GEOL 135 Homework 8 – Sorption Fall 2011

1. Organic phosphorus in Lake Champlain sediments makes up almost ¼ of the total P bound to those sediments. To investigate how well phytate, one of the key forms of that organic P, sorbs to iron oxyhydroxide, the following data was gathered on suspension of FeOOH at 25°C and pH =6 (and constant ionic strength of 10-3):

|  |  |
| --- | --- |
| Phytate added (M) | Phytate left in solution after sorption (M) |
| 0.1 | 0.04 |
| 0.3 | 0.14 |
| 1 | 0.44 |
| 3 | 1.85 |
| 10 | 7.95 |
| 30 | 27.5 |
| 100 |  |

Freundlich: S=KCn Langmuir: $S=\frac{S\_{max}KC}{1+KC}$

Where S is the amount sorbed (umol g-1), C is the concentration in solution, K is the sorption equilibrium constant, Smax is the maximum amount that can be sorbed, and n is the order.

Fit this data to both a Freundlich and a Langmuir isotherm; **discuss which one best describes the sorption behavior and why**. To do this, use the excel sheet provided and change the values of K, Smax, and n to fit the red line to the plotted values, include a copy of your fitted graphs with the appropriate values listed.

2. The following data were collected for Missisquoi Bay sediment P sorption under completely oxic conditions. Determine the equilibrium dissolved P value between Missisquoi Bay water and this sediment at each pH by plotting S (P sorbed per g) vs. P added to begin, noting that the sediment started with some P on it and addition of water with no P results in desorption (a negative value).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **pH 6** |  |  | **pH 7** |  |  | **pH 8** |  |  | **pH 9** |  |
|  **Starting P Conc. (ug/L)** |  **Ending P Conc. (ug/L)** |  |  **Starting P Conc. (ug/L)** |  **Ending P Conc. (ug/L)** |  |  **Starting P Conc. (ug/L)** |  **Ending P Conc. (ug/L)** |  |  **Starting P Conc. (ug/L)** |  **Ending P Conc. (ug/L)** |
| 0 | 26.98 |  | 0 | 22.76 |  | 0 | 46.775 |  | 0 | 69.25 |
| 10 | 80.29 |  | 10 | 106.105 |  | 10 | 70.195 |  | 10 | 141.65 |
| 30 | 127.04 |  | 30 | 131.87 |  | 30 | 57.655 |  | 30 | 172.935 |
| 30 | 115.85 |  | 30 | 93.375 |  | 30 | 68.915 |  | 30 | 127.715 |
| 30 | 98.85 |  | 30 | 131.755 |  | 30 | 68.515 |  | 30 | 188.3 |
| 50 | 130.315 |  | 50 | 145.645 |  | 50 | 90.2 |  | 50 | 158.6 |
| 100 | 53.375 |  | 100 | 83.145 |  | 100 | 63.935 |  | 100 | 107.035 |
| 200 | 25.78 |  | 200 | 19.665 |  | 200 | 81.775 |  | 200 | 201.25 |
| 200 | 20.02 |  | 200 | 34.32 |  | 200 | 69.485 |  | 200 | 141.675 |
| 200 | 18.71 |  | 200 | 27.44 |  | 200 | 97.35 |  | 200 | 28.24 |
| 500 | 21.535 |  | 500 | 29.495 |  | 500 | 82.07 |  | 500 | 162.22 |