Supplementary materials

River water quality of the Selenga-Baikal basin: part I – spatio-temporal patterns of dissolved and suspended metals

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Received: 22 June 2020; Accepted: 25 July 2020; Published: date

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**Table S1.** Overview of the most recent water quality studies in the Selenga River catchment

<table>
<thead>
<tr>
<th>Reference</th>
<th>№ of samp. points</th>
<th>№ of samp. campaigns</th>
<th>River</th>
<th>Measured parameter</th>
<th>Date of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>[93]</td>
<td>76</td>
<td>3</td>
<td>Selenga, Tuul, Khangai, Orkhon, Kharaa</td>
<td>Dissolved As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn</td>
<td>2007 - 2009</td>
</tr>
<tr>
<td>[102]</td>
<td>1</td>
<td></td>
<td>Selenga</td>
<td>Ca²⁺, K⁺, Mg²⁺, Na⁺</td>
<td>2010</td>
</tr>
<tr>
<td>[94,95]</td>
<td>52</td>
<td>1-2</td>
<td>Tuul, Orkhon, Kharaa, Selenga, Dzhida</td>
<td>As, Cd, Mn, Pb, Zn, orthophosphate-P</td>
<td>2010, 2011, 2012</td>
</tr>
<tr>
<td>[89]</td>
<td>31</td>
<td>3</td>
<td>Kharaa</td>
<td>Suspended Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ti, Ti, U, V, W, and Zn</td>
<td>2009, 2010, 2011</td>
</tr>
<tr>
<td>[96]</td>
<td>28</td>
<td>2</td>
<td>Selenga, Tuul, Khangai, Orkhon, Kharaa</td>
<td>pH, EC, DO, Dissolved Na, K, Ca, Mg, Si, Cl, NO, F, Fe, Li, Al, Cr, Mn, Cu, Zn, As, Se, Sr, Cd, Ba, Pb, Hg</td>
<td>2005-2006</td>
</tr>
</tbody>
</table>

Moscow State University field campaigns (this study)

<table>
<thead>
<tr>
<th></th>
<th>№ of samp. points</th>
<th>№ of samp. campaigns</th>
<th>River</th>
<th>Measured parameter</th>
<th>Date of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>July-August 2011</td>
<td>56 (95 samples)</td>
<td>6</td>
<td>Selenga, Tuul, Orkhon, Kharaa, Dzhida, Modonkul, Chikoy, Hilok, Uda, et al</td>
<td>Ca²⁺, K⁺, Mg²⁺, Na⁺</td>
<td>2011-2016</td>
</tr>
<tr>
<td>June 2012 September 2013</td>
<td>55 (114)</td>
<td></td>
<td></td>
<td>Cl⁻, HCO₃⁻, SO₄²⁻</td>
<td>dissolved and suspended Be, B, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Mo, Cd, Sb, Sn, W, Pb, Th, U</td>
</tr>
<tr>
<td>August 2014</td>
<td>53 (83)</td>
<td></td>
<td></td>
<td>pH, DOC, POC</td>
<td>SPM concentrations (g/m³), SL(t/day), SPM in certain classes</td>
</tr>
<tr>
<td>March 2015</td>
<td>22 (34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 2016</td>
<td>30 (39)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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**Table S2.** pH, Total Dissolved Solids (TDS) and Suspended Sediments Concentrations (SSC) in the Selenga River basin

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>TDS (mg/L)</th>
<th>SSC (g/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8.3</td>
<td>120</td>
<td>61</td>
</tr>
<tr>
<td>Median</td>
<td>8.3</td>
<td>115</td>
<td>19</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.5</td>
<td>52</td>
<td>194</td>
</tr>
<tr>
<td>Minimum</td>
<td>6.8</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Maximum</td>
<td>10.5</td>
<td>526</td>
<td>2384</td>
</tr>
</tbody>
</table>
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Figure S1. Granulometric composition of suspended sediments in the Selenga River basin

Figure S2. Dissolved U in river waters of the Selenga basin
### Table S3. PCA results. Factor loadings of dissolved metals concentrations in the Selenga River basin

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>0.90</td>
<td></td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Bi</td>
<td>0.90</td>
<td></td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>0.89</td>
<td></td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Sb</td>
<td>0.84</td>
<td></td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>0.72</td>
<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>As</td>
<td></td>
<td>0.91</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td>0.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>0.43</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mo</td>
<td></td>
<td>0.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sn</td>
<td></td>
<td>0.98</td>
<td></td>
<td></td>
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<tr>
<td>W</td>
<td>0.20</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>0.33</td>
<td>0.31</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>Co</td>
<td>0.51</td>
<td></td>
<td>0.81</td>
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<tr>
<td>Cu</td>
<td>0.50</td>
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<td>0.79</td>
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<tr>
<td>Zn</td>
<td>0.11</td>
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<td>0.69</td>
<td></td>
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<tr>
<td>Cr</td>
<td></td>
<td>0.38</td>
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<tr>
<td>Mn</td>
<td>0.19</td>
<td>0.37</td>
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</tr>
</tbody>
</table>

% of total variance | 35  | 19  | 15  | 8  |

Eigenvalue | 6.3  | 3.5  | 2.7  | 1.4  |

Potential origin | Crustal | Mongolia - metallogenic zones | Mining (Tuul, Orkhon, Dzhida basins) | Urban |

Bold red font corresponds to loadings ≥ 0.7 (strong connection), bold italic black font signifies loadings ≥ 0.5 (moderate connection), and in plain italic are values ≥ 0.3 (weak connection). Empty cells correspond to loading values < 0.1.
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Table S4. PCA results. Factor loadings of suspended metals concentrations in the Selenga River basin

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>0.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cr</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>0.82</td>
<td>0.13</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Co</td>
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<td>0.18</td>
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<tr>
<td>Mn</td>
<td>0.67</td>
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<td>0.43</td>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td>Zn</td>
<td>0.10</td>
<td>0.88</td>
<td>0.15</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>0.88</td>
<td>0.20</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>0.11</td>
<td>0.87</td>
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</tr>
<tr>
<td>Cu</td>
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<td>0.16</td>
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<tr>
<td>Pb</td>
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<td>0.96</td>
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<td></td>
<td></td>
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<tr>
<td>Bi</td>
<td>0.16</td>
<td>0.97</td>
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<td></td>
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<tr>
<td>Sn</td>
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<td></td>
<td>0.76</td>
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<td>Sb</td>
<td>0.26</td>
<td>0.18</td>
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<td>0.64</td>
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</tr>
<tr>
<td>W</td>
<td>0.31</td>
<td>0.19</td>
<td>0.57</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>Mo</td>
<td>0.14</td>
<td>0.40</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>As</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% of total variance: 28, 19, 10, 8, 6

Eigenvalue: 5.0, 3.4, 1.7, 1.4, 1.0

Potential origin: Crustal, Urban, Crustal + mining, Mining (Tuul, Orkhon, Dzhida basins), Mongolia - metallogenic zones

Bold red font corresponds to loadings ≥ 0.7 (strong connection), bold italic black font signifies loadings ≥ 0.5 (moderate connection), and in plain italic are values ≥ 0.3 (weak connection). Empty cells correspond to loading values < 0.1
Figure 3. PCA results for dissolved metals. Distribution of factor score values for Factor 1 (a), Factor 2 (b), Factor 3 (c), and Factor 4 (d). In parentheses in italics are the elements with moderate connection.
Figure S4. PCA results for suspended metals. Distribution of factor score values for Factor 1 (a), Factor 2 (b), Factor 3 (c), Factor 4 (d), and Factor 5 (e). In parentheses in italics are the elements with moderate connection.
Figure S5. Dissolved (a) and suspended (b) Bi in river waters of the Selenga basin
**Figure S6.** Dissolved Mo in river waters of the Selenga basin
Figure S7. Dissolved (a) and suspended (b) Cd in river waters of the Selenga basin.
Figure S8. Concentration factors (CF) for dissolved metals relatively to WHO guidelines (WHO), Mongolian national standard (MNS), Russian guidelines for drinking water (MPCD) if any.

**Dark red** title indicate metals with CF>3. Number of axis (1-3) depends on availability of standards.
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References


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