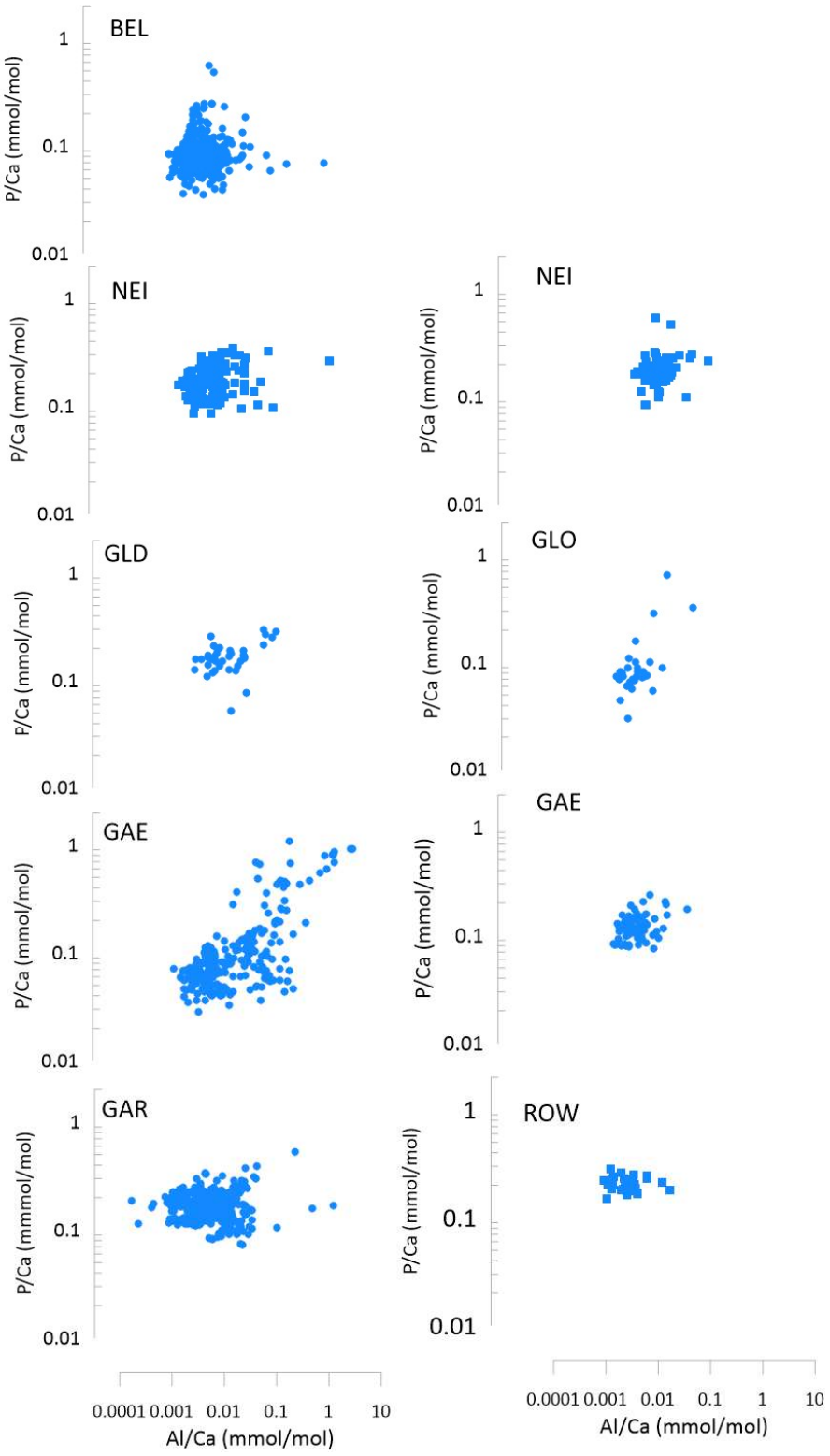

Figure S1. For each evaluated stalagmite, the measured P/Ca ratio vs Al/Ca ratio (mmol/mol). Left column shows results for PGM-LIG, and right column for GS 22.

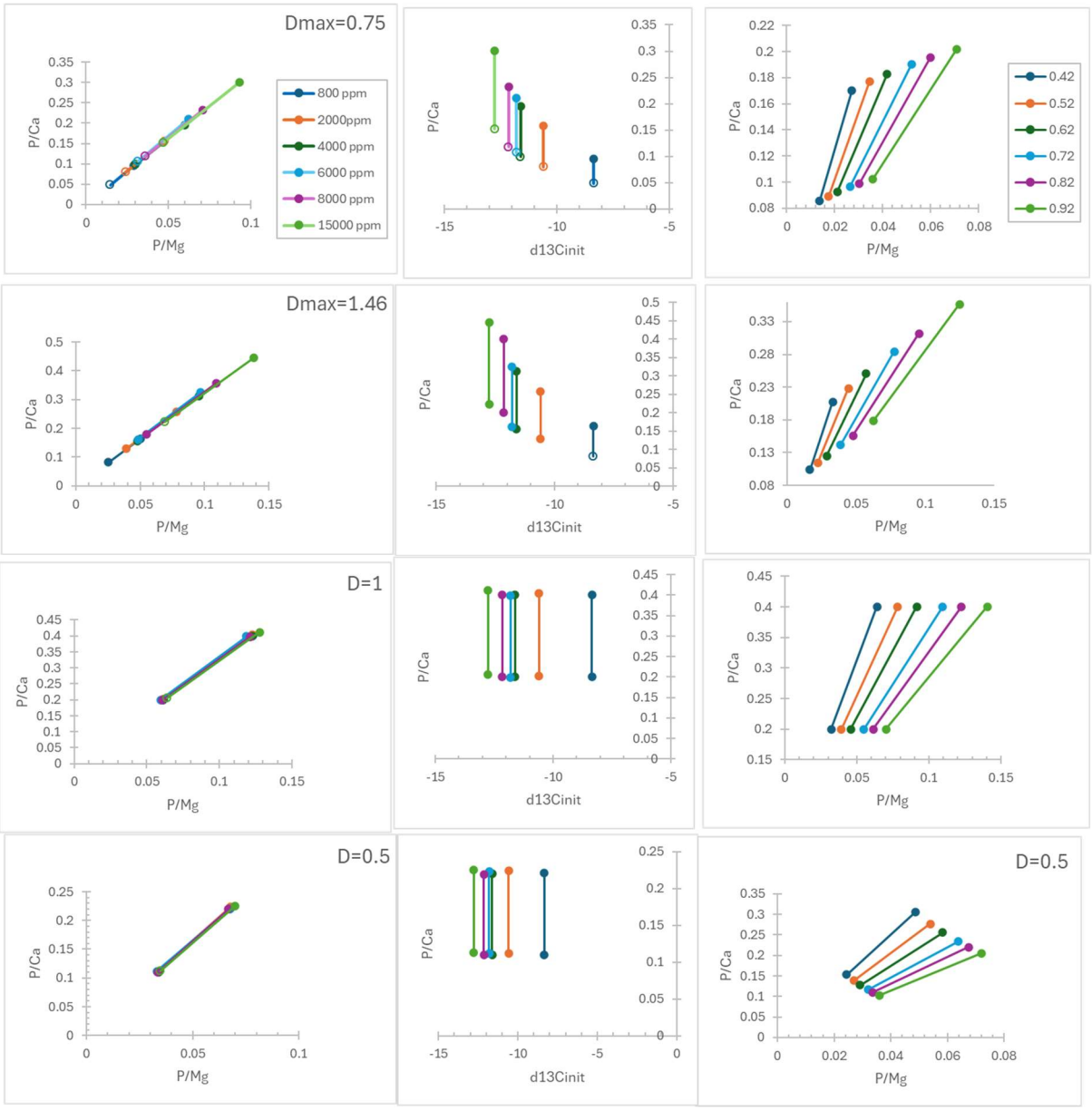

Figure S2. Illustration of stalagmite chemistry predicted from simulations shown in Figure 7, but comparing the effect of two ratios of initial dripwater P/Ca, 0.2 and 0.4 mmol/mol. The left two columns illustrate results for a constant fCa of 0.75 but varying initial soil pCO_2 and solid lines connect simulations of identical soil pCO2 but different initial dripwater P/Ca. The rightmost column llustrates results for a constant soil pCO2 of 4000 ppm but varying fCa, and solid lines connect simulations of identical fCa but different initial dripwater P/Ca. The $\delta^{13}C_{init}$ is estimated from CaveCalc simulations as described in the text.

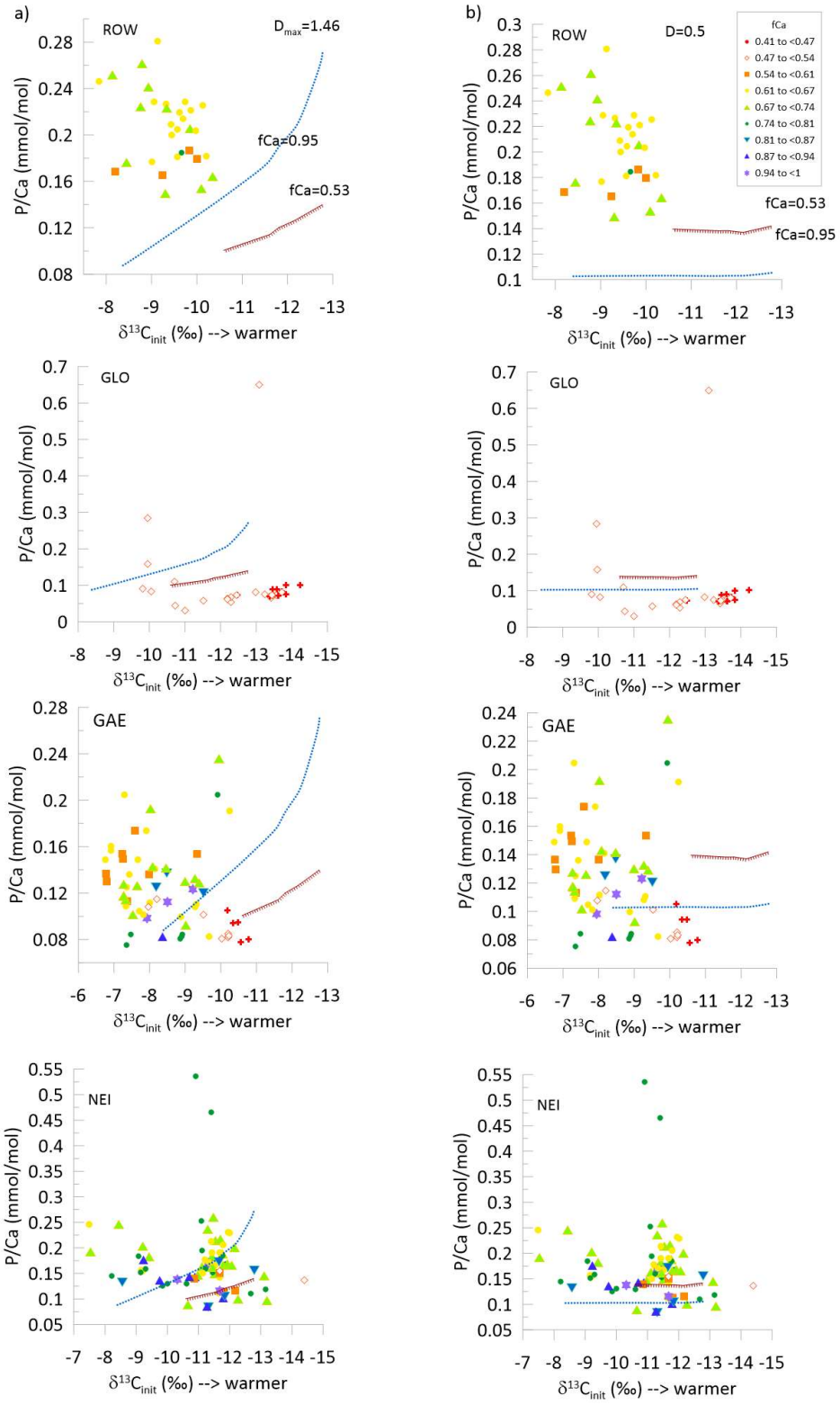

Figure S3. For the stalagmites covering the GS22 period, the P/Ca vs $\delta^{13}C_{init}$, with symbols indicating the fCa. Lines illustrate additionally the modeled variation of P/Ca with $\delta^{13}C_{init}$ for a dripwater of constant initial P/Ca (0.2 mmol/mol) for the case of fCa 0.95 and 0.52. Panel a) illustrates the results of model A where Dmax=1.46 and panel b) illustrates the results of model C where D=0.5.

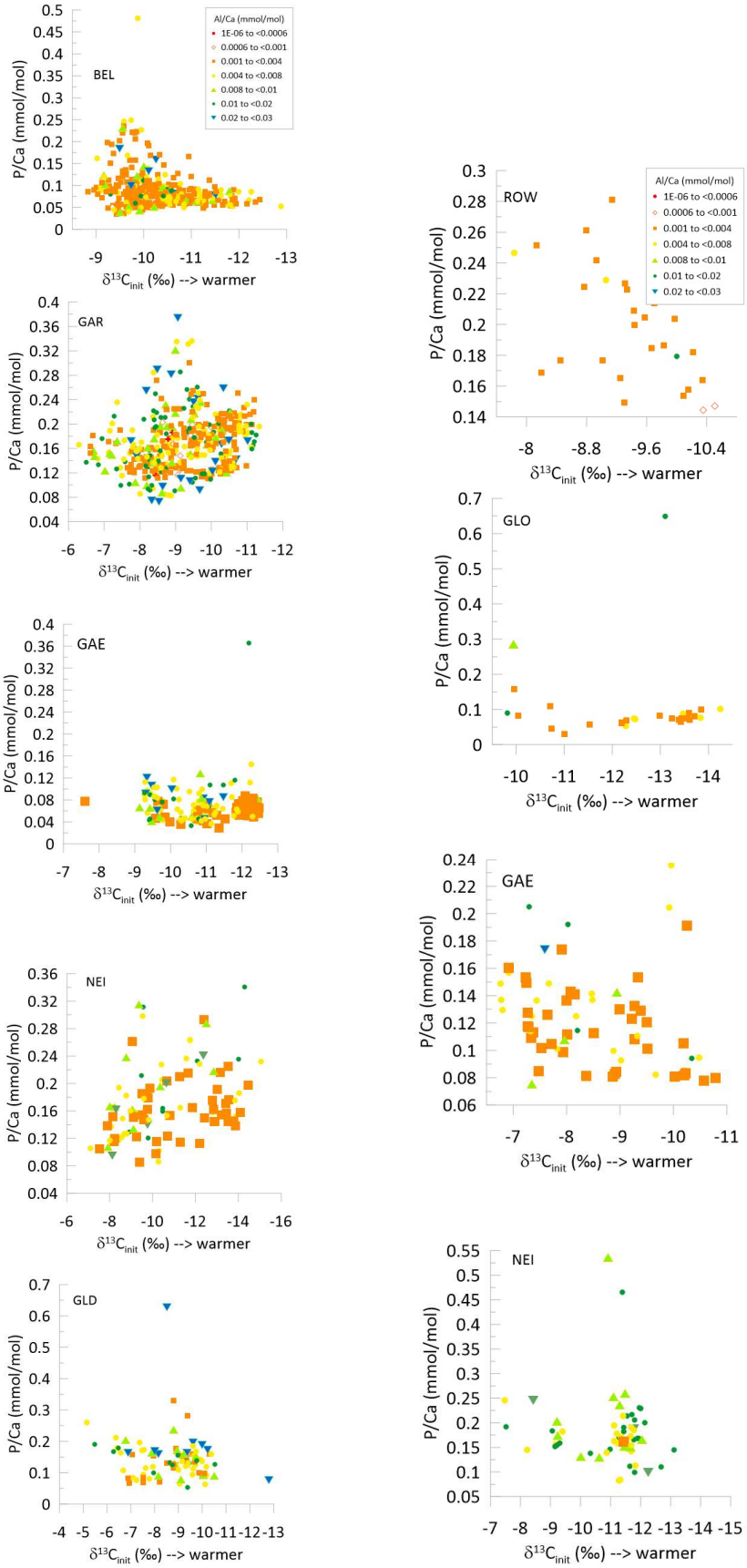

Figure S4. For each evaluated stalagmite, the measured P/Ca ratio vs variation in fCa , symbols coded with the measured Al/Ca ratio.

Table S1: Input parameters used in in the CAVECALC simulations.

soil Gas pCO2	Cave air pCO2	Temperature C	gas volume L
15000	550	13	150
8000	550	13	150
4000	300	9	150
2000	300	5	150
800	300	5	150