

High Precision Trace Element Analysis of Deep-Water, Vent-Related Dolostone in the Borden Basin, Nunavut

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Abstract

The Mesoproterozoic Borden Basin (Nunavut; Nanisivik Zn-Pb district) contains unusual, deep-water dolostone mounds (Ikpiarjuk Formation) that formed during fluid-venting along subaqueous faults. Mounds are hundreds of metres thick, extend for kilometres along mapped faults, and consist of featureless dolomudstone and clotted dolostone. The faults along which mounds nucleated were active during mound accumulation and may have delimited several subaqueous sub-basins.

Mound dolostone was analysed for trace elements using solution ICP-MS. Results from all mounds but one show REE + Y patterns that are typical of Proterozoic seawater, indicating that the carbonate formed from seawater. Positive Ce anomalies indicate that mounds formed in anoxic water (base of stratified water column). An unusual Eu anomaly in most samples is interpreted to indicate a restricted basin in which local weathering-derived solutes influenced REE composition. Although the REE + Y patterns are interpreted as generally seawater-derived, differences in the magnitude of various anomalies and the overall slope of the REE + Y patterns cannot be attributed to detrital impurities incorporated during deposition of the dolostone, or to diagenetic alteration. The differences in REE + Y patterns suggest (a) that although mound dolostone was derived from seawater, vent fluid composition varied subtly by location, and (b) that there was little mixing of bottom-water between sub-basins.

Black shale (Arctic Bay Fm.) accumulated at the same time as the Ikpiarjuk Formation and contains layers that are enriched in the redox-sensitive metals V, Mo, and U.

Enrichment may have been via a dolomite particle shuttle that exported dissolved metals from the upper, oxidised part of the water column to the sea floor. Ikpiarjuk Formation enrichment in these trace metals is best developed in clotted dolostone, which formed under an anoxic water mass and is therefore unrelated to the particle shuttle.

Redox stratification in a basin undergoing extension is a prerequisite for SEDEX/CD deposits. Although mound-related vent fluid composition remains unclear, the distribution and composition of Ikpiarjuk Formation mounds indicate that fluids were locally and voluminously expelled during black shale deposition.