Supplementary Materials

Figure S1 and **S2** show the XRF and XRD analysis of the validation sample applied in the hydrocyclone.

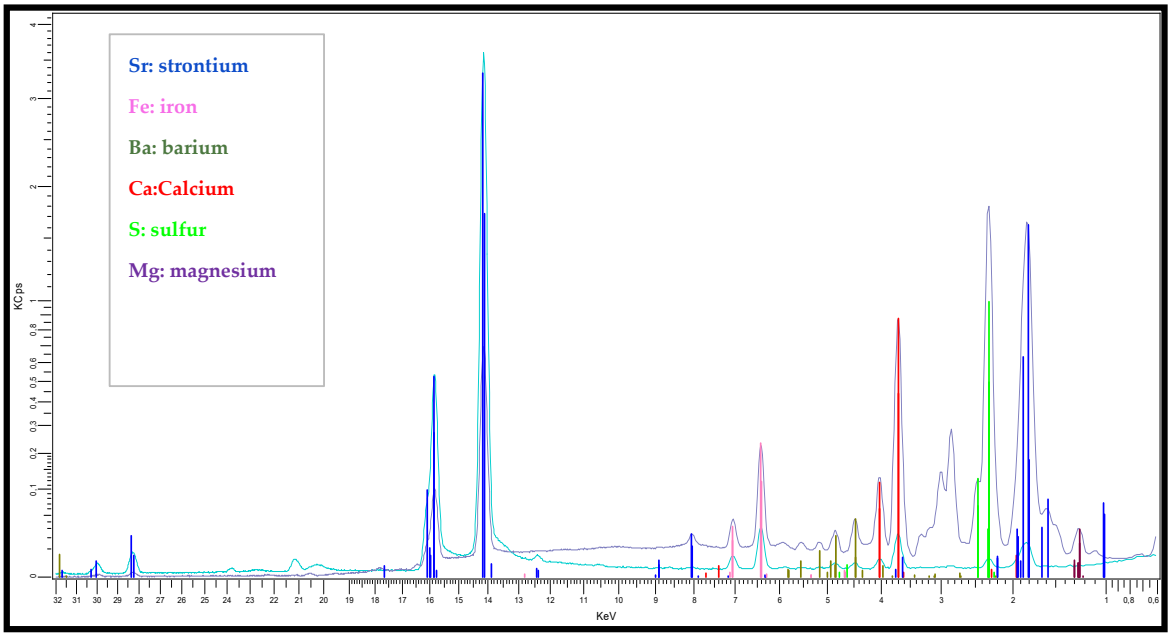

Figure S1. XRF spectra of standard mineral samples.

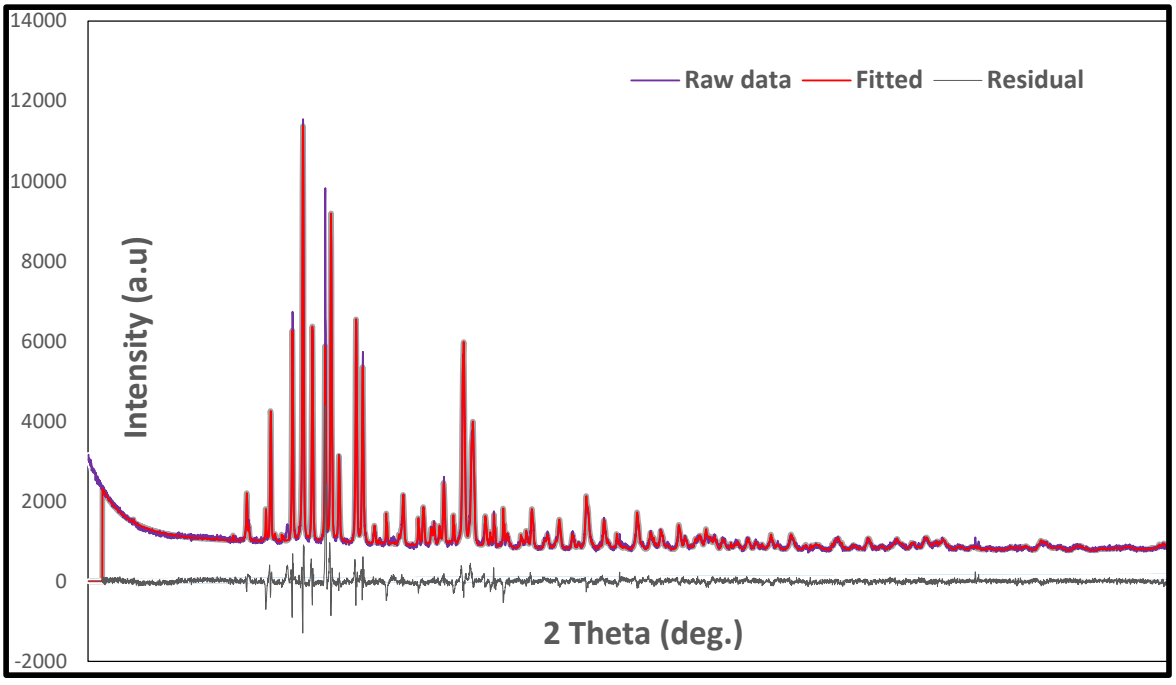

Figure S2. XRD pattern of standard mineral samples analyzed by Rietveld method using Topas software.

Table S1 summarize the main results of the mineral concentration experiments using the hydrocyclone system to test the influence of the following factors: density, inlet pressure and inclination. The chemical

and mineralogical composition of the mineral collected from the under (sink) and over (float) streams determined by XRF ([Sr] and [Ca]) or by XRD analyses ([Celestine] and [Calcite]) are shown. The response surface plot in **Figure 8** was constructed from these data.

Table S1. Test design to validate results in hydrocyclone system.

				UNDER STREAM					OVER STREAM				
	Density (kg/L)	Inclination º	Inlet Pressure (Bar)	[Sr] %	[Celestine] %	[Ca] %	[Calcite] %	Mass %	[Sr]%	[Celestine]%	[Ca] %	[Calcite] %	Mass %
1	2.70	15.00	1.00	55.78	77.23	14.60	10.71	36.80	53.00	74.69	17.88	14.18	63.20
2	2.70	20.00	1.20	55.41	76.33	15.36	11.48	53.54	53.41	74.81	18.18	14.57	46.50
3	2.70	20.00	0.80	55.72	76.14	15.96	10.72	67.80	52.70	74.63	18.16	17.35	32.20
4	2.70	25.00	1.00	55.35	77.07	16.69	11.73	93.50	46.13	53.54	16.30	31.23	6.50
5	2.80	15.00	1.20	62.79	84.24	12.07	9.55	74.48	31.30	51.25	30.05	22.43	25.52
6	2.80	15.00	0.80	59.87	78.02	15.07	8.49	80.00	34.25	64.74	23.01	29.30	20.00
7	2.80	20.00	1.00	61.66	86.55	13.19	9.65	88.79	0.00	0.00	44.16	39.18	11.21
8	2.80	20.00	1.00	62.64	85.70	13.59	9.41	87.41	0.00	0.00	37.99	36.21	12.59
9	2.80	20.00	1.00	62.77	85.32	13.11	10.49	87.23	0.00	0.00	37.99	29.02	12.78
10	2.80	25.00	1.20	59.66	82.89	12.64	8.83	91.78	0.00	0.00	61.58	59.74	8.22
11	2.80	25.00	0.80	57.35	68.58	13.26	9.84	95,47	0.00	0.00	88.25	63.02	4.53
12	2.90	15.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	2.90	20.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	2.90	20.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	2.90	25.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure S3 shows the influence of changing the following experimental factors: density, inlet pressure and inclination of the hydrocyclone on [Sr] (elemental concentration of Sr in the under sample measured by XRF) and [Celestine] (concentration of celestine in the under stream measured by XRD). Density has the greatest effect on the concentration of celestine whereas inclination and inlet pressure have little or no effect.

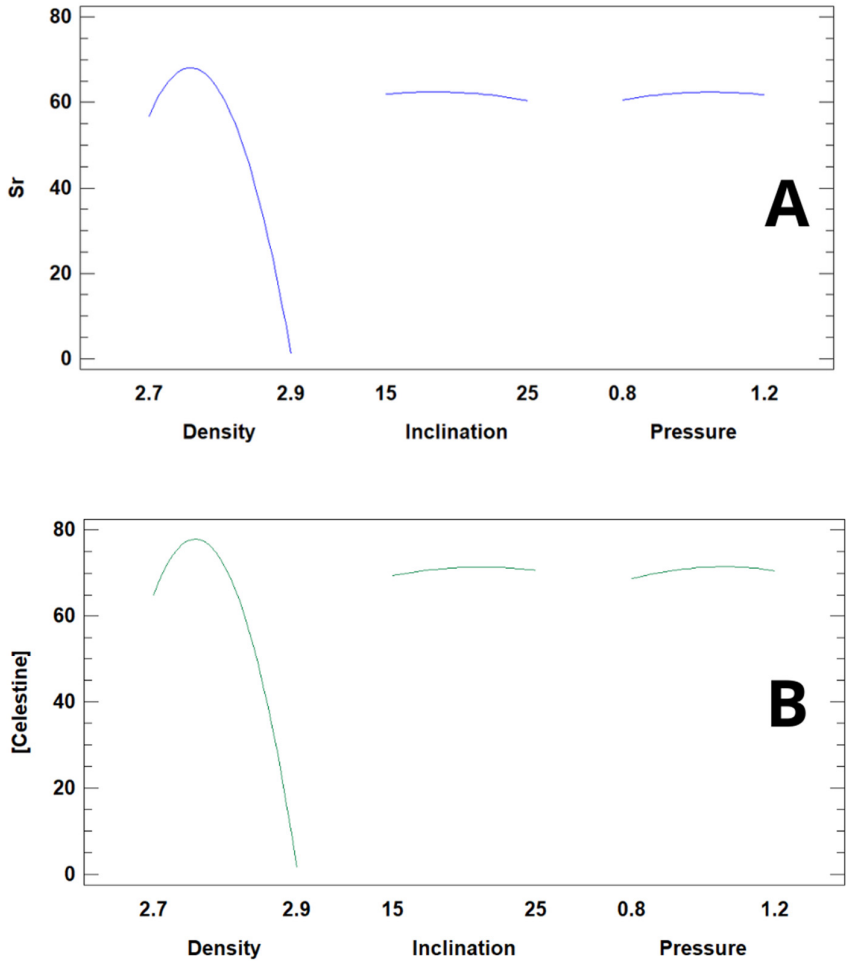

Figure S3. Curve response of Sr/Celestine as density, inclination or pressure changes A) Sr concentration determined by XRF B) celestine concentration determined by DRX.

Table S2 summarizes the main results of the density tests carried out by applying a mixture of water and ferrosilicon at different concentration to the hydrocyclone. The density in the tank (Dtank) and over (Dvortex) and under (Dapex) the hydrocyclone was measured for each case. From the estimation of the average density in the hydrocyclone ($D_{hydrocyclone}$), the average of the densities between the vortex and the apex was taken.

Table S2. Density inside hydrocyclone tests.

	Dtank (kg/L)	Dvortex (kg/L)	Dapex (kg/L)	$D_{hydrocyclone}$(Dvortex +Dapex)/2; (kg/L)
Test 1	1.54	1.10	3.30	2.20
Test 2	1.60	1.04	3.45	2.24
Test 3	1.76	1.10	4.03	2.56
Test 4	1.92	1.16	4.10	2.63
Test 5	2.08	1.66	3.97	2.82