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A missing link in the mid-late Permian record of north-eastern Pangea: A sedimentological evaluation of the Permian Belfast Harbour Evaporite Formation of County Antrim, Northern Ireland

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Abstract

Ancient salt deposits preserve a record of highly specific environmental, climatic and biological conditions, including past surface water chemistry and water depths, local air temperatures, atmospheric composition and halophilic microorganisms. This paper presents the first sedimentological study of the mid-Late Permian Belfast Harbour Evaporite Formation of Northern Ireland. This formation is dominated by bedded halite, contains some siliciclastic mudstone and bedded anhydrite, and is cross-cut by intrusive igneous rocks. The bedded halite lithology contains bottom-growth chevron and cornet crystals, efflorescent crusts and dissolution pipes, which are evidence of a saline surface brine that underwent periods of evapoconcentration, desiccation and flooding. The mudstone lithology contains dewatering structures, intraclasts and mudcracks, which indicate flooding and desiccation in dry mudflats. Bedded anhydrite was deposited as beds of gypsum cumulate crystals in saline surface waters. The Belfast Harbour Evaporite Formation was formed by saline lakes with associated mudflats, based on sedimentary characteristics and supported by mineralogical, geochemical and stratigraphic context. Diagenetic features reflect dissolution and cementation at the surface and shallow subsurface in the depositional environment and limited late-stage alterations. Syndepositional dissolution pipes in bedded halite were formed by flooding events. Early halite cement is present in dissolution pipes and mudstones. Gypsum/anhydrite repeatedly dehydrated and rehydrated to form an interlocking crystal mosaic. Later features include fluid migration and the intrusion of mafic rocks. The Belfast Harbour Evaporite Formation was deposited by an ephemeral saline lake and dry mudflat system in an arid climate. This study, when compared to age-equivalent continental deposits elsewhere, suggests that arid settings with saline lakes existed across much of Pangea during the Permo-Triassic. The Belfast Harbour Evaporite Formation stratigraphically underlies the extremely low pH saline lakes of the Mercia Mudstone Group, implying that it aids in understanding the formation of Pangean acid brine lakes.

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