Multidisciplinary investigation of primary and secondary salt welds in the late Paleozoic Antigonish sub-basin of Nova Scotia

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The Antigonish sub-basin, one of many within the late Paleozoic Maritimes Basin, stretches from the Nova Scotian Antigonish Highlands into western Cape Breton Island. The sub-basin is structural in origin and is bounded by interpreted strike-slip faults that developed late in the history of the Appalachian orogen. The late Devonian to late Carboniferous basin-fill consists primarily of clastic sedimentary rocks with the exception of a marine succession of carbonates and evaporites, the Visean Windsor Group. Previous workers identified a discordant surface extending through much of the sub-basin, initially named the Antigonish Thrust. Later work reinterpreted this surface as a low-angle extensional fault, the Ainslie Detachment. Salt walls, previously identified on seismic lines through St. Georges Bay, and a salt diapir in a coastal outcrop, suggest that these structures may be related to salt expulsion.

The origin of the discordant surface was investigated during fieldwork at locations around Antigonish and western Cape Breton Island. Critical outcrops were surveyed with a drone and modelled in photogrammetric software. Outcrops beneath a potential primary weld at Lakevale show folds suggesting that during deformation brittle limestone layers were encased in ductile evaporites which were then removed by solution after deformation. Core from a drillhole through an equivalent surface shows foliated halite breccia. Potential secondary welds at Little Judique Harbour and Port Hood Island display central breccia zones flanked by steeply dipping younger strata with opposing younging directions. Strata to the west show along-strike thickness changes suggesting synsedimentary tilting.

From a modern salt tectonics perspective, the discordant surface matches the predicted characteristics of a salt expulsion surface. The surface first known as the Antigonish Thrust and then as the Ainslie Detachment is reinterpreted as an evaporite weld produced by salt

expulsion. Other discordant shallowly dipping surfaces in salt-containing sub-basins of the Maritimes Basin should be evaluated as potential primary salt welds. Likewise, steeply dipping surfaces previously interpreted as faults may be secondary salt welds. Further research may show that salt movement had a greater impact on the geometries of the Maritimes Basin than has previously been realized.