

BGP-T4: Microsystems and Macrosystems attributes integration in the petrophysical and seismic domain

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How geological microsystems interact to influence macrosystems properties in an geological aggregate has been widely investigated in rock physics theories in order to derive macro elastic properties such as K , μ , ρ , λ , V_p , V_s from the respective micro properties at the log resolution scale and from the interacting elemental components of each phase such as matrix, fluid, gas. Macro elastic properties are considered as the overall equivalent elastic properties of a minimum investigation volume corresponding to the maximal resolution in the seismic wave propagation domain which is dependent on the minimum wavelength component of the seismic signal. Resolution which is further refined from geostatistical analysis after inversion.

In this context, the most efficient theories are regarded as: "effective medium modeling" of the representative volume of a rock. The most used originate from Gassmann, Voigt, Reuss, Hertz-Mindlin, Walton etc.

All these model consider the elemental elastic properties in there reciprocal stress-strain state.

Petrophysics and Seismic have often been considered as separate fields without many common points other than the calculation of synthetic seismograms. This represent also a relation between

elastic properties: zero offset reflectivity and seismic wavelet combined together from the convolutional operator.

A new approach among all petrophysical properties and elastic seismic attributes has been proposed ^[1].

This is a new field which can be explored in order to propagate microstems properties in the macrosystem of the seismic volume.

The simple Archie equation is an empirical model for describing the measurements of resistivity in clean sands. We introduce empirical parameters like a and m that generalize the macroscopic properties of a rock in its representative elementary volume with the final goal of calculating the water saturation from resistivity and porosity measurements. These relationships are synthetically represented within the Pickett plot. When the empirical factors a and m spatially change within the same formation but the components and their reciprocal quantities remain constant, then the interpreter look for changes in the geometrical properties such as coordination number, aspect ratio, curvature and other geometrical parameters of the elemental components.

References

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