Plumulitid machaeridian remains from the Silurian (Telychian) of Severnaya Zemlya, Arctic Russia

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The machaeridian genus *Plumulites* is reported for the first time from the Severnaya Zemlya Archipelago of Arctic Russia, where it occurs in limestone concretions within the Sredninskaya Formation. Graptolites from the same concretions indicate the late *crispus – griestoniensis* Biozones of the mid Telychian (Llandovery). Similarities to plumulitid sclerites from the Upper Ordovician of the Taimyr Peninsula promotes further interest in machaeridian faunas from this region.

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Introduction

The global record of Silurian machaeridians is limited, but includes rare articulated specimens, and more commonly isolated sclerites that have been found in Britain (de Koninck 1857; Woodward 1865; Withers 1926 and Adrain *et al.* 1991), the Baltic Region (Aurivillius 1892; Schrank 1978; Bengtson 1979; Schallreuter 1985 and Högström 1997), Ukraine (Adrain *et al.* 1991), Bohemia (Barrande 1872; Prokop 1965), the Carnic Alps of Austria (Dzik 1994), North America (Hall and Whitfield 1875; Clarke 1896; Adrain 1992 and Högström and Taylor 2001). Additionally there are a few scattered reports from, e.g., China and Australia (Chapman 1910 and Wu Hong-Ji 1990).

Reports of machaeridians from Arctic Russia and Siberia have been absent from the literature until very recently. Högström (2000) made the first report of *Plumulites* from the Upper Ordovician of Taimyr. Most recently Bogolepova *et al.* (2000) reported on the occurrence of machaeridians from the Early Silurian of Severnaya Zemlya, now described herein. The present paper reports on the study of material from Severnaya Zemlya as part of ongoing work with Arctic Russian and Siberian machaeridians. The Upper Ordovician machaeridians from Taimyr are being described elsewhere. The Severnaya Zemlya material was collected by O.K. Bogolepova and A.P. Gubanov during the Swedarctic International Expedition of 1999 (Gee *et al.* 1999). Specimens are deposited in the Museum of Evolution (Palaeontology section), Uppsala University, Sweden (no. PMU SZ5).

Stratigraphy and locality

Machaeridians discussed herein originate from the Lower Silurian Sredninskaya Formation (Matukhin *et al.* 1999). To avoid nomenclatural questions, it should be noted that these rocks were previously referred to as the Golomaynnaya Formation (Menner *et al.* 1979; Bogolepova *et al.* 2000). It is composed of irregularly thin-bedded limestones with alternating dolomites and calcareous dolomites, and occasional layers (0.1-1 m) of quartz sandstones and siltstones with a calcareous-dolomitic matrix. The limestones are weakly calcareous and dolomitised, greenish-grey and grey. Stromatolitic and microphytolitic limestones are present, but subordinate. The unit is at least 120 m thick at its type locality, but thinner elsewhere.

The present material comes from the locality BG99-13 (N 79°40'28"; E 96°31'10") exposed in the middle reaches of the Ushakova River, central part of October Revolution Island (Fig. 1). Here, a sequence of black shales with dark limestone concretions (0.15-0.25 m in diameter) occurs. The mudstones yield abundant graptolites, less commonly cephalopods, brachiopods and chitinozoans. Within the nodules of clayey micritic limestones graptolites *(Stimulograptus clintonensis, Stimulograptus* sp., *Streptograptus loydelli)*, brachiopods *(Alispira* sp., *Dalejina* sp., *Howelella* sp., *Nalivkinia* sp., and *Zygospiraella* sp.), cephalopods *(Geisonoceras* sp., *Kionoceras* sp., *Phragmoceras* sp., *Pentameroceras* sp. A.), ostracodes *(Entomozoa* aff. *tuberosa)* were commonly found, gastropods *(Holopea* sp., *Loxonema* sp.), bivalves *(Ctenodonta* sp., *Dualina?* sp., *Sibirinka* sp.), lingulids

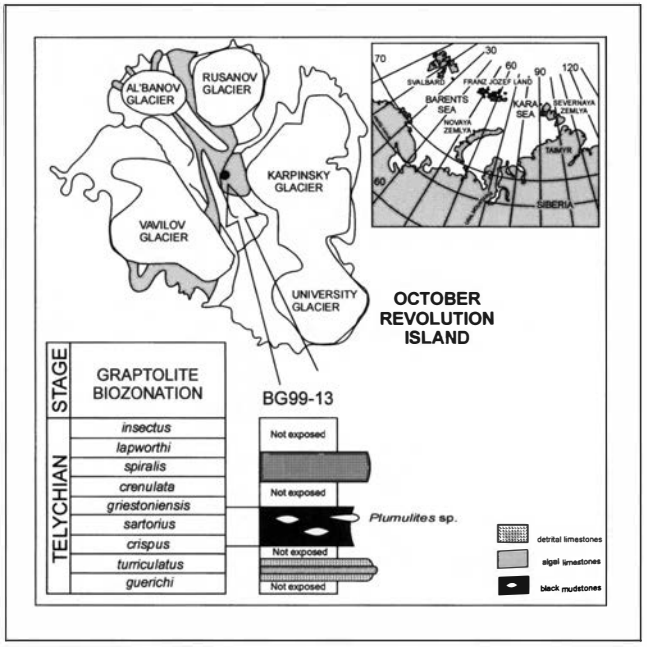

Fig. 1. (A) Generalised map of the October Revolution Island showing location of section BG99-13, Ushakova River, and (B) the machaeridian-bearing part of the Sredninskaya Formation, Llandovery, Silurian.

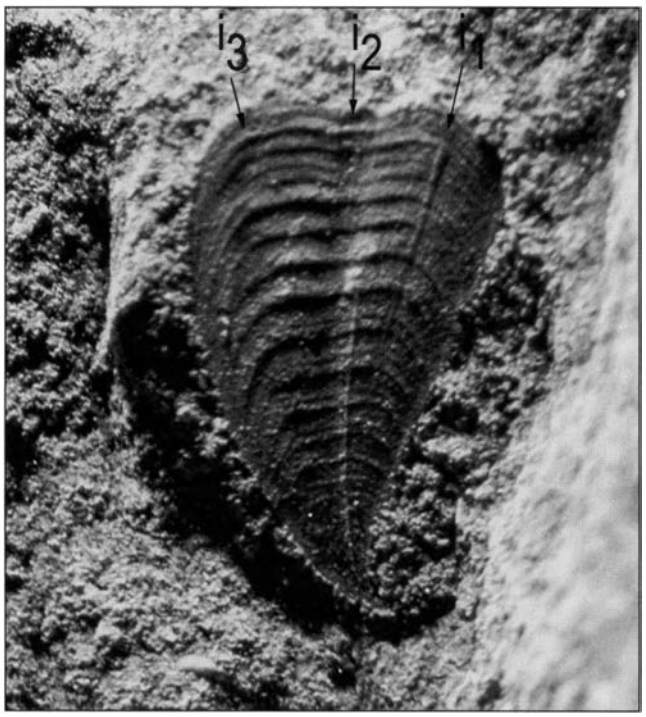

Fig. 2. Outer left sclerite of Plumulites sp. (PMU SZ5) with inflections i_1-i_3 marked, x12.

and algae only rarely. The graptolites provide firm evidence for the age of these strata, indicating a level between the upper part of the *crispus* and the *griestoniensis* Biozone (Bogolepova *et al.* 2000).

Systematic Palaeontology

Class *Machaeridia* Withers, 1926
See Adrain *et al.* (1991) for the definition and usage of inflections when describing machaeridian sclerites.
Order *Turrilepadomorpha* Pilsbry, 1916
Family *Plumulitidae* Jell, 1979
Genus *Plumulites* Barrande, 1872
Plumulites sp.
Fig. 2
Description. - PMU SZ5, outer left sclerite, length (L) = 3.5 mm, width (W) = 2.4 mm. Rugae widely spaced, total no 12-13. Inflections: i_1–i_3 present: median inflection i_2 only slightly expressed. Along i_1 a distinct ridge is expressed. Acute curved apical region. Two additional sclerite fragments consisting of the apical regions of similar sclerites.
Occurrence. - Locality BG99-13, Ushakova River, central part of October Revolution Island, Severnaya Zemlya, Russia. Telychian, Llandovery, Silurian.
Remarks. - The present material is very similar to Upper Ordovician *Plumulites* sp. from the Taimyr Peninsula, occurring primarily with disarticulated trilobites on bedding planes of carbonate layers within a dark graptolitic shale. Also, both the material from Taimyr and the present find are similar to *Plumulites scoticus,* Etheridge, 1878, from the Upper Ordovician of Scotland, but appear to differ primarily in the appearance of the ridge along i_1 and inflection i_2. But a more complete evaluation of the apparent differences between *P. scoticus,* the Taimyr material and this material is necessary before firm conclusions can be reached on the possible relationship between them.

Additionally, the single complete sclerite leads to somewhat uncertain comparisons with the Taimyr material. However, the present similarities to outer sclerites from Taimyr and especially the additional ridge along i_1 (Fig. 2) still suggest that they may be conspecific. Whereas the material from Taimyr (as well as *P. scoticus*) is of upper Ordovician age the material described herein is of lower Silurian (Telychian) age. This possible transgression of the Ordovician – Silurian boundary might be a true pattern, and with further studies and interpretations of the Taimyr faunal assemblages the overall picture of Arctic Russian and Siberian machaeridian faunas will become clearer. The undoubted value of the present find lies in the geographical and stratigraphical expansion of machaeridian faunas in this area and will, together with material from Taimyr, constitute a large increase in the known global distribution of machaeridians.

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