

GEOL 7324 Rock Physics Syllabus

Dr. John Castagna

October 21, 22 & 28

Badge 1: Introduction and Rock Properties

Hypothesis testing in rock physics. Definitions and recommended reading. Rock properties and geophysical response. Types of equations. Bounds. Sensitivity of seismic data to rock properties. Applications. Sedimentary rock-forming minerals. Rock texture. Porosity. Clay. Rock materials. Scales of measurements. Heterogeneity and anisotropy. Factors controlling geophysical properties. Mathematical description of rocks. Pore space properties. Darcy's law. Permeability. Viscosity. Wettability. Measuring Porosity. Density. Mass Balance Equation. Factors Affecting Porosity. Specific surface area. Aspect ratio. Grain size classification. Sorting. Mineralogical composition. Diagenesis. Porosity variation with depth. Lithification. Clay mineral lattices. Mineral densities. Archimedes Principle. Field density measurement. Density logging. Density prediction. Gardner's equation. Organic shales. Velocity-density relationships. Density log editing. Impedance.

Test 1

October 29 & November 4

Badge 2: Rock Mechanics and Velocity

Forces. Stress and strain. Hooke's law. Components of stress. Deformation. Elastic and plastic behavior. Stiffness and compliance tensors. Elastic symmetry. Elastic moduli. Hysteresis. Effective media. Static versus dynamic moduli. Pressure. Pascal's Principle. Hydrostatic Paradox. Confining, pore, differential, and effective pressure. Pressure gradients. Velocity versus pressure. Fracture pressure. Geopressure. Body waves. Laboratory measurement of velocity. Factors affecting velocity. Empirical and theoretical relationships. Velocity-porosity transforms. Microfractures. Velocity versus depth. Anisotropy versus pressure. Saturation effect. Temperature effect. Seismic reflection coefficient and amplitude anomalies.

Test 2

November 5 & 11

Badge 3: Vp/Vs ratios, Fluid Substitution, Composite Media, and Attenuation/Dispersion.

Vp/Vs and Poisson's ratio, Vp-Vs relationships, Mudrock trend and Greenberg-Castagna relations, dry sandstones, brine-saturated rocks, shear-wave velocity versus porosity, mixed lithologies, gas-oil-brine fluid moduli and densities versus composition and TP conditions, Phase diagrams, Wood's equation, effect of free gas on seismic velocity, Gassmann's equations, Biot coefficient, fluid substitution, frame moduli, patchy saturation model, empirical fluid substitution, fizz water, inferences from Gassmann, Biot theory, fluid distribution, effect of dispersion on frame moduli estimation, applications in DHI analysis, stochastic fluid substitution, composite media models, mixing models, Backus average, Hashin-Shtrikman bounds, Kuster-Toksoz model, Porosity explicit versus porosity implicit empirical models, shear-wave velocity prediction, composite media modeling, crack density versus aspect ratio, attenuation, dispersion, spectral ratios, chimneys, velocity versus saturation and frequency, body-wave dispersion curves, squirt and Biot flow, ultrasonic velocity versus saturation, effective fluid modulus, segregated saturation, effect of disconnected porosity, homogenous versus segregated pore fluid distribution

Test 3