Natural attenuation of contaminants in mine drainage at abandoned mines

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IMWA 2010, September 2010, Sydney

Scheme of presentation

- past mining in Sardinia
- level of contamination
- temporal variations
- attenuation processes

Past mining in Sardinia: pre-Roman to 1990s

Mining legacy in Sardinia surface: 19 km²
abandoned mines: 169
waste volume 71*10⁶ m³
(RAS, 2003)

Study area: Pb-Zn ore hosted in silicate-dominated rocks

Water analyses

in situ:
filtration (0.4 µm) + 1% HNO₃
T, pH, Eh, alk.

in lab:
anions by IC
cations by ICP-OES
traces by ICP-MS

mine closure in 1980s: rebound effects

exploitation (Biddau, 1978)
pH: 6.2
80 mg/L Cl
2000 mg/L SO₄
300 mg/L Zn
0.8 mg/L Pb
4 mg/L Mn

rebound 1997
pH: 3.9
60 mg/L Cl
3000 mg/L SO₄
1000 mg/L Zn
2 mg/L Pb
40 mg/L Mn

mine drainage: temporal variations
temporal variations

SO\textsubscript{4} (g/L)

MV4

MV5

0 24 48 72 96 120 144 168

time (months since 1996)

200 300

0 24 48 72 96 120 144 168

time (months since 1996)

S

0 2 4 6

0 2 4 6 8

time (months since 1996)

MV4

MV5

2 km downstream

downstream variations

Ca (mmole/L)

MV16

flow direction

0 2 4 6 8

time (months since 1996)

0 2 4 6 8

time (months since 1996)

MV16

flow direction

pH

Sep 2004

Sep 2008

MV16

flow direction

downstream variations

Pb (µg/L)

MV15

flow direction

-5 -3 -1 0

0 4 8 12 16

distance from mine drainage (km)

0.01 0.1 1 10 100 1000

0 4 8 12 16

distance from mine drainage (km)

Fe (mg/L)

MV16

flow direction

-5 -3 -1 0

0 4 8 12 16

distance from mine drainage (km)

Saturation Index log(IAP/K)
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suggestions for reducing environmental risks

- stabilization of solid residues
- runoff diverting
- treatment of mine drainage
- wetland / decantation pond

Correct disposal and management of mining residues should be mandatory at each active mine

Metals from Montevecchio into the Marceddi lagoon

<table>
<thead>
<tr>
<th>Flow (L/s)</th>
<th>10</th>
<th>70</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn (kg/d)</td>
<td>0.5</td>
<td>1.8</td>
<td>10</td>
</tr>
<tr>
<td>Cd (kg/d)</td>
<td>0.001</td>
<td>0.01</td>
<td>0.7</td>
</tr>
<tr>
<td>Pb (kg/d)</td>
<td>0.003</td>
<td>0.06</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Thanks for your attention