

Continuous Assessment 1

Conor Redington

Problem 1

a)

- REE-O polyhedra has 14 fold coordination.
- CO₃ groups are tetrahedral with a coordination of 5 oxygen molecules.
- REE-O have an corner connection to H₂O molecules and is face sharing with the CO₃ groups.

b)

- Calcium ions seem to have a coordination of 5. Arsenic groupings seems to have a coordination of 4.
- There is edge sharing between calcium structures
- There is corner sharing and edge sharing between arsenic and calcium groups.

Problem 2

a) 6

b)

- All the following is taken from table 2.2 in Document 2b.
- If we consider the radius of the chloride anion to be 1.81Å.
- And we consider the ideal ratio between cation and anion to be 0.414 for this halite crystal structure.
- The replacement ion must be less than half 1.81 to converge to 0.414.
- The only candidate is Lithium with it's radius of 0.76. $0.76/1.81$ is equal to about 0.42 which is close to the ideal limit.

c) the dimensions of the unit cell would become smaller.

Problem 3

a) Celestite: Orthorhombic, Siderite: Hexagonal, Calcite: Hexagonal, Barite: Orthorhombic, Aragonite: Orthorhombic, Magnesite: Hexagonal

b) Argonite and Calcite.

c) From Calcite to Argonite: reconstructive because the crystal structure is completely changed rather than a deformation of bonding.

d) Those with the same crystal structure. So Celestite/Barite/Argonite and Siderite/Calcite/Magnesite.

e) For creating a solid solution to trap radium the simplest substitution type would be anionic or cationic substitution. I would look at a mineral with an ion of the same charge and size as the radium ion. The main candidate then would be a Barium ion, so I would test on Barite. Another candidate could be substitution with Strontium ions in Celestite as it's ion radius for CN = 12 is similar to that of radium. I'm unsure from the data given if interstitial substitution could work.

Problem 4

a) ~4.5

b) 6.8-6.9

- c) It will decrease.
- d) Pressure and temperature.

Problem 5

- a) The more colloidal the more the surface area increases, so I would say a pH below 4 and above 10 the extremes of the graph.
- b) 7-10
- c) When the surface charge is positive and matches that of the negative 3 charge of the PO₄ ion. Below a pH of 4.
- d) When the surface charge is of magnitude 2 and negative. Above a pH of 10.
- e)
 - At a pH of 10 the maximum amount of colloids are suspended in the solution, the approximate aggregate charge of the colloids is -2 which would mean high adsorption of the radium ions.
 - As we go towards a pH of 5 the charge of the colloids becomes more neutral and the amount of colloids in the solution reducing, reducing the surface area of hematite and goethite. The adsorption become less and less as we go towards a pH of 5 and then would start to be repulsive to the radium ions below 5.