Origin of the Green River Kerogen by Serpentinite-Powered Hydrothermalism

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The Eocene Green River Formation (GRF) comprises 3500' of laminated strata. Renowned as a rich 'oil shale', the GRF also hosts fish fossils in dense assemblages. These occur in a few carbonate-rich layers—a tiny fraction of the total thickness of the mostly barren GRF. Rare putative fossilized algal mats have been presented as evidence of a teeming ecosystem: the source of kerogen. The exquisite preservation of a few fossils must be explained in light of the destructive conversion of prodigious volumes of algal matter to hydrocarbons.

In addition, lacustrine sedimentation models have difficulty accounting for atypical carbonate-rich chemical sedimentation (60% of the GRF=dolo-laminites) and significant deposits (180 billion short tons) of sodium bicarbonate. These biological and chemical anomalies inspired a preliminary review from a hydrothermal perspective.

The GRF includes features consistent with chemical exhalation and deep-sourced mud volcanism. Diamondoid-Ni-Co-enriched gilsonite dikes and oil shale horizons with serpentinite metal signatures (Ni, Co, V, Zn, U and Mo) indicate hydrothermal emplacement similar to that in shale-hosted exhalative metal deposits.

We propose that most of the millions of fine-grained dolomitic and kerogen-rich laminae, hosting a restricted fossil distribution are deposits associated with mud volcanism. Chemical mud plumes and brines probably issued from kerogen-generating serpentinite reactions associated with flat subduction beneath the region.