MODELLING THE PRESSURE DEPENDENCE OF P WAVE VELOCITY AND POROSITY ON SANDSTONES

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ABSTRACT

Acoustic velocity in rocks strongly depends on pressure which influences the mechanical, transport and elastic properties of rocks such as porosity and elastic moduli. Therefore a quantitative model - which provides the physical explanation - of the mechanism of pressure dependence is required. In this paper a petrophysical model is presented which provides the connection between the propagation velocity of longitudinal wave and rock pressure. Since porosity is an important parameter in the exploitation of hydrocarbons we developed also a model describing that of pressure dependence. The proposed models are based on the idea that microcracks in a rock in unit volume are closing with increasing pressure thus increasing velocity, decreasing secondary porosity and as a result decreasing total porosity can be measured. The models were applied to laboratory measured acoustic P wave velocity and porosity data sets as function of pressure – published in literature – and they were inverted to prove the applicability of the model and to obtain that of parameters. The quality checked inversion results showed that the calculated data matched accurately with measured data and also proved that the suggested petrophysical models perform well in practice.

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP-4.2.4.A/ 2-11/1-2012-0001 ‘National Excellence Program’