

Table S2: Water chemistry and isotopic data, water sample meta data and mixing model components

Sample ID	Sample description, mixing model end member roles	Sample elevation (m)	River distance (km)	Elevation zone (Fig. 2)	Discharge $m^3 s^{-1}$	Latitude	Longitude	all ion concentrations in $\mu Eq L^{-1}$											ppb				$\mu S L^{-1}$		parts per mil	
								Ca ²⁺	K ⁺	Mg ²⁺	Na ⁺	Cl ⁻	SO ₄ ²⁻	ANC	Si	Cu	Fe	pH	conductivity	D excess	$\delta^{18}O$	δD				
7/17/15	Upstream Putchka	2302	0	Alpine		-9.073493°	-76.938222°	1701.0	18.4	595.4	137.5	63.3	404.8	1991.9	3001.0	0.14	681	7.75	242.1	6.65	-13.87	-104.28				
7/17/15	Putchka tributary	2186	2	Alpine	44	-9.078115°	-76.945142°	1946.5	30.1	796.1	262.7	244.4	1388.6	1481.6	2999.8	0.65	758	7.53	326.4	8.09	-14.67	-109.26				
7/18/15	Downstream Putchka, upstream Yanomayo	1938	39	Alpine	81	-8.895251°	-77.149132°	1739.7	24.5	690.5	188.4	129.0	747.0	1758.8	3098.5	0.38	695	7.75	270.3	7.11	-14.11	-105.79				
7/18/15	Yanomayo tributary	1937	40.5	Alpine	36	-8.902606°	-77.161485°	868.9	18.6	564.4	134.6	47.2	871.9	764.8	2813.1	0.20	330	7.44	169.8	9.65	-14.39	-105.49				
7/20/15	Downstream Yanomayo, Upstream Huaylas	1872	58	Alpine	126	-8.779101°	-77.217443°	1548.3	24.5	678.0	178.5	117.3	806.2	1594.9	3052.7	0.27	601	7.68	424.0	7.79	-14.25	-106.22				
7/20/15	Huaylas tributary	1870	59	Alpine	^b Not calculated	-8.771704°	-77.221419°	2266.5	28.3	1200.1	153.0	23.6	1012.3	2628.1	5202.6	0.10	930	7.79	364.8	7.07	-13.53	-101.20				
7/21/15	Downstream Huaylas, upstream Rupac	1741	101	Alpine	^b Not calculated	-8.511584°	-77.359443°	1748.8	24.4	769.1	284.8	210.6	983.8	1669.9	3175.3	0.31	717	7.78	299.2	7.3	-14.04	-105.03				
7/21/15	Rupac tributary	1750	102	Alpine	15	-8.508563°	-77.366396°	3206.2	48.9	1557.0	404.6	199.9	2367.7	2613.0	4685.6	0.41	1323	7.96	564.9	6.06	-13.18	-99.41				
7/22/15	Downstream Rupac, upstream Actuy	1602	131	Alpine	162	-8.321838°	-77.473847°	1831.4	26.9	833.2	298.7	216.3	1109.9	1797.6	3360.8	0.52	758	7.70	324.8	6.93	-13.91	-104.37				
7/22/15	Actuy tributary	1605	132	Alpine	19	-8.318808°	-77.475659°	3076.0	56.5	1778.6	530.4	487.2	2039.2	2769.7	3890.7	0.35	1300	8.04	586.6	7.36	-13.25	-98.65				
7/23/15	Downstream Actuy, upstream Cajas	1612	138	Alpine	177	-8.275496°	-77.504101°	1956.0	29.0	884.0	316.8	239.7	1227.7	1865.5	3357.4	0.35	818	7.79	342.8	6.89	-13.90	-104.34				
7/23/15	Cajas tributary	1582	138.5	Alpine	21	-8.272440°	-77.505267°	2135.6	22.9	1040.9	323.6	57.6	851.6	2666.4	4480.9	0.32	904	7.83	357.6	7.21	-12.48	-92.61				
7/27/15	Downstream Cajas, upstream San Miguel	1256	200	Alpine	196	-7.885920°	-77.634223°	2009.9	31.5	953.5	340.6	217.6	1221.2	2883.5	3555.2	0.36	839	7.84	350.0	7.02	-13.70	-102.60				
7/27/15	San Miguel tributary	1272	201	Alpine	39	-7.882844°	-77.629097°	2052.9	27.2	650.3	356.5	42.5	1504.6	QNS ^a	4534.1	0.77	849	7.52	325.5	7.95	-12.31	-90.49				
7/30/15	Downstream San Miguel, upstream Chusgon	1093	256.5	Transition	235	-7.485927°	-77.743442°	2114.4	32.9	966.3	349.3	204.2	1353.6	1973.1	3710.5	0.38	869	7.78	364.4	6.98	-13.44	-100.55				
7/30/15	Chusgon tributary	1082	257	Transition	23	-7.479037°	-77.751896°	2575.5	40.5	1352.6	401.1	262.4	1341.9	1861.1	4500.3	0.51	1067	7.99	437.6	7.28	-11.91	-88.13				
8/1/15	Downstream Chusgon, upstream Cresnejas	1047	277	Transition	258	-7.366996°	-77.822635°	2184.6	34.0	985.4	355.9	202.2	1467.9	2033.9	3841.6	0.29	873	7.81	377.6	6.96	-13.25	-99.04				
8/1/15	Cresnejas tributary	1040	278	Transition	18	-7.347826°	-77.833402°	3371.1	82.4	2017.5	710.0	362.4	2497.0	2902.2	6165.0	0.81	1444	8.06	653.1	5.63	-10.98	-82.19				
8/6/15	Downstream Cresnejas, upstream Yangas	761	395	Transition	275	-6.609696°	-78.114522°	2302.1	35.8	1055.6	373.7	214.4	1487.7	2263.9	4016.1	0.37	936	7.94	412.8	6.61	-12.59	-94.12				
8/6/15	Yangas tributary	769	396	Transition	25	-6.603928°	-78.118031°	2721.9	50.0	901.5	655.6	513.2	875.2	3033.2	5812.2	0.55	1147	7.98	452.5	8.89	-10.31	-73.61				
8/8/15	Downstream Yangas, upstream Shuve	710	424	Transition	300	-6.458188°	-78.199172°	2307.0	37.0	1047.5	381.5	214.0	1366.9	2284.0	4149.4	0.35	970	7.72	406.8	6.98	-12.46	-92.73				
8/8/15	Shuve tributary	708	425	Transition	28	-6.455567°	-78.206824°	1109.1	30.5	1265.7	376.4	45.9	534.9	2270.7	7449.9	0.32	464	7.76	273.3	11.64	-8.60	-57.15				
8/11/15	Downstream Shuve, upstream Silaco	537	487	Transition	328	-6.087641°	-78.505627°	2206.6	36.9	1050.5	380.5	211.1	1329.6	2170.1	4439.1	0.31	934	7.91	384.8	7.48	-11.89	-87.63				
8/11/15	Silaco tributary	531	488	Transition	48	-6.087924°	-78.508466°	2923.9	36.7	831.0	339.2	200.0	1316.6	3529.6	4487.3	0.53	1212	7.93	438.0	10.34	-8.80	-60.06				
8/12/15	Downstream Silaco, upstream Chamaya	431	538.5	Jungle	376	-5.798495°	-78.705474°	2266.2	35.8	1011.2	379.4	272.3	1325.2	2265.9	4544.3	0.39	999	7.93	396.4	7.91	-11.40	-83.28				
8/12/15	Chamaya tributary	425	539	Jungle	173	-5.785582°	-78.704206°	1508.5	23.3	308.4	242.5	38.3	345.9	1782.1	6794.2	1.13	746	7.56	203.4	14.34	-7.62	-46.66				
8/13/15	Downstream Chamaya, upstream Chinchipe	364	582	Jungle	549	-5.535121°	-78.563920°	1795.8	30.2	689.2	313.7	157.5	890.5	QNS ^a	5109.7	0.63	760	7.66	293.7	10.67	-9.63	-66.40				
8/13/15	Chinchipe tributary	353	583	Jungle	366	-5.516203°	-78.553260°	525.7	20.5	129.5	108.6	15.9	94.4	686.0	4357.6	0.82	236	7.33	80.0	16.05	-6.16	-33.22				
8/14/15	Downstream Chinchipe at Montenegro	326	618	Jungle	915	-5.311663°	-78.431333°	925.8	23.9	291.3	204.8	73.5	358.2	1067.3	5109.8	0.87	417	7.43	150.6	14.18	-7.41	-45.11				
7/29/15	Not an end member, mainstem downstream Vijus mine waste outlet	1165	225	Alpine		-7.721448°	-77.667828°	1998.7	32.5	940.9	335.0	215.1	1318.3	1942.0	3645.1	0.32	841	7.88	367.6	7.02	-13.47	-100.70				
8/8/15	Not an end member, Magdalena creek, tufa stream	638	437	Transition		-6.389930°	-78.281343°	3289.2	160.3	2540.0	1878.4	1549.0	3626.3	2681.1	5592.6	1.11	1355	7.87	883.0	8.44	-7.82	-54.13				
8/9/15	Not an end member, right bank tributary, Conjun River	540	458	Transition		-6.266168°	-78.369008°	1128.1	19.1	600.0	206.0	28.5	305.1	1659.9	7751.8	0.19	491	7.70	192.8	12.54	-8.44	-54.96				

^aQNS = Sample quantity not sufficient for analysis.

^bNot calculated due to anomalous inputs observed in vicinity of Huaylas tributary