

Greenpeace Research Laboratories Analytical Results 2015-10

Analysis of a single water sample collected from a mining location in DRC, 2015, for heavy metals and for the presence of organic contaminants

December 2015

1. Introduction

A single sample of water (our laboratory code NGP15005) was received at our laboratory from Lauren Armistead of Amnesty International on 17th July 2015. According to information provided, this sample had been collected from a lake (Kapata Lake) in the vicinity of a mining operation in the Democratic Republic of the Congo, at a location used for mineral washing operations. The sample was described as “pale milky brown colour with lots of fine sediment”.

2. Materials and methods

Given the very high particulate content of the sample (determined in our laboratory to be 290g/l, or 29% weight:weight), and the likelihood for any organic contaminants of particular concern to partition to the particulate fraction, the decision was taken to carry out the forensic organic screening analysis only on the settled solids/particulate material fraction, after having first left the sample to settle at 4°C in the dark for three days. The water layer was then decanted from the settled solids. A portion of the decanted water fraction was filtered through a 0.45 micron filter. Heavy metal concentrations were determined for both filtered water and for the remaining settled solids using inductively coupled plasma – mass spectrometry (ICP-MS) following acid digestion and using appropriate certified reference materials in addition to intra-laboratory standards. The filtered sediment fraction was prepared for qualitative screening analysis for organic contaminants by extraction into a mixture of pentane and acetone using an accelerated solvent extraction (ASE) system, with both deuterated and brominated naphthalene as internal standards to control for extraction efficiency and extract volume. Extracts were analysed using an Agilent GC-MS system operated in both SCAN and SIM modes, and compounds identified using a combination of automated spectral matching against the Wiley 7N database and expert interpretation of spectra.

More detailed descriptions of the sample preparation and analysis can be provided on request.

**Greenpeace Research Laboratories
School of Biosciences, Innovation Centre Phase 2
Rennes Drive, University of Exeter
Exeter, EX4 4RN, UK**

3. Results and Discussion

Concentrations of metals in the 2 sample fractions are given in the Tables below:

NGP15005A	
Water (filtered)	µg/l
Aluminium	91
Antimony	<0.4
Arsenic	0.8
Barium	48
Beryllium	<10
Cadmium	<0.1
Chromium	0.2
Cobalt	15300
Copper	30
Lead	<0.5
Manganese	8920
Mercury	<5
Molybdenum	6
Nickel	2
Titanium	<5
Vanadium	5.6
Zinc	1

NGP15005B	
Settled solids	mg/kg dry weight
Antimony	<2
Arsenic	6.9
Barium	27
Beryllium	<2
Cadmium	<0.2
Chromium	21
Cobalt	6530
Copper	1300
Lead	8.4
Manganese	647
Mercury	<0.5
Molybdenum	1.5
Nickel	3.6
Titanium	29
Vanadium	115
Zinc	2

The water fraction had a high concentration of dissolved cobalt (15300 µg/l = 15.3 mg/l), far higher than would be typically found in uncontaminated surface waters.

The suspended solids fraction had high concentrations of cobalt (6530 mg/kg dry weight) and copper (1300 mg/kg dry weight), both far higher than concentrations that would be typically found in uncontaminated surface waters sediments.

The qualitative results for the organic screening analysis are given in the Appendix. Of a total of 53 separate peaks that could be resolved in the analysis, reliable chemical identities could be determined for only 17, with a further 5 more tentatively identified. The identities of the other peaks isolated could not be determined through the process of spectral matching, though in many cases their mass spectra appear to be similar to those groups of compounds that were identifiable.

Of those substances reliably identified, the majority were long-chain aliphatic hydrocarbons, which could arise from either natural or anthropogenic sources and which are not distinctive enough in their nature to allow for determination of their sources in this case. Also identified were residues of three phthalate esters (benzenedicarboxylic acid esters), chemicals that receive very widespread use as softeners in plastics such as PVC (vinyl) used in building materials, furnishings, clothing and footwear. Although these are exclusively man-made chemicals, their presence in the sediment settled from the water sample could not be taken as an indication of a particular industrial source linked to the mining operation, as small fragments of PVC plastic contained in the sediments from, for example, PVC waterproof boots or other similar materials, could also give rise to the detection of these chemical additives in this sample.

For more information please contact: David Santillo or Kevin Brigden

Disclaimer: Description of samples and sampling sites are purely according to information supplied with the samples by Amnesty International.

Appendix: organic analytical results (qualitative screening only)

NGP15005, sediment settled from water sample

Number of compounds isolated: 53

Compounds identified to better than 90%:

CAS#	Name
000117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
000084-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
000084-69-5	1,2-Benzenedicarboxylic acid, diisobutyl ester
000629-97-0	Docosane
000544-85-4	Dotriacontane
000630-04-6	Hentriacontane
000593-49-7	Heptacosane
000630-01-3	Hexacosane
000112-39-0	Hexadecanoic acid, methyl ester
000630-03-5	Nonacosane
000630-02-4	Octacosane
000629-99-2	Pentacosane
000646-31-1	Tetracosane
014167-59-0	Tetratriacontane
000638-68-6	Triacontane
000638-67-5	Tricosane
000630-05-7	Tritriacontane

Compounds tentatively identified:

CAS#	Name
000661-19-8	1-Docosanol
018835-33-1	1-Hexacosene
056987-89-4	11,15-Dimethylheptatriacontane
022349-03-7	Cyclohexane, nonadecyl-
000142-91-6	Hexadecanoic acid, 1-methylethyl ester