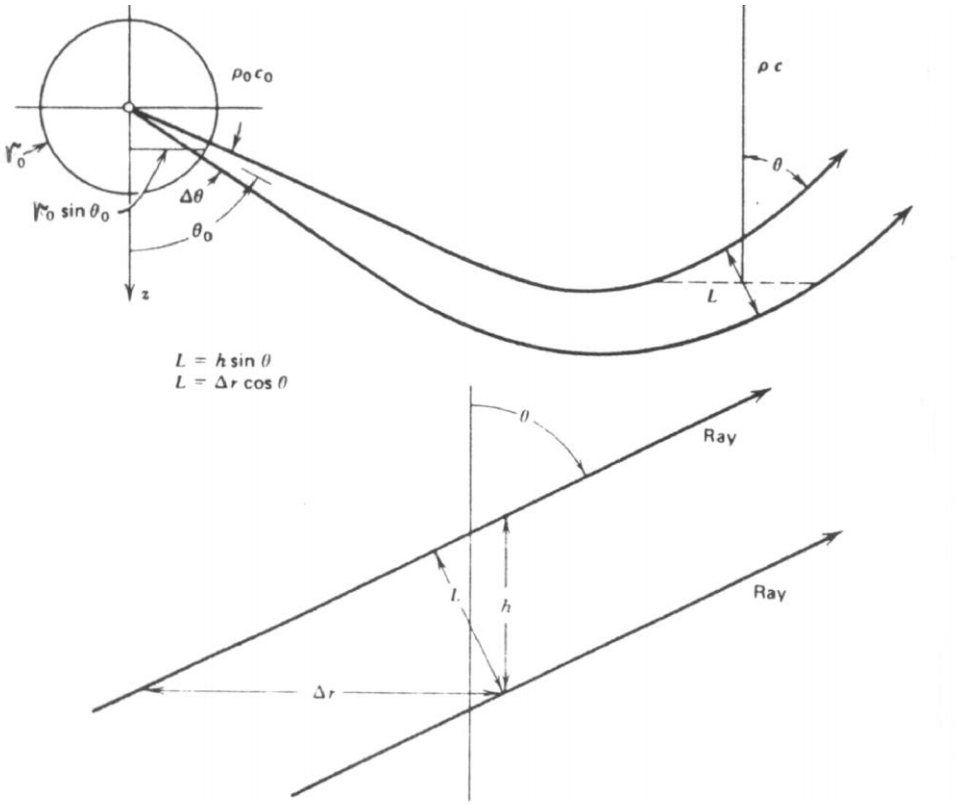
Φυσική εξασθένηση

Εξίσωση SONAR

Εισαγωγή στην Ακουστική Ωκεανογραφία



$$\Delta\Pi = \frac{|p_0|^2}{\rho_0 c_0}(2\pi r_0 \sin\theta_0) r_0 \Delta\theta$$

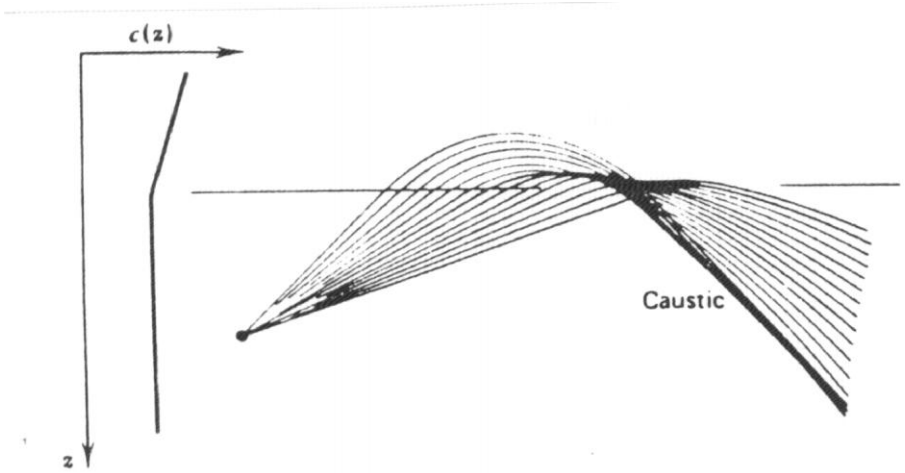
$$|p_0|^2 = \frac{\rho_0 c_0 \Pi}{4\pi r_0^2}$$

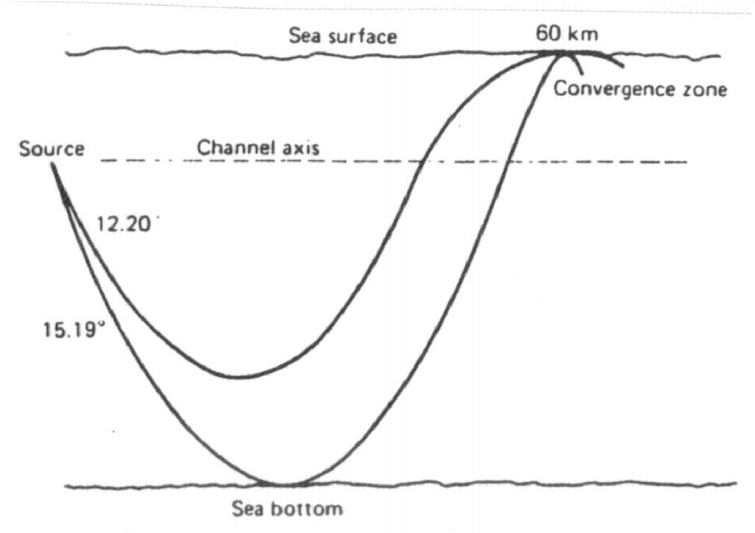
$$\Delta\Pi = \frac{2\pi r_0^2}{\rho_0 c_0}|p_0|^2 \sin\theta_0 \Delta\theta = \frac{2\pi r L |p|^2}{\rho c}$$

$$|p|^2 = \frac{|p_0|^2 r_0^2 \rho c \sin\theta_0 \Delta\theta}{\rho_0 c_0 r L}$$

$$TL = -20\log_{10}\left|\frac{p}{p_0}\right|$$

$$TL = 10\log_{10}\frac{r}{r_0} - 10\log_{10}\frac{\rho c}{\rho_0 c_0} + 10\log_{10}\frac{L}{r_0 \sin\theta_0 \Delta\theta}$$





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Φυσική Εξασθένηση

Μηχανισμοί Φυσικής Εξασθένησης :

Αιτία : Συνεκτικότητα (Viscosity)

Χρόνος Χαλάρωσης : (Relaxation Time) t_r

Απώλεια ενέργειας : Εξαρτάται από το λόγο του χρόνου χαλάρωσης προς την περίοδο : t_r / T

$$\frac{d|p|}{dx} = -a_e |p|$$ Συντελεστής απορρόφησης

$$|p| = |p_i| \exp[-a_e (x - x_0)]$$ Επίπεδα κύματα

$$|p_i| = |p_0| \frac{r_0}{r}$$ Σφαιρικά κύματα

$$|p| = |p_0| \frac{r_0}{r} \exp[-a_e (r - r_0)]$$

$$p(r,t) = \frac{b_c}{r} \exp i(kr - \omega t)$$

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για $r >> r_0$

$$p(r,t) = \frac{b_c}{r} \exp[-a_e r] \exp\left[i(kr - \omega t)\right]$$

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$$k_c = k + ia_e$$

$$p(r,t) = \frac{b_c}{r} \exp i(k_c r - \omega t)$$

$$p(x,t) = b_p \exp i(k_c x - \omega t)$$

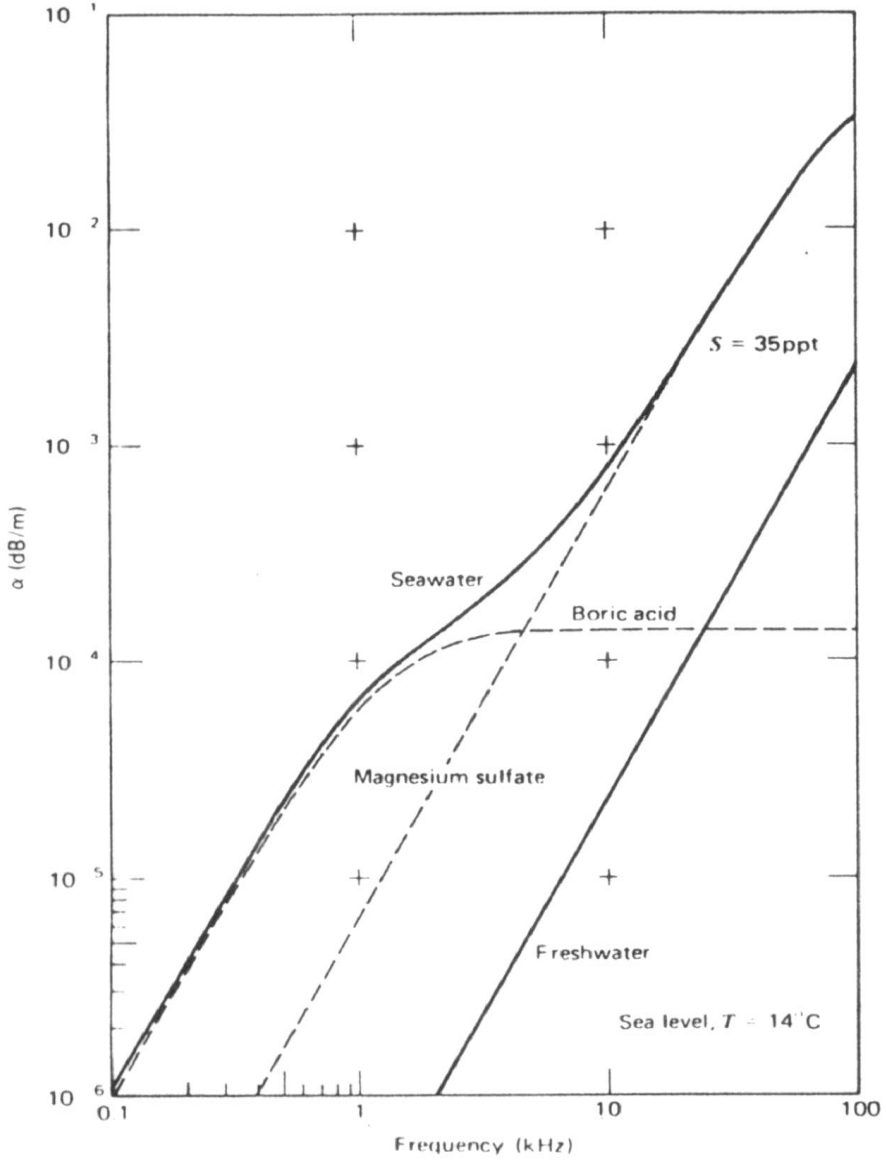
$$TL = 20\log_{10}\left|\frac{p_i}{p}\right| = a_e x(20\log_{10} e) = 8{,}686 a_e x$$

$$a = 8{,}686 a_e \quad \text{dB/m}$$

k

$$k_c = k + i a_e = \frac{\omega}{c_c}$$

$$c_c = \frac{\omega}{k_c} = \frac{\omega}{k + i a_e}$$


10 1
10 2
10 3
10 4
10 5
10 6
α (dB/m)
S = 35ppt
Seawater
Boric acid
Magnesium sulfate
Freshwater
Sea level, T = 14°C
0.1
1
10
100
Frequency (kHz)

Εξίσωση SONAR

$$SPL = SL - TL$$

$$SL = 10\log_{10}\left|\frac{p_0}{p_{ref}}\right|^2$$

$$\left|p\right|^2 = \frac{\left|p_0\right|^2 r_0^2 \rho c \sin\theta_0 \Delta\theta}{\rho_0 c_0 r L} 10^{-a(R-r_0)/10}$$

$$TL = 20\log_{10}\frac{r}{r_0} - 10\log_{10}\frac{\rho c}{\rho_0 c_0} + 10\log_{10}\frac{L}{r_0 \sin\theta_0 \Delta\theta} + a(R - r_0)$$

$$SPL = SL - TL - BL$$

$$SPL = SL - TL - BL - DI$$

$$SPL = SL - TL_1 + TS - TL_2$$