# The extinction of the woolly mammoth: was it a quick freeze?

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**Apart from formerly glaciated areas, woolly mammoth remains are abundant in the surficial sediments of the mid and high latitudes of the Northern Hemisphere, including western Europe, northern and eastern Asia, Alaska and the Yukon. There are probably millions of mammoths buried in the permafrost of Siberia alone. The mammoths are found with a wide variety of other mammals, large and small, many of which were grazers. They lived in a grassland environment with a long growing season, mild winters, very little permafrost, and a wide diversity of plants — quite different from the climate in the region today.**

**The mammoths and other animals colonised the region after the Flood during the ice age. The region's climate during the ice age was ideal for rapid population growth and, in the 600 or so years before their demise, the population had grown to many millions of animals. They were buried in the dust storms that deposited the loess blankets found in those regions today. Some were entombed in a standing position. The good state of preservation of the stomach contents does not call for super-rapid freezing of the carcasses. Rather than food digestion, the mammoth stomach acts as a food storage pouch. The mammoths became extinct when, at the end of the ice age, the climate in the region became more continental, with colder winters, warmer summers, and drier conditions.**

Frozen carcasses and many thousands of tons of bones and tusks of woolly mammoths are buried in Siberia and Alaska. In March 2000, the Discovery Channel produced a special on the excavation of a carcass in north central Siberia, called the Jarkov mammoth. This mammoth was cut out of the permafrost and transported by helicopter into cold storage for future analysis and possible cloning.[1]

Mammoth remains have puzzled scientists and laymen for hundreds of years. Many explanations have been offered. One of the most popular hypotheses is that one eventful day, the hairy elephants were peacefully grazing on grass and buttercups when suddenly, tragedy struck, and millions of them froze instantly.

This article examines the life and death of the woolly mammoth in Siberia, Alaska, and the Yukon Territory of Canada. These areas, together with the surrounding shallow ocean (Bering Strait), are called Beringia. There are still unknowns associated with the woolly mammoth and its environment in Beringia. Some information is conflicting. However, the data is pointing to a unique environment and extinction of the woolly mammoths in Beringia.

### What is a woolly mammoth?

A woolly mammoth (*Mammuthus primigenius*) is one of several types of mammoths in the genus *Mammuthus* within the order Proboscidea. The woolly mammoth is essentially a hairy elephant with a large shoulder hump, a sloping back, small ears, tiny tail, unique teeth, a small trunk with a distinctive tip and two finger-like projections, huge spirally curved tusks up to 3.5 meters long, and spiral locks of dark hair covering a silky underfur (Figure 1).[2]

Mammoths are classified mainly on variables such as molar hypsodonty (height of the crown), number of lamellae (ridges on crown), and enamel thickness. History shows there has been much taxonomic splitting of mammoths, as well as other members of Proboscidea. It is likely that they are all descended from a single created kind.[2] In general, there seem to be two main varieties of mammoths on both Eurasia and North America. The woolly mammoth is the smaller variety that generally inhabited the north. The second, more southern variety, from both Eurasia and North America can be lumped together for simplification and referred to as the Columbian mammoth (*Mammuthus columbi*).

### Mammoth distribution

Mammoths are commonly found in surficial sediments from western Europe eastward through northern and eastern Asia, Alaska and the Yukon (Figure 2).[3,4] Mammoth remains are also found on some of the islands in the Bering Sea[5,6] and are dredged from the shallow continental shelves surrounding Beringia.[7,8] Enormous numbers of ice age mammals, most commonly mammoths, are dredged up from the unconsolidated sediments of the North Sea by trawlers.[9] Woolly mammoths are found in abundance south of the North American ice sheet. They are rare in formerly glaciated areas. Mammoth and mastodon teeth have been dredged from 40 sites along the continental shelf off the eastern US in water up to 120 m deep.[10]

In Siberia, the woolly mammoth inhabited the whole area from the Ural Mountains to the Pacific Ocean. Their east-west distribution is generally uniform, except that they are especially abundant in northeast Siberia.[11] Their numbers increase farther north.[12,13] Mammoth remains are

Photo: Dr Dennis Smith.

***Figure 1.*** *The Beresovka Mammoth.*

amazingly abundant on the Lyakhov Islands[14] and the other islands of the New Siberian Islands, 230 km north of the Arctic coast.[12,15] Frozen mammoth carcasses are usually found eroding out of river banks and along the shore of the Arctic Ocean.

## Mammoth fauna

Woolly mammoths are not the only fossil mammals found in the permafrost of Beringia. There are a wide range of other mammals, large and small, that accompany the mammoths. These include the woolly rhinoceros, wolf, fox, lion, brown bear, camel, deer, ground sloth, pika, wolverine, ferret, ground squirrel, moose, reindeer, yak, musk ox, giant beaver, lemming, porcupine, coyote, skunk, mastodon, antelope, sheep, voles, hare and rabbit, plus many species of birds, rodents, horses, and bisons.[4,16–19] Frozen carcasses of these animals, especially the woolly rhinoceros, are also found. Generally, the same animals are found together throughout much of the mid and high latitudes of the Northern Hemisphere.[3,20]

## How many mammoths are buried in Siberia?

There has been much controversy over how many woolly mammoths are frozen in the permafrost of Siberia. A few scientists attempt to downplay the number,[21] but practically all observers describe the number in superlatives.

The top expert on woolly mammoths in Siberia, Nikolai Vereshchagin, has spent nearly a half century of research on the mammoth fauna. He states that there are *many hundreds of thousands* of large mammals buried in Siberia[22] and also many millions of bones.[23] One estimate he made for one region of Siberia would suggest five million mammoths buried.[24] Is he exaggerating? It would be conservative, therefore, to conclude that several million mammoths are buried in Beringia.

## Perplexing mammoth data

There are many perplexing aspects to the Siberian mammoth finds, including the existence of frozen carcasses and the good preservation of their stomach contents. In addition, a number of the carcasses and skeletons have been unearthed in a general *standing position*, as if the animal sank in a bog.[25–27] The Selerikhan horse was entombed in a general standing position.[28] The new Jarkov mammoth was dug up in a standing position.

It is also relevant that an analysis of several features of the carcasses shows that three woolly mammoths and two woolly rhinoceroses *suffocated*, including the Beresovka (or Beryosovka) mammoth.[29–32] The Beresovka mammoth also had a broken pelvis, ribs, and right foreleg.[13,27]

For carcasses to be frozen and the bones and tusks well preserved, quick burial is necessary. But how could all these woolly mammoths have been forced into the rock hard permafrost, which starts about half a meter deep, below the summer melt zone?

## Beringian paleoenvironmental deductions

The animals themselves tell us much about the paleoenvironment — a controversial subject.[33] The diversity of animals was so great that there must have been a *highly diverse vegetation*.[34] The only similar diversity of mammals is on the Serengeti of East Africa.[34,35] Practically all

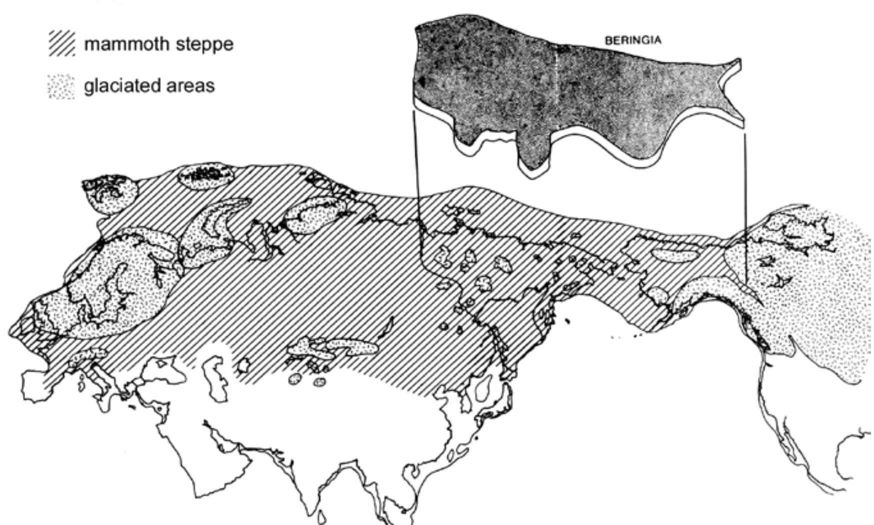


***Figure 2****. Distribution of woolly mammoth remains, and the mammoth steppe. Glaciated areas are shown speckled. Mammoth steppe is shown hatched. The area referred to as Beringia is shown separately (after Guthrie[143]). Note that the extent of the northern and eastern boundaries of the Scandinavian ice sheet is controversial.*

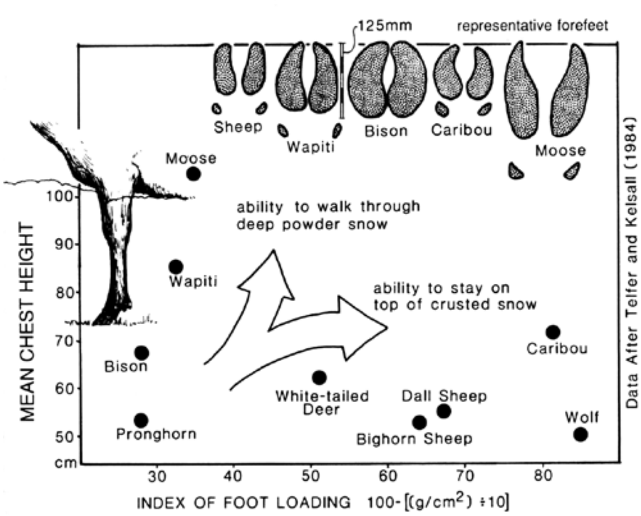


***Figure 3**. Ability of animals to walk through deep snow or to stay on top of crusted snow depends on foot loading and chest height (after Guthrie).[144] The sheep and wolf could not have tolerated deep snow or boggy substrate.*

the large mammals were *grazers* that ate a wide variety of herbaceous vegetation, mainly grasses. Based on the large numbers of healthy individuals, Beringia, as well as Europe and western Russia, must have been mostly one huge grassland during the ice age, called the mammoth steppe or steppe tundra (Figure 2).[3,34,36,37]

To maintain a large variety of herbaceous vegetation on the mammoth steppe would have required a *long growing season with warm soil and rapid spring growth*.[38] This contrasts strongly to the current environment where green vegetation does not appear in northern Siberia until mid June to early July.[39] Ninety percent of the biomass of grass is in the roots below the surface, and the grass cannot grow until the snow melts and the soil warms up. Therefore, *winters must have been milder with light snowfall*. The growth pattern of the mammals reinforces the deduction of a longer growing season.[34] The shaggy ruffs, heavy horns, long tusks, and enormous antlers are what wildlife managers would recognise as indicators of *high-quality habitat* with light competition and a long growing season.[40] Open range with light snowfall during winter is also supported by the existence of several animals that are intolerant of deep snow, such as the saiga antelope, bighorn sheep, Dall sheep, and wolf (Figure 3).[41]

With milder winters and a longer growing season over an extensive grassland, it is likely that there were no significant areas of permafrost. This is because permafrost would have caused a boggy substrate in summer, making it difficult for much grass to grow. Further paleoecological evidence for a lack of permafrost comes from the existence of some animals with small hooves, such as the saiga antelope. This animal cannot manage on boggy substrate. Furthermore, there is plenty of other evidence that the climate of Siberia was once much warmer, but again this evidence is somewhat obscured by uniformitarian dating and pigeonholing the evidence into supposed 'interglacial' and 'interstadial' periods.[42]

### Mammoth uniformitarian problems

How millions of mammoths became entombed in Siberian permafrost really taxes the uniformitarian principle. Why would multitudes of mammoths, plus the many other animals, even want to live in Siberia with its fierce winters and summer bogs? What would these large beasts eat? Siberia today supports only a very few large animals, and these are especially adapted to boggy vegetation and often migrate to escape the full force of winter. Most perplexing of all, how did the woolly mammoths die in Siberia? Was it a quick freeze? Was man the hunter responsible for the demise of the mammoths?

Today, Siberia is well known for its bitterly cold winters. The lowest temperature in the Northern Hemisphere is -68 °C at Verkhoyansk.[43] Large mammals can usually tolerate a fair amount of cold. But could the mammoths, horses, bison, and other animals tolerate 6 to 9 months of bitter cold with even colder wind-chill temperatures in blizzards? Vereshchagin and Baryshnikov[44] state: *'There would be no place for mammoths in the present arctic tundra of Eurasia with its dense snow driven by the winds.'*

Could the animals have lived in Siberia today during the relatively warm summer, perhaps migrating there from the south? The temperature likely would have been pleasant for them, but the environment deadly. Siberia today is in the permafrost zone where up to a metre of the surface melts in the summer. Water pools on the surface forming massive bogs and muskegs, making summer travel difficult, if not impossible, for man and beast.[44,45] Tolmachoff[46] states that a few inches of this sticky mud makes the substrate practically impassable for a man, and that a foot or more would probably trap a mammoth.

Siberia may be lush with vegetation in the summer, but it is the wrong type. Although there are patches of grass, bog and muskeg vegetation predominates, and these are low in nutrition for grazers.[47] The taiga forest vegetation south of the current tundra is also poorly digestible for grazers.[48] Comparing living elephants to mammoths, the daily requirement for a woolly mammoth would have been about 200 to 300 kg of succulent vegetation[49] and 130–190 litres of water! Vereshchagin[50] flatly declares: *'Neither mammoth nor bison could exist in the sort of tundra that exists there [in Siberia] today.'*

The problem is even more paradoxical in a uniformitarian ice age climate. Ice age climate simulations are of variable quality, depending upon the initial conditions, the approximations employed for complex variables, the particular physics, the number of variables, whether the simulation is a general circulation model, etc. Nevertheless, the better general circulation models demonstrate that the glacial climate of Siberia (assuming uniformitarianism) would have been colder (about 10–20 °C) than today: *'Dur-*

*ing glacial and stadial stages, the climate of Siberia was much colder than at present.'*[51] This deepens the mystery of why the lowlands of Siberia and Alaska were never glaciated!

Except possibly on Wrangel Island in the Arctic Ocean,[52–54] the woolly mammoth died out in Siberia at the end of the ice age. Furthermore, the woolly mammoth and many of the other large mammals, including 33 genera from North America, disappeared on whole continents or went extinct. There are two main hypotheses to account for all this extinction at the end of the ice age: either they were killed by man in a great blitzkrieg slaughter, or they died because of climate change.[55] Uniformitarian scientists do not know the answer to this, but it has been extraordinarily controversial for more than *200 years*. At a recent mammoth conference, Alroy expressed his frustration:

> *'After many decades of debate, the North American end-Pleistocene megafaunal mass extinction remains a lightning rod of controversy. The extraordinarily divergent opinions expressed in this volume show that no resolution is in sight.'*[56]

## Non-creationist hypotheses

Such confounding enigmas, not only about the mammoth and the mammoth steppe fauna, but also about the ice age itself, have naturally produced many hypotheses. Early scientists produced a lot of confused writing. For example, Sir Henry Howorth,[7,12] who gathered copious observations from Siberian explorers that are considered fairly accurate, believed the mammoths met their demise in a continental-scale flood, but that this flood was not Noah's Flood.

Immanuel Velikovsky wrote two influential popular books on astral and earth catastrophes, called *Worlds in Collision*[57] and *Earth in Upheaval*.[58] In these books the demise of the woolly mammoths in Siberia played a lead role. He weaved the mysteries of the mammoth, the ice age, and many other puzzles from the earth sciences into a catastrophic adventure featuring Venus and Mars, occurring about 3,500 years ago. Velikovsky is sharp at pointing out the many earth science puzzles of the past, which a large number of scientists seem to either ignore or minimise. However, he cannot help but add an element of hyperbole, such as the following in referring to the 'muck' of Alaska:

> *'Under what conditions did this great slaughter take place, in which millions upon millions of animals were torn limb from limb and mingled with uprooted trees?'*[59]

His mechanism for explaining the extinction of the woolly mammoth, supposedly living in a warm climate and then suddenly being quick frozen, is a catastrophic poleshift to a more vertical Earth axis (to warm the region up) and then back again to near the present 23½ degrees (to cool it down). The idea of a quick freeze is based mainly on the presence of food in the mammoths' mouths and not enough time for their last meals to decay in their stomachs. Other popular writers have accepted and embellished Velikovsky's ideas.[60–62]

Charles Ginenthal[63] provides an updated, more elaborate defense of Velikovsky's pole shift hypothesis. There is one major problem, among many, with Ginenthal's and Velikovsky's hypothesis, and that is a pole shift to a more vertical axis will *cool* the region, not *warm it up*.

## Creationist hypotheses

The information on the woolly mammoths in Siberia is confusing, and most of it is published in Russian. All this data, and the many hypotheses, were bound to influence creationists, who also have been attempting to interpret the evidence in a catastrophic framework related to the Flood. Harold Clark[64] recognised that the extinction of the mammoths in Siberia was a major puzzle that needed a creationist explanation: *'One of the most perplexing phenomena of geology is that of the so-called "frozen mammoths" of Siberia.'*

Many creationists have leaned towards a Flood demise.[65–68] Joseph Dillow,[69] who wrote an in-depth book on the vapour canopy, focussed considerable attention on how the woolly mammoth became extinct.[70] He proposed that the hairy beasts were quick-frozen just before the Flood. Walter Brown[32] included a chapter in his hydroplate model on what happened to the woolly mammoths. He proposed that the woolly mammoths died during the Flood by a quick freeze. Dillow and Brown made several mistaken deductions on the data related to the woolly mammoth and its environment in Beringia, such as that there is over 1,200 m of 'muck' containing animal and vegetative remains.[71,72]

Clark,[64] Harold Coffin,[73] and myself[74] believe that the woolly mammoth lived and died during the ice age after the Flood.

## Did Siberian mammoths die in the Flood?

There is abundant evidence that the woolly mammoths in Siberia, Alaska and the Yukon died after the Flood. They were truly denizens of the post-Flood ice age.

The woolly mammoth is part of an ice age mammoth steppe community that ranged across the non-glaciated portions of the Northern Hemisphere (Figure 2).[3] Strong arguments favour a post-Flood origin for the mammoth steppe animals outside of Beringia. The animals are found in: 1) glacial till near the edge of the ice sheets, 2) river flood plain debris, 3) river terraces, 4) tarpits, 5) caves or rockshelters, 6) loess, 7) sinkholes, and 8) peat bogs. There are an estimated 51 predominantly male mammoths that are found in a sink hole at Hot Springs, South Dakota.[75] In northwest Siberia, mammoths are found in sediments *above* glacial till.[76] Spear points are associated with or embedded in the remains of mammoths at a dozen or more localities in North America.[77] Woolly mammoths are commonly depicted in cave art from Europe eastward to the Russian plain and Ural Mountains.[78,79] Ivory carvings are rather common in early-man sites in southern Siberia.[80] More than 70 mammoth bone huts have been discovered on the Central Russian Plain.[81,82] Such surficial features and deposits would be virtually impossible to form during the Flood and must be post-Flood. To *isolate* the woolly mammoths in Beringia for a special catastrophic extinction during the Flood, while ignoring the fate of the remainder of the post-Flood mammoth steppe fauna does not make sense.

Another strong argument against the mammoth death-in-the-Flood hypothesis is that the Beringian animals are *buried in unconsolidated surficial sediments overlying lithified sedimentary rocks*. If the animals were killed by an ice or hail dump from space during the early Flood, as envisioned by Dillow and Brown, the animals should be found in the lower portion of the sedimentary strata, a little above crystalline rocks. This surficial sediment with indications of post-Flood processes lies *upon hundreds of meters* of consolidated sedimentary rock that a large majority of creationists would attribute to the Flood. For instance, the Selerikhan horse carcass was found in frozen loam between peat layers and above a gold placer that lay over Mesozoic rocks.[83] The baby mammoth, Dima, was found within slope wash on the 10 m terrace of the Kirgilyakh River. The terrace was carved out of Jurassic shales and sandstones.[84,85] Below the surficial sediments that contain the mammoths, most of Siberia is composed of sedimentary rocks from all ages of the geological column.[86] The bedrock below the Cape Deceit fauna of Kotzebue Sound, Alaska, consists of Paleozoic metalimestone, Paleozoic schists, and Pliocene basalts.[87]

## The post-Flood rapid ice age

Mammoth remains in the northern hemisphere are associated with events during the ice age. However, uniformitarian ice age models cannot explain the mammoths, or even the ice age itself. The August 18–25, 1997, issue of *US News & World Report* had a long series of articles on eighteen great mysteries of science. One of those mysteries is: *'What causes ice ages?'*[88] The June 1996 issue of the popular earth science magazine *Earth*, reported on a new theory of the ice age. Daniel Pendick[89] starts his article titled 'The dust ages' by saying: *'If they hadn't actually happened, the ice ages would sound like science fiction'*. However, the unique creationist post-Flood ice age offers a reasonable solution for the mammoth mysteries.

The ice age was caused by the climatic aftermath of the Genesis Flood.[55] As a result of this great tectonic and volcanic upheaval, the stratosphere would have held great quantities of dust and aerosols immediately after the Flood. Copious post-Flood volcanism would have reinforced the polluted stratosphere. Thus sunlight would have been partially reflected back to space from the volcanic products trapped in the stratosphere (Figure 4). Less sunlight would have meant cooler land surfaces, as was observed at various locations after the great volcanic eruption in AD 535.[90] During the Flood, warm water from the 'fountains of the great deep' would have produced a warm post-Flood ocean. Evaporation would be much greater at mid and high latitude than today due to the much warmer water. Copious evaporation close to the ice sheets would have been most favourable for their rapid growth. After many centuries, once the oceans cooled, the ice sheets would have melted rapidly. Many other aspects of the ice age have been estimated, including the average thickness of the ice sheets, the length of the ice age, the number of ice ages, etc.[55]

## Mammoth population explosion

Was there enough time for the mammoth population to increase to millions by the end of the post-Flood ice age? We can estimate the mammoth growth after the Flood by examining the reproductive habits of African elephants, a good analogue.[91]

The elephant reproductive rate can vary significantly.[92] Elephants do not reach sexual maturity until age 10 to 23.[93] They live 50 to 60 years. Eltringham[94] states that generally, elephants produce a calf at intervals of four to five years with twins 1.35 % of the time. However, some have suggested that elephants can give birth every two to three years, and there is a case of a zoo elephant giving birth two years and five months after its first birth.[95] The reproductive rate is especially enhanced in a favourable environment as when the population is low or the animals are being hunted regularly.[92,96–99] There are no natural enemies for a mature elephant, except man,[100] but calves are subject to predation. So, mammoths have the potential to increase rapidly following the Flood.

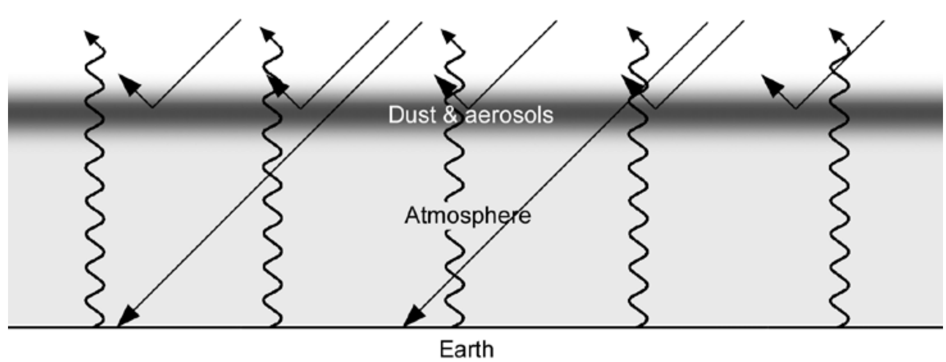


*Figure 4. Effect of volcanic dust on cooling of continental interiors. Straight lines are solar radiation, partly reflected back to space by dust and aerosols. Wavy lines are infrared radiation. The result is the inverse of the greenhouse effect.*

Based on doubling rates of 10 years[101] and 25 years[91] observed in Africa, there would be (assuming ideal circumstances with no predation or calf mortality) 2.1 billion mammoths in 300 years or 8 million mammoths in 550 years,[102] respectively. In other words, there should be no problem for the population of woolly mammoths to reach many millions toward the end of the ice age some 600 years after the Flood.

The post-Flood rapid ice age would have had milder winters and cooler summers with little if any permafrost, mainly because the Arctic and North Pacific Oceans were warm, and ice-free.[55] It would *not* have been the formidable landscape observed today or deduced from uniformitarian ice age expectations. Since the lowlands of Beringia were not glaciated, another uniformitarian conundrum, Beringia would have been a favourable environment for many mammals.

## Extinction of the mammoths at end of ice age

Of all the questions related to the mammoths, their extinction has been the most perplexing. It was not only mammoths that became extinct at the end of the ice age, but also many other large animals. Why? We will first discuss their extinction in Siberia and then the extinction of the mammoths and other ice age mammals on whole continents or worldwide.

### Were woolly mammoths quick-frozen in Siberia?

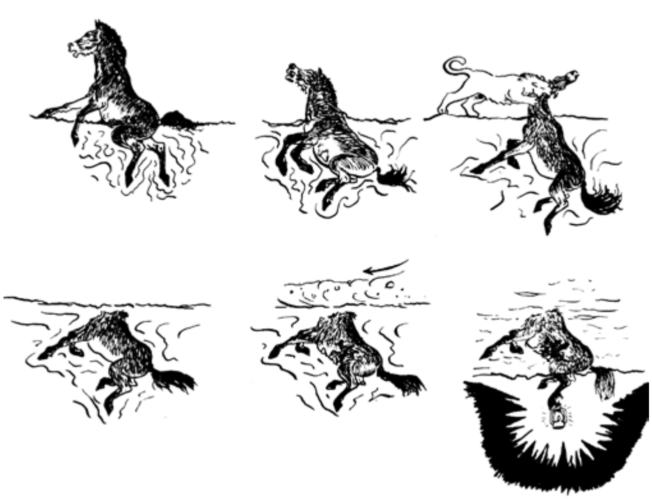

***Figure 5**. Headless horse in mine shaft indicates that some time elapsed between when the animal was trapped and final burial. Guthrie's cartoon[145] speculates how the horse was trapped in a bog with its head and neck exposed, which was subsequently eaten by a carnivore. The sixth picture illustrates how the legs of the horse protruded into the mine shaft. One of its hind legs was used to attach cables and hang lanterns. The horse could have just as easily been mired in wind-blown dust as in a bog. Indeed, the horse was found in loam, sandy loam and sand with a steppe-like sporo-pollen complex,[146] typical of wind blown deposits and vegetation.*

The existence of carcasses with identifiable stomach remains and well-preserved bones and tusks has suggested a 'quick-freeze' to many. This has been reinforced by the research of the Birds Eye Frozen Foods Company, which calculated a sudden fall to below -100 °C based on heat conduction.[103]

Creationist quick-freeze advocates[32,69] postulate that the quick-freeze was directly related to the Flood. However, as previously discussed in the section 'Did Siberian mammoths die in the Flood?' the evidence is strong that the Siberian mammoths are buried in post-Flood sediments associated with the ice age. All the arguments presented in that section, such as the mammoths of Beringia being part of one Northern Hemisphere ice age fauna, would apply against the quick-freeze hypothesis.

There are other arguments against the quick-freeze hypothesis.

1. The number of frozen carcasses, in spite of under-reporting, is very small compared to the number of mammoth bones that underwent normal decay and are entombed in the permafrost.[104,105]
2. The carcasses are often partially decayed with fly pupae and display signs of scavenging,[3,79,106,107] not expected during a quick-freeze.
3. The unique condition of several of the carcasses, such as the famished condition of Dima and the headless Selerikhan horse (Figure 5),[3,83] indicate some time elapsed before final burial.
4. For some of the carcasses, death appears to have occurred at different times of the year.[83,108] A quick- freeze during the Flood, especially as advocated by some creationists, would have occurred in a single instant.
5. The characteristics of the permafrost that entombs the carcasses and bones, show that it was not dumped quickly from above. It is doubtful that ice wedges would form during a quick drop of ice or hail from above.

### How are the stomach contents explained?

The fact that the stomach contents were only partially decayed can be explained satisfactorily by understanding the digestive physiology of the elephant, which was little known until the 1970s.[109] From studying 50 freshly killed elephants, it was discovered that the main digestive process of elephants does not occur in the stomach, but *after* the food passes the stomach, especially in the caecum and colon.[109,110] Digestion is achieved mainly by bacteria and protozoa. Yet the researchers found *no* protozoa, *no* fermentation and very little hydrolysis of cellulose taking place in the stomachs, although the stomach had a very acidic pH of about 2. This high acidity is expected to partially degrade the stomach vegetation. It is clear, therefore, that *the stomach is mainly a storage area before digestion*.[111,112]

Further evidence that the stomach contents should not necessarily decay completely upon death is provided by the preserved stomach contents of mastodons found in North

America. Preserved vegetation from the gastrointestinal tracks of mastodons, which are generally found in former peat bogs, have occasionally been reported from the northeast United States.[113–115] Recently, the skeleton of a mastodon was discovered within peat on top of an ice age end-moraine in Ohio.[115] The remains yielded a discrete, cylindrical mass of plant material found in association with the articulated vertebrae and ribs.

Thus a quick chill is not needed to explain the partially preserved stomach contents of the mammoth carcasses.

### The big chill and desiccation at the end of the ice age

Near the end of the ice age, as the ocean surface temperature cooled at mid and high latitude, and evaporation slowed, the equable ice age climate would have changed to a drier, more continental climate with more seasonal extremes.[116] Permafrost would begin developing in Beringia, and the substrate would become boggier in summer. As the climate became more continental during deglaciation, many animals in Siberia would tend to migrate closer to the Arctic Ocean, where the waters were still unfrozen and the climate would have been less continental. However, the changing climate finally caught up with them and they ended up buried in the permafrost that has continued to this day.

### Extinction of woolly mammoths in Siberia

With this climatic change, there are a number of ways the mammoths and other animals could have died and become interred into the permafrost. One is by becoming trapped in bogs.[73] I once thought the cold and wind, itself, could have simply killed them off,[117] but it is probable that the mammoths could have endured much cold. I am sure some of the animals were trapped by the flooded rivers draining ice sheets and were buried in fluvial or lacustrine deposits.[83,118] Upon further investigation, I now believe the vast majority of the mammoths and other mammals died and were interred into the permafrost by *none* of the above mechanisms. I believe the secret to their demise and burial can be found in the type of sediment surrounding the woolly mammoths.

According to those who have studied these deposits, the vast majority of the animals are found in the 'yedomas' of Siberia[22] and the 'muck' of Alaska. The yedomas, a Yukut term, are hills 10–20 m, sometimes up to 60 m, high, containing a large percentage of ground ice.[119,120] The hills formed after a period of post-ice-age surficial permafrost melting. Muck is the name given by gold miners to the organic-rich material deposited above gold-bearing gravels in Alaska and the Yukon Territory.[121] Vereshchagin[122] states that the yedomas contain a great abundance of mammal bones:

> *'The great abundance of bones of large herbivores in the Yedoma is convincing evidence of the rich pasturage offered by this region during the Pleistocene ....'*

What type of sediment makes up the yedomas and muck? There has been much controversy and a number of hypotheses on the origin of this sediment. There is now general agreement that the yedomas and muck are *loess — a wind-blown silt!*[121,123–127] Much data support the wind-blown origin of this sediment. The loess is also rich in ground ice and ice wedges. The ground ice formed by a segregation process in which layers and lenses of ice, sometimes clear and sometimes inter-mixed with sediment, developed within the silt.[128–130] The loess is *not* thousands of feet deep in Siberia and Alaska, as some have thought, but is a relatively thin veneer that is widespread in Beringia.[123,125,131,132] Some of the loess, especially in Alaska, has been reworked by downslope mass flow. Redeposition of the loess has broken and twisted the vegetation and disarticulated mammal bones, and this has inspired Velikovsky and others to suggest exotic catastrophes.

In the post-Flood ice age model, strong wind would have characterised the big chill and dessication during deglaciation.[133] In a dry environment, this wind would have picked up and transported large quantities of silt and sand. Abundant wind-blown material is observed as relic features of the ice age in the Northern Hemisphere. Copious wind-blown dust even occurs in the ice age portion of the Greenland and Antarctica ice cores. It is known that mammoths and other mammals are entombed in loess in other areas.[122,134–136] Thus, it seems likely that the mammoths in Beringia were mostly killed and buried by *dust storms*.

Dust storms of variable intensity likely blew from time to time for a few hundred years near the end of the ice age. The animals could have died from the direct effect of the dust or some other cause. Regardless, the dust would have buried their remains fairly quickly. The characteristics of the small number of carcasses that must have been buried very rapidly can likely be explained by *gigantic* dust storms. From the Dust Bowl era in the midwest of the United States, it is known that a dust storm can produce dust drifts several meters high, burying tractors and partially covering buildings. It is possible that dust storms at the end of the ice age would be so intense that they could cover and suffocate a woolly mammoth trying to survive the storm. It may even be possible to suffocate a mammoth by the strong wind and blowing dust. The animal would have been buried quickly, since the animal would act like a snow fence. It is not inconceivable that a few of these animals would have been left in a standing position, braced by the dust around them. The permafrost would then move *upward* after the loess was deposited and rapidly freeze the remains, thus accounting for the rapid burial, which seems impossible any other way. The broken bones of the Beresovka mammoth could easily be explained by the shifting of ground ice and frozen sediment[137] — in other words a diagenetic, post-mortem effect of shifting permafrost.[138,139] Although some researchers lean toward such a diagenetic explanation, there was considerable blood near the wound of the foreleg of the Beresovka mammoth. Bleeding had occurred between the muscles and the fatty and connective tissues.[140]

## Mammoth fauna extinction elsewhere

The mammoths and many of the other animals went extinct either over the whole world or on continents they once inhabited. This occurred at the end of the ice age and probably into early post-glacial time. The mystery has a reasonable solution within the post-Flood ice age model.[141]

The animals *thrived* during the ice age because the temperatures were more equable with cool summers and milder winters. (Note that much of the continental land mass was never covered by ice sheets, even during the ice age.) The disharmonious associations of plants and animals all over the Northern Hemisphere during the ice age are evidence of this equable climate. But, this equable climate ended during deglaciation, and the climate became more continental with colder winters and warmer summers. The existence of ice sheets, the development of sea ice and eventually a cooler ocean than today, would have resulted in less evaporation and a drier climate. The cold winters and dry climate would stress the animals all across the Northern Hemisphere. The larger mammals would have been especially susceptible to drought. Thus climate change likely was the main cause of the end-of-the-ice-age extinctions. The reason the large animals did not die out at the end of previous glaciations is because there were no previous glaciations.[142] Man likely aided the extinction process by harvesting weakened animals.

## Conclusion

Carcasses and bones of woolly mammoths in Siberia, Alaska, and the Yukon have been difficult to explain. The mammoth remains are abundant over the mid and high latitudes of the Northern Hemisphere, except in formerly glaciated areas. There are probably millions of them buried in the permafrost of Siberia alone. A wide variety of other mammals, large and small, accompanied the mammoth. Many of these animals are grazers, implying that the paleoenvironment of Beringia was a grassland with a wide diversity of plants. This diversity of plants and animals points to a longer growing season with milder winters and very little permafrost.

This paleoenvironment is contrary to what is observed in Beringia today, with its very cold winters and boggy substrate in summer. Scientists constrained by uniformitarian thinking seem to face conundrum after conundrum in regard to the life and death of the woolly mammoth in Beringia, as well as by the ice age itself. A uniformitarian ice age climate would have been even colder still. It is difficult to conceive that the woolly mammoth and all the other animals could have lived in Siberia under these conditions. It is obvious the uniformitarian assumption does not apply. Thus, many hypotheses, both creationist and non-creationist, have been proposed. Creationists have been divided on whether the woolly mammoth perished in the Flood or afterwards. A number of creationist hypotheses involve a quick freeze, because it was thought that the state of preservation of the carcasses with only half-decayed vegetation in their stomachs demanded it.

Reasonable explanations for all these mysteries are available within the context of a unique post-Flood ice age. Astral catastrophies, pole shifts and other such exotic hypotheses are not needed. A quick freeze is also not necessary, and besides, there is much data against the hypothesis. There is strong evidence that the woolly mammoth died after the Flood during the ice age. There was enough time for the population of the mammoths to have grown to millions by the end of the ice age. Furthermore, this unique ice age was characterised by colder summers and warmer winters, resulting in a more favourable habitat for the animals in the non-glaciated lowlands of Beringia. The animals became extinct at the end of the ice age because the climate changed to a more continental climate, with colder winters and warmer summers, and drier conditions. There is copious data against the hypothesis of a quick freeze. The state of preservation of the stomach contents are better explained by the post-gastric digestive system of elephants in which the stomach is mainly a holding pouch for vegetation.

The question of how the mammoths died in Beringia can be answered by analysing the sediments surrounding the mammoths and other animals. They are mostly entombed in yedomas in Siberia and muck in Alaska. These are mostly loess and reworked loess. It is postulated that the animals were buried by dust storms, whether they met their demise directly by wind-blown silt or not. The carcasses and other perplexing data associated with the carcasses, such as death by suffocation, entombment while in a standing position, and broken bones, can be explained by death during gigantic dust storms and post-mortem shifting of the permafrost.

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