

# Geochemical Characterization of Organic Source Differences Between Wolfcamp A and B Units, Midland Basin

Xun Sun<sup>1</sup>, Tongwei Zhang<sup>2</sup>, Lucy Ting-Wei Ko<sup>2</sup>, Chenjun Wu<sup>3</sup>, Di Meng<sup>4</sup>

<sup>1</sup>University of Texas, Austin; <sup>2</sup>Bureau of Economic Geology; <sup>3</sup>Chinese Academy of Sciences; <sup>4</sup>Northwest University

9.29.2020 - 10.1.2020 - AAPG Annual Convention and Exhibition 2020, Online/Virtual

## Abstract

Among all the strata in Permian Basin since 1920s, the Wolfcamp has, in the past few years, become one of the primary formations for unconventional petroleum exploitation. Among all four units, Wolfcamp A and B have received most of the drilling focus. Our previous studies, head space gas isotope and Rock-Eval analyses have shown that organic matter (OM) type in the Wolfcamp Formation may vary significantly from B unit to A. However, a detailed characterization of OM source input and depositional environment with biomarkers in these units has not been done. Fifty-five samples, which cover Wolfcamp A and B units from 7800 ft to 8600 ft continuous cored interval of Greer #1 well, Reagan Co., TX, Midland basin, were selected for this study to investigate the organic source origins and depositional redox conditions. The TOC values are largely lithofacies-controlled. Siliceous mudrocks are the most TOC-rich (TOC >3 wt.%) facies and dominant in the Wolfcamp A unit (7800 - 8100 ft). Fine-grained clay-mineral rich mudstones are more abundant in Wolfcamp B (8100-8600 ft), where average TOC values are lower. All the samples are in the oil window and most of samples are dominated by Type II kerogen in plots of HI (hydrogen index) vs OI (oxygen index) and HI vs. Tmax. The average HI value for samples from Wolfcamp A is 207.6 mg HC/g TOC, slightly higher than those for Wolfcamp B (an average of 151.7 mg HC/g TOC), indicating a better OM quality in Wolfcamp A unit. Total ion chromatography of saturate fraction exhibits a typical oil-window unimodal n-alkane distribution ranging from n-C12 to n-C39, maximizing at n-C15 with a minor odd over even preference after n-C25 for most of

the samples. Some samples from Wolfcamp B show bimodal distributions, maximum at n-C15 to n-C23, representing contribution of organic matter from two dominant source organisms, which cause by more than one type of algae contribution or where wax-rich OM is involved. Redox-sensitive biomarkers show a strong correspondence between organic matter facies and lithofacies. The lower most section of Wolfcamp B (8400 to 8600 ft) contain abundant carbonate debris flow facies, corresponding organic matter facies were deposited under suboxic conditions characterized by high Pr/Ph ratio (1.3-1.6), high C29 (norhopane)/C30 (hopane) ratio, and high C27 diasteranes vs. C27 regular steranes. The most portion of Wolfcamp B is composed by TOC-rich siliceous argillaceous mudrock facies, and a constant Pr/Ph ratio of 1.3 reflects a deposition with a certain extent of terrigenous input under weakly reducing environment. Across the boundary of Wolfcamp A and B, Pr/Ph ratios gradually decreases upward to 0.85 in the top section of Wolfcamp A, resulting in TOC-rich siliceous/calcareous mudrock facies deposited under a reducing environment. The depositional environment was changed from a suboxic to weakly reducing then to reducing condition during late Wolfcampain time.