

# **Chemical sediments, seawater chemistry and the evolution of Early Earth**

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Geochemical proxies hosted by geoarchives are interpreted to suggest that liquid water had existed on Earth already at the onset of the geological record. Chemical sedimentary rocks are quasi-omnipresent in Earth history and allow us to investigate the chemical evolution of the atmosphere and oceans through time in spite of a potentially severe preservation bias. However, the fundamental prerequisite for the successful application of a geochemical proxy is the thorough screening of sample material for purity and pristineness - which may make whole sample sets useless as geoarchives. This is particularly important if Early Precambrian banded iron-formations, marine cherts or carbonates are studied, as the chemical precipitate (the actual geoarchive of paleoseawater) may be “contaminated” by clastic detritus. Such detritus may show trace element concentrations several orders of magnitude higher than the precipitate and hence even trace amounts of such detritus can effectively obliterate the paleoseawater signal. Post-depositional processes (diagenesis, metamorphism, hydrothermal alteration and weathering) may also compromise the quality of samples, although secondary silicification may help to preserve a primary proxy signal during subsequent overprint. Even pure and well-preserved samples, however, may give conflicting results when different geochemical proxies are investigated. Because of their different physico-chemical properties, different elements may behave differently during processes such as precipitation, solid/liquid partitioning, chemical and physical speciation, and many more. This results in element-specific behavior during weathering and estuarine mixing, for example, and causes the marine residence times of elements to differ. Hence, the specific behavior of the individual elements considered most strongly affects the trace element or isotope ratios that are eventually used as proxies. While this is sometimes held against their use, it may actually provide a wealth of additional information on both source compositions and processes operating in soils, rivers, estuaries, oceans and hydrothermal systems.

These relationships will be addressed and illustrated with examples of Precambrian chemical sediments (mostly marine sedimentary carbonates and banded iron formation) and geochemical proxies that are commonly applied to glean information on the composition of and physico-chemical conditions in their ultimate sources (e.g., continental crust, mantle, seawater).