THE VIABILITY OF THE OSTRACODE VELATOMORPHA ALTILIS (JONES AND KIRKBY 1879) FOR A PALEOENVIRONMENTAL PROXY INDICATOR

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INTRODUCTION

Ostracodes have the potential to divulge paleoenvironmental information with respect to salinity in ancient sedimentary deposits (Tibert & Scott 1999). The Joggins Formation is a world class fossil locality that has a rich flora and fauna including the bivalved crustaceans known as ostracodes. Tibert & Dewey (2006) recently erected a new genus of ostracoda (Velatomorpha) from material collected at Joggins & the coeval Pennsylvanian deposits at Port Hood, Cape Breton Island, Nova Scotia. The paleoenvironment that *Velatomorpha altilis* occupied has been one of intense geological debate. More specifically, the question of marine influence with respect to paleosalinity has been raised (see refs in Tibert & Dewey 2006). The objective of this study is to evaluate the viability of the ostracode *Velatomorpha altilis* as a paleoenvironmental indicator, and assess the potential for diagenetic alteration of the ostracoda carapaces. In order to reconstruct the paleosalinity, the ostracod carapaces will be analyzed for $\delta^{18}O$ and $\delta^{13}C$ stable isotope values.

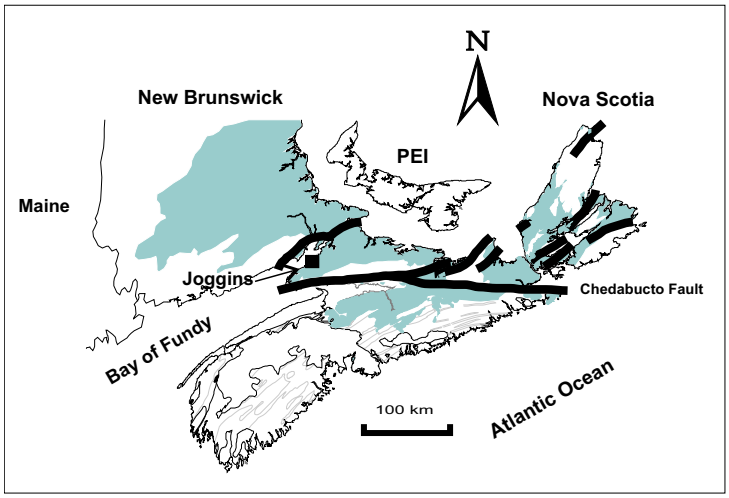

FIGURE 1 -- Map of Nova Scotia illustrating the Chedabucto Fault system (Tibert and Dewey 2006).

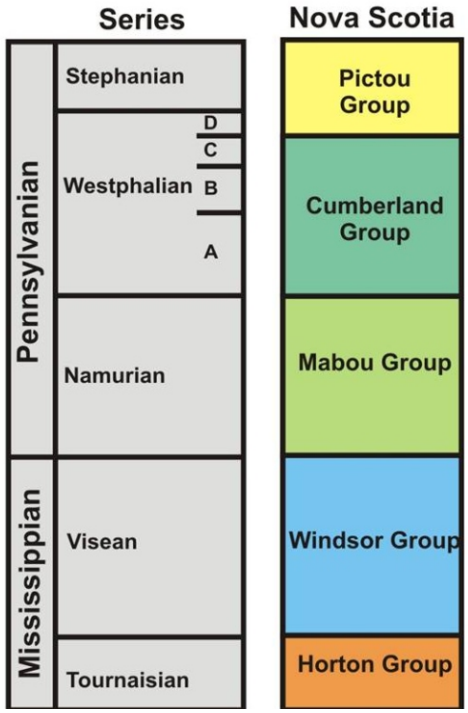

FIGURE 2 -- General Nova Scotia Stratigraphy (Tibert and Dewey 2006)

BACKGROUND

GEOLOGICAL LOCALITY

The Port Hood Formation is of Lower Pennsylvanian (Westphalian) age, and outcrops on Cape Breton Island (Fig. 1)(Fig. 2). During the Carboniferous, Nova Scotia was located near the equator (Rygel & Shipley 2005). Falcon-Lang (2003) has identified cyclic sedimentary deposits that may indicate marginally marine influences.

OSTRACODES

Ostracodes are crustaceans in the Phylum Arthropoda (Fig. 3). They possess two valves connected by a hinge mechanism. Their outer lamella is composed of low magnesium calcite; this biomineralised shell is the part typically preserved in the fossil record. Ostracodes can be found in marine or freshwater sediments, and are useful as paleoenvironmental indicators due to their sensitivity to changes in salinity, temperature, substrate, food supply, pH, and dissolved oxygen levels e.g., (Boomer, 2002). In this study several ostracodes were encountered, however the focus lies on *Velatomorpha altilis*.

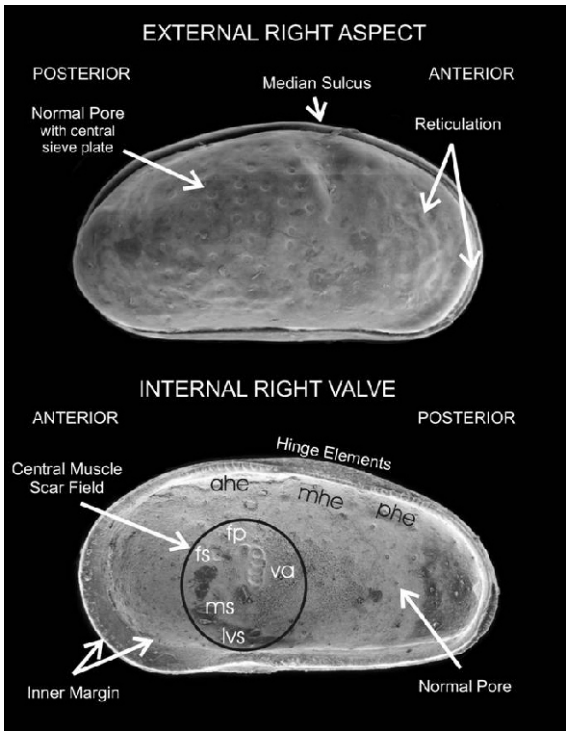

FIGURE 3 -- Ostracod morphology (Tibert and Dewey 2006).

VELATOMORPHA ALTILIS

Meaning "concealed morphology" in latin, *Velatomorpha altilis* possesses internal features that are not easily identified: AMS field, contact margin, and hingement (Fig. 4). *Velatomorpha altilis* is found in Maritimes Basin, North America and is of Lower Pennsylvanian (Westphalian A-C; mid-Langsettian) in age. The presence of *Velatomorpha altilis* supports a marginal marine, estuarine environment (Tibert & Dewey 2006).

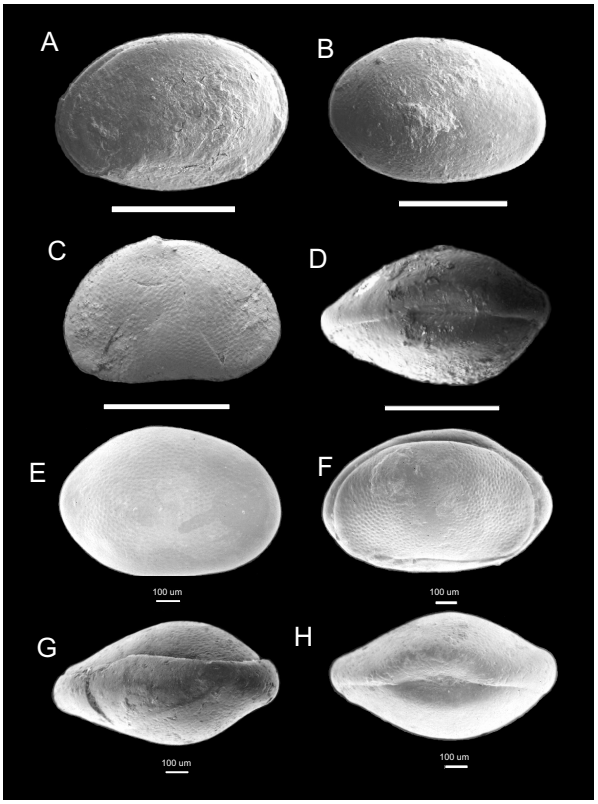

FIGURE 4 – SEM Micrographs of Velatomorpha altilis (Tibert and Dewey 2006).

METHODS

Sediment samples were taken from the Port Hood Formation exposed in Cape Breton Island using standard field procedures. Section was measured to correlate samples stratigraphically.

Sediment was dry sieved and picked for ostracoda using conventional microfossil techniques described in Scott et al (2002). Dry sieving was chosen due to the hard composition of the microfossils. Samples were crushed using a mortar and pestle, and then soaked in a mild solution of water and hydrogen peroxide to loosen the clinging sediment particles. Next, a 125 um sieve was used to separate out the clay particles and prepare the sample for picking. The samples were then dried overnight at 30-40°C, and separated based on grain size for picking.

Velatomorpha altilis carapaces were analyzed with a focus on adult valves. Stable isotope analysis of oxygen and carbon were performed

at the University of Saskatchewan Isotope Laboratory. Stable isotope values are obtained using a Finnigan Kiel-III carbonate preparation device directly coupled to the dual inlet of a Finnigan MAT 253 isotope ratio mass spectrometer. The CO_2 evolved is then cryogenically purified before being passed to the mass spectrometer for analysis. Isotope ratios are corrected for acid fractionation and 17O contribution and reported in per mil notation relative to the VPDB scale. Data is directly calibrated against the international standard NBS-19 that is by definition $\delta^{13}C$ = 1.95‰ VPDB and $\delta^{18}O$ = -2.2‰ VPDB. Standard deviations for $\delta^{13}C$ and $\delta^{18}O$ are 0.05‰ and 0.11‰, respectively (n = 25). Actual sample errors may be greater than these due to heterogeneity, and more accurate data may be obtained for such through repetition. (Pers. Comm. Prokopiuk 2006).

RESULTS

Approximately 60 samples were analyzed for their $\delta^{13}C$ and $\delta^{18}O$ values. In the Joggins samples, $\delta^{18}O$ values ranged from -9.0 to -4.0‰, and $\delta^{13}C$ values ranged from -9.0 to -0.5‰. Results were compared against samples taken from Joggins Fossil Cliffs, Nova Scotia (Fig. 5). Joggins carapaces yielded highly variable $\delta^{13}C$ and $\delta^{18}O$ values that are generally lighter than those specimens analyzed at Port Hood. Valve fragments from both Port Hood and Joggins also demonstrate lighter isotopic values, but there remains an apparent linear trend between the $\delta^{13}C$ and $\delta^{18}O$ values.

DISCUSSION & CONCLUSIONS

The object of this study was to evaluate the viability of the ostracode *Velatomorpha altilis* as a paleoenvironmental indicator.

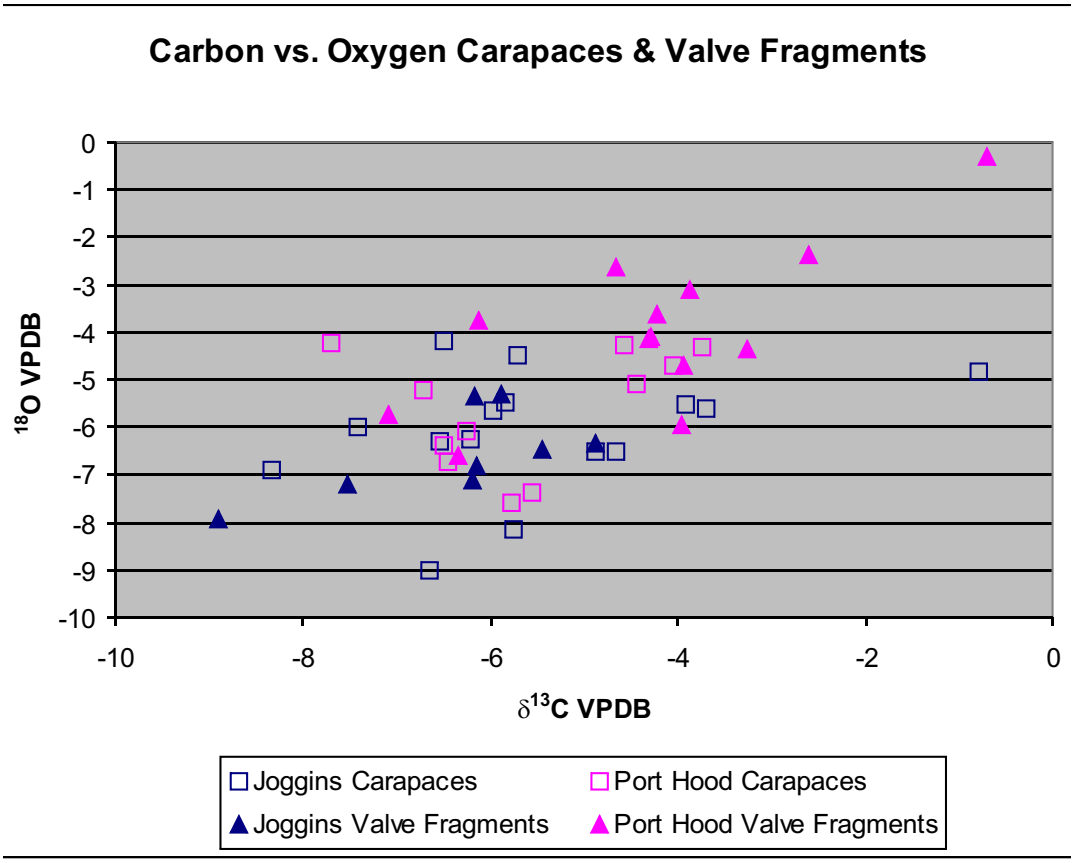

FIGURE 5 -- Carbon and Oxygen Isotopes plotted to evaluate diagenetic influence (Tibert and Dewey 2006).

Carbon and oxygen fractionate at different rates, however there is one common mechanism that can control the fractionation of both isotopes, diagenesis. Therefore, when an overall linear relationship between oxygen and carbon is observed, it is typically an indication of diagenesis. The section the ostracoda were taken from was found to be bituminous grade coal. This is a shallow to intermediate depth coal, experiencing temperatures of ~100˚C; calcite is highly likely to have undergone significant recrystallization by this temperature (Hacquebard 1989). Given that the isotopic data from Joggins and Port Hood illustrates an overall linear relationship between the oxygen and carbon stable isotopes, the signal observed is not paleosalinity, it is diagenetic in origin. Notably, the oxygen and carbon values from both the valves and the articulated carapaces are isotopically heavier from the material collected from Port Hood, which might suggest a potential paleosalinity signal recorded in the carapace calcite. Heavier values would therefore imply higher salinity influenced by either marine sourced water or enhanced evaporation in the Port Hood Basin. Alternatively, the isotopically light values at Joggins might suggest increased diagenetic influences in proximity to the Chedabucto-Cobequid fault system (Waldron & Rygel 2006). Brand (1994) performed stable isotopic analyses on the bivalve Naiadites from the the ostracode beds at Joggins whereas relatively light values were interpreted as influence from nonmarine waters. We maintain, however, that the lighter values would record a significant diagenetic influence in a basin that was subjected to significant alteration necessary for the formation for the associated Bituminous Coals of the Joggins and Port Hood Formations (Waldron & Rygel 2005).

We reached the following conclusions for this study as follows:

1. Stable isotopic values for *Velatomorpha altilis* from Port Hood, Nova Scotia are isotopically heavier than values analyzed at Joggins, Nova Scotia.
2. There is a general linear relationship of increasing ^{13}C and ^{180} values from both Port Hood and Joggins.
3. Diagenesis likely due to fractionation in pore waters post-burial likely contributed to isotopically lighter values at both localities.
4. Port Hood isotopic values are relatively heavier than those seen at Joggins, which might indicate primary paleosalinity influences.

The presence of *Velatomorpha altilis* in the sediment samples retrieved indicates deposition in a slightly brackish marginal marine or coastal lacustrine environment.

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