MARINE PHYSICAL LABORATORY
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San Diego, California 92132

PRELIMINARY RESULTS ON SEAMOUNT AND CONTINENTAL SLOPE REFLECTION ENHANCEMENT OF SHIPPING NOISE

G. B. Morris

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Measurements of ambient noise levels made during a time period when a supertanker passed the observation site clearly show such vessels to be a strong acoustic source. The tonals associated with the propeller blade rate and its frequency harmonics were clearly observed on single, omni-directional hydrophones for ranges out to 240 nautical miles. The received signals from the radiated noise from this vessel increased in level by as much as 10 dB when it was in the vicinity of a seamount and the continental slope, (over)

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ABSTRACT

Measurements of ambient noise levels made during a time period when a supertanker passed the observation site clearly show such vessels to be a strong acoustic source. The tonals associated with the propeller blade rate and its frequency harmonics were clearly observed on single, omni- directional hydrophones for ranges out to 240 nautical miles. The received signals from the radiated noise from this vessel increased in level by as much as 10 dB when it was in the vicinity of a seamount and the continental slope, suggesting a reflection enhancement. The magnitude of this observed reflection enhancement varies inversely with hydrophone depth, being the largest for the shallowest depth.

INTRODUCTION

During August and September 1974 underwater acoustic studies were conducted by the Marine Physical Laboratory of the University of California, the Naval Undersea Center and the Hawaii Institute of Geophysics in an area approximately 350 - 400 miles west of San Diego. One aspect of these studies, collectively designated Exercise CAPER for Combined Acoustic Propagation East Pac Region, was to make ambient noise measurements from a hydrophone system deployed from the Research Platform FLIP. During the noise measurement period a VLCC (Very Large Crude Carrier or supertanker), the Chevron London, passed through the region greatly influencing the background noise levels. The acoustic measurements of this vessel itself, however, are of interest in that VLCC's are strong acoustic sources which contribute significantly to the total ambient noise field and also because we observed apparent signal enhancements of the detected levels when this vessel crossed the region of the continental slope.

The VLCC Chevron London, operated by Chevron Shipping (Standard Oil Company of California), is a 225,000 deadweight ton supertanker. Its length is 1115 feet, beam 170 feet and draught 65 feet, and it is powered by two steam turbines with double reduction gear driving a single screw. This vessel was detected during the exercise by aircraft from Patrol Squadron 50 from Moffett Field, California; however, the navigation track was determined from data supplied by Chevron Shipping Company. The track followed by this vessel is shown in Fig. 1. Its CPA with respect to FLIP, the acoustic receiving platform, was 77 nautical miles and occurred at approximately 1100 PDT August 23. (All times are Pacific Daylight Time.) The vessel was traveling at a speed of 14.4 knots and crossed the continental slope at a position approximately 240 nautical miles due east of FLIP.

Figure 1. Track of VLCC CHEVRON LONDON, 23-24 August 1974, during Exercise Caper, speed 14.4 kts.

ACOUSTIC MEASUREMENT SYSTEM

The research platform FLIP which acted as the acoustic receiver station had four groups of hydrophones deployed beneath it at the depths shown in Fig. 2. Basically, each group consisted of five hydrophones, although two of the twenty were actually electrical networks which provided no acoustic signals but were used to monitor system noise levels.

Power spectra were calculated on-line for sixteen sensors with four sensors being sampled, digitized, and processed simultaneously. Each sensor was sampled such as to produce an ambient noise spectrum from 0 to 1000 Hz with a 1.1 Hz frequency resolution. The final data, stored in digital form, consisted of an average of 128 such individual spectra for each sensor. The sampling, which covered a total time of 115 seconds, processing and data storage for four sensors required slightly less than 3 minutes to accomplish. The sixteen sensors were processed sequentially in groups of four requiring about 12 minutes from start to finish. This process was repeated hourly.

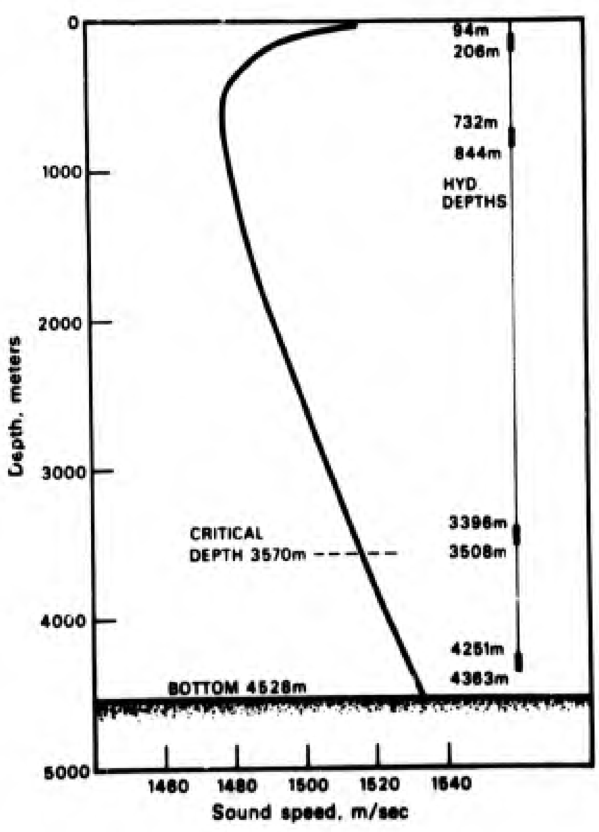

Figure 2. Sound speed profile and depth positions of hydrophones, Exercise Caper.

ACOUSTIC DATA

As a standard procedure, the 1.1 Hz spectral data were processed to form one-third octave levels in standard bands; i.e., center frequencies 25 Hz, 50 Hz, etc. These levels, referenced to micro Pascals in a 1 Hz band, are given for the 50 Hz one-third octave band in Figs. 3a-d for the time period from 1300 PDT 22 August to 0500 PDT 24 August.

Fig. 3a shows the levels for two hydrophones in the deepest group together with the dummy hydrophone or system noise measurement in this group. The early data, from 1300/22 August to 0000/23 August suffered from influences of other nearby shipping and also a gap in the data due to an equipment malfunction. The broad hump starting at about 0400/23 August and ending at about 0100/24 August is due to the Chevron London. There are three reasons we have ascribed signals in this time period to this vessel. First, shipping surveillance provided by the aircraft assigned to the exercise determined this particular vessel to be the only large one that was within 100 nautical miles of FLIP. Second, the maximum shaft rate of the Chevron London is 85 rpm (Don Ross, personal communication) at a speed of 15-1/4 knots. According to the bridge log the vessel was making 14.4 knots which translates to 80.3 rpm or a fundamental blade rate of 6.69 Hz. Our determination of the fundamental blade rate for the acoustic signals within the above mentioned time period is 6.85 Hz. Third, the signal enhancements and the loss of these signals occur at the time this particular vessel passed Rodriquez Seamount and crossed the continental slope.

Again Fig. 3a exhibits an increase in the noise level of 8 dB to 14 dB as a result of this vessel. The levels exhibit a sharp peak for the samples taken shortly after 0000/24 August when the Chevron London is within about 15 nautical miles of Rodriquez Seamount and drop some 10 dB to 15 dB after this time. There is only a modest rise at 0200 when the vessel crosses the 1000 fm contour on the continental slope. The noise levels as measured by the hydrophone group positioned just above the critical depth Fig. 3b, exhibits a fluctuating nature resulting from the vessel passing through acoustic propagation convergence zones. The magnitude of the enhancement is difficult to discern because of the fluctuating levels; however, there are sharp rises in level for the samples taken shortly after 0000 and 0300 on 24 August. The same situation holds for the noise levels measured by the shallower hydrophones, Figs. 3c and 3d. The reflection enhancements are more prominent on Fig. 3d in that at its closest point of approach the

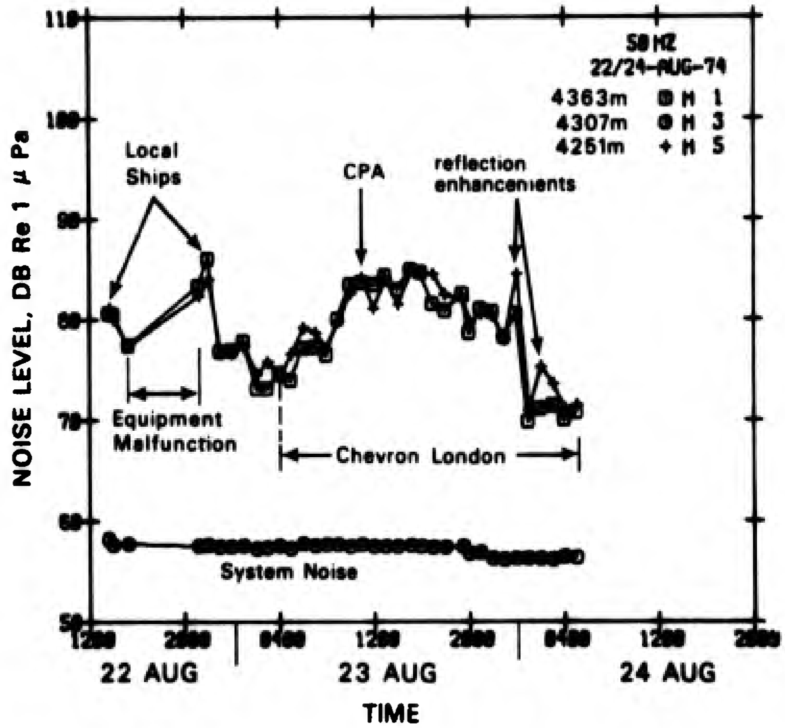

Figure 3a. Noise spectrum levels for the 50 Hz center frequency one-third octave band for two hydrophones from each of four groups.

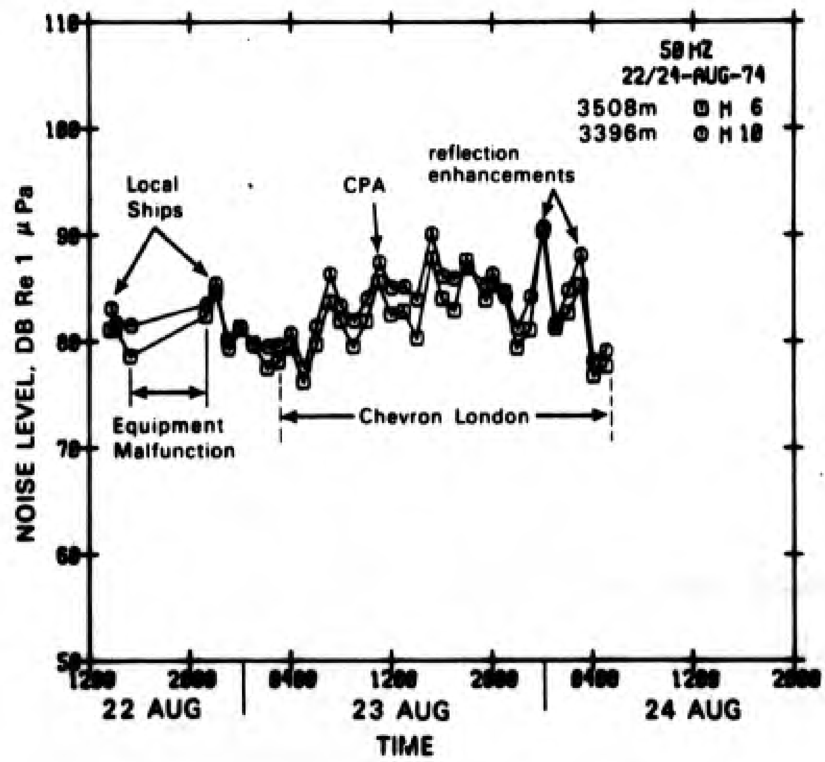

Figure 3b. Noise spectrum levels for the 50 Hz center frequency one-third octave band for two hydrophones from each of four groups.

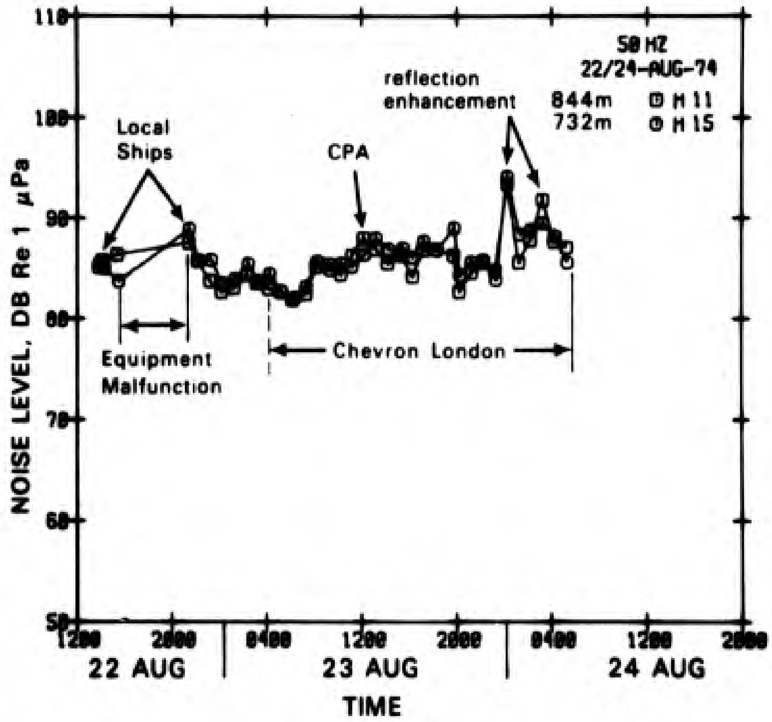

Figure 3c. Noise spectrum levels for the 50 Hz center frequency one-third octave band for two hydrophones from each of four groups.

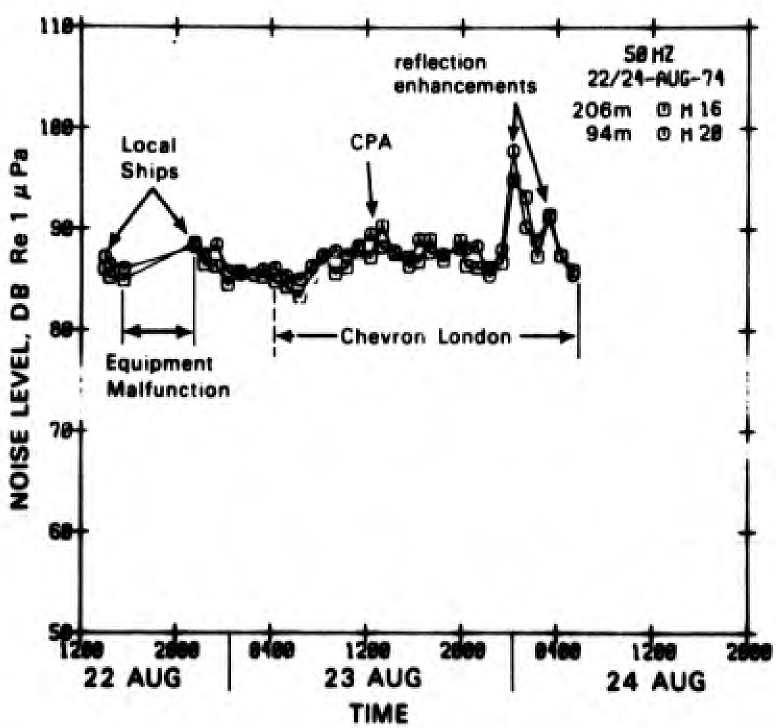

Figure 3d. Noise spectrum levels for the 50 Hz center frequency one-third octave band for two hydrophones from each of four groups.

Chevron London raises the general background level only 2 dB to 5 dB in the 50 Hz one-third octave band. At the times ascribed to reflection enhancement, the levels rise about 10 dB for the 0000 + sample and about 5 dB for the 0300 + sample.

Table I gives subjective measurements of the signal enchancements which occur when this vessel is in the vicinity of the continental slope. The first rise in the double event occurring near 0000 time is believed to be associated with a relfection from Rodriquez Seamount; the second rise at about 0300 is associated with a reflection process in the vicinity of the continental slope. The signal enhancement associated with the seamount reflection is roughly twice that associated with the slope reflection. Both enhancements are greater for the shallower hydrophones than for the deeper ones.

The usual explanation offered for the observation of anomalously strong signals associated with ship traffic near the edge of the continental shelf or for anomalously low propagation loss measurements in the same regions is the so-called "megaphone effect." This phenomenon occurs when signals that are propagating in a downslope direction are reflected from a sloping bottom. The ray angles, with respect to the horizontal, are decreased upon bottom reflection by twice the bottom slope providing a mechanism whereby bottom reflected, surface reflected (BR, SR) paths are shifted into RRR or RSR events. (See Officer, 1958 and Northrop, Loughridge and Werner, 1968.) Such a mechanism may account for the second and weaker of the two observed enhancements where the vessel is above the continental shelf; however, the first and strongest enhancement occurs when the vessel is 15 miles or more outside the 1000 fathom contour. It seems reasonable, therefore, to conclude that the most likely explanation is by some backward reflection process; that is rays from the ship originally traveling away from the receiver are reflected back towards the receivers. This back reflection process must also include some process whereby the signals are strengthened. Possible explanations are geometrical focusing associated with the reflecting bottom, or else, as the radiation pattern of the vessel is anisotropic, directions of high intensity in the radiation pattern are reflected or scattered into RRR or RSR propagation paths.

Figures 4a-d present 1.1 Hz spectra for four sensors in an orthographic projection or what is sometimes called a "waterfall projection." Such a projection is generated by first plotting a spectrum with frequency along the horizontal axis and spectrum level in decibels in the vertical. The next subsequent spectrum is displaced in the vertical by a distance proportional to the time interval between the spectra. The result is a vertical stacking intended to portray a stacking of

Table I. Reflection Enhancements

Hydrophone Group	Depths, Meters	Seamount Enhancement at 0000+PDT, dB	Slope Enhancement at 0300+PDT, dB
1	4251,4363	0 - 4	0
2	3396,3508	4 - 9	3 - 6
3	732,844	7 - 9	4 - 6
4	94,206	8 - 12	5

spectra in time. The vertical dimension has an ambiguity in that it represents both spectrum level and time. Some of the ambiguity is removed by picking a baseline level and plotting only values which exceed this base. In Figs. 4a-d this base is the estimated noise level in the 50 Hz one-third octave band for the hydrophone when the local shipping noise is at a minimum. For scaling on the original plots, one inch equals 20 Hz in frequency, 20 dB in level and 8 hours in time.

These plots contain several prominent persistent signals which warrant explanation. All hydrophones exhibit a 20 Hz line which because of the time averaging (approximately two minutes) appears to be stable. Detailed examination of this 20 Hz signal shows it to be impulsive in character and most probably biologic in origin (J. F. Fish, NUC, personal communication). The shallowest hydrophone, Fig. 4d, has a strong line in the 58 Hz to 60 Hz region which originates from the receiving platform, FLIP.

The waterfall displays emphasize tonal line-ups in particular and provide a compact summary of the noise field and its fluctuation. Several conclusions which can be readily drawn from a visual examination of Figs. 4a-d are as follows:

1. The presence of local shipping is more prominent on the deepest hydrophone, Fig. 4a, because the blade line harmonic signals are greater than the broad band ambient noise and also because the blade lines are more persistent with time as there is little fluctuation associated with convergence zones. The hydrophone near the critical depth, Fig. 4b, also shows strong blade lines; however, there are fluctuations of 6 dB - 10 dB associated with convergence zones.

2. The acoustic spectral pattern or signature of the Chevron London apparently changes with direction. For the time period 0800 to 1200, 23 August the hydrophones are detecting the noise radiated from near broadside of the vessel. The strongest lines are the 8th, 9th and 10th harmonics of the fundamental blade rate. From about 2000 on when there is more of a stern-on look at the noise radiation pattern, the strongest lines are the 6th and 7th harmonics.

3. The abrupt rise in level at 0018, 24 August associated with the seamount reflections shows clearly on Figs. 4c and 4d.

The determination of the radiated source levels for this supertanker are as yet not completed. Normally, the source levels of ships are measured at relatively short ranges (Urick 1967). Although it is theoretically possible to determine source levels using such long range observations as available here, the difficulty is one of correcting for the propagation loss. As yet, reliable propagation losses estimates have not been determined. However, preliminary estimates are that propagation loss varies from about 100 dB to 110 dB. As such, the source level for this ship in the 50 Hz one-third octave band is estimated to be in the range of 185 to 195 dB relative to a micro Pascal at one yard.

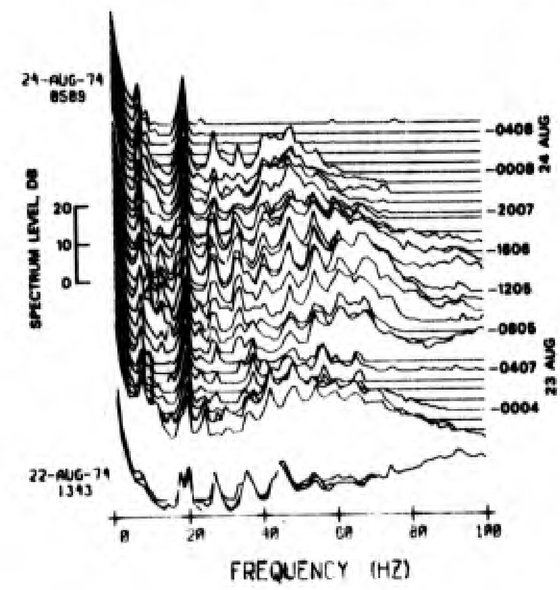

Figure 4a. Ambient noise spectra for the 0-100 Hz Band with 1.1 Hz resolution for the approximate time period 1300/22 August 1974 to 0500/24 August 1974. Hydrophone depth = 4364 meters, baseline level = 72 dB.

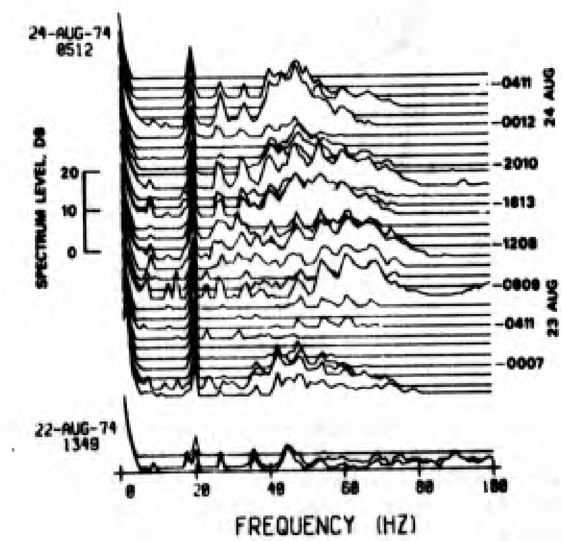

Figure 4b. Ambient noise spectra for the 0-100 Hz band with 1.1 Hz resolution for the approximate time period 1300/22 August 1974 to 0500/24 August 1974. Hydrophone depth = 3508 meters, baseline level = dB.

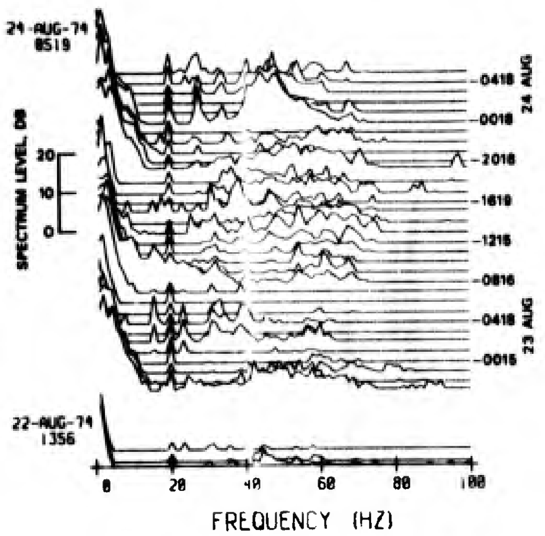

Figure 4c. Ambient noise spectra for the 0-100 Hz band with 1.1 Hz resolution for the approximate time period 1300/22 August 1974 to 0500/24 August 1974. Hydrophone depth = 732 meters, baseline level = 84.5 dB.

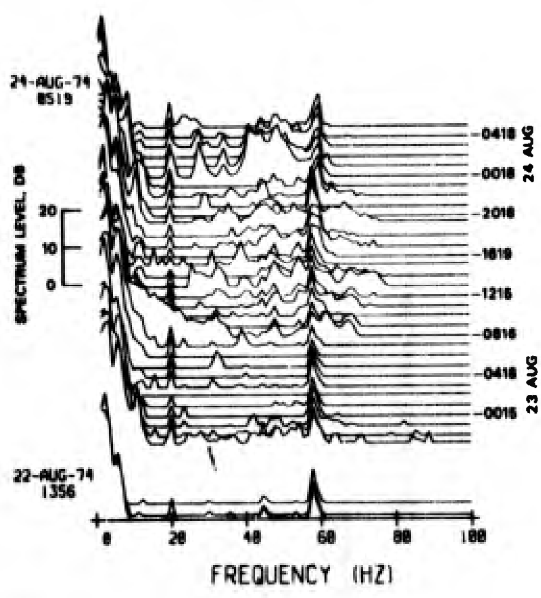

Figure 4d. Ambient noise spectra for the 0-100 Hz band with 1.1 Hz resolution for the approximate time period 1300/22 August 1974 to 0500/24 August 1974. Hydrophone depth = 206 meters, baseline level = 85.5 dB.

CONCLUSIONS

1. The received signals from the radiated noise of the VLCC Chevron London increase in level when this vessel is in the vicinity of the continental slope suggesting a possible reflection enhancement. The first, and largest, increase in level occurs about two hours prior to the time the vessel crosses the 1000 fathom contour on the slope and is hypothesized to originate from reflections off Rodriquez Seamount. The second increase occurs after the vessel has crossed the 1000 fathom contour on the continental slope. The pseudo target strengths for these reflections are greatest for the shallower hydrophones amounting to about + 10 dB for the seamount reflection and + 5 dB for the slope reflection. The deepest hydrophone, being 165 meters above the bottom, shows little increase in signal level at the times of these reflections. The hydrophones near the critical depth show enhancements whose pseudo target strengths are more difficult to determine but are intermediate to those of the shallowest and deepest sensors.

2. The directivity pattern of the radiated noise from the Chevron London is such that the signature depends upon the look direction. Near abeam the strongest lines are in the 50 Hz to 70 Hz region. For the near stern radiation the strongest lines are in the 40 Hz to 50 Hz region.

3. Preliminary estimates are that for the 50 Hz one-third octave, the source level referenced to a micro Pascal at one yard is between 185 dB to 195 dB.

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REFERENCES

Northrop, J., M. S. Loughridge and E. W. Werner, Effect of Near-Source Bottom Conditions on Long-Range Sound Propagation in the Ocean, J. Geophys. Res., 73, 3905-3908, 1968.

Officer, C. B., Introduction to the Theory of Sound Transmission with Its Application to the Ocean, 284 pp., McGraw-Hill, New York, 1958.

Urick, R. J., Principles of Underwater Sound for Engineers, 342 pp., McGraw-Hill, New York, 1967.

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Measurements of ambient noise levels made during a time period when a supertanker passed the observation site clearly show such vessels to be a strong acoustic source. The tonals associated with the propeller blade rate and its frequency harmonics were clearly observed on single, omni-directional hydrophones for ranges out to 240 nautical miles. The received signals from the radiated noise from this vessel increased in level by as much as 10 dB when it was in the vicinity of a seamount and the continental slope, suggesting a reflection enhancement. The magnitude of this observed reflection enhancement varies inversely with hydrophone depth, being the largest for the shallowest depth.

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