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Controls on organic-rich shale deposition in the Triassic Montney Formation, Canada

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The rate of organic carbon burial within a marine basin is modulated by multiple factors, including sea-level change, basin morphology, surface primary productivity, and water-column stratification, all of which are influenced by the interplay between tectonic forcing and global climate conditions. Tectonic development surrounding a basin exerts a fundamental control by governing relative sea-level change, basin configuration and restriction, and nutrient fluxes through chemical weathering in the hinterland and/or nutrient regeneration from sediments. Understanding basin evolution within a source-to-sink framework—including sediment provenance, depositional processes, and early diagenesis—therefore provides a mechanistic basis for evaluating organic carbon production and preservation within the coupled surface processes and carbon cycle system. The Lower Triassic Montney Formation was deposited in the Western Canadian Sedimentary Basin and is widely distributed across northeastern British Columbia and western Alberta, Canada. Although the Montney black siltstones have been extensively explored for their shale gas potential, further geochemical investigation can better constrain sediment provenance, weathering intensity, sediment pathway, and redox conditions associated with intervals of enhanced organic carbon burial during a time of global carbon cycle instability following the end-Permian mass extinction. This study investigates the middle Montney Formation using major and trace element geochemistry and stable carbon and sulfur isotopes to evaluate how variations in detrital input, weathering intensity, and basin redox structure influenced organic carbon production and preservation. These findings clarify how interacting tectonic and surface processes regulated organic carbon sequestration during a major Early Triassic carbon cycle perturbation.