**QUESTION 1**

**Base Case**

* 1.1) Effects of K-Feldspar dissolution rates: K-Feldspar rate 10 and 100 times slower;

**10 times slower**

By making the K-Feldspar dissolution rate 10 times slower, the porosity at various depths is decreases for all times, when compared to the base case.

When the rate is 10 times slower, the K-Feldspar values at various times remain constant no matter the depth.

The volume of quartz present decreases.

**100 times slower**

**Graphs generated are the same as 10 times slower**

* 1.2) Effects of K-Feldspar equilibrium constants: 1 order of magnitude larger or 1 order of magnitude smaller;

**1 order of magnitude smaller**

**1 order of magnitude larger**

* 1.3) Effects of rainwater composition: change the total inorganic carbon (HCO3-) concentration by 2 times larger or 2 times lower, to represent changing CO2 content in rainwater;

**2 times larger**

**2 times smaller**

* 1.4) Effects of annual rainfall (flow velocity): increase and decrease by 2 times.

**Increase by 2 times**

**Decrease by 2 times**

**QUESTION 2**

* 2.1) Calculate the pore volume, residence time τa , and Peclet number (Pe) at each flow velocity;

|  |  |  |  |
| --- | --- | --- | --- |
| **Flow velocity** | **τa (days)** | **Pe** | **Pore volume (cm3)** |
| 0.1 | 100 | 1.0E+06 | 0.00196 |
| 0.31 | 32.25 | 3.1E+06 | 0.00196 |
| 3.6 | 2.78 | 3.6E+06 | 0.00196 |
| 7.2 | 1.4 | 7.2E+07 | 0.00196 |
| 18.5 | 0.5 | 1,85E+08 | 0.00196 |

* 2.2) Set up simulation for each flow velocity, and plot the breakthrough curves (BTCs, concentrations as a function of τa ) under each flow condition for Ca(II), IAP/Keq, and pH; plot one figure for each (Br, Ca(II), IAP/Keq, and pH) so you have all BTCs under different flow conditions in the same figure; comment on the role of flow in determining calcite dissolution and why;
* 2.3) Calculate the column-scale rates under each flow velocity by R = Q(Ceffluent – Cinfluent). Note that Q (volume/time) = v \* Ac, where v is the Darcy flow velocity, Ac is the cross-sectional area of the column;
* 2.4) Calculate the DaI and DaII for each flow velocity;
* 2.5) Make a table of v, R, ττ , Pe, and Da numbers at each flow velocity. Plot R as a function of Pe and DaI and DaII in different figures.