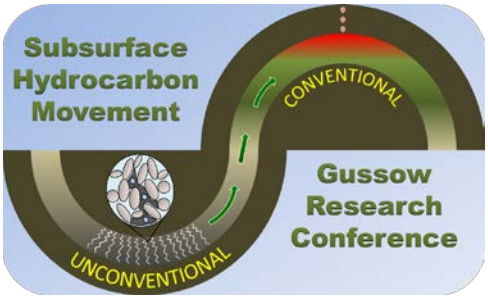


# Towards an understanding of the palaeoecology and palaeodepositional environment of the Lower and Upper Bakken: a biomarker and multi-proxy approach

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## Summary

Using biomarkers and multi-proxy approach, this study presents the analysis, interpretations and a proposed palaeoecology and palaeodepositional model for the Lower and Upper Bakken.

Using samples exclusively derived from core, a high-resolution depth profile of key biomarker abundance and biomarker suites, augmented by transition metal and trace element abundance, indicate a significant variation in concentration of steranes, hopanes and gammacerane with depth and also when compared spatially. Significant variations in sterane, hopane, gammacerane, aryl isoprenoids, isorenieretane and key trace elements (e.g. Mo) can be used to identify at least three biomarker-defined organic facies and significant changes in redox at the time of deposition.

The Lower Bakken mudstone is characterized by a significant change in depositional environment that ranges from euxinia within the lower-most part through to dysoxic conditions within the upper part of the Lower Bakken. This change in palaeodepositional environment is associated with a change in palaeoecology ranging from a stratified water column water, associated with photic zone euxinia, green sulphur bacteria and ciliates within the lower-most Lower Bakken, through to a weaker or periodically absent stratified water column, dysoxic conditions and a number of phytoplankton communities including algae and cyanobacteria within the upper-part of the Lower Bakken.

The Upper Bakken is associated with a much more complex and frequently changing set of palaeodepsotional conditions associated with frequent changes in palaeoecology.

Variations in hopane, sterane, gammacerane, presence of aryl isoprenoids and isorenieretane are rationalized using modern analogues, in which algal/bacterial communities and bacteriovorous ciliates maintain a synergists ‘bloom and bust’ relationship, which ultimately impacts and drives variations in organic matter quantity, quality and source characteristic.

This study identified a number of molecular fingerprints, associated with multiple source facies within the Bakken Formation shale. This study not only provides an understanding of the complex nature of organic matter, but also provides an explanation for that heterogeneity within the Lower and Upper Members of the Bakken Formation. This in turn suggests significant variations in hydrocarbon potential for the Lower and Upper Members of the Bakken Formation will exist.