Sponges, Echinoderms and Stem-Group Brachiopods, Oh My! Paleontology and Evolutionary Change in the Ordovician Manitou Formation, Colorado

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Rock samples collected on the Ute Trail, just North of Aspen, Colorado are assigned here to the Ptarmigan Chert Member of the Ordovician Manitou Formation based on the presence of spiculitic chert and the brachiopod *Apheoorthis lineocosta.* The fossiliferous facies consists of a red dolostone with interbedded chert nodules. Sponge spicules are found in thin sections of the chert. The echinoderm and silicified brachiopods are found in the dolostone. The brachiopods were extracted via hydrochloric acid dissolution. A bioturbation intensity of index level 3 was noted in the interbedded dolostone and chert found in the study area.[1]

Brachiopods recovered by acid dissolution belong to *Apheoorthis lineocosta* (Walcott, 1924)[2]. Although this species has been previously placed in Phylum Brachiopoda with much confidence and little discussion, this study provides new evidence bearing on this taxonomic assignment. Careful examination shows that, due to mismatched pedicle and brachial valves, this brachiopod could not have lived a bivalved mode of life. *A. lineocosta* has greatest affinity to stem group brachiopods such as the families Mickwitziidae, Halkieriidae, and Tianzhushanellidae. The morphology of each of these groups includes two brachiopod-like valves, but the vales are mismatched and the animals did not live as bivalves. A large valve-like shell resided at each end of a typical stem brachiopod, and the rest of the body was covered in small, hard plates, called sclerites. This morphology gave the animal the ability to move around on the sea floor.[3] Stem group brachiopods are presumably an evolutionary precursor to crown group, bivalved brachiopods, and this reclassification of *A. lineocosta* provides important data concerning the evolutionary transition from stem to crown.

Clear evidence that the study area was home to sponges and echinoderms, as well as stem group brachiopods, provides insight into the ecology of the Ordovician sea floor. These organisms together compose a two-tiered fauna, in which some animals filter fed at substrate level, and some fed higher in the water column. This two-tiered system, in conjunction with the observed level of bioturbation, shows a biota in transition. The substrate was experiencing increasing levels of bioturbation, and more sediment was being released into the water. This sediment haze prevented animals from feeding productively, thus providing a catalyst for evolutionary change as seen by the development of the second-tier.

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[1] Dodd, J. R. and Stanton, R. J., Jr., 1990, Paleoecology: Concepts and Applications: John Wiley, New York, p. 502

[2] Walcott, C. D., 1924, Cambrian geology and Paleontology IV: Smithsonian Miscellaneous Collections, v. 67, p. 477-554.

[3] Conway Morris, S. and Peel, J. S., 1995, Articulated Halkieriids from the Lower Cambrian of North Greenland and their role in early protostome evolution. Philosophical Transactions of the Royal Society of London, Series B, v. 347, p. 305-358.