坑井を用いた電気・電磁気探査法と石油貯留層の評価への適用に関する研究

苏, 本玉
九州大学大学院工学府地球資源システム工学専攻

https://doi.org/10.15017/25177

出版情報：九州大学, 2012, 博士（工学）, 課程博士
バージョン：
権利関係：

With the development of oilfields, the distribution of oil and water is becoming more and more complex. It is therefore very crucial for oilfield development to examine accurately the positions of the distribution of oil and water. The seismic method is the most important method for studying the underground geological structures and reservoirs. Whereas seismic surveys can detect the structures that may contain hydrocarbons with great accuracy, seismic methods are not suitable in order to investigate the distribution of oil and water within the reservoir during the period of oil production, because it is very difficult to make a distinction between oil and water within these structures by the seismic methods. However, electrical methods can overcome this problem due to its detecting information of reservoir resistivity. In addition, water and hydrocarbons have distinct different resistivity. Hence during the period of oilfield production for monitoring the reservoir, the electrical methods are indispensable to investigate changing of the reservoir by obtaining reservoir geophysical information. Especially, the information about resistivity of the reservoir should be analyzed. In this dissertation, two types of electrical methods have been discussed. One was direct current (DC) method and the other one was alternate current (AC) method. In order to calculate the oil saturation from the reservoir resistivity, the relationship among types of porosity, resistivity and fluid saturation should be considered. It is noteworthy that the Archie's formula was actually established on the basis of pure sandstone with high-porosity and high-permeability. Besides, the application range of the Archie's formula is valid when the several following conditions are true: (1) the matrix is an insulator or it is not conductive, (2) the distributions of porosities are homogeneous, (3) each fluid saturation of the porosities is also homogeneous, (4) all the fluids are mineralized rather than fresh water, (5) furthermore, electrical properties of the rock are isotropic. However, for low-porosity and low-permeability reservoir, the Archie's formula will definitely confront a big challenge. Hence, it is attempted to use the new formula to describe the relationship among porosity, resistivity and fluid saturation in this dissertation.