



The Marinoan 17O depletion (MOSD) event: New data from northern Baltica

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The occurrence of sedimentary barite crystal fans during the aftermath of Marinoan glaciation at ~635 million years ago (Ma) has been recognized as a global phenomenon. They have been found so far in South China, West Africa, Laurentia, and Central Australia. Their uniqueness is not only reflected in their morphological features, which appear to have occurred only once in the entire Earth's sedimentary record, but also their non-mass-dependently 17O-depleted oxygen isotope compositions that have provided the strongest support to an ultra-high pCO₂ post-Marinoan atmosphere and therefore the Snowball Earth theory. The proposed formation model for the barite fans is that they formed in shallow oceans relatively close to the continent where sulfate influx from oxidative weathering was a significant component and where deep water upwelling brought Ba²⁺. Here we present an example from East Finnmark, in N. Norway, that also supports this formation model, but with a set of distinctive paleogeographic, sedimentary, and stable isotope features.

While growing on or inside cavities of a horizontally deposited cap carbonates in most other sites, barite fans grew either directly on a very uneven end-Cryogenian glaciated crystalline Archean basement surface or on a few centimeters of post-glacial Nyborg Formation sediments in northern Baltica block in today's East Finnmark. The fans have been found occurring only in the Ruossoaivi-Lappaluokoaivi area, immediately west of Varangerfjord; they have not been found at any other outcrops of the Smalfjord or Nyborg formations. Deposition was likely in a tidal or very shallow marine environment. Fans are generally less than 2 cm thick, lie within a dominantly carbonate matrix and are, in some cases, overlain by sandstones. No direct relationships between the barite fans and the cap dolostone have been found. Analysis of 10 samples gave $\Delta^{17}\text{O}$ values ranging from -0.36‰ to -1.08‰. The northern Baltica barite fans are probably the closest to a paleo-continent among all the known occurrences worldwide, which is also consistent with their 17O anomalies being the highest ($\Delta^{17}\text{O}$ value down to -1.08‰ among all known marine barite fans). The variable $\Delta^{17}\text{O}$, $\delta^{18}\text{O}$, and $\delta^{34}\text{S}$ values of these newly discovered barite fans fit the global distribution and represents the first Marinoan 17O depletion (MOSD) record from the Baltica Block.