**Supplementary figures:**

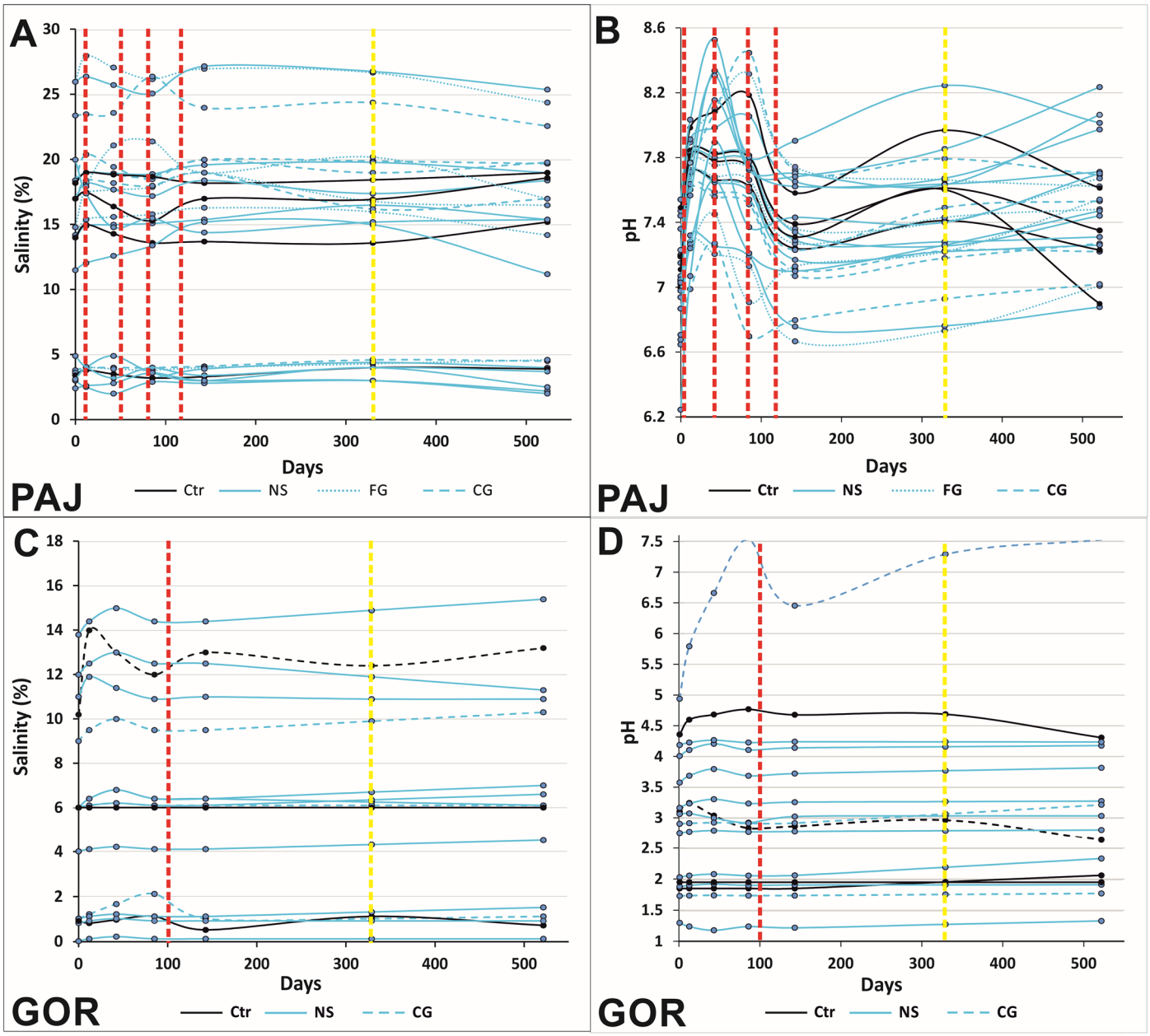


Fig S1: Physicochemistry of Salar de Pajonales **(A, B)** and Salar de Gorbea incubations **(C, D)**. Salinity **(A, C)** and pH **(B, D)** of controls (Ctr) and microbial mat samples with and without substrates (NS) during >500 days. The substrates used were fine gypsum (FG), and coarse gypsum (CG). Dashed red lines delimitate stabilization*, and stabilized water column for mat incubations**. Different pH and salinity scales were used for PAJ and GOR to show fluctuations.

**Incubation stabilization: A period on which salinity of the water column has slightly fluctuated and pH has heavily fluctuated after running incubations and controls. For salinity, there were greater changes in mat samples than in controls, attributing that to microorganism's adaptations to the lab. Slight salinity changes in the controls and pH changes in both controls and mat incubations can be attributed to very slight evaporation, undetected stratified water column in the incubations, or humidity, temperature (T) and pressure (P) changes in the microcosm chamber. Refractive index of brine is a relatively strong function of T and P, so seasonal changes in T or P may slightly change refractometer readings even if refractometer has an automatic temperature compensation system. pH can also change due to T and P changes.*

***Stabilized incubations: A period on which salinity and pH changes of the water column are minor, reflecting no great changes in the mass exchange balance between the microbes and the water column as a function of the interactions nor in the microbial functions of the whole mat. Microbial mats remain active as a community.*

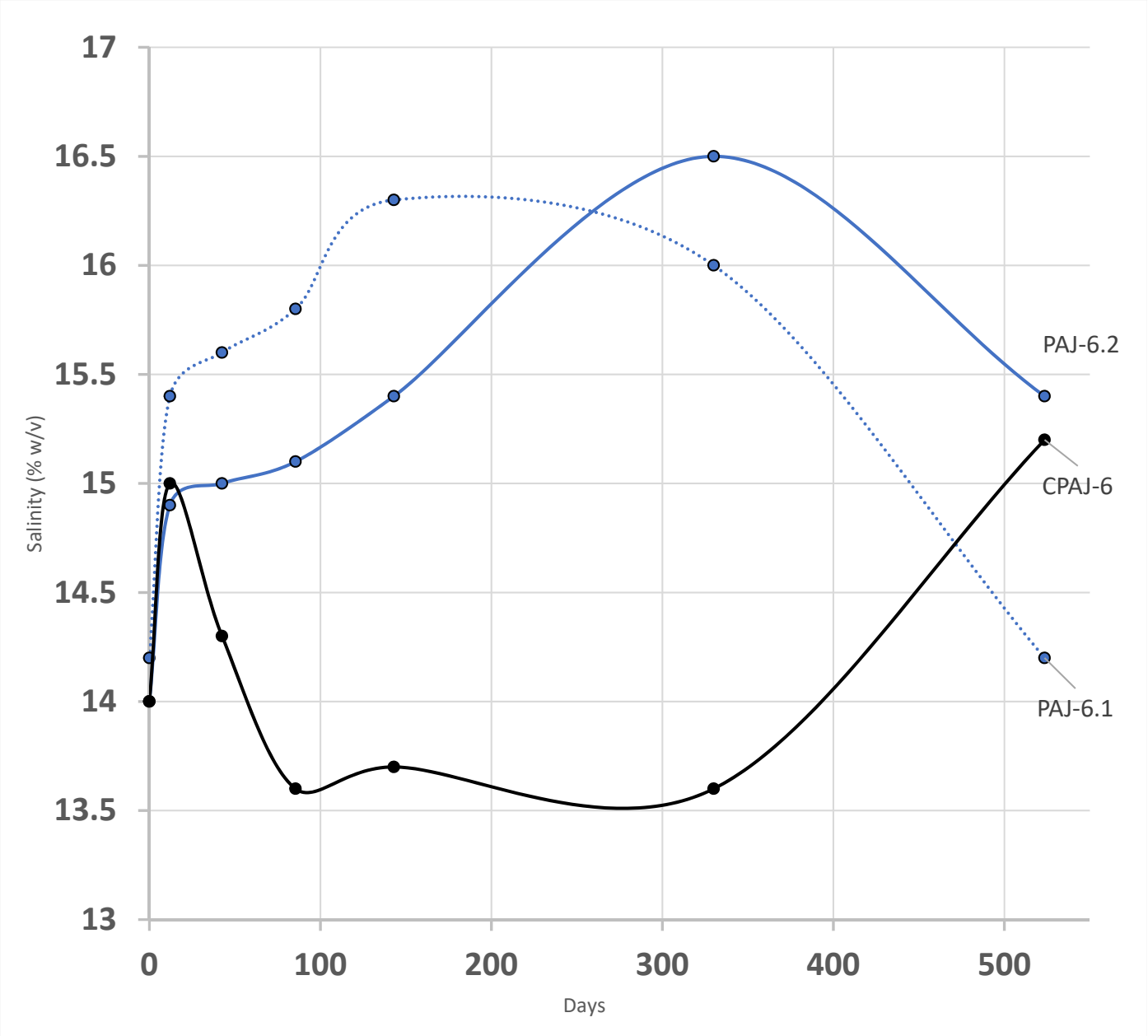


Fig S2: Water column fluctuations of salinity measurements in Salar de Pajonales incubations corresponding to PAJ-6.1 (fine gypsum substrate), PAJ 6.2 (no substrate), and CPAJ-6 (control). Salinity increased for both microbial mats samples PAJ-6.1 and PAJ-6.2 until 140 and 340 days, respectively. In the control experiment, in contrast, it increased up to day 12$^{th}$, then decreased up to day 85$^{th}$, and then, it was stable for over 300 days. No precipitates were detected in any of the incubations with microbial mats neither in water-only control.

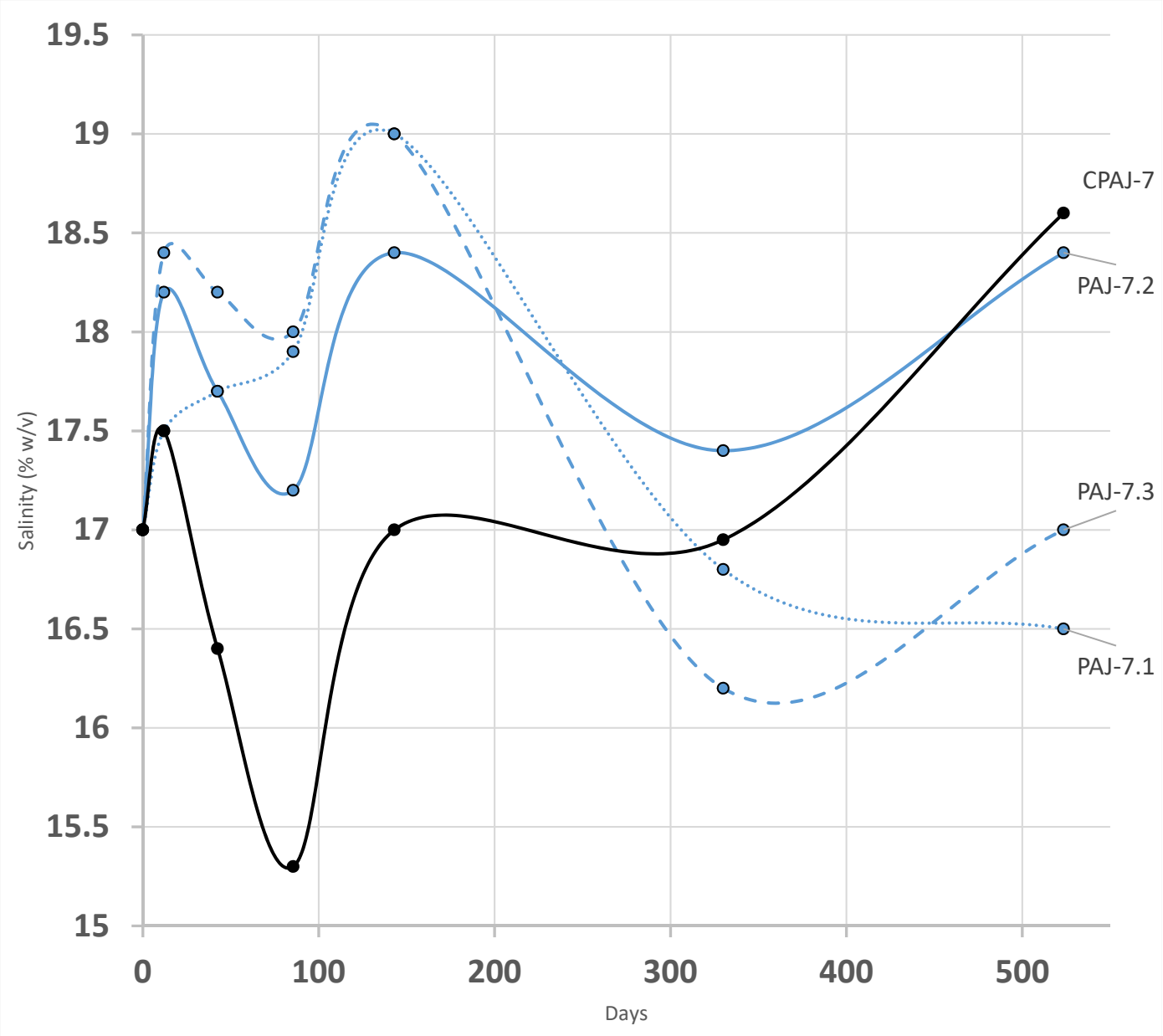


Fig S3: Water column fluctuations of salinity measurements in Salar de Pajonales incubations corresponding to PAJ-7.1 (fine gypsum substrate), PAJ-7.2 (no substrate), PAJ-7.3 (coarse gypsum substrate) and CPAJ-7 (water-only control). Salinity decreased within the first 100 days in PAJ-7.2 and PAJ-7.3 incubations coinciding with gypsum precipitation within the microbial mat of PAJ-7.3. Water-only control showed a similar pattern variation although it did not show precipitates. Fine gypsum substrate incubation also showed gypsum precipitates while salinity increased up to 143 days, and then decreased. Maximum salinity of PAJ-7.1 and PAJ-7.3 (both with substrates) is higher than PAJ-7.2 (no substrate) reflecting that substrate may have dissolved.

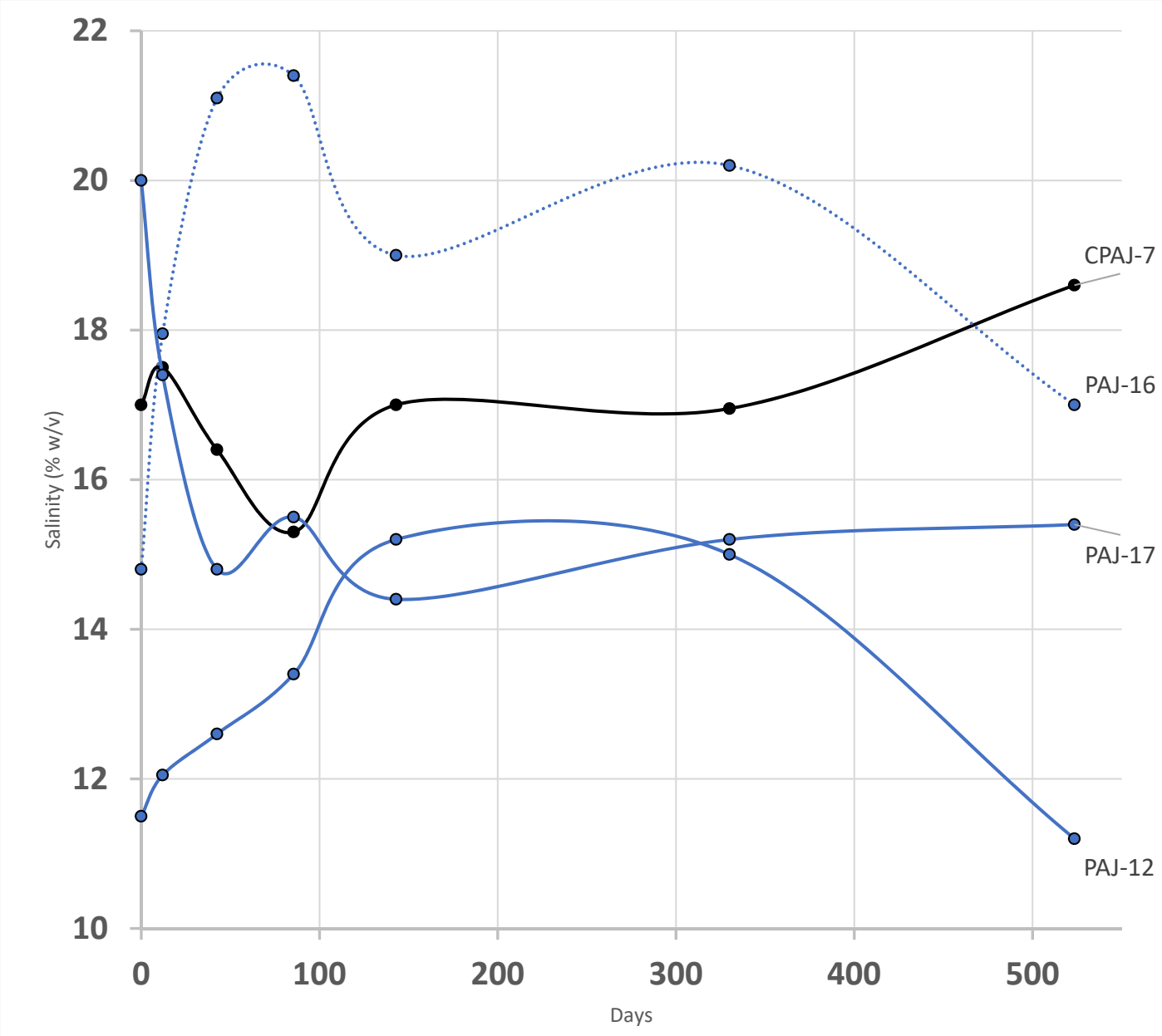


Fig S4: Water column fluctuations of salinity measurements in Salar de Pajonales incubations corresponding to PAJ-16 (fine gypsum substrate), PAJ 12 and PAJ-17 (no substrate), and CPAJ-7 (control). Salinity increased first 85 days in PAJ-16 incubation, then decreased to 143 days without showing precipitates. PAJ-12 salinity increased first 143 days and showed gypsum precipitates. In contrast, PAJ-17 showed a salinity decrease within first 42 days, after that, salinity was slightly fluctuating between 14.4 to 15.5% w/v, and this incubation showed gypsum and halite precipitates at 60 days.

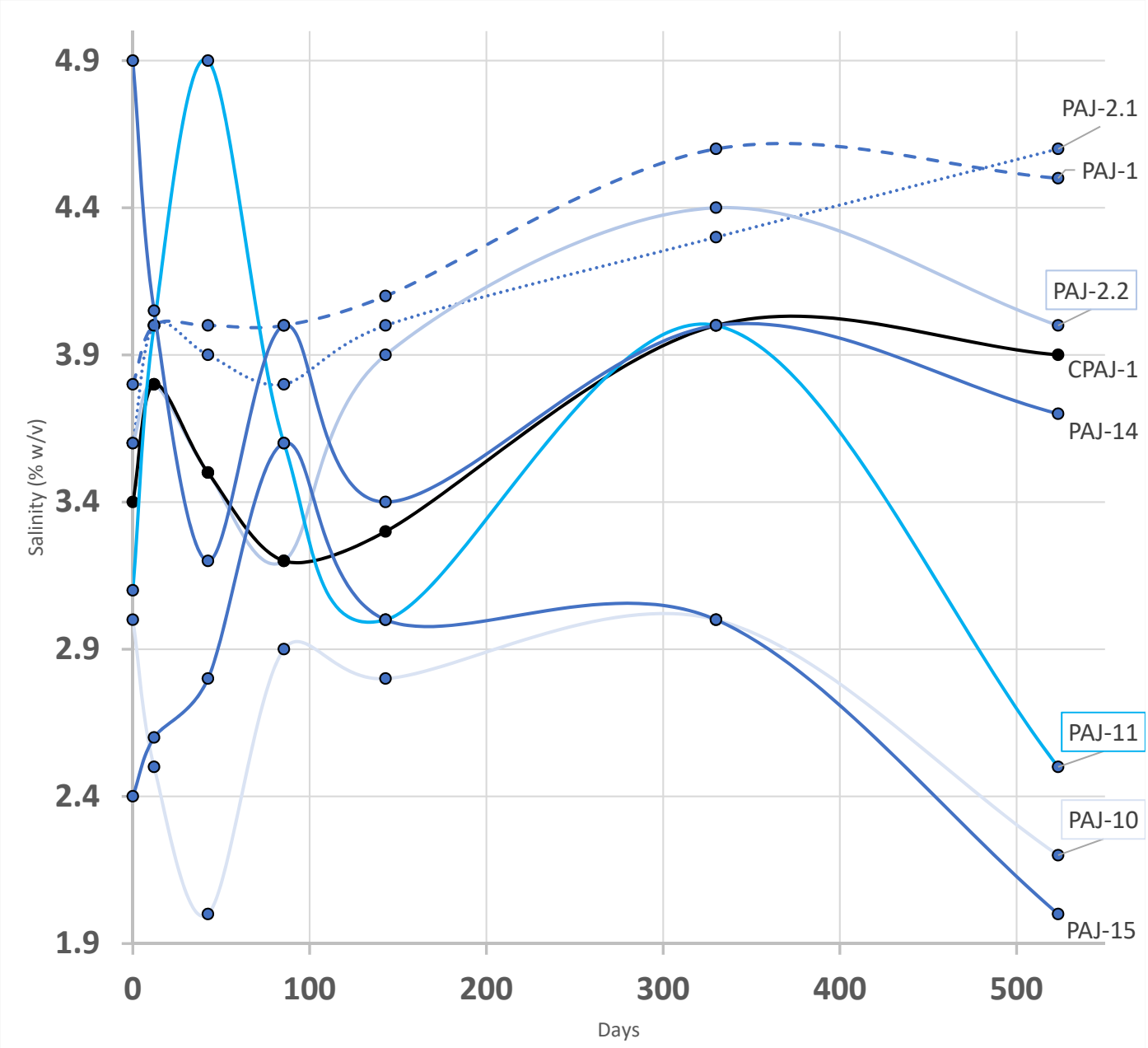


Fig S5: Water column fluctuations of salinity measurements in Salar de Pajonales incubations corresponding to PAJ-2.1 (fine gypsum substrate), PAJ-2.2, PAJ-10, PAJ-11, PAJ-14, PAJ-15, (no substrate), PAJ-1 (coarse gypsum substrate) and CPAJ-1 (control). PAJ-1 incubation precipitated gypsum while salinity slightly increased from 3.8 to 4.1 % w/v within the first 143 days. PAJ-2.1 incubation precipitated gypsum and silicates while its salinity slightly fluctuated between 3.6 to 4 % w/v within the first 143 days. PAJ-10 incubation decreased salinity its first 43 days then stabilized and precipitated calcite. PAJ-11 incubation increased salinity its first 43 days then decreased to starting value and precipitated gypsum. PAJ-14 decreased salinity and then increased slightly and precipitated calcite and silicates. PAJ-15 incubation increased salinity up to 85 days and then decreased and precipitated gypsum. No mineral precipitates were identified in PAJ-2.2 incubation and CPAJ-1 control despite similar or greater changes in salinity were observed.

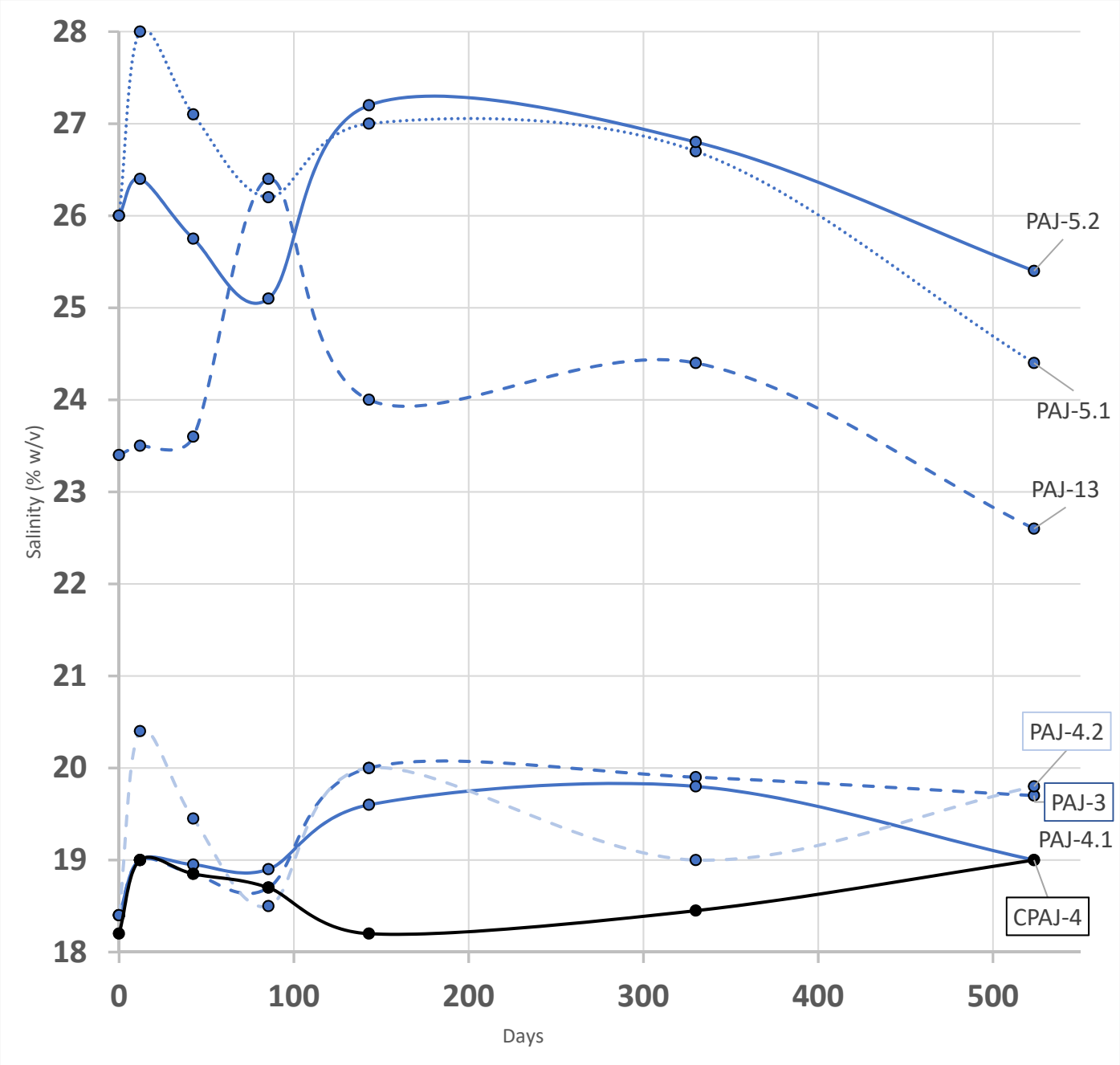


Fig S6: Water column fluctuations of salinity measurements in Salar de Pajonales incubations corresponding to PAJ-5.1 (fine gypsum substrate), PAJ-4.1 and PAJ-5.2 (no substrate), PAJ-3, PAJ-4.2, PAJ-13 (coarse gypsum substrate) and CPAJ-4 (control). Salinity in PAJ-3 incubation increased slightly up to 12 days, then it showed gypsum precipitates at 60 days while salinity slightly decreased up to 85 days, and then, increased. No precipitates were observed within mats of PAJ-5.1 and PAJ-5.2 incubations despite their high salinity and different substrates, neither in PAJ-4.1, PAJ-4.2 and PAJ-13 incubations. CPAJ-4 control with just water did not show precipitates either.

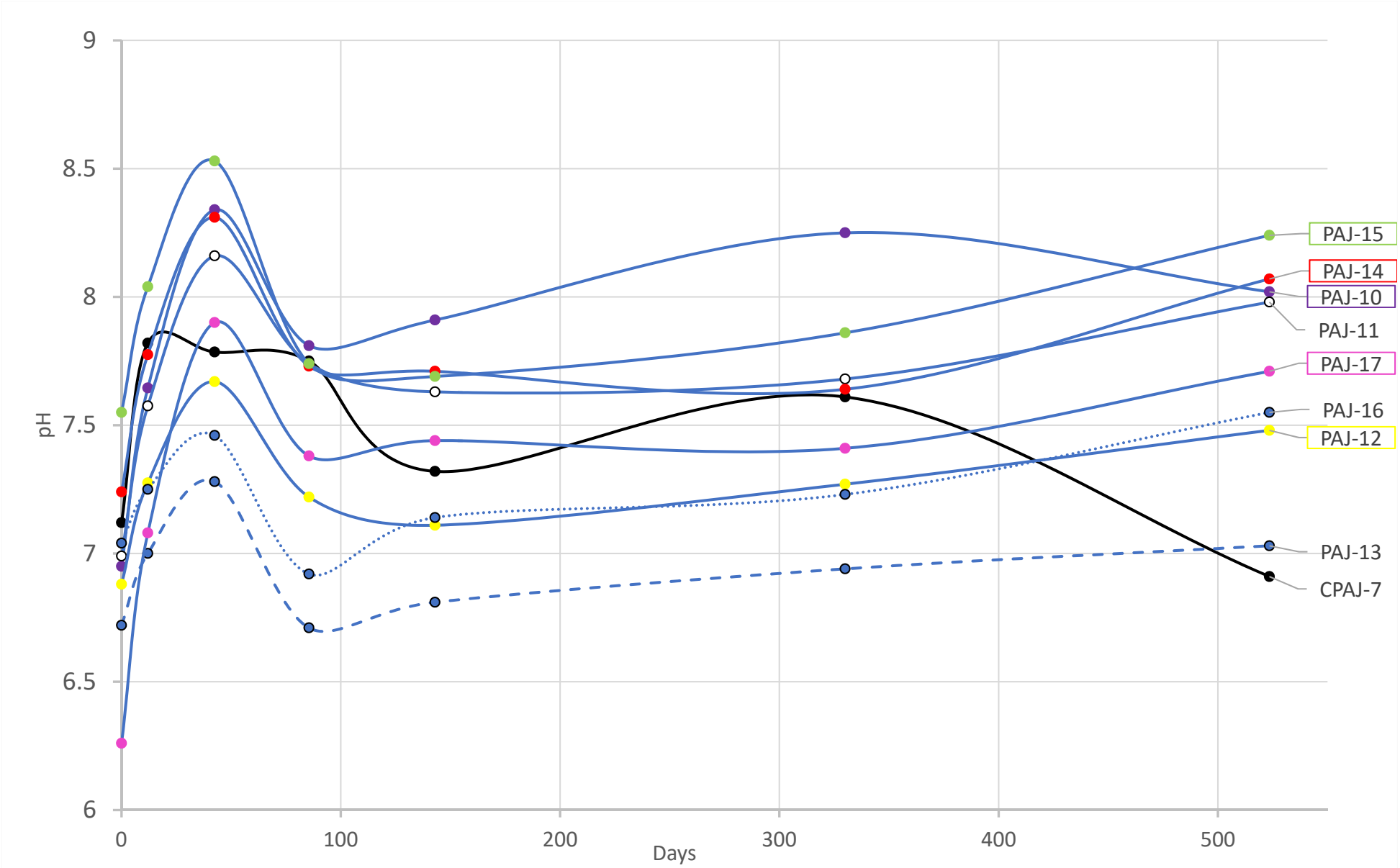


Fig S7: Water column fluctuations of pH measurements in Salar de Pajonales incubations corresponding to PAJ-16 (fine gypsum substrate), PAJ-10, PAJ-11, PAJ-12, PAJ-14, PAJ-15, PAJ-17 (no substrate), PAJ-13 (coarse gypsum substrate) and CPAJ-7 (control). pH fluctuated similarly in every sample except CPAJ-7, increased to 43 days, then decreased to 85 days and, after that, increased again. In the water-only control, pH increased up to 12 days, then slightly fluctuated up to 85 days and, after that, it increased greatly up to 330 days, and finally it decreased.

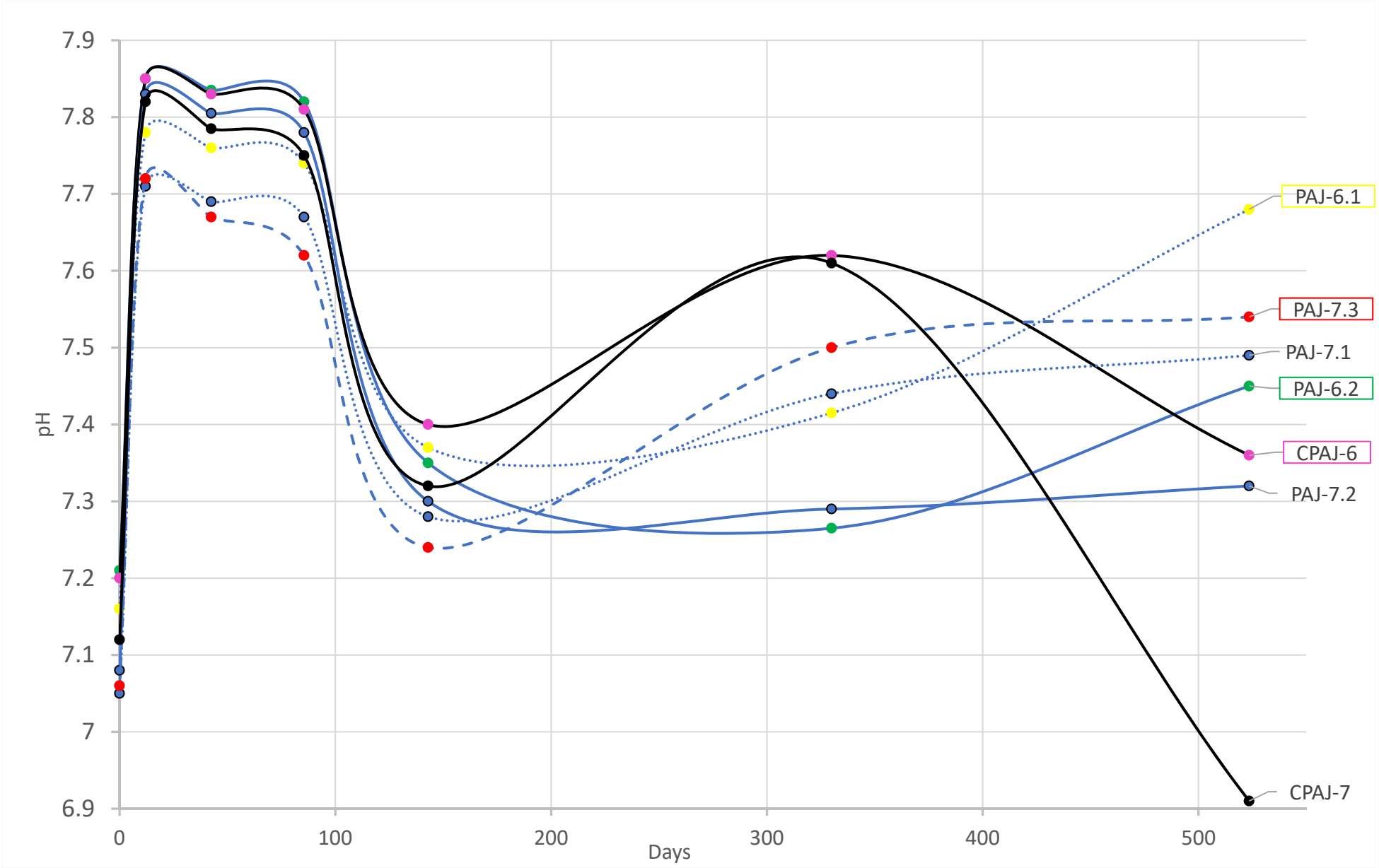


Fig S8: Water column fluctuations of pH measurements in Salar de Pajonales incubations corresponding to PAJ-6.1 and PAJ-7.1 (fine gypsum substrate), PAJ-6.2 and PAJ-7.2 (no substrate), PAJ-7.3 (coarse gypsum substrate) and CPAJ-6 and CPAJ-7 (control). pH fluctuated similarly in every sample up to 143 days, then control samples showed greater fluctuations, decreasing to the end of the graph in contrast with microbial mat incubations which increased slightly as in PAJ-7.2 to sharply as in PAJ-6.1

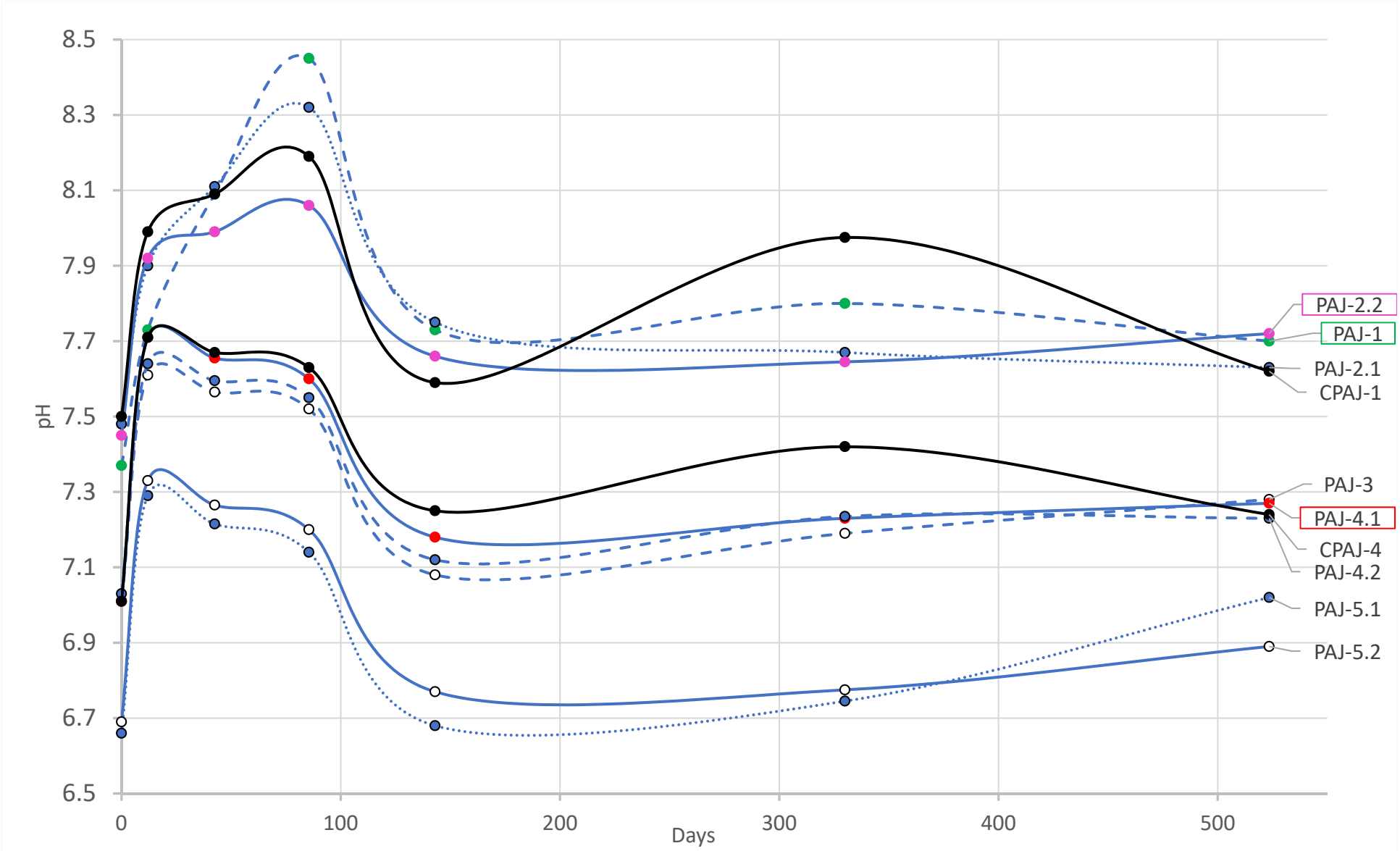


Fig S9: Water column fluctuations of pH measurements in Salar de Pajonales incubations corresponding to PAJ-2.1 and PAJ-5-1 (fine gypsum substrate), PAJ-2.2, PAJ-4.2, PAJ-5.2 (no substrate), PAJ-1, PAJ-3 and PAJ-4.2 (coarse gypsum substrate) and CPAJ-1 and CPA-4(control). Three groups of samples can be differentiated. PAJ-3, PAJ-4.1, PAJ-4.2, CPAJ-4, PAJ-5.1 and PAJ-5.2 increased pH up to 12 days, then slightly decreased up to 85 days and, after that, greatly decreased and fluctuated. PAJ-2.2 and CPAJ-1 greatly increased pH up to 12 days, then, increased slightly up to 42 days, increased again up to 85 days, and decreased up to 143 days. After 143 days, both samples behaved differently. PAJ-1 and PAJ-2.1 increased pH up to 85 days, then followed similar behavior as PAJ-2.2.

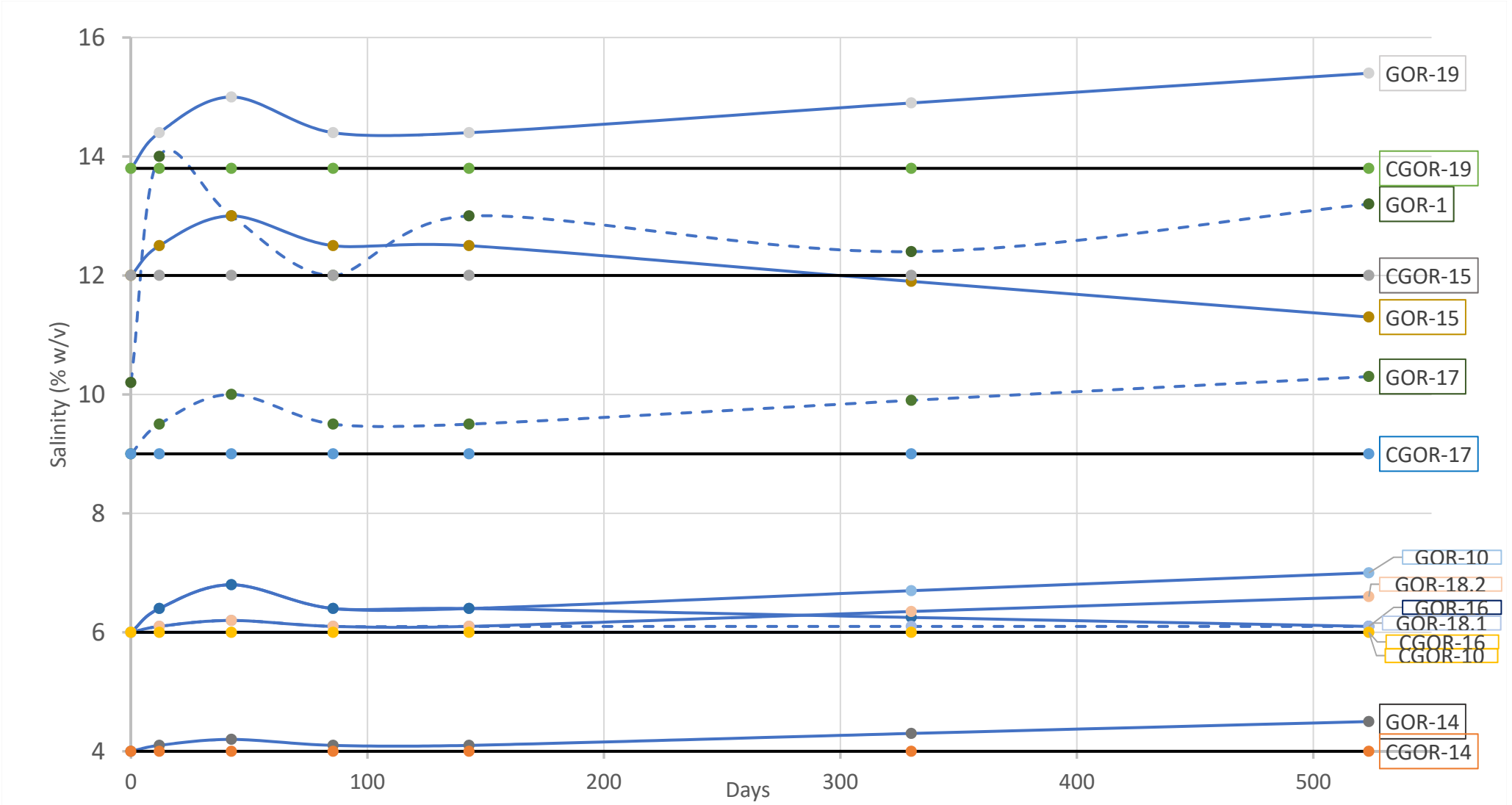


Fig S10: Water column fluctuations of salinity measurements in Salar de Gorbea incubations corresponding to GOR-10, GOR-14, GOR-15, GOR-16, GOR-18.2, GOR-19 (no substrate), GOR-1, GOR-17, GOR-18.1 (coarse gypsum substrate) and CGOR-10, CGOR-14, CGOR-15, CGOR-16, CGOR-17, CGOR-19 (control). GOR-1 increased salinity greatly from 10.2 to 14 % w/v within 12 days, then showed gypsum crystals from 30 days while decreasing to 12 % w/v up to 85 days, and then, it kept fluctuating. GOR-10, GOR-15, GOR-17, GOR-19 incubations showed a trend of increasing their salinity up to 42 days, then decreased up to 85 days. Half of these samples (GOR-10 and GOR-17) showed gypsum precipitates at 60 and 30-days check-ups, respectively. GOR-14 and GOR-18.2 incubations showed a similar trend with lower fluctuations and no precipitates were identified on them. All other incubations and controls did not show changes through time despite at 60 days some showed precipitates of gypsum as in GOR-1 and gypsum, calcite, halite, and silicates as in GOR-16. *CGOR-1 is not represented in this graph as it was let to evaporate, and showed gypsum precipitated from 90 days.

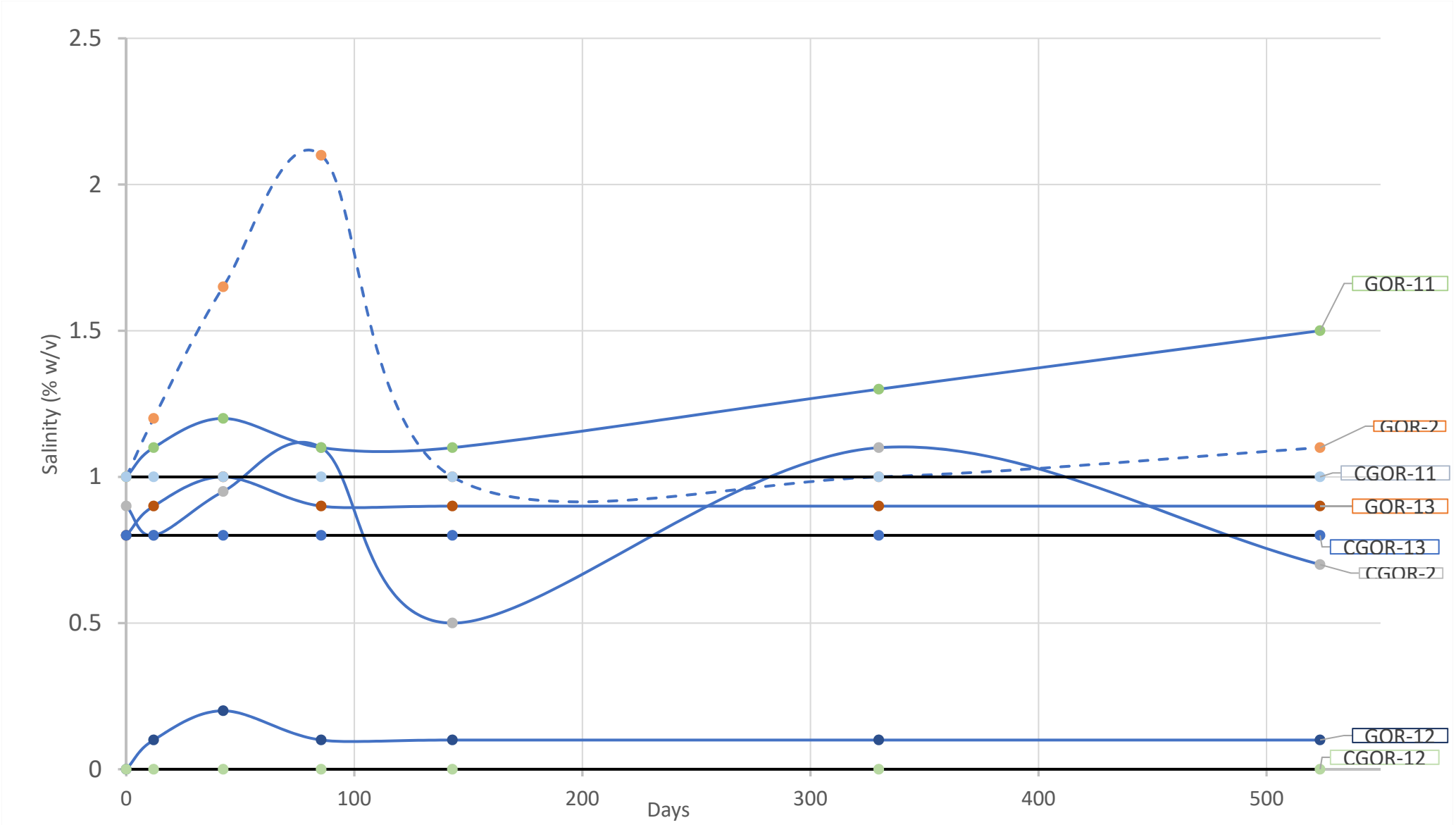


Fig S11: Water column fluctuations of salinity measurements in Salar de Gorbea incubations corresponding to GOR-11, GOR-12, GOR-13, (no substrate), GOR-2 (coarse gypsum substrate) and CGOR-2, CGOR-11, CGOR-12, CGOR-13 (control). GOR-11, GOR-12 and GOR-13 incubations increased salinity slightly up to 42 days, then they decreased and stabilized, except GOR-11 which greatly increased. Only GOR-11 showed gypsum precipitates at 30 days. GOR-2, which showed gypsum precipitates from 30 days, increased salinity up to 85 days and then decreased. CGOR-2 fluctuated between 0.5 to 1.1 % w/v, while CGOR-11, CGOR-12 and CGOR-13 remained stable. None of them showed mineral precipitates.

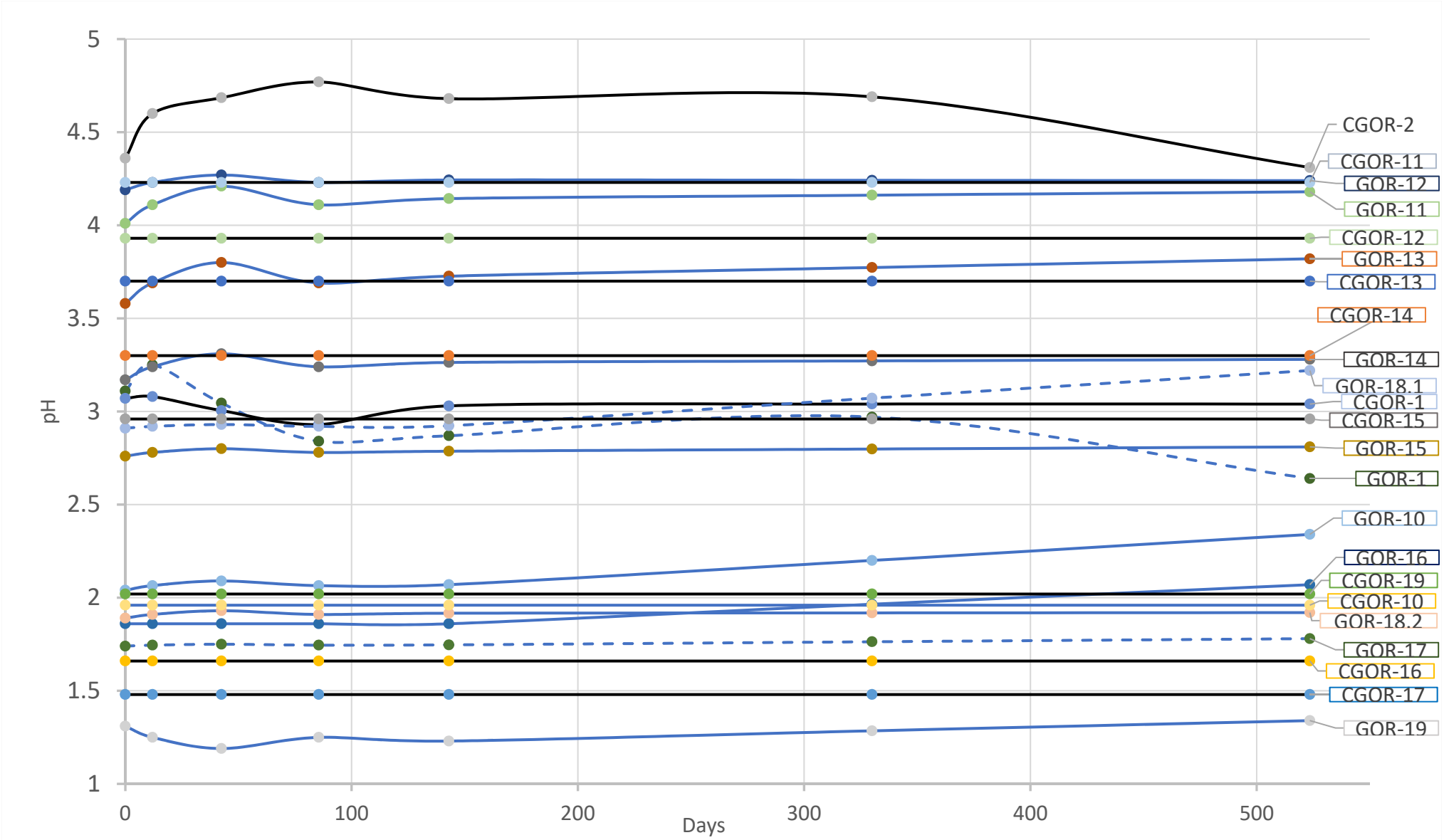


Fig S12: Water column fluctuations of pH measurements in Salar de Gorbea incubations corresponding to all samples except GOR-2. Some of the samples showed stability in pH except GOR-11, GOR-13, GOR-14 which increased to 42 days, and then they decreased; GOR-10, CGOR-10 and CGOR-11 which slightly increased up to 42 days; GOR-19 which behaved the opposite to GOR-13 up to 85 days, then similarly; CGOR-2 which increased pH up to 85 days, then it decreased; GOR-1 which decreased pH up to 85 days, then it fluctuated; and GOR-18.1 which steadily increased. Note that dashed lines represent the experiment with coarse gypsum substrate, blue lines no substrate and black lines are controls.

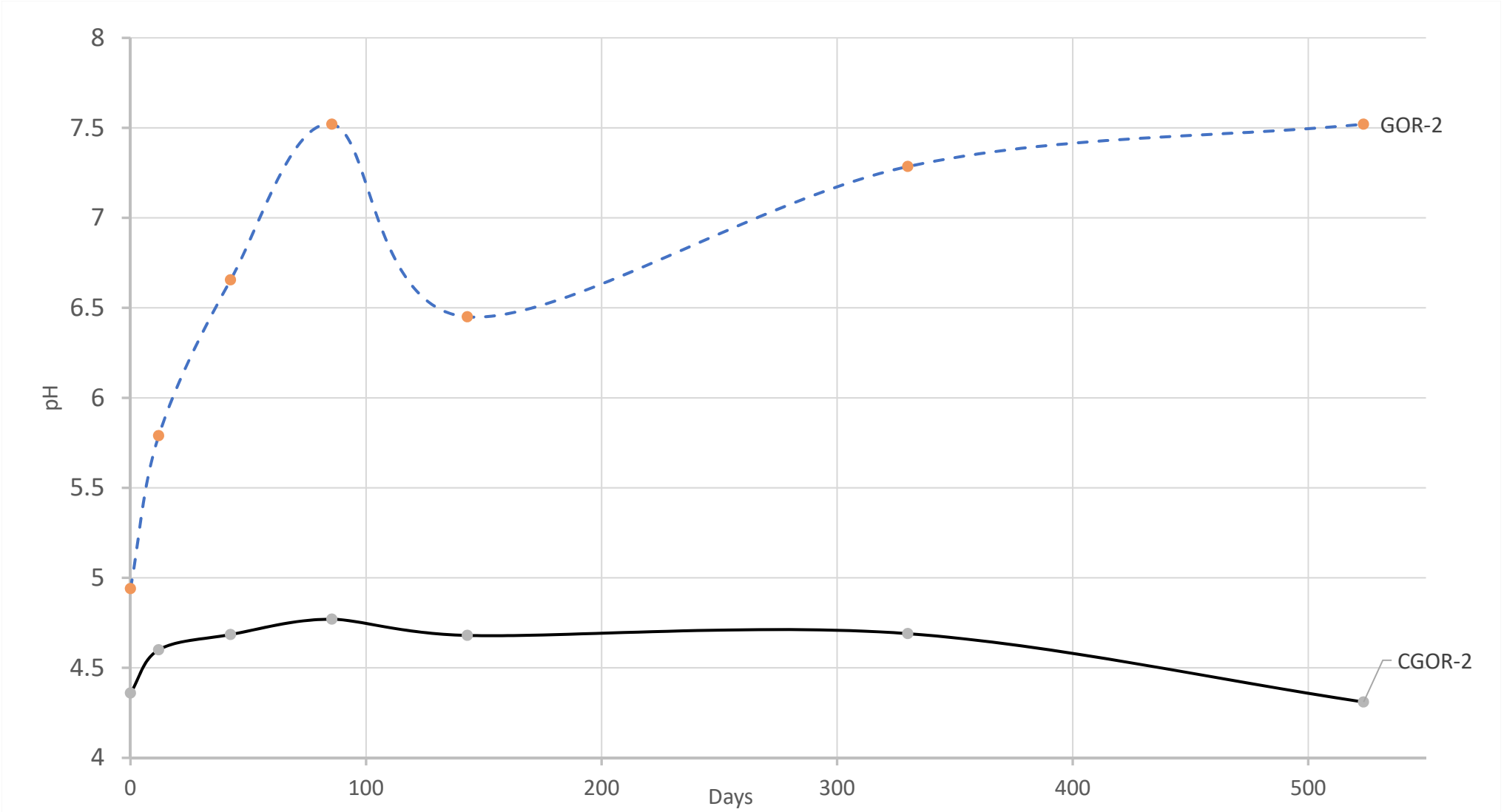


Fig S13: Water column fluctuations of pH measurements in Salar de Gorbea incubations corresponding to GOR-2 (coarse gypsum substrate), and CGOR-2 (control). GOR-2 greatly increased pH up to 85 days, and then it fluctuated.

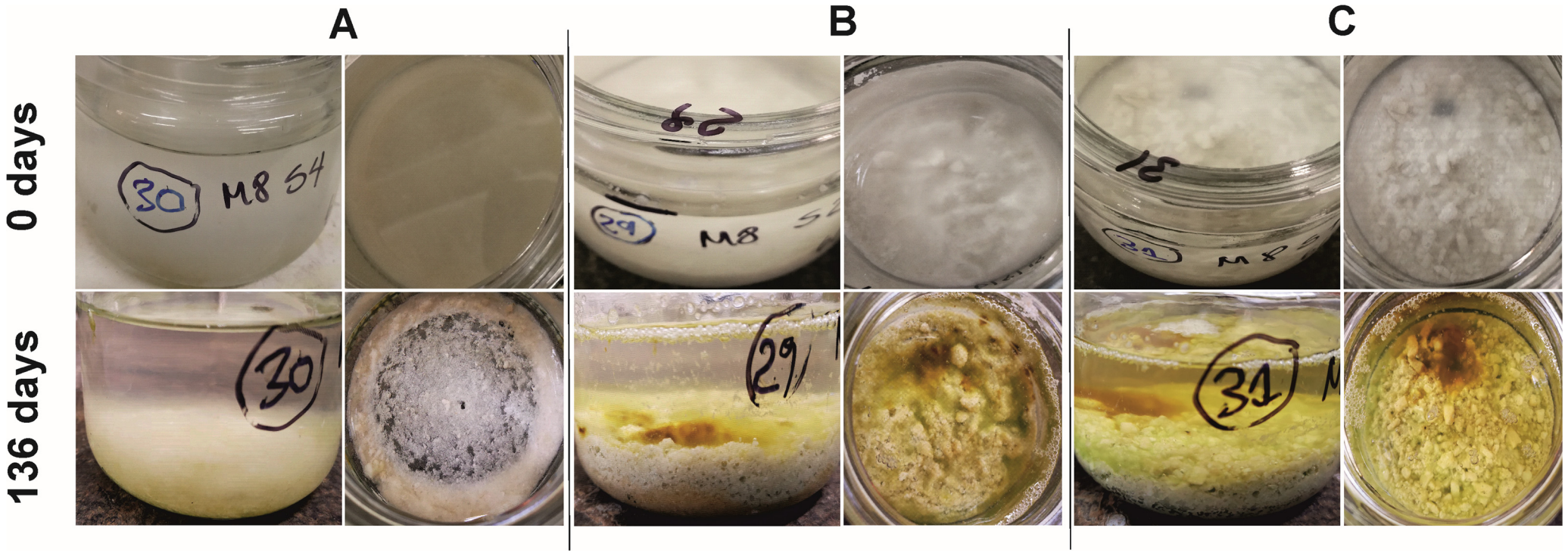


Fig S14: Side (left photographs) and top views (right photographs) of no substrate PAJ-7.2 **(A)**, fine gypsum substrate PAJ-7.1 **(B)**, and coarse gypsum substrate PAJ-7.3 **(C)** incubations from 0 days (upper photographs) to 136 days (lower photographs). The sample without substrate (PAJ-7.2) did not show microbial mat growth.

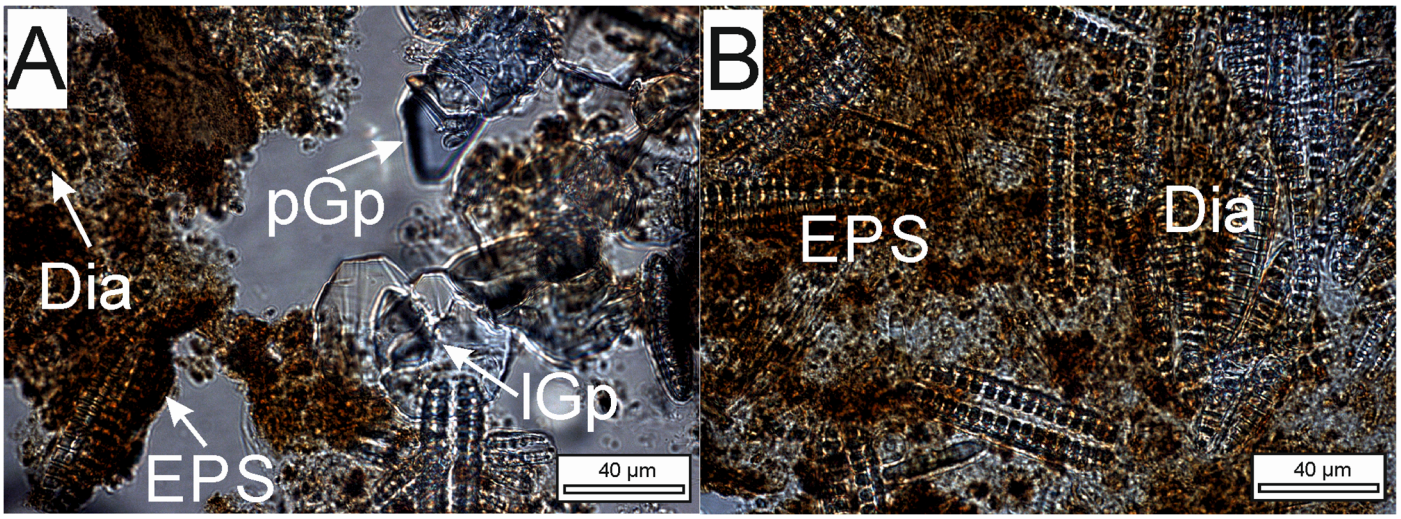


Fig S15: Bright light microphotographs of a microbial mat with diatoms (Dia) embedded in extracellular polymeric substances (EPS) including prismatic (pGp) and lenticular (lGp) gypsum crystals before purification **(A)** and after purification without crystals **(B).**