain facts possibly indicating the opposite. For example, a relatively large river basin with predominantly fine-grained deposits transported through the network of smaller rivers before reaching the main river (it can significantly decrease sediment delivery ratios due to downstream increase of sediment trap efficiency of floodplains) and extensive bank erosion in lower reaches of the main river. Thus, even for deltaic facies, we may observe the predominance of the bank source.

We have employed the fingerprinting approach to establish the ratio of different sediment sources within the heavily polluted drainage basin (i.e. Selenga tributaries catchments and bank source: floodplain and terraces erosion in the lower reaches).

MATERIALS

The Selenga River delta is a large (>600 km^2) fluvially dominated river delta formed on the southeast margin of Lake Baikal. Fluvially-dominated deltas are primarily controlled by the water density difference between the inflowing river water and the standing water on the basin. Located in southern Siberia both the Selenga delta and its basin have a continental semi-arid climate.

Modern delta of the Selenga is situated within the territory bound by the villages of Zhilino, Istomino and Dubinino. The deltaic area consists of two geomorphologically distinct zones, one of which is dominated by the limnic regime and waterlogged landscapes - wetlands, and the other (upper part of the delta) by fluvial conditions (Fig. 1). The annual runoff distribution in the lower reaches is nonuniform. Results of the V.B.Sochava Institute of Geography SB RAS field studies allowed to divide the Selenga River delta into three distinctively different sectors: Selenginskiy, Sredneystevoy and Lobanovskiy, basing on specific features of their morphodynamic regimes (Pavlov et al. 2016).

There are three generations of the deltaic floodplain that can be distinguished on a basis of altitude difference and resulting differences of vegetation communities and sedimentary composition. These will be further referred to as old, middleage and seasonal floodplain levels (Fig. 1). The old floodplain occupies the largest areas of the upper delta, its true altitude is about 460-458 meters (Illycheva et al. 2015).

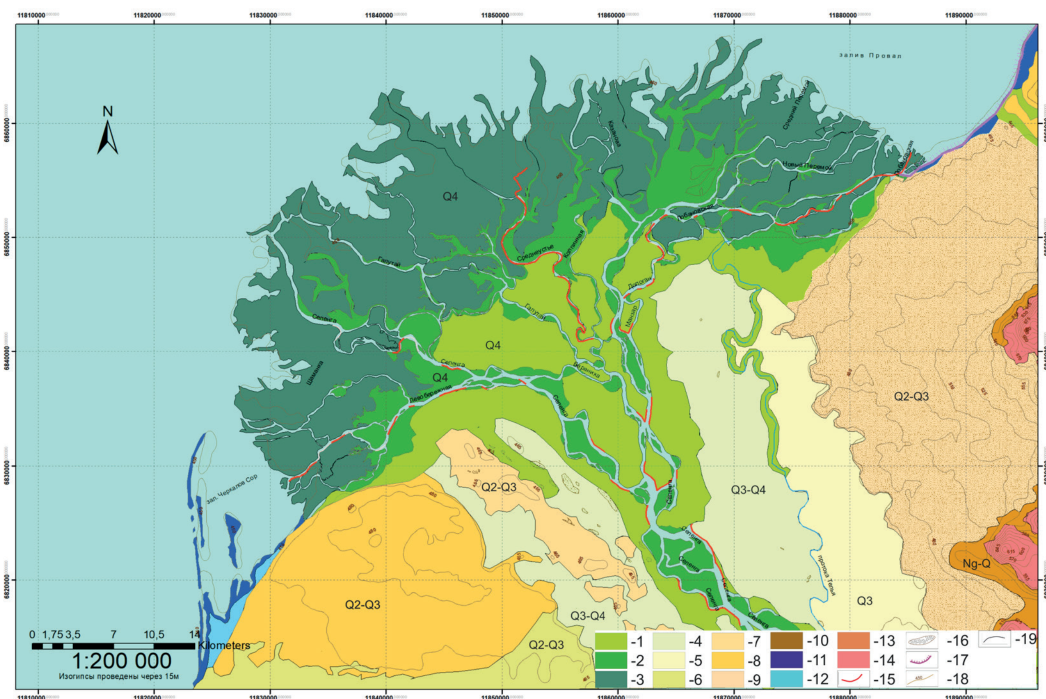


Fig. 1. Geomorphological scheme of the Selenga River Delta (compiled by the author using the following materials: (Budaev and Kolomiets 2014)

Limno/fluvial environments

Flood basins

1-old floodplain 460-458 m. (Q4)
2-middleage floodplain 458-456 m. (Q4)
3-seasonal floodplain 456-454 m. (Q4)
4-Kabansk alluvial terrace 465-460 m. (Q3-Q4)
5-Kudara alluvial terrace (Q3)
6-Terrace formation III (Q3)
7-Terrace formation IV (Q2-Q3)
8-Terrace formation V (Q2-Q3)
9-Terrace formation VI (Q2-Q3)

Systems of seasonally fills

10-Seasonally fills bed and floodplain (Q4)

Baikal basins

11-Lower lake terrace (Q4)
12-Upper lake terrace (Q3-Q4)

Areas dominated by complex tectonic-denudation and denudation topography

13- Piedmonts with low-gradient slopes covered by thin colluvial mantle
14- Dissected low-elevation mountains with moderate to steep slopes

Other landforms

15- Riverbank erosion
16-Sand dunes
17-Ledge associated with seismic fault

Other symbols

18-15 m isohypses
19-Landforms boundary

The middleage floodplain is distributed mainly along the largest arms (Selenginskaya, Levoberezhnaya) and on islands formed by smaller deltaic branches. Geomorphic boundary between the seasonal and middleage floodplains is rather poorly defined. During the fieldwork in 2019-2020 years, the middleage floodplain was completely flooded from 06.08.2019 to 09.08.2019 and from 31.07.2020 to 28.08.2020. The surface of the seasonal floodplain is hidden under water for most of the flood period and appears above the water level only during low levels. In the upper part of the delta, seasonal floodplain is in most cases represented by a narrow strip along the deltaic channels. The width of seasonal floodplain segments rarely exceeds several meters.

METHODS

Three essential geomorphological positions were selected to assess the nature and dynamics of sedimentation in different deltaic zones: the old floodplain surface and the oxbow lake. Data from analysis of the suspended sediment samples collected during the period of 2011-2016 from the Selenga tributaries were used as a prototype of the basin sources (Chalov et al. 2017). The 2013 year fieldwork- end of the flood period (8-20 September), 2011 year fieldwork – summer floods (8-19 August), 2014 year -low water period (4-19 August) and 2016 year – summer-autumn flood (11-30 August) (Fig. 2) (Kasimov et al. 2020; Lychagin et al. 2017; Kasimov et al. 2019).

The bank sources and sediment traps materials were collected at the lower reaches of Selenga river during the 2019-2020 summer expeditions (between 28th of July and 18th of August). Overall, data used in this study were obtained from 19 samples of fresh spring flood deposits from sediment traps, 27 samples from oxbow lake column, 162 suspended sediment samples from the upstream Selenga river (that we consider as a basin source), 68 samples of floodplain and terrace sediments (selected as a channel source) taken throughout the Selenga basin, including the Mongolian part. The samples were mainly taken from the zones of the old floodplain, the terrace and the oxbow lake Khlystov Zaton. The Khlystov Zaton oxbow lake is located in the backarc of a old floodplain at an absolute height of 458.9 m (according to the differential GNSS survey). It remains isolated during the low-water periods, depth ranges from 1 to 2 m (Pavlov 2019).

To assess the accuracy and reliability of the results obtained in this study, we distinguish several floodplain levels characterized by certain elevation intervals and evaluate the sediment contribution from different floodplain parts into fresh sedimentation throughout the delta. Floodplain elevation based on the detailed differential GNSS survey profiles.

Most of the suspended sediment load of the Selenga gets transported during a few high peak discharge flood events. Samples collected in 2011 (low level of water) describe heavy metals composition during low water discharge (Kasimov et al. 2020).

Layer-by-layer samples taken from high floodplains and terraces provide insight into the entire thickness of the eroded banks and contain information for assessment of a potential dispersion of sediment sources. Additional depth-incremental sampling was conducted with 5-cm intervals and 10x10 cm^2 area, total depth reaching down to 60–70 cm. The samples collected from the floodplains and terraces upstream the first bifurcation of the Selenga River delta apex were accounted as the channel source. When channel banks are being eroded dominantly sandy material gets transported into the main channel arms and accumulates on the deltaic surface.

The sediment samples of fresh floods, represented as sediment traps, were collected throughout the delta, in the

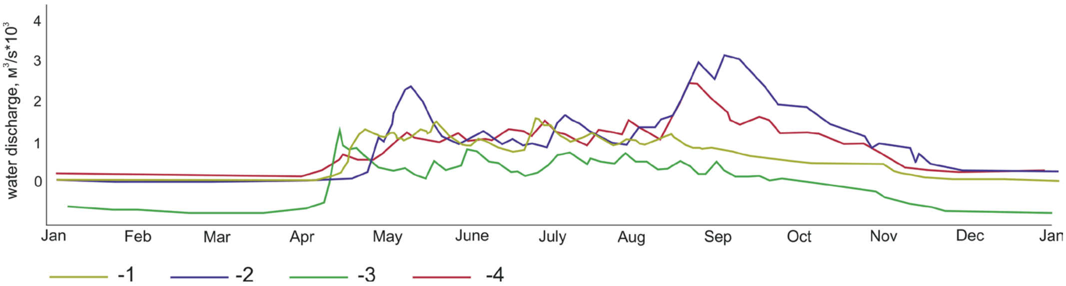
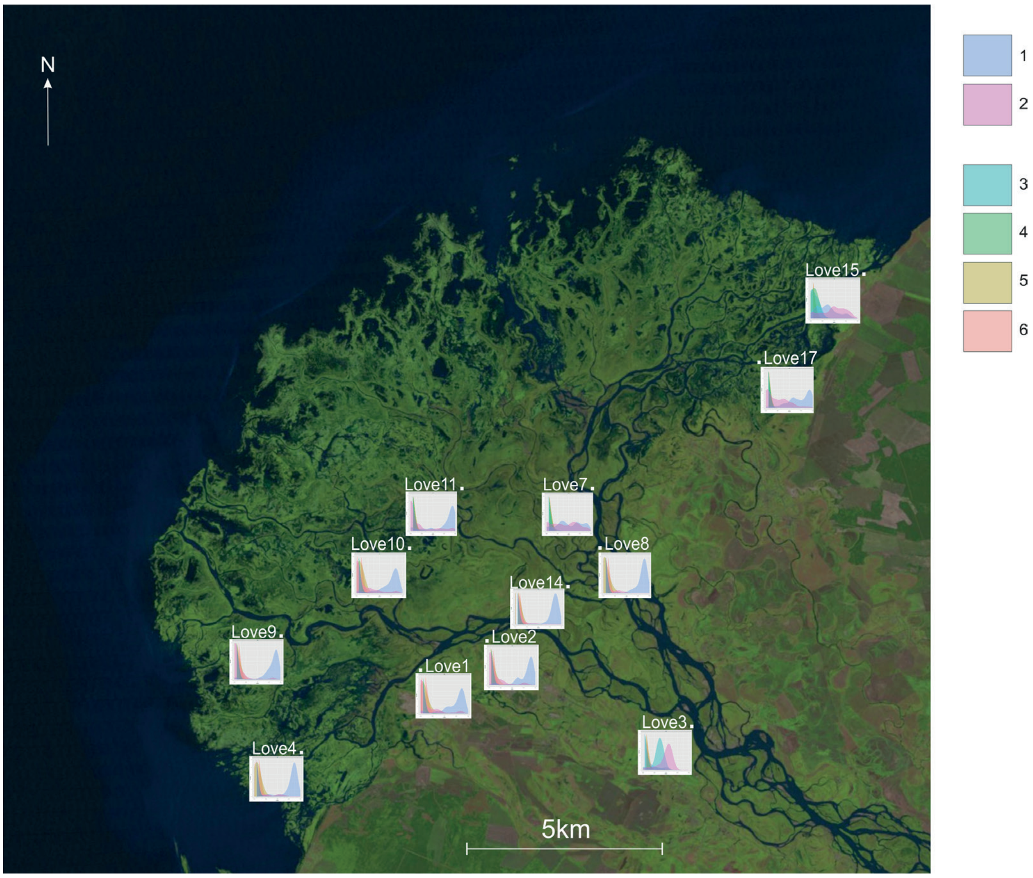


Fig. 2. Daily mean discharges of the Selenga (Kabansk) 1-2011; 2-2013; 3-2014; 4-2016 (gis.vodinfo.ru)

middle and upper course of the Selenginskiy, Sredneystevoy and Lobanovskiy sectors (Fig. 3). The sampling points were eventually selected at the same level as the corresponding old floodplain.

The grain size fractions were separated using the fractionation method by Kachinski (1931). Graph of the nature of hydrodynamics conditions was built on the basis of the dependence of deposits' average diameter from its standard deviation of deposits size. The weighted mean diameter of transported particles varies from fine sand to gravel, depending on the phase of the hydrological regime. Samples from sedimentation traps were matched to



(3)

Fig. 3. Location map for fresh-flood sediment sampling. 1-old floodplain (CE18); 2-Kabansk alluvial terrace (SE-ref-2); 3-flood deposits (2016); 4-flood deposits (4-19 August 2014); 5-flood deposits (8-20 September 2013); 6-flood deposits (8-19 August 2011)

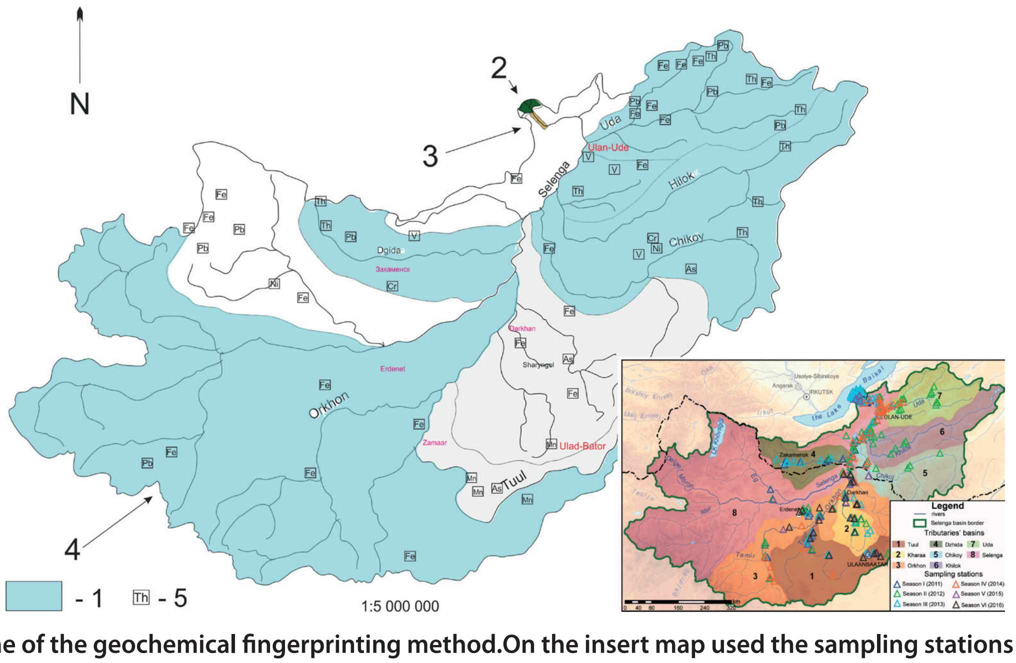


Fig. 4. Scheme of the geochemical fingerprinting method.On the insert map used the sampling stations from the art Kasimov et al. (2020)

1-Proposed river basins
2-Sedimant traps (old floodplain, oxbow lake)
3-Sediment sources in lower reaches of Selenga (bank and bed erosion)
4-Sediment sources of upper reaches of Selenga basin (soil and bank erosion)
5-Heavy metals deposits

the source samples using fingerprinting methods. Geochemical fingerprinting (FingerPro package) is, in fact, a modern implementation of the sedimentary provenances analysis (Fig. 4). ICP-AES analysis of sources and sediment traps samples was applied to define a range of potential fingerprint heavy metals markers: Ag, As, B, Be, Bi, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Th, U, V. All source materials were crushed down to 250 μm. Concentration of the technogenic radioactive isotope ^{137}Cs was also used as an additional fingerprinting parameter.

In order to select the most appropriate set of properties to include into the final composition of heavy metals (Lizaga 2018) we used two-stage statistical procedure. At first, we performed the Kruskall-Wallis H-test to establish which properties exhibited signifcant differences between the individual source groups within a particular category of sources (Fig. 5).

In our case, Bi, Cs, Th, U, V, Zn and especially Cs are elements that showed significant differences between the sources. Markers failing this test were removed from the following stage of analysis. Secondly, multivariate discriminant function analysis was applied to the markers selected during the first stage in order to evaluate its input into the source and trap composition. This operation is performed in 50 iterations and is verified each time on the training dataset using cross-validation. The procedure was focused on defining the source proportions allowing to keep the mass balance for all markers. The quality of each candidate is measured using goodness of fit (GOF). Function that describes GOF is based on the sum of the squares of the relative error (Lizaga et al. 2018). In the end, this succession of analytical procedures produced a graph showing the dependence of the source contribution on goodness of fit for each sediment trap.

RESULTS

Spatial differentiation of the fresh flood deposits particle size composition is primarily affected by the water and sediment runoff in the channels. The expected correlation between floodplain height and deposited sediment particle size was not observed. Moreover, granulometry of the fresh floodplain sediments exhibits a large differentiation within each floodplain level. The average thickness and mean particle diameter of the fresh alluvial deposits show a general decrease as one moves from a channel bank to floodplain backarc.

The range of granulometric composition of different samples along the channels is comparable to the grain size differentiation throughout the entire delta floodplain level. Further complicating the overall spatial pattern of sedimentation are marginal channels, floodplain branches, meadow vegetation, and the typical floodplain hollow and ridge topography.

As a result, a range of fresh floodplain sediments can be observed on one floodplain level, from predominantly clayey deposits in the depressions of the floodplain backarc (bluff line, neck cut-off) to sandy deposits along the channel bank where alluvial levees commonly form. Despite the fact that fresh floodplain deposits were sampled at approximately the same geomorphological positions (the edge part of the floodplain), there is a large number of factors that affect its particle size distribution including the sampling points position on a convex or concave river bank, presence of a "flow and sedimentary shadow" in the form of floodplain vegetation, levees, microtopographic depressions, minor channel arms and floodplain branches that strongly affect the water flow and sedimentation patterns.

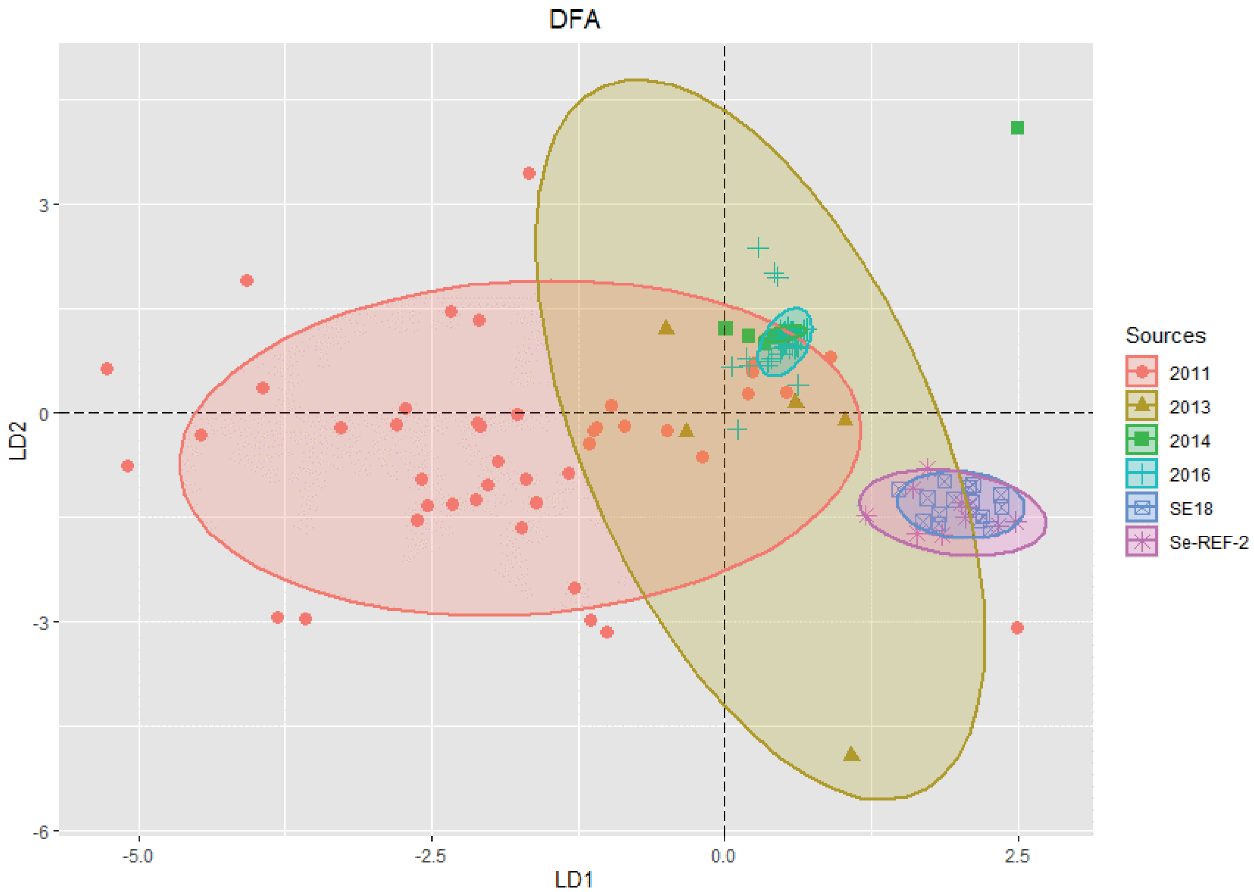


Fig. 5. The results of applying the Kruskall-Wallis test to assess the ability of each tracer property to discriminate between the six main source. 2011-flood deposits (2011); 2013-flood deposits (2013); 2014-flood deposits (2014); 2016-flood deposits (2016); SE18-old floodplain (CE18); Se-REF-2-Kabansk alluvial terrace (SE-ref-2)

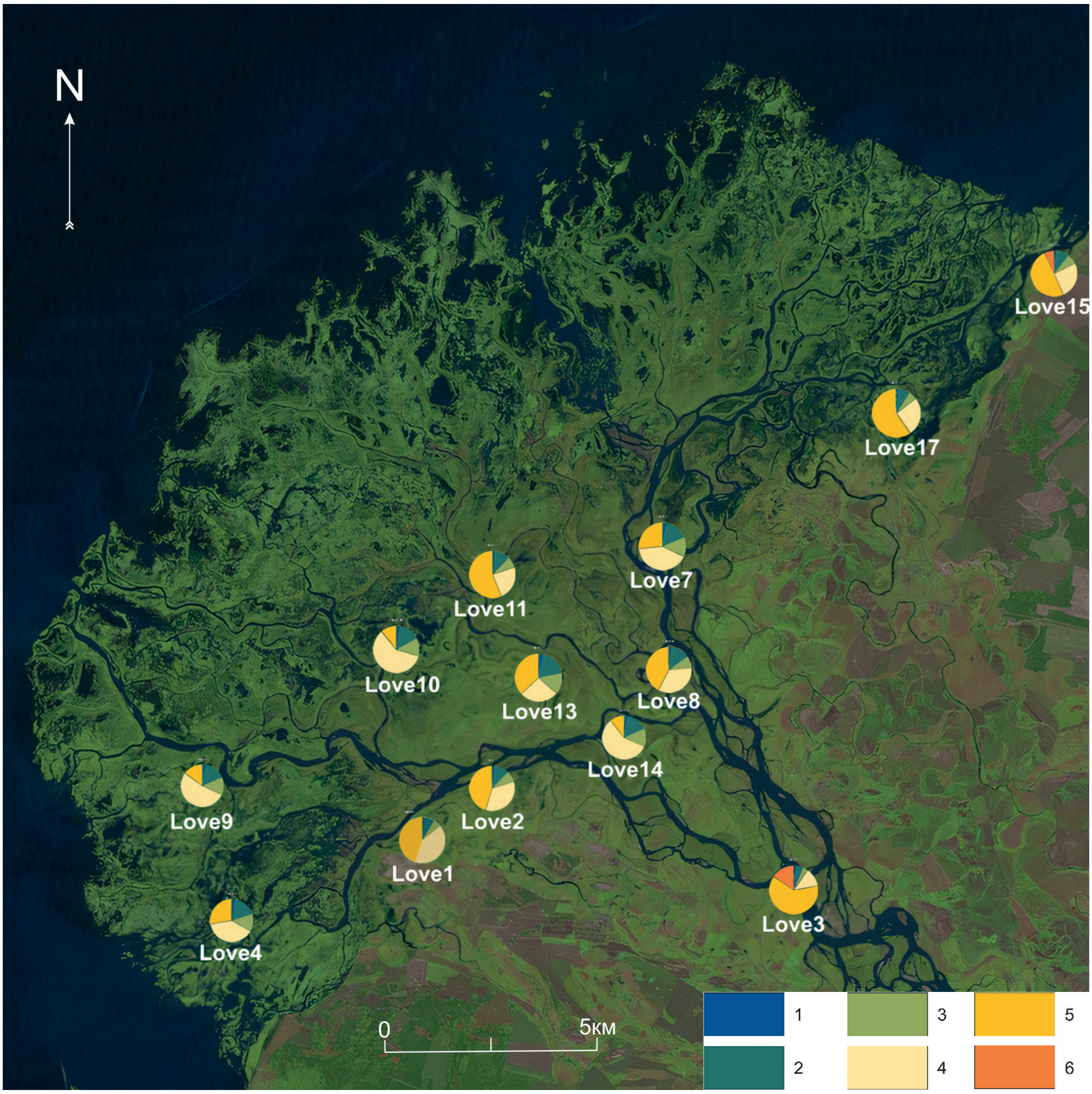


Fig. 6. Grain size composition of fresh flood deposits: 1) <1 µm; 2) 1-5 µm; 3) 5-10 µm; 4) 10-50 µm; 5) 50-250 µm; 6) >1000 µm

The finer-fraction dispersed component of the suspended sediment is the dominant source of accumulation at the floodplain, which distinguishes the latter from other positions. The Selenga floodplain sediments correspond to hydrodynamic conditions of a tranquil flow. Basically, those alluvial facies are composed of the finest material carried by the flow – physical clay (Kachinskiy 1931). At the old floodplain from 55% (Love 3 sampling point) to 90% (Love 14 sampling point) of sediments were delivered from the eroded floodplain and terrace banks upstream and only about 10-15% originates from the remote basin sources.

The most heterogeneous grain-size composition was found in the oxbow lake. Sand fractions in all floodplain lakes indicated high water levels of the main river during floods. Sedimentary environment in the Khlystov Zaton, located in the old floodplain backarc, reveals a greater variety than on the floodplains. 40% of sediments from the upper 5 cm-layer originated from the flood, taking place in 2013 (Tarasov 2019), and 30% were the product of floodplain and terraces banks erosion.

For the oxbow lake Khlystov Zaton, the analysis of sources was carried out for three horizons that differ sharply in sediment proportion: the upper one - presumably accumulated during the last major flood in 2013 (the first 60 cm), the middle one, with the maximum amount of clay in the section (76-77 cm) and the lower one - similar in sediment proportion to the upper horizon. This gives grounds to assume the accumulation of these deposits in the conditions, similar to 2013 flood (Fig. 7).

The nature of sedimentation in oxbows is highly heterogenic. Silt fraction is strongly dominant in sediments, which is common for limnic sedimentation. The increase in standard deviation compared to the floodplain values indicates periods of the hydrodynamic connection with main delta arms. Thus, the finer basin material was delivered into oxbow lakes during high floods (Table 1).

It can be assumed that coarser bank erosion material is deposited on the floodplain, while the basin sources material is carried away with floodplain flows further. Finer deposits of the basin source settle in stagnant water of oxbow lake. The oxbow lake sediments have a more complete size range of sediments and, accordingly, sources than the floodplain. Also, pollutants better retain on the silty sediments surface. Evidently, the use of oxbow lakes as sediment traps is more relevant in studies of sediment sources based on geochemical fingerprinting.

Oxbow lake sediment sources

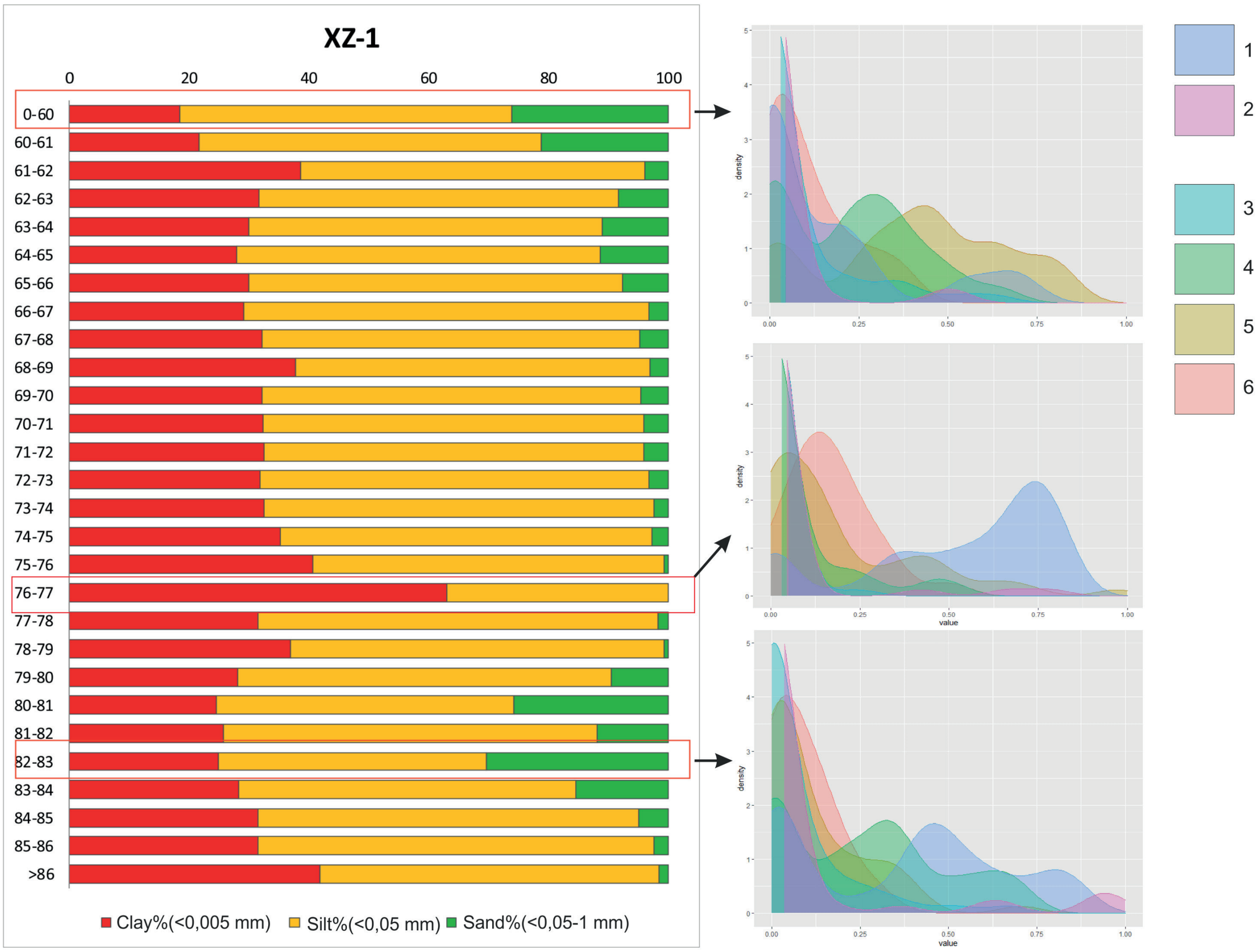


Fig. 7. Similarity of oxbow lake (Khlystov Zaton-XZ-1) sediment geochemical composition (the left figure) and different sources of sediments:

1-old floodplain (CE18); 2-Kabansk alluvial terrace (SE-ref-2); 3-flood deposits (2016); 4-flood deposits (2014); 5-flood deposits (2013); 6-flood deposits (2011) (the right figure)

Despite the confirmation of the hypothesis about the genesis of the source, it is worth taking a closer look at the ratio of the channel sources themselves in the flood deposits in order to reveal their spatial distribution controls. The fresh flood sediment samples acquired in the Lobanovsky sector differ most prominently from the general background (Fig. 2). Major distinctive feature of these samples is the lower contribution of high floodplain material with an increasing proportion of terrace bank erosion products. Apparently, the coarser material of the terrace, picked up by the bottom currents from the eroded left bank, follows the Lobanovskaya channel. This result can be a signal that the main flow is directed to the Lobanovskaya channel, but this statement requires additional studies.

DISCUSSION

The results of genetic analyses of the modern deltaic depositionary facies obtained using the fingerprinting method are quite atypical for the rivers of Eastern Siberia (Potemkina et al. 2011). Despite steep slope and channel gradients in the upper reaches of the Selenga drainage basin, plowing and grazing in the basin, which, as expected, increase the contribution of the basin source for all facies, it is the channel source of sediment that exert dominant contribution in the deltaic floodplain deposition.

Besides elevation, the relative importance of various sources could be affected by the distance from the main bifurcation node. The delta fan is composed of alluvial deposits represented by gravel sands at the head and in the middle of the delta and by fine-grained sands and silts in the estuarine sections (Dong et al. 2016). It serves as a perfect example of the source-to-source differentiation between the head and estuarine section of the delta.

An interesting correspondence between the genetic facies of sediments and the weighted average diameter of sediments was found. Classical ratio for most Siberian rivers is basin source consisting of finely dispersed material, and more coarse-grained corresponding to the channel source (Chalov 2008). For the lower reaches of the Selenga, an opposite relationship is observed: the coarser sediments belong to the basin source. This correlation is clearly illustrated by distribution of sediment sources for oxbow deposits. The oxbow samples exhibit a regular increase of the basin source contribution with a decrease of fine-grained deposits in the sample. It can be suggested that mountainous nature of the upper part of the basin is a reason for the coarser basin material that cannot accumulate on the floodplain surface. Thus, even for floodplain facies, we observe the predominance of the main river lower reach channel bank erosion source.

There are also some sectoral differences of deltaic sedimentation, associated with the contribution of various

Table 1. Contribution of each source types (based on GOF mean) to the samples from oxbow and floodplain from the lower reaches of the Selenga River

			Source types contribution					
			2011 flood deposits	2013 flood deposits	2014 flood deposits	2016 flood deposits	CE18 flood deposits	Se-ref-2 flood deposits
Sediment traps	Floodplain sediments	Love 1	0.06	0.08	0.00	0.00	0.73	0.12
		Love 2	0.04	0.05	0.00	0.00	0.79	0.12
		Love 3	0.03	0.04	0.04	0.35	0.06	0.49
		Love 4	0.06	0.07	0.00	0.00	0.81	0.06
		Love 7	0.02	0.02	0.02	0.01	0.51	0.42
		Love 8	0.05	0.05	0.00	0.00	0.84	0.05
		Love 9	0.05	0.05	0.00	0.00	0.81	0.09
		Love 10	0.06	0.08	0.00	0.00	0.72	0.13
		Love 11	0.01	0.02	0.02	0.00	0.76	0.18
		Love 13	0.00	0.01	0.12	0.05	0.51	0.30
		Love 14	0.05	0.05	0.00	0.00	0.85	0.05
		Love 15	0.01	0.01	0.08	0.08	0.34	0.48
		Love 17	0.01	0.02	0.02	0.00	0.71	0.25
	Oxbow sediments	XZ	0.11	0.41	0.22	0.07	0.16	0.02
		XZ max	0.08	0.12	0.26	0.07	0.37	0.10
		XZ min	0.17	0.19	0.06	0.01	0.54	0.04

* The table shows the contribution of each source as a percentage of the fingerprinting model results. Green color of cells show the high source contribution to sediment traps composition; Red color of cells on the contrary – low source contribution.

channel sources (eroded floodplain banks and the Kabansk terrace banks) among the samples of floodplain sediments (Fig. 3). The main distinctive feature of the Lobanovsky sector samples is noticeable increase of the terrace bank erosion material contribution into the floodplain overbank deposition. One of the possible explanations of variation observed between contributions of the two detected bank sources in different delta sectors is direction of the main flow to the Lobanovskaya channel. However, this assertion requires further research.

The area of the Selenga basin is 447 000 km^2 and each of its parts has its own nature of the morphodynamic regime. This brings up the problems associated with lack of samples of spring floods deposits and suspended materials allowing to establish the relative contribution of different sources throughout the delta. The obtained results reflect the relative contributions of various sources to individual sediment traps represented by each particular sample, and, therefore may not show all variations of sources and accumulation conditions on the floodplain and in oxbows. For this reason, it is important to collect more suspended sediment samples to further decipher spatial and temporal heterogeneity of sediment sourcing and yield.

CONCLUSIONS

The optimum fingerprint set, including, was able to correctly distinguish 80% of the source area samples (Fig. 4). Adding further tracer properties to fingerprint composition does not allow to diversify the sources any further. Sediment transport from the channel to the floodplain and oxbows, depending on increasingly rare high flow events, had the most fine-grained composition. The material sampled in oxbow lakes was deposited in a more heterogenic environment due to the connection with the main delta arms during high flood events.

Fresh flood deposits selected throughout the delta is very different. The most coarsely dispersed silt was collected along the Selenga and Lobanovskaya channels, the maximum coarse fraction is observed in the main channel and the Lobanovskaya channel, the finest material accumulates in the lake part of the Selenga sector delta. The size of the silt most strongly correlates with the water discharge near the sampling point. Therefore, we can talk about the greatest activity and growth of the Lobanovsky sector at the moment.

At the old floodplain 54% of sediments were delivered from the floodplain and terraces bank erosion within the Selenga River lower reach and just 29% originated from the upper and middle parts of the river basin. Sedimentary environment in the oxbow lake reveals a greater diversity than on the floodplains. The 40% of oxbow sediments most similar in geochemical composition to the 2013 flood deposits and 30% - to the products of floodplain and terraces banks erosion. The 45% of pool sediments were most similar to the flood taking place in 2013 and 31% - by the year 2016.

Among the fresh flood deposits samples, there are also some sectoral differences associated with the relative importance of different channel sources: floodplain banks and banks of the Kabanskaya terrace. The main distinctive feature of the Lobanovsky sector samples is the lower contribution of the eroded floodplain bank material with an increasing proportion of the terrace bank erosion products. This is affected by the direction of main flow: the coarser terrace material uptaken by the strong water flow into the Lobanovsky sector, thus creating the observed distribution of sediment sources. This may indicate more activity in the sector and its growth active aggradation in recent times, but it's requires further research.

Heavy metals and metalloids come from territories of mineral resources exploration, industrial and urban areas, agricultural lands with finer fractions of suspended sediment during high floods. This material accumulates in the lower reaches of the Selenga on the floodplain surface, deltaic lakes and oxbows. Probably, considering the outlined tendency of a recently observed decrease of runoff during floods (Garmaev et al. 2022), increasing concentrations of pollutants can be expected to be carried into Lake Baikal, while lower percentage will remain intercepted within the delta sediment. Further studying. Further research of the sedimentation mechanism would allow to suggest reliable approaches to prevent excessive delivery of pollutants into the unique and vulnerable Baikal Lake ecosystem.

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