

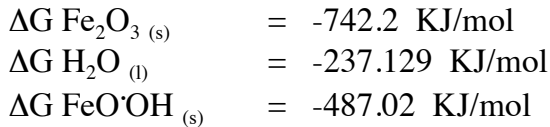
Thermodynamics and Isotopes in Geology, Problem 1

Stability of Goethite versus Hematite.

Goethite is a Fe-hydroxide ($\text{FeO}\cdot\text{OH}$) and hematite is an Fe-oxide (Fe_2O_3), yet the Fe in both is entirely oxidized (Fe^{3+}). Both form in oxidizing environments, yet most “red-beds” of sedimentary rock are red because of the presence of earthy hematite, rather than goethite. Which mineral is more stable in water at 25°C and 1 bar, hematite or goethite?

Step 1:

In the space below, write a balanced reaction between hematite and goethite (at 25°C, 1 bar):

Step 2:

Using the Gibbs Free Energies for hematite, goethite, and liquid water listed above, calculate the ΔG of the products, and reactants:

ΔG products: _____

ΔG reactants: _____

Which is the “stable” side of the reaction at the Earth’s surface? _____

Why? _____

Calculate the ΔG of reaction (in KJ/mol):

Describe the relationship between the sign of ΔG_{rxn} and which way the reaction will proceed under the conditions (i.e. is the *product* stable or is the *reactant* stable?).

