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NAVY UNDERWATER SOUND LAB NEW LONDON CONN
ACOUSTIC ATTENUATION RESEARCH AT USL.(U)
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NAVY UNDERWATER SOUND LABORATORY
FORT TRUMBULL, NEW LONDON, CONNECTICUT

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ACOUSTIC/ATTENUATION RESEARCH AT USL.

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INTRODUCTION

This paper describes the research which has been done at this Laboratory concerning the attenuation of low-frequency sound in the ocean. By low frequency we mean from 10-10,000 Hz. Starting in the middle 1950's, interest in long-range acoustic systems stimulated low frequency attenuation measurements. The small losses involved at these frequencies require somewhat specialized experimental conditions which are shown in the first figure. In order to get totally refracted acoustic paths over the order of hundreds of miles the so-called sound channel is utilized. By detonating explosive charges at the sound velocity minimum, some of the energy is constrained by the two gradients to travel along the channel axis. The received signals when analyzed, are filtered to give data in a particular frequency band.

LEVEL 11

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This paper was presented at the 34th Meeting of the Undersea Warfare Research and Development Planning Council, 25-28 June 1968 at the U. S. Navy Underwater Sound Laboratory, Fort Trumbull, New London, Connecticut.

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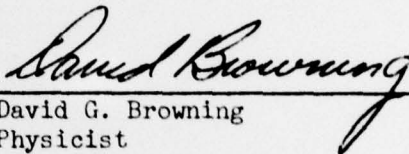
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We do feel that we should pursue the idea of a structural relaxation further. Since the Atlantic Ocean where the saltwater measurements were made and Lake Superior were at the same temperature, the crucial test will be to make measurements at a different water temperature and see if we get a shift in the relaxation frequency. In support of this, Leroy's measurements in the Mediterranean (13°C) indicate a relaxation frequency of 1.7 kHz. Fig. 9 shows what the prediction would be for the cases with the greatest difference, Lake Tanganyika (freshwater) and the Red Sea (saltwater). These bodies of water are where we plan to make our next measurements. If there is a shift and we live to tell the tale, we can identify the cause and compute the activation energy of the process.


David G. Browning
Physicist

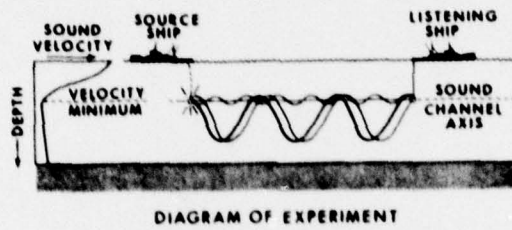


FIG. 1

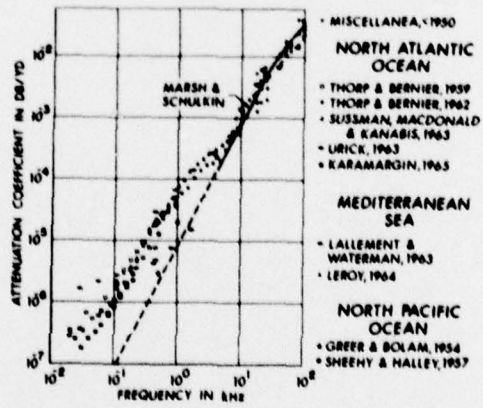


FIG. 2

POSSIBLE EXPLANATIONS FOR ATTENUATION ANOMALY

1. Suspended Matter	Duykers, JASA 41 (67) 1330
2. Biological Scattering	Weston, JASA 40 (66) 1558
3. Finite-Amplitude Effects	Marsh, Mellen, Konrad, JASA 38 (65) 326
4. Inhomogeneities	Urick, JASA 35 (63) 1413
5. Eddy Viscosity	Schulkin, JASA 35 (63) 253
6. Channel Leakage	Urick, JASA 35, (63) 1413
7. Internal Waves	(No calculations)
8. Relaxation Process (Unknown)	Thorp, JASA 38, (65) 648 Urick, JASA 39 (66) 904 LeRoy, JASA 36 (64) 1014
9. Relaxation Process - ions	Horne, T.R. 33 ONR
10. Relaxation Process - water	Browning, Thorp, Mellen - Int. Congress- Tokyo

These references discuss the concepts involved but are not necessarily in support of them.

FIG. 3

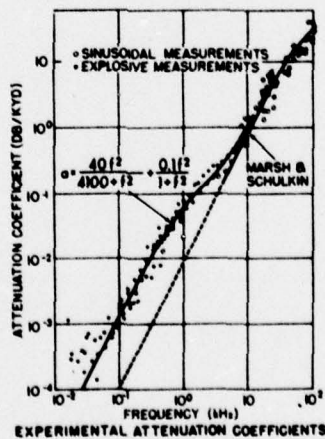


FIG. 4

ATTENUATION IN SEAWATER

LOW-FREQUENCY ANOMALY	MgSO ₄ RELAXATION	VISCOUS ABSORPTION
$\alpha = \frac{0.1 f^2}{1 + f^2}$	$+ \frac{40 f^2}{4100 + f^2}$	$+ 0.000275 f^2$

α = ATTENUATION IN DB/KYD
 f = FREQUENCY IN kHz

FIG. 5

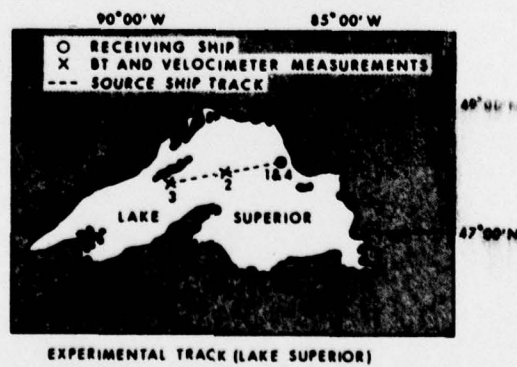


FIG. 6

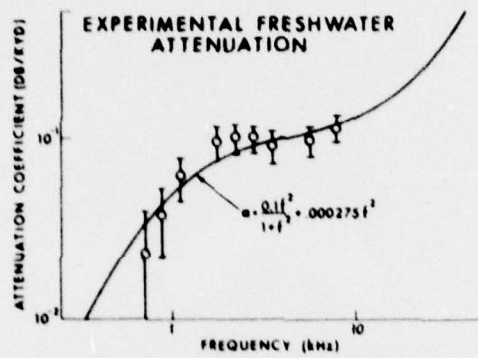


FIG. 7

ATTENUATION IN FRESHWATER

$$\alpha \text{ (DB/KYD)} = \frac{0.11^2}{1+f^2} + 0.000275 f^2, \quad f \text{ (kHz)}$$

ATTENUATION IN SEAWATER

$$\alpha \text{ (DB/KYD)} = \frac{0.11^2}{1+f^2} + \frac{40f^2}{4100+f^2} + 0.000275 f^2, \quad f \text{ (kHz)}$$

FIG. 8

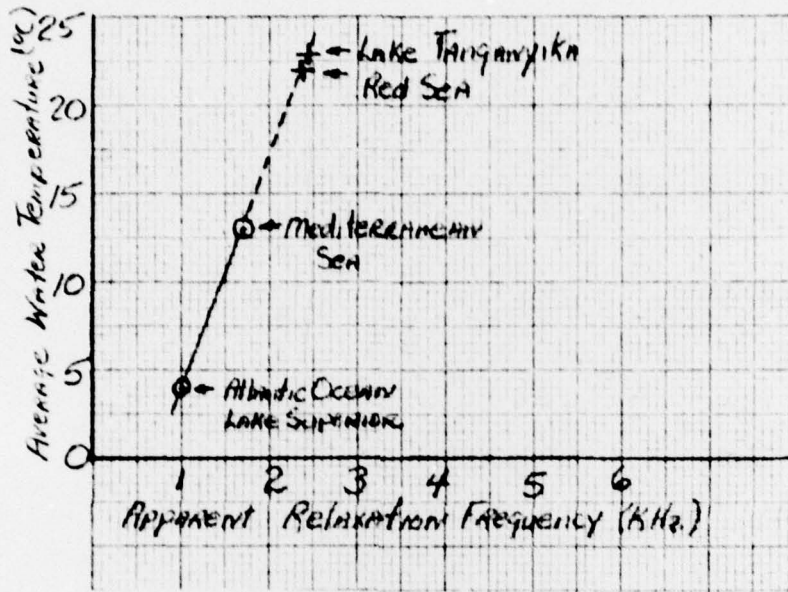


FIG. 9