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A SATURATION INTERPRETATION MODEL for the DIELECTRIC CONSTANT OF SHALY SANDS

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INTRODUCTION

A long standing goal in log interpretation has been to accurately estimate oil saturation in fresh water shaly sands. In fresh water shaly sands the resistivity is determined to a large extent by the clays. Quantifying shaliness has been limited to correlations with logs such as the gamma ray, sonic, or differences in the neutron and density porosity logs.[1] This type of correlation is based on different physics than the conductivity. This means that the correlations are of limited applicability other than in the specific area where they are developed. Recently there has been considerable interest in applying dielectric measurements to interpret oil saturation but this has mostly been directed at texture effects.[2,3]

The dielectric response of clays however should be a very useful interpretation tool since it is directly related to physics controlling the clay conductivity. Particularly useful in the case of fresh water shaly sands. For fresh formation waters the dielectric response is insensitive to the brine resistivity. This allows a two frequency measurement of the dielectric constant to be interpreted independent of salinity and pore geometry for shaliness and saturation.

PURPOSE AND SCOPE

In this paper the dielectric constant of shaly sands is investigated. A model has been developed in the 1 Mhz to 1 GHz frequency range. The equation associated with this model involves the same parameters as those governing the resistivity response of shaly sands. The frequency independent high frequency limit is discussed first. Then the effects of porosity and shaliness on the dielectric constant are then examined at fixed frequency and salinity by comparing two groups of data each at nearly the same porosity. The salinity and frequency dependence of the derived parameters are then discussed for an expanded data set. The saturation dependent data and model are then discussed in the context of the brine saturated model.