HUMAN OCCUPATION OF THE UPPER YUKON RIVER CANYON: EXPANDING THE GEOGRAPHY OF DATED COMPONENTS IN THE ALASKA-YUKON BORDERLANDS

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ABSTRACT

The upper reach of the Yukon River is a terraced riparian corridor that traverses eastern Alaska, United States, and the west-central Yukon Territory, Canada. We consolidate 62 radiocarbon dates among numerous archaeological sites and develop a model of cultural occupation of this region spanning the Chindadn through Dene Traditions (ca. 13,770–200 cal BP). We present Bayesian sum probability density plots derived from our radiocarbon dataset, report on dated components with sourced obsidian, provide new dates on Denali microlithic components, and elaborate on the White River volcanic eruptions. An assemblage of southern sourced obsidian and the introduction of copper metallurgy at the time of the eastern lobe of the White River ash suggests a possible northern displacement of people or an expanded social network following the eruption. The consolidated radiocarbon record across the broad riparian landscape of the Upper Yukon River Canyon expands the spatial extent of dated cultural components in Alaska and the Yukon Territory.

INTRODUCTION

The Yukon River basin is the central geographic feature traversing Alaska and the Yukon Territory. This geographic region also forms the westernmost extent of the subarctic Athabascan (Dene) culture area as it existed prior to modern European contact and is home to nine major Dene language groups (Krauss 1982; VanStone 1974; VanStone and Goddard 1981). The Yukon River basin extends 3200 km, from headwaters on the lee side of the Cordilleran Range to its outlet at the Bering Sea, encompassing an area of 832,700 km^2 (Brabets et al. 2000). Above the headwater region are glacially scoured valleys transecting the coastal mountains where strategic trade routes existed between the peoples of the Interior Alaska river basins and peoples along the Southeast Alaska panhandle and coastal British Columbia by middle to Late Holocene times, and probably earlier.

Despite the Yukon River being a dominant geographic feature, an established locus of past human settlement, and an obvious travel corridor, the main stem of the Yukon has received surprisingly little archaeological investigation compared to its primary tributary, the Tanana River (Cook 1969; Dixon 1985; Goebel et al. 1991; Graf et al. 2015; Hoffecker 2001; Holmes 2001, 2011; Holmes et al. 2022; Potter 2008a, 2008b; Potter et al. 2014) and adjacent parts of west-central Yukon Territory between the Yukon and Tanana Rivers (Easton et al. 2011; Easton et al. 2018; Hefner 2002). The comparatively low intensity of field research on the main channel of the Yukon River has resulted in a void in the archaeological record of this major waterway. Here, we report on a sequence of radiocarbon-dated components in the upper reach of the Yukon River basin along a ca. 450 km riparian corridor that we designate the Upper Yukon River Canyon (UYRC). We believe this reach of the Yukon River was an important riparian landscape for social interaction among Indigenous peoples since the arrival of people in the New World.

The study area covers a riparian corridor, approximately bounded by modern Dawson City, Yukon Territory, and the village of Circle, Alaska (Fig. 1). Our dataset is consolidated primarily from unpublished studies archived in agency repositories of the National Park Service, Yukon Heritage Branch of Parks Canada, and Tanana Chiefs Conference (a regional Alaska Native tribal organization). Some of these data were collected from sites on Indigenous-owned lands or through consultations with First Nation and Alaska Native tribal governments. Emphasis is given to radiocarbon assays from buried components at multiple stratified sites. These dated components draw attention to an archaeologically important region in North America

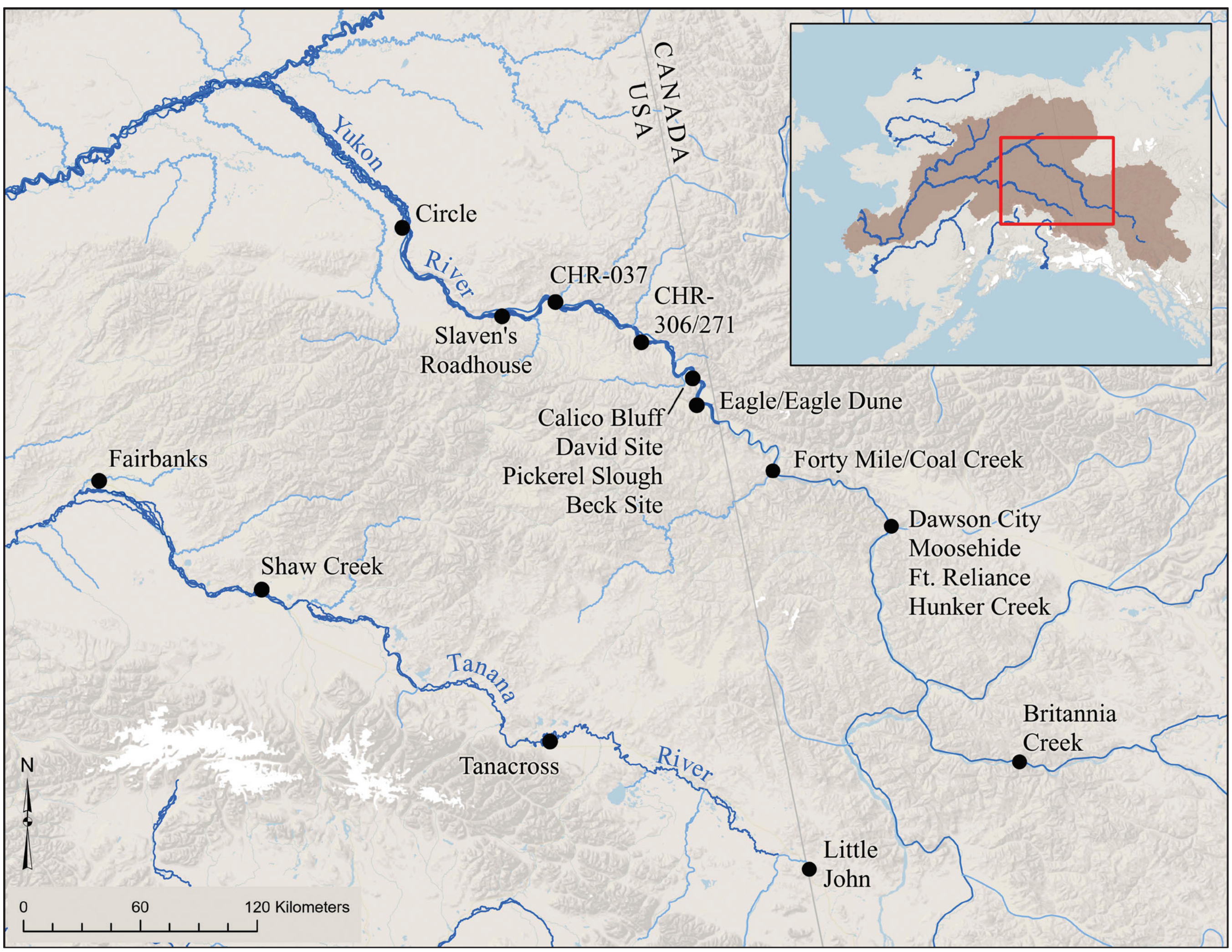

Figure 1. Upper Yukon River Canyon study area with geographic place names mentioned in text and location in the Yukon River basin (brown polygon in inset map). Graphic designed by Martin Bryne of National Park Service, Alaska.

with broad-ranging, underdeveloped research potential. A thorough review of the lithic assemblages among the dated components is beyond the scope of this paper, but the chronological ordering of components presented here will guide further analysis on similarly dated assemblages in the study area. For background, a geomorphological summary of the region is followed by a synthesis of ethnography and archaeology to contextualize the ensuing presentation of radiocarbon data.

A long-standing research interest regarding the archaeology of the Yukon River headwaters is the question about possible diffusion of microblade technology between Interior Alaska and the Pacific Coast during the early Holocene (Carlson 1983, 1998, 2008a, 2008b; Magne and Fedje 2007). We present dated microblade components located along the most likely route for the early Holocene movement of microlithic technology into the Southeast Alaska panhandle (cf. Gomez-Coutouly 2013). A factor in understanding the spread of microblade technology is through dated types of obsidian, and we expand on obsidian sourcing. The pattern of sourced obsidian toolstone in the headwaters of the Yukon River basin (including the Tanana River tributary) strengthens the hypothesis of long-term overland connections with geographic regions proximal to Southeast Alaska and the Pacific Coast.

In the late Holocene, large-scale volcanic activity in the headwater region of the Yukon River caused ecological effects that influenced human displacement within the trajectory of the White River ash plumes. Hypotheses have been advanced on a wide scale of ecological consequences of ash deposits, effects on human populations, their social networks, and replacement of weapon technologies (Grund and Huzurbazar 2018; Hare et al. 2012; Ives 1990, 2003; Kristensen et al. 2019, 2020; Mullen 2012; Rainville 2016; Workman 1979). Alternative analysis suggests demographic and resource factors influenced cultural development preceding the White River eruptions and ecological forcing associated with the volcanic events had minor effects on endemic peoples within ecological and social spheres of the ash plumes (Doering et al. 2020). In this paper, we link the timing of the White River ash eastern (WRAe) lobe to a dated cultural component with a novel artifact assemblage at Calico Bluff that sheds a different light on the debate. We recognize an expansion of copper metallurgy with two southern sources of obsidian along a downstream (northward) trajectory at the time of the WRAe eruption.

GEOGRAPHIC AND ETHNOGRAPHIC OVERVIEW OF THE YUKON RIVER BASIN

The Yukon River drains the fourth-largest freshwater river basin in North America and ranks fifth in the continent by annual discharge (Schumm and Winkley 1994). The southwest-southeast arcuate orientation of the Yukon River course is bordered by the Brooks Range to the north and the Alaska Range to the south and supports 20 ecoregions, ranging from alluvial floodplains to glaciated alpine terrain (Brabets et al. 2000:36–46). The Yukon River basin is largely forested and represents the northwest extent of the vast taiga biome that covers the northern North American continent. Vegetation cover throughout the Yukon River basin consists of mixed spruce forest with paper birch, cottonwood, and aspen arboreal cover, with willow, alder, and birch shrublands (Brabets et al. 2000:25–27).

Topographic Settings and Geological Contexts for Human Occupation

The geographic and topographic setting of the UYRC is characterized by paired and unpaired relict terraces along valley slopes and in the forested floodplain where mid-channel islands and gravel bars are common. The highly varied landscape includes uplifted fluvial terraces formed during the Pliocene and early to middle Pleistocene (Froese 2001; Froese et al. 2001), late Pleistocene terraces (Duk-Rodkin 1999; Sattler and Mills 2002; Thorson 1982), and Holocene floodplain deposits (Buvit and Rasic 2011; Buvit et al. 2015; Livingston et al. 2009; Mason 1993; Sattler et al. 2015; Urban et al. 2016). The varied morphology of relict terrains within the canyon and the surrounding hills provided diverse habitats for human habitation. The floodplain environs provide complementary topographic contexts, driven by a heavy suspended load in the Yukon River, creating overbank and loess deposits within the riparian zone.

Despite the diversity of extensive postglacial terrain features and depositional environments, multicomponent archaeological sites are underrepresented in the UYRC. The most extensively tested multicomponent site is the David site at the base of Calico Bluff, a prominent escarpment in the central portion of the UYRC. Bands of argillite near the base of the bluff provided a source of quarried Calico argillite toolstone for lithic production over millennia. The David site components include disproportionate quantities of the locally quarried argillite toolstone among lithic sources (97%, *n* = 11,430; Fik 2014).

Numerous archaeological sites are located around Calico Bluff, and those included in this paper are the David site, Pickeral Slough, and the Beck site.

The postglacial alluvial history of the UYRC is emerging as more geological and archaeological data becomes available on radiocarbon-dated cultural components, channel gravels, sand sheet deposits, eolian loess, and overbank deposits. Immediately preceding the earliest dated cultural components in the study area are dated remains of late glacial fauna in stratified geological contexts (Table 1). For example, in the central portion of the UYRC, the remains of *Bison* sp. embedded in late glacial channel gravels demonstrate a terminal phase of postglacial alluviation around 14,325–14,125 cal BP (Sattler and Mills 2002). Other faunal elements are dated at Britannia Creek, Dawson City, and Eagle. In the geological record, Froese et al. (2005:396) identified facies of channel alluvium ranging between ca. 12,000–13,500 cal BP below fine-grained overbank and eolian deposits that suggest vertical stability of the Yukon River around that time. Sand sheets formed along the margins of the floodplain between ca. 9800–12,000 cal BP, and small cliff-head dune fields formed on terraces adjacent to the Yukon River channel through the Holocene. These depositional environments provide high-probability locales for deeply buried, multicomponent archaeological sites.

Fluvial deposits in the riparian zone indicate a high river stand during the early Holocene. The most prominent river terrace of early Holocene age is elevated ca. 6–7 m above the ordinary high-water mark on the upstream side of Calico Bluff. The terrace is lateral to the modern channel but was a midchannel bar during the early Holocene. This relict terrace is constructed of massive silt deposits below a disconformity with overbank sediments that yielded an OSL age of 10,390 ± 1650 (USS-1171) approximately 50 cm below the disconformity. An overlying radiocarbon age of 8770 cal BP on charcoal at the disconformity is associated with the initial cultural occupation in the postglacial riparian zone. This sedimentary record suggests a peak in postglacial discharge around 9000 years ago during the early Holocene thermal maximum.

Late Holocene Volcanism Influences in the UYRC

Regional volcanism during the past two millennia affected the UYRC with air-fallen ash and sediment loading from runoff and erosion following the eruptions. Two major events are sourced to the Mount Churchill volcanic field approximately 300 km south of the central region of the UYRC (Fig. 2). The earlier eruption blanketed the UYRC with a relatively light tephra deposit between ca. 1800–1625 cal BP and is referenced in the literature as the northern lobe of the White River volcanic ash (WRAn) (Davies

Table 1. Radiocarbon dates on faunal remains in the Upper Yukon River Canyon.

Lab No.	Site	C^{14} Age	Cal BP	Median	C^{13}/C^{12}	Taxa	Material	Reference
WK-32828	Dawson City (LaVk-34)	9064±41	10,170–10,290	10,220	n/a	*Cervis elaphus*	CO*	Burkmar and Kristensen, n.d.
UOC-14665	Britannia Creek (KfVi-3)	9541±69	11,080–10,500	10,700	n/a	n/a	CO	Thomas, unpublished
Beta-258419	Eagle (EAG-335)	10,900±70	13,030–12,730	12,820	–19.9	*Alces alces*	CO	Rasic, unpublished
Beta-367211	Britannia Creek (KfVi-3)	11,010±50	13,090–12,780	12,940	–19.6	*Ovis* sp.	CB**	Altamira 2014
Beta-147161	Eagle (EAG-335)	11,660±60	13,740–13,350	13,520	n/a	*Canis lupus*	CO	Sattler and Mills 2002
UCIAMS-154425	Britannia Creek (KfVi-3)	12,135±40	14,130–13,810	14,040	n/a	n/a	CO	Thomas, unpublished
UOC-14667	Britannia Creek (KfVi-3)	12,173±51	14,310–13,860	14,080	n/a	n/a	CO	Thomas, unpublished
Beta-128757	Eagle (EAG-070)	12,270±50	14,050–14,810	14,200	n/a	*Bison* sp.	CO	Sattler and Mills 2002
UOC-14670	Britannia Creek (KfVi-3)	12,267±52	16,280–15,890	16,090	n/a	n/a	CO	Thomas, unpublished

* CO: bone collagen

** CB: cremated bone

Note: UOC-14665 at Britannia Creek may be associated with a Denali component, but bone was collected out of context.

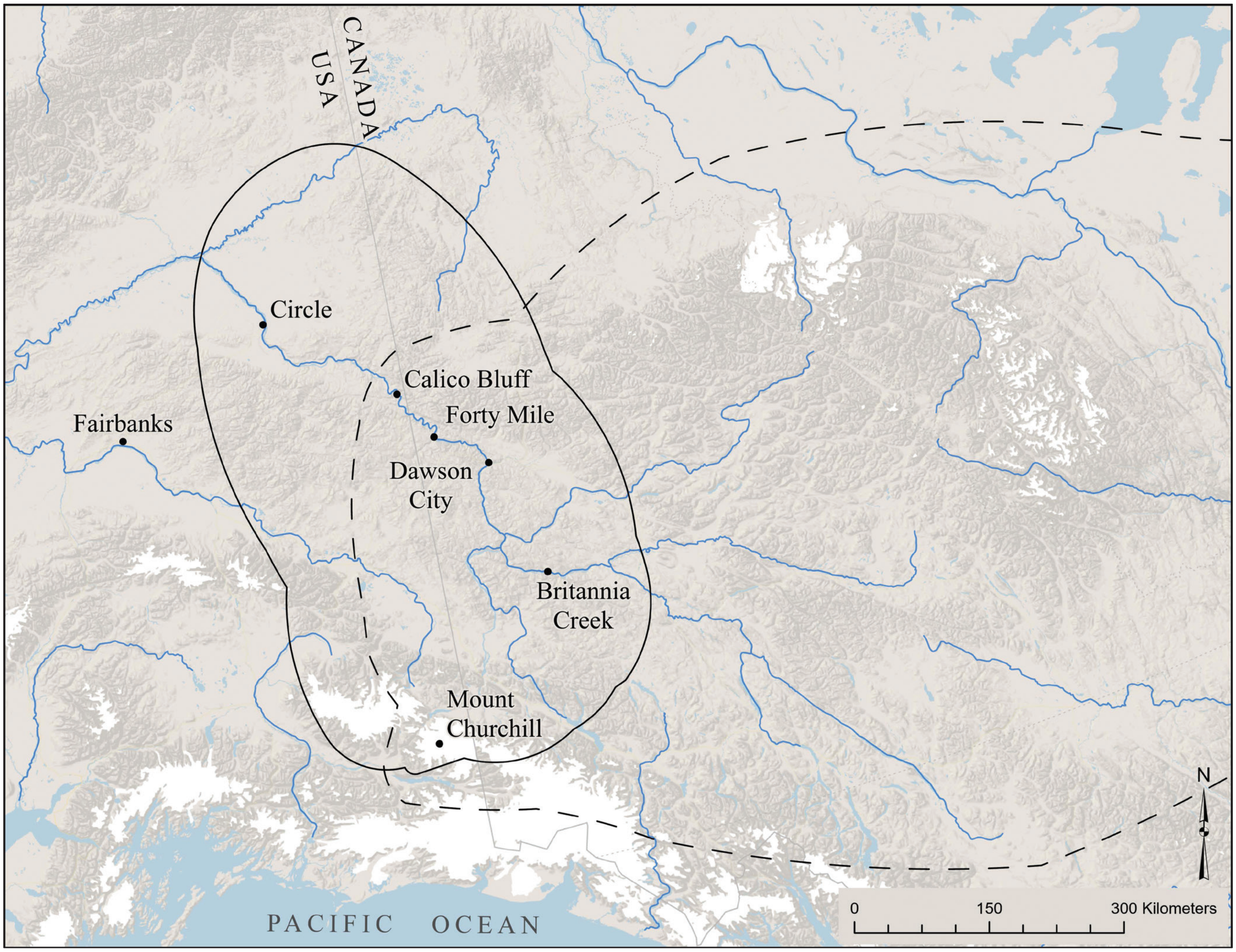

Figure 2. Spatial extent of the White River tephras. The WRAn is shown in the solid line and WRAe is shown in the dashed line. Spatial data from Mulliken et al. (2018). Figure produced by Martin Byrne of the National Park Service, Alaska.

et al. 2016; Lerbekmo et al. 1975; Reuther et. al 2020). A much larger second eruption, the White River eastern lobe (WRAe), occurred a few centuries later (1104–1102 cal BP; Jenson et al. 2014) and resulted in a substantially heavier lobe of air-fall ash and sediment loading upstream of the UYRC. The two eruptions deposited massive quantities of volcanic material across the headwater region of the Yukon River proximal to Mount Churchill, and the tephra deposits settled differentially across the UYRC study area (see Mullen 2012).

ETHNOGRAPHY AND HUMAN HISTORY OF THE UYRC

The UYRC is the traditional territory of the Hän Hwëch'in Athapascans, literally translating as "River People" (Mishler and Simeone 2004). The relatively abundant natural resources in the UYRC led noted Hän ethnographer Cornelius Osgood to conclude that the area provided the most diverse biota for human habitation in the surrounding 250,000 square miles (Osgood 1971:70). At the time of Western contact, multiple bands of Hän people occupied summer and winter camps in the UYRC, its tributaries, and their portages (Crow and Obley 1981; Mishler and Simeone 2004; Osgood 1971). The Hän were known as trading middlemen between their southern neighbors (Tutchone, Tagish, and coastal Tlingit), the Dene people farther downstream along the Yukon River, and Dene people across the Yukon-Tanana uplands in the Tanana River valley (Murray 1910). Ethnohistoric accounts identify multiple overland trails that were used for travel and trade across the Cordilleran coastal range (Kristensen et al. 2019; Mooney et al. 2012). The routes were largely controlled by coastal Tlingit who resided along the Southeast Alaska coast (Emmons 1991; Glave 2013; Johnson 2009;

McClellan 1975; Mooney et al. 2012; Neufeld and Norris 1996:22–48). Cruikshank (2005) documents cultural knowledge held by Athapascan and Tlingit peoples of these montane, often glaciated, overland trading passes.

Hammer (2001) reported a disproportionate number of undated surface lithic scatters found on deflated terrain features that dominate the archaeological record of the UYRC. Because there are so few dated components in the study area, the culture history of the UYRC has often been tenuously inferred from typological comparisons to regional constructs in adjacent areas of Interior Alaska and the Yukon Territory (Hare et al. 2008). This study is the initial attempt to consolidate dated components among numerous sites in the borderlands of the Yukon River. A large portion of the study area is within the Yukon-Charley Rivers National Preserve, in which over 600 historic and precontact heritage sites are identified, but with very few dated components (Holloway 2020). Faunal and organic preservation is poor, given that the majority of these sites occur in shallowly buried upland contexts, and as a result little information is available about diet, subsistence, or organic technology. Flaked stone lithic artifacts of Calico argillite are the most common class of preserved material culture, which includes early-stage reduction debitage, shaped bifacial and unifacial forms, and, less frequently, microlithic technology. The number of formal tools is low, and an even smaller number of diagnostic forms have been documented. Consequently, our synthesis of available radiocarbon-dated occupations provides a temporal ordering of components that will guide further analysis to integrate the UYRC data with published cultural sequences in adjacent areas of Interior Alaska and the Yukon Territory (Dixon 1985; Easton et al. 2018; Hare 1995; Hefner 2002; Holmes 2009; Holmes et al. 2022; Workman 1978).

METHODS

Our analysis is based on the existing dataset of radiocarbon assays generated by multiple researchers working independently over several decades. The series of 62 dates on archaeological components was collated from a few published sources and a greater number of previously unreported dates in unpublished government agency technical documents. The dataset is calibrated at the 94.5% (2 sigma) confidence interval based on conventional ages using Oxcal version 4.4 and the InterCAL20 calibration curve and presented in cal BP (Millard 2014; Ramsey 2009; Reimer et al. 2020). The calibrated radiocarbon dataset was input into a probability density function using the *Sum* command in Oxcal (Ramsey 2009, 2017). The youngest date (Table 1, Ref 1) was a poor fit and rejected in the modeling process. Consequently, 61 radiocarbon dates form the basis of the probability density plots.

All but one of the summed probability plots of the date series are derived on unmodeled radiocarbon date calibrations rounded to 10 years after calibration. The modeled probability plot is a kernel density plot of Late Holocene components and is a curve-smoothing function of the Oxcal output (Ramsey 2017). The *Sum* function in OxCal sums the probabilities of individual radiocarbon age probability distributions into a Bayesian probability density function across the spectrum of similar age ranges. The probability density plots provide a visualization of similarly dated components across the study area. The relative peaks in the sum plots are age ranges of a larger number of radiocarbon dates at the same calendar age range. We use the term *component* to designate an occupation with an associated radiocarbon date from a discrete site or a dated occupation at a site with nonoverlapping probability distributions and vertical stratigraphic separation. Most components are dated by single radiocarbon assays, but multiple overlapping dates from the David site and Britannia Creek are treated as single components.

Overlapping probability distributions of single dates from different sites coalesce to form multiple plots with probability ranges, peaks, and temporal gaps across the calibrated range. Generally, a density plot with temporal gaps on either side reflects the summed probability of (1) a radiocarbon date of a single component at one site, (2) multiple overlapping dates within a component at one site, or (3) overlapping probability distributions of multiple dated components among multiple sites. The variations (peaks and troughs) in the probability density plots are not demographic proxies (population size) but are a reflection of sample size and noise in the calibration process. The emphasis of our dataset is along the horizontal axis of the density plots that show the combined sum probability of 61 available dates. Probability density plots are labeled alphabetically and referenced throughout the paper. Table 2 lists all radiocarbon dates input to the probability plots. Bayesian probability density analysis is becoming common in the treatment of archaeological radiocarbon data (Hamilton and Krus 2018; Price et al. 2021; Williams 2012) and in Alaska and the Yukon (Anderson et al. 2019; Grund and Huzurbazar 2018; Ledger et al. 2018; Reuther et al. 2020).

Table 2. Radiocarbon ages from archaeological sites in the Upper Yukon River Canyon.

Ref	Lab No.	Site (Locus)	Site #	C^{14} Age	Cal BP	Median	C^{13}/C^{12}	Material	Reference
1	Beta-367209	Britannia Creek	KfVi-3	70±30	n/a	n/a	–16.6	CB	Altamira 2014
2-A	Beta-136368	Tr'ochek (Dawson)	LaVk-10	220±70	n/a	210	—	C	Thomas, unpublished
3-A	S-1319	Moosehide	LaVk-2	220±60	n/a	200	—	CB	Hunston 1978
4-A	Beta-162899	Forty Mile	LcVn-2	310±40	480–290	390	—	C	Thomas, unpublished
5-A	Beta-162898	Forty Mile	LcVn-2	520±40	630–490	540	—	C	Thomas, unpublished
6-A	Beta-288585	Yukon-Charley	CHR-306	520±40	630–490	540	—	—	Rasic, unpublished
7-A	WK-32837	Forty Mile	LcVn-2	592±25	650–540	600	—	C	Thomas, unpublished
8-A	Beta-371371	Pickerel Slough	EAG-309	860±30	900–680	760	–25.0	C	this study
9-A	Beta-178732	David (Dog Yard)	EAG-288	900±50	930–690	810	–25.0	C	this study
10-A	Beta-240240	Yukon Charley	CHR-271	900±40	920–730	810	—	—	Rasic, unpublished
11-A	Beta-240239	Yukon-Charley	CHR-037	940±40	930–740	850	—	—	Rasic, unpublished
12-A	UOC-5647	Forty Mile	LcVn-2	1119±24	1070–950	1010	—	C	Smith 2020
13-A	Beta-331855	David (Greenhouse)	EAG-288	1120±30	1180–950	1010	–23.7	C	this study
14-A	Beta-372307	Britannia Creek	KfVi-3	1190±30	1250–990	1110	—	CO	Altamira 2014
15-A	Beta-216697	Beck site	EAG-287	1300±40	1300–1120	1230	—	C	this study
16-A	Beta-167229	Beck site	EAG-287	1350±60	1370–1120	1260	–25.0	C	this study
17-A	Beta-372308	Britannia Creek	KfVi-3	1360±30	1350–1170	1290	—	CB	Altamira 2014
18-A	S-1003	Moosehide	LaVk-2	1405±60	1410–1170	1320	—	—	Hunston 1978
19-A	Beta-366149	Forty Mile	LcVn-2	1590±30	1540–1400	1470	—	C	Smith 2020
20-A	S-3436	Fort Reliance	LaVk-14	1630±70	1700–1360	1510	—	C	Clark 1995
21-A	Beta-167228	Beck site	EAG-287	1660±60	1700–1400	1540	–25.0	C	this study
22-A	UOC-6203	Forty Mile	LcVn-2	1724±26	1700–1540	1610	—	C	Smith 2020
23-A	Beta-294681	Eagle Dune (B)	EAG-742	1790±30	1750–1590	1660	–26.1	C	this study
24-A	UOC-5645	Forty Mile	LcVn-2	1801±25	1750–1610	1700	—	CO	Smith 2020
25-A	Beta-366146	Coal Creek	LcVn-15	1830±30	1830–1630	1730	—	—	Thomas, unpublished
26-B	Beta-305587	David (Dog Yard)	EAG-288	2070±30	2120–1940	2030	–24.4	CW	this study
27-B	UGAMS-61300	Eagle Dune (E)	EAG-742	2190±25	2310–2120	2240	–26.7	C	this study
28-B	Beta-185977	Forty Mile	LcVn-2	2230±40	2340–2120	2230	–23.4	C	Smith 2020
29-B	UOC-5650	Forty Mile	LcVn-2	2262±23	2350–2150	2230	—	C	Smith 2020
30-B	Beta-185976	Forty Mile	LcVn-2	2330±40	2490–2160	2350	–26.3	C	Smith 2020
31-B	UOC-14647	Britannia Creek	KfVi-3	2421±28	2700–2350	2450	—	C	Thomas, unpublished
32-B	Beta-237882	David (Archaic)	EAG-288	2580±40	2770–2490	2720	–25.7	CB	this study

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Table 2 (cont.)

Ref	Lab No.	Site (Locus)	Site #	C^{14} Age	Cal BP	Median	C^{13}/C^{12}	Material	Reference
33-B	Wk-30243	Tr'ochek (Dawson)	LaVk-34	2664±26	2850–2740	2770	—	C	Burkmar and Kristensen, n.d.
34-C	UOC-14650	Britannia Creek	KfVi-3	3516±33	3890–3690	3780	—	C	Thomas, unpublished
35-C	Beta-305590	Eagle Dune (C)	EAG-742	3700±30	4150–3920	4040	–25.3	C	this study
36-D	Beta-258420	Slaven's Cabin	CHR-030	3970±40	4530–4290	4440	–25.6	W	Buvit and Rasic 2011
37-D	Beta-258421	Slaven's Cabin	CHR-030	4060±40	4800–4420	4550	–23.9	W	Rasic and Buvit 2011
38-D	Beta-372306	Britannia Creek	KfVi-3	4220±30	4860–4620	4740	—	—	Altamira 2014
39-D	Beta-372309	Britannia Creek	KfVi-3	4180±30	4840–4580	4720	—	—	Altamira 2014
40-E	Beta-305589	David (Dog Yard)	EAG-288	4750±40	5590–5320	5510	–25.3	C	this study
41-F	Beta-305588	David (Dog Yard)	EAG-288	5110±40	5940–5740	5820	–24.3	C	this study
42-F	Beta-85289	David (Archaic)	EAG-288	5220±90	6270–5740	6000	—	C	this study
43-F	Beta-237881	David (Archaic)	EAG-288	5620±50	6500–6290	6400	–25.2	C	this study
44-F	S-1002	Moosehide	LaVk-2	5625±80	6630–6280	6410	—	—	Hunston 1978
45-F	Beta-230276	David (Archaic)	EAG-288	5740±40	6650–6410	6540	–24.5	C	this study
46-F	Beta-167230	David (Archaic)	EAG-288	5760±80	6750–6350	6560	–25.0	C	this study
47-F	Beta-230278	David (Archaic)	EAG-288	5950±40	6890–6670	6780	–24.9	C	this study
48-G	UOC-1221	Britannia Creek	KfVi-3	6837±51	7790–7580	7670	—	—	Thomas, unpublished
49-G	Beta-331856	David (Dog Yard)	EAG-288	6680±40	7620–7430	7540	–24.8	C	this study
50-H	Beta-332692	David (Archaic)	EAG-288	7490±40	8380–8190	8300	–25.7	C	this study
51-I	Beta-371370	David (Dog Yard)	EAG-288	7930±40	8990–8600	8770	–24.8	C	this study
52-I	TO-1936	Moosehide	LaVk-2	8050±100	9270–8600	8910	—	—	Hunston 1978
53-J	Beta-367213	Britannia Creek	KfVi-3	10,870±50	12,890–12,730	12,790	–18.8	CB	Altamira 2014
54-J	Beta-367210	Britannia Creek	KfVi-3	10,920±50	12,970–12,740	12,820	–19.5	CB	Altamira 2014
55-J	Beta-367208	Britannia Creek	KfVi-3	10,950±50	13,060–12,750	12,860	–20.2	CB	Altamira 2014
56-J	Beta-367212	Britannia Creek	KfVi-3	11,060±50	13,100–12,840	12,990	–19.2	CB	Altamira 2014
57-J	Beta-275121	Hunker Creek	n/a	11,350±110	13,460–13,090	13,240	—	CB	Harington and Morlan 1992

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Table 2 (cont.)

Ref	Lab No.	Site (Locus)	Site #	C^{14} Age	Cal BP	Median	C^{13}/C^{12}	Material	Reference
58-J	Beta-367207	Britannia Creek	KfVi-3	11,350±50	13,330–13,120	13,230	–19.4	CB	Altamira 2014
59-J	UOC-1234	Britannia Creek	KfVi-3	11,506±67	13,590–13,300	13,420	—	CO	Thomas, unpublished
60-J	UOC-1232	Britannia Creek	KfVi-3	11,515±60	13,500–13,240	13,390	—	CO	Thomas, unpublished
61-J	UOC-1235	Britannia Creek	KfVi-3	11,621±74	13,610–13,310	13,480	—	CO	Thomas, unpublished
62-J	UOC-1233	Britannia Creek	KfVi-3	11,694±81	13,770–13,360	13,550	—	CO	Thomas, unpublished

Note: All dates are conventional ages and calibrated to 95% with IntCal20 calibration curve and 10-year rounding after calibration, OxCal version 4.4 (Ramsey 2009; Reimer et al. 2020). Ref column identifies each date referenced in text and their assignment to specific probability density plots. Date Ref 1 is excluded from the probability density analysis. Britannia Creek fauna: 1 is caribou (*Rangifer tarandus*, right tibia), 53-J is wolf (*Canis lupus*, tooth), 60-J is bear (*Ursus* sp.), 62-J is moose or bear. Hunker Creek Punch, 57-J is caribou (*Rangifer tarandus*, antler). David site fauna 41-F is moose (*Alces alces*, mandible).

CW: charred wood; C: charcoal; CB: cremated bone; CO: bone collagen; W: wood

Letters with Eagle Dune and names with David site refer to loci.

The probability density plots are classified into three periods using Interior Alaska cultural traditions defined by Holmes et al. (2022): Chindadn (ca. 13,500–12,000 cal BP), Denali (ca. 12,000–6000 cal BP, Northern Archaic (ca. 6000–1300 cal BP), and Dene (ca. 1300–250 cal BP). For this study, temporal groups include Chindadn (CDND), Denali-Early Northern Archaic (DENA), and Late Northern Archaic-Dene (LNAD). The groups are differentiated based on temporal gaps in the radiocarbon record in the dataset and geological contexts in the UYRC. For example, the CDND period precedes DENA components by several millennia and stands alone in the radiocarbon record. The DENA components are grouped together based on geological contexts bracketed by the early Holocene terrace-building phase that terminated around 9000 cal BP to a late Holocene period of river stabilization around 3000 cal BP. The LNAD group is defined by a phase of overbank accretion in the riparian floodplain of the UYRC beginning just after 3000 cal BP that created ca. 2–3 m high terraces bordering the modern channel of the Yukon River. Similar terracing is recorded upstream of the UYRC along headwater tributaries (Fuller 1986).

The geochemical analysis of obsidian identified in the UYRC is consolidated from the Alaska Obsidian Database (AOD), largely developed over the past two decades by one of us (Jeff Rasic) with the National Park Service and colleagues at the University of Alaska Museum of the North. Nondestructive X-ray fluorescence (XRF) analyses were conducted primarily at the National Park Service Fairbanks Administrative Center using a portable Bruker Tracer III-V portable XRF analyzer equipped with a rhodium tube and a SiPIN detector with a resolution of ca. 170 eVFHWM for 5.9 keV X-rays (at 1000 counts per second) in an area of 7 mm^2. Methods followed those described by Philips and Speakman (2009). Analyses were conducted at 40 keV, 15 µA, using a 0.076-mm copper filter and 0.0305 aluminum filter in the X-ray path for a 200 second live-time count. Ten elements were measured: potassium (K), manganese (Mn), iron (Fe), gallium (Ga), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Peak intensities for measured elements were calculated as ratios to the Compton peak of rhodium, converted to elemental concentrations using linear regressions derived from analysis of 15 well-characterized obsidian samples analyzed by NAA and/or XRF (Glascock 2011) and are reported in parts per million (ppm). Source assignments were made by comparing the composition of analyzed samples to a catalog of nearly 100 geochemical signatures tracked in the AOD, which are derived from geological source samples and archaeological specimens from locations across northwestern North America (Alaska, Yukon, and northern and central British Columbia) and the Russian Far East (Chukotka and Kamchatka) (Cook 1995; Rasic et al. 2016; Reuther et al. 2011; Schmuck et al. 2022). Correlations between artifacts and source signatures are considered meaningful when key elements fall within two standard deviations of mean source values (Hughes 1998).

RESULTS

RADIOCARBON DATING IN THE UYRC

The radiocarbon dataset differentiates into 10 discrete probability density plots (Fig. 3). The temporal separation is structured by a relatively large number of dates in the past three millennia with one possible temporal gap of more than a century, and a relatively small number of radiocarbon dates among fewer components with multiple temporal gaps of longer duration. The pool of 61 dates represents approximately 40 components at 19 discrete sites (or localities within larger sites). Just over half of the radiocarbon dates (*n* = 32) span the past 2850 calendar years and are draw from 15 discrete sites representing 25 components. The older series of radiocarbon dates (*n* = 19) are broadly spread out over the preceding 10 millennia and are drawn from six sites representing 12 components that range between 3690 and 13,770 cal BP. The three broad periods of dated components and their probability density plots are detailed here.

Chindadn (CDND) Period, ca. 13,770–12,730 cal BP)
Radiocarbon dates from two sites define the CDND period, both of which are in the west-central Yukon Territory and the most southern range of the study area (Fig. 4, Plot J; Table 2:53–62). These include nine dates from Britannia Creek and one from the Dawson City area (*n* = 10). All dates are based on bone collagen and include the basal occupation at Britannia Creek (single component) and a date on a caribou antler tool found in a placer mine in the Dawson Creek gold fields during the 1970s, named the Hunker Creek punch (Harington and Morlan 1992). The antler tool yielded an AMS date of 11,350±110 (13,460–13,090 cal BP; Table 2:57) and falls within the probability density range of the Britannia Creek series. The Chindadn period dates in the UYRC are similar to dated occupations at Little John site in west-central Yukon Territory near the headwaters of the Tanana River (Easton et al. 2016, 2018).

Five additional dates from Britannia Creek are excluded from the probability density analysis (Table 1). Four of the excluded dates are older than the archaeological component and unassociated with cultural contexts. The other date falls within the age range of the Denali Tradition, but the bone sample was collected out of stratigraphic context and rejected. The pre-Chindadn faunal remains at Britannia Creek are a natural assemblage that includes mountain sheep (*Ovis canadensis*), wolf (*Canis lupus*), and caribou (*Rangifer* sp.). This faunal assemblage contrasts with the bison- and wapiti-dominated faunas at the Shaw Creek region of the Tanana River and the Little John site (Potter et al. 2014; Yesner et al. 2011). However, remains of caribou and mountain sheep at Britannia Creek are in agreement with the highest frequency of large mammals in the southern Yukon, subalpine ice-patch fields (Farnell et al. 2004; Hare et al. 2012).

The Britannia Creek component has yielded mainly debitage but includes one diagnostic shaped biface (Altimira 2014; Thomas et al. 2016). The fragmented biface is a thin triangular form and compares typologically with the Chindadn bifaces in the Tanana River valley and the Little John site (Easton and Mackay 2008). Tanana River valley sites with Chindadn forms include Healy Lake sites (Cook 1969, 1996; Sattler et al. 2011; Younie and Gillispie 2016), the Shaw Creek Flats sites (Holmes 2011; Holmes et al. 2022; Potter et al. 2014), and the Nenana Complex sites (Goebel et al. 1991; Graf et al. 2015).

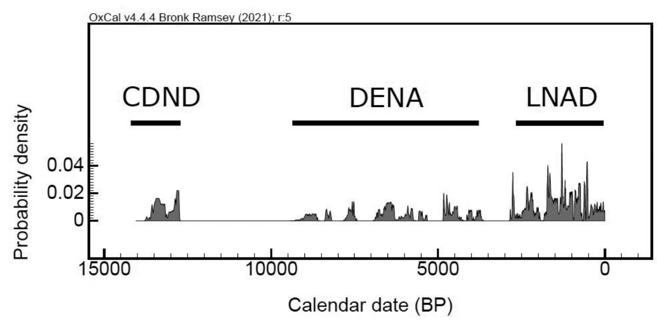

Figure 3. Sum probability plots for the UYRC radiocarbon dataset. CDND is Chindadn period, DENA is Denali-Early Northern Archaic period, and LNAD is Late Northern Archaic-Dene period.

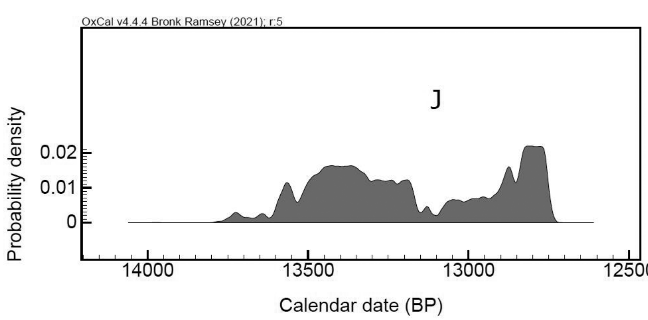

Figure 4. Probability density plot of the Chindadn period. (See Table 2 for J series radiocarbon dates.)

Denali-Early Northern Archaic (DENA) Period, ca. 9270–3690 cal BP

A temporal gap of five millennia separates the earliest dated occupation of the Chindadn period from the DENA period. DENA period consists of 19 radiocarbon assays from six sites representing 12 components across a wide portion of our study area (Table 2:34–52). This period features seven discrete probability densities among the radiocarbon dataset (Fig. 5). The labeled plots with number of dates in each probability density plot includes C (n = 2), D (n = 4), E (n = 1), F (n = 7), G (n = 2), H (n = 1), and I (n = 2). Notably, the next younger component following the Chindadn period is a Denali microblade assemblage in the basal occupation at the David site (8600–8990 cal BP, Table 2:51, Fig. 5, Plot I). A second, slightly younger Denali component at the David site is dated to 8190–8380 cal BP (Table 2:50, Fig. 5, Plot H). Within the same temporal range of the earliest dated microblade components at the David site is a nonmicroblade assemblage at Moosehide dated to 8600–9270 cal BP (Table 2:52; Fig. 5, Plot I). The next younger components in the DENA period includes an assay of 7430–7620 cal BP (Table 2:49) on a nonmicroblade assemblage at the David site and a date of 7580–7790 cal BP (Table 2:48) at Britannia Creek. Plot G is the probability density of the overlapping probability distributions of these two components.

The microblade technology reported here conforms to the temporal range of the Denali Tradition of central Alaska (Dixon 1985; Holmes et al. 2022; Mason et al. 2001; West 1967, 1996) and is coeval with the Little Arm Phase of the earliest dated microblade sites in the Yukon Territory (Clark and Gotthardt 1999; Hare and Hammer 1997; Workman 1978). Though the microblade components at the David site have not produced cores, Denali microblade cores are dated to a slightly younger temporal range at Moosehide (6280–6630 cal BP, Table 2:44; Fig. 5, Plot F) (Hunston 1978:37).

The Denali component at Moosehide (a single radiocarbon date) falls within the range of a millennial period of occupation at the David site estimated by six radiocarbon dates (Table 2:41–47; Fig. 5, Plot F). The middle Holocene record at David spans ca. 1150 calendar years ranging between 5740 and 6890 cal BP and consists of two components (see below) that plot as a bimodal probability density. The probability density peak in plot F is around 6300 cal BP and falls around the time of the transitions between the Denali and Northern Archaic Traditions (Holmes et al. 2022). Rare faunal remains of moose (*Alces*) are associated with this middle Holocene occupation at the David site (5940–5740 cal BP, Table 2:41). A temporally differentiated, slightly younger component at the David site is shown in plot E and spans 5320–5590 cal BP (Table 2:40; Fig. 5). Both of these middle Holocene components at the David site feature extensive use of the Calico argillite quarried hundreds of meters downstream from the site at the base of Calico Bluff. The lithic assemblages associated with probability densities F and E include early-stage reduction debitage, utilized flakes, unifacial flake tools, end scrapers, and bifacial preforms but lack complete projectile points and microblade technology. A distinctive feature dated to plot F is a lithic concentration of early- to middle-stage reduction debitage in a mound that represents a single event.

The eight radiocarbon dates representing the two middle Holocene components at the David site are from spatially discrete use areas within a widely distributed charcoal-rich soil. The soil is distributed across hundreds of meters, and the broad extent of the buried soil suggests that it developed during an extended period of repeated occupations. Charcoal abundance within the soil is anomalous compared with typical loess or other overbank deposits across the study area. Without evidence of similar charcoal-rich soils identified at the same age, the abundant charcoal at the David site appears to be anthropogenic. The charcoal is spatially distributed as scattered fragments of relatively small clasts rather than burned rooted stumps that would suggest charcoal sourced to natural forest fires.

The intensive middle Holocene occupation at the David site is followed by a 400-year hiatus. The next younger components are dated at Britannia Creek and Slaven's Roadhouse, upstream and downstream of Calico

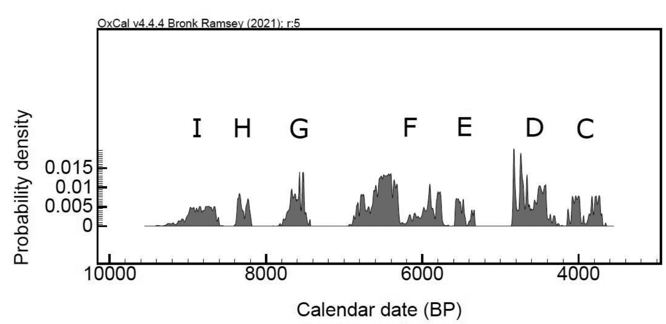

Figure 5. Probabilty density plots of the Denali-Early Northern Archaic period. (See Table 2 for radiocarbon date series for each alphabetically labeled plot.)

Bluff, respectively. Those dates combine into probability density plot D and include four radiocarbon dates, two assays from both Britannia Creek and Slaven's that span pproximately 700 radiocarbon years (Fig. 5). The two dates at Britannia Creek calibrate to 4620–4960 cal BP (Table 2:38–39) in one component. The dates from Slaven's calibrate to 4290–4800 cal BP (Table 2:36–37) in one component and overlap with the probability distribution of the Britannia Creek assays. The component at Slaven's includes one of the only dated complete projectile points in the study area, a large lanceolate bifacial form (Buvit and Rasic 2011).

The latest radiocarbon-dated components in the DENA period include occupations at Britannia Creek and Eagle Dune (Fig. 5, Plot C). The Eagle Dune site is about halfway between Britannia Creek and Slaven's Roadhouse, across the river from the community of Eagle, Alaska, slightly downstream of the international border. The Britannia Creek component is dated by a single radiocarbon assay that ranges between 3690 and 3890 cal BP (Table 2:34). Eagle Dune yielded a radiocarbon age range of 3920–4150 cal BP (Table 2:35) associated with secondary percussion debitage and highly fragmented calcined large mammal bone. The probability distributions of these two dated components overlap at the tails and form a bimodal probability plot. The Eagle Dune site is a multiple loci complex where localities are situated across a series of dune ridges that are elevated 15–25 m above the ordinary high-water mark of the Yukon River. The Eagle Dune component is in a distinctive greasy organic soil buried ca. 65 cm below the surface of a loess mantle that overlies noncultural massive eolian sand that produced an OSL age of 7830±1090 BP (USU-1172). Dating of cultural and noncultural deposits at Eagle Dune suggests a transition of depositional environments from active dune formation to finer loess deposition between 4000 and 8000 cal BP.

Late Northern Archaic-Dene (LNAD) Period, ca. 2850–220 cal BP

Following the Eagle Dune and Britannia Creek components in density plot C is a temporal gap of close to a millennium until around 2850 cal BP. The end of this temporal gap coincides with an apparent phase of river stabilization and overbank terrace building in the UYRC floodplain. The gap in the cultural radiocarbon record and the geological shift in the fluvial regime of the Yukon River define the beginning of the LNAD period. The earliest cultural component of the LNAD period is a date of 2850 cal BP at Forty Mile (Ch'ëdä Dëk) in fluvial deposits along the margin of the Yukon River channel. Among the sites of this period are 32 radiocarbon dates that coalesce in a nearly continuous probability density to the present (Table 2:2–33; Fig. 6). The LNAD series of radiocarbon ages are drawn from 15 spatially discrete loci among sites in the southern half of the UYRC between Britannia Creek and Calico Bluff. Series A includes 24 radiocarbon dates, and series B includes eight radiocarbon dates (Table 3) and represents 25 components.

The LNAD radiocarbon record is largely derived from several multicomponent sites at ethnographically documented Hän villages. These include village sites that are predominantly located at the confluence of freshwater streams and the Yukon River channel: Moosehide, Forty Mile, Ft. Reliance, and Calico Bluff, all of which are in the core area of the Hän traditional land-use areas (Crow and Obley 1981; Osgood 1971). The prevalence of multicomponent cultural sites at these traditional seasonal camps demonstrates long-term use at the confluences of freshwater sources. Artifact assemblages from these traditional villages conform to lithic, bone, and copper artifact types that define the Athabascan/Dene Tradition across Alaska (Dixon 1985; Holmes et al. 2022) and the Aishihik phase in Yukon (Workman 1978). The radiocarbon dataset of the LNAD period is drawn from well-defined stratigraphic contexts in overbank deposits featuring superimposed beds of organic soil, horizontally bedded deposits of eolian and fluvial sand and silt, and facies of White River tephra (Hammer and Thomas 2006; Livingston et al. 2009; Smith 2020).

Stratigraphic contexts of the LNAD period include tephra from one or both of the White River volcanic eruptions. Fig. 7 illustrates the probability density of radiocarbon ages of the LNAD period showing the age estimates

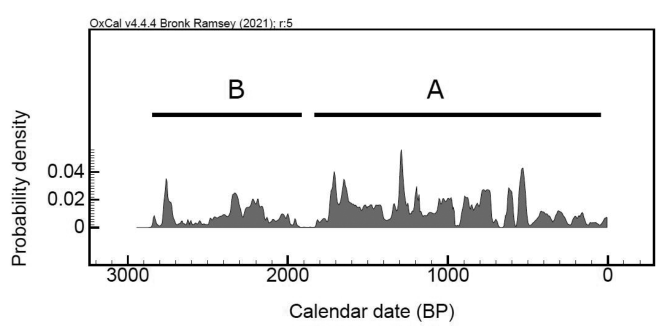

Figure 6. Probability density plot of the Late Northern Archaic-Dene period. (See Table 2 for radiocarbon dates for series A and B.)

Table 3. Dated archaeological sites in the LNAD period with number of radiocarbon dates on components younger than ca. 2850 cal BP. *Additional components are present in this period but are undated.*

Site Name	Number of dates	Number of components
Britannia Creek	3	2
Moosehide	2	2
Forty Mile	10	5
David site	4	4
Beck site	3	2
Yukon Charley (*n* = 3)	3	3
Pickerel Slough	1	1
Ft. Reliance	1	1
Eagle Dune	2	2
Coal Creek (Yukon Territory)	1	1
Dawson City	2	2
Total	**32**	**25**

Note: Yukon Charley refers to three sites in the Yukon-Charley Rivers National Preserve. See Table 2 for radiocarbon dates of series A (*n* = 24) and series B (*n* = 8).

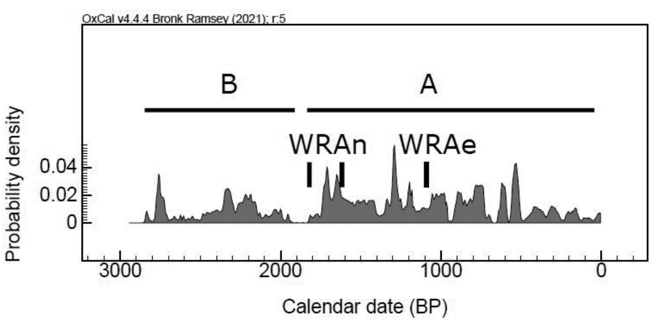

Figure 7. Probability density plot of the LNAD dataset with plotted ranges of radiocarbon dating of the northern lobe of the White River ash (WRAn, ca. 1800–1625 cal BP) and the White River Ash east lobe (WRAe, ca. 1100 cal BP).

of both volcanic eruptions. Neither of the eruptions coincide with expected temporal gaps in the archaeological record if the study area had been abandoned following the eruptions. However, a temporal gap of a century or more appears in the cultural record preceding the age ranges attributed to the WRAn eruption. Fig. 8 illustrates the possible temporal gap between ca. 1830–1940 cal BP that falls closer to the initial age estimate for the WRAn than the more recently proposed Bayesian median age estimate of 1625 cal BP. This gap is bounded on the older end by the tail of the probability distribution of radiocarbon date

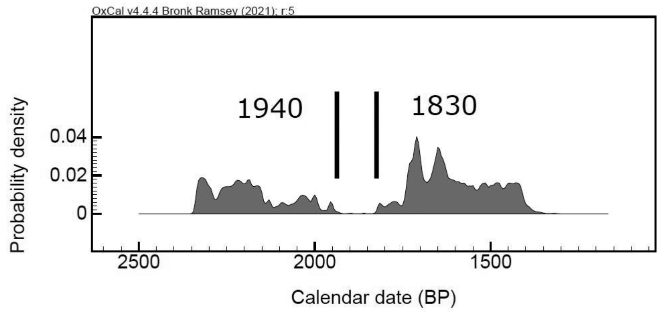

Figure 8. Probability density plot of possible temporal hiatus around the time of the WRAn eruption, showing the probability distributions of radiocarbon dates 25-A and 26-B (Table 2). Date 25-A is the oldest radiocarbon age of series A (n = 24), and date 26-B is the youngest radiocarbon age of series B (n = 8).

26-B that ranges between 1940 and 2120 cal BP (Table 2, median age of 2030 cal BP). And the gap is bounded on the younger end by the probability distribution tail of date 25-A that ranges between 1630 and 1830 cal BP (median age of 1730 cal BP, Table 2). The full range of the probability distribution medians span 300 calendar years and hints at a possible larger temporal gap between the age ranges of the probability distributions.

Though this possible temporal gap is unequivocal, a kernel density plot of the radiocarbon date series in the LNAD period shows a peak in probability density following the WRAn eruption (Fig. 9). The kernel density plot is not a direct model of higher population density following the WRAn but is representative of a larger number of dated components. The larger number of dated components following the WRAn eruption may simply be a sampling bias skewed by the relative ease of site discovery in shallowly buried, stratified overbank deposits in the floodplain. Another contributing factor to the large number of dated components in the LNAD period is the rapid accretion of overbank deposits that has separated components vertically. During the past two millennia, rapid accretion in the riparian zone has been linked to episodic ice-jam flooding on regular intervals of 25–40 years (Livingston et al. 2009), which is on the scale of a human generation and has resulted in well-stratified superimposed components.

TYPES OF OBSIDIAN TOOLSTONE ACROSS THE UYRC

An array of obsidian debitage (and less common tools) in the UYRC includes a small number of artifacts in dated contexts and a larger quantity of flaking debris found in undated surface or shallowly buried contexts. The remarkable pattern evident among the obsidian toolstone is the wide range of sources imported to the study area that derive from a ca. 1800 km swathe spanning a northwest-southeast axis across north-central Alaska, the southern Yukon Territory, and northern British Columbia (Fig. 10). Despite known trade contacts between coastal Tlingit groups and inland Dene groups, no obsidian in the UYRC is sourced to Southeast Alaska. The assemblage of obsidian demonstrates extensive human mobility, social networks, and long-distance exchange across north-central and southern Interior Alaska to the southern Yukon Territory and beyond.

Five obsidian geochemical groups have been traced to geographic areas peripheral to the UYRC. The most common group is Batza Tena (Group B) that is sourced to a volcanic field on the upper reach of the Koyukuk River, a tributary of the middle Yukon River situated ca. 600 km northwest of the UYRC (Clark and Clark 1993). The second most common group is Wiki Peak obsidian (Group A), sourced to the Nutzotin Mountains of east-central Alaska in the easternmost subrange of the Alaska Range (Richter et al. 2000) and situated south of the UYRC. The Wiki Peak geological source occurs near the divide between the tributary headwaters of the Yukon River and the eastern margin of the Tanana River basin. A third common type is Group A' (A prime), most commonly identified in the Copper River basin 350 km south-southwest of the study area; the source quarry is unknown. The least common groups are Mt. Edziza obsidian, sourced to the Stikine volcanic belt in northwest British Columbia approximately 1000 km southeast of the UYRC (Fladmark 1984, 1985; Godfrey-Smith 1985; Reimer 2015; Souther 1992; Souther et al. 1984), and Hoodoo Mountain, sourced to the southern Yukon Territory.

Dated components with sourced obsidian include occupations at the David, Eagle Dune, Forty Mile, Moosehide, and Britannia Creek sites. Among these sites are geochemically characterized artifacts manufactured of Batza Tena, Wiki Peak, and Group A'. The rare occurrences of Mt. Edziza and Hoodoo Mountain obsidian have uncertain temporal associations (Fig. 10). Batza Tena is dated in three components at the David site with median estimated ages: (1) 8770 cal BP on microblades (Dog Yard locus, Table 2:51), (2) debitage at ca. 5000 cal BP (Archaic locus), and (3) flaking debris and an end scraper at 2720 cal BP (Dog Yard locus) (Table 2:32). Batza Tena flaking debris is dated to 1660 cal BP at Eagle Dune site (Locus B) (Table 2:23), and a microblade is dated to ca. 4730 cal BP at Britannia Creek (Table 2:38, 39).

Sourced and dated Wiki Peak (Group A) obsidian includes (1) the Chindadn component at Britannia Creek (Greg Hare, pers. comm. to Jeff Rasic), (2) 6410 cal BP at Moosehide (Hammer 2002:6), (3) 1010 cal BP at the David site (Greenhouse locus, Table 2:13), and (4) Eagle Dune (Locus E) where it is most likely associated with a 2240 cal BP hearth feature (Table 2:27). Group A' occurs with the Wiki Peak obsidian at the David site (Greenhouse locus) along with a copper rod preform dated to 1010 cal BP and in two components at the Forty Mile site, both younger than the WRAn tephra (Smith 2020). Mt. Edziza obsidian at Moosehide is dated to 6410 cal BP (Table 2:44) and in undated contexts at the David site (Dog Yard locus), but likely younger than 1000 years ago.

For a broader context of evaluating obsidian through the UYRC, we expanded the inventory to include undated geochemically analyzed obsidian in the study area by adding the Fireguard site in the town of Eagle (Table 4).

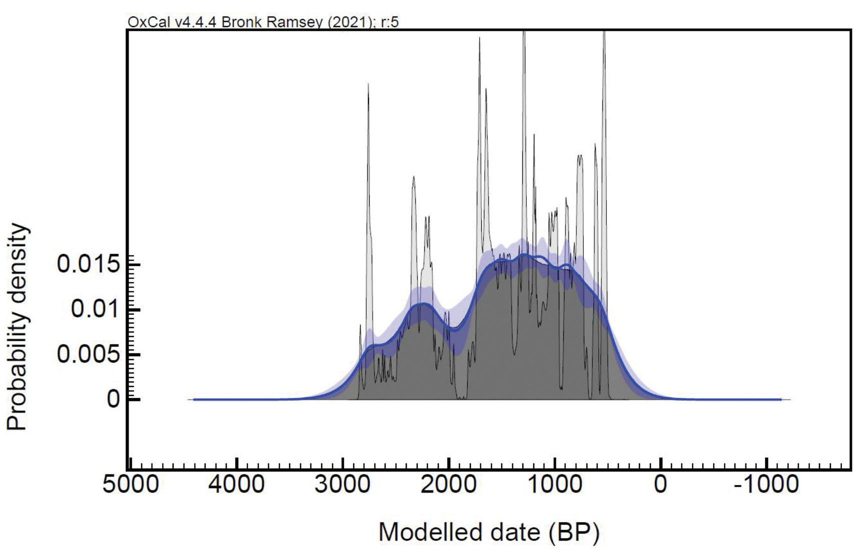

Figure 9. Kernel density plot of LNAD radiocarbon date series that shows the highest probability following the northern lobe of the White River volcanic eruption. The trend is not a direct demographic proxy of population size but is a peak based on a larger number of dated components. The line diagram is the nonmodeled probability curve for the LNAD shown in Figure 3.

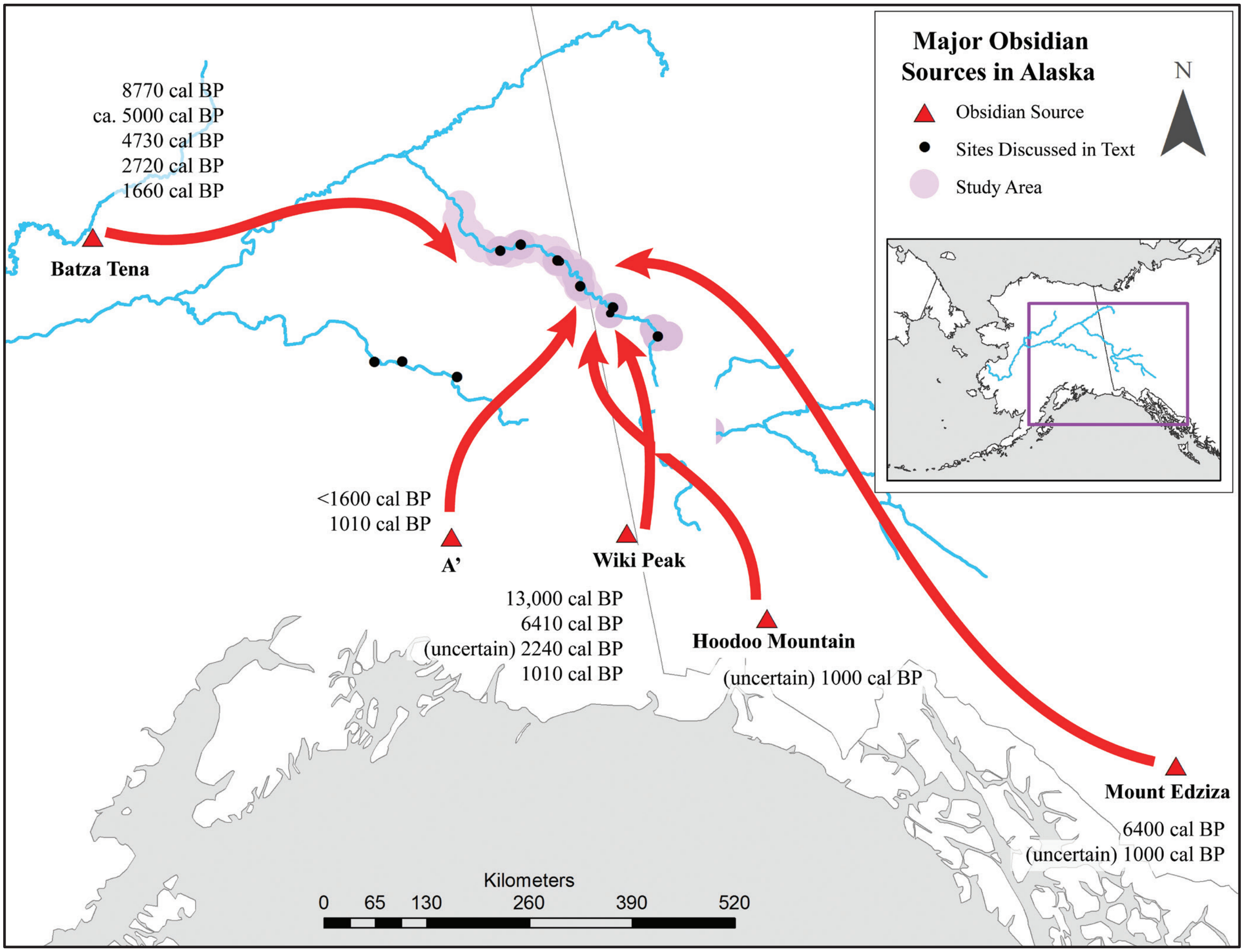

Figure 10. Geographic patterns of sourced obsidian among analyzed groups in the UYRC. The geographic source of A' obsidian is unknown, but it is most frequent in the Copper River basin where shown on the map.

Table 4. Obsidian artifacts from sites in the Upper Yukon River Canyon subject to geochemical composition analysis.

	Obsidian Source (Geochemical Group)					
Site	Batza Tena (B)	Wiki Peak (A)	Group A' (A')	Mount Edziza (E, E1)	Hoodoo Mountain (M, J)	Row Total
Britannia Creek (KfVi-3)	1	5	—	—	6	12
Moosehide (LaVk-2)	3	10	—	13	3	29
Eagle Dune (EAG-742)	6	1	—	—	—	7
Fireguard Station (EAG-070)	3	—	—	11	—	14
Forty Mile (LcVn-2)	—	—	2	—	—	2
David site (EAG-288)	59	24	64	2	—	149
Column Total	**72**	**40**	**66**	**26**	**9**	**213**

The sum total of sourced obsidian artifacts equals 213 pieces, nearly all of which is flaking debris. Collectively, the obsidian from the six sites derives from five geological sources of obsidian that include Batza Tena (*n* = 72), Wiki Peak (*n* = 40), A' (*n* = 66), Edziza (*n* = 26), and Hoodoo Mountain (*n* = 9). These are relatively low frequencies but are expected given that all obsidian is highly curated from geographic areas peripheral to the UYRC and derived from sites where limited systematic testing has been conducted.

DISCUSSION

HUMAN OCCUPATION IN THE UYRC

Our treatment of the current sample of radiocarbon dates in the UYRC offers a preliminary view of human occupation at a landscape scale along a prominent reach of the Yukon River. The result is a first-approximation model of human occupation where ancestral Dene peoples developed social networks and exchange systems across and beyond the Yukon River basin, the homelands of Indigenous First Nations and Alaska Native citizenry who occupied the lands and resources of the UYRC for millennia. Given that many of the cultural heritage sites are located on tribal, First Nations, and government lands, our approach to summarizing radiocarbon-dated sites across land jurisdictions will programmatically elevate cultural resources in long-term resource planning among Indigenous, state, and federal land managing agencies (Altschul 2016; Doelle et al. 2016).

The radiocarbon dataset used in this study emerged among multiple researchers over decades of reconnaissance surveys and limited systematic data recovery. The results offer guidance for a more comprehensive approach to radiocarbon sample selection and dating of sites across the study area. We encourage a systematic approach to date all components at individual sites that would reduce researcher bias in the radiocarbon record and expand datasets for Bayesian modeling. A more robust approach to dating all components would provide a larger number of radiocarbon dates to explore a broader scale of research questions about the volcanic impacts. For example, Kristensen et al. (2020:170) evaluate the array of adverse effects on biota at the trophic level within isopachs of tephra depths and suggest that a century hiatus for ecological recovery to pre-WRA environs is not unreasonable for tephra deposits similar to those that settled across the UYRC. However, the possible temporal gap in our model precedes the earlier WRAn eruption by a couple of centuries and is sympathetic to the hypothesis that the cultural transition of the late Holocene Athabascan (Dene) Tradition had begun prior to ecological consequences of regional volcanism (Doering 2020:484–487). Alternatively, the temporal gap in the existing dataset may be structured by researcher bias given less inclination to submit radiocarbon samples closely associated with time-stratigraphic tephra deposits, i.e., a small sample size.

Preference given to dating all components would generate a more controlled radiocarbon dataset for evaluating broader geological and taphonomic factors that bias the radiocarbon and archaeological records. An important research theme to pursue on a landscape basis is the scale of site destruction resulting from riverbank erosion, spring ice-jam flooding, base-level fluctuations, and river loading from volcanic sedimentation. For example, the low number of sites that exceed 3000 radiocarbon years may be skewed by reoccurring destructive geological forcings in the riparian zone during the DENA and LNAD periods. The existing radiocarbon dataset has provided an initial understanding of geological and taphonomic factors to inform predictive modeling for new site discovery strategies that would address the scale of site destruction by large-scale fluvial processes.

An expanded radiocarbon dataset would further refine chronological control and strengthen inferences on observed exotic lithic sourcing patterns. For example, the patterns of sourced obsidian toolstone suggest that the UYRC was a conduit of widespread social relationships that extend deep into the past. The overlap of Batza Tena and Edziza obsidian hints at how wide and far a broad exchange system had been connected. Wiki Peak obsidian at the earliest component at Britannia Creek suggests an established network of distantly accessed lithic material at the time of the earliest archaeological components in the Tanana River drainage and the Yukon Territory. Emerging archaeological studies in geographic areas between the UYRC and the Tanana River basin (and proximal to Little John site) provide comparable data to elaborate on social relations and interaction spheres within and beyond the URYC. For example, Coffman and Mills (2023; Coffman et al. 2018) have identified a Chindadn occupation in the headwaters of the Forty Mile River, and Holloway (2020) has reported a late Holocene archaeological district in the headwaters of the Seventymile River. Both the Forty Mile and Seventymile Rivers are substantive freshwater tributaries of the Yukon River and are natural geographic corridors that trend eastward to the headwaters of middle Tanana River tributaries.

DENALI MICROLITHIC TECHNOLOGY IN THE UYRC

Microlithics of early Holocene age in the UYRC expand the known geographic range of Denali microblade technology within Interior Alaska and the Yukon Territory. In the adjacent southern Yukon Territory, microblade technology appears after 7000 cal BP (Clark and Gotthardt 1999; Hare and Hammer 1997). Prior to this study, the UYRC had produced only one radiocarbon date on microblades at the site of Moosehide. The two Denali components at the David site push back the temporal depth of microblades in the UYRC, but these dates are more than a millennium younger than dated microblade components in Southeast Alaska and the Northwest Coast. Microlithic technology in Southeast Alaska and the Northwest Coast generally date to around 9300 cal BP (Fedje et al. 2011; Lee 2007), but more recent dating has extended microblade technology a millennium older to around 10,300 cal BP in Southeast Alaska (Carlson 2017; Carlson and Baichtal 2015). Aside from the difference of a millennia in the radiocarbon record, the identification of microblades made of Batza Tena obsidian in the early Holocene UYRC components supports the hypothesis of a diffusion trajectory from central Interior Alaska through the UYRC to the southern Yukon Territory. Clearly, a more expansive effort to identify and radiocarbon date additional microblade assemblages is an important research question for future work in the UYRC.

EFFECTS OF THE WHITE RIVER VOLCANIC ERUPTIONS

The UYRC suffered environmental impacts from both late Holocene White River volcanic eruptions, and the primary ecological consequences to human foragers included adverse effects to keystone caribou and salmon subsistence resources (Kristensen et al. 2020). The UYRC study area is centered in the path of the WRAn tephra lobe and along the northern margin of the WRAe lobe (see Fig. 2). Tephra deposits across terrestrial habitats resulted in food uptake and nutritional constraints to caribou, while tephra sedimentation on gravel-bottom salmon spawning and rearing streams probably resulted in lowered salmon fecundity for one or more salmon life cycles. Both volcanic events resulted in massive deposits of tephra in the headwater drainage network of the Yukon River basin, resulting in large quantities of volcanic sediment being mobilized and retransported as suspended load through the UYRC. Both eruptions forced ecological impacts in the freshwater habitats immediately following the eruptions and likely extended adverse effects during spring breakup and the summer thaw season for a more prolonged period following the eruptions.

Perhaps the most significant ecological effect on endemic people in the UYRC concerns the immediate impacts to fish populations caused by water quality degradation. Undoubtedly, an order of magnitude increase in suspended load at the time of the eruptions, or during consecutive spring breakups following the eruptions, would have resulted in heightened mortality to anadromous and freshwater fish populations. Kristensen et al. (2020) evaluate the probable effects of volcanic eruptions to both freshwater and anadromous fish populations forced by increased turbidity, changes in water chemistry, and other adverse biological factors affecting fish and other wild food resources. In the UYRC, hydrological and geological processes such as spring runoff, ice-jam flooding, fluvial erosion, and upland landslides would have caused episodic pulses of tephra and other ejecta into the fluvial regime of the Yukon River for many years following the eruptions. Those factors likely extended the duration of adverse conditions on anadromous salmon compared to freshwater fish populations. Episodic pulses, or phases, of increased turbidity in the main channel may have shifted or focused the settlement pattern of endemic peoples to the freshwater tributaries for nonanadromous fishing until salmon populations recovered.

Cultural Effects of the White River Lobes

Within the UYRC, Smith (2020) conducted a multiple-themed analysis that evaluated the potential impacts of the WRAn on people living at the Forty Mile site at the confluence of the Forty Mile River. Her study is the lone analysis of archaeological and paleoecological data applied to evaluate ecological and cultural effects of the eruption on endemic people and the wild food resources in the riparian zone of the UYRC. The stratigraphy at Forty Mile includes overbank deposits featuring multiple horizontally bedded paleosols within laminated beds of sands and silts with good organic preservation. Her analysis of components before and after the WRAn suggest an immediate occupation following the eruption followed by subsequent components that indicate repeated use of the Forty Mile village site (Smith 2020:116–117). The cultural patterns identified before and after the WRAn transition at Forty Mile agree with technological changes in the archaeological record of the Athabaskan (Dene) Tradition in Alaska (Dixon 1985; Doering et al. 2020; Holmes et al. 2022) and late prehistoric period in the Yukon (Thomas 2003; Workman 1979). At the Forty Mile site, the initial hints of technological changes associated with the transition between cultural traditions preceded the WRAn eruption.

This paper's contribution to the debate over potential effects to inhabitants in the plume of tephra deposits is confined to novel archaeological data at the time of the WRAe eruption at the David site. The assemblage there, which consists of sourced obsidian and native copper, conforms to the timing of the WRAe eruption and suggests a downstream (northern) displacement of people. More specifically, the assemblage includes Wiki Peak and Group A' obsidian in association with a copper preform, all highly curated cultural material from southern sources more proximal to the volcanic field and in the area of southern trading partners of the Hän at the time of contact. This novel assemblage is associated with a hearth, fire-cracked rock, and processed caribou (*Rangifer* sp.) remains. An additional southern-sourced artifact, an end scraper of Mt. Edziza obsidian, was found near the hearth and is believed to date to the same time. Dated copper in this component is the initial appearance of metallurgy in the UYRC.

This assemblage is stratigraphically placed within a greasy organic soil (A horizon) with no visible tephra but is associated with charcoal dated to 950–1070 cal BP (median 1010 cal BP) (Table 2:13). The radiocarbon date is approximately a century younger than the precise age of the eruption (1104–1102 cal BP; Jenson et al. 2014). In an attempt to conform the dating more closely, we added 73 calendar years to account for the difference between the current calendar and the 1950 AD datum for the radiocarbon time scale. This slight adjustment yielded calibrated age ranges between 1226 and 1243 cal BP (2.3%), 1055 and 1179 cal BP (88.5%), and 1000 and 1027 cal BP (4.6%) with a median of 1112 cal BP. The resulting age comparison suggests a plausible association between WRAe eruption and a downstream foray away from the ash plume, particularly if the eruption occurred in the late fall or early winter (West and Donaldson 2002). The Yukon River would have provided the most expedient route of exodus by watercraft before winter freeze-up, perhaps in birch-bark canoes.

Alternatively, the close radiocarbon age estimates between the WRAe and the southern-sourced artifact assemblage may be evidence of expanded, or blended, social networks with southern people. Displacement of resident populations may have expanded the trade networks or made new materials available, such as copper and A' obsidian. Supplemental evidence of expanded and continued interaction spheres developed subsequent of the WRAe event is the occurrence of A' obsidian found stratigraphically above a contemporaneous radiocarbon dated component at Forty Mile (Smith 2020:92–93; Component 3, Table 2:12). Further evidence to support expanded social interaction spheres following the WRAe eruption is independently dated copper at Pickerel Slough, between 680 and 900 cal BP (Table 2:8), in the shadow of Calico Bluff in overbank deposits adjacent to the main channel of the Yukon River. The A' obsidian at Forty Mile and the post-WRAe copper at Pickerel Slough illustrate continuity of a social network for distantly sourced, highly curated toolstone and metallurgy.

Metallurgy in the archaeological record of Interior Alaska and the Yukon Territory appeared in the Copper River basin (Cooper 2012) and the southern Yukon (Thomas 2003) around a millennia ago. The most extensive assemblage in the Yukon River basin is in the Upper Tanana River area at the site of Dixthada, an ancestral village of Upper Tanana people near the modern village of Tanacross. The Dixthada assemblage consists of small projectile points, awls, and a knife blade among discarded fragments (Shinkwin 1979). Radiocarbon dating of copper metalwork at Dixthada is ambiguous, but a short distance downstream on the middle Tanana River a copper awl is dated to 1256 ± 38 BP (AA-88629; 1080–1280 cal BP; Doering et al. 2020:480). The radiocarbon dating of copper in the middle Tanana River and the copper at the WRAe David site component nearly overlap at two sigma in their radiocarbon probability distributions.

The trajectory of southern sourced material culture appearing in the UYRC following the WRAe eruption supports one of the early hypotheses of a northern displacement of endemic populations hypothesized by Derry (1975). The dated assemblage at the David site has broad implications of the Yukon River as an alternative vector for human displacement in addition to the widely hypothesized model of Athabascan migration to the mid-latitudes of North America, specifically the American Southwest (Ives 1990, 2003; Seymour 2012; and others). The data here is admittedly very limited but is unique in the archaeological record of east-central Alaska. More radiocarbon-dated components during this time period could elaborate on the human displacement modeling by Mullen (2012). This new data broadens the discussion on possible human displacement during regional volcanism in the headwaters region of the Yukon River basin.

CONCLUSION

The radiocarbon dataset collated in this study has provided a first-approximation landscape model of human settlement in the riparian zone of UYRC. The radiocarbon record suggests that this diverse geographic riverine landscape had drawn ancestral-Dene peoples beginning with the initial peopling of the Americas. The UYRC offers a comparative dataset of human occupation centered between established culture chronologies in the Tanana River and the southern and west-central Yukon Territory. Bayesian probability analysis has temporally ordered components, and the chronological scaling will guide analysis of lithic assemblages, especially in reference to the spatial distribution of Calico argillite, the only known toolstone quarry in the UYRC. A comprehensive approach to dating all components in the UYRC would shed more light on how this riparian corridor may have been a central hub of regional interaction among humans inhabiting Interior Alaska and the Yukon Territory for millennia.

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