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Submarine hydrothermal and continental weathering inputs in Neoarchean seawater: insights from Temagami Banded Iron Formations (2.7 Ga, Canada)

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Banded Iron Formations (BIF) are chemical sedimentary rocks constituted of millimetric to centimetric iron- and silica-rich bands that have the potential to record the Archean seawater composition. Temagami BIFs (2.7 Ga-old, Canada) are amongst the best-preserved seawater archives and have been widely studied to investigate the interplay between hydrothermal and continental weathering inputs into Archean oceans. However, it is still unclear from previous studies whether elements hosted in silica- and iron-rich bands do share the same sources or record distinct hydrothermal and continental inputs. To provide new insights into the formation of BIF and the environmental conditions in which they were precipitated, the silica- and iron-rich bands of Temagami BIFs were carefully separated and individually analyzed for major and trace element contents as well as Lu-Hf and Sm-Nd isotopic compositions. Apparent Lu-Hf and Sm-Nd 'isochron' ages of 2718 +/- 164 Ma and 2669 +/- 284 Ma, are consistent with expected depositional ages within errors, suggesting that primary Hf-Nd isotopic compositions were preserved in the studied samples. Additional statistical analyses (Monte-Carlo simulations) further demonstrate that the large errors associated to the apparent ages could be accounted for by a mixing between two sources of Hf – hydrothermal and continental - into the Neoarchean seawater at deposition time. Initial Nd isotopic compositions (recalculated at 2700 Ma) of silica- and iron-rich bands are undistinguishable from each other pointing towards a common chondritic to juvenile source ($\varepsilon_{Nd\ (T)}$ = -1.6 to +2.0) that could correspond to a mixture between hydrothermal and continental inputs. In contrast, initial Hf isotopic compositions vary between $\varepsilon_{Hf\ (T)}$ = -13.5 to +31.2 with a tendency for silica-rich bands to have more radiogenic isotopic compositions than iron-rich bands. Silica-rich bands thus display the typical Nd-Hf decoupled isotopic signature of modern seawater which is interpreted to reflect the weathering of zircon-bearing rocks – granitoids - on continents. We thus explored the possibility that Hf and Nd from silica-rich bands derived from the erosion of large felsic continental landmasses while Hf and Nd from iron-rich bands preferentially derived from hydrothermal sources at 2.7 Ga.