THE WHITE RIVER ASH FALL: MIGRATION TRIGGER OR LOCALIZED EVENT?

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Abstract

The effect of the White River Ash (WRA) was not as catastrophic as most people believe and was not related to the origins of the Navaho and Apache.

Resumen

El efecto de la caída de ceniza en el White River: catalizador de migración o un evento local?
El efecto de la lluvia de ceniza en el White River no fue una catástrofe como mucha gente cree y tampoco está relacionado con en el origen de los indios Navajo y Apache.

Résumé

La retombée de cendre White River Ash (WRA): catalyseur de migration ou évènement local?
Les effets de la retombée de cendre appelée White River Ash n'ont pas été aussi catastrophiques que certains prétendent et ne sont pas à l'origine des peuples Navajo et Apache.

Resumo

O efeito de White River Ash (WRA): catalizador de migração ou um evento localizado?
Os efeitos da calota de cinzas chamada White River Ash não foram uma catástrofe tão grande como muitos acreditam e não estão relacionados com a origem dos povos Navajo e Apache.

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Introduction

The White River ash deposits in the Yukon, Northwest Territories and Alaska resulted from two separate eruptions of Mount Churchill-Bono, a stratovolcano near the Alaska-Yukon border (Lerbekmo and Cambell 1969; Richter *et al.* 1995), although recent research has cast some doubt on this point of origin (Anonymous 2004). The second and largest of these eruptions, at AD 803 (1147 years before the radiocarbon baseline of 1950), produced the eastern ash lobe, estimated to contain up to 30km^3 of tephra (West and Donaldson 2000) and covering some 540,000km^2 (Robinson *et al.* 2000). The ash generally varies in thickness from a trace to 60cm, depending on distance from the source (Figure 1). At the time of the eruption the area around the vent itself was unpopulated, while that further afield to the east was inhabited by sparsely scattered Dene hunter-gatherers.

Proposed Effects of the White River Ash Fall and Athapaskan Migrations

Derry (1975), Workman (1979) and to a lesser extent, Moodie, Catchpole and Able (1992) and Hare (cited in Gamble 2007) link a Dene exodus from northwestern Canada with the White River ash (WRA) fall. Ives (1990:42-6) reiterates Derry and Workman's early long distance proposal that "The (eastern) ash fall… is thought to have initiated the Athapaskan (Dene) migrations that, to the south, culminated in the formation of the… Apache and Navajo of the southwestern United States" (Workman 1974, 1979). In his PhD thesis, Workman (1978:430) took a more moderate view, stating that the Aishihik-Kluane Dene of the southwest Yukon were relatively unaffected by the ash fall. Lately, he (pers. comm. 2011) neither advocates nor discourages any exodus theory, preferring to wait for new data on which to base his judgment.

Lately, two other discoveries have appeared that are roughly contemporaneous with the eastern ash fall. They are the switch from atlatl and dart to bow and arrow by resident hunter-gatherers, and a change in caribou subspecies. Respecting the latter, Letts *et al*. (2012:80-94) suggest the ash fall may have displaced Southern Lakes caribou (Kuhn *et al*. 2010) because they were absent for 400 years, after which a genetically different population existed. It is tempting but likely misleading to link this change in any causal relationship. To suggest a possible influx of other post-ash hunters into any abandoned land on the basis of these discoveries remains unproven, although new trade goods were imported. I will discuss each of these events in greater detail below.

Depending upon changes in wind velocity and direction, the ash did not fall evenly on hills or in valleys or even decrease evenly from the southwest Yukon to the Northwest Territories. Figure 1 is a generalization, with visible

ash depth in road cuts and hillsides being very irregular due to flooding and local slope wash. Workman (pers. comm. 2011) says some areas even relatively close to the vent were quite untouched. In this mosaic of varying depth, small numbers of widely-scattered resident hunters in heavily affected areas could easily have walked to safer areas. There was no exodus, certainly not via a domino effect to the American Southwest, and likely just the temporary use of a nearby valley or mountainside. Based on a population density of one person per 100-250km^2, Workman estimates 500 people were seriously affected by the eruption and ash fall. Ives (2003:267) says an additional 50-100 people could easily have been absorbed by their neighbours, basing his estimate on slight pre- and post-ash vegetational differences. Yet he sees a ripple effect on these neighbours that triggered the Dene migration south.

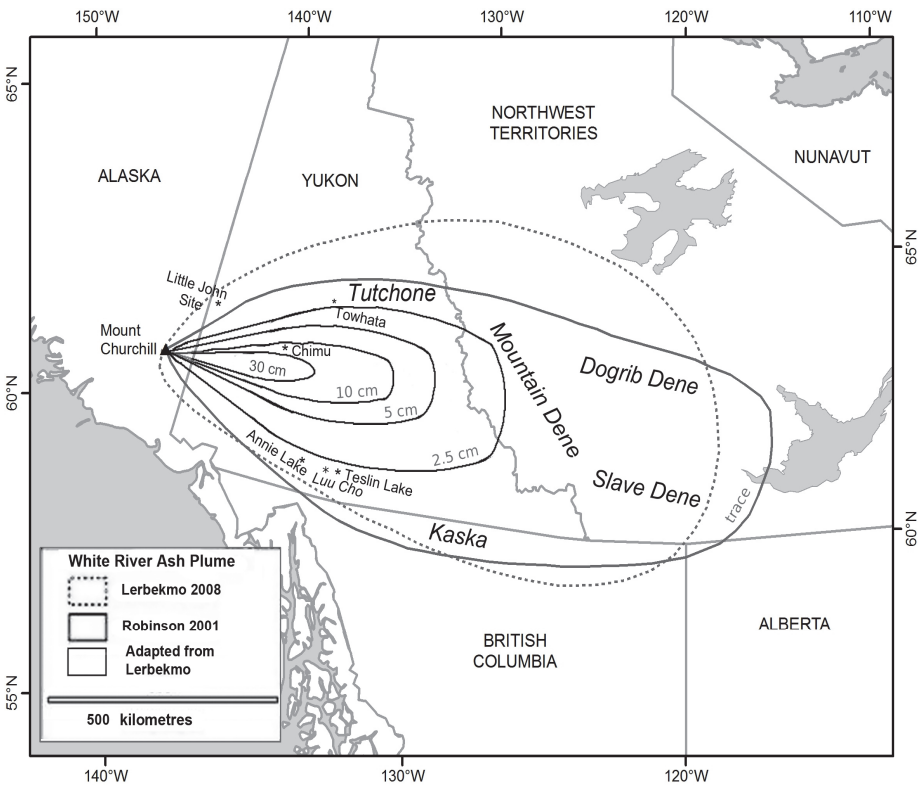

Figure 1. The East Lobe of the White River Ash (WRA) distribution and thicknesses (composite adapted from Lerbekmo 2008 (top), Robinson 2001 (middle) and Lerbekmo *et al.* 1975 (bottom)).

Hare *et al*. (2012:133) link weapon change, hunter abandonment and WRA about 1200 years ago, especially around the vent. But they add southwest Yukon abandonment due to ecological devastation, with new arrivals later having the bow and arrow. However, conditions near the vent were much more catastrophic than in the southwest Yukon as a whole. No one lived near the vent, and the Southern Lakes area was not so devastated that human abandonment ensued. Froese *et al*. (2008) conclude the WRA was between 1140 and 1200 years ago. They mention the most recent ice patch date before the WRA is 1250 years ago and the earliest post-WRA date is 1060 years ago, while the earliest post-WRA caribou date is 1030 years ago. The problem here is assuming that weapon change and human and caribou abandonment and replacement coincide in time and space.

Moodie, Catchpole and Abel (1992) discuss Athapaskan oral traditions of volcanic explosions and envisage a migration of Dene peoples into the Mackenzie Valley of the Northwest Territories from a location farther west where they would have been adversely impacted by the ash fall. While accepting that a wider ripple effect on migration might have occurred, they say that only the westernmost Dene, closest to the ash fall, were subject to the eruption's effects. The groups now living at the eastern margins of the ash field, the Mountain Den, Dogrib and Slave (Figure 1), have stories of an explosion or ash fall. But the current occupants of the worst impacted area, the Kaska and Tutchone, do not, implying the need for clarification. This might be interpreted as evidence of recent in-migration by these two groups. The Tutchone do retain a legend of a minor Volcano Mountain eruption half way between Whitehorse and Dawson City in the central Yukon Territory between 300 and 1000 years ago (Moodie, Catchpole and Abel 1992:150), but this was not Mount Churchill-Bono.

I doubt Workman's suggested domino effect ever occurred because those adversely affected could have been absorbed by their neighbours. Further, there is no evidence for it. Most Dene lived in regions where the ash fall was patchy, its thickness often less than 10cm (Figure 1), certainly not enough to cause an exodus. As ash falls quickly, a more serious problem is sulphuric acid emission, whose droplets spread widely and remain suspended in the atmosphere, blocking the sun for more than a year. This had little effect on hunters in winter when the ash fell (Hanson 1965; West and Donaldson 2000, 2002). They occupied semi-subterranean shelters and would have had previously stored food. Even those with insufficient stores might easily have been accommodated by neighbours. Furthermore, snow readily buried the ash, hastening a faster return to normalcy for the environment. Hopefully, a refined archaeological-paleoenvironmental chronology may demonstrate if this suggestion has merit. Workman diminished his catastrophist approach when he said that "a restudy of some of MacNeish's material and additional information has led me to the interpretation of strong cultural continuity between

the Taye Lake and Aishihik phases…" (Workman 1979:250). Earlier, MacNeish (1964:322) had suggested a cultural break between the final Taye Lake culture phase and the post-ash Aishihik phase.

Crucial here are Workman's 1979 Tables 25 and 27 showing faunal remains before and after the ash fall. Table 25, showing post-ash faunal remains of his Chimu site JjVi-7, indicates the most important game was caribou. Table 27 shows that pre-ash faunal remains follow the same pattern in levels 1-4 immediately below the ash. This suggests to me that caribou continued to be widely available, except possibly for a few years when the ash affected their food supply. Kuhn *et al*. (2010) claim to have found evidence from caribou DNA in bones found in ice patches just north of the British Columbia border that ancient herds are not related to those living in the area today. The discontinuity occurs about 1,000 years ago, they report, and thus could be linked to the ecological disruption caused by White River ash. Again, this evidence is circumstantial and inconclusive in the sense that the timing is approximate and possibly coincidental. In addition, a change in fauna subspecies does not necessarily equate to a change in human culture in the same area. Against this scenario must be weighed the differences between archaeological assemblages before and after the ash fall. Unfortunately, Chimu yielded few post-ash diagnostic artifacts for comparison, but regionally, Derry (1975:138) said, "there is strong evidence to suggest that stemmed points, not totally dissimilar to the Kavik type, were present in both pre- and post-ash phases in some parts of the area".

Using atmospheric patterns and ash topography, Workman (1974:260; 1979:350-2) had favored a winter ash fall, a view also supported by Hanson (1965) and West and Donaldson (2000, 2002). Donaldson (West and Donaldson 2002) provides evidence from Bock's Creek, 100km east of Mt. Churchill, that the ash must have been frozen before being buried in a subsequent spring flood. The Donjek River section, 130km southeast of Mt. Churchill, contains pumice clasts thought to result from a frozen layer of airfall ash, later fragmented during spring flooding (West and Donaldson, 2000). To understand the ash fall's effects on aquatic ecosystems, Bunbury (2004, 2008) collected lake sediment cores along a transect at increasing distances from Mount Churchill. Although the ash thickness is 1m near its vent, it falls off steeply to a discontinuous 5mm 1300km away (Robinson 2001:158) and may have actually helped plants, fish and game by providing nutrients. For mid-range, I suggest most land and water biota survived, their full recovery taking a few years (Workman 1979). I think that post-ash hunting initially exceeded fishing, which took longer to recover, as seen in the longer-term effect on fish due to ash from Mount St. Helens, another exploding stratovolcano in Washington State (Crisafulli and Hawkins 1998; McDowall 1996; Pringle and Scott 2001).

Forest thinning caused by widespread firing of ground litter may have led to a change in game species that favored the recently introduced bow and arrow over the atlatl and dart for communal caribou hunting. The dart and lance are superior to the arrow for penetrating the vital organs of bison, the old game of choice. But the arrow is superior for rapid fire, greater accuracy, smaller game like caribou, and stealth hunting in forest openings (especially the horizontal bow for hunter concealment and approach). Hare *et al*. (2004) investigated artifacts uncovered in alpine ice patches in southwest Yukon and found an abrupt switch from throwing dart to bow and arrow technology around 1200 years ago. They suggest a link between this change and the roughly contemporaneous White River ash fall. While this dating is suggestive, it is hardly conclusive. I would instead suggest that a change in game availability, possibly but not necessarily resulting from the White River ash fall, may have promoted use of the new bow and arrow technology. As Hare himself states, "This transition in the Yukon is broadly comparable to the timeline for bow-and-arrow technology elsewhere in North America" (Hare *et al.* 2004:270).

From his investigations of KdVo-6 (the Little John site just east of the Alaska border and 12km north of Beaver Creek, Yukon), Easton finds the same replacement but does not see evidence of a catastrophic disruption of living patterns: "The bow and arrow is exclusively a [sic] Aishihik Phase technology in this region. Such a correlation between the second White River Volcanic ash fall and the introduction of the new bow and arrow… is suggestive of a brief period of rapid population displacement and replacement, although undoubtedly of the same Athapaskan language family" (Easton 2007a:38). He goes on to state that "recovered artifacts show that the Little John site continued to be used throughout the Late Prehistoric, perhaps by a smaller population which left a smaller imprint on the archaeological record…." (Easton 2007a:116). In a subsequent survey there, he reports being told by several Upper Tanana elders that the traditional village site "was the location to which their ancestors retreated at the time of the eruption and subsequent ash fall - a time referred to in their oral history as the year of two winters" (Easton 2007b:17).

Moodie *et al*. (1992:148-171) say the blast height exceeded 25km, resulting in a heavy 12-hour acid precipitation that created an unlivable desert. Their account is catastrophist, but effects several hundred kilometers downwind were ultimately beneficial because more open space for new game was created from tree kill-off. Peat specialist Steve Robinson (pers. comm. 2006; Robinson and Moore 2000) says the ash fouled rivers, sterilized soil (see also King and Brewster 1978) and killed trees. Many of Robinson's Mackenzie Valley peat cores hundreds of kilometers east have burnt wood over ash. But he used White River ash only as a chronomarker, without assuming his burnt wood reflects anything other than widespread local burning

of dry, dead trees, and was not due to Alaskan-Yukon volcanism (Robinson and Moore 2000:164). Most people in the Kluaine-Aishihik region 150km downwind from the vent not only survived but likely did not move far and only temporarily. At the Tatlmain Lake site near Pelly Crossing in central Yukon, Thomas (2003:99-101) says game selection patterns differed above and below the White River ash, yet distant trade continued throughout, especially with Edziza and Hoodoo Mountain tool-making obsidian. Pre-ash game had more food value (44% beaver; 25% whitefish) than post-ash game (29% beaver; 9% whitefish), but this may be due to cultural preference, game shortages and possible taphonomic effects on fauna. However, broad similarities in settlement and subsistence patterns suggest an *in situ* stratigraphic and cultural development throughout the White River ash fall (Thomas 2003:103). Thomas' excavations at Towhata Lake in central Yukon lead him to conclude that the site was probably occupied continuously over the last 5-8,000 years and that the same populations who inhabited Tatlmain Lake likely inhabited Towhata (Thomas 2005:26). Though he does not have carbon-dated cultural material, their stratigraphy shows no indication of an interruption in occupation. Investigations at the Luu Cho and other sites (Nustsehe, Teslin Lake, Squanga Lake, etc.) have found similar cultural materials just above and below the White River ash layer (Greer 1983:18 ff.). At Annie Lake, some 200 miles east of Mt. Churchill, the ash layer is only a few centimeters thick. As such it may have seen newcomers from more hard hit regions (www.tc.gov.uk.ca/931.html). Thus, the disruptive effects of the WRA may well have been quite local in impact and have varied widely from location to location. Frenchman and Tatchun Lakes similarly have a thin layer of ash, but the archaeological record shows little change in how people made their living or the tools they made before and after the eruption, even using the same campsites pre- and post-ash fall <www.tc.gov.yk.ca/976.html>.

None of these findings support the 1970s theory of human outmigration and replacement, certainly not to the extent of causing a human domino effect all the way to the Southwest.

Effects of Similar Prehistoric and Historic Eruptions

A recent paper by Grattan (2006) looks broadly at the impact of volcanic eruptions on human history and civilization and concludes that catastrophic interpretations are usually mistaken. While not minimizing volcanic impacts, he finds that they often acted as a stimulus rather than a brake to cultural growth and that volcanic modification of weather is as often beneficial as it is harmful. Human adaptation to volcanism was the norm, not the exception, examples being those of South and Central American cultures persisting for centuries alongside active volcanoes and surviving such events as the

Ilopango eruption of ca. AD 425 in El Salvador, which resulted in a far deeper ash deposition than the White River event (Dull *et al*. 2001). A particularly catastrophic eruption of the Laki Fissure in Iceland in 1783 damaged crops and vegetation, resulting in the death of one quarter of the population and three quarters of their livestock in this marginally agricultural country. The inhabitants considered abandonment of the island, but instead stayed and eventually flourished. Grattan also cites Melanesian societies exposed to frequent volcanic eruptions and notes that their low population densities and networks of alliances allowed them to relocate temporarily and return when the ecology was re-established. Much the same conditions would have applied to the Dene living in the path of the White River ash.

Dugmore *et al*. (2007) suggest that linking farm abandonment in Iceland's ðjórsárdalur valley in AD 1104 and AD 1300 to Hekla's eruptions is too simplistic. Other research has been unable to significantly link eruptions to farm abandonment or epidemics. The impact of volcanic eruptions "was rarely fatal to settlements and if so, only on a small scale and for a short period", adding that, "between the extremes of continuity and abandonment, there are a number of different possibilities" (2007:2-3).

One of the world's most destructive events was Sumatra's Toba eruption. Its ash in post-74,000 year-old Jurreru Valley sites in India shows humans present just before and just after 15cm of ash fell all over Southeast Asia. This is based on the presence of similar stone tools, showing the survivors belonged to the same group (http://toba.arch.ox.ac.uk/-research_arch.htm).

One of the largest volcanic eruptions of the last 10,000 years buried the Bronze Age city of Akrotiri on Thera and ended occupation of the island for generations. This disrupted trade networks with Crete, yet the record shows that its immediate impact on Cretan civilization was minimal, as trade routes were redirected with little effect on overall activity (Knappert *et al*. 2011).

Conclusions

All of these recent research findings indicate that, while serious, local effects very likely took place and only displaced populations for a relatively short period. The inhabitants survived with little interruption in their subsistence patterns or cultural continuity.

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