

Petroleum Potential of the Upper Three Forks Formation, Williston Basin, USA

Stephen A. Sonnenberg¹, Rick Sarg¹, and Alan Gantyno¹

The upper Three Forks is evolving into a significant resource play in the Williston Basin. Although Three Forks production was established in Antelope Field in 1953, the play has re-emerged because of the horizontal drilling and multi-stage fracturing technologies. The upper Three Forks can be subdivided into three main facies: a) massive to chaotic bedded dolostone; b) interbedded dolostone with green mudstones; c) bioturbated dolostone to sandstone. The bioturbated sandstone and dolostone is referred to as the Sanish. The units represent an overall transgressive sequence ranging from upper intertidal/supratidal to subtidal.

The upper Three Forks has poor reservoir quality with low porosities (generally less than 8%) and low permeabilities (less than 0.1 md). The reservoirs require fracture stimulation to produce economically. Sweet spot areas are related to favorable facies development, natural fractures, and mature Bakken source rocks. The main source rock for the Three Forks is the lower Bakken shale. Where the lower and middle Bakken members thin in the southern part of the Williston basin, the primary source rock becomes the upper Bakken shale. The Three Forks is overpressured and overpressuring is related to hydrocarbon generation.

The upper Three Forks does not appear to be in communication with the overlying middle Bakken reservoirs where the lower Bakken shales are sufficiently thick to form a barrier between the producing units. The Three Forks resource potential is estimated to be 2 billion barrels of recoverable oil.

¹Colorado School of Mines

Steve Sonnenberg is a Professor of Geology and holds the Charles Boettcher Distinguished Chair in Petroleum Geology at the Colorado School of Mines. He specializes in unconventional reservoirs, sequence stratigraphy, tectonic influence on sedimentation, and petroleum geology. A native of Billings, Montana, Sonnenberg received BS and MS degrees in geology from Texas A&M University and a Ph.D. degree in geology from the Colorado School of Mines. Steve began teaching at Colorado School of Mines in 2007 after working in the petroleum industry for over 25 years. Steve has served as President of several organizations including the American Association of Petroleum Geologists, Rocky Mountain Association of Geologists, and Colorado Scientific Society.