A Basin-Play Scale Predictive Model for H2S Contents in the Devonian of Western Canada

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In the carbonate-dominated Devonian Petroleum systems of the Western Canada Basin hydrogen sulphide contents in gas accumulations vary from 0% to around 90%. In general the H2S is associated with high LOM hydrocarbon gases but no consistent H2S predictive relationship to LOM can be established. A model has been developed based on the generation of H2S during catalytic sulphate reduction (TSR). This reaction generates H2S from the reduction of sulphate by low molecular weight hydrocarbon gases. The hydrocarbon source is the Duvernay formation which is thickest in basinal locations and thins onto time equivalent carbonate platforms. The occurrence of sulphate in the sub-surface is controlled by evaporite distribution as well as remobilization during dolomitization. The occurrence of reflux dolomite porosity can be used as a surrogate for the occurrence of sulphate in the late Devonian.

The thesis of this model is that limitations in either of the reactants (hydrocarbon gas or sulphate) will produce very high or very low concentrations of H2S respectively. Where the Duvernay is thin or absent the charge of hydrocarbon gas is limited and will react almost completely with the excess of sulphate to form H2S. This will give rise to the 90% H2S pools such as Bearberry. Where reflux dolomitization is absent (in limestone reefs for example) no sulphate will have accessed the reef and no TSR will have occurred therefore H2S contents are zero. Mapping Duvernay source thickness and reflux dolomitization has allowed the creation of a risk map for H2S contents.