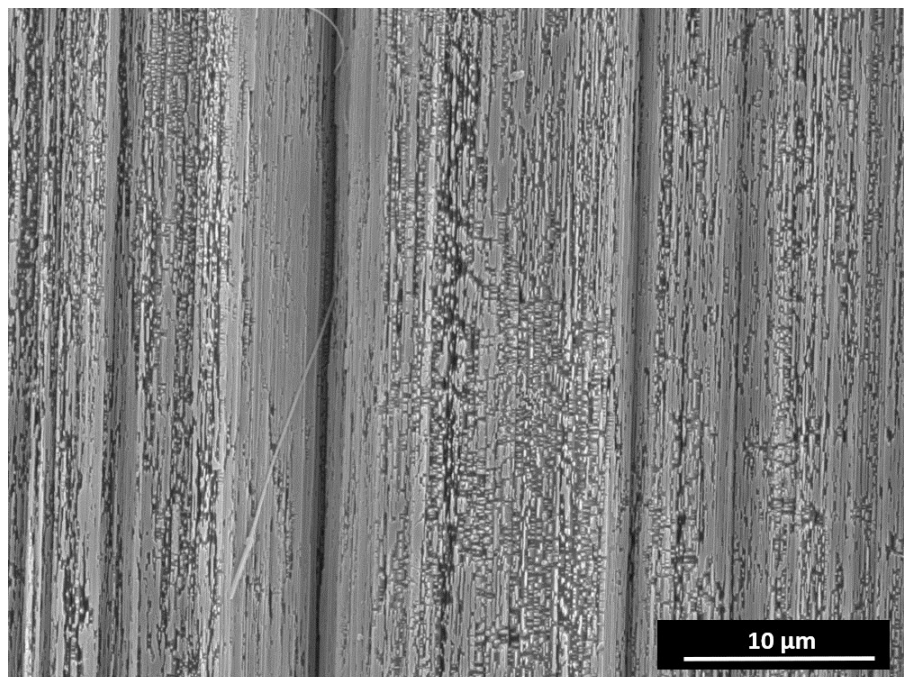
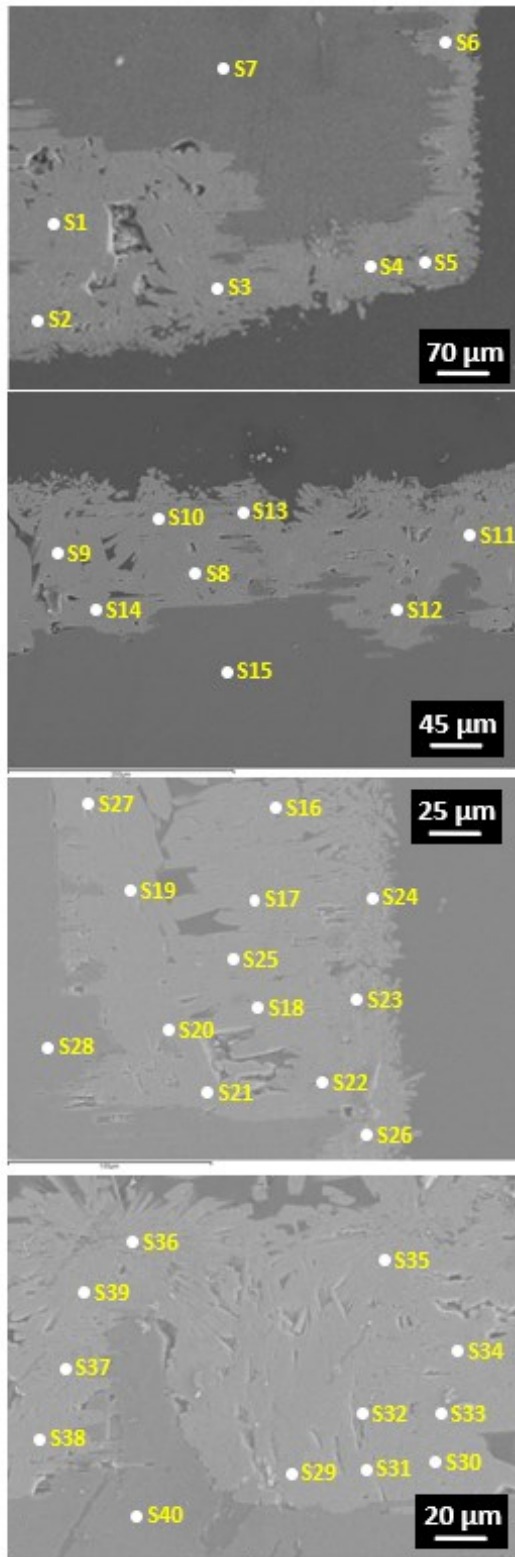


### ***Supplementary Material:***



**Figure S1.** (a) SEM image of an anhydrite (001) cleavage surface after 2 hours interaction with a Sr-bearing aqueous solution [ $Sr = 0.1 \text{ g/L}$ ]. The nucleation of a secondary phase is not observed regardless the interaction time when the initial concentration of Sr in the aqueous solution is  $0.1 \text{ g/L}$ .



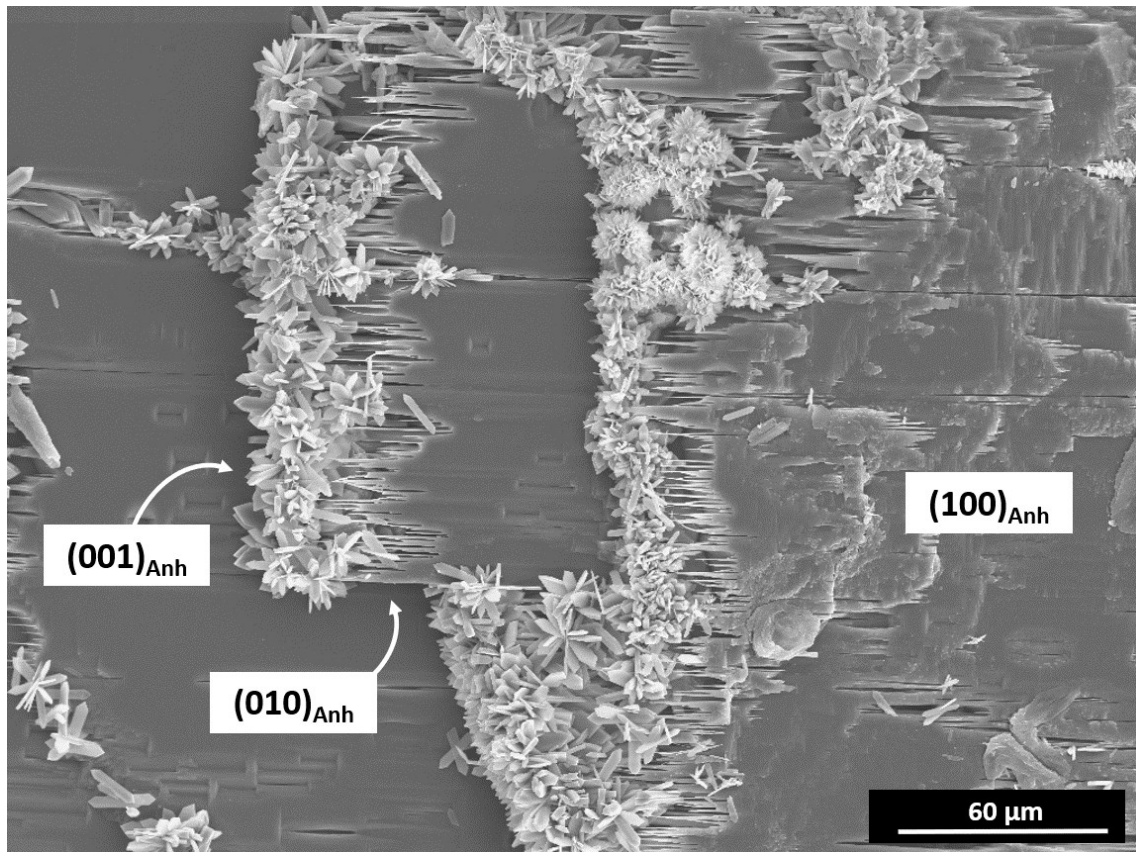
Spectrum	In stats.	S	Ca	Sr	O	Total
Spectrum 1	Yes	16.51	0.02	49.67	33.80	100.00
Spectrum 2	Yes	16.31	0.13	49.97	33.59	100.00
Spectrum 3	Yes	16.90	0.17	48.68	34.26	100.00
Spectrum 4	Yes	17.41	0.22	47.53	34.83	100.00
Spectrum 5	Yes	16.24	0.36	49.84	33.56	100.00
Spectrum 6	Yes	16.30	1.27	48.65	33.79	100.00
Spectrum 7	Yes	23.50	29.32	0.26	46.92	100.00

Spectrum	In stats.	S	Ca	Sr	O	Total
Spectrum 8	Yes	16.01	0.64	50.00	33.35	100.00
Spectrum 9	Yes	16.63	0.17	49.24	33.96	100.00
Spectrum 10	Yes	15.79	0.08	51.13	33.00	100.00
Spectrum 11	Yes	16.20	0.10	50.25	33.46	100.00
Spectrum 12	Yes	16.66	0.29	49.05	34.01	100.00
Spectrum 13	Yes	16.64	0.04	49.39	33.94	100.00
Spectrum 14	Yes	15.96	0.38	50.41	33.25	100.00
Spectrum 15	Yes	23.82	28.81	0.19	47.18	100.00

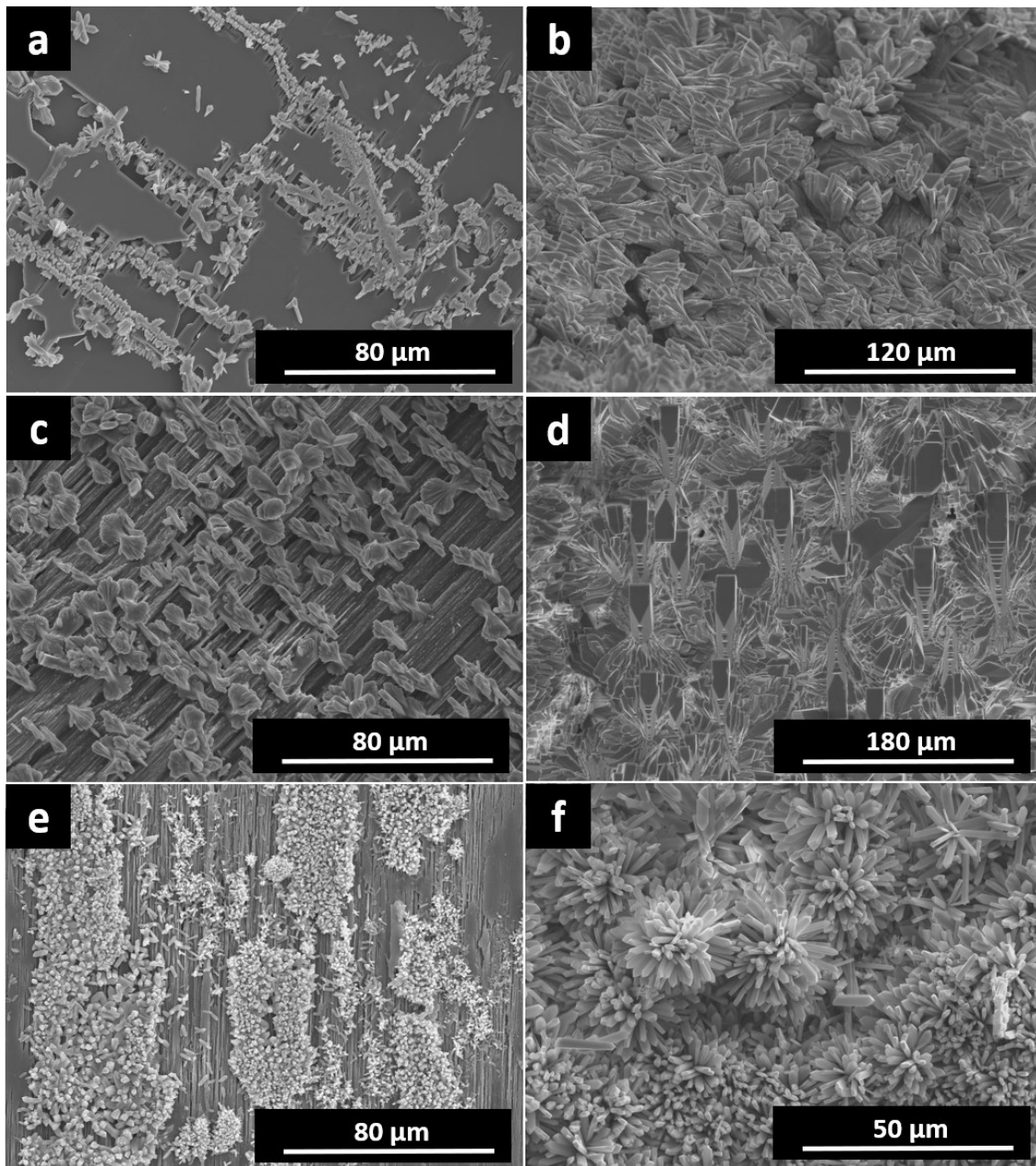
Spectrum	In stats.	S	Ca	Sr	O	Total
Spectrum 16	Yes	15.81	0.20	50.94	33.05	100.00
Spectrum 17	Yes	16.42	0.11	49.76	33.71	100.00
Spectrum 18	Yes	16.04	0.30	50.35	33.32	100.00
Spectrum 19	Yes	16.33	0.06	50.01	33.60	100.00
Spectrum 20	Yes	15.79	0.15	51.05	33.01	100.00
Spectrum 21	Yes	15.84	0.15	50.93	33.08	100.00
Spectrum 22	Yes	15.51	3.84	47.26	33.38	100.00
Spectrum 23	Yes	16.89	2.00	46.54	34.58	100.00
Spectrum 24	Yes	15.77	1.18	49.86	33.19	100.00
Spectrum 25	Yes	15.62	0.21	51.33	32.84	100.00
Spectrum 26	Yes	16.75	0.22	48.95	34.09	100.00
Spectrum 27	Yes	16.26	0.17	50.02	33.54	100.00
Spectrum 28	Yes	23.62	29.41	-0.11	47.08	100.00

Spectrum	In stats.	S	Ca	Sr	O	Total
Spectrum 29	Yes	15.60	0.27	51.30	32.83	100.00
Spectrum 30	Yes	15.82	0.58	50.47	33.13	100.00
Spectrum 31	Yes	16.68	0.27	49.01	34.03	100.00
Spectrum 32	Yes	16.72	0.43	48.75	34.10	100.00
Spectrum 33	Yes	16.06	0.67	49.86	33.41	100.00
Spectrum 34	Yes	16.12	0.18	50.32	33.39	100.00
Spectrum 35	Yes	15.49	0.20	51.61	32.70	100.00
Spectrum 36	Yes	15.71	0.42	50.89	32.98	100.00
Spectrum 37	Yes	15.85	0.38	50.63	33.13	100.00
Spectrum 38	Yes	16.22	0.04	50.27	33.47	100.00
Spectrum 39	Yes	16.29	0.37	49.74	33.61	100.00
Spectrum 40	Yes	23.77	28.57	0.57	47.09	100.00

**Figure S2.** BSE images of an anhydrite crystal cross-cut along (100) after 7 days interaction with a Sr-bearing aqueous solution ( $[Sr]_{aq} = 50$  g/L). The darker phase corresponds to the original anhydrite substrate, while the brighter one corresponds to the celestine rim. 40 EDS analyzes performed on this polished sample show that the secondary celestine incorporates small amounts of calcium in amounts ranging from 0.02 wt.% to 3.84 wt. %.



**Figure S3.** SEM image of an anhydrite (100) cleavage surface after 1 hour interaction with a Sr-bearing aqueous solution [ $Sr = 10 \text{ g/L}$ ]. The orientation of the anhydrite substrate plays a relevant role in the speed at which the original anhydrite surfaces become carpeted by celestine crystals. Thus, for solutions with the same Sr concentration, (001) surfaces are covered by celestine crystals more quickly than (100) and (010) surfaces.



**Figure S4.** SEM micrographs showing anhydrite main cleavage surfaces of anhydrite (a,b) (100), (c,d) (001) and (e,f) (010) after 2 hours (a,c,e) and 5 days (b,d,f) interaction with an aqueous solution bearing  $[Sr] = 50 \text{ g/L}$ .