

ESS 551 Homework  
October 26, 2006  
Due November 2, 2006

Provided MATLAB functions:

```
[velocities,eigvec] = xstl(dcos,rho,Cij,symcode)
cout=rotateCij(cin,atr)
```

Albite properties: density = 2.623 gm/cc,

```
C=[69.9 34.0 30.8 5.0 -2.4 -0.9 183.5 5.5 -3.9 -7.7
   -5.8 179.9000 -8.7 7.1 -9.8 24.9 -2.4 -7.2 26.8
    0.5 33.5];
```

The  $C_{ij}$  order is 11, 12, 13, ..., 22, 23, 24, ...

The constants are associated with a choice the Cartesian coordinates. For most of the crystal classes, it is easy to associate the Cartesian coordinates with the crystal coordinates. However, since no orthogonal relationships exist in the triclinic system, the choice of the coordinate system is totally arbitrary. The constants given here were set to a system where the y-axis is parallel to b. The x-axis is perpendicular to a plane defined by the b and c axes, and z then follows from the right-hand rule.

- Apply symmetry operations of the orthorhombic class to determine the form of the elastic constants matrix (ie –determine which elements are zero and which elements are equal or non-equal)
  - Add the extra symmetry for the cubic class to determine the form of its elasticity matrix
- Given the set of triclinic elastic constants and density for albite, determine velocities and polarizations of elastic waves in the x-y, x-z and y-z planes. Plot these results. It is a bit tricky to decide how to plot the polarization vectors since they represent motion in three spatial coordinates. One solution of many is to rotate the vectors into a common direction of propagation and then plot the projection of the vectors onto a plane perpendicular to the propagation.
- Determine the isotropic velocity bounds for albite.
- Assume that albite crystals are always multiple twins via the “albite twin law” (composition face perpendicular to the y-axis and rotation of 180 degrees about the z-axis). Determine the pseudo-single-crystal elastic constants. What symmetry class is this equivalent to?
  - Assume a rock contains 100% albite with a LPO consisting of b-axes vertical with the a and c axes randomly distributed by rotation about the b-axis. Determine the elastic constants and elastic compliances for this rock. Discuss the form of these matrixes – ie which elements are equal and non-zero.
  - Calculate velocities as a function of direction in the vertical plane for the elastic constants/compliances determined in b. Discuss your results.