

GG325 -- PRINCIPLES OF GEOCHEMISTRY

Homework set #5 - Due on 11/16

1a) Give 3 compositional reasons for why we know that our sun is at least a second generation star

1.

2.

3.

1b) How and why has the abundance of H in the universe changed since the big bang?

2a) What is the product of this reaction $^{12}\text{O}_6 + ^4\text{He}_2 \rightarrow ?$

2b) What type of radioactive decay is this: $^{238}\text{U} \rightarrow ^{234}\text{Pa}$

2c) What is the reactant of the reaction $? \rightarrow ^{64}\text{Zn}_{30} + \beta^-$

2d) What is the product of the reaction $^{62}\text{Ni}_{28} + ^1\text{n}_0 \rightarrow ?$

3. The following equilibrium applies to the condensation of corundum, Al_2O_3 , from the gasses of the solar nebula: $\text{Al}_2\text{O}_3 (\text{s}) \leftrightarrow 2 \text{Al} (\text{g}) + 3 \text{O} (\text{g})$.

Table 1. solar nebula abundances for the elements in the atomic state relative to Si at 1×10^6 atoms.

| | | | |
|--------------------------|------------------------|-----------------------|----------------------|
| H = 2.2×10^{10} | Al = 7.4×10^4 | O = 2.0×10^7 | Si = 1×10^6 |
|--------------------------|------------------------|-----------------------|----------------------|

3a) write out the K_{eq} expression for this reaction. What are the units this constant is in?

3b) The condensation temperature of Al_2O_3 is 1768°K when $P_{\text{total}} = 10^{-4}$ atm. What is the partial pressure of Al in a unit volume of solar nebula at 1780°K ?

$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$

3c) Assuming the above condensation has gone to completion at 1768°K and that it is the only reaction governing the amount of Al and O in the nebula, would you expect there to be any O left in the gas phase? If yes, how much? *Hint: consider the stoichiometry of the reaction.*

3d) why is the abundance of Al in the solar system so much lower than that of Si?

4 Pick a chemical element other than H, He, O, Si, Al, Fe, Mg, Ca, Na, K, Ti; perhaps avoid really obscure ones too. You will be using this element below and in your final project, so pick one you like. (We will make selections in class on **Monday**, so come prepared with a first and second choice)

4a) What is the abundance of YOUR element in the solar system relative to Si at 1×10^6 atoms.

4b) What is it's most abundant isotope of YOUR element and what % of that element does it comprise?

4c) How is that isotope formed during nucleosynthesis (i.e., He-burning, r-process, s-process, etc..)?