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## Western Canada Sedimentary Basin Petroleum Systems: Where is the Secondary Biogenic Gas?

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### Summary

Western Canada Sedimentary Basin (WCSB) crude oil source rocks accumulated typically in “starved” depositional settings of Sloss outer detrital facies belts and lesser stratigraphic cycles. These produced petroleum from marine Type II organic matter in response to burial by commonly westward-thickening, overlying successions. Oil occurs commonly within the “Sloss” sequence containing its source rock, often up-dip from the “petroleum kitchen”. Migration pathways cross stratal contacts, unconformities and structures, and much oil migrates into adjacent sequences, especially into Lower Cretaceous Mannville Gp. reservoirs. Anaerobic biodegradation affects oil quality and generates secondary biogenic gas. The WCSB oil system paradigm predates the recognition of anaerobic biodegradation. Biodegradation in post-Mannville reservoirs remains under-appreciated. Natural gases originate by thermogenic and biogenic mechanisms from kerogens, coals and crude oils. Gas are variably altered, physically, microbially and inorganically. Few oil studies addressed solution and associated primary thermogenic or secondary biogenic gas. Gas studies were independent of oil studies and none recognize secondary biogenic gas even in association with biodegraded oils. We hypothesize that secondary biogenic gas occurs commonly, often mixed with other gas, to produce hydrocarbon isotope ratios and variations distinctive from primary biogenic and thermogenic gases. Where Mannville oil pools have sources in underlying marine rocks, Mannville gases are attributed largely to non-marine sources. Currently, cross-stratal migration is inferred less common for gas than for oil. The inference of gas stratigraphic immobility is problematic for biodegradation studies that infer large secondary biogenic gas fluxes into soil and atmospheric sinks, the migration pathways of which, pass through Cretaceous strata. In some unconventional plays, gas isotopic “rollover” and “reversal” due to thermal cracking has implications for reservoir performance. Efforts to understand Cordilleran petroleum systems merits investigation to extend unconventional resource plays westward from Interior Platform.