Linear Mathematical Model Developed Using Statistical Methods to Predict Permeability from Porosity

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Abstract

As a matter of general belief there does not exist a universal mathematical relationship between porosity and permeability. Common practice to drawrelationship between these two parameters is usually graphical, for instance using picket plots or picking general trends in the core or well logs data. Trends picked are mostly explicit and subjective i.e. limited to well and cannot be extrapolated to full field if the degree of heterogeneity is greater than fifty percent. In this article a general rigorous procedure for deriving a linear mathematical model for predicting permeability given porosity and vice versa, using statistical methods i.e. regression analysis & probability distribution, is developed from appropriate core data.

Based upon the literature review to the best of knowledge sofar regression analysis presented between porosity & permeability is so shallow and is only limited up to drawing the trends in the core data or well logs data. Wheras in this paper, applications of standard regression analysis methods opted from statistics is discussed in more details which include the appliance of normality check using Shapiro-Wilk test, detection of outliers using cook's distance & residual plots used to treat heterogeneity if present and transforming data into linear mathematical model is presented. As a result a linear mathematical model is developed for prediction.

Besides in any new oil & gas field for reserves calculation and production forecast usually average porosity and permeability is used. However, for best estimates average values for porosity & permeability have been calculated in terms of confidence intervals using probability distribution techniques; furthermore the validity of obtained intervals is checked by using certain statistical hypothesis testing techniques e.g. P- value test etc. Average values obtained are more reliable than those obtained using simple averagingmethods and could give reserves/resources and productionforecast relative to conventional estimates with up to 95% confidence.