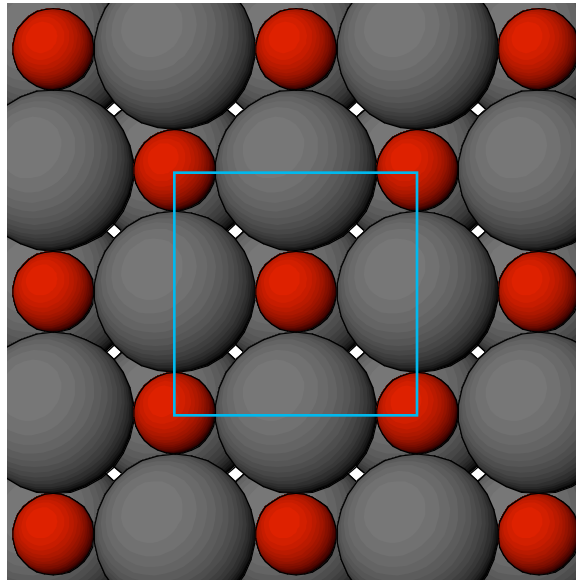


Mineralogy Lab Measuring Atoms

X-ray diffraction may be used to measure the spacing between planes of atoms in a crystal. The figure is a model of the crystal structure of the isometric mineral periclase (MgO) viewed down the c-axis (a-axis points down the page, b-axis points right). The end of a face-centered unit cell is shown in blue. Mg atoms are shown in red and O atoms are shown in gray. The spacing of the horizontal rows of red atoms represent the spacing of the atoms that produce the (002) x-ray peak. The spacing of the (001) peak (never observed) is given by the unit cell edge. $d_{(001)} = 2 \times d_{(002)}$.



All of the following list of minerals has a simple oxide with a crystal structure like periclase:

- (a) bunsenite (NiO)
- (b) lime (CaO)
- (c) manganosite (MnO)
- (d) periclase (MgO)
- (e) unnamedite (SrO)

These minerals are isostructural with each other. A powder diffraction pattern is shown for each on the attached pages. These patterns were collected using the Smith diffractometer, which has a Cu x-ray tube ($\lambda = 0.1540$ nm).

- (1) With your lab group, collect a diffraction pattern for one of these oxides. Scan from 25-85° (2θ) at 5° per minute. Identify the peaks by comparing your pattern with the PDF data file. Print out your pattern with the peaks labeled.
- (2) Use the Scintag crystallography software to determine the one unit cell parameter (**a**).
- (3) Using the (002) peak from your pattern, calculate the size of the unit cell using Bragg's Law.
- (4) Assuming that the radius of the oxygen atoms is 0.140 nm, calculate the size of the metal atom in your mineral. Give an uncertainty for your answer.
- (5) Is your answer reasonable? How does it compare with the radius given in the book?

Figure 1.

