NEW INSIGHTS INTO CARBON CYCLE-CLIMATE COUPLING DURING THE NEOPROTEROZOIC

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RESUMO: It has long been recognized that the Neoproterozoic glaciations are closely coupled to perturbations to the global carbon cycle. Negative anomalies in the carbon isotope composition of seawater ($\delta^{13}C_{carb}$) are a hallmark feature of post-glacial rocks during the Neoproterozoic. Global climate models require significant declines in pCO_2 to initiate global glaciation, whereas modeling and theoretical considerations, $\Delta^{17}O$ (a signatures of mass-independent fractionation) and B isotope data, and a spike in $^{87}Sr/^{86}Sr$ suggest extraordinarily high pCO_2 during and immediately after glaciation. Recent radiometric ages and refinements in the chemostratigraphic record indicate that at least three Neoproterozoic glaciations were preceded by large negative $\delta^{13}C_{carb}$ anomalies, but it in all of these cases, $\delta^{13}C_{carb}$ began to increase again prior to the growth of large continental ice sheets. This temporal relationship between glaciation and the $\delta^{13}C_{carb}$ record is reminiscent of the Cenozoic record, where global cooling events appear to be preceded by global warming "overshoots." New $\delta^{13}C_{org}$ data also suggest that the large dissolved organic carbon (DOC) reservoir postulated to explain the Shuram-Wonoka anomaly in the middle Ediacaran Period probably initiated at some time in the Cryogenian Period. Intuitively, carbon transfer between the organic and inorganic carbon pools must have strongly modulated global climate. Precise new U-Pb zircon ages demonstrate that the Franklin large igneous province of NW North America stretched from the Yukon to Ellesmere Island and coincided with Rapitan glaciation. This temporal coincidence implies a connection between continental break-up, flood basalt magmatism, and glaciation that appears to be supported by the Sr isotope record, which shows a decline in $^{87}Sr/^{86}Sr$ (0.7070–0.7065) leading into the Rapitan glaciation that interrupts an otherwise long-term rise throughout the Neoproterozoic. A large and sustained increase in $^{87}Sr/^{86}Sr$ (0.7068–0.7073) following this glaciation cannot be explained just by a weathering pulse during a transient high in pCO_2. It may instead reflect the effect of global glaciation on the weatherability of the continents, thus implying an underappreciated feedback between glaciation, silicate weathering, nutrient delivery, and pCO_2 that may help to explain the onset of the subsequent end-Cryogenian glaciation. In summary, a synthesis of new geologically constrained radiometric and chemostratigraphic data contributes to an emerging picture of a complex but logically consistent connection between the global carbon cycle, silicate weathering, tectonics, and the extreme climate change that punctuates the record of the dynamic Neoproterozoic Earth.