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The Archaeology and Petrology of Coal Artifacts from a Thule Settlement on Axel Heiberg Island, Arctic Canada

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ABSTRACT. Coal artifacts are occasionally excavated by archaeologists from Thule culture settlements (c. A.D. 1100–1700) in the Canadian Arctic and Alaska. This study examines two such artifacts from a Thule settlement located on the east coast of Axel Heiberg Island, Canada. One specimen has a petrographic composition typical of a cannel shale, in which sporinite is the most abundant organic constituent; the other is characterized by *Botryococcus*-alginite bodies typical of a boghead coal. Nearby exposures of Tertiary coal are generally woody and are not known to contain boghead layers or cannel shales. It is suggested that these artifacts may have their origin in Alaska, where boghead coal and cannel shales show strikingly similar petrographic features.

Key words: Arctic Canada, Axel Heiberg Island, Thule culture, coal artifacts, coal petrology, archaeology

RÉSUMÉ. Il arrive que des artefacts de charbon soient mis à jour lors de fouilles archéologiques dans les sites de peuplement de la culture Thulé (v. 1100-1700 apr. J.-C.) dans l'Arctique canadien et en Alaska. La présente étude se penche sur deux de ces artefacts provenant d'un site de peuplement Thulé qui se trouve sur la côte est de l'île Axel Heiberg, au Canada. Un des objets a une composition pétrographique typique d'un schiste sapropélique, dans lequel la sporinite est le constituant organique dominant; l'autre artefact se caractérise par la présence d'organismes d'alginite-*Botryococcus* typique d'un boghead. Des affleurements voisins de charbon datant du tertiaire sont généralement ligneux et ne contiennent pas, à ce que l'on sache, de couches de boghead ou de schistes sapropéliques. On suggère que ces artefacts pourraient venir de l'Alaska, où le boghead et les schistes sapropéliques offrent une similarité frappante des caractéristiques pétrographiques.

Mots clés: Canada arctique, île Axel Heiberg, culture Thulé, artefacts de charbon, pétrologie de la houille, archéologie

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INTRODUCTION

Coal petrographical techniques, such as the determination of vitrinite reflectance and maceral analysis, have been used successfully over the past years to identify the provenance of coal artifacts excavated by archaeologists. Teichmüller (1992) studied coal ornaments from Roman and Celtic grave sites and was able to trace some of the materials to their sources in southern Germany, Bohemia, and Czechoslovakia. Smith (1996, 1997) studied coal relics collected from Roman sites in Britain and found that nearly all the specimens originated from the nearest outcrop exposures of coal seams.

In the Canadian Arctic and Alaska, coal artifacts are occasionally found in excavated winter house ruins from the Thule culture period (Steffian, 1992; Kalkreuth et al., 1993a), which represents an early phase of Inuit occupation. Previous examinations of coal artifacts from the Bache Peninsula region of eastern Ellesmere Island, including the analysis of beads and a possible labret, showed that the artifacts consisted of a variety of coal and organic-rich shale types (lignite, boghead coal, cannel shale), some of which could be traced to nearby outcrop exposures (Kalkreuth et al., 1993a).

The present study focuses on two coal artifacts excavated from a small prehistoric occupation site (identified as the Buchanan Lake site, SiHw-1) located between Buchanan Lake and Mokka Fiord on the east side of Axel Heiberg Island (Sutherland, 1980, 1981, 1983; Fig. 1). The site comprises a late Dorset Palaeoeskimo occupation, as well as three Thule houses (Fig. 2), which yielded over 800 catalogued specimens of bone, ivory, antler, wood, metal, amber, and coal. Three radiocarbon dates on samples of caribou and muskox bone relate to the Thule Inuit occupation of the site: I-12341, 900±80 BP (calibrated A.D. 1002–1277); S-2212, 555±105 BP (calibrated A.D. 1263–1629); I-11755, 420±75 BP (calibrated A.D. 1407–1649), University of Washington Calibration Program 3.0.3c.

The range of radiocarbon dates and the styles of artifacts recovered from the site suggest that the locality was occupied by at least two groups of Thule Inuit, and that these occupations probably occurred between the 12th and the 17th centuries. The coal specimens were recovered from a stratigraphically complex portion of one house

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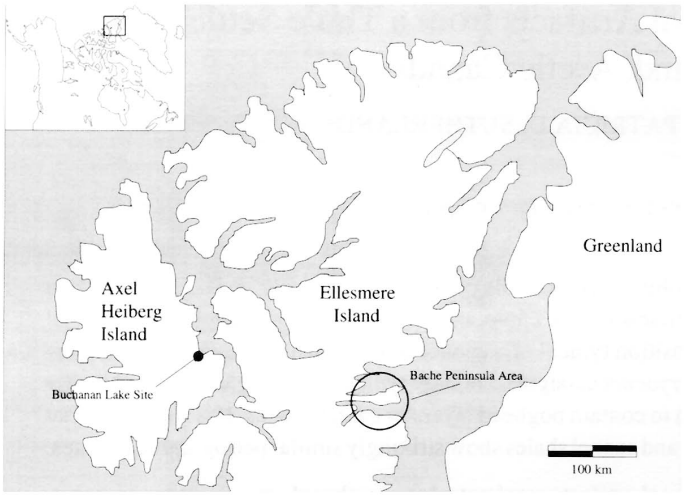

FIG. 1. Map of High Arctic Canada showing locations of the Buchanan Lake site and the Bache Peninsula area.

FIG. 2. The Buchanan Lake site, SiHw-1.

feature that had suffered partial disturbance due to looting, but the artifacts were most likely associated with the earlier of these occupations.

In the present study, the two coal artifacts were analyzed to establish coal rank and petrographic composition, and to identify possible sources of the materials.

SAMPLING AND ANALYTICAL PROCEDURES

Small fragments were scraped from the surface of the artifacts and prepared for incident light microscopy using standardized procedures (Bustin et al., 1989). The nomenclature for the description of the organic components is that of the International Committee for Coal Petrology (ICCP, 1963, 1971, 1995).

RESULTS AND DISCUSSION

Coal Artifact SiHw-1:650

This artifact is a polished piece of coal, with an outline form resembling a stylized whale (Fig. 3A), measuring 58 × 43 × 17 mm.

Petrographic analysis showed that the composition is that of a cannel shale, in which the maceral sporinite is the predominant organic constituent. In white-light illumination, the cannel shale displays fine-grained clay minerals (Fig. 3B), associated with rare inertodetrinite (bright material) and abundant sporinite (dark stringers). Under blue-light illumination, the sporinite displays intense, yellowish fluorescence colour, typical for a relatively low level of organic maturity. Mean random vitrinite reflectance was determined to be 0.65%, which corresponds to a coal rank of high volatile B bituminous.

The relatively high vitrinite reflectance level makes it unlikely that the specimen originated in the nearby coal measures of the Tertiary Eureka Sound Group, since nearby exposures of coal seams on the west coast of Ellesmere Island have reflectances below 0.55% (Bustin et al., 1977; Kalkreuth et al., 1993a, b, 1996).

Elsewhere in the Canadian Arctic, lithologies with similar petrographic composition are known to occur in Carboniferous oil shales on Devon Island (Cameron et al., 1984; Goodarzi et al., 1987), although the reported reflectances for these shales (< 0.50 % R_{random}) are lower than the reflectance level determined for artifact SiHw-1:650.

Compositionally, the specimen is very similar to one artifact described from the Skraeling Island Site on the east coast of Ellesmere Island (artifact SfFk-4:2292, Kalkreuth et al., 1993a), although the specimens differ in reflectance (0.65 versus 0.31). The specimen from Axel Heiberg Island is also strikingly similar to samples of artifacts and naturally occurring dull coal bands on Kodiak Island and the Alaskan Peninsula (Kalkreuth, unpubl. data), which would suggest a common origin of these materials.

Coal Artifact SiHw-1:636

This artifact is a polished piece of coal that has been carved in the shape of a human figure (Fig. 4A). The specimen is broken, and the remaining portion measures 50 × 26 × 9 mm.

Petrographic analysis showed that the specimen consists almost entirely of algal remains, typical for a boghead coal. The algal remains resemble *Botryococcus*-type algae (Fig. 4B). The dark alginite bodies are separated from each other by a matrix of medium gray vitrinite. Under blue-light excitation, the alginite bodies display a yellowish fluorescence colour and well-preserved cell structure. The mean random reflectance was determined to be 0.63%, which corresponds to a rank of high volatile B bituminous. Alginite-rich coals and oil shales are known to have significantly lower (depressed) vitrinite reflectances compared to stratigraphically equivalent strata with no or little alginite (Hutton and Cook, 1980; Kalkreuth and Macauley,

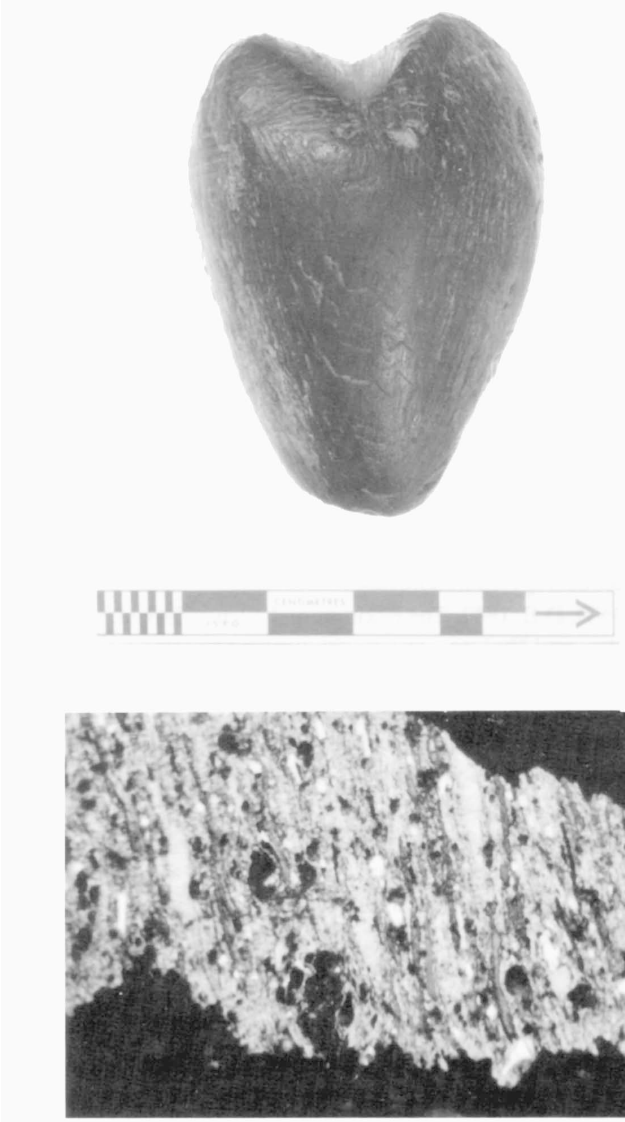

FIG. 3. A) Coal artifact SiHw-1:650. Specimen has been carved and polished to the form of a stylized whale. Maximum dimension is 58 mm. B) Micrograph showing fine-grained clay minerals, with inclusions of inertodetrinite (bright) and sporinite (dark stringers). White-light illumination; long axis of photograph is 200 microns long.

1987). In other words, the alginite-rich boghead coal investigated in this study may well be characterized by a depressed reflectance value in the order of 0.4–0.5% R_{random}, and the coal rank may be higher than that indicated by vitrinite reflectance.

The material of this artifact is strikingly similar to that determined in coal beads from Thule settlements located on the east coast of Ellesmere Island (Kalkreuth et al., 1993a), indicating a common source for these specimens. The massive boghead coal appears to have been particularly suitable for carving delicate ornaments and figurines, such as the artifact described here and the beads and the possible labret found in the Bache Peninsula region of Ellesmere Island. As with the stylized whale artifact (SiHw-1:650), the origin of the boghead coal is uncertain.

FIG. 4. A) Coal artifact SiHw-1:636. Specimen has been carved and polished to the form of a human figure. Part of the head and one leg are broken off. Maximum dimension is 50 mm. B) Micrograph showing *Botryococcus* alginite, showing cauliflower-like internal structure. Dark alginite bodies are separated from each other by medium-gray vitrinite matrix. White-light illumination; long axis of photograph is 200 microns long.

Investigations on coal-bearing strata of the Tertiary Eureka Sound Group (Kalkreuth et al., 1993a, b, 1996) have failed to identify boghead-type layers in the predominantly woody lignites. Kalkreuth et al. (1993a) suggested a possible origin in Alaska, where alginite-rich layers have been described in Cretaceous coal-bearing strata of similar rank (Rao and Smith, 1983). These layers show compositional features very similar to those observed in the artifacts.

CULTURAL IMPLICATIONS

The Thule culture is believed to have originated on the northern coast of Alaska in the centuries around A.D. 1000, and the eastward expansion of the Thule people during the 12th and 13th centuries is interpreted as the event that spread Inuit occupation across Arctic Canada and Greenland (Mathiassen, 1927; Dumond, 1987). The culture and technology of these ancestral Inuit were very similar to those of their Alaskan relatives, and the original Thule expansion appears to have occurred relatively rapidly. However, the nature and timing of the expansion are not understood in detail, nor has archaeological evidence provided clear indications of continued contact between Alaska and Arctic Canada during the Thule period.

The coal artifacts described in this paper are portable, durable, and made from a material which may have been highly valued for its rarity and its appeal as a medium for the fabrication of ornaments. Items such as these may have been carried from Alaska by early Thule people, may have been traded for long distances during the centuries subsequent to the Thule expansion, and may have survived as heirlooms for several generations. The continued identification and analysis of materials such as these from other Thule culture settlements may be expected to provide information useful to our understanding of the manner in which early Inuit established their occupation of Arctic North America.

DEDICATION

The senior author wishes to dedicate his contribution to this paper to Prof. V. Jacobshagen, who retired in 1997 at the Freie Universität Berlin (FU), Germany, after a distinguished career in geological research and teaching.

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REFERENCES

BUSTIN, R.M., HILLS, L.V., and GUNTHER, P.R. 1977. Implications of coalification levels, Eureka Sound Formation, northeastern Arctic Canada. Canadian Journal of Earth Sciences 14:1588–1597.

BUSTIN, R.M., CAMERON, A.R., GRIEVE, D.A., and KALKREUTH, W.D. 1989. Coal petrology - Its principles, methods and applications. Geological Association of Canada, Short Course Notes, Volume 3. 3rd ed. 278 p.

CAMERON, A.R., GOODARZI, F., and POTTER, J. 1994. Coal and oil shale of Early Carboniferous age in northern Canada: Significance for palaeoenvironmental and palaeoclimatic interpretation. Palaeogeography, Palaeoclimatology, Palaeoecology 106:135–155.

DUMOND, D.E. 1987. The Eskimos and Aleuts. 2nd ed. London: Thames and Hudson.

GOODARZI, F., DAVIES, G.R., NASSICHUK, W.W., and SNOWDON, L. 1987. Organic petrology and Rock-Eval analyses of the Lower Carboniferous Emma Fiord Formation in the Sverdrup Basin, Canadian Arctic Archipelago. Marine Petroleum Geology 4:132–145.

HUTTON, A.C., and COOK, A.C. 1980. Influence of alginite in the reflectance of vitrinite from Joadja, N.S.W., and some other coals and oil shales containing alginite. Fuel 59:711–716.

ICCP (INTERNATIONAL COMMITTEE FOR COAL PETROLOGY). 1963. International handbook of coal petrography. Paris: Centre National de la Recherche Scientifique.

———. 1971. International Committee for Coal Petrology. International handbook of coal petrography, 1st supplement to 2nd edition. Paris: Centre National de la Recherche Scientifique.

———. 1995. Vitrinite classification, ICCP System 1994. Aachen, Germany.

KALKREUTH, W.D., and MACAULEY, M. 1987. Organic petrology and geochemical (Rock Eval) studies on oil shales and coals from the Pictou and Antigonish areas, Nova Scotia, Canada. Bulletin of Canadian Petroleum Geology 35:263–295.

KALKREUTH, W.D., McCULLOUGH, K.M., and RICHARDSON, R.J.H. 1993a. Geological, archaeological and historical occurrences of coal, east-central Ellesmere Island, Arctic Canada. Arctic and Alpine Research 25(4):277–307.

KALKREUTH, W.D., McINTYRE, D.J., and RICHARDSON, R.J.H. 1993b. The coal geology, coal petrography and palynology of Tertiary coals from the Eureka Sound Group at Strathcona Fiord and Bache Peninsula, Ellesmere Island, Canada. International Journal of Coal Geology 24(1993):75–111.

KALKREUTH, W.D., McINTYRE, D.J., FOWLER, M.G., RICHARDSON, R.J.H., RIEDIGER, C.L., and MARCHIONI, D. 1996. Petrological, palynological and geochemical characteristics of Eureka Sound Group coals, Stenkul Fiord,

southern Ellesmere Island, Arctic Canada. International Journal of Coal Geology 30(1996):151–182.

MATHIASSEN, T. 1927. Archaeology of the Central Eskimos. Report of the 5th Thule Expedition 1921–1924, Vol. 4 (1) and (2). Copenhagen: Gyldendalske Boghandel, Nordisk Forlag.

RAO, P.D., and SMITH, J.E. 1983. Petrology of Cretaceous coals from northern Alaska. Mineral Industry Research Laboratory Report No. 64. Anchorage, Alaska: U.S. Geological Survey.

SMITH, A.H. 1996. Provenance of coals from Roman Sites in U.K. counties bordering River Severn and its estuary and including Wiltshire. Journal of Archaeological Science 23:373– 389 .

———. 1997. Provenance of coals from Roman sites in England and Wales. Britannia 28:297–324.

STEFFIAN, A.F. 1992. Archaeological coal in the Gulf of Alaska: A view from Kodiak Island. Arctic Anthropology 29:111–129.

SUTHERLAND, P.D. 1980. Archaeological excavation and survey on northern Ellesmere and Eastern Axel Heiberg Island: A preliminary report. Archaeological Survey of Canada Ms# 1886. Unpubl. report available from the Archaeological Survey of Canada, Canadian Museum of Civilization, 100 Laurier Street, P.O. Box 3100, Station B, Hull, Quebec J8X 4H2, Canada.

———. 1981. Archaeological excavations at Buchanan Lake, Eastern Axel Heiberg Island, Summer 1981. Archaeological Survey of Canada Ms# 2062. Unpubl. report available from the Archaeological Survey of Canada, Canadian Museum of Civilization, 100 Laurier Street, P.O. Box 3100, Station B, Hull, Quebec J8X 4H2, Canada.

———. 1983. 1983 Field Report, Eureka Upland Archaeological Project. Archaeological Survey of Canada Ms# 2357. Unpubl. report available from the Archaeological Survey of Canada, Canadian Museum of Civilizati, 100 Laurier Street, P.O. Box 3100, Station B, Hull, Quebec J8X 4H2, Canada.

TEICHMÜLLER, M. 1992. Organic petrology in the service of archaeology. International Journal of Coal Geology 20:1–21.