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RESEARCH REPORT

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Antelope Springs: A Folsom Site in South Park, Colorado

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ABSTRACT
The Antelope Springs Folsom locality is located near Trout Creek Pass, which connects South Park, a high elevation basin in the Rocky Mountains, with the headwaters region of the Arkansas River. The pass is also the source of an eponymous jasper that dominates the small, surface collection of Folsom points, preforms, tools, and debitage we report on here. The Antelope Springs assemblage was focused on the reduction and replacement of a stone tool kit. There does not appear to have been a substantial Folsom-age presence in South Park, although based on other Folsom sites where Trout Creek jasper occurs, and least-cost paths of travel through the southern Rocky Mountains, South Park and Trout Creek Pass may well have been regularly traversed between Middle Park and San Luis Valley, areas that had a more significant Folsom presence.

KEYWORDS
Folsom; mobility; Trout Creek jasper; southern Rocky Mountains

1. Introduction

The Antelope Springs Folsom site (5PA1) in South Park, Colorado, was first recorded in 1949 (Chenault 1999; Lincoln et al. 2003, appendix G), and at the time was reported to extend over a mile in length and include tipi circles along with exposed fire places, pits, bones, and artifacts such as pottery and manos, as well as projectile points including "9 Yumas, 3 Folsoms, 1 Sandia point" (Morton 1949). Although there were obviously multiple occupations over a large area associated with the springs, the spatial or stratigraphic integrity of the Folsom occupation went unrecorded. The site was subsequently collected by an unknown number of individuals, including the late Robert J. Patten, an experimental archaeologist and highly accomplished flintknapper. Patten's collection from the site comprises a small sample of flaked-stone tools and debitage, to which he made occasional reference in his volume on Paleoindian technology, *Peoples of the Flute* (Patten 2005).

Patten inferred that Antelope Springs marked a locality where "intensive reduction and replacement of partially exhausted stores took place" (Patten 2005, 182–183). He estimated ~30 Folsom points were made there of jasper obtained from the nearby Trout Creek source, and perhaps as many bifaces were manufactured of a chalcedony crafted from stone available at the site (Patten 2005, 163, 168). He illustrated a few of the specimens (Patten 2005, 126, 141, 145). The assemblage was not large, and the site was only surface collected by him, not excavated.

After Patten's passing in early 2017, his wife Laurey donated his library, flintknapping materials, and collection to Kent State University's Experimental Archaeology Laboratory. Included in this gift was a portion of the Antelope Springs assemblage – principally that made of Trout Creek jasper. Here we describe the assemblage, and what little is known of its archaeological context.

Of particular interest is the fact that Antelope Springs is one of very few Folsom or Paleoindian sites recorded in South Park, despite extensive surveys and work with local collectors in the region (Bender 2015; Black 2013; Friedman and Lincoln 2003; Friedman, Lincoln, and Tigner 2002; Friedman, Lincoln, and Tigner 2003; Lincoln et al. 2003). We surmise that it is not a coincidence that one of the rare Folsom-age sites in South Park is located near a source of high-quality toolstone, and a source that is also at a key mountain pass for transit between South Park – the headwaters of the South Platte River – and the upper reaches of the Arkansas River. As Trout Creek jasper is also found in Folsom sites to the north and south of South Park, we also explore here

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the potential routes Folsom groups may have taken in moving through the region, and what Antelope Springs might reveal of Folsom mobility in this region of the southern Rocky Mountains.

2. Site setting

Antelope Springs is located south of Hartsel, Colorado, at an elevation of ~2780 meters above sea level (masl) (Figure 1). It is along a minor, perennially dry tributary of the South Platte River on the western margin of South Park, the largest and highest of several high-elevation basins in the midst of the Rocky Mountains (Bender 2015). It is surrounded by mountains, all of which have peaks in excess of 4000 masl; there are a finite number of mountain passes into the park, some over 3000 m in elevation (Bender 2015; Black 2013), with Trout Creek Pass itself at 2892 masl.

Antelope Springs is located ~16 km east of and ~100 m lower than Trout Creek Pass, and its eponymous jasper source, which is found at the base of the western slope of Kaufman Ridge, a series of north–south running hogback mountains adjacent to and east of the Collegiate Peaks (Black and Theis 2015). Although there are a number of look-alike jasper sources in the region (Black 2013; Black and Theis 2015, 341), Patten suspected the jasper on which the majority of the artifacts at Antelope Springs were made was obtained from the Trout Creek source (Patten 2005, 163). Given the proximity of the source to the site, that seems a reasonable inference, and one we tested (below).

The ownership status of the land at the time the site was collected by Patten is unknown. As far as we can ascertain, only surface collection has ever taken place at the site. It was reported almost two decades ago (Lincoln et al. 2003) that an investigation was planned at the site for the fall of 2003, but the fieldwork did not take place. To the best of our knowledge, and of those who have conducted fieldwork in South Park, none has since (S. Bender, K. Black, T. Lincoln, personal communication, 2020). Two of the authors (BNA and DJM) visited the area in 2018. The locality today is on private land, and the access road is gated ~250 m north of the site. Landowner permission to visit the site could not be obtained, so its current status and archaeological integrity and potential could not be ascertained.

Folsom-age material is reported from other localities in South Park, but from past surveys it is very rare (as is Paleoindian material in general), and comprised of roughly half a dozen isolated fragments of Folsom points, mainly from the northern portion of South Park (Bender 2015; Black 2013; Friedman and Lincoln 2003; Friedman, Lincoln, and Tigner 2002; Friedman, Lincoln, and Tigner 2003; Lincoln et al. 2003). This could, of course, reflect unevenness in survey coverage (Black 2013). It is noteworthy that in Middle Park to the north and in the San Luis Valley to the south, there is evidence of a substantial Folsom presence, most notably at the sites of Barger Gulch and Cattle Guard, respectively (e.g., Jodry 1999a; Naze 1986; Surovell and Waguespack 2007).

It may be relevant to add that the floor of South Park is at least 300 m higher in elevation than both of those mountain basins, and though it is a game-rich region, it is subject to severe winter weather, making it seasonally less habitable (Bender 2015; Black 2013). It is also worth noting, as is discussed below in more detail, that Trout Creek jasper appears to have been used by Folsom groups in both those adjacent regions. In effect, the scarcity of Folsom material in South Park does not preclude Folsom groups having been here, though it may suggest something of the nature of Folsom land use and movement in this region.

3. Assemblage description

The assemblage we describe is not the entire assemblage Patten collected, for he makes mention of 360 surface-collected flakes from the site (Patten 2005, 168); only two dozen flakes were part of the donation. Patten reports that there was a large component made of the chalcedony that outcrops at the site's edge (Patten 2005, 163). Its whereabouts, and that of the missing jasper materials, are not known. As noted, Antelope Springs is a multi-component site. Obviously, the Folsom points, preforms, and channel flakes date to the Folsom period. Not knowing whether the Folsom component was spatially isolated from later material, but suspecting that Patten only collected material from where he found diagnostic Folsom artifacts, we will assume that the tools and debitage were likely associated, though whether they are, in fact, Folsom age cannot be known for certain.

3.1. Finished Folsom points

There are two finished Folsom points (specimens AS01 and AS02) in the assemblage (Table 1). Both are slightly tapered, laterally-snapped bases with pronounced ears and basal concavities. Each exhibits ground lateral edges. Both were knapped on chert macroscopically consistent with Trout Creek jasper, and both would appear to fit readily within the same hafting armature. The reason for breakage in each case appears to be snapping either from use, transport, or post-depositional

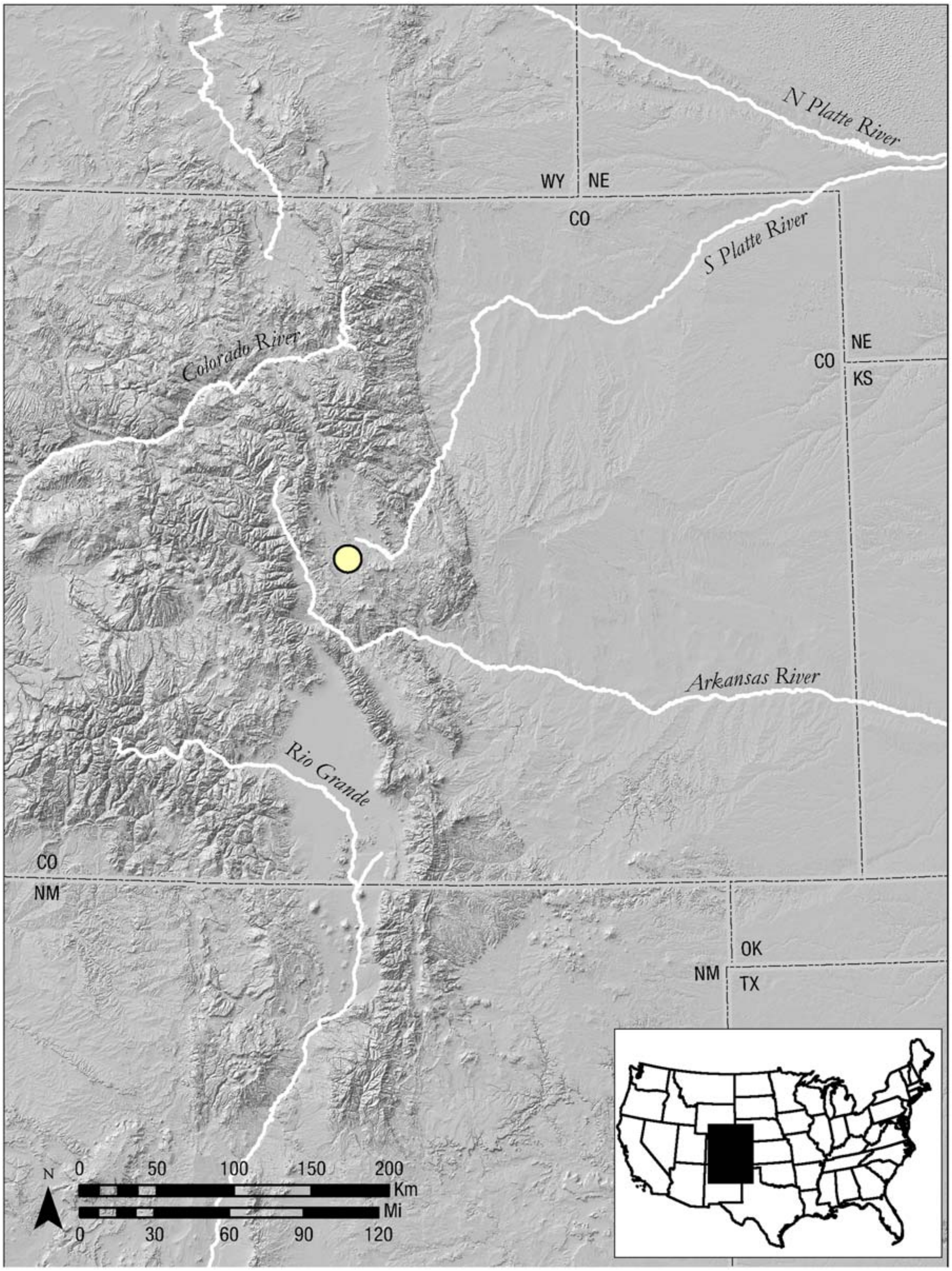

Figure 1 Location map of the Antelope Springs site, Colorado.

factors. No portion of the blade is present on either specimen (grinding on each edge extends to the lateral break), hence it is not possible to determine whether the points were reworked or suffered impact damage (as could account for their breaks (Meltzer 2006, 286)).

Specimen AS01 possesses one snapped ear while its other ear is missing completely (Figure 2). The first point's flutes are asymmetrical relative to each face, skewed in each instance toward the right lateral edge. As a consequence, the left lateral edge on each

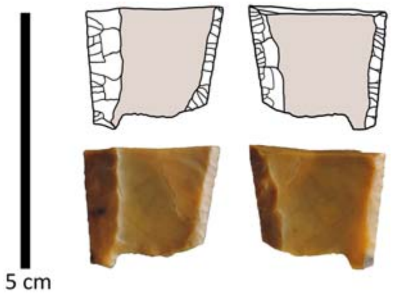

Figure 2 Folsom point specimen AS01.

face shows two sets of pressure flaking: one for producing the convexity necessary for full face fluting and a subsequent set (most visible on the line drawing) for cleaning up the edge (Figure 2). The right lateral edge on each face only shows the second set of pressure flakes.

The second finished point (AS02), although knapped on the same toolstone as the first point, was produced on a grainier variety (Figure 3). It possesses one complete ear and one snapped ear, the latter snapping perhaps explaining the small burination on the lateral edge just distal to the ear. Like the first point, the second point possesses a left lateral edge exhibiting two sets of pressure flakes (Figure 3), while the right lateral edge only shows one set.

The basal edge of both of these finished Folsom points shows some small, irregular flake removals that might have accrued during the hafting process or from use (e.g., Story et al. 2019; Thomas et al. 2017), or as a result of post-depositional factors. The small irregular flake removals might also simply be remnants from flute platform preparation. Regardless, the bases were neither ground nor finished with fine pressure flaking, as can be seen in other Folsom assemblages (e.g., Folsom (Meltzer 2006), Lindenmeier (Wilmsen and Roberts 1978), Mountaineer (Andrews, Meltzer, and Stiger forthcoming)).

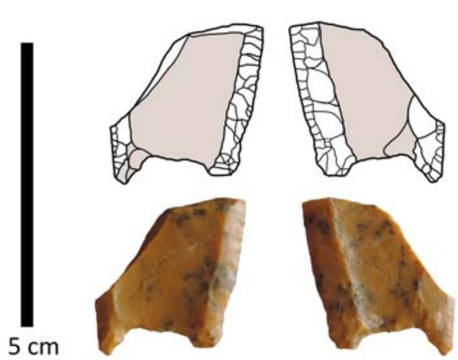

Figure 3 Folsom point specimen AS02.

3.2. Folsom point preforms

There are eight preforms in this collection (Table 1, specimens AS03-AS10), seven knapped on jasper macroscopically consistent with Trout Creek jasper (though the chemistry of one of the specimens – AS09 – is an outlier, as noted below). The eighth (AS10) was knapped on a siliceous, white, translucent toolstone, presumably the chalcedony Patten reported as occurring at the site (Patten 2005, 163, 168).

Preform AS03 (Figure 4(a); also Patten 2005, 126, specimen G) is a tapered point base that is fluted on only one face. Its lateral edges are sharp and slightly irregular, and there is only one set of pressure flakes evident on the fluted face, unlike the two finished points described above. The non-fluted face is not ready for fluting: no convexity-building had yet taken place, there is no flute striking platform, and the original (flake?) toolstone surface is present on the left portion this face.

Preforms AS04-AS06 (Figure 4(b–d); AS05 is illustrated in Patten 2005, 126, specimen A) appear to be the distal ends of specimens snapped during fluting attempts. Each snapped tip exhibits a stepped remnant flute scar which in all three cases terminated before reaching the distal end. Each preform also shows irregularities at the slightly thickened and rounded distal tip, such as crushing or snapping. In the case of preform AS04, a break at the distal tip was initiated, but did not propagate all the way through the specimen, leaving a visible cleavage. These distal-tip irregularities are consistent with the use of a supporting anvil during the fluting process (Patten 2005).

Preform AS07 (Figure 5(a), also Patten 2005, 126, specimen D) is a longitudinally-split lateral and distal portion of a long preform. Similarly broken forms are occasionally found in other Folsom assemblages (e.g., Wilmsen and Roberts 1978, figure 102). No grinding is present on the remaining edge. One face shows evidence of a long flute scar, which traveled at least ~55 mm. The opposite face possesses parallel pressure flake scars that were perhaps used to help build the convexity for the second flute removal. However, it is impossible to say whether this specimen broke during the first flute removal, during an attempt at removing the second flute, or even from post-depositional processes.

Specimens AS08 and AS09 (Figure 5(b,c)) are bifacially-knapped specimens we assume were preforms. Unfortunately, they are so fragmented we cannot identify whether they are distal, lateral, medial, or proximal portions.

Table 1 Observation and metric data on the tools from Antelope Springs (in mm/g).

ID	Class	Raw material	Portion	Mass	Length	Width	Width at snap	Basal width	Basal concavity	Thickness	Inter-flute thickness	Flute width 1	Flute width 2
AS01	Point	Trout Creek	Proximal	2.85	25.03	24.31	26.29	21.53[a]	3.59[a]	3.91	2.43	17.08	15.03
AS02	Point	Trout Creek	Proximal	2.78	28.01	26.80[a]	28.90[a]	20.28	4.46	3.70	2.51	17.22[a]	17.89[a]
AS03	Preform	Trout Creek	Proximal	4.50	26.78	28.07	29.54	21.47	3.29	5.10	n/a	13.68	n/a
AS04	Preform	Trout Creek	Distal	2.83	23.84	18.41	22.42	n/a	n/a	4.45	n/a	10.89	n/a
AS05	Preform	Trout Creek	Distal	3.51	26.49	25.01	27.42[a]	n/a	n/a	3.67	n/a	17.96	n/a
AS06	Preform	Trout Creek	Distal	3.54	26.41	23.20	25.23	n/a	n/a	4.53	n/a	8.40	n/a
AS07	Preform	Trout Creek	Lateral distal	3.63	59.28	11.63	n/a	n/a	n/a	4.21	n/a	n/a	n/a
AS08	Preform	Chalcedony	Unclear	1.38	21.44	11.71	n/a	n/a	n/a	4.05	n/a	n/a	n/a
AS09	Preform	Jasper	Unclear	1.72	23.15	15.55	n/a	n/a	n/a	3.76	n/a	n/a	n/a
AS10	Preform	Chert (white)	Proximal	0.62	15.68	15.14	15.14	11.23	0.00	2.75	2.13	5.40	6.63
AS11	End scraper	Trout Creek	Proximal	4.86	21.53	41.11	30.74	n/a	n/a	4.38	n/a	n/a	n/a
AS12	Retouched flake	Trout Creek	Distal lateral	2.47	31.30	19.50	n/a	n/a	n/a	3.43	n/a	n/a	n/a
AS13	Graver spur	Chert (opaque, mottled white)	Unclear	0.91	21.63	19.97	n/a	n/a	n/a	2.74	n/a	n/a	n/a

[a]Minor breakage precluded precise measurement; actual values should be ±1 mm, based on extant form.

Table 2 Observation and metric data on the channel flakes and debitage from Antelope Springs (in mm or g).

ID	pXRF ID	Figure	Flute flake?	Raw material	Fragment	Mass	Length	Width	Thickness	Platform width	Platform depth
AS14	105	5a	Yes	Trout Creek jasper	Proximal	1.41	30.61	14.64	2.34	3.82	1.33
AS15	112	5b	Yes	Trout Creek jasper	Mid-section	1.52	29.14	15.84	2.22	n/a	n/a
AS16	116	5c	Yes	Chert (brown translucent)	Mid-section	1.58	38.67	13.37	2.18	n/a	n/a
AS17	114	5d	Yes	Chert (Translucent)	Mid-section	1.16	25.81	15.51	2.11	n/a	n/a
AS18	133	n/a	Yes	Trout Creek jasper	Proximal	0.43	19.87	11.04	1.27	4.86	1.76
AS19	134	n/a	Yes	Trout Creek jasper	Mid-section	0.84	17.81	14.65	2.26	n/a	n/a
AS20	135	n/a	Yes	Trout Creek jasper	Distal	0.55	18.72	13.32	1.84	n/a	n/a
AS21	136	n/a	Yes	Trout Creek jasper	Distal	0.68	17.16	14.88	1.90	n/a	n/a
AS22	137	n/a	Yes	Trout Creek jasper	Mid-section	0.77	20.62	13.32	2.22	n/a	n/a
AS23	138	n/a	Yes	Trout Creek jasper	Mid-section	0.56	15.14	14.70	1.92	n/a	n/a
AS24	139	n/a	No	Trout Creek jasper	Mid-section	0.18	9.40	12.39	0.99	n/a	n/a
AS25	140	n/a	Yes	Trout Creek jasper	Mid-section	0.36	10.43	17.43	1.64	n/a	n/a
AS26	141	n/a	Yes	Trout Creek jasper	Mid-section	0.22	11.96	10.93	1.16	n/a	n/a
AS27	142	n/a	Yes	Trout Creek jasper	Mid-section	0.36	9.66	13.90	1.97	n/a	n/a
AS28	144	n/a	Yes	Trout Creek jasper	Proximal	1.05	20.81	16.40	2.36	5.51	1.95
AS29	145	n/a	Yes	Trout Creek jasper	Mid-section	0.42	9.99	14.99	2.34	n/a	n/a
AS30	146	n/a	Yes	Trout Creek jasper	Mid-section	0.65	16.19	15.23	1.90	n/a	n/a
AS31	147	n/a	Yes	Chert (brown translucent)	Proximal	0.43	12.34	13.11	2.29	4.36	1.37
AS32	148	n/a	Yes	Chert (brown translucent)	Proximal	0.42	15.51	15.18	1.58	3.36	1.46
AS33	149	n/a	No	Chert (brown translucent)	Mid-section	0.31	9.81	16.14	1.89	n/a	n/a
AS34	143	8d	No	Trout Creek jasper	Distal	0.27	15.70	6.74	3.01	n/a	n/a

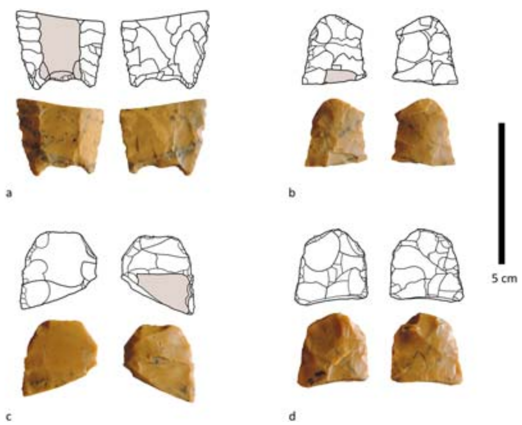

Figure 4 Folsom point preforms: (a) AS03; (b) AS04; (c) AS05; (d) AS06.

Finally, Specimen AS10 (Figure 5(d)) appears to be a "miniature" of an artifact preform (e.g., Buchanan et al. 2019; Ellis 1994; MacDonald 1968; Moeller 1980). Both faces possess flake scars that could be flutes. Unfortunately, the lack of a distal half prevents a definitive identification.

3.3. Unifacial tools

Three unifacial tool specimens (AS11-AS13) are present in Patten's assemblage (Table 1), two made on chert macroscopically consistent with Trout Creek jasper. Specimen AS11 (Figure 6(a)) is the distal end of a relatively large, snapped flake or possibly at one time a large end scraper that snapped. It possesses a wide distal bit, and a notch on the right lateral edge. There is a large flake scar on its dorsal face that is parallel to the bit (and perpendicular to the original flake) that extends across its entire width; this may have been either an overface flake removal or overshot mistake. Specimen AS12 (Figure 6(b)) is the distal lateral fragment of a retouched flake. The third unifacial tool (AS13, Figure 6(c)) is a graver spur that was knapped on a whitish-gray fossiliferous chert.

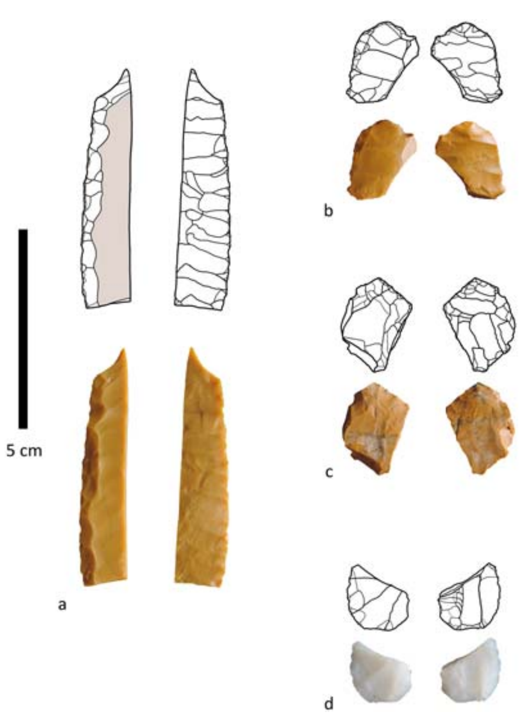

Figure 5 Folsom point preforms: (a) AS07; (b) AS08; (c) AS09; (d) AS10.

3.4. Debitage

The Patten collection comprises 24 pieces of debitage, most of which ($n = 18$) are consistent morphologically with Folsom flute removal (channel) flakes. The small number and high proportion of channel flakes may reflect a case of sample bias: Patten reported collecting several hundred flakes from the site (Patten 2005, 168), which more than likely included biface-thinning flakes and other debitage resulted from the point and biface production that was taking place at the site. It is unclear why the collection we received is dominated by channel flakes. In any case, four of the channel flakes are illustrated (Figure 7(a–d)), and the basic metric data for these and the other pieces of debitage are provided in Table 2. Four specimens that are too small and fragmentary to confidently identify are not included in the table.

With respect to the flute-removal flakes, there are no refits between flakes, or between flakes and the preforms or points. Five are proximal fragments possessing platforms, thirteen are mid-sections, and two are distal fragments (Table 2). Between the fragment and raw-material tallies, the minimum number of flute removals is seven. This is less than the 30 fluted points Patten (2005, 163) estimated were manufactured at the site, a discrepancy likely owed to the incompleteness of the sample in this analysis.

4. Morphometrics

We compared the width and thickness of the two basal point fragments (Points 1 and 2) from Antelope Springs to the width and thickness of complete Folsom points from documented assemblages. The measurements of complete Folsom points were compiled from the published literature and correspond to 113 specimens from 24 assemblages (Supplemental Online Material). We focus on the comparison of width and thickness because both could be directly measured on the Antelope Springs point fragments and were recorded on the points in the larger sample.

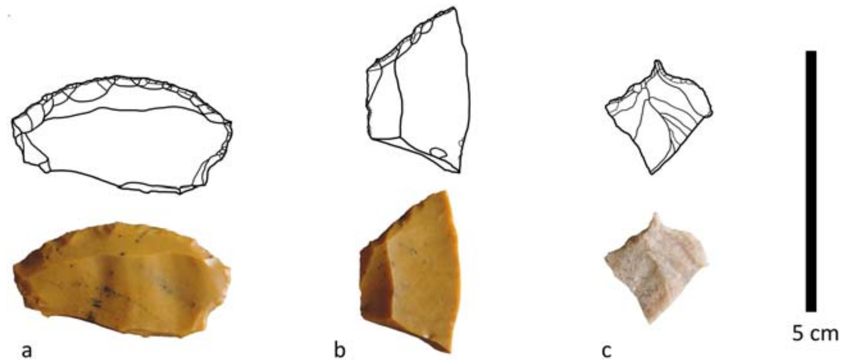

Figure 6 Unifacial tools: (a) AS11; (b) AS12; (c) AS13.

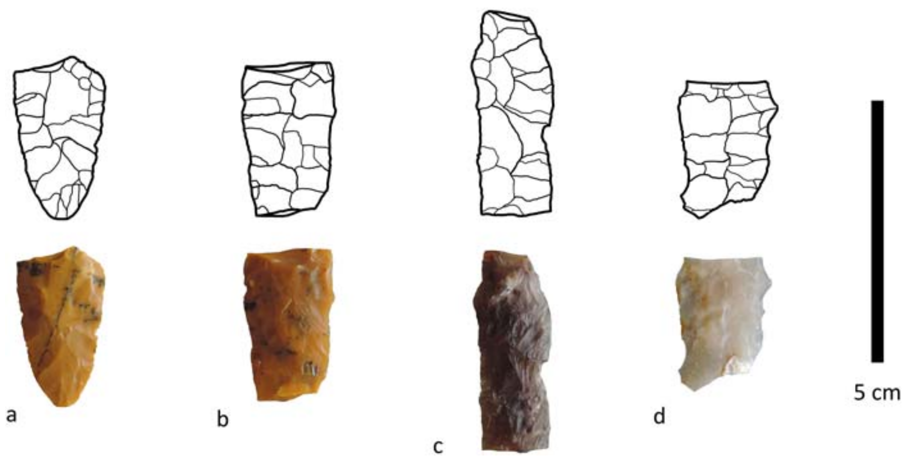

Figure 7 Select channel flakes: (a) AS14; (b) AS15; (c) AS16; (d) AS17.

The distribution of both width and thickness of the complete Folsom points conform to an underlying normal distribution (Shapiro–Wilk tests: width $W = 0.99$, $p = 0.72$; thickness $W = 0.98$, $p = 0.08$), indicating that the mean is a good measure of central tendency of these samples. The average value of Folsom point width (excluding the Antelope Springs specimens) is 19.47 mm (95% bootstrapped confidence limits of 18.93–20.02) and the average thickness is 3.93 (95% bootstrapped confidence limits of 3.76–4.10). Both Antelope Springs point fragments are wider than average but fall within the thickness range of other Folsom specimens. In the case of Antelope Springs Point 1, it is significantly wider than the average width of complete Folsom points in our sample, as indicated by *t*-test (Table 3).

5. Microwear

We conducted lithic microwear analysis of all tools and debitage using an Olympus BX51M metallurgical microscope equipped with a digital camera and Olympus Stream software to compare use-wear patterns on archaeological specimens to experimentally replicated use-wear patterns (Keeley 1980; Van Gijn 2014). Prior to analysis and following modern convention for the removal of human finger oils that can mimic use polish, we washed each artifact in a bath of liquid soap and then water for ten minutes using an ultrasonic cleaner. This washing method has proven effective in our studies of Paleoindian assemblages, largely from the eastern USA, as well as those of others in the southeast and west of the Mississippi River (Bebber et al. 2017; Eren et al. 2016; Kay 1996; Loebel 2013; Miller 2013, 2014; Miller et al. 2019; Pevny 2012; Smallwood 2015; Smallwood and Jennings 2016; Werner et al. 2017).

Table 3 *T*-scores for individual values of width and thickness for Antelope Springs point fragments 1 and 2 in comparison to a sample of width (mean = 19.47 mm) and thickness (mean = 3.93 mm) for 113 complete Folsom points.

Specimen and measure	Antelope Springs value	*t*	*p*
Point 1, width	26.29	2.28	0.02*
Point 1, thickness	3.91	−0.02	0.98
Point 2, width	20.28	0.27	0.79
Point 2, thickness	3.70	−0.25	0.80

*This case is significantly different from sample.

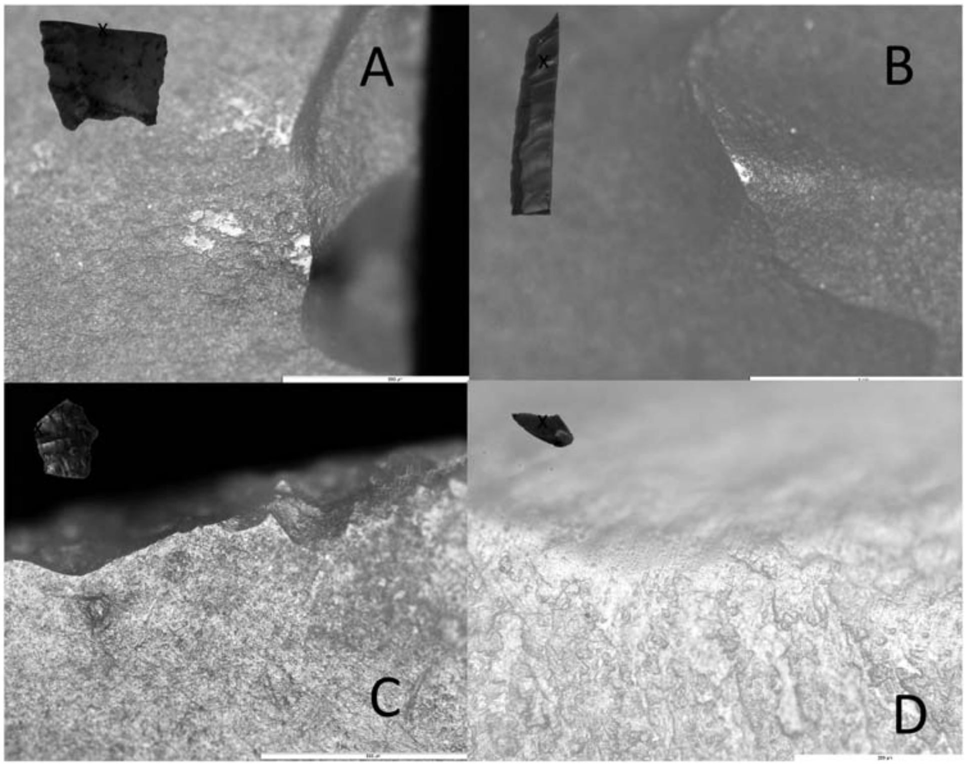

Figure 8 (a) Bright spot of polish in the flute scar of a fluted point preform (AS03; magnification is 100×); (b) bright spot of polish in the flute scar of a fluted point preform fragment (AS07; magnification is 50×); (c) glossy patina on the surface of a biface fragment (AS09; magnification is 100×); (d) matte polish and edge rounding on the dorsal surface of a retouched flake (AS34; magnification is 200×). The locations of all photos are indicated by the inset artifact photos.

Microwear analysis of the assemblage was hampered by the presence of a light to moderately developed glossy patina over artifacts surfaces (e.g., Figure 8(c), specimen AS09). This has the potential to mask faintly developed use-wear traces, especially those related to meat and hide working (Levi-Sala 1986). Thus, the wear patterns described below represent the minimum number of utilized tools and their functions.

One unifacial tool (AS11) was used in a scraping motion, as evidenced by striations perpendicular to the working edge, on bone/antler material (Figure 9). The bright micro-pitted polish on the uniface was restricted to a narrow band along the working edge, all of which are consistent with experimentally-produced bone/antler polish. Numerous bright spots of polish were observed throughout the surface of the tool, especially on the ventral face. These may be associated with hafting or transport. Given the presence of glossy patina on this implement and all others in the assemblage, as well as the presence of bright spots on numerous other artifacts, it is perhaps more likely these are the result of post-depositional processes such as contact with soil or stone through natural mechanical processes such as bio and cryoturbation (Levi-Sala 1986; Pevny 2012).

Fragments of fluted-point preforms AS03 and AS07 contained evidence of bright spots of polish (Figure 8 (a,b)). Experimentally, these have been associated with hafting and transport (Loebel 2013; Rots 2010), and the bright spots in this assemblage may relate to one or both of these behaviors. However, as bright spots

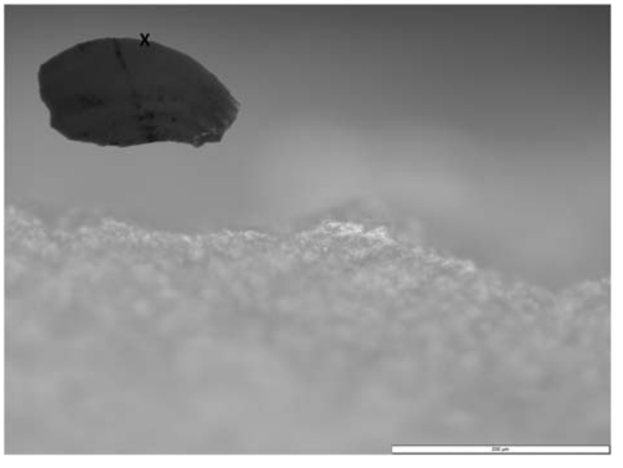

Figure 9 Bright, micro-pitted polish restricted to the working edge of unifacial tool (AS11) used to scrape bone/antler (magnification is 200×). Location of polish is indicated by the X on the inset artifact photo.

are also associated with post-depositional processes, and given the presence of glossy patina on all Antelope Springs artifacts, we cannot rule out post-depositional factors as the main culprit of bright-spot formation.

Similarly, the presence of polish along the tool edges of some artifacts, such as the retouched flake pictured in Figure 8(d) (AS34), suggests that these may have been utilized. If this artifact was utilized, it must have been as part of a larger implement with this flake removed during a subsequent re-sharpening or re-working event. However, the impact of post-depositional polish cannot be ruled out for these specimens due to the overall impact on the assemblage and experimental evidence demonstrating the ability of post-depositional polish to mimic use-wear in some ways (Levi-Sala 1986; Pevny 2012).

In summary, one implement (AS11) was definitively utilized to scrape bone/antler while the presence of definitive, and suspected, post-depositional surface modifications preclude further functional inferences in the assemblage.

6. Antelope Springs lithic sources

As noted earlier, Patten identified the jasper used to manufacture the Folsom points at Antelope Springs as likely coming from the Trout Creek source (5CF84), which outcrops over a large (400 ha) area (Black and Theis 2015), just ~16 km west of Antelope Springs. He also noted that a chert or chalcedony outcrops at the site, and several specimens in the assemblage are made on this material (Tables 1 and 2). We were not able to collect samples of the local chert/chalcedony, but having samples of Trout Creek jasper for comparison,[1] we conducted a pXRF analysis of the artifacts from Patten's collection, comparing the specimens to hand samples of Trout Creek jasper, to look-alike jasper collected from Parlin Flats in the Gunnison Basin, and from a flake from the Folsom site previously visually identified as Black Forest silicified wood (Meltzer 2006), which in smaller flakes can readily resemble Trout Creek jasper (Jodry 1999a, table 46).

With three exceptions, all of the Antelope Springs tools and most of the channel flakes and debitage that appear visually similar to Trout Creek jasper are chemically similar as well (Supplemental Online Material), and in fact cluster in a manner that suggests most of the specimens are from flakes derived from a chemically distinctive and homogeneous jasper. There is one exception among the tools, preform fragment AS09 (Figure 5(c)), which not only is distinct from all the other Trout Creek jasper specimens (with significantly higher Zn and Fe content), but also is dissimilar from the Parlin Flats and Black Forest stone sources. This suggests that "blanks" for point production were brought to the site from another source, which is emphasized by two channel flakes that are significant outliers (though in this instance by virtue of much higher Fe levels). The other source(s) need not have been distant: jaspers similar to Trout Creek are known to occur elsewhere in South Park (Black 2000; Black and Theis 2015), and it is possible that this chemically-outlying preform was from one of those look-alike sources. Given that one of the Antelope Springs artifacts is visually similar to, but chemically distinct from, both hand samples of Trout Creek jasper, and the rest of the Antelope Springs artifacts, future detailed geochemical provenance research in this region rich in look-alike stone sources (Black 2013; Black and Theis 2015; Black et al. 2003) would be fruitful.

7. Trout Creek Pass as a possible travel corridor

Though traditionally considered a High Plains-oriented group, research over the past two decades indicates that Folsom peoples made extensive use of the Rocky Mountains, in some cases likely overwintering there (e.g., Barger Gulch, Mountaineer) and possibly occupying montane basins year-round (Andrews, Meltzer, and Stiger forthcoming; Kornfeld 2013; Kornfeld and Frison 2000; Naze 1986; Pitblado and Brunswig 2007; Surovell and Waguespack 2007).

Movement in and across this mountainous region, however, would have varied seasonally and been constrained and/or directed by topography. Most especially, groups moving from the High Plains into the mountains, or between interior montane parks (North Park, Middle Park, South Park) and valleys (Arkansas, Gunnison, San Luis), would almost certainly have used passes or low saddles when crossing the Continental Divide or the other mountain ranges separating these regions.

The Trout Creek lithic source is located at and derives its name from one such pass, which forms a key transit point between the southwestern corner of South Park and the headwaters region of the Arkansas River. Once in the latter, Folsom foragers would have had relatively easy access over Poncha Pass south into the headwaters area of the Rio Grande River, and could also travel further southwest into the Gunnison Basin and beyond (and move in the reverse direction, of course). Hence, it is reasonable to hypothesize that the Trout Creek lithic source could have been readily accessed in the course of travel in the mountains (an instance of embedded procurement (Binford 1979)), as well as being an easily located source for a task group procuring the stone (Speth et al. 2013).

It is noteworthy, therefore, that Trout Creek jasper is reported to occur in assemblages at other Folsom sites, including Barger Gulch Locality B, located in Middle Park, ~140 km to the north (Surovell and Waguespack 2007, 224), as well as four Folsom sites in the San Luis valley – Cattle Guard, Linger, Reddin, and Zapata – at distances of ~100–150 km to the south of the Trout Creek source[2] (Jodry 1999b, table 6–11). Trout Creek jasper is also reported farther afield at the Lindenmeier site, ~260 km to the north (Jodry 1999a, table 48). Visually similar stone can be found at other sources, some near the principal Trout Creek quarry (Black 2013; Black and Theis 2015), and others more distant, including in the Hartville Uplift of east-central Wyoming (Miller 1996; Reher 1991), which would be ~100 km closer to Lindenmeier than the Trout Creek source. As we have not examined the lithic materials at those sites ourselves, for this analysis we will accept the identifications made by the respective investigators.

On the surmise that Trout Creek jasper was part of Folsom lithic assemblages to the south and north of the source, we undertook a detailed GIS study of least-cost paths through South Park. We were particularly interested in least-cost routes that might have been taken by Folsom groups moving through that region, either traveling north–south, such as between the San Luis Valley and Middle Park, or east–west, as for example from the High Plains into the Rockies. The primary question we sought to answer was whether such movement would bring them to and through Trout Creek Pass, and hence into the vicinity of Antelope Springs.

For purposes of the GIS analysis, we used known Folsom sites as location proxies for these regions and movements. The sites in the analysis were Antelope Springs, Barger Gulch, Black Mountain, Cattle Guard, Folsom, Lindenmeier, Mountaineer, Platte Canyon, and Westfall (Eren, Meltzer, and Colwell 2011; Hofman, Westfall, and Westfall 2002; Jodry 1999a; 1999b; Meltzer 2006; Surovell and Waguespack 2007; Wilmsen and Roberts 1978). We also incorporated into the analysis other lithic sources potentially or known to be used by Folsom groups: Flattop chalcedony from northeastern Colorado, and Black Forest silicified wood (also known as Bijou Basin or Elizabeth Petrified Wood) from just east of the Front Range in central Colorado (Banks 1990; Black et al. 2003; Hoard et al. 1992). There are other sources both west and east of the Continental Divide in Colorado that yield silicified wood (Black et al. 2003, figure 5), but we will assume for the purpose of this analysis that it was the Black Forest/Bijou Basin source, which is extensive and known to have been used in Folsom and Paleoindian times (Banks 1990).

Least-cost paths (LCPs) were calculated using the Path Distance tool in ESRI's ArcGIS Pro (v. 2.5). Elevation and slope were extracted from the 1 arc-second (ca. 30 m) SRTM digital elevation dataset (Supplemental Online Material). The Path Distance analysis determines a least-cost travel corridor, factoring in differences in cost between uphill and downhill paths. Two sets of path analyses were performed: one in which cost was defined as the time required to traverse terrain from the origin to the destination using Tobler's hiking function (Tobler 1993), and one in which cost was defined as the amount of energy (kcal) expenditure along the path (Minetti et al. 2002). Our modeling was conducted assuming that travel occurred during months when snow accumulation would not restrict movement into and out of mountainous terrain. Given the absence of easily navigable waters in our study area, our modeling neither favors nor penalizes travel by water. Both cost metrics produced very similar least-cost paths (they differed in only a few instances of which route would be more likely to be taken, but mostly – for reasons discussed below – in areas away from South Park and Trout Creek Pass). Reasoning that the amount of energy is a more relevant measure in movement through mountainous terrain, the maps that follow all use the amount of energy expenditure as the cost basis (Figure 10). Paths were calculated from each site to each lithic source, as well as from each site to each other site. Interested readers are referred to our Supplemental Online Material where both sets of cost paths are provided for further study and analysis.

There are a number of observations to be made of these maps, both in terms of the LCPs between the various Folsom sites to the lithic sources, and between the Folsom sites themselves. What is perhaps most striking is the likelihood that Folsom groups traveling into or through the mountains would have come into the vicinity of Trout Creek Pass, and its stone source.

For example, there are two LCPs between Middle Park and the San Luis Valley (Figure 11) depending on which metric is used to model the cost of travel. When energy (kcal) is the cost metric, the LCPs between Cattle Guard and Barger Gulch both pass between Antelope Springs (within 6 km to the east) and Trout Creek Pass (roughly 8 km to the west). The specific paths through South Park differ (though not on a scale visible in Figure 11), but both go through Boreas Pass on the north end of South Park, Badger Creek on the south end of South Park, and Hayden Pass into/out of the San Luis Valley. When using time as the cost metric, the path from Barger

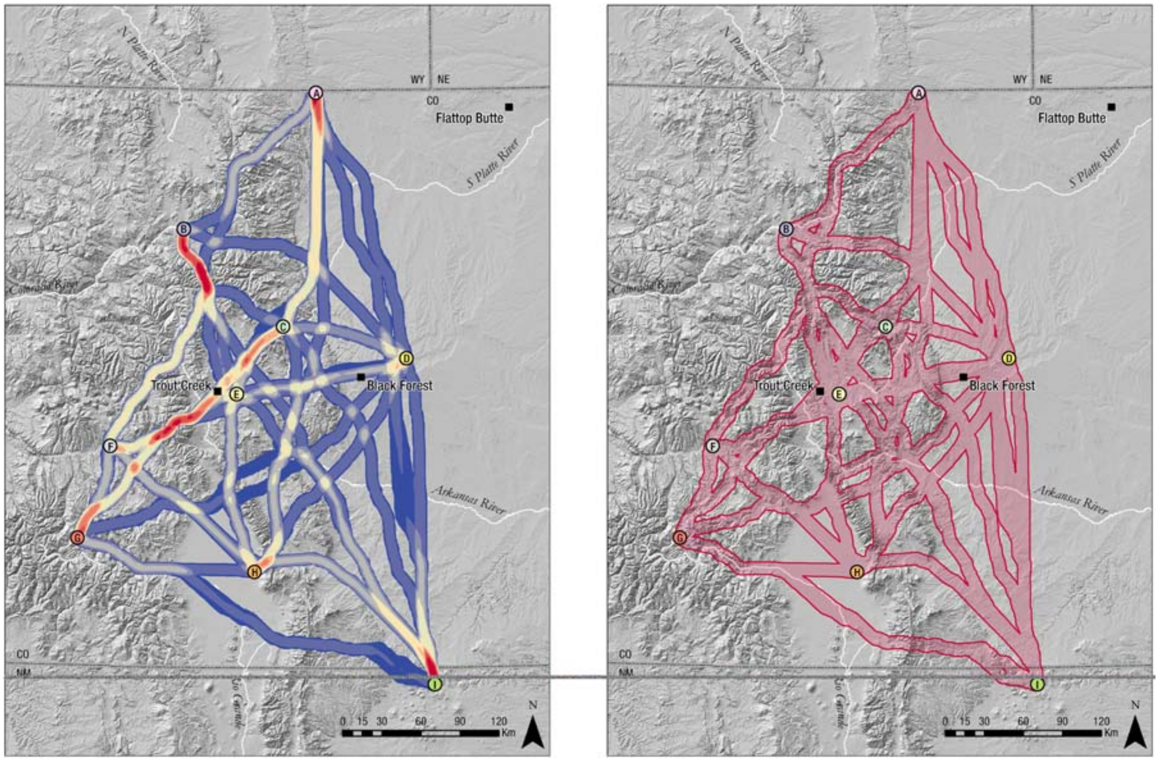

Figure 10 (left) Heat map showing the densities of overlapping least-cost paths between Folsom sites in the southern Rocky Mountains, with cost defined as the amount of energy (kcal) expenditure (coloration is a gradient from blue (low; 0.0001), to yellow (median; 0.001), to red (high; 0.002) showing the density of overlapping paths per six square miles); (right) as map on left, with colors removed to show underlying topographic detail (paths have been buffered to represent a six-mile-wide corridor). Sites: (A) Lindenmeier, (B) Barger Gulch, (C) Platte Canyon Bypass, (D) Westfall, (E) Antelope Springs, (F) Mountaineer, (G) Black Mountain, (H) Cattle Guard, (I) Folsom.

Gulch to Cattle Guard is more or less identical to those using energy as the metric. Interestingly, the path from Cattle Guard to Barger Gulch determined using time as the cost measure takes an entirely different route: exiting the San Luis Valley through Poncha Pass (further to the west), through the Arkansas River valley before turning up and through Trout Creek Pass, and passing through Hoosier Pass at the northern end of South Park.

Thus, regardless of what measure is used, the LCPs suggest that individuals moving between these regions would pass either through or immediately adjacent to the Trout Creek lithic source. It is therefore not surprising that Barger Gulch and Cattle Guard, separated by a distance of ~300 km, both have Trout Creek jasper in their assemblages (as do the other Folsom sites in the San Luis Valley (Jodry 1999a, table 48)). Lindenmeier, even farther afield, is reported to have a small amount of Trout Creek jasper as well (Jodry 1999a, table 48; Jodry 1999b, table 6–11; Surovell and Waguespack 2007, 224). This is not to say it was the very same Folsom group at these sites. However, it highlights the fact that people moving north or south between these regions would have passed by the Trout Creek source with a minimum of detouring.

Folsom groups moving east–west between the High Plains and into the mountains (Figure 12) might under some circumstances travel through South Park and exit (or enter) via Trout Creek Pass. For example, the most efficient paths connecting the Westfall site on the High Plains, with Mountaineer and Black Mountain in the mountains, all come through Trout Creek Pass. Interestingly, the Platte Canyon Folsom locality appears to be especially well situated as an entry point into the mountains for groups coming from the High Plains. That the modern roadway in the mountains from the Front Range (US Highway 285) comes through this same area was likely based on similar topographic considerations.

LCPs from various Folsom sites in and adjacent to this region of the Rocky Mountains (Figure 13) further demonstrate how travel is constrained by topography. Coming in from the High Plains at a variety of points (whether from the north (Lindenmeier), east (Westfall), or south (Folsom)), the LCPs enter the mountains at various spots (including near Platte Canyon), but soon converge on single optimal routes. Similar convergences of paths can be seen for groups traveling from the opposite side of the Continental Divide (as

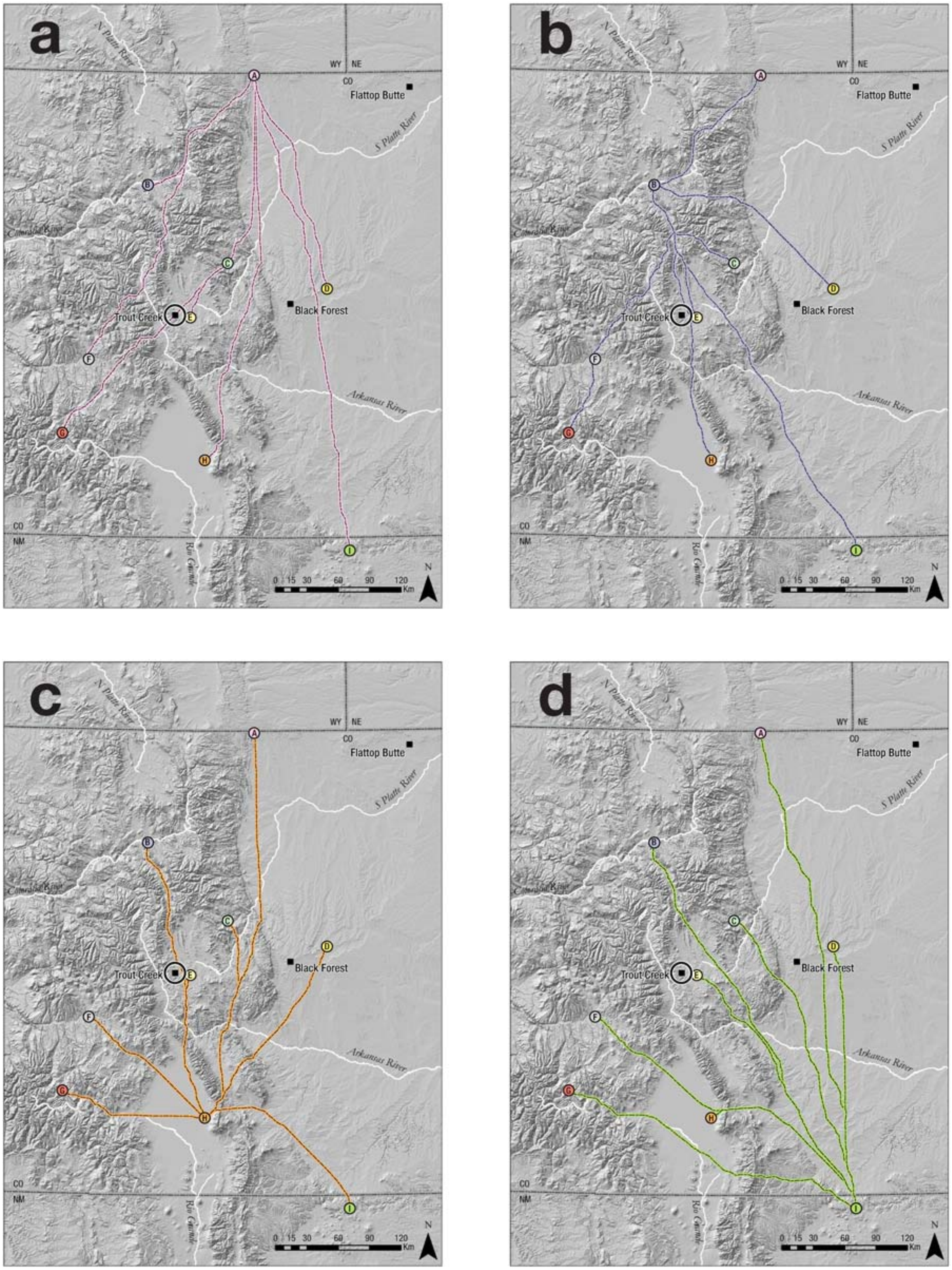

Figure 11 Least-cost paths between Folsom sites in the southern Rocky Mountains: (a) Lindenmeier, (b) Barger, (c) Cattle Guard, (d) Folsom. Site designations as in Figure 10.

from the Mountaineer and Black Mountain sites). In effect, the combination of topography and the limited number of lower-elevation passes through the mountains would have guided animal and human movements.

8. Discussion and conclusions

Given the evidence for Folsom-point production at the Antelope Springs site, the relative dearth of other tool types at the site, and what Patten (2005, 282–283) described as "intensive reduction and replacement of partially exhausted stores," Antelope Springs appears to represent a briefly occupied re-tooling spot, located near a perhaps-often used topographic pass that happens to have a source of high-quality stone. Least-cost paths between areas of the Rocky Mountains, particularly to and from more heavily-occupied lower-elevation basins, would from many starting points have ultimately taken groups through South Park and Trout Creek Pass. In montane environments, where

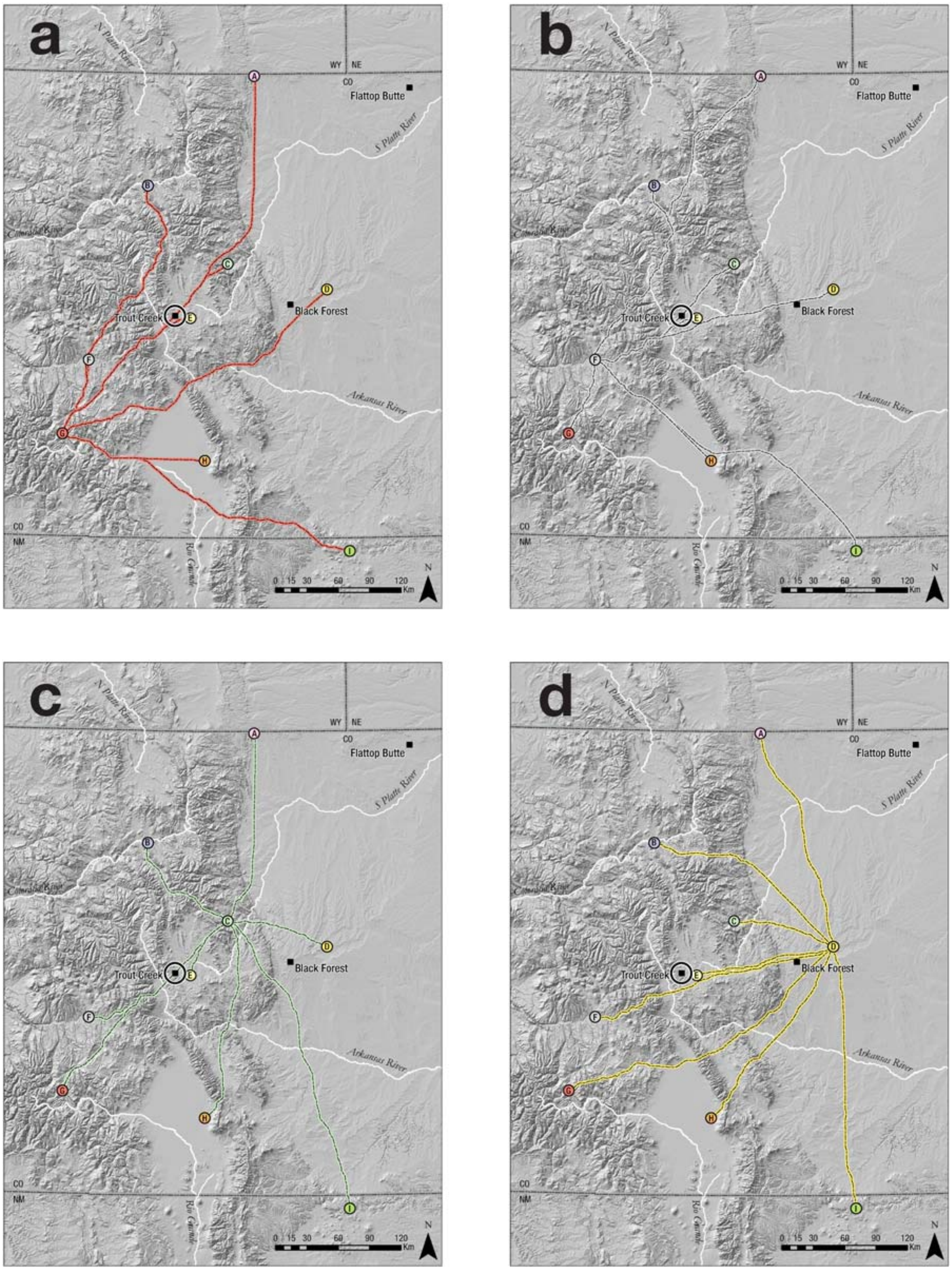

Figure 12 Least-cost paths between Folsom sites in the southern Rocky Mountains: (a) Black Mountain, (b) Mountaineer, (c) Platte Canyon, and (d) Westfall. Site designations as in Figure 10.

there are relatively few low saddles and passes amidst high ranges, many routes through the mountains will converge on the same transit points over the mountains. If, indeed, the Trout Creek Pass and its lithic source was something of a "waystation" for Folsom groups traveling through the region, there once may have been other sites like Antelope Springs in the vicinity which have yet to be found, or were since lost.

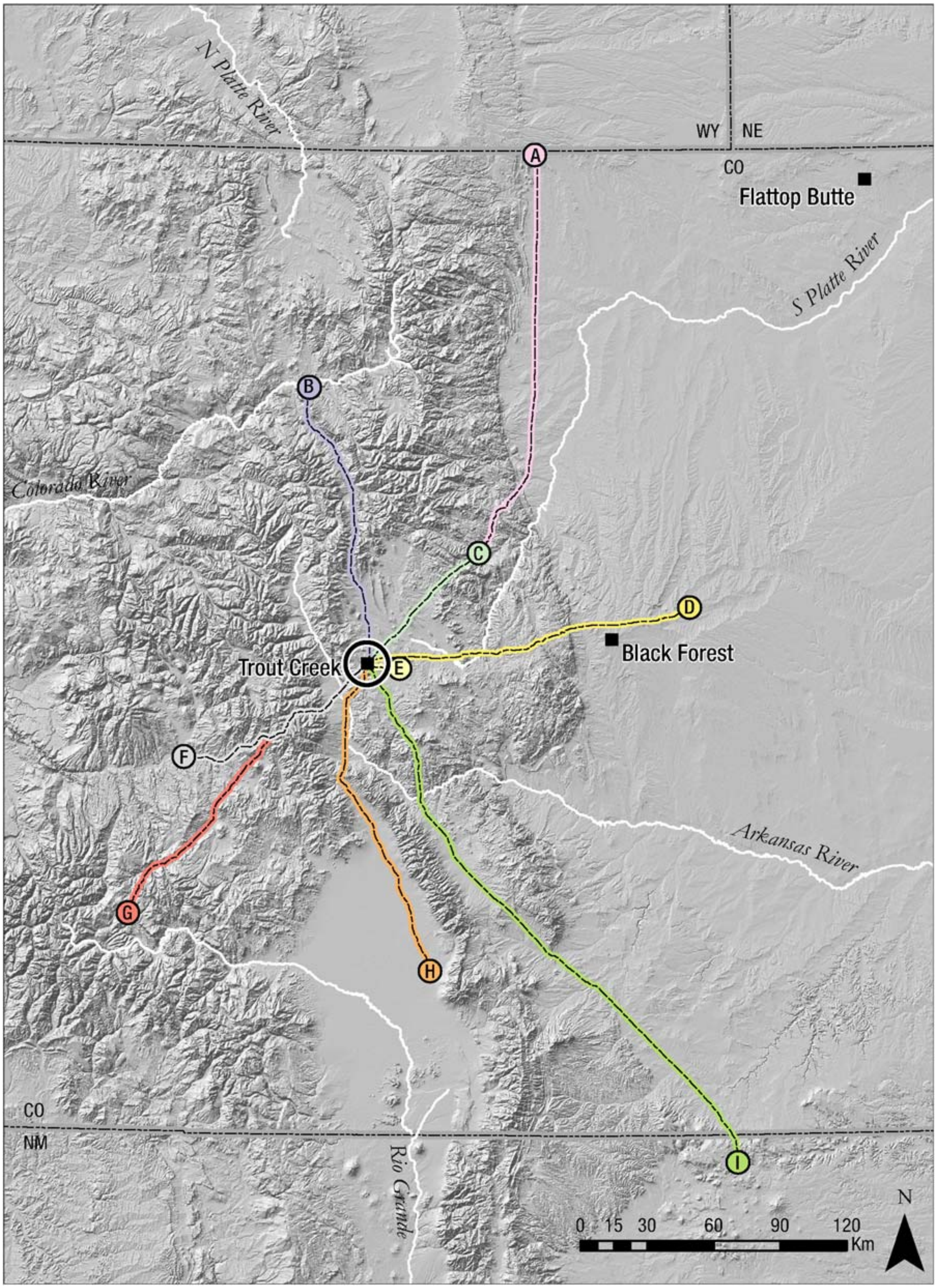

Figure 13 Least-cost paths from Folsom sites in the southern Rocky Mountains to Trout Creek Pass. Site designations as in Figure 10.

The distribution of lithic raw-material sources used by Folsom groups in the southern Rocky Mountains and adjacent High Plains, relative to the locations of their sites, and the constraints imposed by topography in moving between them, potentially provides broader insight into Folsom mobility patterns and settlement ranges.

For example, the occurrence of Trout Creek jasper appears to be principally used at sites located on a roughly north–south axis through the interior southern Rocky Mountains (Table 4). Significantly, it does not occur in two of the Folsom sites west/southwest of the Continental Divide – Mountaineer and Black Mountain – even though both are within relative proximity on a Folsom scale (~100 and ~160 km, respectively) of the Trout Creek source. But then reaching the Trout Creek source from those sites requires travel over high-elevation passes (e.g., Cottonwood Pass at ~3700 masl or Monarch Pass at ~3500 masl from the Gunnison Basin where Mountaineer is located), which may have served as a formidable barrier, especially during winter in the late Pleistocene. In fact, no stone from the other two major lithic sources east of the Continental Divide and Front Range (Black Forest and Flattop) occur in the Mountaineer or Black Mountain Folsom assemblages, although of course the distances from these sites to those sources are greater (a distance on the order of 200–500 km), and require crossing even more high mountain divides. Mountaineer was also found to be an isolated outlier in an analysis of shared toolstone networks (Buchanan et al. 2019), with no identifiable materials shared with any other known Folsom sites.

It is also the case that stone sources east of the Continental Divide are not evenly distributed across Folsom sites on that side of the Divide (Table 4). Flattop chalcedony, for example, appears to be absent from Barger Gulch[3] and Cattle Guard (Jodry 1999a; Surovell and Waguespack 2007), yet is present – albeit in low percentages – at the Folsom site (Meltzer 2006). This is so, despite the fact that the distance from Folsom to Flattop is over 450 km, far greater at least than the distance from Barger Gulch to Flattop (< 300 km). But then travel between Folsom and Flattop (and the Black Forest source as well) was far less circuitous, and did not involve crossing substantial topographic barriers. In a sort of mirror image to the pattern at Barger Gulch and Cattle Guard, Trout Creek jasper is not present at Folsom; the distance (~295 km) is less than from Folsom to Flattop, but has the added travel cost of moving through the mountains, rather than on the open High Plains.

Present in all of these sites in the southern Rocky Mountains and adjacent High Plains is silicified wood, though it is present in different amounts (Table 4). As earlier noted, we assume for the purpose of this analysis that the source was Black Forest chert from the Bijou Basin. Accordingly, we observe that silicified wood is abundant at the Westfall site which is near that source (Hofman, Westfall, and Westfall 2002); that silicified wood comprises one-third of the assemblage at Cattle Guard, ~180 km from the source (Jodry 1999a). Black Forest silicified wood occurs in far smaller amounts at Folsom (Meltzer 2006), and only in trace amounts at Barger Gulch and Lindenmeier (Jodry 1999a; Surovell and Waguespack 2007). It is worth adding that in terms of distance and ease of movement, the Black Forest source was accessible to both the Folsom and Lindenmeier sites (they are almost equidistant (~230–250 km) to that source), and yet it is scarce at Lindenmeier and, as Stanford (1999) observed, occurs only rarely north of the South Platte River.

Other patterns emerge in looking at the diversity of stone types represented in the assemblage. At Barger Gulch and Mountaineer, for example, single lithic sources dominate, and in both cases the dominant stone is locally abundant and available: Troublesome Formation (Kremmling) chert at Barger Gulch, and local quartzites at Mountaineer (Andrews, Meltzer, and Stiger forthcoming; Surovell and Waguespack 2007). It is perhaps no coincidence that both sites may represent a long term, possibly winter occupation, where Folsom groups stayed put long enough to exhaust any materials carried in from elsewhere, save for trace amounts, such as the Trout Creek jasper and Black Forest chert at Barger Gulch (Andrews, Meltzer, and Stiger forthcoming; Surovell 2009). At those sites, in fact, the

Table 4 Distances and distribution of lithic raw material at Folsom sites in the southern Rocky Mountains (raw material source data from Jodry 1999a, table 48; Meltzer 2006; Surovell and Waguespack 2007).

	Black Forest silicified wood			Flattop chalcedony			Trout Creek jasper			Local stone
	Present?	Amount	Distance	Present?	Amount	Distance	Present?	Amount	Distance	Available?
Cattle Guard	Yes	37%	181	No	n/a	432	Yes	12%	153	No
Folsom	Yes	7%	255	Yes	7%	462	No	n/a	295	No
Lindenmeier	Yes	Trace	230	Yes	12.5%	152	Yes	5%	262	No
					Continental Divide					
Barger Gulch	Yes	Trace	195	No	n/a	288	Yes	Trace	138	Yes
Black Mountain	No	n/a	275	No	n/a	486	No	n/a	167	No
Mountaineer	No	n/a	217	No	n/a	425	No	n/a	106	Yes

presence of locally-available stone is what likely made an extended stay possible (Surovell 2009).

In sites with more lithic raw-material diversity, which are routinely ones where there is no locally-available stone, there are geographic patterns of note: of the identifiable stone at Folsom, the majority (~72 per cent) came from the Alibates agatized dolomite and Tecovas jasper sources in the Texas Panhandle ~200–375 km to the southeast of the site, with smaller components from the Black Forest (8 per cent) and Flattop (12 per cent) sources to the north (Meltzer 2006). Cattle Guard has a variety of materials, though none in frequencies > 40 per cent, and represented at that assemblage is stone from sources north, east, and south of the site, including Alibates agatized dolomite and Edwards formation chert from the Texas Panhandle and central Texas, the latter ~750 km distant (Jodry 1999a). Perhaps even more diverse and equally widely scattered geographically is the stone comprising the assemblage at Lindenmeier. The predominant material (~50 per cent) comes from the Hartville Uplift of east central Wyoming north of the site, but also includes small amounts of stone from distant and geographically widely scattered sources, such as Knife River flint from North Dakota, Chuska chert from New Mexico, and even Edwards formation chert from central Texas (Hofman, Todd, and Collins 1991; Jodry 1999a; Wilmsen and Roberts 1978).

In effect, diverse as these assemblages are, they have different geographic "centers of gravity," as determined by the direction from which most of the stone used at the site was obtained. They nonetheless overlapped to a degree in their use of certain sources, as indicated by the presence of Black Forest silicified wood at the Folsom sites east and west (Barger Gulch) of the Continental Divide (Table 4; also Stanford 1999). At a broader geographic scale, network analysis of Folsom toolstone usage shows significantly "denser" networks than earlier groups, and suggests that Folsom people likely had regular habits of toolstone acquisition as they settled in to their local habitats (Buchanan et al. 2019). In so far as these reflect a habitual pattern of movement, as opposed to merely the last stone source visited by the group, the toolstone patterns could mark areas of their exchange networks, an aggregation event (as suggested might be the case at Lindenmeier (Hofman 1994)), and/or as Stanford suggests, the "traditional areas of exploitation by independent Folsom bands" (Stanford 1999, 303; see also Meltzer 2006, 292–293).

In this last regard, and to emphasize a point made earlier: there is limited overlap in raw-material sources between Folsom sites east and west of the Continental Divide. Stone used at Rocky Mountain Folsom sites west of the Divide was either locally obtained (as at Mountaineer), or was obtained from sources to the south and southwest (e.g., the Mosca and Cumbres sources used at Black Mountain (Jodry 1999a)). It appears the Continental Divide was in places a substantial topographic barrier keeping separate the Folsom groups on either side, even where the distances between source and site – such as the ~100 km between Trout Creek and Mountaineer – were insignificant, at least on the scale of Folsom-period mobility.

Notes

1. The hand samples used in the pXRF analysis are from the Tony Baker collection, Quest Archaeological Research Laboratory, SMU. Unfortunately, the precise spot where Baker collected the samples was not recorded. Although we suspect they came from 5CF84, the principal Trout Creek Quarry site, we have not been able to confirm this suspicion.
2. Black and Theis (2015) observe that lithic material macroscopically similar to Trout Creek occurs south of the principal source, indicating a potentially shorter (by ~40 km) travel distance to the San Luis Valley, assuming groups exploited those localities.
3. Todd Surovell (personal communication, 2020) reports that while he and his colleagues have never positively identified Flattop at Barger Gulch, there are a couple of artifacts that he suspects may be made of that material. However, because of its similarity to Troublesome chert, he has not identified Flattop as the source of those specimens.

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