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## PUBLICATIONS OF CLIFF FROHLICH – March 2022

### BOOKS AND EDITED COLLECTIONS

- Frohlich, C. *Deep Earthquakes*, Cambridge Univ. Press, Cambridge, U. K., 574 pp., 2006.
- Frohlich, C., and S. D. Davis. *Texas Earthquakes*, Univ. Texas Press, Austin, Texas, 275 pp., 2002.
- C. Frohlich. (Guest Associate Editor). Deep and Intermediate Focus Earthquakes, Phase Transitions, and the Mechanics of Deep Subduction, special section of *J. Geophys. Res.*, **92**, December, 1987.
- C. Frohlich (Editor). *Physics of Sports: Selected Reprints*, American Association of Physics Teachers, College Park, Maryland, 123 pp., 1986.

### SCHOLARLY ARTICLES

- Hager, B. H., J. Dieterich, C. Frohlich, R. Juanes, S. Mantica, J. H. Shaw, F. Bottazzi, F. Caresani, D. Castineira, A. Cominelli, M. Meda, L. Osculati, S. Petroselli and A. Plesch. A process-based approach to understanding and managing triggered seismicity, *Nature*, **595**, 684-689, 2021, doi.org/10.1038/s41586-021-03668-z.
- Frohlich, C., C. Hayward, J. Rosenblit, C. Aiken, P. Hennings, A. Savvaidis, C. Lemons, E. Horne, J. I. Walter and H. R. DeShon. Onset and cause of increased seismic activity near Pecos, West Texas, USA from observations at the Lajitas TXAR seismic array, *J. Geophys. Res., Solid Earth*, **125**, 2020, doi:10.1029/2019JB017737.
- Walter, J. I., C. Frohlich and T. Borgfeldt. Natural and induced seismicity in the Texas and Oklahoma Panhandles, *Seismol. Res. Lett.*, **89**, 2437-2446, 2018, doi:10.1785/0220180105.
- Quinones, L. A., H. R. DeShon, M. B. Magnani and C. Frohlich. Stress orientations in the Fort Worth Basin, Texas, determined from earthquake focal mechanisms, *Bull. Seismol. Soc. Amer.*, **108**, 1124-1132, doi:10.1785/0120170337, 2018.
- Frohlich, C., H. R. DeShon, B. W. Stump, C. Hayward, M. J. Hornbach and J. I. Walter. A historical review of induced earthquakes in Texas, *Seismol. Res. Lett.*, **87**, 1022-1038, doi:10.1785/0220160016, 2016.
- Hornbach, M. J., M. Jones, M. Scales, H. R. DeShon, M. B. Magnani, C. Frohlich, B. W. Stump, C. Hayward and M. Layton. Ellenburger wastewater injection and seismicity in North Texas, *Phys. Earth Planet. Int.*, **261**, 64-68, doi:10.1016/j.pepi.2016.06.012, 2016.
- Juanes, R., B. Jha, B. H. Hager, J. H. Shaw, A. Plesch, L. Astiz, J. H. Dieterich and C. Frohlich. Were the May 2012 Emilia-Romagna earthquakes induced? A coupled flow-geomechanics modeling assessment, *Geophys. Res. Lett.*, **43**, doi:10.1002/2016GL069284, 2016.

- Walter, J. I., P. J. Dotray, C. Frohlich and J. F. W. Gale. Earthquakes in northwest Louisiana and the Texas-Louisiana border possibly induced by energy resource activities within the Haynesville shale play, *Seismol. Res. Lett.*, **87**, 285-294, [doi:10.1785/0220150193](https://doi.org/10.1785/0220150193), 2016.
- Frohlich, C., J. I. Walter and J. F. W. Gale. Analysis of transportable array (USArray) data shows earthquakes are scarce near injection wells in the Williston Basin, 2008-2011, *Seismol. Res. Lett.*, **86**, 492-499, [doi:10.1785/0220140180](https://doi.org/10.1785/0220140180), 2015.
- Frohlich, C., W. Gan and R. B. Herrmann. Two deep earthquakes in Wyoming, *Seismol. Res. Lett.*, **86**, 810-818, [doi:10.1785/0220140197](https://doi.org/10.1785/0220140197), 2015.
- Gan, W., C. Frohlich and Z. Jin. Origin and significance of deep earthquake clusters surrounding a pronounced seismic gap in northeast China, *J. Asian Earth Sci.*, **100**, 91-97, [doi:10.1016/j.jseaes.2015.01.002](https://doi.org/10.1016/j.jseaes.2015.01.002), 2015.
- Hornbach, M. J., H. R. DeShon, W. L. Ellsworth, B. W. Stump, C. Hayward, C. Frohlich, H. R. Oldham, J. E. Olson, M. B. Magnani, C. Brokaw and J. H. Luetgert. Causal factors for seismicity near Azle, Texas, *Nature Communications*, **6**, 6728, [doi:10.1038/ncomms7728](https://doi.org/10.1038/ncomms7728), 2015.
- Thirumalai, K., F. W. Taylor, C.-C. Shen, L. L. Lavier, C. Frohlich, L. M. Wallace, C.-C. Wu, H. Sun and A. K. Papabatu. Variable Holocene deformation above a shallow subduction zone extremely close to the trench, *Nature Communications*, **6**, 7607, [doi:10.1038/ncomms8607](https://doi.org/10.1038/ncomms8607), 2015.
- Frohlich, C. Design considerations for the Analon slide rule, *J. Oughtred Soc.*, **23(2)**, 22-28, 2014.
- Frohlich, C., W. Ellsworth, W. A. Brown, M. Brunt, J. H. Luetgert, T. MacDonald and S. Walter. The 17 May 2012 M4.8 earthquake near Timpson, east Texas: An event possibly triggered by fluid injection, *J. Geophys. Res., Solid Earth*, **119**, [doi:10.1002/2013JB010755](https://doi.org/10.1002/2013JB010755), 2014.
- Frohlich, C. and M. Brunt. Two-year survey of earthquakes and injection/production wells in the Eagle Ford Shale, Texas, prior to the MW4.8 20 October 2011 earthquake, *Earth Planet. Sci. Lett.*, **379**, 53-63, [doi:10.1016/j.epsl.2013.07.02](https://doi.org/10.1016/j.epsl.2013.07.02), 2013. Reprinted in *Earth Planet. Sci. Lett.*, **402**, 257-264, [doi:10.1016/j.epsl.2014.06.006](https://doi.org/10.1016/j.epsl.2014.06.006), 2014.
- Gan, W. and C. Frohlich. Gas injection may have triggered earthquakes in the Cogdell oil field, Texas, *Proc. National Acad. Sci.*, **110**, 18786-18791, [doi:10.1073/pnas.1311316110](https://doi.org/10.1073/pnas.1311316110), 2013.
- Justinic, A., B. Stump, C. Hayward and C. Frohlich. Analysis of the Cleburne, Texas, earthquake sequence from June 2009 to June 2010, *Bull. Seismol. Soc. Amer.*, **103**, 3083-3093, [doi:10.1785/0120120336](https://doi.org/10.1785/0120120336), 2013.
- Frohlich, C. Two-year survey comparing earthquake activity and injection well locations in the Barnett Shale, Texas, *Proc. National Acad. Sci.*, **109**, 13934-13938, [doi:10.1073/pnas.1207728109](https://doi.org/10.1073/pnas.1207728109), 2012.

- Frohlich, C., J. Glidewell and M. Brunt. Location and felt reports for the 25 April 2010 mbLG3.9 earthquake near Alice, Texas: Was it induced by petroleum production? *Bull. Seismol. Soc. Amer.*, **102**, 457-466, [doi:10.1785/0120110179](https://doi.org/10.1785/0120110179), 2012.
- Chen, M.-C., C. Frohlich, F. W. Taylor, G. S. Burr and A. Quarles. Arc segmentation and seismicity in the Solomon Islands arc, SW Pacific, *Tectonophysics*, **507**, 47-69, [doi:10.1016/j.tecto.2011.05.008](https://doi.org/10.1016/j.tecto.2011.05.008), 2011.
- Frohlich, C. Resource letter PS-2: Physics of sports, *Amer. J. Physics*, **7**, 565-574, [doi:10.1119/1.3552157](https://doi.org/10.1119/1.3552157), 2011.
- Frohlich, C., C. Hayward, B. Stump and E. Potter. The Dallas-Fort Worth earthquake sequence: October 2008 through May 2009, *Bull. Seismol. Soc. Amer.*, **101**, 327-340, [doi:10.1785/0120100131](https://doi.org/10.1785/0120100131), 2011.
- Frohlich, C., E. Potter, C. Hayward and B. Stump. Dallas-Fort Worth earthquakes coincident with activity associated with natural gas production, *Leading Edge*, **29**, 270-275, [doi:10.1190/1.3353720](https://doi.org/10.1190/1.3353720), 2010
- Hornbach, M. J., N. Braudy, R. W. Briggs, M.-H. Cormier, M. B. Davis, J. B. Diebold, N. Dieudonne, R. Douilly, C. Frohlich, S. P. S. Gulick, H. E. Johnson, P. Mann, C. M. G. McHugh, K. Ryan-Mishkin, C. S. Prentice, L. Seeber, C. C. Sorlien, M. S. Steckler, S. J. Symithe, F. W. Taylor, and J. Templeton. High tsunami frequency as a result of combined strike-slip faulting and coastal landslides, *Nature Geoscience*, **3**, 783-788, [doi:10.1038/NNGEO975](https://doi.org/10.1038/NNGEO975), 2010.
- Frohlich, C., M. J. Hornbach, F. W. Taylor, C.-C. Shen, A. Moala, A. E. Morton and J. Kruger. Huge erratic boulders in Tonga deposited by a prehistoric tsunami, *Geology*, **37**, 131-134, [doi:10.1130/G25277A.1](https://doi.org/10.1130/G25277A.1), 2009.
- Frohlich, C. and Y. Nakamura. The physical mechanisms of deep moonquakes and intermediate-depth earthquakes: How similar and how different? *Phys. Earth Planet. Int.*, **173**, 365-374, [doi:10.1016/j.pepi.2009.02.004](https://doi.org/10.1016/j.pepi.2009.02.004), 2009.
- Hornbach, M. J., S. A. Mondziel, N. R. Grindlay, C. Frohlich and P. Mann. Did a submarine slide trigger the 1918 Puerto Rico tsunami? *Sci. Tsunami Hazards*, **27**, 22-31, 2008.
- Taylor, F. W., R. W. Briggs, C. Frohlich, A. Brown, M. Hornbach, A. K. Papabatu, A. J. Meltzner and D. Billy. Rupture across arc segment and plate boundaries in the 1 April 2007 Solomons earthquake, *Nature Geoscience*, **1**, 253-257, [doi:10.1038/ngeo159](https://doi.org/10.1038/ngeo159), 2008.
- Taylor, F. W., M. G. Bevis, I. W. D. Dalziel, R. Smalley, C. Frohlich, E. Kendrick, J. Foster, D. Phillips, and K. Gudipati. Kinematics and segmentation of the South Shetland Islands-Bransfield basin system, northern Antarctic Peninsula, *Geochem., Geophys., Geosyst.*, **9**, Q04035, [doi:10.1029/2007GC001873](https://doi.org/10.1029/2007GC001873), 2008.
- Frohlich, C. and L. R. Wetzel, Comparison of seismic moment release rates along different types of

- plate boundaries, *Geophys. J. Int.*, **171**, 909-920, [doi:10.1111/j.1365-246X.2007.03550.x](https://doi.org/10.1111/j.1365-246X.2007.03550.x), 2007.
- Frohlich, C. Practical suggestions for assessing rates of seismic moment release, *Bull. Seismol. Soc. Amer.*, **97**, 1158-1166, [doi:10.1785/0120060193](https://doi.org/10.1785/0120060193), 2007.
- Frohlich, C. and Y. Nakamura. Possible extra-Solar-System cause for certain lunar seismic events, *Icarus*, **185**, 21-28, [doi:10.1016/j.icarus.2006.07.002](https://doi.org/10.1016/j.icarus.2006.07.002), 2006.
- Frohlich, C. A simple analytical method to calculate the thermal parameter and temperature within subducted lithosphere, *Phys. Earth Planet. Int.*, **155**, 281-285, [doi:10.1016/j.pepi.2006.01.001](https://doi.org/10.1016/j.pepi.2006.01.001), 2006.
- Frohlich, C. What makes bowling balls hook? *Amer. J. Phys.*, **72**, 1170-1177, [doi:10.1119/1.1767099](https://doi.org/10.1119/1.1767099), 2004.
- Matthews, R. K. and C. Frohlich. Maximum flooding surfaces and sequence boundaries: Comparisons between observations and orbital forcing in the Cretaceous and Jurassic (65-190 Ma), *GeoArabia*, **7**, 503-538, 2002.
- Bilich, A., C. Frohlich and P. Mann. Global seismicity characteristics of subduction-to-strike-slip transitions, *J. Geophys. Res.*, **106**, 19443-19452, 2001.
- Frohlich, C. Display and quantitative assessment of distributions of earthquake focal mechanisms, *Geophys. J. Int.*, **144**, 300-308, [doi:10.1046/j.1365-246X.2001.00341.x](https://doi.org/10.1046/j.1365-246X.2001.00341.x), 2001.
- Frohlich, C. and L. Resler. Analysis of publications and citations from a geophysics research institute, *J. Amer. Soc. Information Sci. Tech.*, **52**, 701-713, [doi:10.1002/asi.1121](https://doi.org/10.1002/asi.1121), 2001.
- Massell, C., M. F. Coffin, P. Mann, S. Mosher, C. Frohlich, C. S. Duncan, G. Karner, D. Ramsay and J.-F. Lebrun. Neotectonics of the Macquarie Ridge complex, Australia-Pacific plate boundary, *J. Geophys. Res.*, **105**, 13457-13480, 2000.
- Nyffenegger, P. and C. Frohlich. Aftershock occurrence rate decay properties for intermediate and deep earthquake sequences, *Geophys. Res. Lett.*, **27**, 1215-1218, [doi:10.1029/1998GL010371](https://doi.org/10.1029/1998GL010371), 2000.
- Frohlich, C. and S. D. Davis. How well constrained are well-constrained T, B, and P axes in moment tensor catalogs? *J. Geophys. Res.*, **104**, 4901-4910, 1999.
- Frohlich, C. and J. Pulliam. Single-station location of seismic events: A review and a plea for more research, *Phys. Earth Planet. Int.*, **113**, 277-291, [doi:10.1016/S0031-9201\(99\)00055-2](https://doi.org/10.1016/S0031-9201(99)00055-2), 1999.
- Bilich, A., S. Clark, B. Creighton and C. Frohlich. Felt reports from the Alice, Texas, earthquake of 24 March 1997, *Seismol. Res. Lett.*, **69**, 117-122, 1998.

- Frohlich, C. Does maximum earthquake size depend on focal depth? *Bull. Seismol. Soc. Amer.*, **88**, 329-336, 1998.
- Matthews, R. K. and C. Frohlich. Forward modeling of sequence stratigraphy and diagenesis: Application to rapid, cost-effective carbonate reservoir characterization, *GeoArabia*, **3**, 359-384, 1998.
- Nyffenegger, P. and C. Frohlich. Recommendations for determining p values for aftershock sequences and catalogs, *Bull. Seismol. Soc. Amer.*, **88**, 1144-1154, 1998.
- Schuur, C. L., M. F. Coffin, C. Frohlich, C. G. Massell, G. D. Karner, D. Ramsay and D. W. Caress. Sedimentary regimes at the Macquarie Ridge Complex: Interaction of Southern Ocean circulation and plate boundary bathymetry, *Paleoceanography*, **13**, 646-670, 1998.
- Frohlich, C., M. F. Coffin, C. Massell, P. Mann, C. L. Schuur, S. D. Davis, T. Jones and G. Karner. Constraints on Macquarie Ridge tectonics provided by Harvard focal mechanisms and teleseismic earthquake locations, *J. Geophys. Res.*, **102**, 5029-5041, 1997.
- Matthews, R. K., C. Frohlich and A. Duffy. Orbital forcing of global change throughout the Phanerozoic: A possible stratigraphic solution to the eccentricity phase problem, *Geology*, **25**, 807-810, 1997.
- Frohlich, C. Cliff's nodes concerning plotting nodal lines for  $P$ ,  $S_H$ , and  $S_V$ , *Seismol. Res. Lett.*, **67**, 16-24, 1996.
- Zhao, L.-S. and C. Frohlich. Teleseismic body waveforms and receiver structures beneath seismic stations, *Geophys. J. Int.*, **124**, 525-540, 1996.
- Zhao, L.-S., M. K. Sen, P. Stoffa and C. Frohlich. Application of very fast simulated annealing to the determination of crustal structure beneath Tibet, *Geophys. J. Int.*, **125**, 355-370, 1996.
- Davis, S. D., P. Nyffenegger and C. Frohlich. The 9 April 1993 earthquake in south-central Texas: Was it induced by fluid withdrawal? *Bull. Seismol. Soc. Amer.*, **85**, 1888-1895, 1995.
- Frohlich, C. Characteristics of well-determined non-double-couple earthquakes in the Harvard CMT catalog, *Phys. Earth Planet. Int.*, **91**, 213-228, 1995.
- Frohlich, C. Shaken to the core, *New Scientist*, **148**, No. 2007, 42-46, 1995.
- Frohlich, C., K. Kadinsky-Cade, and S. D. Davis. A reexamination of the Bucaramanga, Colombia, earthquake nest, *Bull. Seismol. Soc. Amer.*, **85**, 1622-1634, 1995.
- Frohlich, C. Baseball: Pitching no-hitters, *Chance*, **7(3)**, 24-30, 1994. Reprinted in *Anthology of Statistics in Sports*, edited by J. Albert, J. Bennett and J. J. Cochran, Society for Industrial and Applied Mathematics, Philadelphia, PA, 103-109, 2005.

- Frohlich, C. Earthquakes with non-double-couple mechanisms, *Science*, **264**, 804-809, 1994.
- Davis, S. D. and C. Frohlich. Did (or will) fluid injection cause earthquakes: Criteria for a rational assessment. *Seismol. Res. Lett.*, **64**, 207-224, 1993.
- Frohlich, C. and S. D. Davis. Teleseismic b values; Or, much ado about 1.0, *J. Geophys. Res.*, **98**, 641-644, 1993.
- Frohlich, C. Triangle diagrams: Ternary graphs to display similarity and diversity of earthquake focal mechanisms, *Phys. Earth Planet. Int.*, **75**, 193-198, 1992.
- Frohlich, C. and K. D. Apperson. Earthquake focal mechanisms, moment tensors, and the consistency of seismic activity near plate boundaries, *Tectonics*, **11**, 279-296, 1992.
- Olson, D. R. and C. Frohlich. Felt reports from the 20 July 1991 Falls City earthquake, Karnes County, Texas, *Seismol. Res. Lett.*, **63**, 603-604, 1992.
- Davis, S. D. and C. Frohlich. Single-link cluster analysis, synthetic earthquake catalogues, and aftershock identification, *Geophys. J. Int.*, **104**, 289-306, 1991.
- Davis, S. D. and C. Frohlich. Single-link cluster analysis of earthquake aftershocks: Decay law and regional variations, *J. Geophys. Res.*, **96**, 6335-6350, 1991.
- Frohlich, C. and R. K. Matthews. STRATA-various: A flexible Fortran program for dynamic forward modeling of stratigraphy, in *Sedimentary Modeling: Computer Simulations and Methods for Improved Parameter Definition*, ed. by E. K. Franseen, W. L. Watney, C. G. St. C. Kendall and W. Ross, *Kansas Geological Survey Bulletin* **233**, 449-461, 1991.
- Matthews, R. K. and C. Frohlich. Orbital forcing of low-frequency glacioeustasy, *J. Geophys. Res.*, **96**, 6797-6803, 1991.
- Frohlich, C. Note concerning non-double-couple source components from slip along surfaces of revolution, *J. Geophys. Res.*, **95**, 6861-6866, 1990.
- Frohlich, C., and S. D. Davis. Single-link cluster analysis as a method to evaluate spatial and temporal properties of earthquake catalogues, *Geophys. J. Int.*, **100**, 19-32, 1990.
- Frohlich, C., R. Louat and Y. Nakamura. Earthquake activity in the southern Vanuatu arc recorded by the Texas digital OBS, *Mar. Geophys. Res.*, **12**, 253-267, 1990.
- Taylor, F. W., R. L. Edwards, G. J. Wasserburg and C. Frohlich. Seismic recurrence intervals and timing of aseismic subduction inferred from emerged corals and reefs of the central Vanuatu (New Hebrides) frontal arc, *J. Geophys. Res.*, **95**, 393-408, 1990.
- Wardlaw, R. L., C. Frohlich and S. D. Davis. Evaluation of precursory seismic quiescence in sixteen

- subduction zones using single-link cluster analysis, *Pure Appl. Geophys.*, **134**, 57-78, 1990.
- Frohlich, C. Deep earthquakes, *Sci. Amer.*, **260(1)**, 48-55, 1989.
- Frohlich, C. The nature of deep focus earthquakes, *Ann. Rev. Earth Planet. Sci.*, **17**, 227-254, 1989.
- Frohlich, C., M. A. Riedesel and K. D. Apperson. Note concerning possible mechanisms for non-double-couple earthquake sources, *Geophys. Res. Lett.*, **16**, 523-526, 1989.
- Louat, R., C. Frohlich, P. Charvis, Y. Hello, P. McPherson, Y. Nakamura and B. Pontoise. Etude d'un essaim seismes dans le Sud de Vanuatu (SO-Pacifique) par un reseau de stations sismologiques sous-marines (OBS), *C. R. Acad. Sci. Paris*, **309 II**, 213-218, 1989.
- Adamek, S., C. Frohlich and W. D. Pennington. Seismicity of the Caribbean-Nazca boundary: Constraints on microplate tectonics of the Panama region, *J. Geophys. Res.*, **93**, 2053-2075 1988.
- Apperson, K. D. and C. Frohlich. The relationship between Wadati-Benioff zone geometry and P, T and B axes of intermediate and deep focus earthquakes, *J. Geophys. Res.*, **92**, 13821-13831, 1987.
- Frohlich, C. Aftershocks and temporal clustering of deep earthquakes, *J. Geophys. Res.*, **92**, 13944-13956, 1987.
- Frohlich, C. Kiyoo Wadati and early research on deep-focus earthquakes: Introduction to special section on deep and intermediate focus earthquakes, *J. Geophys. Res.*, **92**, 13777-13788, 1987. Reprinted in *History of Geophysics*, **4**, 166-177, 1990.
- Frohlich, C. and R. J. Willemann. Aftershocks of deep earthquakes do not occur preferentially on nodal planes of focal mechanisms, *Nature*, **329**, 41-42, 1987.
- Frohlich, C. and R. J. Willemann. Statistical methods for comparing directions to the orientations of focal mechanisms and Wadati-Benioff zones, *Bull. Seismol. Soc. Amer.*, **77**, 2135-2142, 1987.
- Matthews, R. K. and C. Frohlich. Forward modeling of bank-margin carbonate diagenesis, *Geology*, **15**, 673-676, 1987.
- Taylor, F. W., C. Frohlich, J. Lecolle and M. Strecker. Analysis of partially emerged corals and reef terraces in the central Vanuatu arc: Comparison of contemporary coseismic and nonseismic with Quaternary vertical movements, *J. Geophys. Res.*, **92**, 4905-4933, 1987.
- Willemann, R. J. and C. Frohlich. Spatial patterns of aftershocks of deep focus earthquakes, *J. Geophys. Res.*, **92**, 13927-13943, 1987.
- Burbach, G. V. and C. Frohlich. Intermediate and deep seismicity and lateral structure of



- subducted lithosphere in the Circum-Pacific region, *Rev. Geophys.*, **24**, 833-874, 1986.
- Frohlich, C. Resource letter PS-1: Physics of sports, *Amer. J. Phys.*, **54**, 590-593, 1986.
- Frohlich, C. Effect of wind and altitude on record performance in foot races, pole vault and long jump, *Amer. J. Phys.*, **53**, 726-730, 1985; reprinted in *The Physics of Sports*, ed. A. Armenti, Amer. Inst. Phys., New York, 120-124 1992.
- Frohlich, C. and S. D. Davis. Identification of aftershocks of deep earthquakes by a new ratios method, *Geophys. Res. Lett.*, **12**, 713-716, 1985.
- McLaren, J. P. and C. Frohlich. Model calculations of regional network locations for earthquakes in subduction zones, *Bull. Seismol. Soc. Amer.*, **75**, 397-413, 1985.
- Pulpan, H. and C. Frohlich. Geometry of the subducted plate near Kodiak Island and Lower Cook Inlet, Alaska, determined from relocated earthquake hypocenters, *Bull. Seismol. Soc. Amer.*, **75**, 791-810, 1985.
- Scott, G. R. and C. Frohlich. Large-volume, magnetically shielded room: A new design and material, in *Magnetite Biomineralization and Magnetoreception in Organisms*, ed. J. L. Kirschvink, D. S. Jones and B. J. MacFadden, Plenum Press, 197-220, 1985.
- Stark, P. B. and C. Frohlich. The depths of the deepest deep earthquakes, *J. Geophys. Res.*, **90**, 1859-1869, 1985.
- Burbach, G. V., C. Frohlich, W. D. Pennington and T. Matumoto. Seismicity and tectonics of the subducted Cocos plate, *J. Geophys. Res.*, **89**, 7719-7735, 1984.
- Buskirk, R. E., C. Frohlich and K. G. Ross. The natural selection of sexual cannibalism, *Amer. Naturalist*, **123**, 612-625, 1984.
- Frohlich, C. Aerodynamic drag crisis and its possible effect on the flight of baseballs, *Amer. J. Phys.*, **52**, 325-334, 1984.
- Chen, A. T., C. Frohlich and G. V. Latham. Seismicity of the forearc marginal wedge (accretionary prism), *J. Geophys. Res.*, **87**, 3679-3690, 1982.
- Frohlich, C. Seismicity of the central Gulf of Mexico, *Geology*, **10**, 103-106, 1982.
- Frohlich, C., S. Billington, E. R. Engdahl and A. Malahoff. Detection and location of earthquakes in the central Aleutian subduction zone using island and ocean bottom seismograph stations, *J. Geophys. Res.*, **87**, 6853-6864, 1982.
- Frohlich, C. and R. E. Buskirk. Survivorship curves and growth rates for a population of mustache hairs, *Texas J. Sci.*, **34**, 207-214, 1982.

- Frohlich, C. and R. E. Buskirk. Transmission and attenuation of vibration in orb spider webs, *J. Theor. Biol.*, **35**, 13-36, 1982.
- Lawton, J., C. Frohlich, H. Pulpan and G. V. Latham. Earthquake activity at the Kodiak continental shelf, Alaska, determined by land and ocean bottom seismograph networks, *Bull. Seismol. Soc. Amer.*, **72**, 207-220, 1982.
- Buskirk, R. E., C. Frohlich and G. V. Latham. Unusual animal behavior before earthquakes: A review of possible sensory mechanisms, *Rev. Geophys. Space Phys.*, **19**, 247-270, 1981.
- Buskirk, R. E., C. Frohlich, G. V. Latham, A. T. Chen and J. Lawton. Evidence that biological activity affects ocean bottom seismograph recordings, *Mar. Geophys. Res.*, **5**, 189-205, 1981.
- Frohlich, C. Aerodynamic effects on discus flight, *Amer. J. Phys.*, **49**, 1125-1132, 1981; reprinted in *The Physics of Sports*, ed. A. Armenti, Amer. Inst. Phys., New York, 237-244, 1992.
- Frohlich, C. and G. R. Scott. Where spectators sit to catch baseballs, *Baseball Res. J.*, **10**, 132-138, 1981.
- Huppert, L. N. and C. Frohlich. The P velocity within the Tonga Benioff zone determined from traced rays and observations, *J. Geophys. Res.*, **86**, 3771-3782, 1981.
- Frohlich, C. and M. Barazangi. A regional study of mantle velocity variations beneath eastern Australia and the southwestern Pacific using short-period recordings of P, S, PcP, ScP and ScS waves produced by Tongan deep earthquakes, *Phys. Earth Planet. Int.*, **21**, 1-14, 1980.
- Frohlich, C. The physics of somersaulting and twisting, *Sci. Amer.*, **242(3)**, 154-164, 1980.
- Frohlich, C. and R. E. Buskirk. Can fish detect seismic waves? *Geophys. Res. Lett.*, **7**, 569-572, 1980.
- Frohlich, C., J. G. Caldwell, A. Malahoff, G. V. Latham and J. Lawton. Ocean bottom seismograph measurements in the central Aleutians, *Nature*, **286**, 144-145, 1980.
- Frohlich, C. An efficient method for joint hypocenter determination for large groups of earthquakes, *Computers & Geosciences*, **5**, 387-389, 1979.
- Frohlich, C. Do springboard divers violate angular momentum conservation? *Amer. J. Phys.*, **47**, 583-592, 1979; reprinted in *The Physics of Sports*, ed. A. Armenti, Amer. Inst. Phys., New York, 311-320, 1992.
- Frohlich, C., M. Barazangi and B. L. Isacks. Upper mantle structure beneath the Fiji plateau: Seismic observations of second P arrivals from the olivine-spinel phase transition zone, *Geophys. J. Roy. Astr. Soc.*, **50**, 185-213, 1977.
- Caldwell, J. G. and C. Frohlich. Microearthquake study of the Alpine fault zone near Haast, South Island, New Zealand, *Bull. Seismol. Soc. Amer.*, **65**, 1097-1104, 1975.

Frohlich, C., M. W. Major and B. L. Isacks. Strainmeter and tiltmeter measurements from the Tonga island arc, *Bull. Seismol. Soc. Amer.*, **65**, 563-579, 1975.

Scholz, C. H., J. M. W. Rynn, R. W. Weed and C. Frohlich. Detailed seismicity of the Alpine fault zone and Fiordland region, New Zealand, *Geol. Soc. Amer. Bull.*, **84**, 3297-3316, 1973.

## **NOTES, BOOK REVIEWS, AND COMMENTARY**

Frohlich, C., H. R. DeShon, B. W. Stump, C. Hayward, M. J. Hornbach and J. I. Walter. Reply to "Comment on 'A historical review of induced earthquakes in Texas' by Steve Everley", *Seismol. Res. Lett.*, **87**, 1381-1383, doi:10.1785/0220160148, 2016.

Frohlich, C., and R. Frohlich, Review of *The Science of the Perfect Swing*, by P. Dewhurst, *Amer. J. Physics*, **84**, 814-815, 2016.

Frohlich, C. and W. Gan. Earthquakes, deep, in *Encyclopedia of Complexity and Systems Science*, edited by R. A. Meyers, doi:10.1007/978-3-642-27737-5\_594-1, 2014.

Frohlich, C., and E. Potter. What further research could tell us about "close encounters of the third kind": Intraplate earthquakes associated with fluid injection, in *Critical Assessment of Shale Resource Plays*, edited by J. Chatellier and D. Jarvie, AAPG Memoir **103**, 109-113, 2013.

Frohlich, C. Review of *Physics of Baseball and Softball*, by Rod Cross, *Physics Today*, **64** (5), 48-50, 2011.

Frohlich, C., M. J. Hornbach and F. W. Taylor. Megablocks, in *Encyclopedia of Modern Coral Reefs*, ed. D. Hopley, Springer Verlag, 679-683, 2011.

Hornbach, M. J., P. Mann, C. Frohlich, K. Ellins and L. Brown. Assessing geohazards near Kingston, Jamaica: Initial results from chirp profiling, *Leading Edge*, **30**, 410-413, 2011.

Frohlich, C. Review of *The Road to Total Earthquake Safety*, by C. Lomnitz, *EOS*, **80**, 540, 1999.

Frohlich, C. Review of *Fundamentals of Geophysics*, by W. Lowrie, *EOS*, **79**, 187, 1998.

Frohlich, C. Review of *The Earth's Shifting Axis -Clues to Nature's Most Perplexing Mysteries*, by M. B. Strain, *Geotimes*, **42** (12), 37-38, 1997.

Frohlich, C. Review of *Structure and Fate of Subducting Slabs*, by T. Lay, *EOS*, **78**, 373, 1997.

Frohlich, C., Review of *Exercises in Active Tectonics*, by N. Pinter, *EOS*, **77**, 322, 1996.

Frohlich, C. A break in the deep, *Nature*, **368**, 100-101, 1994.

- Frohlich, C. and S. P. Grand. The fate of subducting slabs, *Nature*, **347**, 333-334, 1990.
- Frohlich, C. New rumbles on deep sources, *Nature*, **341**, 687-688, 1989.
- Frohlich, C. Review of *Newton at the Bat: The Science in Sports*, ed. E. W. Schrier and W. F. Allman, *Amer. J. Phys.* **53**, 187-188, 1985.
- Frohlich, C. Comments on 'Is a baseball a sand-roughened sphere?' *Amer. J. Phys.*, **53**, 583, 1985.
- Frohlich, C. Review of *Earthquakes, Tides, Unidentified Sounds and Related Phenomenon*, by W. R. Corliss, *Icarus*, **58**, 451-452, 1984.