An overview of saline lake carbonates, the Northern Great Plains of Western Canada

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Abstract: The northern Great Plains of Western Canada, a vast region stretching from the Precambrian Shield east of Winnipeg westward for some 1400 km to the foothills of the Rocky Mountains, contains literally millions of saline lakes and wetlands. Although often characterized as a Na-SO$_4$ system, in fact the wide range of water chemistries exhibited by the lakes leads to an unusually large diversity of sediment composition. The more common non-detrital components are Mg-calcite, aragonite and dolomite. Many of the basins whose brines have very high Mg/Ca ratios also have hydromagnesite, magnesite, and nesquehonite. Calcite, a very common detrital mineral in the glacial deposits, is surprisingly rare as an endogenic component in the lacustrine sediments. Inorganic precipitation of carbonate minerals due to simple thermodynamic supersaturation is common in the salt lakes of NGP, as it is on a global basis. Most of the lakes are strongly supersaturated with respect to the common Ca and CaMg carbonate minerals. Supersaturation and precipitation of carbonates can take place for a variety of reasons, including photosynthetic uptake of CO$_2$ and consequent increase in pH, concentration changes brought about by evaporation or dilution, temperature changes, and mixing of brines of different compositions. In most of the lakes, carbonate mineral supersaturation is likely due to the seasonal uptake of CO$_2$ by primary organic productivity. With the exception of ostracodes, organic carbonates in the form of shell material are rare. Because of their ubiquity, carbonate minerals have been the workhorse for physical and geochemical paleolimnology in the northern Great Plains. However, distinguishing endogenic lacustrine carbonates from those derived by weathering and erosion of the carbonate-rich bedrock or even those formed by diagenetic processes after the sediment has been deposited (i.e., authigenic) is often an exceedingly difficult task which has limited the use of carbonate stratigraphy in the region. The rare occurrences of shoreline and nearshore carbonates associated with microbialites and hardgrounds/beachrocks are of note because of their potential as paleoenvironmental archives.