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A genetic perspective of prehistoric hunter-gatherers in the Siberian Arctic: Mitochondrial DNA analysis of human remains from 8000 years ago

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ABSTRACT

Archaeological evidence of human occupation in Arctic Siberia dates to at least 27,000 years before present (YBP) but the population history of these early inhabitants is not fully understood. Genetic research on contemporary indigenous Siberian populations has suggested a distinct pattern between populations from south/central Siberia and the extreme northeast Siberia. However, the picture is complicated by the fluctuations of movement by various cultural groups in the last millennium that has resulted in admixture as well as genetic drift. In order to better understand the genetic history of early humans in northern Siberia, we obtained ten human skeletal remains from four areas of the eastern Siberian Arctic, stretching from the low Yana River in the west to midstream of Bol'shaya Chukoch'ya River and Kolyma River in the east, and the Zhokhov site in the New Siberian Islands. We extracted DNA from the skeletal remains ranging from around 27,000 YBP to as recent as the 18th century AD and analyzed the mitochondrial DNA (mtDNA) control region. We successfully identified five haplotypes that include haplogroups A2 and C4. The presence of haplogroup C4 in Arctic Siberia by 8000 years ago illustrates the antiquity and widespread distribution of the maternal lineage in the region. On the other hand, haplogroup A2 is frequent among contemporary northeastern Siberian populations. Overall, the results from our ancient DNA analysis suggest maternal lineages among contemporary Siberians were present as far back as 8000 years ago in the Siberian Arctic.

1. Introduction

Ecological transformation around 30,000 years ago from a boreal forest into a mammoth-steppe environment initiated the earliest arrival of hunter-gatherers in northern Siberia who mainly subsisted on large herd animals. In the Siberian Arctic, commonly referring to the area north of 66° 33′ 44″ N in latitude, human occupation has been identified as early as 27,000 ^{14}C years before present (YBP) at the Yana RHS site located at 71°N (Pitulko et al., 2004). Yana RHS has yielded a wealth of cultural artifacts including a wide variety of tools and flakes made from ivory and animal bone and faunal remains of more than a dozen different species. Evidence illustrating continuous human occupation in Siberia (subarctic and arctic) is unclear, especially during the Last Glacial Maximum (LGM, ca. 22,000–18,000 ^{14}C YBP). Scholars debate whether the larger Siberian region was repopulated with groups associated with new technologies for the Late Upper Paleolithic after 18,000 YBP (Graf, 2009). The site of Berelekh (70°N), typically known as a "mammoth cemetery," was considered the single pre-Holocene site in Arctic Western Beringia initially thought to be around 13,000 years old (Vereschagin and Mochanov, 1972; West, 1996). Recent examination of Berelekh suggested human habitation is dated to 12,100–11,800 ^{14}C YBP, which post-dates the mammoth remains (Pitulko et al., 2014a). The site of Zhokhov located in the New Siberian Islands (76°N) dates to around 8000 ^{14}C YBP and shows a distinct

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material culture that is comparable to the contemporaneous Sumnagin culture that appeared in northern and eastern Siberia after 10,000 years ago (Pitulko, 1993, 2001). As part of the Siberian mainland at the time, occupants at Zhokhov appear to have specialized in hunting of reindeer and polar bears (Pitulko, 1993; Pitulko et al., 2015a).

Contemporary Siberian Arctic populations practice varying degrees of sedentary and mobile subsistence strategies that involve hunting and domestication of reindeer (Forsyth, 1992). Native populations of eastern Siberian Arctic in the present day include the Yukaghirs, Evenks and Evens, Yakuts, and to the farthest northeast, the Chukchi. The Yukaghirs are considered one of the oldest indigenous groups in Arctic Siberia, possibly reflecting a population history associated with the Selemdzha culture that originated in the mid-Amur region around 25,000 YBP (Derevianko et al., 1998; Volodko et al., 2008). During the LGM, depopulation of northern Siberia may have resulted in eliminating preexisting genetic distinction between populations that congregated in the southern regions (Forster, 2004). Population studies suggest a re-expansion of human groups into the north after the LGM, during which Tungusic populations (Evenks and Evens) emerged and dispersed from central Siberia and introduced reindeer herding into the northern regions (Forster, 2004; Schurr et al., 2010; Simchenko, 1976). While the current distribution of indigenous populations has been influenced by sociopolitical changes since the 17th century with Russian integration, there appears to be a distinct pattern of genetic variation between northern Siberian populations in the western and eastern regions, and the Chukchi in northeast Siberia that show a closer genetic affinity to the Aleuts and Eskimos of Beringia (Crawford et al., 2010; Derenko et al., 2007; Dryomov et al., 2015; Starikovskaya et al., 1998; Volodko et al., 2008). Overall, scholars have suggested that the present genetic profiles of indigenous Siberians were largely formed during the last 10,000 years (Forster, 2004; Schurr et al., 2010).

While several studies have examined Siberian human remains from the Middle and Late Pleistocene to address questions of human evolution and origins (e.g. Fu et al., 2014; Raghavan et al., 2014), genetic analysis of post-LGM human remains to understand Arctic Siberian population history has been relatively lacking, partly due to the lack of materials that are well-preserved in the region. Genetic analysis of Neolithic skeletal remains from Siberia has elucidated interesting genetic affinities with modern populations in the region. For example, a study of two Neolithic cemeteries in the Cis-Baikal region illustrated that the earlier Neolithic group shared matrilineal affinities to Western Siberian groups while the later Cis-Baikal Neolithic group shared affinities with native populations in East Asia (Mooder et al., 2010). Also, a Neolithic skeleton (ca. 3600 YBP) excavated from the lower Kolyma River showed genetic affinities with east Siberians (Ricaut et al., 2005). To further examine genetic affinities of prehistoric populations in eastern Arctic Siberia, our study focuses on human remains dated to as early as 8000 years ago.

2. Material and methods

2.1. Sample information

Human remains analyzed in this study come from archaeological excavations and geological surveying in the northern portions of the Siberian coastal plains (Yana-Indighirka and Kolyma lowlands) and the New Siberian Islands. We obtained ten specimens that include findings from Bol'shaya Chukoch'ya River, Duvanny Yar in the downstream of Kolyma River, Buor-Yuryakh stream of low Yana River, Yana RHS site, and the Zhokhov site from the New Siberian Islands (Fig. 1, Table 1). All specimens were in good preservation condition that is typical of skeletal remains from permafrost deposits. With the exception of the specimen from Bol'shaya Chukoch'ya, all other remains predate the integration of Russians in the region. Detailed information regarding the context of each specimen follows below.

2.1.1. Zhokhov

The site at Zhokhov Island (Fig. 1) is situated beneath 76°N latitude and belongs to the New Siberian Island chain, constituting the natural boundary between the Laptev and the East Siberian Seas. Dated to 7800–8000 YBP, this is one of the northern most archaeological sites in the Arctic that harbors abundant artifacts and faunal remains including numerous microblades, pieces of hunting equipment, and wooden artifacts. Human remains were identified in portions of the excavated

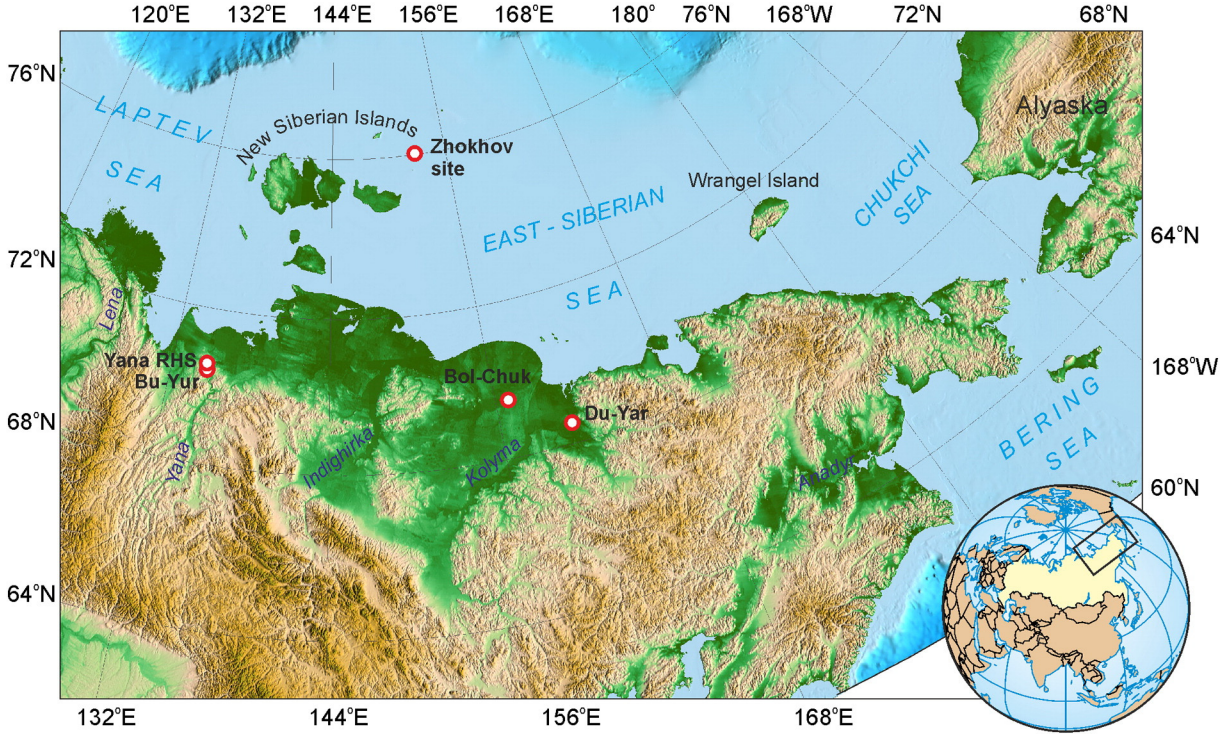

Fig. 1. Map of location from which human remains were collected: Zhokhov site, Yana RHS, Buor-Yuryakh (Bu-Yur), Bol'shaya Chukoch'ya River (Bol-Chuk), and Duvanny Yar (Du-Yar).

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