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LETTERS TO THE EDITOR

COMMENTS ON "SOME RECENT *Lg* PHASE DISPLACEMENT SPECTRAL DENSITIES AND THEIR IMPLICATIONS WITH RESPECT TO PREDICTION OF GROUND MOTIONS IN EASTERN NORTH AMERICA" BY R. STREET

BY L. C. HAAR, C. S. MUELLER, J. B. FLETCHER, AND D. M. BOORE

Street (1984) states that earthquakes from the 1982 Arkansas swarm and the 1982 Miramichi aftershock sequence are anomalous. His conclusion is based on a comparison between seismic moments and corner frequencies obtained from regionally recorded *Lg* phases and the relationship between spectral parameters proposed for mid-plate earthquakes by Nuttli (1983). Whereas Street finds anomalously low corner frequencies for some of these events (relative to the Nuttli curve), two recent studies found significantly higher corner frequencies for the same earthquakes in spectra obtained from locally recorded body waves at Arkansas (Haar *et al.*, 1984) and Miramichi (Mueller and Cranswick, 1985). Thus, a main conclusion of these two studies is *reinforced* by Street's findings: corner frequencies from regionally recorded *Lg* are too low relative to those from locally recorded body waves. In general, we expect locally recorded spectra to provide more direct source information than regionally recorded *Lg*, for which excitation and propagation are more poorly understood. Although site effects have been recognized to complicate the body-wave data (Mueller and Cranswick, 1985; Cranswick *et al.*, in preparation), there is no reason to assume that the regionally recorded *Lg* data is not also complicated by site effects.

The purpose of this comment is three-fold

1. to directly compare spectral parameters from the three Eastern North American (ENA) events in Street's study which were recorded both regionally and locally.
2. to extend the discussion in (1) to examine the issue of whether the Arkansas and Miramichi data are anomalous as suggested by Street; and
3. to provide evidence from recent published results showing a similar discrepancy between regionally and locally recorded data from Baja, California (Munguia and Brune, 1984).

Figure 1 compares local body-wave (from both California and ENA events) and regional *Lg*-wave (ENA events only) source parameters. Three of the events plotted have source parameter estimates from both local (Haar *et al.*, 1984; Boatwright, personal communication, 1985) and regional recordings; for each of these events a line has been drawn connecting the two estimates. In each case, the corner frequency from the regionally recorded *Lg* data is considerably lower than that observed from the locally recorded body waves. Horizontal component seismograms and spectra from local recordings of one of these events (Arkansas, 30 June 1982, 16:21) are shown in Figure 2. Street reports a corner frequency of 1.2 Hz for this event, whereas Figure 2 suggests that a corner of 10 Hz would be more appropriate. The discrepancy between local and regional recordings is the most obvious feature of Figure 1; source parameters from local recordings scale similarly whether they are from inter- or intraplate events. The difference between source parameters derived from regional and local recordings is most prominent in the moment range above

10^{20} dyne-cm and can be explained in terms of a correlation between event size and recording distance (Figure 3). Smaller events in the *Lg* data set tend to be recorded more locally and hence produce source parameters which are similar to those derived from the locally recorded body waves.

Street (1984) finds that the Arkansas and Miramichi earthquake spectra from

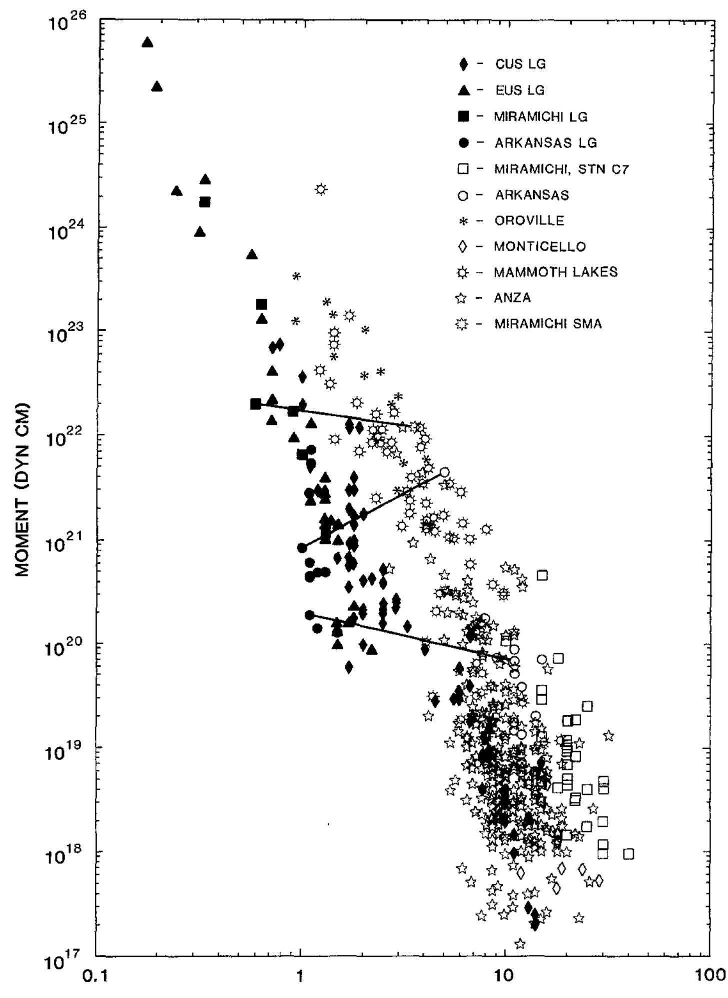

FIG. 1. Seismic moment versus source radius for Arkansas local recordings (Haar *et al.*, 1984), Arkansas *Lg* (Street, 1984), Miramichi, New Burnswick local recordings (all but the largest event; Mueller and Cranswick, 1985, largest event; Boatwright, personal communication), Miramichi, New Brunswick *Lg* (Street, 1984) Northeastern United States *Lg* (Street and Turcotte, 1977), Central United States *Lg* (Street *et al.*, 1975), Monticello, South Carolina, local recordings (Fletcher, 1982; Fletcher *et al.*, 1983a, b), Mammoth Lakes, California local recordings (Archuleta *et al.*, 1982). Oroville, California, local recordings (Fletcher, 1980; Fletcher *et al.*, 1983 a, b), and Anza, California, local recordings (Fletcher *et al.*, in preparation).

regional recordings are anomalous with respect to those from other intraplate events. In light of the similarity between source parameters derived from local recordings of both inter- and intraplate events (Figure 1), the discrepancies between *Lg* data sets only illustrates the unreliability of source parameters determined from regionally recorded *Lg* waves.

A similar discrepancy between spectra from local and regional recordings has recently been documented in an interplate environment. Spectra from regional recordings of Baja California earthquakes have consistently yielded lower corner frequencies than have spectra from local recordings of California earthquakes of comparable moment (Munguia and Brune, 1984). Munguia and Brune (1984) examined spectra from local and regional recordings of 44 events from the March 1978 Victoria earthquake swarm. Figure 4 is from their paper. It shows that the long-period levels of distance-corrected local and regional spectra are similar, but corner frequencies differ by an order of magnitude.

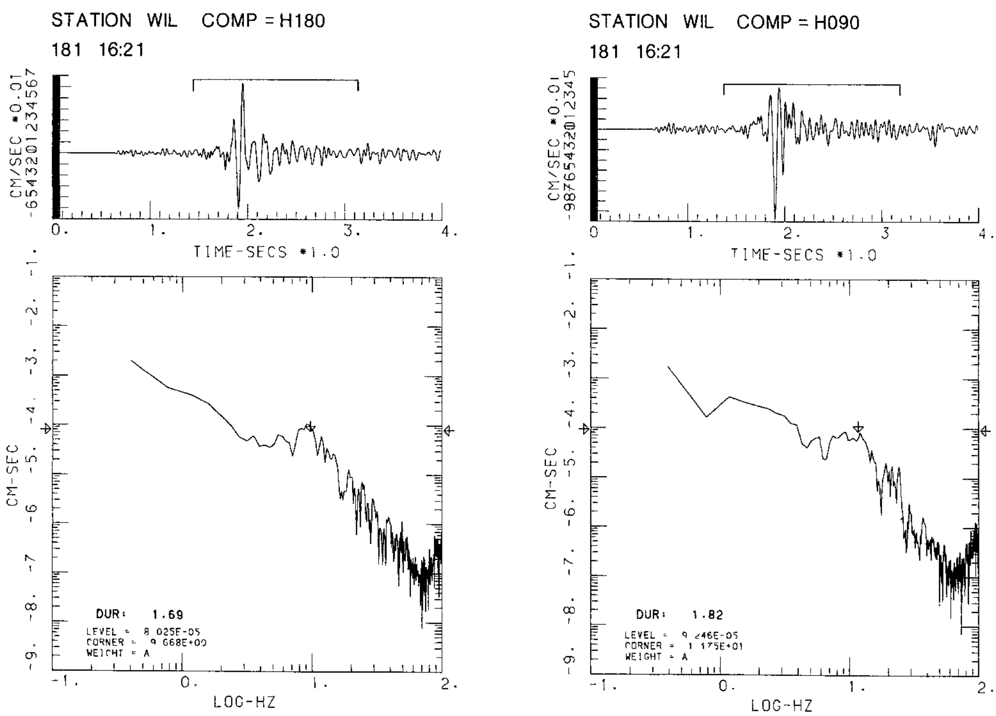

FIG. 2. Spectra for two horizontal components of the U.S. Geological Survey station WIL for 30 June 1984 Arkansas event.

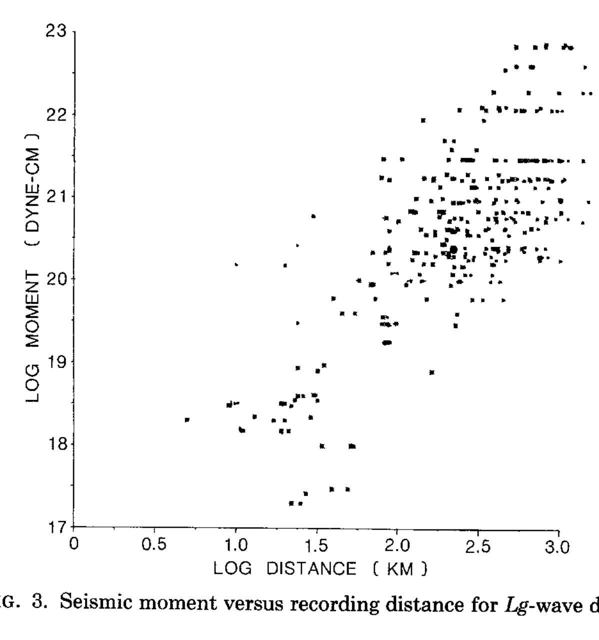

FIG. 3. Seismic moment versus recording distance for *Lg*-wave data.

The evidence presented here suggests that spectra from regionally recorded waveforms do not accurately reflect source properties. Haar *et al.* (1984) and Mueller and Cranswick (1985) have discussed the uncertainties associated with constructing source-scaling relationships from such data. It follows that swarm and aftershock events cannot be dismissed as "unusual" based on analyses of such data; we feel that the locally recorded Arkansas and Miramichi datasets provide important constraints on the ENA source-scaling question. Full understanding of ground

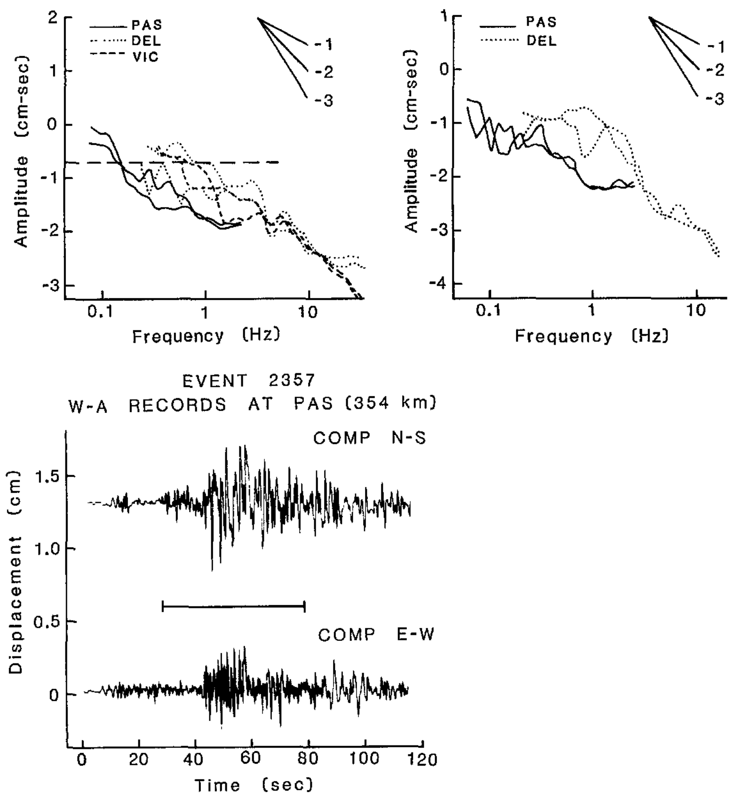

FIG. 4. Comparison of spectra from near source and distant station data for the 11 March 1978 (23:57 UTC, $M_L = 4.8$) Victoria swarm earthquake (*left*) and the 9 June 1980 (23:33 UTC, $M_L = 4.3$) Victoria aftershock (*right*). These 1978 and 1980 spectra were normalized to distances of 19 and 13 km, respectively (distances to station DEL). The horizontal dashed line drawn with the 1978 spectra indicates the low-frequency level inferred analyses of surface-wave data. Wood-Anderson records at Pasadena (PAS) for the 1978 earthquake are also shown.

motion attenuation and wave propagation in ENA will only result from analysis of seismograms made at a range of distances. The discrepancies described in this note point up the need for greater effort to obtain more local records from ENA earthquakes.

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