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Natural Microfractures in Unconventional Shale-Oil and Shale-Gas Systems: Real, Hypothetical, or Wrongly Defined?

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ABSTRACT

The debate about the existence and significance of natural microfractures in unconventional mudrock (shale) reservoirs is important because microfractures are commonly proposed as a principal pore and permeability network in the production of hydrocarbons from mudrocks. Many studies have addressed the existence of microfractures, but few have documented them with reliable criteria, or documented their abundance or connectivity. We define natural microfractures in mudrocks as fractures (generally mode I) up to several millimeters long (generally <10 mm) and several micrometers wide (generally <15 μm) that occur within mudrocks where they were buried in the subsurface. Our experience is that natural microfractures do occur in mudrocks but that they are relatively rare and do not contribute to forming a permeable pathway for fluid movement into induced hydraulic fractures. Many microfractures described as natural are actually artifacts created during coring or post-coring by the coring process, subsequent handling, and sample preparation. Also following coring, dehydration of clay-rich samples creates desiccation microfractures, and devolatilization of bitumen creates shrinkage microfractures. Nonsulfate-related cements in fractures indicate that micro-fractures are natural and not induced post-coring. Some microfractures could be produced in the matrix during hydraulic fracturing, but a post-fracking core would be needed to address this research question. Our investigation seeks to determine how interpretation of natural microfractures in mudrocks can be improved and how the importance of natural microfractures as fluid-flow pathways can be seriously addressed.