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Combining chert provenance and least-cost pathway analyses to reconstruct Pre-Dorset and Dorset mobility on southern Baffin Island

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ABSTRACT

We combine chert provenance and least cost path analyses to investigate Palaeo-Eskimo mobility on southern Baffin Island, in the eastern Canadian Arctic. ICP-AES trace element analysis links chert artifacts from coastal and inland sites to quarries in the interior of the study area. Using a multi-criteria cost surface, we model least cost paths between quarry and occupation sites linked by the results of provenance analysis. These pathways will be used to structure a future program of pedestrian survey in the area between the coast and interior of southern Baffin Island.

1. Introduction

In artifact provenance analysis, the most probable origin of artifact raw materials is established by comparative chemical or physical assay of artifacts with samples from potential sources. By establishing points of raw material acquisition that can be compared to points of artifact discard documented during survey or excavation, provenance analysis allows archaeologists to examine spatial aspects of artifact use lives. This information can be used to reconstruct group catchment areas and degrees of mobility (Evans et al., 2007, 2010; Jones et al., 2003; Nash et al., 2016; Parish, 2016; ten Bruggencate et al., 2014), identify changes in landscape use over time (Eerkens et al., 2008; Pintar et al., 2015), or add a geographic dimension to discussions of lithic reduction strategies (Andrefsky, 2009; Eerkens et al., 2007, 2008; Smith et al., 2013). At its most basic level, provenance analysis is also a relatively objective approach to determining whether two or more specific archaeological sites were linked by travel and/or exchange in the past (Hull et al., 2008, 2014; Nadooshan et al., 2013).

While artifact provenance analysis can link points on past landscapes, reconstructing potential routes of material transport *between* those points requires supplementary methods. To this end, archaeologists have started combining provenance analysis with GIS-based least cost pathway (LCP) analysis to reconstruct the most likely routes of human travel between sites linked by raw material transport (Contreras, 2011; Cortegoso et al., 2016; Taliaferro et al., 2010; McCoy et al., 2011). This approach has the added advantage of addressing the potentially deterministic a priori assumptions of site connectivity sometimes made when least-cost pathway analysis is used as a standalone technique (Fábrega-Álvarez, 2006).

On southern Baffin Island, in the eastern Canadian Arctic (Fig. 1), our efforts to understand ancient human mobility have been focused on developing a chert provenance technique to determine how Palaeo-Eskimo hunter-gatherers moved between seasonal camps on the coast and in the interior (Milne et al., 2009, 2011; ten Bruggencate et al., 2015), and to determine the role played by lithic raw material availability in shaping those movements. In this paper, we present preliminary chert provenance data suggesting links between inland chert sources, inland summer occupation sites, and coastal winter sites on southern Baffin Island. Using a multicriteria cost surface developed through previous research aimed at reconstructing a network of pedestrian travel routes across southern Baffin Island (described in full in ten Bruggencate et al., 2016), we propose least cost pathways between these sites, which may have served as corridors of Palaeo-Eskimo movement.

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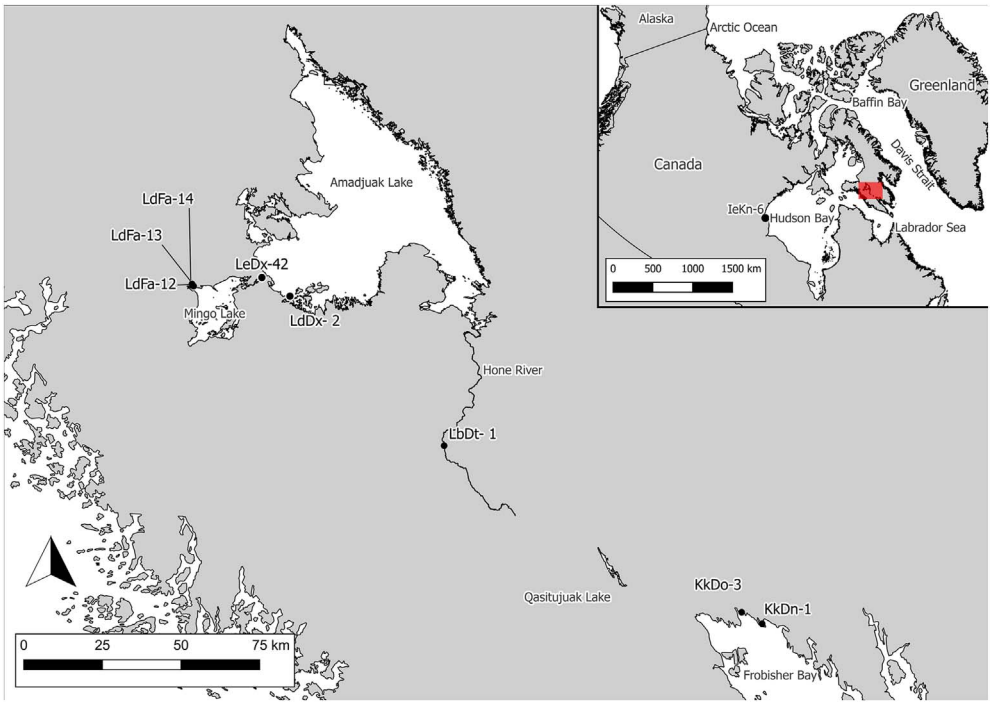

Fig. 1. Map of the study area showing location of archaeological sites and major water bodies discussed in text. Inset: Location of study area and IeKn-6.

1.1. Chert on southern Baffin Island

While later Thule (1000–1400 CE) populations preferred tools made from other materials, chert was by far the most common lithic raw material used by Pre-Dorset (2250–800 BCE) and Dorset (500 BCE–1000 CE) hunter-gatherers in the eastern Canadian Arctic (Stenton and Park, 1998:11). On southern Baffin Island, the distribution of this raw material is uneven: chert is scarce to absent in coastal regions (Maxwell, 1973), and can only be found in large quantities further inland (Milne, 2005; Milne et al., 2012, 2013). The relative abundance of chert in the interior, along with the presence of migrating caribou and waterfowl there in the summer and early fall likely contributed to a continuous pattern of coastal-inland seasonal mobility throughout both the Pre-Dorset and Dorset periods (Milne, 2003; Milne and Donnelly, 2004; Milne et al., 2012). This differs from other areas of the eastern Arctic, where Pre-Dorset populations practicing a dual marine-terrestrial subsistence economy were succeeded by presumably more sedentary and marine-focused Dorset populations who spent more of the year at semi-permanent coastal occupation sites (e.g. Betts et al., 2015; Bielawski, 1988; Darwent, 2004; Maxwell, 1985; McCartney and Helmer, 1989; McGhee, 1996:117, 118; Murray, 1999).

While the distribution of Dorset and Pre-Dorset assemblages on southern Baffin Island suggests that seasonal travel between the coast and interior was practiced by at least some of the population throughout the Palaeo-Eskimo period, the precise geography of this mobility remains unknown. This is largely a result of the spatial coverage of past surveys in the study area. Archaeologists have conducted detailed surveys of both coastal and deep interior regions of southern Baffin Island. The vast landscape between these regions, however, has yet to be systematically investigated. The goals of this study are to begin linking known coastal and inland sites on southern Baffin Island using chert provenance analysis and to identify probable corridors of pedestrian travel between them using least-cost pathways. Generated pathways will serve as a predictive model for future survey in this intermediate region of the study area. Recoveries and observations made during this survey will be used to ground-truth analytic results and geographically situate the annual round of Palaeo-Eskimo hunter-gatherers on southern Baffin Island.

2. Materials and methods

2.1. Chert provenance analysis

2.1.1. Chert sources

Chert characterized for comparison to artifacts from coastal and inland sites on southern Baffin Island was taken from two sources: LbDt-1 and LdDx-2 [for a more complete description of these sites, see ten Bruggencate et al., 2015]. LbDt-1 is located on the Hone River, approximately 100 km west-northwest of Iqaluit (Fig. 1). At this site, chert is available both in primary context as nodules embedded in exposed limestone bedrock, and in secondary context, where exposed cobbles have been freed by erosion and have subsequently rolled down to form part of a shoreline gravel deposit (Fig. 2). A thick layer of chert debitage covering part of the site's upper terrace is indicative of intensive exploitation of raw materials available at this site. Twenty-seven chert samples taken from the four exposed limestone outcrops and the gravel beach at LbDt-1 were selected for analysis by ICP-AES. Samples were chosen to represent the physical properties of chert present at the site.

At LdDx-2, located on the south shore of Amadjuak Lake (Fig. 1), in situ weathering of limestone bedrock has resulted in a layer of scattered, degrading limestone boulders, nodules and fragments of chert, and limestone gravel blanketing part of the site (Fig. 3). There are up to seven tent rings present at LdDx-2, confirming human occupation. Very little of the chert present at LdDx-2 shows any sign of human modification. However, chert is available at LdDx-2 in nodules small enough to be easily transported elsewhere for reduction. As at LbDt-1, samples of chert from LdDx-2 were selected to be representative of the physical diversity of materials present on site. Nine chert samples from LdDx-2 were prepared and submitted for ICP-AES trace element analysis.

2.1.2. Archaeological sites

2.1.2.1. Seahorse Gully (IeKn-6). To determine whether 'non-local' chert could be identified by our analytic and statistical approach, we analyzed a sample of chert artifacts from a site where toolmakers most likely did not use chert from southern Baffin Island. The Seahorse Gully site is located on the Churchill West Peninsula, across the Churchill River from the town of Churchill, Manitoba on the west coast of Hudson Bay (Fig. 1). The Pre-Dorset lithic assemblage at IeKn-6 includes chert