

Geology 221a - Mineralogy Problem Set

Optics I

1. At 15°C and 1.013 bars pressure, the refractive index of air is 1.0002765 for sodium light (589 nm). The refractive index of water for the same light under the same conditions is 1.33377. What is the critical angle for a planar water-air interface? Be sure to report your answer using the appropriate number of significant figures.
2. In examining isotropic minerals in the laboratory, we observed that some minerals show colored Becke Lines when the refractive index of the oil is nearly identical to that for the mineral. Other isotropic minerals have only white Becke Lines when the refractive index of the oil is nearly identical to that for the mineral. Explain this observation.
3. A quartz plate is made from a quartz crystal with its c-axis oriented horizontal (parallel to the plate). The older gypsum plates were made with the b-axis vertical, using the perfect (010) cleavage to make the plates. For sodium light (589 nm) at 15°C and 1.013 bars pressure:
 - (a) What is the thickness of the quartz plate required to produce a retardation of 550 nm?
 - (b) What is the orientation of the c-axis in the quartz plate relative to the slow direction?
 - (c) What is the thickness of the gypsum plate required to produce a retardation of 550 nm?
 - (d) What is the orientation of the c-axis in the gypsum plate relative to the slow direction? (Remember the difference between the crystallographic coordinate system a,b,c and the optic coordinate system X,Y,Z.)

Note: You will need to look up some data regarding these minerals in Nesse to answer this question.

4. Two different tetragonal minerals (quartz and zircon) of equal thickness display identical 1st order gray interference color when at 45° to extinction. One has a nearly vertical c-axis. The other has a nearly horizontal c-axis. Which mineral has the nearly vertical c-axis? Explain fully how you know?