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A General Expression for Body Wave Acoustic Velocities in Terms of Bulk Density, Molecular Weight, and Melting Temperature

by

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ABSTRACT

A relationship is shown in which compressional and shear acoustic velocities are related to bulk density, molecular weight and melting temperature in various media. These media include monatomic solids, pure minerals, atomic and molecular fluids, and rock samples. The velocities in these media range from 100 to 10,000 meters per second.

Three relationships in five forms are developed: Relationship I: velocity = $a(\rho^{1/3}/A^{5/6})^b$, where a = 5630 and b = 0.947 for the compressional case, and a = 20,300 and b = 0.762 for the shear case. Relationship II: velocity = $a(T_m^{\frac{1}{2}}\rho^{1/3}/A^{5/6})^b$, where a = 2510 and b = 0.710 for the compressional case, and a = 1320 and b = 0.738 for the shear case. Relationship III: $$v_s \left(\frac{3V_c^2 - 4v_s^2}{V_c^2 - v_s^2}\right)^{\frac{1}{2}} = a\,(T_m/A)^b,$$

where a = 62.9 and b = 0.435. T_m is the melting temperature, in degrees Kelvin, ρ in grams /cc, and A, the molecular weight, in grams/mole. These relationships have uncertainties of 25 to 30 percent for a 67 percent confidence level, and are based on over 170 samples.

Possible applications of this relationship to non-hydrocarbon mineral exploration and an example using evaporite minerals are discussed.

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