

Geochemistry and sedimentology of a 1.4 Ga playa system: Implications for the paleoatmosphere

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The 900 m thick Sibley Group consists of playa to deltaic to aeolian deposits outcropping north of Lake Superior, Ontario, Canada. The sediments in the lowermost 100 m thick succession of highly oxidized siliciclastic rocks and dolostone can be divided into 15 lithofacies associations representing distinct depositional environments. The lower siliciclastic unit contains: boulder conglomerate-sandstone-dolomite (proximal ephemeral braided stream), pebble to cobble conglomerate (ephemeral braided stream), trough cross-stratified sandstone (braided stream), green sandstone-siltstone (delta), massive cobble conglomerate (transgressive shoreline lag), planar cross-stratified sandstones (nearshore lacustrine sandwaves), and thinning-upward sandstones (lacustrine storm sand sheets). The overlying mixed siliciclastic-carbonate unit contains: red siltstone (non-saline lake), red siltstone-dolomite or dolomitic sandstone (saline lake), and halite-mudstone (ephemeral salt pans). Next is the upper siliciclastic unit with: sheet sandstones (lake infilling) and stromatolitic dolomite-chert (shoreline). After final desiccation of the lake terra rosa soils, collapse breccias and intraformational conglomerates developed. Sr isotopes reflect shallow groundwater circulation and lacustrine dolomite containing significant radiogenic Sr. Carbon and O isotopes are heavier upward in the saline lake deposits, probably due to evaporation and residence time effects. Most interestingly, REE patterns for dolomite in the dolomite, stromatolitic shoreline deposits and overlying intraformational conglomerates are similar to modern oxygenated groundwater, whereas the saline lake dolomites have middle REE enriched patterns resembling modern groundwater draining waterlogged, organic-rich areas.