Task 1:

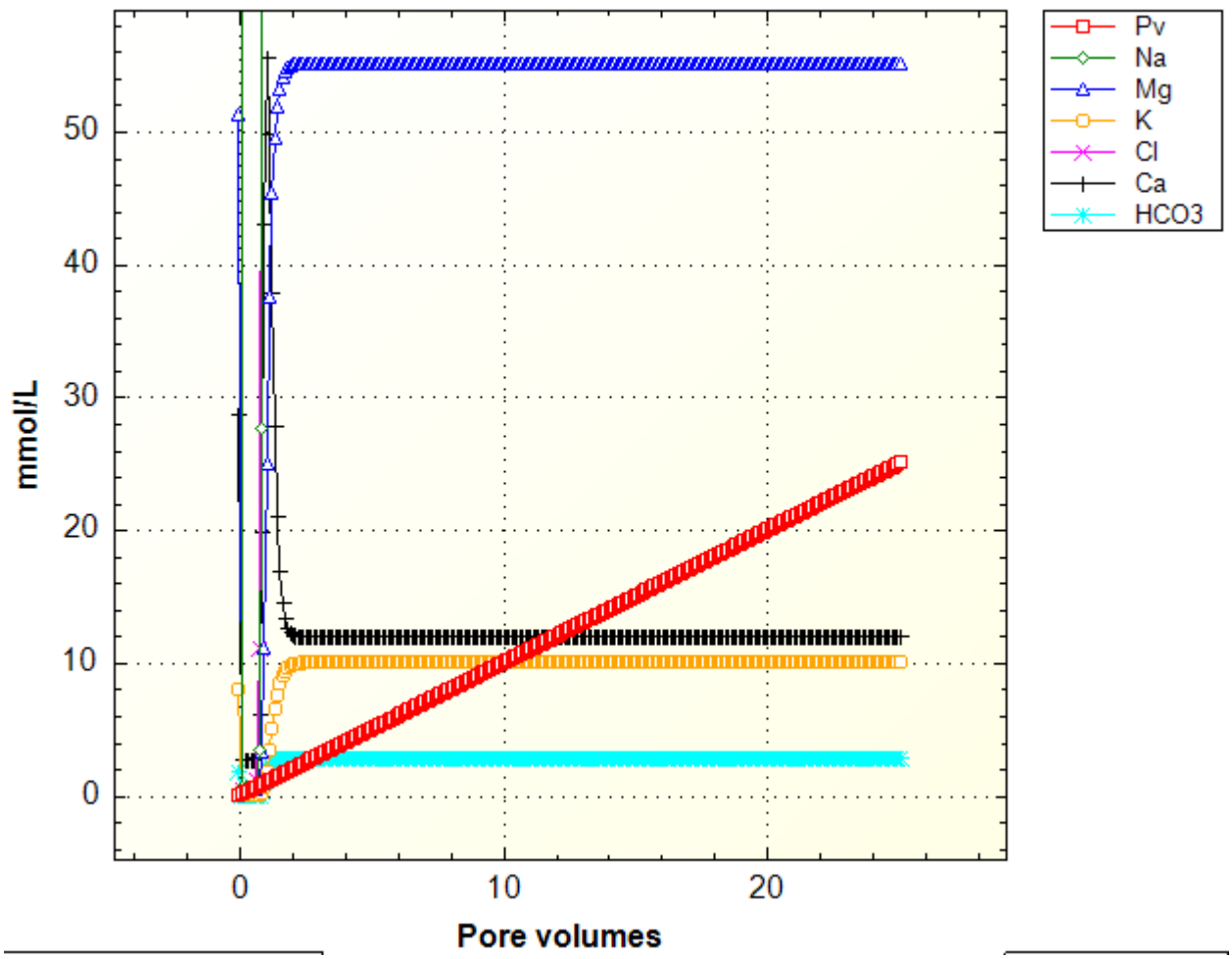
Exchange composition of the solution is shown in table 1

X 5.000e+02 mol

Species	Moles	Equivalents	Equivalent Fraction	Log Gamma
CaX2	1.782e+02	3.563e+02	7.127e-01	-0.163
NaX	7.010e+01	7.010e+01	1.402e-01	-0.041
KX	2.978e+01	2.978e+01	5.955e-02	-0.043
MgX2	2.189e+01	4.378e+01	8.755e-02	-0.160

Task 2/3:

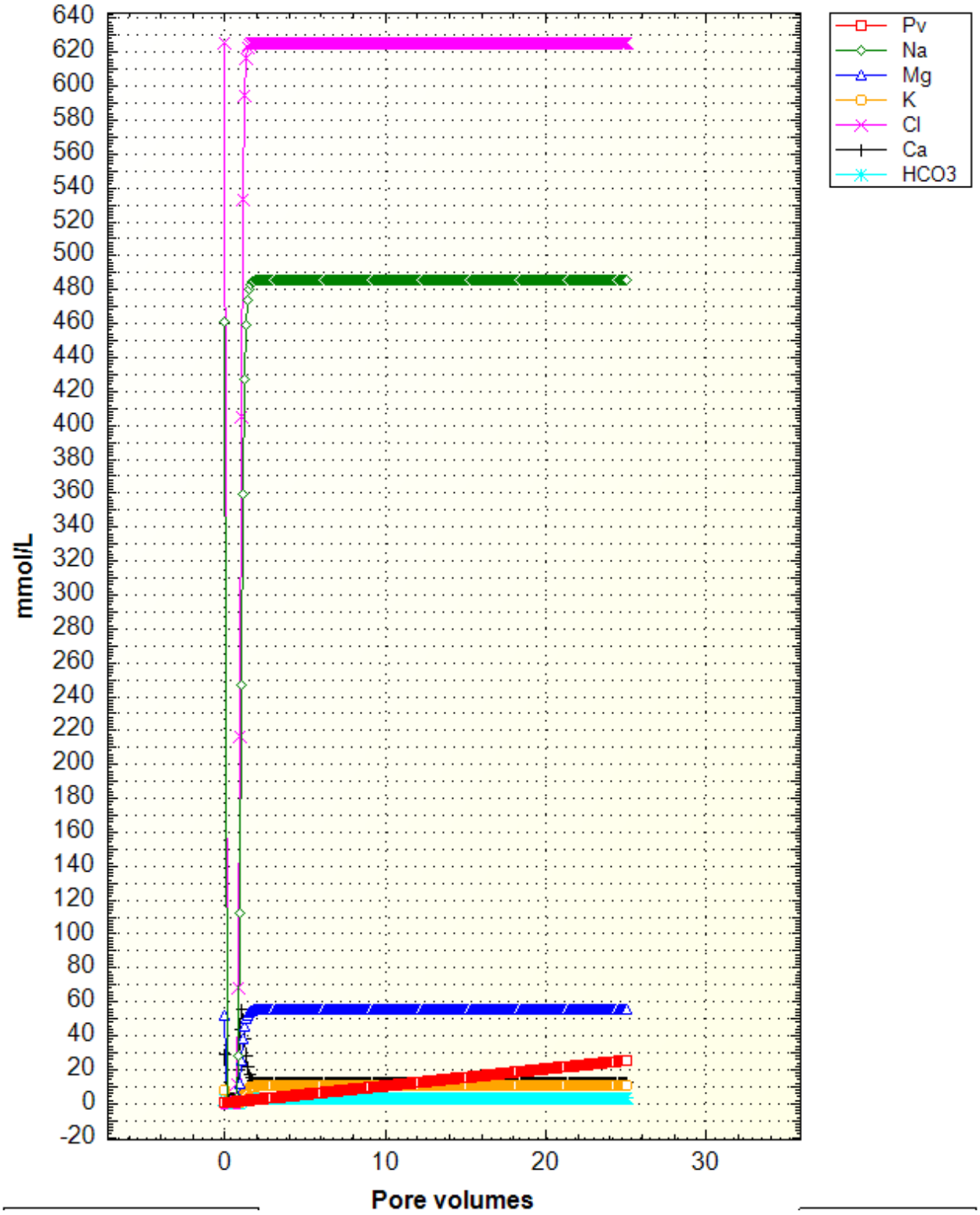
Using a solution similar to task 1, and saltwater was injected into the system.



As can be seen in figure 2, the system only uses a few pore water volumes before reaching a ion solution resembling that of sea water. First, Ca dissolved into the solution, before HCO3 is created, driving the Ca concentrations down. As Ca concentrations fall, the other ions dissolve quickly into solution. Cl brakes out after 6 calculations, or about 0.6 pore volumes. Ca is released from the exchanger shortly before Cl brakes out, at 0.5 pore volumes, the Ca is shortly after depleted and after 1 pore volume Ca is in equilibrium at 12mmol/l.

The solution resembles that of seawater after only 2.5 pore volumes, with final concentrations that can be read in table 2.

Element	PHREEQC values (mmol/l	Actual sea water composition (mmol/l)
Cl	625	546
Na	485	469
Mg	55	52.8
K	10	10.2
Ca	11	10.3
HCO3	~0.2	2(TOC)


Pv
Na
Mg
K
Cl
Ca
HCO3
mmol/L
Pore volumes
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
0
10
20
30