Supplemental Information for:
Okaya, D., Vel, S.S., Song, W.J., and Johnson, S.E, 2018, Modification of crustal seismic anisotropy by geological structures ("structural geometric anisotropy"): Geosphere, v. 14, https://doi.org/10.1130/GES01655.1.

Four Supplemental files:
(1) Excel spreadsheet table: "1_EMs_Tensors.xlsx"
(2) Animation: "2_cylindrical_fold_SGA_0-90degrees.pdf"
(3) PDF table: "3A_rotation_matrix_21x21.pdf"
(4) ASCII text source code: "3B_c21x1_rotation_code.f.txt"

Introduction

This journal article examines the anisotropic effects of crustal rock fabrics that have been reconfigured with structural geometry. The article describes that finer-scale fabric geometry has an equivalent definition of effective media that will produce the same seismic anisotropy signals. This effective media can be described as an elastic tensor that is the tensor average of subvolumes of the fabric structure. This journal article illustrates sinusoid folds of fabric and their equivalent anisotropic effective media. While tensors are difficult to visualize, elastic tensors can be viewed by using their seismic properties such as P-wave velocities and shear wave split times. Figures 4 and 9A-9B in the article show these seismic properties draped on spheres of all propagation directions for sinusoid folds having fold limb angles of 0°, 30°, 45°, 60°, 75°, and 90°. There is a progression in anisotropy symmetry with tighter folding.

(1) Excel spreadsheet table "1_EMs_Tensors.xlsx"

This Excel spreadsheet contains the effective medium tensors for all structures illustrated in Figures 3, 4, 7, 9, and 10. The tensors are presented in Voigt notation (Cij, i,j=1-6). Each tensor in the spreadsheet shows 21 tensor elements that represent the upper right portion including the diagonal. The tensor is diagonal symmetric (e.g., Cji = Cij).

The tensors are organized by figure and figure panel. Tensor element values are provided in units of Pa. Excel view option or column format options will allow all numerical digits to be viewed.

Sample densities accompany the tensors so that seismic phase velocities can be calculated via the use of Christoffel equations.

(2) Animation "2_cylindrical_fold_SGA_0-90degrees.pdf"

PDF file "2_cylindrical_fold_SGA_0-90degrees.pdf" shows the seismic properties for anisotropic effective media representing folds from 0° to 90° fold limb angle, increasing 1 degree per page. Scrolling through the PDF pages (using arrow keys) with the page display set to one page per screen will emulate an animation movie.

The caption for Figure 4 applies to the frames in this animation. Each frame shows P-wave velocity and shear wave split time draped on velocity spheres. The P-wave velocities are in meters/sec. The shear wave split times are seconds per km of propagation. The black shear wave split bars indicate fast shear direction; the length of the red bars indicate split time magnitude.

There are two sets of spheres—one for when the rock fabric within the folds is assumed to have elliptical transverse isotropy symmetry. The other set is when the rock fabric symmetry is full transverse isotropy. There is significant difference in the shear wave split behavior between these two types of symmetry. The full transverse isotropy symmetry has sphere sectors that have either sagittal or transverse fast shear wave motion.

The sequence of frames from 0° to 90° fold limb angles shows the changes in anisotropy symmetry that is associated with progressive folding.

(3) PDF table "3A_rotation_matrix_21x21.pdf"

This PDF document describes the rotation matrix associated with a 21-element elasticity vector as defined in Appendix B. Each element of the 21x21 rotation matrix is defined using the directional cosines that relate the rotated orientation with respect to the unrotated coordinate frame.

(4) ASCII text source code "3B_c21x1_rotation_code.f.txt"

This text file contains software code that will define and apply a rotation to a 21-element elasticity vector. While the code is written in F77 Fortran, it can be easily translated into C or C++, python, or Matlab scripting. One of the software subroutines is the code equivalent of the 21x21 rotation matrix that is defined in Supplemental Information document #3 "3A_rotation_matrix_21x21.pdf".