Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19758

Tracing the emergence of continental crust in the Archean-to-Proterozoic using boron isotopes of marine deposits (cherts and iron formations)

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A major step in the evolution of continental crust on Earth was the time in which continental crust transitioned from being mostly submarine to mostly subaerial. This change is intimately linked with the volumetric accumulation of continental crust on Earth and the onset of plate tectonics, the timing of both is still debated among scholars. Different approaches to study and trace continental emergence address the continental crust itself, whether in specific localities or in compilation of large datasets. The conclusions derived from these approaches may be challenged as they might suffer from various kinds of biases or that the samples merely represent local activity rather than the global regime. We offer a new approach that might help overcome some of these shortcomings by observing the emergence of continental crust through its mirror in the oceanic boron isotope record preserved in Archean to Proterozoic marine deposits. Boron is a continental element that is concentrated in the continental crust over time. The oceanic boron isotopic composition is controlled by the balance between the different sources and sinks of boron in and out of the ocean, amongst which the largest source is continental runoff. The onset of widespread continental emergence must have initiated the largest boron influx into the ocean, thus greatly affecting the oceanic B concentration and isotopic budget. We analyzed samples of Archean and Proterozoic chert and iron formations for B isotopes using in-situ LA-MC-ICP-MS in order to construct the oceanic boron isotopic record throughout that critical period. We observe a significant increase both in B concentration and in the range and variation of B isotopic values across the Archean–Paleoproterozoic transition that may suggest a transition of oceanic boron towards modern values (modern ocean $\delta^{11}B$ = +39.6 ‰) at that time, implying a large increase in the area of exposed continental crust.