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Pore volume compressibilities and stress sensitivity of low permeability reservoir rocks in China's oilfield development

Sun He³, Dou Hongen¹ and Ma Shiying²

¹Research Institute of Petroleum Exploration & Development, China

²Schlumberger, China

³China University of Petroleum, China

This paper presents a new equation of the reservoir rock pore volume compressibility with rock bulk compressibility and grain compressibility at constant confining pressure by the means of compressibility definition of the reservoir rock. The research also clarifies confusion conceptions of both the rock pore volume compressibility and rock grain volume compressibility in reservoir rock analysis. The research shows that total rock compressibility can derive from the material balance equation and diffusion equation of slightly compressible fluid, however, differences of two total compressibilities and how to use them are pointed out in the paper. In addition, through Terzaghi's effective stress formula, a new effective stress equation is derived to evaluate stress sensitivity of low-permeability reservoir rock. The results indicate very large reductions of the low permeability reservoir with increasing effective stress of reservoir rock by rock stress sensitivity analysis of the low permeability reservoirs in the laboratory, therefore, our experimental data are in accordance with theoretical evaluation results, strong stress sensitivity of the low-permeability reservoir rock have been proved, and weak stress sensitivity of low permeability reservoir or inexistence of the stress sensitivity, are not coincidence with actual oilfield development and production. The derived rock compressibility equations have been used to the reserves assessment and rock compressibility analysis. The research is very great significance for understanding currently low-permeability reservoir behavior, and interpreting well testing, evaluating reservoir rock stress sensitivity and guiding oilfield development of low-permeability reservoir.

shakyjelly@gmail.com