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Research and application of experimental measurement and calculation methods in computational petrophysics

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Computational petrophysics uses applied mathematics, computational science, and information science to solve various theoretical and practical problems that cannot be solved by analytical methods. It is carried out in computer hardware and software environments. Computational petrophysics can not only simulate the complex microscopic structure inside the rock, but also study the flow principle of fluid in macro and micro, etc. Compared with the results obtained from laboratory physics experiments, the physical properties predicted by petrophysics are more accurate. Recently, with the development of high-performance computing and computing technology, researchers can better deal with the problems associated with porous reservoir systems by computational petrophysics, and simulate multiple physical responses on models with real pore microstructures. Based on this, the author firstly introduces the laboratory measurement methods of some physical properties of rock (such as deformation, stress, static elastic parameters, etc.), including mechanical, acoustic, and optical methods; Several methods used in computational petrophysics (mainly finite difference method, finite element method, boundary element method and discrete element method). Secondly, the author carried out the practical application of laboratory measurement and calculation of related petrophysical properties. The data obtained by the above laboratory measurement methods are the results obtained by the physical experiments in the laboratory, and the data obtained by computational petrophysics are obtained based on the analysis model and the rock values, and the results are more accurate. Comparing the two, the correctness and scope of some empirical formulas are verified by comparison. The fracture of rock is related to some physical properties of rock, such as rock strength, stress state, fluid, etc., and the data obtained by computational petrophysics is more accurate, which makes the prediction of rock fracture more reasonable. It is important for the analysis and prediction of faults.