A Pragmatic Way of Incorporating Sub-Seismic Fault Zone Structures into a Production Simulation Model

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ABSTRACT

Most petroleum reservoirs contain faults which are highly complex heterogeneous and anisotropic volumes of 3D deformed rock but are generally represented in production flow simulation models as 2D planar surfaces. A major technical challenge is modeling the influence of fault zones and their associated fault rock properties on fluid flow in hydrocarbon reservoirs. Vendor commercial reservoir simulators have limited functionality for modeling faults. Faults are usually expressed as ad hoc transmissibility variations during the history matching phase of the model instead of retaining geologically realistic fault zone description. As a result, simulators are inept to describe the nature of across-fault and along-fault fluid flow. To address these shortcomings, we aimed to find a flexible and improved solution for representing faults in hydrocarbon reservoir models considering the geometrical complexity of fault zones and their associated fault rock properties. To accomplish these objectives, we devised an emerging algorithm called flow-based geometrical upscaling (FBGU), defined as the process of calculating the connection transmissibilities arising from a high-resolution truth model (which contains 3D fault zone geometry explicitly) and representing those transmissibilities at the equivalent location of a production flow simulation model (which is referred as a low-resolution upscaled model in this paper). The accuracy of the method is assessed by comparing the flow responses of high-resolution truth model with that of model upscaled using FBGU method. The results revealed that the FBGU method is extremely accurate and geometrically flexible.

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