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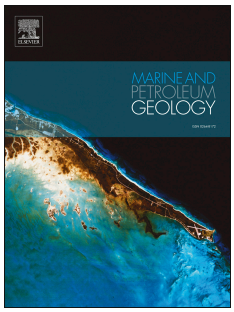

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ACCEPTED MANUSCRIPT

A New Method for Calculating the Primary Porosity of Unconsolidated Sands Based on Packing Texture: Application to Modern Beach Sand

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Abstract:

The primary porosity is one of the fundamental parameters for quantitatively predicting reservoir quality and studying diagenetic evolution. Primary porosity is usually estimated by empirical approaches or empirical formula, through using a single parameter, such as sorting or grain size. However, these methods have some disadvantages which lead to obvious errors. Primary porosity can be affected by multiple factors, such as particle size, sorting, grain shape and packing texture, therefor, one empirical formula is not practical for different type of sands. A new mathematical model is proposed in this paper for calculating the primary porosity of unconsolidated sands based on the concept of packing texture. The grain size, grain size distribution curve and packing texture are considered in this mathematical model. This paper tests the practicability of the mathematical model through using 40 modern beach sands sample collected from eastern China and 37 samples from literature. These modern beach sands in the study area can be divided into three types based on the particle size distribution curve. Each type sample is further divided into several units according to the particle size ratio. The mathematical model firstly calculates the primary porosity of two adjacent units by using the binary packing model, and then the primary porosity of the entire sand sample. The error of model-predicted primary porosity ranges between -2%~2%, and the correlation coefficients are all above 0.9. As a comparison, the errors of empirical formula-predicted results range between -6%~6%, and the correlation coefficient is 0.63. The newly-proposed mathematical model for the primary porosity based on grain size distribution and packing texture is more reliable compared to the traditional empirical formula.

Keywords: Primary Porosity, Mathematical Model, Packing Texture, Grain Size Distribution, Beach Sands.

01. Introduction

Sandstone consists of a framework of grains, interstitial detrital silt and clay, chemical cements and an interconnecting network of void space or pores (Pettijohn et al, 1972). Pores are

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