

References

- Aki, K., and P. G. Richards, 2002, *Quantitative seismology*: University Science Books.
- Al-Chalabi, M., 1974, An analysis of stacking, rms, average, and interval velocities over a horizontally layered ground: *Geophysical Prospecting*, **22**, 458–475.
- Al-Dajani, A., and I. Tsvankin, 1998, Nonhyperbolic reflection moveout for horizontal transverse isotropy: *Geophysics*, **63**, 1738–1753.
- Al-Dajani, A., I. Tsvankin, and M. N. Toksoz, 1998, Nonhyperbolic reflection moveout for azimuthally anisotropic media: 68th Annual International Meeting, SEG, Expanded Abstracts, 1479–1482.
- Alfaraj, M. N., 1993, Transformation to zero offset for mode-converted waves: Ph.D. thesis, Colorado School of Mines.
- Alford, R. M., 1986, Shear data in the presence of azimuthal anisotropy: 56th Annual International Meeting, SEG, Expanded Abstracts, 476–479.
- Alkhalifah, T., 1995, Gaussian beam depth migration for anisotropic media: *Geophysics*, **60**, 1474–1484.
- , 1996a, Seismic processing in transversely isotropic media: Ph.D. thesis, Colorado School of Mines.
- , 1996b, Transformation to zero offset in transversely isotropic media: *Geophysics*, **61**, 947–963.
- , 1997a, Seismic data processing in vertically inhomogeneous TI media: *Geophysics*, **62**, 662–675.
- , 1997b, Velocity analysis using nonhyperbolic moveout in transversely isotropic media: *Geophysics*, **62**, 1839–1854.
- Alkhalifah, T., and K. Larner, 1994, Migration error in transversely isotropic media: *Geophysics*, **59**, 1405–1418.
- Alkhalifah, T., and I. Tsvankin, 1995, Velocity analysis for transversely isotropic media: *Geophysics*, **60**, 1550–1566.
- Alkhalifah, T., I. Tsvankin, K. Larner, and J. Toldi, 1996, Velocity analysis and imaging in transversely isotropic media: Methodology and a case study: *The Leading Edge*, **15**, 371–378.
- Anderson, J. E., T. Alkhalifah, and I. Tsvankin, 1996, Fowler DMO and time migration for transversely isotropic media: *Geophysics*, **61**, 835–844.
- Anderson, J. E., and I. Tsvankin, 1997, Dip-moveout processing by Fourier transform in anisotropic media: *Geophysics*, **62**, 1260–1269.

- Artley, C. T., and D. Hale, 1994, Dip moveout processing for depth-variable velocity: *Geophysics*, **59**, 610–622.
- Auld, B. A., 1973, *Acoustic fields and waves in solids*: John Wiley and Sons.
- Bakulin, A., V. Grechka, and I. Tsvankin, 2000a, Estimation of fracture parameters from reflection seismic data—Part I: HTI model due to a single fracture set: *Geophysics*, **65**, 1788–1802.
- , 2000b, Estimation of fracture parameters from reflection seismic data—Part II: Fractured models with orthorhombic symmetry: *Geophysics*, **65**, 1803–1817.
- , 2000c, Estimation of fracture parameters from reflection seismic data—Part III: Fractured models with monoclinic symmetry: *Geophysics*, **65**, 1818–1830.
- Ball, G., 1995, Estimation of anisotropy and anisotropic 3-D prestack migration, offshore Zaire: *Geophysics*, **60**, 1495–1513.
- Banik, N. C., 1984, Velocity anisotropy of shales and depth estimation in the North Sea basin: *Geophysics*, **49**, 1411–1419.
- , 1987, An effective parameter in transversely isotropic media: *Geophysics*, **52**, 1654–1664.
- Bartel, D. C., W. L. Abriel, M. A. Meadows, and N. R. Hill, 1998, Determination of transversely isotropic velocity parameters at the Pluto Discovery, Gulf of Mexico: 68th Annual International Meeting, SEG, Expanded Abstracts, 1269–1272.
- Bednar, J. B., 1997, Least squares dip and coherency attributes: Stanford Exploration Project Report #95, 219–225.
- Ben-Menahem, A., 1990, SH waves from point sources in anisotropic inhomogeneous media: *Geophysics*, **55**, 488–491.
- Ben-Menahem, A., R. L. Gibson, and A. G. Sena, 1991, Green's tensor and radiation patterns of point sources in general anisotropic inhomogeneous elastic media: *Geophysical Journal International*, **107**, 297–308.
- Berryman, J. G., 1979, Long-wave elastic anisotropy in transversely isotropic media: *Geophysics*, **44**, 896–917.
- Berryman, J. G., V. Grechka, and P. A. Berge, 1999, Analysis of Thomsen parameters for finely layered VTI media: *Geophysical Prospecting*, **47**, 959–978.
- Black, J. L., K. L. Schleicher, and L. Zhang, 1993, True-amplitude imaging and dip moveout: *Geophysics*, **58**, 47–66.
- Bleistein, N., 1984, *Mathematical methods for wave phenomena*: Academic Press.
- , 1990, Born DMO revisited: 60th Annual International Meeting, SEG, Expanded Abstracts, 1366–1369.
- Booth, D. C., and S. Crampin, 1983, The anisotropic reflectivity technique: Theory: *Geophysical Journal of the Royal Astronomical Society*, **72**, 755–766.
- Byun, B. S., 1982, Seismic parameters for media with elliptical velocity dependencies: *Geophysics*, **47**, 1621–1626.

- Byun, B. S., and D. Corrigan, 1990, Seismic travelttime inversion for transverse isotropy: *Geophysics*, **55**, 192–200.
- Byun, B. S., D. Corrigan, and J. E. Gaiser, 1989, Anisotropic velocity analysis for lithology discrimination: *Geophysics*, **54**, 1564–1574.
- Castle, R. J., 1994, A theory of normal moveout: *Geophysics*, **59**, 983–999.
- Červený, V., 1972, Seismic rays and ray intensities in inhomogeneous anisotropic media: *Journal of Geophysics*, **28**, 1–13.
- Červený, V., and I. Pšenčík, 1984, Gaussian beams in elastic 2-D laterally varying layered structures: *Geophysical Journal of the Royal Astronomical Society*, **78**, 65–91.
- Chapman, C. H., and R. G. Pratt, 1992, Traveltime tomography in anisotropic media—I. Theory: *Geophysical Journal International*, **109**, 1–19.
- Cheadle, S. P., R. J. Brown, and D. C. Lawton, 1991, Orthorhombic anisotropy: A physical modeling study: *Geophysics*, **56**, 1603–1613.
- Chesnokov, E. M., and S. S. Abaseev, 1986, Theoretical seismograms of surface waves in anisotropic media: *Reports of the Soviet Academy of Sciences (USSR)*, **286**, 592–597 (in Russian).
- Cohen, J. K., 1997, Analytic study of the effective parameters for determination of the NMO velocity function in transversely isotropic media: *Geophysics*, **62**, 1855–1866.
- , 1998, A convenient expression for the NMO velocity function in terms of ray parameter: *Geophysics*, **63**, 275–278.
- Contreras, P., V. Grechka, and I. Tsvankin, 1999, Moveout inversion of P-wave data for horizontal transverse isotropy: *Geophysics*, **64**, 1219–1229.
- Crampin, S., 1985, Evidence for aligned cracks in the earth's crust: *First Break*, **3**, 12–15.
- , 1991, Effects of singularities on shear-wave propagation in sedimentary basins: *Geophysical Journal International*, **107**, 531–543.
- Crampin, S., and M. Yedlin, 1981, Shear-wave singularities of wave propagation in anisotropic media: *Journal of Geophysics*, **49**, 43–46.
- de Bazelaire, E., and J. R. Viallix, 1994, Normal moveout in focus: *Geophysical Prospecting*, **42**, 477–499.
- Dellinger, J., and F. Muir, 1988, Imaging reflections in elliptically anisotropic media: *Geophysics*, **53**, 1616–1618.
- , 1993, Dix revisited: A formalism for rays in layered media: *Canadian Journal of Exploration Geophysics*, **29**, 93–97.
- Desegaulx, P., J. Piazz, J. Esteve, and J. Jeannot, 1994, Uncertainties in depth imaging: A multitechnique approach on real data: 64th Annual International Meeting, SEG, Expanded Abstracts, 695–698.
- Dix, C. H., 1955, Seismic velocities from surface measurements: *Geophysics*, **20**, 68–86.

- Duren, R. E., 1992, Range-equation weights for AVO: *Geophysics*, **57**, 1203–1208.
- Fedorov, F. I., 1968, *Theory of elastic waves in crystals*: Plenum Press.
- Fowler, P., 1984, Velocity independent imaging of seismic reflectors: 54th Annual International Meeting, SEG, Expanded Abstracts, 383–385.
- , 1988, Seismic velocity estimation using prestack time migration: Ph.D. thesis, Stanford University.
- Fryer, G. J., and L. N. Frazer, 1987, Seismic waves in stratified anisotropic media. Elastodynamic eigensolutions for some anisotropic systems: *Geophysical Journal of the Royal Astronomical Society*, **91**, 73–101.
- Fuchs, K., 1971, The method of stationary phase applied to the reflection of spherical waves from the transition zones with arbitrary depth dependent elastic moduli and density: *Journal of Geophysics*, **37**, 89–117.
- Gaiser, J. E., 1996, Multicomponent V_P/V_S correlation analysis: *Geophysics*, **61**, 1137–1149.
- Gaiser, J. E., 1999, Applications for vector coordinate systems of 3-D converted-wave data: *The Leading Edge*, **18**, 1290–1300.
- Gajewski, D., 1993, Radiation from point sources in general anisotropic media: *Geophysical Journal International*, **113**, 299–317.
- Gajewski, D., and I. Pšenčík, 1987, Computation of high frequency seismic wavefields in 3-D laterally inhomogeneous anisotropic media: *Geophysical Journal of the Royal Astronomical Society*, **91**, 383–412.
- Gazdag, J., 1978, Wave equation migration with the phase-shift method: *Geophysics*, **43**, 1342–1351.
- Gidlow, P. W., and J. L. Fatti, 1990, Preserving far offset seismic data using non-hyperbolic moveout correction: 60th Annual International Meeting, SEG, Expanded Abstracts, 1726–1729.
- Graebner, M., 1992, Plane-wave reflection and transmission coefficients for a transversely isotropic solid: *Geophysics*, **57**, 1512–1519.
- Granli, J. R., B. Arntsen, A. Sollid, and E. Hilde, 1999, Imaging through gas-filled sediments using marine shear-wave data: *Geophysics*, **64**, 668–677.
- Grechka, V., 2009, Applications of seismic anisotropy in the oil and gas industry: EAGE.
- Grechka, V., G. A. McMechan, and V. A. Volovodenco, 1996, Solving 1-D inverse problems by Chebyshev polynomial expansion: *Geophysics*, **61**, 1758–1768.
- Grechka, V., and I. Obolentseva, 1993, Geometrical structure of shear wave surfaces near singularity directions in anisotropic media: *Geophysical Journal International*, **115**, 609–616.
- Grechka, V., A. Pech, and I. Tsvankin, 2002, P-wave stacking-velocity tomography for VTI media: *Geophysical Prospecting*, **50**, 151–168.

- Grechka, V., S. Theophanis, and I. Tsvankin, 1999a, Joint inversion of P- and PS-waves in orthorhombic media: Theory and a physical-modeling study: *Geophysics*, **64**, 146–161.
- Grechka, V., and I. Tsvankin, 1998a, Feasibility of nonhyperbolic moveout inversion in transversely isotropic media: *Geophysics*, **63**, 957–969.
- , 1998b, 3-D description of normal moveout in anisotropic inhomogeneous media: *Geophysics*, **63**, 1079–1092.
- , 1999a, 3-D moveout velocity analysis and parameter estimation for orthorhombic media: *Geophysics*, **64**, 820–837.
- , 1999b, 3-D moveout inversion in azimuthally anisotropic media with lateral velocity variation: Theory and a case study: *Geophysics*, **64**, 1202–1218.
- , 2000, Inversion of azimuthally dependent NMO velocity in transversely isotropic media with a tilted axis of symmetry: *Geophysics*, **65**, 232–246.
- Grechka, V., I. Tsvankin, and J. K. Cohen, 1999b, Generalized Dix equation and analytic treatment of normal-moveout velocity for anisotropic media: *Geophysical Prospecting*, **47**, 117–148.
- Guest, W. S., and J.-M. Kendall, 1993, Modelling seismic waveforms in anisotropic inhomogeneous media using ray and Maslov asymptotic theory: Applications to exploration seismology: *Canadian Journal of Exploration Geophysics*, **29**, 78–92.
- Hake, H., K. Helbig, and C. S. Mesdag, 1984, Three-term Taylor series for $t^2 - x^2$ curves over layered transversely isotropic ground: *Geophysical Prospecting*, **32**, 828–850.
- Hale, D., 1984, Dip-moveout by Fourier transform: *Geophysics*, **49**, 741–757.
- , 1992, Migration by the Kirchhoff, slant stack, and Gaussian beam methods: Center for Wave Phenomena Research Report (CWP-121).
- Hale, D., and C. Artley, 1993, Squeezing dip moveout for depth-variable velocity: *Geophysics*, **58**, 257–264.
- Hale, D., N. R. Hill, and J. Stefani, 1992, Imaging salt with turning seismic waves: *Geophysics*, **57**, 1453–1462.
- Han, B., T. Galikeev, V. Grechka, J. Le Rousseau, and I. Tsvankin, 2000, A synthetic example of anisotropic P-wave processing for a model from the Gulf of Mexico, *in* L. Ikelle and A. Gangi, eds., *Anisotropy 2000: Fractures, converted waves and case studies*: Proceedings of the 9th International Workshop on Seismic Anisotropy (9IWSA), SEG.
- Hanyga, A., 1984, Point source in anisotropic elastic medium: *Gerlands Beitrage zur Geophysik*, **93**, 463–479.
- , 1986, Gaussian beams in anisotropic elastic media: *Geophysical Journal of the Royal Astronomical Society*, **85**, 473–563.

- Helbig, K., 1966, A graphical method for the construction of rays and traveltimes in spherically layered media. Part 2: Anisotropic case, theoretical considerations: *Bulletin of the Seismological Society of America*, **56**, 527–559.
- , 1983, Elliptical anisotropy—its significance and meaning: *Geophysics*, **48**, 825–832.
- , 1993, Longitudinal directions in media with arbitrary anisotropy: *Geophysics*, **58**, 680–691.
- , 1994, *Foundations of elastic anisotropy for exploration seismics*: Pergamon Press.
- Helbig, K., and M. Schoenberg, 1987, Anomalous polarization of elastic waves in transversely isotropic media: *Journal of the Acoustical Society of America*, **81**, 1235–1245.
- Hill, N. R., 1990, Gaussian beam migration: *Geophysics*, **55**, 1416–1428.
- Hubral, P., and T. Krey, 1980, Interval velocities from seismic reflection time measurements: SEG.
- Isaac, J. H., and D. C. Lawton, 1999, Image mispositioning due to dipping TI media: A physical seismic modeling study: *Geophysics*, **64**, 1230–1238.
- Jech, J., and I. Pšenčík, 1989, First-order perturbation method for anisotropic media: *Geophysical Journal of the Royal Astronomical Society*, **99**, 367–376.
- Keith, C. M., and S. Crampin, 1977, Seismic body waves in anisotropic media: Reflection and refraction at a plane interface: *Geophysical Journal of the Royal Astronomical Society*, **49**, 181–208.
- Kim, K. Y., K. H. Wroldstad, and F. Aminzadeh, 1993, Effects of transverse isotropy on P-wave AVO for gas sands: *Geophysics*, **58**, 883–888.
- Kiselev, A. P., 1983, Extrinsic components of elastic waves: *News of the Soviet Academy of Sciences, Physics of the Solid Earth*, **9**, 51–56 (in Russian).
- Kiselev, A. P., and I. Tsvankin, 1989, A method of comparison of exact and asymptotic wave field computations: *Geophysical Journal International*, **96**, 253–258.
- Kitchenside, P., 1991, Phase shift-based migration for transverse isotropy: 61st Annual International Meeting, SEG, Expanded Abstracts, 993–996.
- Korn, G., and T. Korn, 1968, *Mathematical handbook for scientists and engineers*: McGraw-Hill.
- Kumazawa, M., and O. L. Anderson, 1969, Elastic moduli, pressure derivatives and temperature derivatives of single crystal olivine and single crystal forsterite: *Journal of Geophysical Research*, **74**, 5961–5972.
- Larner, K., 1993, Dip-moveout error in transversely isotropic media with linear velocity variation in depth: *Geophysics*, **58**, 1442–1453.
- Larner, K. and J. K. Cohen, 1993, Migration error in factorized transversely isotropic media with linear velocity variation in depth: *Geophysics*, **58**, 1454–1467.

- Leary, P. C., S. Crampin, and T. V. McEvilly, 1990, Seismic fracture anisotropy in the earth's crust: An overview: *Journal of Geophysical Research*, **95** (B7), 11105–11114.
- Le Stunff, Y., V. Grechka, and I. Tsvankin, 2001, Depth-domain velocity analysis in VTI media using surface P-wave data: Is it feasible?: *Geophysics*, **66**, 897–903.
- Levin, F. K., 1971, Apparent velocity from dipping interface reflections: *Geophysics*, **36**, 510–516.
- , 1989, SV-wave velocities from P-P and P-SV data for transversely isotropic solids: *Geophysics*, **54**, 1336–1338.
- , 1990, Reflection from a dipping plane—Transversely isotropic solid: *Geophysics*, **55**, 851–855.
- Liner, C. L., 1990, General theory and anatomy of dip moveout: *Geophysics*, **55**, 595–607.
- Lynn, H., K. Simon, C. Bates, and R. Van Doc, 1996, Azimuthal anisotropy in P-wave 3-D (multiazimuth) data: *The Leading Edge*, **15**, 923–928.
- Lynn, W., A. Gonzalez, and S. MacKay, 1991, Where are the fault-plane reflections?: 61st Annual International Meeting, SEG, Expanded Abstracts, 1151–1154.
- MacBeth, C., 2002, Multi-component VSP analysis for applied seismic anisotropy: Pergamon Press.
- Martinez, R. D., 1993, Wave propagation effects on amplitude variation with offset measurements: A modeling study: *Geophysics*, **58**, 534–543.
- Martynov, V. N., and B. G. Mikhailenko, 1984, Numerical modelling of elastic waves in anisotropic inhomogeneous media for the halfspace and the sphere: *Geophysical Journal of the Royal Astronomical Society*, **76**, 53–63.
- Meadows, M., and W. Abriel, 1994, 3-D poststack phase-shift migration in transversely isotropic media, 64th Annual International Meeting, SEG, Expanded Abstracts, 1205–1208.
- Mensch, T., and P. Rasolofosaon, 1997, Elastic-wave velocities in anisotropic media of arbitrary symmetry—generalization of Thomsen's parameters ϵ , δ , and γ : *Geophysical Journal International*, **128**, 43–64.
- Musgrave, M. J. P., 1970, *Crystal acoustics*: Holden Day.
- Nolte, B., D. V. Sukup, P. M. Krail, B. O. Temple, and B. Cafarelli, 2000, Anisotropic 3D prestack depth imaging of the Donald field with converted waves: 70th Annual International Meeting, SEG, Expanded Abstracts, 1158–1161.
- Notfors, C. D., and R. J. Godfrey, 1987, Dip moveout in the frequency-wavenumber domain: *Geophysics*, **52**, 1718–1721.
- Payton, R. G., 1983, *Elastic wave propagation in transversely isotropic media*: Martinus Nijhoff Publishers.
- Phadke, S., S. Kapotas, N. Dai, and E. R. Kanasewich, 1994, Migration of P-wave reflection data in transversely isotropic media: *Geophysics*, **59**, 591–596.

- Pšenčík, I., and D. Gajewski, 1998, Polarization, phase velocity, and NMO velocity of qP -waves in arbitrary weakly anisotropic media: *Geophysics*, **63**, 1754–1766.
- Radovich, B. J., and F. K. Levin, 1982, Instantaneous velocities and reflection times for transversely isotropic solids: *Geophysics*, **47**, 316–322.
- Robertson, J. D., and D. Corrigan, 1983, Radiation patterns of a shear-wave vibrator in a near-surface shale: *Geophysics*, **48**, 19–26.
- Rommel, B. E., 1994, Approximate polarization of plane waves in a medium having weak transverse isotropy: *Geophysics*, **59**, 1605–1612.
- Rommel, B. E., and I. Tsvankin, 2000, Analytic description of P-wave ray direction and polarization in orthorhombic media, *in* L. Ikelle and A. Gangi, eds., *Anisotropy 2000: Fractures, converted waves and case studies: Proceedings of the 9th International Workshop on Seismic Anisotropy (9IWSA)*, SEG.
- Rüger, A., 1997, P-wave reflection coefficients for transversely isotropic models with vertical and horizontal axis of symmetry: *Geophysics*, **62**, 713–722.
- , 1998, Variation of P-wave reflectivity with offset and azimuth in anisotropic media: *Geophysics*, **63**, 935–947.
- , 2002, Reflection coefficients and azimuthal AVO analysis in anisotropic media: SEG.
- Rüger, A., and I. Tsvankin, 1997, Using AVO for fracture detection: Analytic basis and practical solutions: *The Leading Edge*, **16**, 1429–1434.
- Rutherford, S. R., and M. W. Williams, 1989, Amplitude-versus-offset variations in gas sands: *Geophysics*, **54**, 680–688.
- Sams, M. S., M. H. Worthington, and M. S. Khanshir, 1993, A comparison of laboratory and field measurements of P-wave anisotropy: *Geophysical Prospecting*, **41**, 189–206.
- Sarkar, D., B. Lamb, and J. Castagna, 1999, AVO and velocity analysis: 69th Annual International Meeting, SEG, Expanded Abstracts, 840–843.
- Sayers, C. M., 1994a, The elastic anisotropy of shales: *Journal of Geophysical Research*, **99** (B1), 767–774.
- , 1994b, P-wave propagation in weakly anisotropic media: *Geophysical Journal International*, **116**, 799–805.
- Sayers, C. M., and D. A. Ebrom, 1997, Seismic traveltime analysis for azimuthally anisotropic media: Theory and experiment: *Geophysics*, **36**, 1570–1582.
- Sayers, C. M., and J. E. Rickett, 1997, Azimuthal variation in AVO response for fractured gas sands: *Geophysical Prospecting*, **45**, 165–182.
- Schoenberg, M., and K. Helbig, 1997, Orthorhombic media: Modeling elastic wave behavior in a vertically fractured earth: *Geophysics*, **62**, 1954–1974.
- Sena, A. G., 1991, Seismic traveltime equations for azimuthally anisotropic and isotropic media: Estimation of interval elastic properties: *Geophysics*, **56**, 2090–2101.

- Sena, A. G., and M. N. Toksöz, 1993, Kirchhoff migration and velocity analysis for converted and nonconverted waves in anisotropic media: *Geophysics*, **58**, 265–276.
- Seriff, A. J., and K. P. Sriram, 1991, P-SV reflection moveouts for transversely isotropic media with a vertical symmetry axis: *Geophysics*, **56**, 1271–1274.
- Sexton, P., and P. Williamson, 1998, 3D anisotropic velocity estimation by model-based inversion of prestack traveltimes: 68th Annual International Meeting, SEG, Expanded Abstracts, 1855–1858.
- Shah, P. M., 1973, Use of wavefront curvature to relate seismic data with subsurface parameters: *Geophysics*, **38**, 812–825.
- Siliqi, R., and N. Bousqué, 2000, Anelliptic time processing based on a shifted hyperbola approach: 70th Annual International Meeting, SEG, Expanded Abstracts, 2245–2248.
- Stolt, R. H., 1978, Migration by Fourier transform: *Geophysics*, **43**, 23–48.
- Taner, M. T., and F. Koehler, 1969, Velocity spectra—digital computer derivation and applications of velocity functions: *Geophysics*, **34**, 859–881.
- Taylor, D. B., 1987, Double contour integration for transmissions from point sources through anisotropic layers as used in ROCPAC software: *Geophysical Journal of the Royal Astronomical Society*, **91**, 373–382.
- Tessmer, G., and A. Behle, 1988, Common reflection point data-stacking technique for converted waves: *Geophysical Prospecting*, **36**, 671–688.
- Thomsen, L., 1986, Weak elastic anisotropy: *Geophysics*, **51**, 1954–1966.
- , 1988, Reflection seismology over azimuthally anisotropic media: *Geophysics*, **53**, 304–313.
- , 1993, Weak anisotropic reflections, *in* J. Castagna and M. Backus, eds., *Offset dependent reflectivity*: SEG, 103–114.
- , 1999, Converted-wave reflection seismology over inhomogeneous, anisotropic media: *Geophysics*, **64**, 678–690.
- , 2002, *Understanding seismic anisotropy in exploration and exploitation*: SEG/EAGE Distinguished Instructor Series.
- Toldi, J., T. Alkhalifah, P. Berthet, J. Arnaud, P. Williamson, and B. Conche, 1999, Case study of estimation of anisotropy: *The Leading Edge*, **18**, 588–594.
- Tsvankin, I., 1995a, Normal moveout from dipping reflectors in anisotropic media: *Geophysics*, **60**, 268–284.
- , 1995b, Body-wave radiation patterns and AVO in transversely isotropic media: *Geophysics*, **60**, 1409–1425.
- , 1995c, *Seismic wavefields in layered isotropic media (course notes)*: Samizdat Press (<http://samizdat.mines.edu>).
- , 1996, P-wave signatures and notation for transversely isotropic media: An overview: *Geophysics*, **61**, 467–483.

- , 1997a, Reflection moveout and parameter estimation for horizontal transverse isotropy: *Geophysics*, **62**, 614–629.
- , 1997b, Moveout analysis for transversely isotropic media with a tilted symmetry axis: *Geophysical Prospecting*, **45**, 479–512.
- , 1997c, Anisotropic parameters and P-wave velocity for orthorhombic media: *Geophysics*, **62**, 1292–1309.
- Tsvankin, I., and E. M. Chesnokov, 1987, Plane wave propagation in nonlinear-elastic anisotropic media: *Geophysical Journal of the Royal Astronomical Society*, **91**, 413–427.
- , 1990a, Synthesis of body-wave seismograms from point sources in anisotropic media: *Journal of Geophysical Research*, **95** (B7), 11317–11331.
- , 1990b, Synthetic waveforms and polarizations at the free surface of an anisotropic halfspace: *Geophysical Journal International*, **101**, 497–505.
- Tsvankin, I., and V. Grechka, 2000, Dip moveout of converted waves and parameter estimation in transversely isotropic media: *Geophysical Prospecting*, **48**, 257–292.
- , 2011, *Seismology of azimuthally anisotropic media and seismic fracture characterization*: SEG.
- Tsvankin, I., and L. Thomsen, 1994, Nonhyperbolic reflection moveout in anisotropic media: *Geophysics*, **59**, 1290–1304.
- , 1995, Inversion of reflection traveltimes for transverse isotropy: *Geophysics*, **60**, 1095–1107.
- Uren, N. F., G. N. F. Gardner, and J. A. McDonald, 1990a, Dip moveout in anisotropic media: *Geophysics*, **55**, 863–867.
- , 1990b, Normal moveout in anisotropic media: *Geophysics*, **55**, 1634–1636.
- Uzcategui, O., 1995, 2-D depth migration in transversely isotropic media using explicit operators: *Geophysics*, **60**, 1819–1829.
- Uzcategui, O., and D. L. Mujica, 1995, Anisotropic poststack depth migration, eastern Venezuela: 65th Annual International Meeting, SEG, Expanded Abstracts, 1171–1174.
- Van der Hijden, J. H. M. T., 1987, *Propagation of transient elastic waves in stratified anisotropic media*: North Holland Publishing Company.
- Vavryčuk, V., 1999, Properties of S-waves near a kiss singularity: A comparison of exact and ray solutions: *Geophysical Journal International*, **138**, 581–589.
- Vavryčuk, V., and I. Pšenčík, 1998, PP-wave reflection coefficients in weakly anisotropic elastic media: *Geophysics*, **63**, 2129–2141.
- VerWest, B. J., 1989, Seismic migration in elliptically anisotropic media: *Geophysical Prospecting*, **37**, 149–166.
- Vestrum, R. W., D. C. Lawton, and R. Schmid, 1999, Imaging structures below dipping TI media: *Geophysics*, **64**, 1239–1246.

- Wild, P., and S. Crampin, 1991, The range of effects of azimuthal isotropy and EDA anisotropy in sedimentary basins: *Geophysical Journal International*, **107**, 513–529.
- Winterstein, D. F., and M. A. Meadows, 1991, Shear-wave polarizations and subsurface stress directions at Lost Hills field: *Geophysics*, **56**, 1331–1348.
- Wright, J., 1987, The effects of transverse isotropy on reflection amplitude versus offset: *Geophysics*, **52**, 564–567.

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Author Index

- Abaseev, 104
Abriel, 153, 385, 417
Aki, 1, 2, 8, 66, 79, 82, 83, 91, 103, 104, 386
Al-Chalabi, 176, 181
Al-Dajani, 165, 176, 185
Aleksiev, 62
Alfaraj, 203
Alford, xv, 351
Alkhalifah, xvi, 20, 153, 178, 189, 254, 265, 294, 302, 305, 312, 329, 358, 373, 385, 387, 389–391, 410, 414, 416, 417
Anderson, 355, 359, 360, 365, 369, 372, 374, 375
Artley, 303, 305, 368
Auld, xv, xvi, 20
- B**
Bakulin, 9, 10, 12, 36, 37
Ball, 153, 385, 416
Banik, 81, 91, 156
Bartel, 417
Bednar, 215, 219, 231, 351
Behle, 211, 229
Ben-Menahem, 62, 98, 100
Berryman, 5, 20, 57
Black, 371, 372
Bleistein, 64, 371, 372, 376
Booth, 62
Bousqué, 173
Byun, xvi, 183
- C**
Castle, 173
Cervený, 62, 390, 391
Chapman, 47
Cheadle, 41
Chesnokov, 62–65, 67, 79, 85, 100, 104
Cohen, 112, 128, 235, 261, 265, 385
Corrigan, 98, 101, 102, 183
Crampin, xv, 4, 38, 39, 46, 62, 79, 81
- D**
De Bazelaire, 173
Dellinger, 173, 269, 273
Desegaulx, 156
Dix, xvii, 149, 293
Duren, 81
- F**
Fatti, 185
Fedorov, xv, xvi, 8
Fowler, xviii, 288, 312, 353–355, 359
Frazer, 62, 63, 100
Fryer, 62, 63, 100
Fuchs, 64
- G**
Gaiser, 199, 213, 351
Gajewski, 41, 62, 64, 77, 98, 102
Gazdag, xviii, 264, 385–387
Gidlow, 185
Godfrey, 384
Graebner, 81
Granli, xvi, 199
Grechka, xiii, 38, 40, 46, 49, 65, 100, 156, 160, 161, 164, 165, 185, 189, 199, 204, 225, 227, 235, 247, 262–264, 282, 294, 297, 312, 313, 316, 323, 327, 335, 337, 338, 347, 351, 389, 417
- Guest, 62
- H**
Hake, 176, 180, 181
Hale, xviii, 159, 166, 171, 255, 303, 305, 354, 368–372, 375, 376, 384, 390
Han, 294, 400, 403
Hanyga, 103, 390, 391
Helbig, xv, xvi, 1, 4–6, 8, 10, 19, 35–38, 43, 46, 51, 56, 190, 269, 273
Hill, 389–391
Hubral, 166, 207
- I**
Isaac, 130, 272
- J**
Jech, 47, 396
- K**
Keith, 81

- Kendall, 62
 Kim, 82, 92, 94
 Kiselev, 67, 77
 Kitchenside, xvi, 358, 385
 Koehler, 109, 181, 316
 Korn, 56
 Krey, 166, 207
 Kumazawa, 67
- L**
 Larner, 128, 265, 368, 385, 387
 Lawton, 130, 272
 Le Stunff, 269, 347, 353
 Leary, 111
 Levin, 111–113, 116, 159, 160, 190,
 192, 229, 355
 Liner, 384
 Lynn, H., 164
 Lynn, W., xvi, 287, 302
- M**
 MacBeth, xiii, xviii
 Martinez, 82
 Martynov, 62, 79
 Meadows, 9, 153, 385, 417
 Mensch, 41, 46, 47
 Mikhailenko, 62, 79
 Muir, 173, 269, 273
 Mujica, 156, 385
 Musgrave, xv, xvi, 1, 4–6, 8, 20, 46,
 103, 190
- N**
 Nolte, 350
 Notfors, 384
- O**
 Obolentseva, 38, 65
- P**
 Payton, 1
 Phadke, 385
 Pratt, 47
 Pšenčík, 41, 47, 62, 77, 91, 390, 396
- R**
 Radovich, 192
 Rasolofosaon, 41, 46, 47
 Richards, 1, 2, 8, 66, 79, 82, 83, 91,
 103, 104, 386
 Robertson, 98, 101, 102
 Rommel, 35, 51, 54, 74
 Rüger, xiii, 38, 46, 81, 82, 91–94, 100
- S**
 Sams, 20
- S**
 Sarkar, 215
 Sayers, 11, 47
 Schoenberg, 19, 35–37, 43, 51, 56
 Sena, 183, 385
 Serif, 207, 229
 Sexton, 334
 Shah, 149
 Siliqi, 173
 Sriram, 207, 229
 Stolt, xviii, 354–356, 358, 387
- T**
 Taner, 109, 181, 316
 Taylor, 62
 Tessmer, 211, 229
 Thomsen, xiii, xv, xvi, 1, 2, 17–24, 26,
 36, 40–44, 46, 49, 51, 54, 55, 81,
 82, 91, 92, 102, 107, 113, 116,
 118, 131, 136, 143, 153, 161,
 162, 174, 176, 179, 180, 184,
 187, 190, 193, 199, 219, 227,
 228, 232, 253, 270, 287, 336,
 345, 361, 389, 392
- Toksöz, 385
 Toldi, 333, 413
 Tsvankin, xiii, xvi, 21, 35–38, 46, 49,
 51, 54, 62–65, 67, 74, 77, 79, 82,
 85, 87, 91, 100, 104, 110, 115,
 130, 131, 153, 156, 160, 161,
 164, 165, 176, 178, 180, 184,
 185, 189, 199, 227, 228, 232,
 254, 263, 264, 282, 312, 313,
 316, 323, 327, 335–338, 351,
 368, 369, 372, 374, 375, 417
- U**
 Uren, 140, 177, 273
 Uzcategui, 156, 385
- V**
 Van der Hijden, 62
 Vavryčuk, 91, 95, 100
 Vestrum, 272
 Viallix, 173
- W**
 Wild, 46
 Williamson, 334
 Winterstein, 9
 Wright, 81
- Y**
 Yedlin, 38, 39

Subject Index

- Acquisition, 199, 219, 270, 288, 315, 340
- Aliasing, 356, 359
- Amplitude, 38, 54, 61, 62, 64, 67, 77, 79–81, 105, 107, 253, 269, 271, 288, 316, 361, 386, 390, 392
- focusing caused by anisotropy, 30, 32, 61, 66, 67, 71, 80, 82, 84, 95, 100, 101, 392
 - of converted waves, 199, 215, 219, 351
 - preservation in DMO, 371, 375, 384
- Amplitude variation with offset (AVO), 81, 335
- AVO gradient, 91, 94, 101
 - for converted waves, 215
 - for P-waves, 84, 91, 101, 271
 - for S-waves, 94, 101
- Anisotropic symmetry, 1
- general TI, 11, 14, 21, 34, 69
 - HTI, 12, 14, 38, 44, 110, 130, 132, 159, 161, 176, 177
 - monoclinic, 9, 10
 - orthorhombic, 9, 10, 12, 14, 35, 36, 67, 85, 95, 110, 111, 115, 149, 152, 161, 177, 178, 187, 208, 228, 232, 288, 340, 351, 369, 384
 - tilted TI, 12, 112, 130, 159, 168, 208, 272, 285, 384, 397
 - triclinic, 8, 9
 - VTI, 11, 12, 14, 17, 21, 34, 37, 44, 51, 61, 67, 72, 81, 105, 113, 132, 151, 152, 159, 163, 164, 173, 176, 177, 181, 185, 190, 195, 197, 200, 207, 208, 228, 241, 254, 264, 269, 283, 287, 353
- Anisotropy parameters
- for HTI media, 44, 164
 - for orthorhombic media, 40, 44, 46, 51, 67, 69, 72, 115, 162, 164, 165
 - for VTI media, *see* Thomsen parameters
- parameter η , 22, 119, 178, 181, 185, 197, 253, 260–264, 269–272, 288, 289, 312, 334, 353, 354, 369, 387, 389, 400, 403, 405, 406, 409, 410, 414, 417
- parameter η for tilted TI media, 274
- Aperture, 265, 360, 361, 402, 405
- Apparent dip, 124, 274
- Attenuation, 81, 199
- Azimuthal anisotropy, 6, 8–10, 12, 36, 62, 64, 67, 72, 74, 77, 80, 111, 115, 130, 156, 161, 176, 185, 223, 272, 351
- C-waves**, 219
- Chebyshev polynomials, 294, 297, 310, 402
- Check shots, 152, 153, 271, 334, 353, 389, 406
- Christoffel equation, 3–5, 7, 11, 14, 16, 34, 36–39, 41, 51, 56, 57, 61, 63, 65, 104, 203, 204, 206, 209, 223, 234, 241, 255, 392
- Christoffel matrix, 3, 4, 8, 14, 16, 37, 39, 57, 66, 89, 104, 106
- Common-conversion-point (CCP)
- gather, 199, 204, 221, 223, 231, 233, 250, 340, 345, 347, 350
- Compliance tensor, 2
- Conversion-point dispersal, 200, 204, 231, 340, 345, 350
- Converted waves, 199, 288, 334
- Cracks (microcracks), 1, 62
- penny-shaped, 12
- Critical angle, 315
- for converted waves, 230
- Crosshole survey, 34, 82, 270, 287, 288
- Cusp (triplcation) on shear wavefront, 5, 34, 38, 51, 62, 79, 100, 102, 111, 135, 158, 190, 200, 231

- Data processing**, 18, 20, 34, 81, 110, 111, 130, 272, 287, 353
 depth-domain, 152, 271, 273, 334, 389, 400
 for converted waves, 200, 334
 time-domain, 178, 264, 270, 273, 280, 289, 312, 354, 369, 385, 400, 410
- Density**, 2, 4, 56, 81, 91, 103, 216
- Dipping layer**, 12, 112, 130, 272
- Dipping reflector**, 49, 110, 114, 115, 118, 130, 159, 169, 200, 208, 219, 233, 239, 241, 246, 250, 254, 265, 269, 271, 272, 283, 285, 289, 337, 346, 354, 369, 387, 389, 392, 400, 410
- Displacement**, 2
 for plane waves, 3, 37, 38, 63–65, 105, 106
 from a point source, *see* Green's function
- Dix equation**
 2D, anisotropic, 130, 144, 149, 151, 159, 169, 170, 261, 282, 291, 293, 310, 384, 400, 402, 410
 3D, anisotropic, 264, 297
 conventional, 149, 151–154, 163, 181, 185, 189, 197, 291, 293, 322, 323, 327, 336, 340, 350
 for converted waves, 207, 225, 227
 for quartic moveout term, 181, 182, 189, 197, 312, 322, 323, 327, 333
- DMO**
 Fowler, 353, 354
 Hale, 354, 369
 Transformation to zero offset, *see* TZO
- Eigenvalue**, 4, 16, 63, 156, 159, 172
- Eigenvector**, 4, 16, 34, 63, 66, 158, 172
- Elliptical anisotropy**, 15, 16, 22–24, 28, 30, 39, 44, 45, 85, 89, 91, 95, 98, 100, 102, 113–115, 118, 119, 124, 125, 131, 140, 156, 161, 173, 177, 181, 183, 187, 212, 253, 255, 256, 261–263, 269, 271, 272, 279, 280, 283, 285, 335, 342, 357
- Equivalence**
 Orthorhombic/HTI, 14, 37, 162, 164, 177
 Orthorhombic/VTI, 11, 14, 37, 40, 44, 47, 51, 69, 72, 81, 162, 163, 165, 177, 178, 187, 208, 228, 232, 288, 351, 369
- Factorized medium**, 125, 136, 305, 387, 392, 394, 395
- Fault-plane reflection**, 151, 287, 291, 302, 310, 340, 350, 365, 387, 389, 400, 410
- Fermat's principle**, 237
- Field-data examples**, 153, 302, 327, 365, 410, 417
- Finite-difference modeling**, 62, 399, 400
- Focusing**
 of amplitude, *see* Amplitude focusing
 of imaged reflections, 266, 303, 305, 354, 361, 365, 369, 385, 387, 396, 400, 405, 406, 409, 414, 416
- Fractures**, 1, 10, 12, 111, 163
 microcorrugated, 9
 multiple sets, 9, 10
- Frequency**, 3, 5, 63–65, 98, 105, 217, 321, 355, 358–360, 386, 391, 394, 396
- Frequency domain**, 65, 80, 386, 390
- Frequency spectrum**, 103
- Frequency-wavenumber domain**, 305, 354–356, 359, 368, 370, 386
- Gaussian noise**, 296, 338, 342, 347, 349
- Geometrical seismics**, 54, 64, 67, 77, 81, 132
- Green's function**, 62, 103
 far-field approximation, 64, 82, 105
- Group angle**, 5, 21, 65, 66, 69, 80, 166, 233, 234
 for orthorhombic media, 38, 46, 54, 67, 69, 71, 72, 77

- for TI media, 26, 34, 82–85, 89, 98, 102, 107, 132, 194, 195, 241–243, 258
- Group velocity, 5, 57, 65, 69, 233, 247
 - for orthorhombic media, 38, 45, 49, 51
 - for TI media, 26, 95, 132, 136, 192, 195, 210, 241, 242, 258, 270, 271
- Group-velocity surface, 15, 38, 51
- Group-velocity vector, 4, 5, 16, 24, 26, 57, 63, 74, 80, 82, 110, 111, 131, 135, 166, 167, 169, 201, 203, 205, 223, 234, 235, 247, 391
- Head wave**, 288
- Helmholtz equation, 386
- Heterogeneity, 1, 3, 82, 156, 171, 173, 235, 365, 369, 389, 392, 413
 - vertically heterogeneous media, 125, 128, 144, 159, 169, 282, 291, 305, 310, 329, 333, 336, 358, 368, 384, 386, 387, 410
- Hooke's law, 2, 3, 17
- Horizontal slowness, *see* Ray parameter
- Horizontal transverse isotropy (HTI), *see* Anisotropic symmetry, HTI
- Intrinsic anisotropy**, 1, 11, 20, 305, 333, 365, 410
- Inversion**
 - field-data examples, 302, 327, 365, 410
 - joint of P and PS data, 334
 - of dip moveout, 256, 289, 387, 400, 410
 - of NMO ellipse, *see* NMO ellipse
 - of NMO velocity, *see* NMO velocity
 - of nonhyperbolic moveout, 312
 - stability issues, 289, 291, 294, 297, 299, 300, 302, 310, 312, 315, 317, 327, 333, 335–337, 342, 346, 347, 402
 - using Fowler DMO, 356
- Jacobian** (for DMO), 370–373, 384
- Lamé's constants**, 13
- Layered media, 144, 149, 159, 169, 180, 185, 189, 190, 197, 219, 228, 250, 261, 269, 282, 291, 310, 321, 329, 333, 340
- Longitudinal direction, 5
- Mapping**, *see* Resampling
- Migration**
 - finite-difference, 403
 - Gaussian beam, 385, 389, 416
 - Gazdag, 264, 265, 385, 414
 - Kirchhoff, 353, 385, 392
 - poststack depth, 385, 389, 416
 - poststack time, 264–266, 354–356, 358, 385, 387, 411, 414
 - prestack depth, 403
 - Stolt, 354–356, 358, 387
- Mode conversions, *see* Converted waves
- Monoclinic media, *see* Anisotropic symmetry, monoclinic
- Moveout (finite-spread) velocity, 110, 113, 116, 118, 124, 128, 139, 173, 176, 190, 229, 300, 377
 - azimuthally dependent, 165, 297
- Moveout attributes
 - for converted waves, 200, 201, 203, 204, 209, 211, 213, 214, 226, 231, 338, 341, 342, 350
- NMO ellipse**, 156, 171
 - application in VTI inversion, 297, 312, 335, 336, 346, 351
 - for converted waves, 225, 227
 - for HTI media, 161
 - for orthorhombic media, 161
 - for VTI media, 159, 263
- NMO velocity**, 109, 166, 169, 171, 173, 180, 181, 207, 285, 354, 369
 - expressed through ray parameter, 254, 272, 283
 - for converted waves, 200, 204–206, 211, 214, 227–230, 232, 239, 245
 - for HTI media, 161
 - for orthorhombic media, 54, 161
 - for tilted TI media, 130, 168, 272
 - for VTI media, 18, 54, 84, 113, 159, 178, 180, 181, 183, 185, 187, 189, 190, 192, 195, 197, 253,

- NMO (*continued*)
 264, 269–272, 288, 312, 313,
 315, 321, 323, 325, 327, 329,
 333, 353, 387, 400, 403, 410
 inversion for VTI, 288, 289, 335,
 337, 354, 400, 410
- Nongeometrical phenomena, 54, 77,
 81, 87
- Nonhyperbolic moveout, 110, 113, 173,
 195
 for azimuthal anisotropy, 165, 297
 for converted waves, 228, 230
 for P-waves, 116, 124, 139, 185, 197,
 270, 271, 288, 297, 310, 358,
 361, 373, 377, 414
 for SV-waves, 190
 general equation, *see* Tsvankin-
 Thomsen moveout equation
 inversion for VTI media, 312
 nonhyperbolic semblance analysis,
 315
- Orthorhombic media, *see* Anisotropic
 symmetry, orthorhombic
- Overmigration, 266, 361, 416
- Parameter estimation, *see* Inversion
- Particle motion, 34, 67
 nonlinear, 67, 77
- Particle motion (polarization)
 diagrams, 67
- Phase angle, 6, 14, 29, 30, 34, 37–39,
 65, 69, 71, 80, 82, 83, 85, 102,
 107, 131, 132, 135, 136, 141,
 144, 167, 176, 195, 207, 234,
 241–243, 254, 255, 283, 284,
 356, 386, 387
- Phase velocity, 3–7, 11, 56, 57, 65–67,
 69, 72, 80, 104, 110–112, 168,
 176, 207, 254, 356
 for orthorhombic media, 37–39, 41,
 45–47, 51, 54, 164
 for TI media, 14, 15, 17–19, 21, 26,
 28, 29, 32, 83, 84, 87, 89, 94,
 95, 105, 107, 113–115, 118, 119,
 131, 132, 135, 136, 140, 141,
 144, 160, 168, 174, 177, 179,
 190, 192, 241, 242, 255, 270,
 271, 273, 280, 283, 299, 353,
 358, 359, 369, 374, 385, 387
- Phase-velocity surface, 4, 39, 40, 80,
 82, 84, 125
- Phase-velocity vector, 4–7, 16, 19,
 28–30, 34, 46, 63, 72, 77, 80,
 110, 131, 135, 149, 166, 169,
 201, 233, 241, 254
- Plane wave, 1–3, 8, 14, 36, 56, 61,
 63–66, 71, 80, 103–105
- Point-source radiation, 4, 5, 15, 28, 35,
 54, 61, 103–105, 131
- Polarization vector (angle), 1, 3–6, 8,
 10, 61, 63, 105, 201, 223
 for curved wavefront, 5, 61, 65–67,
 72, 77, 79, 80
 for orthorhombic media, 38–40, 43,
 45, 46, 51, 54, 67, 72, 77, 79, 80
 for TI media, 14–17, 19, 22, 34, 83,
 85, 95, 98, 269, 271
- Propagation phenomena, 82, 84, 92,
 94, 100, 102
- Quartic moveout coefficient
 for converted waves, 228
 for pure modes, 176, 190
- Radiation pattern, 62, 66, 77, 80
 for orthorhombic media, 54, 67, 69,
 75, 80
 for TI media, 22, 34, 81, 82, 84, 94,
 100, 101, 105, 271
- Ray parameter (horizontal slowness),
 62, 63, 80, 105, 107, 119,
 124, 125, 141, 144, 149,
 156, 158, 161, 166, 169, 172,
 203, 205–208, 210, 221, 223,
 225–227, 231, 237, 240, 244,
 245, 250, 254, 255, 262, 271,
 272, 274, 280, 283, 285, 289,
 291, 293, 294, 297, 299, 300,
 305, 310, 338, 341, 346, 350,
 355–357, 359, 370, 372, 373,
 384, 386, 390, 400
- Ray tracing, 30, 62, 77, 81, 128, 132,
 185, 188, 204, 216, 223, 225,
 231, 305, 314, 315, 347, 360,
 375, 377
 using Gaussian beams, 390–392

- Reflection coefficient, 38, 45, 81
 for P-waves, 19, 91, 101, 270, 271
 for S-waves, 94, 100, 101
- Reflection moveout, *see* Moveout
 velocity, NMO velocity,
 nonhyperbolic moveout
- Reflection-point dispersal, 157, 166,
 170, 171, 177, 207, 371
 for converted waves, *see* Conversion-
 point dispersal
- Reflectivity method, 62, 80
- Regularization, 297, 402
- Resampling, 355–359, 365, 368, 371
- Seismic processing, *see* Data
 processing
- Shale anisotropy, 11, 12, 20, 30, 82, 92,
 94, 112, 116, 153, 179, 190, 305,
 333, 365, 410
- Shear-wave singularity, 4, 57, 62, 66
 for orthorhombic media, 38, 39, 79
 for TI media, 15, 16
- Shear-wave splitting, 4, 13, 16, 38–40,
 43, 57, 63, 72, 79, 104, 164, 201,
 351
- Shifted hyperbola, 173
- Slope of CMP moveout, 215, 235
 for converted waves, 204–206, 209,
 212, 215, 221, 226, 231, 239,
 244, 338, 340, 341, 350
 in squared coordinates, 110, 156,
 190, 192, 253
- Slope on zero-offset section, 125, 208,
 254, 289, 291, 299, 338, 341,
 342, 346, 350, 357, 372, 390
- Slowness surface, 4, 5, 15, 38, 62, 80,
 98, 125, 136, 182
 concave, 5, 34, 100, 194
 ellipsoidal, 15, 22, 39
- Slowness vector, 3–6, 11, 14, 30, 34, 38,
 46, 51, 57, 61–63, 66, 104–106,
 110, 112, 149, 151, 156, 166,
 170, 172, 204, 205, 223, 225,
 226, 231, 234, 241, 242, 247,
 251, 254, 261, 346, 356
- Snell's law, 203–206, 221, 223,
 225–227, 231, 234, 239, 244,
 245, 247, 250, 396
- Stacking velocity, *see* Moveout
 (finite-spread) velocity
- Stationary-phase approximation, 61,
 64, 67, 69, 72, 77, 80, 85, 87–90,
 95, 98, 105, 108
- Stiffness matrix, 8
 for HTI media, 12
 for isotropic media, 13
 for monoclinic media, 9
 for orthorhombic media, 10, 36
 for tilted TI media, 12
 for triclinic media, 8
 for VTI media, 12, 14
- Stiffness tensor, 2, 3, 7, 16, 17, 36, 65,
 75, 103
- Strain tensor, 2, 8
- Stress tensor, 2, 8
- Symmetry, *see* Anisotropic symmetry
- Symmetry axis
 of general TI media, 11, 14, 82, 102,
 110, 177, 372
 of HTI media, 12, 14, 37, 44, 162
 of tilted TI media, 12, 112, 130, 159,
 272, 384, 394
 of VTI media, 11, 15–18, 20, 21, 23,
 34, 37, 81, 95, 100, 161, 190,
 208, 255, 394
- Symmetry planes
 horizontal, 9, 176, 180, 199, 207
 of general TI media, 11, 110
 of HTI media, 12, 14, 162, 177
 of monoclinic media, 9
 of orthorhombic media, 10, 14, 36,
 37, 40, 44, 47, 51, 67, 72, 77,
 80, 162, 177, 178, 187
 of tilted TI media, 130, 272
 of VTI media, 14, 16, 28, 30, 32, 81,
 113, 160, 177, 208, 228, 253,
 287, 353
 vertical, 12, 14, 58, 64, 66, 105, 110,
 149, 166, 167, 169, 176, 180,
 200, 219, 227, 233, 234, 251,
 384
- Synthetic seismograms, 62, 67, 265,
 316, 324, 360, 375, 387, 392,
 396, 400
 for converted waves, 215, 219

- Thomsen parameters, 2, 17–21, 24, 26, 36, 82, 92, 102, 107, 113, 115, 118, 131, 136, 143, 168, 187, 190, 195, 209, 243, 244, 253, 269–273, 283, 285, 287, 334, 336, 337, 339, 341, 343, 361, 389
- Tilted transverse isotropy (TTI), *see* Anisotropic symmetry, tilted TI
- Time-to-depth conversion, 110, 114, 151, 232, 269, 271, 287, 347, 409, 410, 413
- Transmission coefficient, 64
- Transmission losses, 81
- Transverse isotropy (TI), *see* Anisotropic symmetry, TI
- Traveltime, *see* Moveout velocity, NMO velocity, nonhyperbolic moveout
- Triclinic media, *see* Anisotropic symmetry, triclinic
- Triplcation, *see* Cusp
- Tsvankin-Thomsen moveout equation, 184, 230, 232
- TZO (transformation to zero offset), 305, 310, 373, 414, 416
- Udermigration, 266, 361, 394
- Velocity, *see* Phase velocity, Group velocity, Moveout velocity, NMO velocity
- Velocity analysis, *see* Inversion
- Velocity dispersion, 5
- Velocity gradient
lateral, 269, 389
vertical, 125, 136, 303, 305, 323, 356, 365, 368
- Vertical transverse isotropy (VTI), *see* Anisotropic symmetry, VTI
- Voigt recipe, 8
- VSP (vertical seismic profiling), xvi, 34, 82, 183, 327, 414
- Wave equation
anisotropic, 2, 3, 7, 17, 63, 103, 104
isotropic, 13, 386
- Wave vector, 5
- Wavefront, 4, 5, 16, 61, 63, 65, 79, 80, 82, 205, 392
ellipsoidal, 15, 28, 101
for orthorhombic media, 38, 39, 67, 71
for TI media, 19, 30, 83, 92, 100–102, 131, 141, 194, 200, 231, 392
- Weak-anisotropy approximation, 21, 270
for converted-wave moveout, 200, 208, 232, 241
for DMO operator, 374
for group velocity, 29, 32
for NMO velocity, 115, 119, 141, 161, 163, 164, 168, 256, 261, 263, 273, 284, 297
for nonhyperbolic moveout, 178, 183, 195
for phase velocity, 23, 26
for polarization, 35
for radiation pattern, 82, 84, 95, 101, 105
for reflection coefficient, 91, 94, 100, 101
for velocity in orthorhombic media, 45, 46, 54
- Weyl integral, 61, 63, 64, 80, 104, 105
- WKB solution, 386
- Zero-offset migration, *see* Migration, poststack
- Zero-offset migration impulse response, 264
- Zero-offset migration operator, 354
- Zero-offset ray, 110, 112, 119, 124, 135, 141, 144, 149, 151, 161, 166, 169, 254, 261, 272, 291, 293, 346, 386
- Zero-offset reflection, 109, 130–132, 156, 166, 169, 171, 244, 254, 263, 283, 291, 294, 299, 340, 346, 402
for converted waves, 200, 209, 215, 221, 226
- Zero-offset section, 111, 125, 208, 254, 264, 265, 305, 310, 341, 355, 357, 370, 372, 374, 375, 386, 392, 396