Preventative Maintenance at The Mammoth Site:

Excavation and Stabilization Methods for an Active In-situ Bonebed

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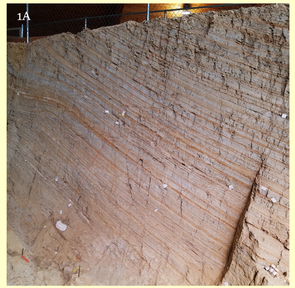
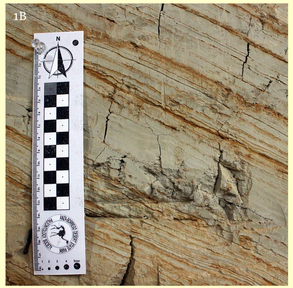
Abstract

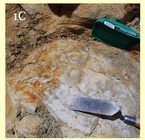
The Mammoth Site (The MS) of Hot Springs has been undergoing near constant investigation since 1974. Excavation continues today with both summer internship participants as well as on-site volunteer based programs. Most new discoveries of mammoth and other Pleistocene taxa produced by ongoing investigation are left in-situ for observation by visiting scholars, scientists, and the public. From initial discovery to present, excavation practices and excavators have played a key role in direct outreach to the public, as well as significantly contributing to the long-term stability and management objectives for in-situ excavation.

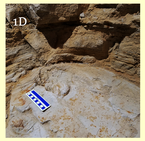
Excavation methods have varied from year to year as research goals have changed along with the physical conditions of The MS. Methodology in the 1970s was salvage driven, focusing on exposing and recovering fossils prior to backfilling between field seasons. Having transitioned to an in-situ excavation in the mid-1980s, The MS sinkhole effectively acts as an exhibit space, a natural preparation laboratory, and collections archive. Current excavation techniques are slower and geared toward promoting stability of exposed specimens in a dynamic environment. This means that excavation methods have shifted to a finer scale and require attention to detail in order to produce quality display items for the visiting public. Excavators observe and react to changing sediment patterns by shifting to finer tools and techniques as they approach potential objects in the matrix, reducing the chance for large discovery marks. Small fractures resulting from the ongoing seasonal shrinking and swelling of clays indicate areas where excavators may preemptively apply appropriate consolidation and support structures. These techniques help prevent damage and present a more aesthetically pleasing and morphologically valuable new specimen.

Existing in-situ bones are always affected by nearby excavation in some way; however, careful methods of digging can be applied to minimize destabilization of supporting matrix. Careful observation of support pedestals allows for selective excavation of destabilized sediments preventing 'tear-away' destruction of fossils. Where needed, in-situ specimens may be fitted with clay-support structures maintaining specimen integrity until the eventual removal of the fossil. These preemptive and reactive steps in turn lead to increased longevity of important specimens maintained in The MS in-situ collection.







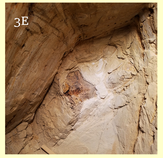


The Sediment

Sediments at The MS are predominantly fine-grained sands, silts, and clays (1A, 1B); some coarser sands and gravels exist near the edge of the sinkhole. The deposit has be laid down in fine laminae (1B), in some cases only millimeters thick. These strata are easily deformed by other factors in the bonebed, including both geologic processes, such as settling, slumps, slides, and cobbles (1C, 1D), but also biogenic sources like animal movement and root entrenchment.

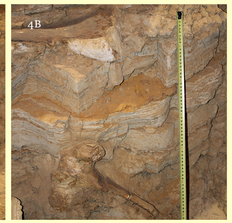
Case Study 1 - Western Edge

Arctodus simus specimen discovered in 2016 (2A; 16HS194) was carefully prepared in-situ by author Storms. Tools used included trowels, wood carving tools, and small wooden sculpting tools. Numerous other bear and mammoth specimens were found adjacent to 16HS194, namely several ribs (2A, 2B, 2C, 2D - 09HS041, 09HS044, 18HS007 and others). Irregularities in drape structure (2B) of fine sediment laminae indicate an excavator's proximity to new specimens, a small rib portion (2C, 2D - 18HS007) and sinistral condyle of a mammoth mandible (2E - 07HS017). Careful observation of laminar shape during excavation allowed for preparation with minimal to no discovery marks. The entire area (2F - all specimens) is a highly complicated network of specimens, but taphonomic data was not compromised by primary excavation.



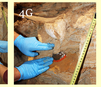
Case Study 2 - Central West End

This area of the bonebed is rich in specimens. With the removal of a skull (3A - 89HS062), the decision was made to pursue additional elements of an articulated mammoth (3A, 3B - 12HS040) in the remaining pedestal. Removal of the north end of the pedestal by excavator B. Dowell (and later R. Clemmer) proceeded quickly until a radial epiphysis was unovered (3C, 3D, 3E - 18HS047). By following deformed laminae, the excavators were able to uncover a nearly completely articulated dextral carpus and manus with minimal damage. Note increasingly dramatic draping adjacent to specimens (3F, 3G, 3H - multiple specimens).

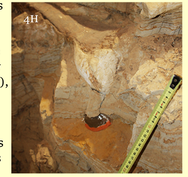


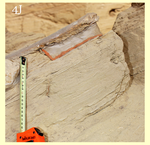
Case Study 3 - Preventing Catastrophic Collapses

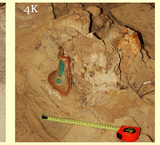
The sediments at The MS contain both expansive and non-expansive clays. These layers sitting adjacent to bones and often on uncemented sand laminae. In places where this occurs, blocks of sediment begin to deteriorate and threaten to damage specimens above by destabilization (4A, 4B - 89HS018) and specimens below through impact (4A, 4B - 07HS168). Treatment starts with careful removal of the loose blocks.



After major blocks are removed, the area is examined for any other unstable areas. In (4B), small loose but trapped blocks are present under tibia (89HS018). In order to treat unstable areas, small amounts of clay are combined with structural supports (4C), shaped and sized (4D), covered with sediment colored clay, a notice strip, and plastic wrap barrier (4E), and applied to immoblize the loose area (4F, 4G, 4H). This method allows direct support of specimens in cases of undercutting (4I, 4J, 4K).







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