

Regional moments, energy levels, and a new discriminant

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Abstract

Teleseismic observations of explosions tend to be richer in short-period energy than are earthquakes, thus the effectiveness of them $b : M_s$ discriminant. At regional distances the same basic separation occurs for smaller events in terms of $M_L : M_o$ (Woodset *al.*, 1993) and $m_b : M_o$ (Patton and Walter, 1993). While these studies demonstrate the basic differences in excitation, they suffer in practical application because of the detailed information required in the retrieval of M_o . In this paper, we introduce a new method of discrimination, based on the energy strength (M_E) from broadband regional records that appears to be effective and efficient. In this method all events are processed as earthquakes, and explosions are distinguished by their stronger energy levels relative to their long-period amplitudes. Results from 29 events recorded by TERRAscope, sampling 15 explosions from NTS and 14 earthquakes from the southwestern United States, are represented, indicating complete separation (45 data points). $M_L = 3.6$ is the smallest event examined to date but the method can probably be extended to even smaller levels in calibrated regions.

Key words

Energy discriminant magnitude amplitude earthquake explosion

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References

Aki, K., and Richards, P. G., *Quantitative Seismology* (W. H. Freeman and Company, San Francisco 1980).

[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Quantitative%20Seismology&author=K.%20Aki&author=P.%20G.%20Richards&publication_year=1980)

Dreger, D. S. (1992), *Modeling Earthquakes with Local and Regional Broadband Data*, Ph.D. Thesis, Calif. Inst. of Technol., Pasadena.

[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Modeling%20Earthquakes%20with%20Local%20and%20Regional%20Broadband%20Data&author=D.%20S.%20Dreger&publication_year=1992)

Dreger, D. S., and Helmberger, D. V. (1991a), *Source Parameters of the Sierra Madre Earthquake from Regional and Local Body Waves*, *Geophys. Res. Lett.* **18**, 2015–2018.

[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Source%20Parameters%20of%20the%20Sierra%20Madre%20Earthquake%20from%20Regional%20and%20Local%20Body%20Waves&author=D.%20S.%20Dreger&author=D.%20V.%20Helmberger&journal=Geophys.%20Res.%20Lett.&volume=18&pages=2015-2018&publication_year=1991)

Dreger, D. S., and Helmberger, D. V. (1991b), *Complex Faulting Deduced from Broadband Modeling of the February 28, 1990 Upland Earthquake ($M_L = 5.2$)*, *Bull. Seismol. Soc. Am.* **81**, 1129–1144.

[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Complex%20Faulting%20Deduced%20from%20Broadband%20Modeling%20of%20the%20February%2028%2C%201990%20Upland%20Earthquake%20%28ML%3D5.2%29&author=D.%20S.%20Dreger&author=D.%20V.%20Helmberger&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=81&pages=1129-1144&publication_year=1991)

Dreger, D. S., and Helmberger, D. V. (1993), *Determination of Source Parameters at Regional Distances with Three-component Sparse Network Data*, *J. Geophys. Res.* **98**, 8107–8125.

[Google Scholar](#) (http://scholar.google.com/scholar_lookup?title=Determination%20of%20Source%20Parameters%20at%20Regional%20Distances

%20with%20Three-
component%20Sparse%20Network%20Data&author=D.%20S..%20Dreger&author=D.
%20V..%20Helmberger&journal=J.%20Geophys.%20Res.&volume=98&pages=8107-
8125&publication_year=1993)

Dziewonski, A. M., and Anderson, D. L. (1981), *Preliminary Reference Earth Model*, Phys. Earth Planet. Inter. **25**, 297–356.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Preliminary%20Reference%20Earth%20Model&author=A.%20M..%20Dziewonski&author=D.%20L..%20Anderson&journal=Phys.%20Earth%20Planet.%20Inter.&volume=25&pages=297-356&publication_year=1981)

Harkrider, D. G., *Coupling near source phenomena into surface wave generation*. In *Identification of Seismic Sources-earthquakes or Underground Explosion* (Hasebye, E. S., and Mykkeltreit, S., eds.) (Reidel Publishing Co. 1981) pp. 277–326.

Google Scholar (<https://scholar.google.com/scholar?q=%0AHarkrider%2C%20D.%20G.%2CCoupling%20near%20source%20phenomena%20into%20surface%20wave%20generation.%20In%20Identification%20of%20Seismic%20Sources-earthquakes%20or%20Underground%20Explosion%20%28Hasebye%2C%20E.%20S.%2C%20and%20Mykkeltreit%2C%20S.%2C%20eds.%29%20%28Reidel%20Publishing%20Co.%201981%29%20pp.%20277%E2%80%93326>.)

Helmberger, D. V., Dreger, D., Stead, R., and Kanamori, H. (1993), *Impact of Broadband Seismology on Strong Motion Attenuation*, Bull. Seismol. Soc. Am. **83**, 830–850.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Impact%20of%20Broadband%20Seismology%20on%20Strong%20Motion%20Attenuation&author=D.%20V..%20Helmberger&author=D..%20Dreger&author=R.%20Stead&author=H.%20Kanamori&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=83&pages=830-850&publication_year=1993)

Ho-Liu, P., and Helmberger, D. V. (1989), *Modeling Regional Loves: Imperial Valley to Pasadena*, Bull. Seismol. Soc. Am. **79**, 1994–1209.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Modeling%20Regional%20Loves%3A%20Imperial%20Valley%20to%20Pasadena&author=P.%20Ho-Liu&author=D.%20V..%20Helmberger&journal=Bull%20Seismol.%20Soc.%20Am.&volume=79&pages=1994-1209&publication_year=1989)

Kanamori, H., Mori, J., Hauksson, E., Heaton, T., Hutton, L., and Jones, L. (1993), *Determination of Earthquake Energy Release and M_L Using TERRAscope*, Bull. Seismol. Soc. Am. **83**, 330–346.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Determination%20of%20Earthquake%20Energy%20Release%20and%20ML%20Using%20TERRAscope&author=H.%20Kanamori&author=J.%20Mori&author=E.%20Hauksson&author=T.%20Heaton&author=L.%20Hutton&author=L.%20Jones&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=83&pages=330-346&publication_year=1993)

Langston, C. A., and Helmberger, D. V. (1975), *A Procedure for Modeling Shallow Dislocation Sources*, Geophys. J. R. Astr. Soc. **42**, 117–130.

Google Scholar (http://scholar.google.com/scholar_lookup?title=A%20Procedure%20for%20Modeling%20Shallow%20Dislocation%20Sources&aut

Taylor, S. R., Denney, M. D., Vergino, E. S., and Glaser, R. E. (1989), *Regional Discrimination Between NTS Explosions and Western U.S. Earthquakes*, Bull. Seismol. Soc. Am. **79**, 1142–1176.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Regional%20Discrimination%20Between%20NTS%20Explosions%20and%20Western%20U.S.%20Earthquakes&author=S.%20R.%20Taylor&author=M.%20D.%20Denney&author=E.%20S.%20Vergino&author=R.%20E.%20Glaser&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=79&pages=1142-1176&publication_year=1989)

Thio, H. K., and Kanamori, H. (1992), *Moment Tensor Inversions in Southern California Using Surface Waves Recorded by TERRAscope* (abstract), EOS Trans. AGU **73**, 376.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Moment%20Tensor%20Inversions%20in%20Southern%20California%20Using%20Surface%20Waves%20Recorded%20by%20TERRAscope&author=H.%20K.%20Thio&author=H.%20Kanamori&journal=EOS%20Trans.%20AGU&volume=73&pages=376&publication_year=1992)

Woods, B., and Harkrider, D. G. (1995), *Investigating Long-period Source Spectra of Nevada Test Site Explosions Using Regional Surface Wave Data with Applications to Yield Estimation and Discrimination*, Bull. Seismol. Soc. Am. (in press).

Google Scholar (<https://scholar.google.com/scholar?q=%0AWoods%2C%20B.%2C%20andHarkrider%2C%20D.%20G.%20%281995%29%2CInvestigating%20Long-period%20Source%20Spectra%20of%20Nevada%20Test%20Site%20Explosions%20Using%20Regional%20Surface%20Wave%20Data%20with%20Applications%20to%20Yield%20Estimation%20and%20Discrimination%2C%20Bull.%20Seismol.%20Soc.%20Am.%20%28in%20press%29.>)

Woods, B., Kedar, S., and Helmberger, D. V. (1993), *M_L : M_o as a Regional Seismic Discriminant*, Bull. Seismol. Soc. Am. **83**, 1167–1183.

Google Scholar (http://scholar.google.com/scholar_lookup?title=ML%E2%88%B6Mo%20as%20a%20Regional%20Seismic%20Discriminant&author=B.%20Woods&author=S.%20Kedar&author=D.%20V.%20Helmberger&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=83&pages=1167-1183&publication_year=1993)

Zhao, L. S., and Harkrider, D. G. (1992), *Wave Fields from an Off-center Explosion in an Embedded Solid Sphere*, Bull. Seismol. Soc. Am. **82**, 1927–1955.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Wave%20Fields%20from%20an%20Off-center%20Explosion%20in%20an%20Embedded%20Solid%20Sphere&author=L.%20S.%20Zhao&author=D.%20G.%20Harkrider&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=82&pages=1927-1955&publication_year=1992)

Zhao, L. S., and Helmberger, D. V. (1994), *Source Estimation from Broadband Regional Seismograms*, Bull. Seismol. Soc. Am. **84**, 91–104.

Google Scholar (http://scholar.google.com/scholar_lookup?title=Source%20Estimation%20from%20Broadband%20Regional%20Seismograms&author=L.%20S.%20Zhao&author=D.%20V.%20Helmberger&journal=Bull.%20Seismol.%20Soc.%20Am.&volume=84&pages=91-104&publication_year=1994)

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