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Molar Tooth Structures in Mesoproterozoic and Neoproterozoic Carbonate Successions: Insights from Lithium, Barium, and Stable Strontium Isotope Systems

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Molar tooth structures, characterized by distinctive laminations and columnar formations, are among the most enigmatic features in Mesoproterozoic and Neoproterozoic carbonate successions. These deposits have been interpreted as a product of microbial-mediated processes in shallow marine environments, but the geochemical drivers behind their deposition/formation remain poorly understood. This study investigates the behavior of lithium (Li), barium (Ba), and stable strontium (Sr) isotopes in molar tooth deposits from carbonate sequences of the Mesoproterozoic and Neoproterozoic eras. The goal is to assess the isotopic fractionation of these elements during the formation of molar tooth structures and to explore their potential as proxies for reconstructing the geochemical conditions of ancient seawater. We examine the relationships between isotopic compositions and environmental factors such as water chemistry, temperature, and microbial activity. By comparing these isotope systems with modern analogs and known diagenetic pathways, we aim to refine the interpretation of molar tooth structures and their role as indicators of past oceanic conditions. Ultimately, this work will contribute to the understanding of early Earth biogeochemical cycles and offer new tools for interpreting Precambrian carbonate successions.