

Late Ordovician Lagerstätten in Manitoba, Canada

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Ordovician lagerstätten are rare globally, particularly in comparison with the Cambrian record. Manitoba has at least three Ordovician sites with soft tissue preservation. Although these have not yet been thoroughly documented, they have already significantly enhanced our understanding of global Ordovician biodiversity. Of the three lagerstätten, the Cat Head and William Lake biotas occur in the Williston Basin, while the Airport Cove biota is in the Hudson Bay Basin. The Cat Head, of early Maysvillian age, is significantly older than the other two, which are considered to be Richmondian. Depositional environments also differ: the William Lake and Airport Cove biotas represent restricted marginal marine conditions, while the Cat Head was apparently deeper water.

The Cat Head fossils are found along the west shore of Lake Winnipeg, in bedded fine-grained dolostones of the Cat Head Member, Red River Formation. Fossils, generally rare but abundant at some levels, include algae, sponges, conulariids, brachiopods, possible hydrozoans, nautiloids, trilobites, and dendroid graptolites. Some are remarkably preserved; the soft algae (seaweeds) are among the best anywhere in the Early Palaeozoic, and have been interpreted as rhodophytes, heterokontophytes, and chlorophytes. The preservation of algae and some of the other fossils, in part as carbon- or iron-rich films, suggests that the Cat Head Member in this area should be recognized as a lagerstätte. The lithology and associated biota are consistent with deposition in the photic zone below storm wave base, although it has also been suggested that this was a restricted marine environment having little contact with the open sea.

The William Lake and Airport Cove sites represent distinct depositional environments, but they share biotic elements: eurypterids, xiphosurids, algae, and large problematic tubes. The xiphosurid *Lunataspis aurora*, found at both sites, is among the oldest known true horseshoe crabs. The superb eurypterids will enhance the sparse Ordovician record of this group.

The William Lake biota occurs in the Williams Member, Stony Mountain Formation. Thin-bedded dolomudstones representing restricted low-energy conditions, contain common medusae (jellyfish). A single pycnogonid specimen is the geologically earliest known adult sea spider. Medusae and articulated arthropods occur in largely homogeneous mud layers or lenses; both fossils and lithology suggest rapid deposition. Medusae are preserved as sparry dolomite slightly enriched in iron and silica, surrounded by degraded pyrite.

Airport Cove fossils are in rocks tentatively assigned to the Churchill River Group. Laminated calcareous dolostones, deposited under more open circulation, contain scolecodonts and common noncalcified algae (seaweeds). Macrofossils are preserved with pyrite, as carbonate, and as organic matter. Eurypterid sclerites are commonly disarticulated or broken, but organic cuticle retains exceptional detail.

Together, William Lake and Airport Cove provide unique information about tropical shoreline communities prior to the Late Ordovician extinction. Almost half the taxa (ordinal level or higher) are rare or unknown elsewhere in the Ordovician of North America. Macrofossils with calcareous skeletons are remarkably rare, making up only 4-5% of the total specimens at each site. At William Lake, 33% of fossil groups are calcareous, in contrast with normal marine carbonates lower in the Stony Mountain Formation where 95% are calcareous.