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Data Article

Chemical data on environmental matrices from an abandoned mining site

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ABSTRACT

This article contains analytical data on chemical composition of waters and solid samples (mining wastes and biominerals) collected in an abandoned mining area, and they are related with the research article "Geochemistry of rare earth elements in water and solid materials at abandoned mines in SW Sardinia (Italy)" (Medas et al., 2013).
Specifically, we present physicochemical data (temperature, electrical conductivity, pH, and redox potential), major components and the main contaminants (Zn, Mn, Cd, Ni, Cu, Pb) detected in stream waters and drainages from mine wastes. Waters were monitored from 2009 to 2011 during different seasonal conditions to give an insight into metal dispersion under different hydrological conditions.

1. Data

Water and solid samples were collected in the Ingurtosu Zn-Pb abandoned mining site, located in the South-West of Sardinia, Italy. Physicochemical data and major components of the Rio Naracauli waters are reported in Tables 1–3; Tables 4–6 show concentrations of selected metals (Mn, Cd, Ni, Cu and Pb) in the stream waters. Physicochemical data, major components, and selected metals (Mn, Cd, Ni, Cu and Pb) of the Rio Pitzinurri tributary are reported in Tables 7 and

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Specifications table

Subject area	*Environmental Science*
More specific subject area	Environmental Science: Pollution
Type of data	Tables.
How data was acquired	Inductively coupled plasma optical emission spectrometry (ICP-OES, ARL Fisons ICP Analyzer 3520 B), inductively coupled plasma mass spectrometry (ICP-MS, Perkin-Elmer, Elan 5000/DRC-e, USA).
Data format	Analyzed.
Experimental factors	Water samples were collected and stabilized according to established protocols, then they were stored in a refrigerator until the analysis. Solid samples were dried, grounded and acid digested by a microwave (ETHOS One, Advanced Microwave Digestion System, Milestone) prior to the analysis by ICP-OES and ICP-MS.
Experimental features	Chemical composition of waters, mine wastes and biominerals was determined.
Data source location	Ingurtosu, SW Sardinia, Italy.
Data accessibility	Data are with this article.
Related research article	Medas D, Cidu R, De Giudici G, Podda F. Geochemistry of rare earth elements in water and solid materials at abandoned mines in SW Sardinia (Italy). *J Geochem. Explor*. (2013). 133, 149–159.

Value of the data

- Data reported in this article represent the chemical status of river waters, mining wastes and biogenic minerals in a Zn-Pb abandoned mine.
- Provided data can be useful to develop a global database to evaluate the impact of mining activity on the environment.
- The presented data are also helpful for geochemical modelling to develop remediation management strategies.

8, respectively. Tables 9 and 10 show the physicochemical data, major components, and selected metals (Mn, Cd, Ni, Cu and Pb) in waters draining mine tailings. Data on solid samples (mine tailings and biominerals) are reported in Tables 11 and 12. For a detailed description and discussion of the data see Ref. [1].

2. Experimental design, materials, and methods

2.1. Study area

Environmental and health problems [2–7] associated with the dispersion of metals and with their transfer from the geosphere to the biosphere [8–11] are becoming increasingly common worldwide. The knowledge of metal pathways is a fundamental parameter to plan efficient remediation actions of waters and soils and it can be achieved by an accurate geochemical investigation. In this context, chemical composition of stream waters and drainages from mine tailings were monitored from 2009 to 2011, and mine wastes and biominerals were analyzed. During the mining activity, wastes were disposed near the Rio Naracauli, the main stream of the area, resulting in a relevant threat for the health of living organisms. When the mine was closed (1968), dump and tailings were abandoned without applying any remediation technique [1,12]. Zinc dispersion along the stream is controlled by the bioprecipitation of two biominerals: hydrozincite, $Zn_5(CO_3)_2(OH)_6$ [9,10], and an amorphous Zn-silicate [13–15].

2.2. Materials and methods

Biominerals and mine waste samples were dried at room temperature, and ground for acid digestion by a microwave (ETHOS One, Advanced Microwave Digestion System, Milestone), according to Ref. [1]. Samples were digested in duplicate and analyzed to estimate method precision (expressed as standard deviation/mean concentration) that was in the range 0.1–5%. To evaluate

Table 1
Temperature, pH, redox potentials (Eh), electrical conductivity (Cond) and major components in the Rio Naracauli waters, continues.

Sample	Date	T °C	pH	Eh mV	Cond μS/cm	Ca	Mg	Na	K	Zn	HCO_3^-	Cl	SO_4^{2-}	SiO_2
						mg/l								
NS-100	18 March 2009	15	7.4	466	1590	154	64	57	6.6	38	216	107	500	9.2
NS-170	18 March 2009	17	7.5	466	1583	146	60	57	6.1	36	214	104	497	8.6
NS-330	18 March 2009	18	7.7	475	1875	211	79	62	6.7	23	250	101	695	9.4
NS-420	18 March 2009	18	7.8	492	1860	208	79	69	7.3	19	220	102	638	8.8
NS-590	18 March 2009	19	7.9	492	1847	210	80	69	6.3	12	217	109	653	8.6
NS-630	18 March 2009	14	7.4	497	1040	89	36	59	4.3	7.2	135	91	270	14
NS-1200	18 March 2009	14	7.7	511	1038	91	36	62	4.2	7.3	126	91	278	14
NS-1600	18 March 2009	15	7.8	480	966	73	32	65	3.9	5.9	147	91	237	17
NS-100	25 March 2009	16	7.3	488	1609	153	61	58	6.2	35	201	109	476	8.6
NS-170	25 March 2009	16	7.4	483	1592	150	63	57	6.2	29	192	109	483	9.1
NS-330	25 March 2009	16	7.6	480	1920	213	80	63	7.4	22	226	104	674	8.3
NS-420	25 March 2009	17	7.8	458	1910	223	83	64	7.5	18	217	101	659	7.2
NS-590	25 March 2009	16	7.9	446	1900	224	84	70	6.7	11	219	104	650	7.5
NS-100	17 April 2009	17	6.9	602	1305	165	61	62	6.2	47	165	109	593	9.5
NS-170	17 April 2009	17	7.1	571	1357	162	62	64	5.9	43	157	106	617	9.8
NS-330	17 April 2009	18	7.2	615	1450	202	72	67	6.4	35	187	104	696	10
NS-420	17 April 2009	18	7.2	619	1080	199	72	68	6.0	38	176	104	678	9.8
NS-590	17 April 2009	18	7.3	474	1400	189	69	68	6.0	32	154	106	668	10
NS-1200	17 April 2009	16	7.2	483	850	74	29	58	4.0	12	99	89	241	15
NS-100	07 May 2009	18	7.2	536	1525	166	66	64	6.0	37	201	114	584	10
NS-170	07 May 2009	18	7.4	524	1552	166	68	66	6.1	30	195	118	602	10
NS-330	07 May 2009	18	7.6	513	1727	206	77	65	6.5	23	233	109	671	8.9
NS-420	07 May 2009	19	7.8	516	1717	223	82	69	6.0	18	230	109	763	9.8
NS-590	07 May 2009	21	7.8	505	1696	219	81	69	6.3	14	216	112	722	9.3
NS-1200	07 May 2009	18	7.9	499	1022	101	40	63	4.3	11	140	99	323	16
NS-100	21 May 2009	19	7.2	523	1411	154	63	62	5.9	34	212	109	551	10
NS-170	21 May 2009	21	7.5	505	1399	164	68	65	6.2	24	201	109	545	10
NS-330	21 May 2009	20	7.7	490	1699	232	83	67	6.7	17	216	109	713	8.8
NS-420	21 May 2009	21	7.8	545	1682	230	83	68	6.2	12	209	106	737	9.2
NS-590	21 May 2009	23	8.0	513	1670	234	85	70	6.3	6.0	189	109	752	8.9
NS-100	27 May 2009	18	7.3	525	1377	160	65	62	5.8	38	217	106	536	10
NS-170	27 May 2009	19	7.6	502	1365	166	69	66	6.2	27	198	104	530	10
NS-330	27 May 2009	19	7.8	490	1712	252	91	72	6.5	19	234	106	728	8.6
NS-420	27 May 2009	20	8.0	473	1702	253	91	73	6.0	13	220	106	737	9.1
NS-590	27 May 2009	21	8.2	436	1688	249	90	73	6.4	6.1	201	106	758	9.1
NS-100	03 June 2009	19	7.4	525	1327	143	58	56	6.6	41	201	104	527	11
NS-170	03 June 2009	21	7.6	486	1316	143	58	56	6.8	31	184	106	506	10
NS-330	03 June 2009	21	7.8	467	1711	230	82	67	7.2	19	227	106	800	11
NS-420	03 June 2009	22	7.9	450	1690	236	84	67	7.7	14	221	104	734	9.5
NS-590	03 June 2009	25	8.1	450	1660	239	85	68	7.8	5.4	198	101	760	9.2

the analytical accuracy of the acid digestion procedure, experimental values and the certified values of the reference material RTS-3 (CANMET, Canadian Certified Reference Materials Project (CCRMP)), prepared with the same mixture, were compared, and the percentage recovery of each metal was calculated as:

$$\%\ Recovery = \frac{Mean\ value\ of\ the\ measured\ concentration}{Certified\ concentration} \bullet 100$$

Recovery was between 85 and 102%.

Table 2
Temperature, pH, redox potentials (Eh), electrical conductivity (Cond) and major components in the Rio Naracauli waters, continues.

Sample	Date	T °C	pH	Eh mV	Cond µS/cm	Ca mg/l	Mg	Na	K	Zn	HCO_3^-	Cl	SO_4^{2-}	SiO_2
NS-100	10 June 2009	18	7.5	445	1396	149	61	57	6.4	34	218	104	512	7.7
NS-170	10 June 2009	21	7.6	429	1370	149	61	57	6.5	23	209	106	500	9.8
NS-330	10 June 2009	20	7.8	424	1814	249	87	67	7.2	16	245	104	823	10
NS-420	10 June 2009	21	7.9	407	1808	254	88	80	7.6	11	232	104	796	9.4
NS-590	10 June 2009	24	8.2	387	1793	254	90	68	7.5	4.2	211	104	787	8.8
NS-100	17 June 2009	19	7.3	471	nd	157	65	62	6.2	35	218	106	512	11
NS-170	17 June 2009	22	7.5	451	nd	150	64	61	6.0	22	198	104	503	10
NS-330	17 June 2009	20	7.6	447	nd	242	82	60	7.2	15	253	109	835	10
NS-420	17 June 2009	21	7.8	435	nd	261	90	67	7.0	9.5	238	106	859	9.8
NS-590	17 June 2009	24	8.0	417	nd	253	89	66	7.3	2.9	228	109	874	9.3
NS-100	25 June 2009	19	7.4	457	1360	153	62	62	6.4	33	189	104	536	11
NS-170	25 June 2009	20	7.5	449	1350	150	60	62	6.3	20	165	104	515	11
NS-330	25 June 2009	20	7.7	446	1850	232	86	61	7.0	12	232	106	862	9.6
NS-420	25 June 2009	20	7.8	450	1840	267	90	66	6.7	8.2	220	106	850	9.5
NS-590	25 June 2009	20	8.0	448	1830	255	88	66	6.4	3.1	209	106	832	9.4
NS-100	08 July 2009	20	7.1	422	1190	120	46	58	6.5	44	134	99	437	11
NS-170	08 July 2009	21	7.3	418	1170	122	46	59	6.9	35	123	99	440	11
NS-330	08 July 2009	21	7.9	422	1720	228	75	63	7.1	16	224	104	792	10
NS-420	08 July 2009	21	7.7	422	1720	267	90	66	7.2	12	212	101	799	10
NS-590	08 July 2009	24	7.9	416	1720	238	80	66	6.1	3.9	200	101	793	9.4
NS-100	15 July 2009	20	7.3	460	1120	116	44	60	6.6	36	124	94	407	12
NS-170	15 July 2009	22	7.3	451	1100	115	43	60	6.4	28	119	94	404	11
NS-330	15 July 2009	22	7.6	442	1690	252	85	71	6.8	14	214	97	748	10
NS-420	15 July 2009	22	7.7	445	1680	248	85	71	6.9	10	212	101	725	9.9
NS-590	15 July 2009	24	8.0	432	1670	246	82	69	6.5	3.8	202	99	728	9.5
NS-100	29 July 2009	20	7.4	445	1120	103	36	50	5.5	31	134	89	383	12
NS-170	29 July 2009	23	7.5	426	1100	104	36	51	5.4	20	107	89	367	11
NS-330	29 July 2009	21	7.7	404	1710	242	79	66	6.2	9.9	248	96	751	9.0
NS-420	29 July 2009	21	7.8	422	1710	231	81	69	6.1	6.3	226	96	739	9.1
NS-590	29 July 2009	22	8.1	407	1720	246	82	71	6.0	2.3	220	96	713	8.3
NS-330	19 August 2009	21	7.5	459	1520	208	74	66	8.1	16	194	93	642	7.7
NS-420	19 August 2009	22	7.7	452	1500	209	71	66	8.3	11	192	96	599	7.6
NS-590	19 August 2009	24	8.0	440	1490	212	72	67	7.6	4.2	186	94	605	6.4
NS-100	19 October 2009	17	6.9	473	770	70	23	50	7.0	32	102	76	237	12
NS-170	19 October 2009	17	7.3	490	750	72	25	53	6.9	28	89	84	239	11
NS-420	19 October 2009	17	7.7	475	1410	197	69	65	8.4	10	196	94	658	7.3
NS-590	19 October 2009	16	8.0	407	1380	208	71	65	10.5	5.4	206	90	633	7.7
NS-1200	19 October 2009	17	7.4	453	1070	123	45	76	5.6	6.8	166	114	339	12

Zn and $S_{(tot)}$ were analyzed by inductively coupled plasma optical emission spectrometry (ICP-OES, ARL Fisons ICP Analyzer 3520 B), and Fe, Zn, Pb, Cd, Mn, Co, Ni, Cu, Al, As, Cr, Sb and Ag were determined by inductively coupled plasma mass spectrometry (ICP-MS, Perkin-Elmer, Elan 5000/DRC-e, USA).

Stream waters, from the Rio Naracauli (NS-100 to NS-1600) and the Rio Pitzinurri tributary (sample D), and drainages from tailings (samples A and B) were collected from 2009 to 2011. Temperature, electrical conductivity (Cond), pH, redox potential (Eh), and alkalinity were determined on site according to Ref. [1]. Major cations were determined by ICP-OES and Zn, Cu, Ni, Cd, Mn and Pb were determined by ICP-MS on filtered (0.4 µm, Nuclepore 111130) and acidified samples (1% HNO_3 suprapure grade). Anions were analyzed by ion chromatography (Dionex ICS3000) on filtered and non-acidified aliquots.

Procedural blanks, standard solutions and reference solutions (SRM 1643e and EnviroMAT Drinking Water, High EP-H-3 and Low EP-L-3) were analyzed after every five samples to estimate potential

Table 3
Temperature, pH, redox potentials (Eh), electrical conductivity (Cond) and major components in the Rio Naracauli waters.

Sample	Date	T °C	pH	Eh mV	Cond μS/cm	Ca	Mg	Na	K	Zn	HCO_3^-	Cl	SO_4^{2-}	SiO_2
						mg/l								
NS-100	11 November 2009	10	7.0	494	1182	96	29	54	8.0	119	77	68	471	11
NS-420	11 November 2009	16	7.0	468	1431	157	53	63	7.6	69	115	79	590	8.6
NS-100	28 November 2009	16	7.1	482	1113	104	34	56	7.2	56	101	87	398	11
NS-420	28 November 2009	17	7.6	472	1740	240	80	66	8.1	13	225	93	752	8.1
NS-590	28 November 2009	16	7.7	474	1680	231	76	65	8.0	5.9	216	90	696	6.2
NS-100	17 March 2010	18	7.3	437	1420	152	64	57	7.1	31	209	88	495	8.9
NS-420	17 March 2010	17	7.6	451	1719	226	83	65	7.6	15	224	89	660	7.3
NS-590	17 March 2010	19	7.7	465	1724	226	84	66	7.1	9.7	202	88	728	7.6
NS-100	21 April 2010	18	7.4	456	1460	152	68	61	7.5	27	222	91	500	8.7
NS-170	21 April 2010	20	7.5	450	1453	156	65	61	8.0	18	208	92	500	9.7
NS-330	21 April 2010	18	7.6	445	1983	280	97	72	7.9	13	265	97	896	7.8
NS-420	21 April 2010	19	7.8	435	1975	280	95	72	8.0	9.8	251	96	895	8.2
NS-590	21 April 2010	19	8.0	431	1965	280	94	71	7.4	3.3	222	94	896	8.4
NS-1200	21 April 2010	16	7.8	450	1021	93	34	58	5.2	5.6	141	91	275	17
NS-100	30 June 2010	19	7.5	469	1417	143	51	58	10.0	57	134	90	540	13
NS-170	30 June 2010	25	7.5	457	1392	143	51	59	10.0	38	101	98	535	12
NS-330	30 June 2010	22	7.9	467	1922	271	88	67	10.0	12	281	97	800	10
NS-420	30 June 2010	22	8.1	469	1919	271	88	67	10.0	5.8	278	97	800	9.9
NS-590	30 June 2010	22	8.4	486	1904	274	89	68	10.0	1.6	253	96	800	9.5
NS-1200	30 June 2010	22	8.0	447	1515	174	60	64	6.8	9.8	193	107	550	14
NS-100	29 October 2010	17	7.2	475	1266	121	43	56	10.0	58	97	91	510	12
NS-170	29 October 2010	15	7.3	480	1304	120	42	55	10.0	50	119	88	500	12
NS-420	29 October 2010	16	7.8	475	1879	244	86	69	10.0	11	245	100	740	11
NS-590	29 October 2010	14	8.0	482	1814	232	83	68	10.0	3.6	240	102	725	9.9
NS-1200	29 October 2010	15	7.6	490	1159	103	39	70	5.3	6.1	176	122	290	16
NS-1600	29 October 2010	17	7.9	480	1018	84	34	65	4.9	3.8	187	107	223	20
NS-100	01 December 2010	17	7.2	608	1423	133	51	53	8.0	86	139	78	560	11
NS-420	01 December 2010	17	7.5	609	1548	160	60	56	9.0	65	129	82	640	10
NS-590	01 December 2010	17	7.6	583	1482	158	58	56	9.0	60	131	84	590	9.9
NS-1600	01 December 2010	16	8.0	555	758	53	22	52	4.8	9.0	93	87	162	16
NS-100	26 January 2011	17	7.3	511	1441	164	64	55	5.3	37	217	90	502	10
NS-330	26 January 2011	16	7.7	518	1731	215	77	61	5.6	20	229	89	700	9.9
NS-420	26 January 2011	16	7.8	517	1732	215	74	59	6.0	19	212	100	656	9.9
NS-590	26 January 2011	15	7.9	519	1680	202	72	61	5.7	13	198	79	668	9.7
NS-1200	26 January 2011	11	7.8	548	973	86	35	55	3.7	7.0	119	87	260	15
NS-1600	26 January 2011	12	7.9	585	880	76	30	52	3.6	6.0	126	75	213	17
NS-100 (h 10:50)	02 February 2011	16	7.0	542	1322	130	48	53	5.4	52	164	80	474	9.9
NS-100 (h 13:30)	02 February 2011	16	7.1	609	1326	132	49	54	5.0	53	153	80	486	10
NS-330 (h 11:00)	02 February 2011	16	7.3	516	1480	180	64	59	5.7	37	183	93	600	9.7
NS-330 (h 13:42)	02 February 2011	16	7.5	515	1527	190	66	60	5.5	37	178	96	581	9.8
NS-590 (h 11:05)	02 February 2011	15	7.4	518	1430	170	60	58	5.4	38	152	90	580	9.8
NS-590 (h 13:56)	02 February 2011	16	7.4	533	1400	168	59	58	5.3	37	151	90	570	9.9
NS-100	11 February 2011	17	7.3	519	1857	156	61	54	5.1	34	212	90	510	9.2
NS-330	11 February 2011	17	7.8	513	2190	210	75	60	5.5	22	222	94	640	9.7

Table 4
Mn, Cd, Ni, Cu and Pb in the Rio Naracauli waters, continues.

Sample	Date	Mn	Cd	Ni	Cu	Pb
		μg/l				
NS-100	18 March 2009	1160	345	130	5.1	76
NS-170	18 March 2009	1160	342	127	4.6	51
NS-330	18 March 2009	750	223	131	3.6	32
NS-420	18 March 2009	720	220	108	2.2	18
NS-590	18 March 2009	700	210	110	1.6	7.6
NS-630	18 March 2009	220	98	43	2.2	8.7
NS-1200	18 March 2009	173	103	34	3.4	15
NS-1600	18 March 2009	170	74	28	1.6	8.3
NS-100	25 March 2009	1242	318	150	5.0	59
NS-170	25 March 2009	1230	307	124	2.9	28
NS-330	25 March 2009	757	204	122	4.4	31
NS-420	25 March 2009	752	202	127	3.3	19
NS-590	25 March 2009	750	192	94	2.2	6.3
NS-100	17 April 2009	920	395	127	20	47
NS-170	17 April 2009	890	390	110	22	80
NS-330	17 April 2009	660	307	112	5.1	59
NS-420	17 April 2009	670	372	112	2.3	37
NS-590	17 April 2009	550	367	101	1.4	25
NS-1200	17 April 2009	152	131	44	4.6	28
NS-100	07 May 2009	1038	277	130	4.0	38
NS-170	07 May 2009	1071	258	122	2.6	25
NS-330	07 May 2009	627	199	105	2.3	29
NS-420	07 May 2009	558	189	101	<2.3	17
NS-590	07 May 2009	542	204	89	<2.3	13
NS-1200	07 May 2009	135	121	34	<2.3	29
NS-100	21 May 2009	1130	243	129	4.2	40
NS-170	21 May 2009	1180	230	114	2.8	21
NS-330	21 May 2009	580	163	100	<2.3	22
NS-420	21 May 2009	533	153	92	<2.3	12
NS-590	21 May 2009	469	153	73	<2.3	8.9
NS-100	27 May 2009	1040	242	124	5.2	54
NS-170	27 May 2009	1120	229	112	<2.3	25
NS-330	27 May 2009	374	155	99	2.4	31
NS-420	27 May 2009	514	145	91	<2.3	17
NS-590	27 May 2009	449	139	71	<2.3	12
NS-100	03 June 2009	1000	311	113	4.7	81
NS-170	03 June 2009	1080	296	106	2.5	41
NS-330	03 June 2009	583	192	96	2.4	34
NS-420	03 June 2009	522	176	89	<2.3	19
NS-590	03 June 2009	498	160	66	<2.3	11

Table 5
Mn, Cd, Ni, Cu and Pb in the Rio Naracauli waters, continues.

Sample	Date	Mn	Cd	Ni	Cu	Pb
		μg/l				
NS-100	10 June 2009	1200	246	126	4.2	71
NS-170	10 June 2009	1270	233	110	2.7	26
NS-330	10 June 2009	560	156	98	2.54	29
NS-420	10 June 2009	495	144	92	<2.3	21
NS-590	10 June 2009	446	127	65	<2.3	6.9
NS-100	17 June 2009	1213	246	122	4.1	70
NS-170	17 June 2009	1260	224	108	<2.3	23
NS-330	17 June 2009	451	137	99	<2.3	27
NS-420	17 June 2009	409	130	90	<2.3	11
NS-590	17 June 2009	367	118	62	<2.3	6.5
NS-100	25 June 2009	1124	281	121	3.7	70
NS-170	25 June 2009	1025	260	105	1.6	15
NS-330	25 June 2009	285	134	102	2.1	13
NS-420	25 June 2009	271	127	94	9.6	6.4
NS-590	25 June 2009	258	125	71	1.7	4.2
NS-100	08 July 2009	666	365	83	5.9	122
NS-170	08 July 2009	583	350	78	2.5	39
NS-330	08 July 2009	235	162	94	3.0	3.0
NS-420	08 July 2009	206	154	84	1.7	8.9
NS-590	08 July 2009	180	150	62	1.6	5.5
NS-100	15 July 2009	607	350	75	5.4	116
NS-170	15 July 2009	540	342	71	2.6	44
NS-330	15 July 2009	213	152	91	2.5	22
NS-420	15 July 2009	190	148	81	1.7	10
NS-590	15 July 2009	160	136	59	1.4	6.0
NS-100	29 July 2009	620	289	70	3.9	99
NS-170	29 July 2009	563	264	63	1.5	16
NS-330	29 July 2009	173	102	86	2.4	18
NS-420	29 July 2009	141	99	77	1.8	8.5
NS-590	29 July 2009	118	92	53	1.3	7.7
NS-330	19 August 2009	220	152	88	<3.5	18
NS-420	19 August 2009	93	149	82	<3.5	7.8
NS-590	19 August 2009	92	140	58	<3.5	7.7
NS-100	19 October 2009	113	456	52	5.5	150
NS-170	19 October 2009	106	398	45	3.5	82
NS-420	19 October 2009	326	213	88	<3.5	18
NS-590	19 October 2009	287	173	72	<3.5	6.4
NS-1200	19 October 2009	12	130	24	3.8	61
NS-100	11 November 2009	81	1215	80	20	278
NS-420	11 November 2009	290	700	96	6.5	82
NS-100	28 November 2009	283	674	62	5.7	137
NS-420	28 November 2009	430	183	90	<3.5	16
NS-590	28 November 2009	352	163	70	<3.5	6.7

Table 6
Mn, Cd, Ni, Cu and Pb in the Rio Naracauli waters.

Sample	Date	Mn	Cd	Ni	Cu	Pb
		µg/l				
NS-100	17 March 2010	1459	290	132	5	55
NS-420	17 March 2010	580	187	99	2.3	17
NS-590	17 March 2010	534	184	92	1.8	11
NS-100	21 April 2010	1470	266	122	3.6	53
NS-170	21 April 2010	1407	247	114	1.7	15
NS-330	21 April 2010	423	144	100	3.2	23
NS-420	21 April 2010	345	140	88	1.9	11
NS-590	21 April 2010	302	119	65	1.3	3.5
NS-1200	21 April 2010	55	76	24	2.2	14
NS-100	30 June 2010	471	609	79	5	74
NS-170	30 June 2010	439	584	82	<3	15
NS-330	30 June 2010	242	117	85	3.6	23
NS-420	30 June 2010	165	108	71	<3	7.3
NS-590	30 June 2010	112	83	46	<3	6.3
NS-1200	30 June 2010	31	162	33	<3	25
NS-100	29 October 2010	5.1	645	69	3.8	134
NS-170	29 October 2010	8.8	637	69	2.2	47
NS-420	29 October 2010	390	119	95	3.7	15
NS-590	29 October 2010	300	109	55	1.1	12
NS-1200	29 October 2010	19	84	18	2.7	34
NS-1600	29 October 2010	55	49	13	1.2	3.6
NS-100	01 December 2010	840	870	114	10	144
NS-420	01 December 2010	640	700	110	5.9	67
NS-590	01 December 2010	430	690	99	2.7	32
NS-1600	01 December 2010	58	95	18	3.5	20
NS-100	26 January 2011	1400	320	120	4.2	26
NS-330	26 January 2011	770	210	100	2.8	24
NS-420	26 January 2011	720	210	90	2.0	19
NS-590	26 January 2011	500	210	90	1.7	20
NS-1200	26 January 2011	130	87	33	2.7	24
NS-1600	26 January 2011	96	66	26	2.2	21
NS-100 (h 10:50)	02 February 2011	810	510	100	7.8	53
NS-100 (h 13:30)	02 February 2011	820	520	100	12	57
NS-330 (h 11:00)	02 February 2011	580	360	113	5.6	49
NS-330 (h 13:42)	02 February 2011	570	360	107	5.3	44
NS-590 (h 11:05)	02 February 2011	470	420	90	2.9	31
NS-590 (h 13:56)	02 February 2011	470	430	90	2.8	27
NS-100	11 February 2011	1300	260	110	4.2	20
NS-330	11 February 2011	750	200	122	3.0	26

Table 7
Temperature, pH, redox potentials (Eh), electrical conductivity (Cond) and major components in the tributary waters.

Sample	Date	T °C	pH	Eh mV	Cond µS/cm	Ca	Mg	Na	K	Zn	HCO_3^-	Cl	SO_4^{2-}	SiO_2
						mg/l								
Rio Pitzinurri (D)	21 April 2010	15	8.3	471	546	28	13	57	3.2	0.3	102	91	37	24
Rio Pitzinurri (D)	29 October 2010	13	7.9	450	702	37	17	71	3.6	2.1	132	124	56	23
Rio Pitzinurri (D)	18 March 2009	13	8.2	440	524	25	12	59	3.3	0.3	96	79	38	21
Rio Pitzinurri (D)	19 October 2009	17	7.3	458	690	44	20	82	3.9	2.7	143	136	71	22

contaminations, and the accuracy and precision of trace element analysis. The limits of detection (LOD) and of quantification (LOQ) were calculated as 3 times and 10 times the standard deviation of the blank measurements, respectively. Rhodium was added as internal standard for ICP-MS analysis to correct for instrumental drift.

Table 8
Mn, Cd, Ni, Cu and Pb in the tributary waters.

Sample	Date	Mn	Cd	Ni	Cu	Pb
		μg/l				
Rio Pitzinurri (D)	21 April 2010	47	2.4	3	0.9	2.1
Rio Pitzinurri (D)	29 October 2010	15	15	4.4	3.3	4.9
Rio Pitzinurri (D)	18 March 2009	26	4.2	1.6	1.3	3.0
Rio Pitzinurri (D)	19 October 2009	41	22	7.8	3.8	2.9

Table 9
Temperature, pH, redox potentials (Eh), electrical conductivity (Cond) and major components in the tailing drainages.

Sample	Date	T °C	pH	Eh mV	Cond μS/cm	Ca	Mg	Na	K	Zn	HCO_3^-	Cl	SO_4^{2-}	SiO_2
						mg/l								
A	18 March 2009	19	6.9	473	2660	148	42	55	6.3	600	21	99	1347	11
A	25 March 2009	12	6.6	547	2760	153	42	55	7.5	630	23	101	1365	12
A	17 April 2009	18	6.5	659	1940	158	40	55	6.1	640	34	87	1568	13
A	07 May 2009	22	6.5	539	2460	160	42	56	6.7	690	22	94	1503	14
A	11 November 2009	14	6.6	452	2680	209	48	59	9.0	704	21	71	1700	8.6
A	01 December 2010	16	6.7	503	2290	161	38	51	9.0	710	31	71	1672	13
A	02 February 2011	13	6.6	591	2280	141	32	50	6.1	699	39	70	1360	12
A	02 February 2011	14	6.9	646	2130	140	32	47	5.9	634	44	70	1368	13
A	11 February 2011	10	6.8	531	3280	170	42	52	6.5	760	26	79	1690	14
B	25 March 2009	16	6.6	508	2600	107	67	70	5.6	530	17	157	1263	12
B	17 April 2009	21	6.4	656	1510	76	49	73	4.2	300	28	138	796	17
B	07 May 2009	25	6.5	516	2100	95	62	75	5.0	463	20	155	1051	12
B	21 May 2009	24	6.2	580	2190	111	71	84	5.7	514	13	172	1171	13
B	27 May 2009	21	6.4	529	2220	117	75	83	5.1	533	13	165	1213	13
B	01 December 2010	18	7.0	606	2350	104	71	55	8.0	540	45	77	1400	13
B	02 February 2011	13	6.6	541	1428	61	40	61	3.6	280	27	106	680	6.5
B	02 February 2011	15	7.0	524	1449	65	41	64	3.4	280	35	106	664	6.5
B	11 February 2011	14	7.0	515	1821	87	53	66	4.2	390	20	116	920	13

Table 10
Mn, Cd, Ni, Cu and Pb in the tailing drainages.

Sample	Date	Mn	Cd	Ni	Cu	Pb
		μg/l				
A	18 March 2009	144	5700	320	19	875
A	25 March 2009	154	5980	273	15	611
A	17 April 2009	1100	5500	287	29	507
A	07 May 2009	101	6130	279	12	970
A	11 November 2009	675	7170	360	112	1010
A	01 December 2010	1115	6500	59	68	600
A	02 February 2011	980	5300	333	87	490
A	02 February 2011	1003	5500	344	83	566
A	11 February 2011	820	5800	350	79	700
B	25 March 2009	2960	5040	128	7.5	87
B	17 April 2009	1570	3000	100	4.2	35
B	07 May 2009	1995	3900	102	4.9	88
B	21 May 2009	2350	4575	112	5.5	134
B	27 May 2009	2320	4660	119	5.3	154
B	01 December 2010	2315	5065	120	11	94
B	02 February 2011	980	2300	72	5.8	43
B	02 February 2011	973	2300	66	6.6	45
B	11 February 2011	1200	3200	95	7.1	64

Table 11
Sulphur, Fe, Zn, Al, Pb, Mn, Cu, As, Cd, Cr, Sb, Co, and Ag concentrations in mine tailings.

Sample	Date	S	Fe	Zn	Al	Pb	Mn	Cu	As	Cd	Cr	Sb	Co	Ag
		g/kg					mg/kg							
MTA - 1	28-Apr-12	12	27	19	2.6	10	1160	880	170	80	60	100	20	20
MTA - 2	28-Apr-12	13	36	19	39.5	17	1800	720	250	130	90	30	40	25
MTA - 3	28-Apr-12	7.1	29	18	7.2	10	1300	710	230	90	60	90	40	20
MTB - 1	28-Apr-12	10	20	22	6.5	1.8	1010	530	140	100	40	40	55	4
MTB - 2	28-Apr-12	8.3	27	25	2.8	2.1	1240	370	100	100	40	50	10	5
MTB - 3	28-Apr-12	8.9	14	27	3.19	0.7	710	370	80	130	40	40	10	4

Table 12
Sulphur, Zn, Pb, Ni, Cd, Fe, Mn, Cu and Co concentrations in the bio-hydrozincites (N34-42) and Fe-hydrozincite + bio-hydrozincite sample (N32).

Sample	Station	Date	S	Zn	Pb	Ni	Cd	Fe	Mn	Cu	Co
			g/kg			mg/kg					
N32	NS170	21 May 2009	1.8	465	5.5	420	510	50500	400	420	50
N34	NS590	27 May 2009	1.8	530	0.9	930	850	630	650	70	70
N36	NS590	03 June 2009	1.8	460	1.5	890	790	2600	610	80	70
N37B	NS420	10 June 2009	1.7	490	1.6	650	600	1700	470	120	50
N39	NS420	15 July 2009	1.6	520	0.9	900	750	130	400	65	41
N41A	NS420	29 July 2009	1.4	510	1.1	830	620	260	310	80	30
N42	NS420	29 July 2009	1.7	540	0.9	1000	720	180	360	60	40

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