National geochemical baseline database

TAPIR

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Geological Survey of Finland
Government Decree (214/2007) on soil contamination

- The assessment of soil contamination and remediation needs should be based on evaluations of hazardous properties of contaminants in soil for human health or for the environment.

- **Threshold value**: The possible contamination of soil and need for remediation should be assessed if the legally prescribed threshold value is exceeded by one or more contaminant.

- For metals threshold value = *regional baseline concentration*

- Decree introduces soil quality guideline values for over 50 chemicals and chemical groups based on their health or environmental risk.
## Guidance values for metals and other trace elements (214/2007)

(p) = groundwater pollution risk should be considered  
(e) = based on ecological risk  
(t) = based on health risk

<table>
<thead>
<tr>
<th>Element</th>
<th>Natural concentration (mg/kg)</th>
<th>Threshold value (mg/kg)</th>
<th>Lower guideline value (mg/kg)</th>
<th>Higher guideline value (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony Sb (p)</td>
<td>0.02 (0.01-0.2)</td>
<td>2</td>
<td>10 (t)</td>
<td>50 (e)</td>
</tr>
<tr>
<td>Arsenic As (p)</td>
<td>1 (0.1-25)</td>
<td>5</td>
<td>50 (e)</td>
<td>100 (e)</td>
</tr>
<tr>
<td>Mercury Hg</td>
<td>0.005 (&lt;0.005-0.05)</td>
<td>0.5</td>
<td>2 (e)</td>
<td>5 (e)</td>
</tr>
<tr>
<td>Cadmium Cd</td>
<td>0.03 (0.01-0.15)</td>
<td>1</td>
<td>10 (e)</td>
<td>20 (e)</td>
</tr>
<tr>
<td>Cobalt Co (p)</td>
<td>8 (1-30)</td>
<td>20</td>
<td>100 (e)</td>
<td>250 (e)</td>
</tr>
<tr>
<td>Chromium Cr (tot)</td>
<td>31 (6-170)</td>
<td>100</td>
<td>200 (e)</td>
<td>300 (e)</td>
</tr>
<tr>
<td>Copper Cu</td>
<td>22 (5-110)</td>
<td>100</td>
<td>150 (e)</td>
<td>200 (e)</td>
</tr>
<tr>
<td>Lead Pb</td>
<td>5 (0.1-5)</td>
<td>60</td>
<td>200 (t)</td>
<td>750 (e)</td>
</tr>
<tr>
<td>Nickel Ni</td>
<td>17 (3-100)</td>
<td>50</td>
<td>100 (e)</td>
<td>150 (e)</td>
</tr>
<tr>
<td>Zinc Zn</td>
<td>31 (8-110)</td>
<td>200</td>
<td>250 (e)</td>
<td>400 (e)</td>
</tr>
<tr>
<td>Vanadium V</td>
<td>38 (10-115)</td>
<td>100</td>
<td>150 (e)</td>
<td>250 (e)</td>
</tr>
</tbody>
</table>
GTK + SYKE co-operation 2008-2009: National geochemical baseline database TAPIR

- Threshold value vs. regional geochemical baseline

- Finland was divided into geochemical provinces based on existing geological and geochemical data as well as on threshold values

- Three set of provinces/maps:
  - Seven metal provinces
  - Four arsenic provinces
  - Several individual urban geochemical studies

- Regional geochemical baselines were determined for each province
Metal provinces

- Metal provinces are areas that have shown anomalous concentration of Co, Cr, Cu, Ni, Zn and V in regional geochemical mapping.

- TAPIR provides statistical information for different soil types in each province.

- Pb, Hg and Cd
- B, Ba, Mo, Se, Sn, Be, Tl
Arsenic provinces

- Areas with elevated arsenic concentrations do not coincide with the metal provinces
- The highest natural As concentrations are found in the South-Pirkanmaa – Häme (province 4)
- Antimony is also included
Geochemical baseline and urban areas

• Term "baseline" refers both to the natural geological background concentrations and the diffuse anthropogenic input of substances at regional scale

• TAPIR provides information also on geochemical baselines within urban areas (Helsinki, Turku, Tampere, etc.)

• PAH- and PCB-compounds are reported

• Even in urban soils the natural background can be more important than man-made diffuse contamination
National geochemical baseline database

• GTK, SYKE, MTT Agrifood Research Finland and several Finnish consulting companies provide and use the information on the geochemical baseline concentrations

• The point-wise analytical results are used to calculate statistics for pre-described geographical regions, provinces

• Statistics are regularly updated and calculated separately for each soil parent material type and for each geochemical province.

• The summary data are publicly available through a web-based geographical user interface (http://www.geo.fi/tapir).
Information datasheet

• Information is collected via datasheets by logging into the web-based interface

• Sampling site, coordinates, depth, chemical analysis, etc.

• Elements with guidance values: Sb, As, Hg, Cd, Co, Cr, Cu, Pb, Ni, Zn, V and PAH + PCB

• Other elements: TI, B, Ba, Be, Mo, Se, Sn

• Sample material is classified based on variation in grain size and organic carbon content; e.g. glacial till, clay and other fine-grained sediments, sand and other coarse-grained sorted sediments, humus or other natural biogenic topsoil, man-made soil with variable texture

• Statistics (e.g. median, mean, 25th and 75th percentiles) are always calculated to each sample material separately
As province: 4
Soil type: sand
Soil type: Gravel and sand
Arsenic province 4

Näytetyyppi: Luonnonmaa: sora, hieka tai karkea hieta
Alue: Arseeniprowinssi 4

<table>
<thead>
<tr>
<th></th>
<th>Sb mg/kg</th>
<th>As mg/kg</th>
<th>Hg mg/kg</th>
<th>Cd mg/kg</th>
<th>Co mg/kg</th>
<th>Cr mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>N kelvollisia</td>
<td>146</td>
<td>146</td>
<td>146</td>
<td>146</td>
<td>146</td>
<td>146</td>
</tr>
<tr>
<td>puuttuvia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>keskiarvo</td>
<td>0.11</td>
<td>10.93</td>
<td>0.01</td>
<td>0.10</td>
<td>8.27</td>
<td>33.18</td>
</tr>
<tr>
<td>mediaani</td>
<td>0.10</td>
<td>6.49</td>
<td>0.01</td>
<td>0.07</td>
<td>7.29</td>
<td>29.50</td>
</tr>
<tr>
<td>maksimi</td>
<td>0.30</td>
<td>176.00</td>
<td>0.10</td>
<td>0.74</td>
<td>30.50</td>
<td>75.50</td>
</tr>
<tr>
<td>pros. piste 25</td>
<td>0.08</td>
<td>3.19</td>
<td>0.01</td>
<td>0.05</td>
<td>5.19</td>
<td>19.90</td>
</tr>
<tr>
<td>75</td>
<td>0.14</td>
<td>11.75</td>
<td>0.02</td>
<td>0.12</td>
<td>10.00</td>
<td>45.35</td>
</tr>
<tr>
<td>SSTP kunnysarvo</td>
<td>0.23</td>
<td>25</td>
<td>0.04</td>
<td>0.23</td>
<td>17</td>
<td>76</td>
</tr>
</tbody>
</table>

Average
Median
Maximum
Percentile 25 and 75
Maximum Acceptable baseline (SSTP)
Threshold value
Trigger value – maximum acceptable baseline

- The upper limit of the baseline variation within a geochemical province is an important parameter for decision makers (ISO 19258)

- \[ \text{ULBL}_X = P_{75} + 1.5 \times (P_{75} - P_{25}) \]
  - \( P_{75} = 75^{\text{th}} \) percentile of element X concentrations
  - \( P_{25} = 25^{\text{th}} \) percentile of element X concentrations.

⇒ The maximum acceptable baseline concentration for a geochemical province
⇒ Precautionary principle (outliers are excluded)
⇒ Can be used instead of threshold value
Advantages and use of the TAPIR

• All information on baselines is easily accessible
• Scientifically sound baseline values are used at national level => transparent decision-making

• Baseline information on elements that don’t have guidance values (e.g. Tl, Be, Mo, Sn) is also provided

• More precise information on regional or local baselines is provided when sufficient data is available => delineation of potential risk areas, risk assessment procedures, environmental baseline studies

• Regional (or local) upper and lower guideline values can be defined by adding the national baseline concentration to the concentration that prescribes the maximum acceptable risk to the environment
http://www.geo.fi/tapir/

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