

**Appendix 1.** Anomalously high element concentrations and specific isotopic compositions associated by source. Peak values are shown in brackets. See Figure 2 for the sampling site number location. (\*T): Tributary of a main river or stream in the area. Source is from geological maps (SERNAGEOMIN, AAPlc exploration and mining geological maps) and field observation during sampling for all sites of the river stream float and basin talus. For the agricultural areas, N isotopes have been used to identify the source as fertiliser, sewage and mixture of nitrate sources and sulphur isotopes to identify sulphur and sulphate sources.

Sample Site N°	Area ID	pH	TDS mg/l	Anomalous chemistry and isotopic composition	Source
<b>Colorado River, 203 km<sup>2</sup></b>					
1	Colorado River	7.7	334	Cd (0.8 µg/l), Ni (5.6 µg/l), $\delta^{34}\text{S}$ (3.5‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-3.4‰)	Hydrothermal Alteration
2	Blanco River (*T)	5.9	407	Cd (3.3 µg/l), Fe (6 mg/l), Ni (14.5 µg/l), Zn (175 µg/l), $\delta^{34}\text{S}$ (-0.6‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (8.3‰)	Hydrothermal Alteration
3	Colorado River	7.4	355	Cd (1.4 µg/l), Hg (3.4 µg/l), Ni (11 µg/l)	Hydrothermal Alteration
4	Colorado River	7.5	336	Ni (7.3 µg/l), $\delta^{34}\text{S}$ (2.1‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (1.2‰)	Hydrothermal Alteration
<b>Riecillos River, 11 km<sup>2</sup></b>					
5	Agua Mala (*T)	7.2	86	As (65.9 µg/l), Mo (8.1 µg/l), $\delta^{34}\text{S}$ (0.5‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-1‰)	Hydrothermal Alteration
6	Riecillos River	7.7	198	As (11.3 µg/l), $\delta^{34}\text{S}$ (5.9‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (0.5‰)	Hydrothermal Alteration
<b>Arrayán and San Francisco rivers, 55 km<sup>2</sup></b>					
7	Ortiga (*T)	4.8	106	Al (0.3 mg/l), F <sup>-</sup> (480 µg/l), $\delta^{34}\text{S}$ (2.8‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (3‰)	Hydrothermal Alteration
8	Del Rayo (*T)	3.2	206	Al (4 mg/l), F <sup>-</sup> (838 µg/l), Fe (5 mg/l), Ni (21 µg/l), Zn (40 µg/l), $\delta^{34}\text{S}$ (-3.8‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-7.7‰)	Hydrothermal Alteration
9	Ortiga (*T)	3.4	334	Al (6 mg/l), F <sup>-</sup> (380 µg/l), Fe (5 mg/l), Hg (3.1 µg/l), Ni (33 µg/l), Zn (83 µg/l), $\delta^{34}\text{S}$ (-3.8‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-4.5‰)	Hydrothermal Alteration
10	Valle Largo (*T)	4.7	437	Al (5 mg/l), F <sup>-</sup> (504 µg/l), Fe (0.8 mg/l), Ni (28 µg/l), $\text{SO}_4^{2-}$ (357 mg/l), Zn (31 µg/l), $\delta^{34}\text{S}$ (-0.7‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (4.5‰), $\delta^{15}\text{N}$ (2‰), $\delta^{18}\text{O}_{\text{NO}_3}$ (34‰)	Hydrothermal Alteration
11	El Plomo (*T)	6.8	137	Ni (6.5 µg/l), Zn (102 µg/l), $\delta^{34}\text{S}$ (-2‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-4.8‰)	Hydrothermal Alteration
12	Duarte (*T)	8	204	Mo (9.3 µg/l), P (68 µg/l), $\delta^{34}\text{S}$ (4.3‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-2.9‰)	Hydrothermal Alteration
<b>Tupungato and Maipo Volcanoes, 110 km<sup>2</sup></b>					
13	Rabicano (*T)	7.9	595	$\text{SO}_4^{2-}$ (354 mg/l), Zn (71 µg/l)	Hydrothermal Alteration
14	Las Amarillas (*T)	7.9	1076	Ca (294 mg/l), Mg (29 mg/l), Ni (16 µg/l), $\text{SO}_4^{2-}$ (953 mg/l), $\delta^{34}\text{S}$ (0.3‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-4.1‰)	Hydrothermal Alteration
15	Barroso River	7.1	1352	As (17 µg/l), Fe (3043 µg/l), Mg (38 mg/l), Ni (40 µg/l), $\delta^{34}\text{S}$ (10.2‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-2.1‰)	Hydrothermal Alteration
<b>Colorado River, 8 km<sup>2</sup></b>					
16	Torin (*T)	2.8	506	Al (12 mg/l), Cd (1.3 µg/l), Cu (457 µg/l), Fe (8 mg/l), Ni (19 µg/l), Pb (1.4 µg/l), $\text{SO}_4^{2-}$ (368 mg/l), Zn (219 µg/l), $\delta^{34}\text{S}$ (4.3‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-1.8‰)	Cu-mineralized areas
<b>Barriga River, 17 km<sup>2</sup></b>					
17	Barriga River	5.4	905	Al (8 mg/l), Ca (215 mg/l), Cd (0.89 µg/l), Cu, (120 µg/l), F <sup>-</sup> (650 µg/l), Fe (1 mg/l), Hg (1.3 µg/l), Mg (26 mg/l), Ni (59.1 µg/l), $\text{SO}_4^{2-}$ (968 mg/l), Zn (265 µg/l), EC (1136 µS/cm), $\delta^{34}\text{S}$ (-0.2‰), $\delta^{18}\text{O}_{\text{SO}_4}$ (-4.5‰), $\delta^{15}\text{N}$ (0.0‰), $\delta^{18}\text{O}_{\text{NO}_3}$ (34.8‰)	Cu-mineralized areas
<b>San Francisco River, 12 km<sup>2</sup></b>					



38	Maipo River	8.5	854	Ca (152 mg/l), Cl (128 mg/l), K (6 mg/l), Na (79 mg/l), NO <sub>3</sub> <sup>-</sup> (5 mg/l), P (98 µg/l), SO <sub>4</sub> <sup>2-</sup> (401 mg/l), δ <sup>34</sup> S (11‰), δ <sup>18</sup> O <sub>SO4</sub> (10.1‰), δ <sup>15</sup> N (8.8‰), δ <sup>18</sup> O <sub>NO3</sub> (29.9‰)	Agricultural areas
<b>Human settlements, 93 km<sup>2</sup></b>					
39	Colina Stream	8.2	211	As (14.8 µg/l), Pb (4 µg/l)	Human settlements
40	Maipo River	8.0	672	Ca (122 mg/l), Cl (99 mg/l), Na (66 mg/l), Pb (3.5 µg/l), SO <sub>4</sub> <sup>2-</sup> (377 mg/l)	Human settlements, evaporites
41	Manzanito (*T)	7.6	115	Al (0.7 mg/l), Fe (697 µg/l), P (185 µg/l)	Human settlements
<b>Blanco River, 10 km<sup>2</sup></b>					
42	Andina mine	7.7	264	Mo (17 µg/l), δ <sup>34</sup> S (2.3‰), δ <sup>18</sup> O <sub>SO4</sub> (-3.0‰)	Mine area waters
<b>San Francisco River, 24 km<sup>2</sup></b>					
43	Los Bronces mine	7.9	468	Cd (0.89 µg/l), Cl (82 mg/l), Na (51 mg/l), Zn (91.3 µg/l), δ <sup>34</sup> S (2.2‰), δ <sup>18</sup> O <sub>SO4</sub> (-2.4‰), δ <sup>15</sup> N (1.1‰), δ <sup>18</sup> O <sub>NO3</sub> (37.5‰)	Mine area waters
<b>El Gallo Stream, 0.2 km<sup>2</sup></b>					
44	El Soldado mine	8.4	672	Fe (178 µg/l), Mg (34 mg/l), Mo (12 µg/l), SO <sub>4</sub> <sup>2-</sup> (324 mg/l), δ <sup>34</sup> S (3.7‰), δ <sup>18</sup> O <sub>SO4</sub> (0.7‰)	Mine area waters
<b>La Poza Stream, 20 km<sup>2</sup></b>					
45	La Poza and Restauradora mines	7.1	324	HCO <sub>3</sub> <sup>-</sup> (178 mg/l), Pb (1.1 µg/l), Zn (87 µg/l), δ <sup>34</sup> S (-1.1‰), δ <sup>18</sup> O <sub>SO4</sub> (-0.4‰)	Mine area waters