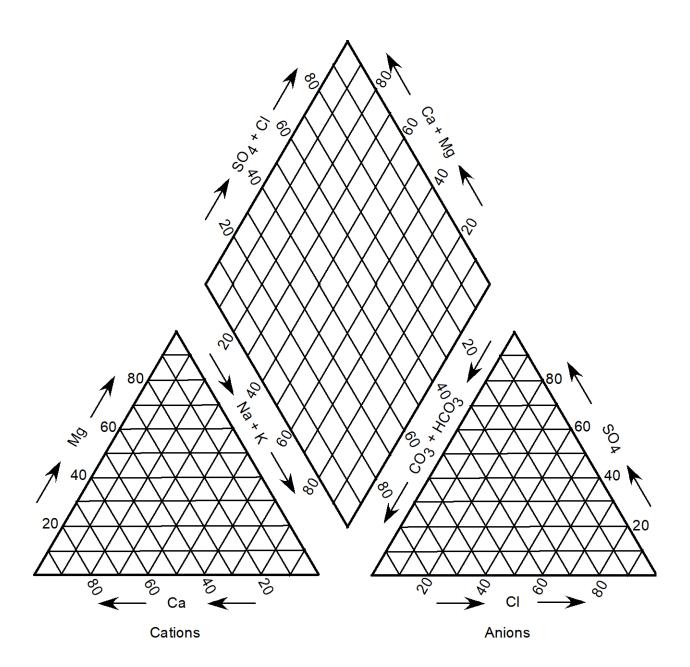
Homework 6 Due April 27

- 1. Problem 9.8. Add (K) Plot the major ions on the trilinear diagram with three x symbols.
- 2. The following analyses of water are from the perched aquifer beneath the Pantex Plant.

Constituent	Measurement
Calcium	34.6 mg/L
Magnesium	33.4 mg/L
Sodium	26.5 mg/L
Potassium	5.7 mg/L
Bicarbonate	298 mg/L
Sulfate	26.0 mg/L
Chloride	24.0 mg/L
Temperature	15°C
pН	7.28

- [a] Calculate the ionic strength of the water.
- [b] Plot the major ions on the trilinear diagram with three circle (o) symbols.
- [c] Find the P_{CO2} in bar for this water in the aquifer. Consider only the carbonate equilibrium, and use the activities.
- [d] When the water is brought to the surface, it comes in contact with the atmosphere. The CO_2 degasses and the P_{CO2} in the water drops to $10^{-3.5}$ bar, with the other dissolved concentrations (except pH) and temperature are unchanged. Find the pH of the water after it was brought to the surface. Consider only the carbonate equilibrium and use the activities.
- 4. Problem 10.1.
- 5. Problem 10.5.
- 6. Problem 10.7.





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Problem 9.8

Given:

Tabulated groundwater analyses with major ions, pH = 7.6, TDS = 542 mg/L

Find:

See statements in each section below

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You can follow	the format re	commende	d on page 3	182	107	10	151	10
	Formula		tonic	Conc.		Activity	Chemical	Conc.
lon	Weight (g)	Charge z	Radius a,	(mg/L)	m, (mol/L)	Coef, y	Activity a	(meq/L)
Cations								
Calcium	40	2	6	83.27	2.08E-03	0.673	1.40E-03	4.16
Magnesium	24.3	2	8	24.32	1.00E-03	0.687	6.88E-04	2.00
Sodium	23	1	4	18,33	7.97E-04	0.901	7.18E-04	0.80
Potassium	39.1	1	3	2.34	5.98E-05	0,896	5.37E-05	0.06
Total				128.26		400		7.02
Anions								
Sulfate	96	-2	4	23.45	2.44E-04	0.658	1.61E-04	0.49
Bicarbonate	61	-1	4	366.78	6.01E-03	0,901	5.42E-03	6.01
Chloride	35,5	-1	3	12.5	3.52E-04	0.898	3,16E-04	0.35
Total				402.73				6.85

BO total

[b] Ionic Strength

$$I = \frac{1}{2} \sum m_i z_i^2$$

$$-\log \gamma_i = \frac{Az_i^2 \sqrt{I}}{1 + a_i B \sqrt{I}}$$

[d] Activity

$$\alpha_i = \gamma_i m_i$$

[e] Convert to meq/L

$$\#\frac{meq}{L} = \#\frac{mg}{L}\frac{meq}{\#mg}$$

[I] Cation-anion balance

$$Error = 100 \frac{\sum_{\text{collisions}} m_i z_i - \sum_{\text{collisions}} m_i z_i}{\sum_{\text{collisions}} m_i z_i + \sum_{\text{collisions}} m_i z_i}$$



[g] K_{ap} of CaSO₄

$$K_{tap} = \alpha_{Ca^2}, \alpha_{SO_4^2}$$

[h] Compare K_{so} to K_{so}

3.16E-05 > K_{lap} so undersaturated with respect to anhydrite [

[I] Find K_{ep} of calcite CaCO₃

No CO₃² concentration given, so assume equilibrium dissociation of bicarbonate

2.25E-07

$$HCO_{3}^{*} \Leftrightarrow H^{+} + CO_{3}^{2}$$

$$K_{HCO_{3}^{+}} \approx \frac{\alpha_{H} \cdot \alpha_{CO_{3}^{+}}}{\alpha_{HCO_{3}^{+}}} = 10^{-10.33}$$

$$\alpha_{CO_{3}^{+}} = \frac{10^{-10.33} \alpha_{HCO_{3}^{+}}}{\alpha_{H}}$$

$$K_{top} = \alpha_{Co_{3}^{+}} \cdot \alpha_{CO_{3}^{+}}$$

$$\alpha_{H_0} = 10^{-prt} \text{ pH} = 7.8$$

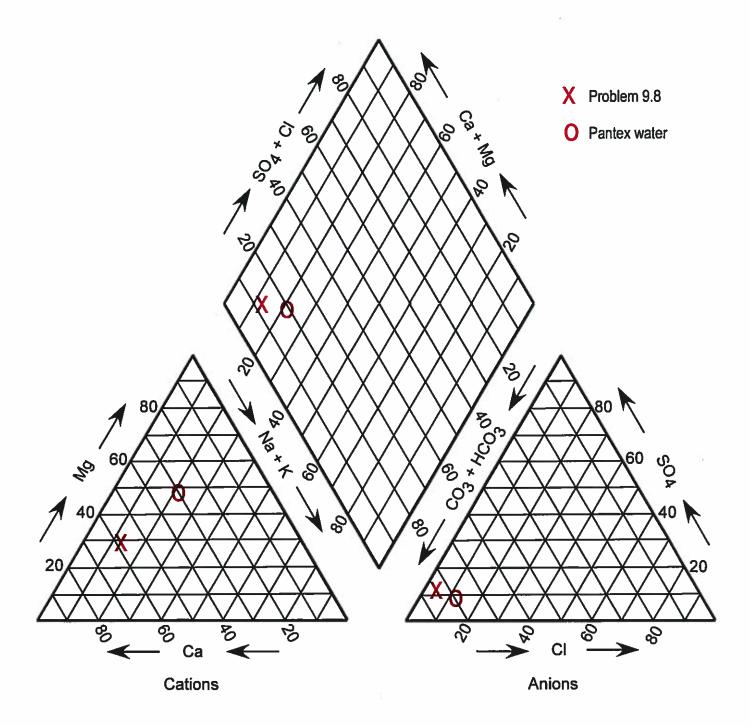


[j] Compare Kiap to Ksp

3,98E-09 < K_{ap} so oversaturated with respect to calcite (5)

(k) Trilinear diagram

	Conc.	Percent of
lon	(meq/L)	Total
Cations		
Calcium	4.16	59.3
Magnesium	2.00	28.5
Sodium	0.66	12.2
Total	7.02	
Anions		
Sulfate	0.49	7.1
Bicarbonate	6.01	87.7
Chlorida	0.35	5.1
Total	8.85	



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Problem 3

Given:

Pantex perched groundwater, pH = 7.28, T = 15 C

Find:

See statements in each section below

You can follow the format recommended on page 382.

			1	·	The second second			
					[a]	[c]	[d]	[e]
	Formula		Ionic	Conc.		Activity	Chemical	Conc.
lon	Weight (g)	Charge z _i	Radius a _i	(mg/L)	m _i (mol/L)	Coef. γ _i	Activity α _i	(meq/L)
Cations				_				
Calcium	40	2	6	34.6	8.65E-04	0.699	6.04E-04	1.73
Magnesium	24.3	2	8	33.4	1.37E-03	0.711	9.77E-04	2.75
Sodium	23	1	4	26.5	1.15E-03	0.910	1.05E-03	1.15
Potassium	39.1	1	3	5.7	1.46E-04	0.907	1.32E-04	0.15
Total				100.2				5.78
Anions								.:
Sulfate	96	-2	4	26	2.71E-04	0.685	1.86E-04	0.54
Bicarbonate	61	-1	4	298	4.89E-03	0.910	4.44E-03	4.89
Chloride	35.5	1	3	24	6.76E-04	0.907	6.13E-04	0.68
Total				348				6.10

[a] Ionic Strength

$$I = \frac{1}{2} \sum m_i z_i^2$$

|=

[b] Trilinear diagram

	Conc.	Percent of
ion	(meq/L)	Total
Cations		
Calcium	1.73	29.9
_Magnesium	2.75	47.6
Sodium	1.30	22.5
Total	5.78	
Anions		
Sulfate	0.54	8.9
Bicarbonate	4.89	80.0
Chloride	0.68	11.1
Total	6.10	

[TO] values + plot (previous page)

[c] Activity Coefficient

$$-\log \gamma_i = \frac{Az_i^2 \sqrt{I}}{1 + a_i B \sqrt{I}}$$

Activity

$$\alpha_i = \gamma_i m_i$$

Continue on hand calculations



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CO2+ H20 = H2CO3		
그는 아이 집에 가게 하는 것이 하는 것이 되어 있다. 그 나는 아이트를 가게 되었다.	-1.84	
1 Con = 0 HLC03 - 10	3	15°C ()
Pevz		
42CO3 = H++HCO3+		
16 - 04 ducor	, -6.42 @ T=	1502 (2)
1 CHZCOS = WH+ WHCOS- =	(0	
	(15-7.28) (444	×/(^3)
O) duzos = dut ducos = (10-6:42	Aid
11203	-4	
= 10-3.2 = 6.		40
Paz = amecoz =	6. (x10-+	
Koz -	10-1,34	
Peoz = 0.013 bar :	- 10 - 19 1	
1 teoz = 0.013 227	10 84	
] Water to Surface . Pear = 10	- 3,2 box. Fund	PH.
V& Eqs. from [c]	- don't have to	write them again
(1) co2 + H20 = H2003		
24.00	10-134 @ 7-15	q.
Claz Pear	10	101
dynus = Kenz Pec	=(10-134)(10-3.5)=10-48+=1,4210-5
(2) +12 (O3 = +1+ HCO3)	-6.42	
0) KH2CO3 = WH2CO3	= 10	2 150
~ Ku cu.	11.10 (10-6	42)(10-4.84)
	4.	44X 10-3
2/ - 12	10-9 = 10-89	
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1 PH= 8.9		
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Girai: K = 83 mL, Pb = 2.12 £3, 0 = 0.26 Find: relative velocity is Ve = Vx

10.7 Gwa: Capture well Q= 37000 tt3/4, confued aguster, K=925tt/4

Find: [a] maximum width of capture time
[b] distance from with to stagnostion point

Max width = 370-t

$$(40 + 1) = \frac{6}{2\pi (40 + 1)(625 + 6)(0.0021)}$$

$$= \frac{2\pi (40 + 1)(625 + 6)(0.0021)}{2\pi (40 + 1)(625 + 6)(0.0021)}$$

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