Evolution of the Sr and C Isotopic Composition of Cambrian Oceans

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Systematic fluctuations in the Sr (87Sr/86Sr) and C (d13C) isotopic composition of seawater has occurred across a range of temporal scales throughout Earth history. These 'secular' isotopic variations are valuable paleoenvironmental proxies as well as provide a much-needed means of chronostratigraphic correlation in intervals plagued by a paucity of age-diagnostic biostratigraphic markers. In this paper, we present the first set of high-resolution seawater Sr and C isotope curves for the late Early through early Late Cambrian that were defined in continuous exposures of marine carbonates in the Great Basin, U.S., and southern Canadian Rockies. These secular seawater isotope curves constrain primary variations in ocean chemistry during this period of large-scale continental reorganization associated with the amalgamation of Gondwana and a possible inertial interchange true polar wander event. These 'newly defined' seawater curves document previously unrecognized fluctuations, thereby revealing a more dynamic evolution of Cambrian ocean chemistry than defined to date.

The Sr curve documents a rapid rate of increase through this period that is comparable to that recorded by the late Cenozoic seawater Sr proxy record of uplift and attendant weathering of the Himalayan-Tibetan Plateau. The non-monotonic Cambrian rise in Sr values is interpreted to record Pan African-Brasiliano orogenesis, and reaches 87Sr/86Sr values (0.70930 to 0.70940) that are higher than any other time in Earth history. Numerous superimposed smaller scale oscillations appear to constrain the timing of discrete tectonic phases of the Pan African Brasiliano orogenesis. The C isotope curve for the same time interval

reveals several previously unrecognized short-term fluctuations of up to 4‰. A sharp shift in d13C values near the Early-Middle Cambrian boundary indicates major paleoceanographic and climatic change associated with a trilobite mass extinction event. Used in concert, these high-resolution 87Sr/86Sr and d13C records offer an unprecedented level of chronostratigraphic resolution for intra- and interbasinal correlation and refined paleogeographic reconstructions, as well as provide quantitative geochemical constraints for the origin of Cambrian tectonic, paleoceanographic, paleoecologic and biogeochemical events.