# Occurrence and Ecological Risk Assessment of Heavy Metals from Wuliangsuhai Lake, Yellow River Basin, China

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**Text S1 Steps of BCR**

The optimized BCR three-stage extraction procedure is used to determine the distribution of heavy metal in different chemical fractions and the steps of sequential extraction are listed as following:

Step 1 (Exchangeable fraction): A total of 40mL of 0.11M acetic acid is added to 1g freezing-dried sediment and shake overnight. The mixture is centrifuged to separate the extract from residue.

Step 2 (Reducible fraction): A total of 40mL of 0.5M hydroxylammonium chloride, adjusted with nitric acid to the pH of 1.5, is added to the residue from Step 1 and then extraction performed as above.

Step 3 (Oxidizable fraction): The residue from Step 2 is treated twice with 8.8M hyfrogen peroxide, evaporated to near dryness, then 50mL of 1.0 M ammonium acetate, adjusted to pH 2 with nitric acid, is added and the extraction performed as above.

Step 4 (Residual fraction): The material remaining at the end of the BCR procedure is digested in 20mL aqua regia, with microwave assistance, as described above.

**Table S1 Results of the recovery test of standard samples (GSD7)**

**Table S1.** Results of the recovery test of standard samples (GSD7).

| Element | Measured value (mg/kg) | Standard value (mg/kg) | Recovery (%) |
|---|---|---|---|
| Cr | 110.75 | 122±7 | 90.78 |
| Ni | 48.79 | 53±4 | 92.06 |
| Cu | 33.62 | 38±2 | 88.47 |
| Zn | 258.51 | 238±12 | 108.62 |
| As | 83.21 | 84±6 | 99.06 |
| Cd | 1.00 | 1.05±0.06 | 95.24 |
| Hg | 0.049 | 0.053±0.013 | 92.45 |

| | | | |
|---|---|---|---|
| Pb | 345.48 | 350±17 | 98.71 |

**Table S2 Classification of EF**

**Table S2.** Classification of EF.

| EF value | Grades of EF risk |
|---|---|
| EF<2 | minimal enrichment |
| 2≤EF<5 | moderate enrichment |
| 5≤EF<20 | significant enrichment |
| 20≤EF<40 | very high enrichment |
| EF≥40 | extreme enrichment |

**Table S3 Classification of $I_{geo}$**

**Table S3.** Classification of $I_{geo}$.

| $I_{geo}$ value | Grades of Igeo risk |
|---|---|
| $I_{geo}$≤0 | practically unpolluted |
| 0<$I_{geo}$ ≤1 | unpolluted to moderately polluted |
| 1<$I_{geo}$ ≤2 | moderately polluted |
| 2<$I_{geo}$ ≤3 | moderately to strongly polluted |
| 3<$I_{geo}$ ≤4 | strongly polluted |
| 4<$I_{geo}$ ≤5 | strongly to extremely polluted |
| $I_{geo}$>5 | extremely polluted |

**Table S4 Indices and grades of potential ecological risk**

**Table S4.** Indices and grades of potential ecological risk.

| $E_r^i$ value | Grades of ecological risk of single metal | RI value | Grades of potential ecological risk of the environment |
|---|---|---|---|
| $E_r^i$<40 | Low risk | RI<150 | Low risk |
| 40≤$E_r^i$<80 | Moderate risk | 150≤RI<300 | Moderate risk |
| 80≤$E_r^i$<160 | Considerable risk | 300≤RI<600 | Considerable risk |
| 160≤$E_r^i$<320 | High risk | RI≥600 | Very high risk |
| $E_r^i$ ≥320 | Very high risk | | |

**Table S5 Classification of RAC and values of ∂**

**Table S5.** Classification of RAC and values of $\partial$.

| Risk | Metal in exchangeable fraction/% | $\partial$ |
|---|---|---|
| No risk | <1 | 1.00 |
| Low risk | 1-10 | 1.00 |
| Medium risk | 11-30 | 1.20 |
| High risk | 31-50 | 1.40 |
| Very high risk | >50 | 1.60 |