

A Spatial Characterisation of the Major Iron Bearing Phases in the Lena River Catchment Area, NE Russia.

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Fe

100

1600

1200-

800

30

20

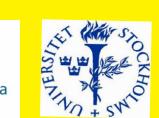
Particulate: > 0.22 μm

1) Fe-Mn HMW colloid in CSP

by amorphous

Mn

Si



Average concentrations with ppb units.

The highest concentration of Fe is in the fraction <0.22 μm

- 10 kDa for CSP, the Viliui

Significant within catchment

River and Aldan River.

concentration for the

particulate and colloidal

variation in iron

 $>0.22 \, \mu m$ $<0.22 \, \mu m$ $<10 \, kDa$ $<1 \, kDa$

Si is relatively constant from $>0.22 \mu m$ to

 $>0.22 \, \mu m$ $< 0.22 \, \mu m$ $< 10 \, kDa$ $< 1 \, kDa$

phase

Lena Amganski Inter River Area

Central Siberian Plateau

 $>0.22 \, \mu m$ $< 0.22 \, \mu m$ $< 10 \, kDa$

LAIRA: highest

colloidal phase.

concentration of Mn in

the particulate and HMW

CSP: high concentration

of Mn in the particulate

10 kDa. Si is present mainly in dissolved

(< 1 kDa) form especially for CSP and

Viliui River.

2. Size Separation Analysis

% 60

40

A

20-

>0.22 µm

Verkhoyansk Mountain Range <a> Aldan River



Al concentration is highest

has a low concentration of

in the Aldan and Lena

River. The CSP and Viliui

Al relative to other sub-

channel.

 $>0.22 \, \mu m$ $<0.22 \, \mu m$ $<10 \, kDa$ $<1 \, kDa$

High concentration of particulate

Ti in the Viliui River and Lena River.

The concentration of Ti is consist-

ent at $< 0.22 \mu m$ for all sub catchments - the VMR has the highest

colloidal concentration of Ti

<0.22 μm < 10 kDa

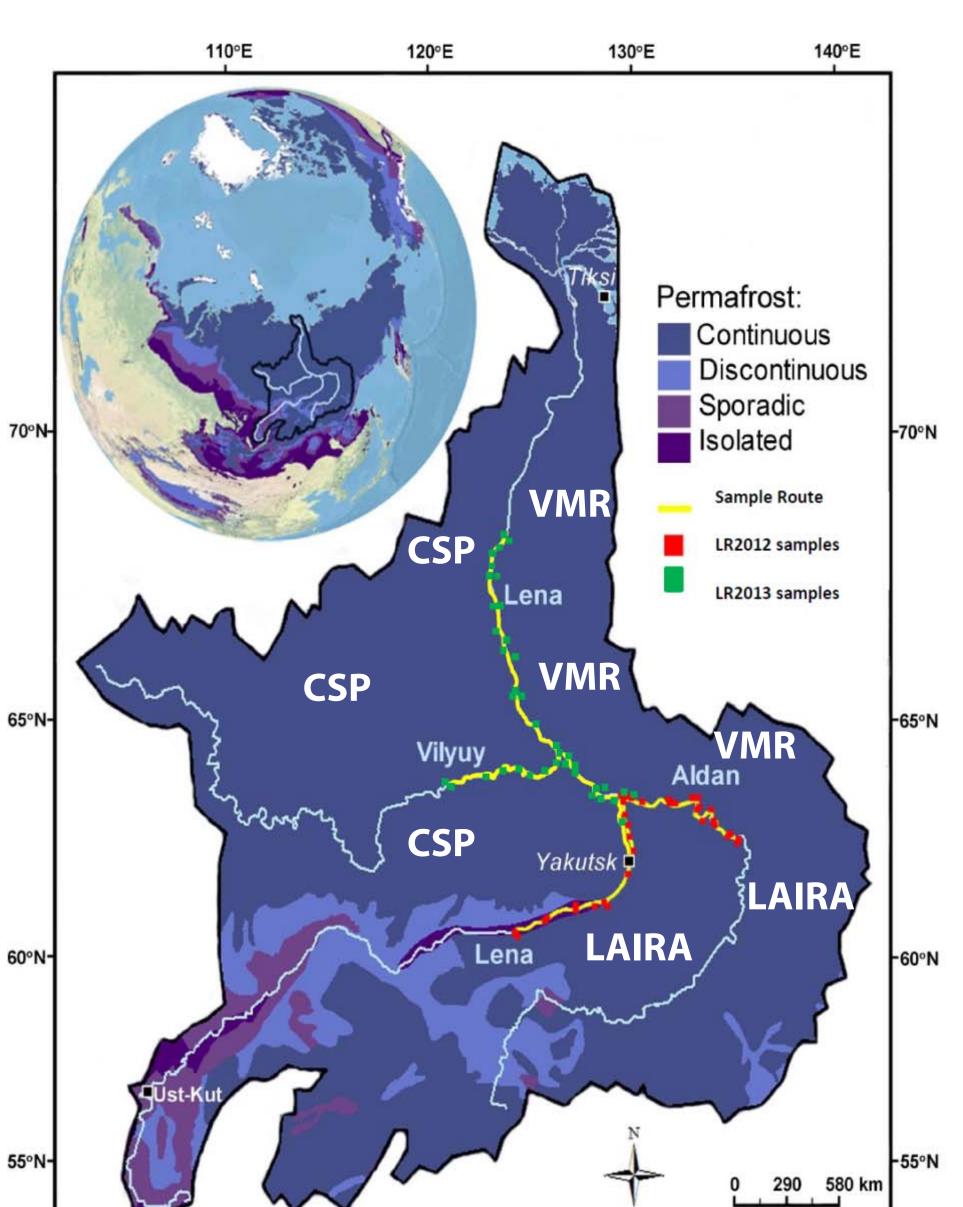
Lena River

< 1 kDa

Dissolved: < 1 kDa

catchments and the main

1.The Lena River



120°E

110°E

Iron is an important nutrient in the oceans. It enters the ocean via rivers, icebergs, wind blown dust and hydrothermal systems.

This study investigates the forms of particulate and colloidal iron in the Lena River Catchment Area. Samples were collected in period June 2012 and July 2013 - following the the spring flood.

The annual Lena River discharge is 581 km³ second to the Yenisei, in its contribution to the Arctic. Ocean.

The Lena River catchment area is divided into subcatchements. These are concordant with the geological units of the region. The Lena River, an ancient antedecent stream, divides these units.

Two major sub basins:

- Aldan River

- Viliui River.

Three major sub catchments:

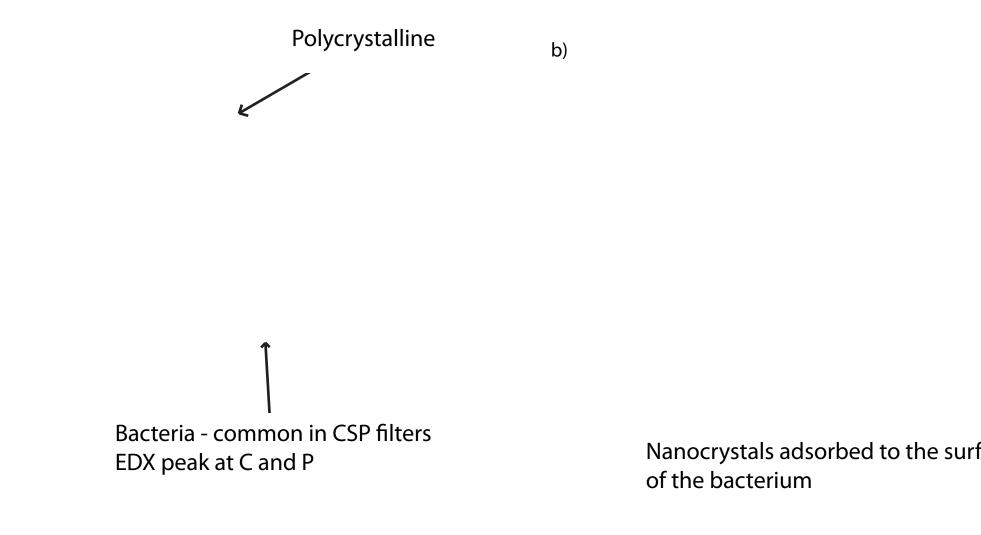
- LAIRA: Lena Amganski Inter River Area

- VMR: Verkhoyansk Mountain Range

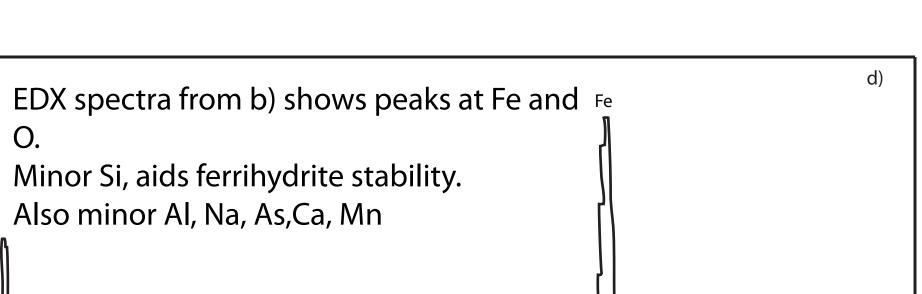
- CSP: Central Siberian Plateau

2. TEM: Iron Oxide (Ferrihydrite)

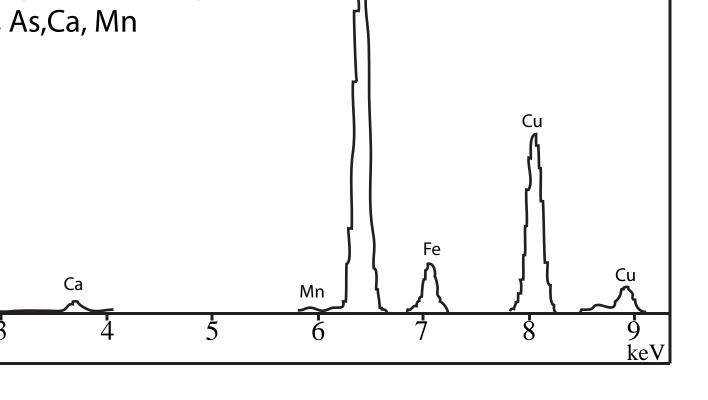
130°E



Sub euhedral crystal faces with characteristic 120° angle.



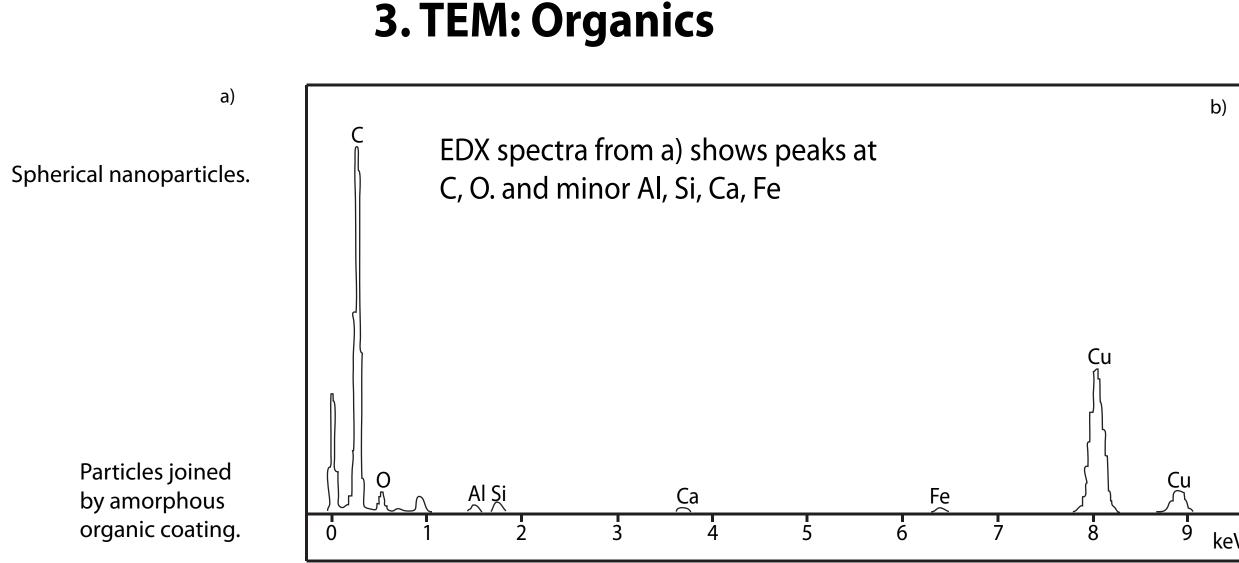
Nanocrystals adsorbed to the surface



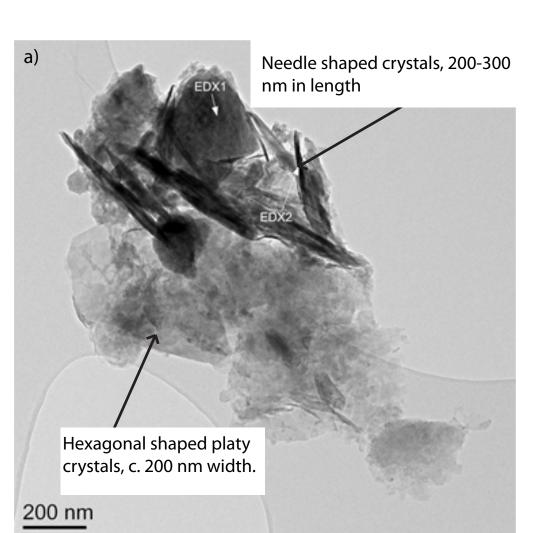
Viliui River

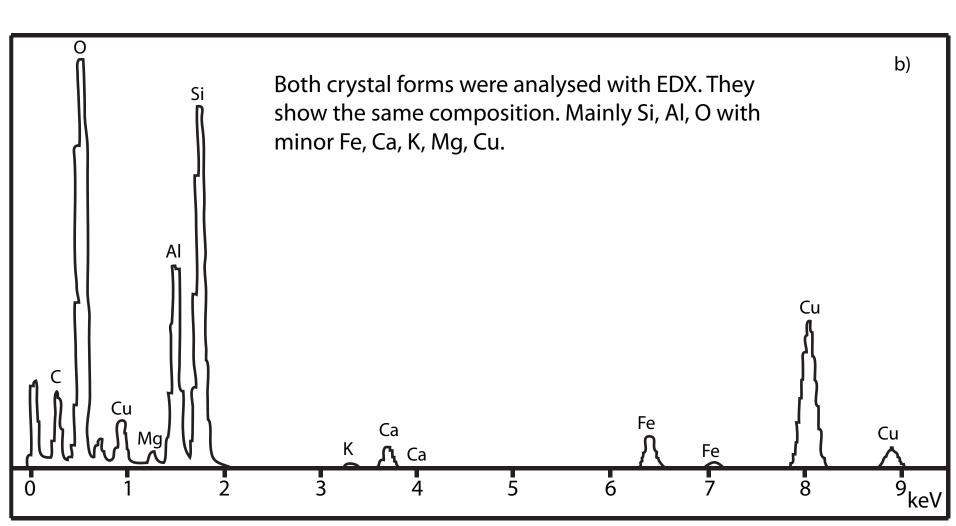
HMW Colloidal: < 0.22 μm - 10 kDa LMW Colloidal: 10 kDa - 1 kDa

2) Al, Fe, Si HMW colloid in the Aldan, LAIRA and Lena River

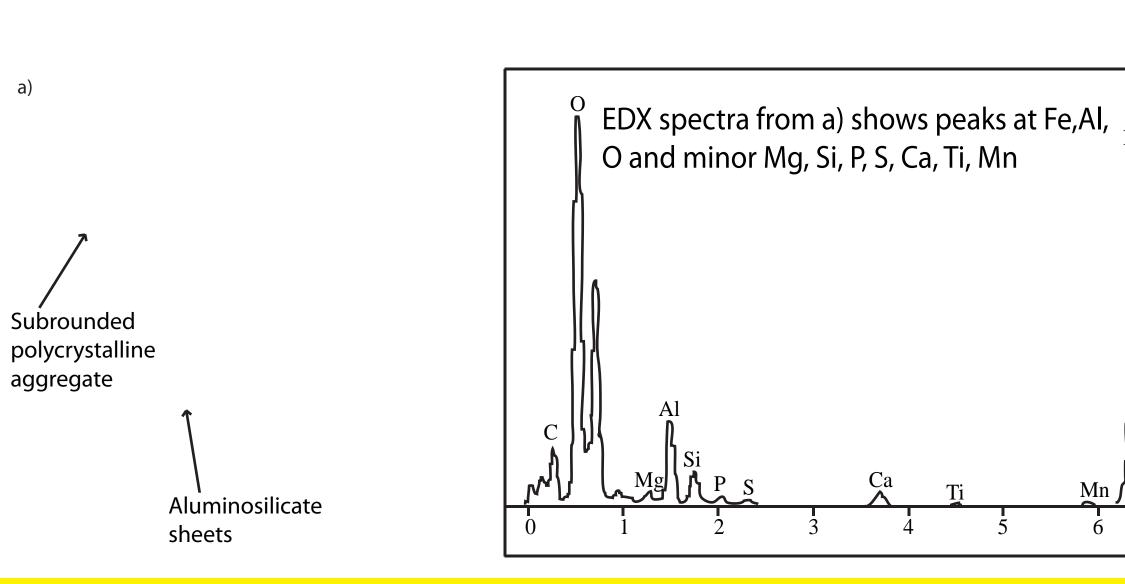


4. TEM: Aluminosilicate





5. TEM: Heamatite & Aluminosilicate



6. Sequential Extraction of Particulate & Colloidal Matter

- 1) Weak HCl Leach: poorly crystalline iron
- 2) Residual dissolution : organic bound iron / silicate bound iron

| Location | Weak HCl Leach Fe (μg Fe / L) | Residual Fe (µg Fe / L) | Total Fe (μg / L of river water) | % Non Crystalline/Amorphous Iron |
|--------------|--------------------------------|--------------------------|----------------------------------|----------------------------------|
| Lena River | 116 | 82 | 198 | 60 |
| Aldan River | 88 | 272 | 360 | 25 |
| Viliui River | 115 | 97 | 212 | 55 |
| CSP | 257 | 60 | 317 | 80 |
| LAIRA | 186 | 59 | 245 | 75 |
| VMR | - | - | - | - |

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7. Conclusions

- 1. In all sub-catchments, the highest iron concentration occurs in the particulate ($>0.22 \mu m$) and HMW colloidal (0.22 µm - 10 kDa) phase.
- 2. There are at least two different forms of colloidal iron in the Lena River catchment area: 1) Fe associated with Al and Si 2) Fe associated with Mn and organic matter.
- 3. 25 81% of the iron corresponds to amorphous / poorly crystalline Fe highly reactive Fe (HR Fe). This is highest in the Central Siberian Plateau.
- 4. TEM analysis confirms the presence of this HR Fe. Ferrihydrite is observed in all subcatchments. It is observed to be attached to the surface of bacteria (CSP) and organic fibrils (CSP) and clay particles (VMR, Aldan River). Other forms of iron include: hematite (VMR) and iron-alumino silicates (LAIRA).