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Mechanism and Control Factors of Particle Migration in Loose Sandstone Reservoirs

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Particle migration and plugging are ubiquitous throughout the entire lifecycle of unconsolidated sandstone reservoir development. During the extraction process, particle migration and plugging alter the microscopic characteristics of the reservoir, while the microscopic parameters of the reservoir control particle transport and plugging. This paper utilizes methods such as CFD-DEM, visualization of laser-etched pore structure models, dynamic core displacement, and thin-section casting to systematically discuss the coupled relationship between the microscopic characteristics of unconsolidated sandstone reservoirs and particle migration. This includes the impact of particle size, concentration, particle/pore throat ratio, pressure drop. Based on particle transport/plugging in different types of pore structure models. The achievements and understanding are as follows: Based on particle size, reservoir particles are categorized into seepage sand (<4μm), formation particles (4~32μm), and framework particles (>32μm). When particle volume concentration is >1%, particles are more likely to be retained on the pore surface and in the throat. When the particle size/throat is less than 1/14, the migration of permeable sand has almost no effect on the permeability of the reservoir. When the particle size/throat is less than 1/7, particles will aggregate and settle in the pores. When the particle size/throat is less than 1/7, particles will disperse and settle in the pores. When the particle size/throat is greater than 1/3, particles will bridge and block the throat in the form of single double particles or multiple particles. This study proposed that the migration/blockage of particles in reservoirs has periodicity, stages, and persistence. This paper evaluated the differences in particle migration and blockage in different types of reservoirs, and established a coupling relationship between the permeability damage rate of particle migration and the microscopic characteristic parameters of the reservoir. And established three mechanisms and six modes of particle and blockage in loose sandstone.

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