Peritidal cycles and paleoecology of the early Carboniferous Windsor Group, Nova Scotia, Canada

LAURA A. MACNEIL[1], PEIR K. PUFAHL[1], NOEL P. JAMES[2], MELISSA GREY[3], DEBORAH M. SKILLITER[4], AND KEN ADAMS[5]

1. Department of Earth and Environmental Science, Acadia University, Wolfville, Nova Scotia B4P 2R6, Canada <laura.macneil@ acadiau.ca> ¶ 2. Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, Ontario K7L 3N6, Canada ¶ 3. Joggins Fossil Institute, 100 Main Street, Joggins, Nova Scotia B0L 1A0, Canada ¶ 4. Nova Scotia Museum of Natural History, 1747 Summer Street, Halifax, Nova Scotia B3H 3A6, Canada ¶ 5. Fundy Geological Museum, 162 Two Islands Road, Parrsboro, Nova Scotia B0M 1S0, Canada

Evaporites and carbonates from Subzone B of the middle Viséan Windsor Group (ca. 340 Ma), Maritimes Basin, define brining-upward peritidal cycles that accumulated during a marine transgression. The exceptional preservation of evaporitic and fossiliferous facies provides a unique opportunity to investigate the formation of saline giants, which lack precise modern analogues. Saline giants are economically significant and hold important clues to understanding Earth's climate evolution.

Stacked, decameter-scale peritidal cycles are composed of up to nine lithofacies that record progressive shallowing and increasing salinity. Cycles are defined by flooding surfaces overlain by fossiliferous or evaporite-rich lime mudstone that grades upward into massive anhydrite. This anhydrite is in turn overlain by massive halite or laminated siltstone that changes gradually into oolitic grainstone, microbialite, nodular anhydrite or red beds. The tops of peritidal cycles are marked by either the basal flooding surface of the next cycle or a karst diastem.

Each aggradational succession is interpreted to reflect progradation of sabkha deposits over subtidal facies. The mosaic of lithofacies composing cycles is interpreted to record the effects of sub-basin geometry and evaporation, which controlled the degree of connectivity with the open ocean and water mass chemistry. Cycles from sub-basins with good connectivity to the open ocean lack massive halite and contain a high diversity assemblage of normal marine organisms that includes crinoids, brachiopods, bryozoans, and ostracods. Sub-basins with restricted circulation are characterized by cycles containing ubiquitous massive halite and a depauperate fauna indicating profound salinity stress.

The variability in facies composition between sub-basins demonstrates the heterogeneous character of some saline giants. Thus, depositional models that evoke evaporation to produce a single, large, stratified water mass from which evaporites precipitate are overly simplistic. Understanding the complex nature of the Windsor Group has provided new information about the effects of climate, tectonics, and oceanography on the development of large evaporitic depositional systems.

Atlantic Geology, 2015, Volume 51, Number 1
41st Colloquium & Annual General Meeting 2015
doi: 10.4138/atlgeol.2015.005