

*Report on the partial re-excavation
of the Laetoli hominid trackway, Site G*

February 2011



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Executive summary

Introduction

In response to a Presidential decision (made in 2008) to open the hominid trackway at Site G permanently to public visitation, the Tanzanian Division of Antiquities organized a partial re-excavation of 3.50m of the southern sector of the trackway for assessment. This took place in February 2011. The GCI was requested to participate, along with a team including specialists from Tanzania, the US, Korea, South Africa, and Spain and a representative from ICCROM (see List of participants, page 53).

The GCI staff members who led the 1990s conservation project participated in the February 2011 partial re-excavation in order to:

- examine the condition of the exposed tracks and check the efficacy of the various technical strategies that had been put in place to preserve the trackway, and prevent site erosion and root penetration into the burial mound; and
- offer a measured approach to construction of a museum over the tracks by pointing to the risks and challenges to sustainability of such an undertaking.

Summary of activities and findings

The footprints exposed in the 3.50 meter trench were G1-36, 37, 38, and 39, and G2/3-27, 28, 29 and 30. The prints were not cleaned to the same level as in 1995 due to limited time and dampness of fill in prints G2/3-27 and 28 (from rain). Re-exposure showed this part of the trackway to be without significant macroscopically evident damage to the morphology of the footprints. However, fine cracks occurred in the floor of some of the prints. These appeared to have propagated mainly from incipient cracking noted in the 1995 documentation. The cracks were not filled with sand particles from the overburden indicating that they had opened during the current re-excavation and are due to drying of the tuff on exposure. Whether the cracking is indicative of mineralogical changes in the tuff, with conversion of tuff minerals into expansive clays (that is, weathering of the tuff) since reburial in 1995 or due to the damp conditions prevailing in February 2011 cannot be determined at this time. Tree roots had circumvented the root-inhibiting geotextiles in the burial mound. Consequently, a wider buffer zone denuded of trees and shrubs will be implemented by the Antiquities Division, following GCI recommendations.

Embedding of sand particles and growth of hair roots in the Bedacryl layer (consolidant used on the prints in 1979) and the tuff obscured details on the floor of the prints. Bedacryl, noted as a problem in 1995, continues to be problematic. It darkens the prints and their immediate surround and has likely trapped moisture in the prints.

The exposed trackway was photogrammetrically documented by two teams: one from the University of Cape Town, who undertook the photogrammetry in 1995 and 1996, and the other from the US Bureau of Land Management. Following re-excavation and documentation the exposed section was reburied again.

Site stabilization and drainage measures put in place at Site G in 1994-1996 had not been maintained in the intervening years. Tree growth along the drainage channels had clogged the drainage and cement aprons on the outflows of the catchment area were breaking up.

Re-excavation of the entire monitoring trench (established in 1995) was also undertaken by the GCI. The assessment brought forth three main points. Biobarrier was effective as a root excluder, but any gaps will allow invasion of roots. The loose fills of a reburial are strong attractors for roots, as is moisture, both of which migrate laterally through the unexcavated soil; therefore, limiting ingress of moisture into the reburial and removing vegetation further away from the trackway are both essential. The condition of the incised triangles in the trench floor indicated that deformation or slumping from mechanical load of overburden is negligible.

GCI staff members visited the Olduvai Museum to check on the condition of the Laetoli exhibit after thirteen years. While the basic condition of the interpretive panels created by the GCI remains good, the lack of maintenance of the building resulted in severe damage to two of the interpretive panels. The original 1979 cast stored at Olduvai has been damaged and is at risk of further damage if not protected.

Review of options for the future of the Laetoli trackway

There are only 3 options for the future of the Laetoli Site G trackway. These are: (1) sheltering the exposed site and opening it to visitation; (2) removal of the trackway or individual prints to a museum; and (3) continued reburial of the trackway, or a combination of these 3 options. Each of these has advantages and disadvantages and associated risks. The overriding objective for the future of Laetoli trackway must be preservation. Whatever treatment or decision is taken should serve this purpose first and foremost. It is therefore worthwhile to consider risks associated with the 3 options mentioned above.

Sheltering of the trackway

Assuming a shelter can adequately protect from intrusion of rain, lateral roots from trees, and animals and people gaining access to the actual trackway, as well as accumulation of dust in the prints and on the trackway requiring regular cleaning with the inevitable risk of damage, then the greatest threat over

the long-term would be subsurface moisture rising by capillarity. This has significant probability of leading to the accumulation of soluble salts on the exposed surface of the trackway as water vapor evaporates, resulting in powdering of the surface and increased weathering of the tuff. Therefore, some level of adequate control of ground water would be needed, possibly through an uphill interceptor trench. This will require a comprehensive study of the sub-surface hydrology. The Bedacryl layer, noted above, obscures surface details and legibility of the prints, which presents an additional challenge if the trackway is exposed for viewing and interpretation. Removal of the Bedacryl with acetone applied with brushes or in a poultice, which was undertaken in 1995 on only 2 prints due to risks presented by deterioration of the Bedacryl in many of the prints, will warrant further research and testing (for instance, a solvent that evaporates more slowly than acetone, such as xylene, might yield better extraction of Bedacryl). Details of the scientific investigations required in advance of any shelter design and the level of research that needs to be undertaken were discussed on site, and are being compiled by Dr. Stefan Simon. These will not be repeated here.

Further consideration concerns the sustainability of a shelter as an effective, functional entity, and this concern is significant, given the experience, not only in Tanzania, but in other parts of the world as well. Maintenance, security, and staffing are critical elements, and if one link fails in the chain, the system will degrade and ultimately lead to loss of the site. For example, lack of maintenance at the Olduvai Museum (broken windows, collapsing gutters) has severely damaged two of the interpretive panels in the exhibition since 1998 and no maintenance of the site stabilization measures at Laetoli has been undertaken since the end of the conservation project in 1996.

Removal of the trackway to a museum

This option has been posed repeatedly over the years, mainly by palaeoanthropologists, who view the tracks as equivalent to fossil bones. It is theoretically possible, but practically it would be a huge engineering undertaking with considerable risk to the trackway. The question of where to locate the removed trackways, likewise, is a challenge. The failure to protect the original 1979 cast of the trackway and the removal of the master cast from Dar es Salaam to the temporary exhibit hall at Laetoli illustrate the management issues related to protecting important objects in storage. The symbolic significance of the trackway in the landscape would be destroyed by its removal to a museum. Removal of individual tracks – an easier undertaking – would destroy the integrity of the trackway itself.

Continued reburial of the trackway

The GCI believes that the original decision made by the joint GCI–Tanzanian team to rebury the trackway remains correct. Without reburial, the site would not have survived today. Reburial provides physical protection and buffers against rapid, destructive changes in moisture; build-up of damaging

salts originating from the subsurface is avoided by capillary continuity through the burial mound. The principal drawback to reburial is the inability to directly observe condition, but in a remote site such as Laetoli and absent human resources committed to constant monitoring of an exposed resource, reburial is a practical, proven, and reversible preservation technique.

The 2011 assessment revealed weaknesses in the Laetoli reburial. The problem of root intrusion can be overcome with additional killing of trees in an extended buffer zone and this step is being implemented by the Antiquities Division. The cracking or weathering of tuff requires further research and an in-depth mineralogical investigation to determine definitively whether cracking is due to mineralogical change (weathering) or drying on exposure or both. Subsurface moisture should be investigated and controlled since indisputedly conversion of tuff minerals into clays is mediated by water. Site drainage and stabilization is essential for preservation of the trackway under conditions of either reburial or sheltering.

Summary conclusions

Since the initial reburial in 1979, there has been progressive change to the hominid prints. Root intrusion was the principal problem in 1995 but incipient cracking and weathering of tuff was already evident at that time. Change since 1995 is ascribed to root intrusion into the trench and hair roots in the prints due to an inadequate buffer zone free of trees around the trackway. Roots are attracted to moisture which at the macro level is addressed through site drainage and at the footprint level is likely exacerbated by moisture beneath the Bedacryl layer. The increase in cracking and possibly weathering of the tuff can be traced back to conditions recorded in 1995 and in some cases to 1979 and is also mediated by moisture and drying on exposure. Therefore root elimination and moisture reduction through comprehensive site drainage, both surface and subsurface, is essential for the future preservation of the trackway. Finally, it should be emphasized that every re-excavation of the trackway results in damage and change, whether physical or through accelerated cracking or weathering, as equilibrium in the reburial is abruptly disturbed by exposure to the external environment.

The three options reviewed above - which need not be mutually exclusive (that is, a combination of approaches could be envisioned) - need to be considered in the light of these findings. But immediate action is required to rectify the problems noted in this report in relation to the current reburial (that is, killing of additional trees and repair and clearance of the drainage system).

Partial re-excavation of the Laetoli hominid trackway, February 2011

A visual summary



The reburial mound prior to removal of boulders



The reburial mound after removal of boulders from the southern 4 meters



Removal of Layer 5



Layer 4 exposed after removal of Layer 5



Removal of Layer 4; Enkamat is beginning to appear.



Removal of Enkamat. Biobarrier 1 is beginning to appear in foreground.

Removal of reburial layers



Biobarrier 1 after removal of Layer 4



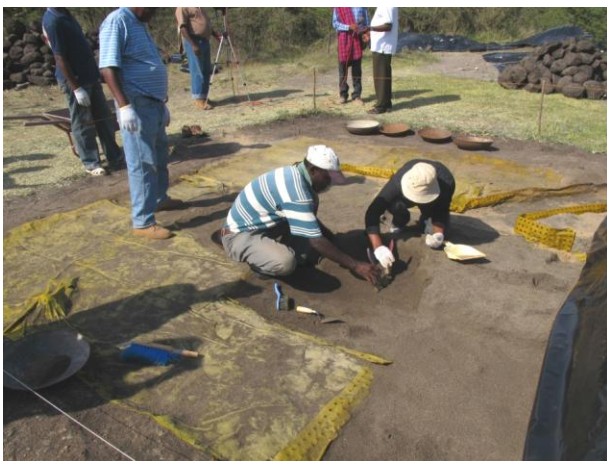
Surficial staining from Biobarrier 1 and impressions of nodules on Layer 3 after removal of Biobarrier.



Removing Layer 3 (mixture of Ngarusi and Kakesio sand)



Biobarrier 2 after removal of Layer 3



Removing Layer 2, below Biobarrier 2. Geotextile laid on unexcavated 1979 land surface and strips of Biobarrier placed vertically on the wall of the 1979 trench remain in situ.



Roots entering trench laterally were found in Layer 2, which abuts the 1979 trench wall.

Removal of reburial layers



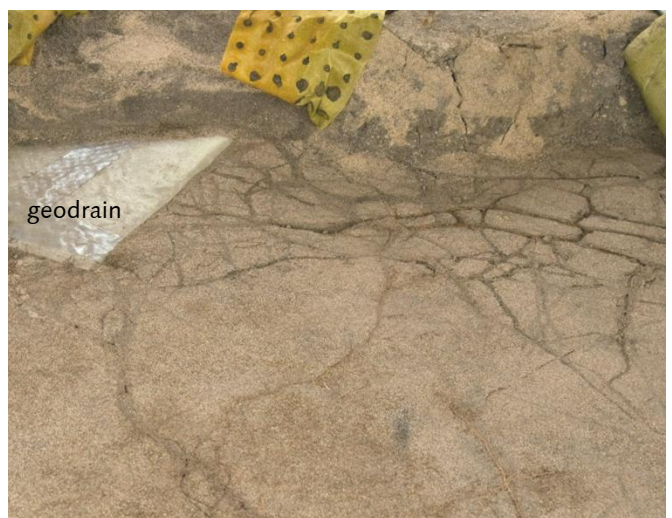
Roots running above geotextile along the Augite Biotite scarp. Roots found easy access below geotextile where 2 pieces of geotextile met at the top of the Augite Biotite scarp.



Roots penetrated geotextile in 2 places (left and center); holes may have been created by termites, allowing root access. Small holes created by termites in geotextile (right).



Geotextile pulled back to reveal Layer 1. Roots growing between geotextile and surface of Layer 1 emanate from east and south 1979 baulk.



Impressions of dead roots in Layer 1 with evidence of termite activity in damp fill near the geodrain drain in the 1979 west trench.

Removal of reburial layers



Removing Layer 1 from surface of tuff. Absorbent paper on prints and tuff that were subject to water infiltration from rain.



Final cleaning of Layer 1 from surface of tuff.



Roots penetrating tuff at edge of Fault 1. Root penetration in conjunction with excavation dislodged a piece of the tuff.



Roots at edge of Fault 1 after cutting; one can follow the root eastward (dashed line) into the unexcavated 1979 trench wall.



Tree growth near the reburial mound



Unidentified tree (likely *Balanites sp.*), growing amidst *Acacia drepanolobium*, was responsible for the lateral roots that entered the mound from the east.



The main root from this tree was traced (far left) traveling 8.3 m to the edge of the trench where it can be seen penetrating unexcavated 1979 ground surface, near Biobarrier 2 (left), to emerge from the 1979 trench wall.



Live, unidentified tree stump (probably *Acacia drepanolobium*) in the SE corner of reburial mound (visible far left during removal of Layer 5). A root running N-S above the geotextile from the SE part of the trench (far right photo) may emanate from this cut tree stump.

Site drainage system



Extensive growth of acacia trees adjacent to drainage channel, which is clogged with vegetation. Catchment sump in foreground.



Inlet channel leading to main catchment sump; cement apron is cracking.



Catchment sump. Steel grill to prevent outflow pipe from clogging with vegetation is missing.



Elephant (and cattle) tracks in mud adjacent to berm where water accumulates. Thorn fence around Site G established in 1996 to deter animals from entering has been removed.



Cement inlet apron on east drainage channel is breaking up.

Trackway and hominid prints after re-excitation in 2011



3.50 meter section of southern trackway after re-excitation in February 2011. Eight footprints and numerous hipparion prints were exposed. The prints were not cleaned to the same level as in 1995 due to lack of time required to remove adherent and embedded fine particles from the floor of the prints. Dark color in the prints and the 'halos' around them is due to Bedacryl applied in 1979. Geotextiles remain in situ on the unexcavated surfaces in photo.

Trackway and hominid prints after re-excitation in 2011



3.50 meter section of southern trackway after re-excitation in February 2011.

Reburial of re-excavated section in 2011



Damaged margin of print G2/3-27 protected with a piece of geotextile and labeled, with Layer 1 sand holding geotextile in place.



Placing Layer 1 on trackway surface. Detached piece of tuff on fault with damage label in foreground



Layer 1 completed.



Geotextile in place over Layer 1.



Layer 2 in place with strips of Biobarrier 1 being placed over it.



Biobarrier 1 completed.

Reburial of re-excavated section in 2011



Layer 3 in place with Biobarrier 2 being placed over it.



Layer 4 and Enkamat in place with Layer 5 being placed over it.



Boulder capping re-instated (temporary shelter still in place).

Olduvai Museum



Irrelevant additions in the Orientation room at Olduvai (bicycle and 2 large panels) and 2m high stone memorials erected at the Olduvai Museum (right) and at the site of Laetoli by a Japanese cyclist undermine the integrity of the exhibit.



Windows and exterior gutters are broken allowing water to enter. This has damaged two panels.



Casts of stone tools in Olduvai room purportedly taken by visitors (left, circled). Hand-made signs and donation box in entry to Laetoli room (right) are intrusive additions.

Laetoli casts



Replica cast of southern trackway in Olduvai exhibit (1). Touching of prints by visitors has deposited oils from hands and removed some of the patination (2). The impact of touching is mainly superficial; the cast could be cleaned and repatinated. The master epoxy cast made in 1995 (3), which is now the only replicable cast of the trackway as excavated in 1979, was transported from its permanent storage in Dar es Salaam to the temporary exhibit hall at the Laetoli site in 2009.



The original 1979 cast has a scientific value that surpasses that of the trackway itself since it constitutes the most precise record of the southern trackway as excavated in 1979. The mother mold from which it was made is deteriorated beyond use and the cast cannot be further replicated due to risk of damage. The cast was wrapped for its protection and placed in purpose-built shelving by the GCI in a storeroom at Olduvai in 1996. In 2011 it was found to be in an exposed and vulnerable state (4) resulting in some mechanical damage on its exposed edge (5).

Condition record of Laetoli hominid prints re-excavated in February 2011

Introduction to the condition record

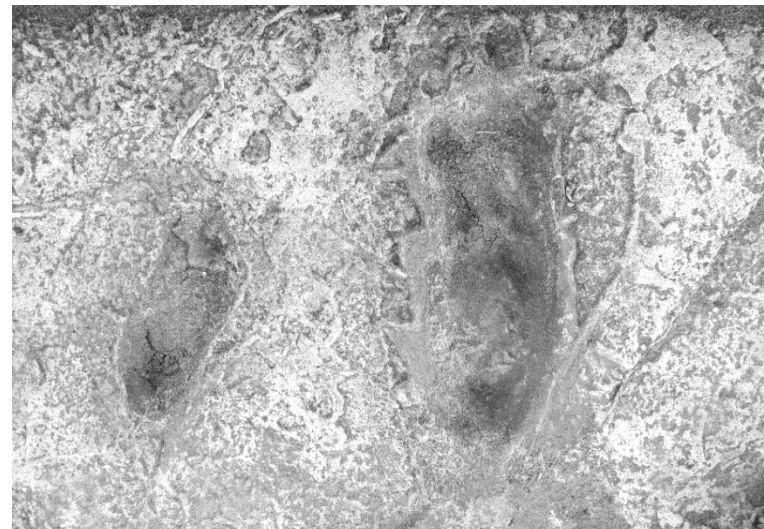
Eight prints were re-excavated in February 2011. This is the third time these prints have been excavated. The 2011 excavation marks almost 16 years since the previous excavation in 1995 and 32 years since their initial excavation in 1979.

The circumstances under which the re-excavation took place were not ideal. The time for re-excavation of the reburial mound and prints was somewhat limited (11 days total including documentation and reburial). Rain and leaks in the improvised shelter hampered excavation. A presidential visit involving some two hundred people and a public day for visitation further encumbered the process.

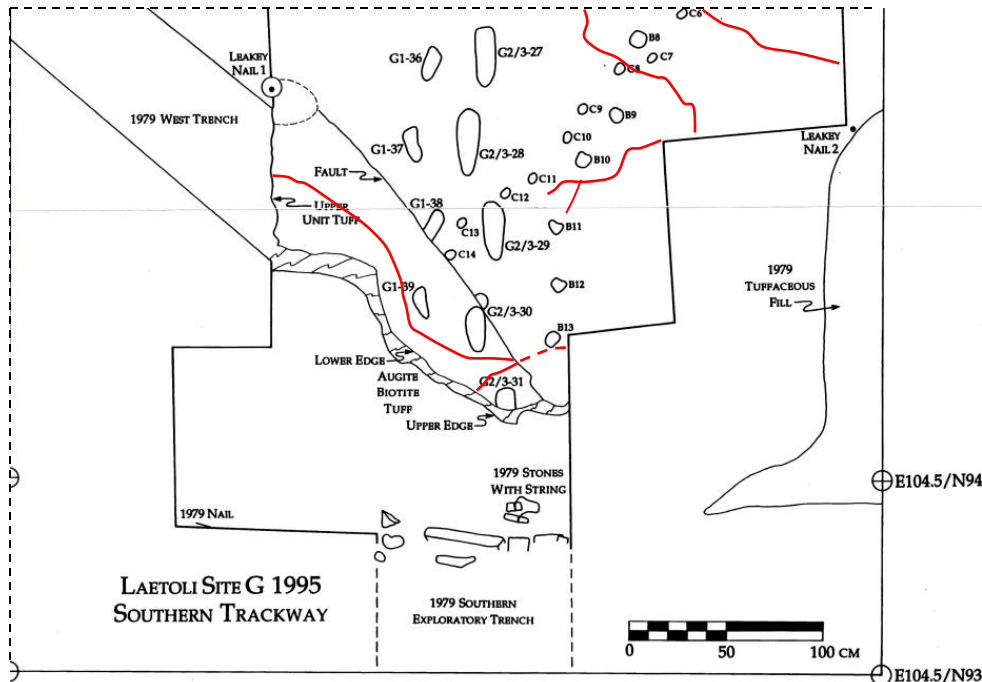
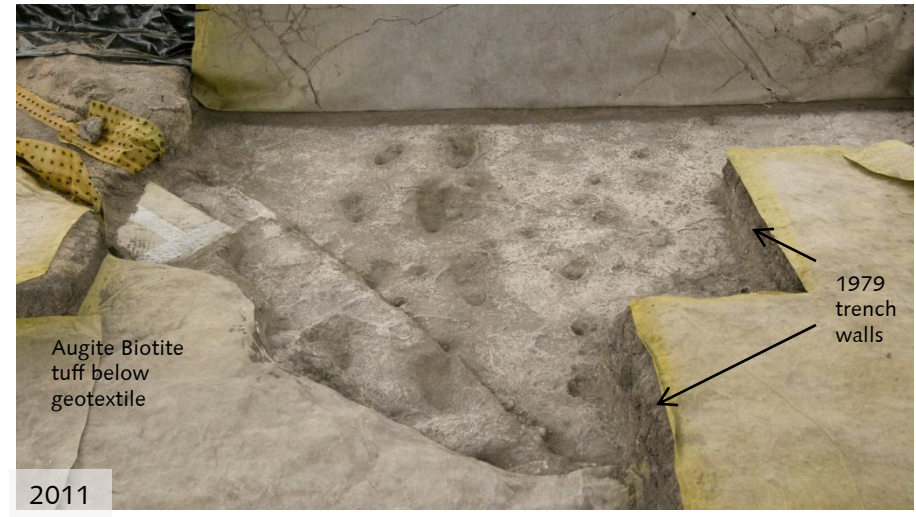
The basis for recording condition in 2011 was the condition methodology established in 1995. The 1995 terminology has been retained and the principle of comparing the current condition with the previous recorded condition was followed.

The observations of condition in 2011 have been added in brackets in blue font to the 1995 written condition records to facilitate comparison and interpretation. The graphic recording of condition in 1995 is not included here but can be found in the full 1995-1996 condition report.

Since the prints were not cleaned to the same level as in 1995, comparisons do not allow the precision that would have been desired. The original intention to re-excavate only 3 meters of the trackway was altered during the field work thus exposing prints G1-36 and G2/3-27 for which there was no detailed documentation available in the field which hindered in situ assessment of these prints.



Area re-excavated in 2011



Area re-excavated in 2011 (above right) and as seen in 1995 photo and in the plan of the southern part of the trackway (left). The geotextile that covered unexcavated surfaces in the 1995 reburial were not removed in 2011 and can be seen in situ above. The 1979 West trench was re-excavated only in its upper layers and the geodrain placed in the trench in 1995 at the bottom of the 1979 trench can be seen protruding into the 2011 excavated area.

The unexcavated Augite Biotite tuff and the 1979 trench walls, referred to in the report, are indicated above. The main root system that entered the trench from the east is approximately indicated on the plan in red.

Summary of conditions in 2011

The summary of conditions corresponds to the general format, terminology and definitions established in 1995-1996 to record conditions on the tuff. The definitions of all conditions recorded in 1995 are to be found on page 24; however, not all of the conditions recorded in 1995 were found or observed in 2011. Condition records of the eight individual footprints re-excavated in Feb. 2011 come after the definitions, beginning on page 27.

General conditions

Reburial mound and fills: Vegetation growth on the mound was recorded by the documentation group (information not available for this report). Annuals, grasses, perennial wild asparagus and at least one tree (see below) were, however, noted. The 1995 reburial fills and separator layers (Biobarrier, geotextile and Enkamat) were all intact; all the soil and sand fills were only slightly to moderately damp, but not wet.

Removal of Layer 1, above the trackway surface, was easily achieved by brushing the trackway surface, with only patches of upper layer (natural) consolidation encountered. The majority of fill in the prints was also easily removed but became more consolidated and adherent toward the floor of the prints. None of the footprints were cleaned of adherent and embedded sand particles to the level of cleaning achieved in 1995 due to lack of time for careful cleaning.

Footprints: Eight hominid footprints were re-excavated. Four prints (G1-37, G1-38, G2/3-28 and G2/3-29) were judged to exhibit minor alteration and thus to be in good condition compared to their condition in 1995. The principal condition was embedding. Four prints (G1-36, G1-39, G2/3-27 and G2/3-30) showed moderate alteration and thus to be in fair condition compared to their condition in 1995. Conditions were principally related to increased cracking of the tuff and penetration of hair roots.

Tuff Conditions:

Weathering/cracking: Distinct areas of cracking were evident in and around prints, especially outside the margin of print G1-39. The areas of cracking correspond to incipient cracking and/or

weathering recorded in 1995 and often to areas of deteriorated Bedacryl. The cracks were free of sand infill indicating that cracking resulted from drying from exposure during re-excavation. It is not clear whether some of the cracking inside prints is due solely to drying or involves actual progressive weathering, that is, mineralogical change of tuff, or both.

The Footprint Tuff of the re-excavated trackway outside the prints was in generally excellent condition. It exhibits little of the cracking seen in the prints and adjacent tuff (both hominid and hipparion), which either causally or coincidentally corresponds to the area of Bedacryl application (see Bedacryl below).

Mechanical damage: The 2011 re-excavation resulted in mechanical damage from excavation to the fossil termite burrow on print G2/3-27.

Detached/loose tuff: A small piece of tuff on the edge of Fault 1 was detached from root penetration.

Conditions related to 1978-79 interventions:

Bedacryl layer: A polymeric consolidant, trade name Bedacryl (chemically a polymer of n-butylmethacrylate) was used in an organic solvent, concentration unknown, by the Leakey team in 1979 to consolidate the footprints prior to molding. Bedacryl has properties that make it unsuitable for application on the footprints: it darkens the tuff and creates a yellow halo effect around the prints; it acts as a sealant on the footprints and likely contributes to accumulation of moisture in the prints; and its glass transition temperature (T_g) is 20 to 22° C, a low temperature, which means at this temperature range and above, Bedacryl is plastic and deformable under mechanical stress, which would result in embedding of sand grains in it.

From the GCI's field observations in 1995, Bedacryl was inconsistently applied; in many of the trackway prints it was thickly applied, sometimes puddling and slightly uplifted in the low points of the floor of a print, and in all cases caused slight obscuring or

loss of fine detail on the tuff surface.

As in 1995, in 2011 Bedacryl was distinctly visible as darkening and yellowing of the tuff. Yellowing is most obvious where Bedacryl extends beyond margins of prints (hominid and hipparion) creating the halo effect. In three of the 2011 re-excavated prints Bedacryl was noted in 1995 as having been thickly applied (G1-37, G2/3-27, G2/3-29). In all re-excavated prints deterioration (cracking, blistering or loss) of the Bedacryl was recorded in 1995. In 2011 the prints were not sufficiently cleaned to determine if the Bedacryl layer was further deteriorating. It is also probable that it may be trapping moisture thus promoting natural chemical processes of weathering of the tuff and encouraging penetration of root hairs attracted to the moisture.

Embedding of Layer 1: Cleaning of sand particles from the prints in 1995 was never fully achieved; dark colored Ngarusi sand grains from the original 1979 reburial that were embedded in the tuff and Bedacryl from that time were not completely removed in 1995 and can be clearly seen in the photographs. In 2011 cleaning of embedded sand particles was not done to the same level as in 1995. Embedding was most problematic on the floor of the prints and may be related in part to Bedacryl plasticity (see Bedacryl above). It was often difficult to distinguish between 1995 and 1979 embedding with the naked eye (requires magnification). Embedding and the level of cleaning results in loss of resolution of detailed features (as noted in 1995). Removal of the Bedacryl would address this but problems associated with Bedacryl removal, as pointed out in 1995 report, need to be taken into account.

Root damage:

Roots: Roots were found following the interface between the geotextile and Layer 2 (above the geotextile) and Layer 1 (below the geotextile). Roots range in size from 5-10mm where they enter the trench down to very fine rootlets (less than 1mm) and hair roots. The main root system entered the 1979 trench from the east at 4 points. With one exception (below), all roots and adventitious rootlets appear to emanate from one tree (tentatively identified as *Balanites sp.*) approximately 3m east of the reburial mound (the main root was traced winding its way from the source tree for 8.3m

to the edge of the trench). The exception was a N-S running root of clearly different type (dark brown in color). Its source tree was likely a small tree growing in the SE corner of the reburial mound. The tree had been cut prior to identification and recording (remaining stump approximately 2.5cm diam.), but appears to be an *Acacia drepanolobium*. Roots penetrated the geotextile in several places. All roots were from a lateral invasion, growing under the vertically placed Biobarrier to emerge in the adjacent fill; none grew from above the Biobarrier.

Roots penetrated near the surface of the Augite Biotite tuff overlying the Footprint Tuff at the southern unexcavated end of the trackway. The only substantial tuff penetration occurred at the SE end of the fault, where a root detached a piece of tuff on the edge of the fault. Hair roots were evident in many of the prints, often penetrating the tuff and/or the embedded/adherent sand or the Bedacryl layer. Without further cleaning and microscopic examination this cannot be clarified.

Insect activity

Holes in the geotextile are likely due to insect (possibly termite) activity. Trails of termites in impressions of roots were evident in the NW part of the trench in the surface of Layer 1. Since termites only eat dead wood, this suggests that the source tree for these roots must have been killed at some point, although we have no record of any tree killing by Antiquities staff. Two stumps and one root cut and treated in 1995 with PCP showed no evidence of termite activity.

Interventions

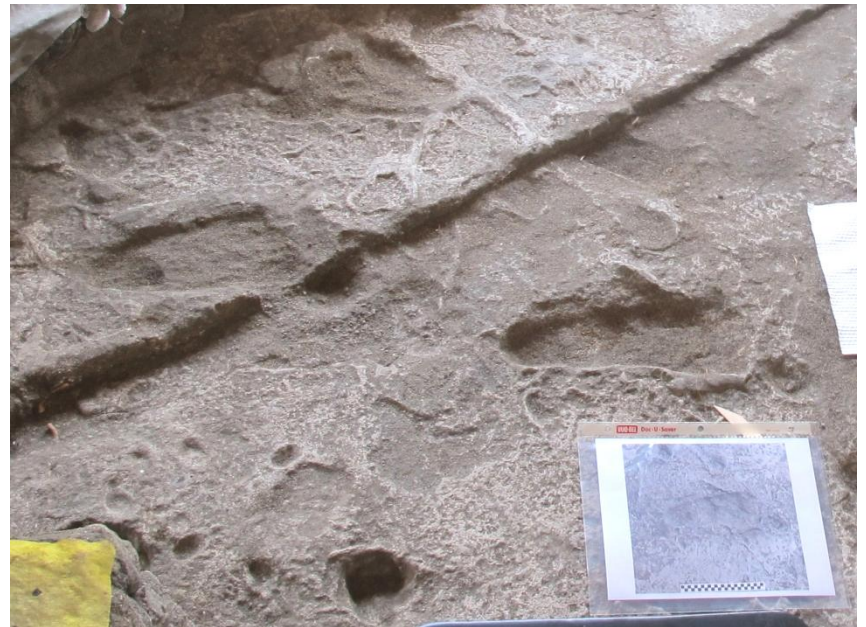
Roots intruding in the burial were cut; the tree stump at the SE corner of the reburial mound was treated with Baphosate 480SL (chemically glyphosate isopropyl ammonium salt) provided by Dr Joel Bujulu. Our information is that this is the equivalent of 'Round-Up' (sodium glyphosate) used to kill trees previously. Antiquities staff will return to the site to treat all trees within a 35m buffer zone around the reburial mound and then 4 months later for re-treatment as necessary and followed by annual inspections and treatment as needed. Antiquities staff was also requested to undertake all necessary repairs to the site stabilization and drainage interventions.



Hominid prints as re-excavated in 1995 (left) and February 2011 (right)



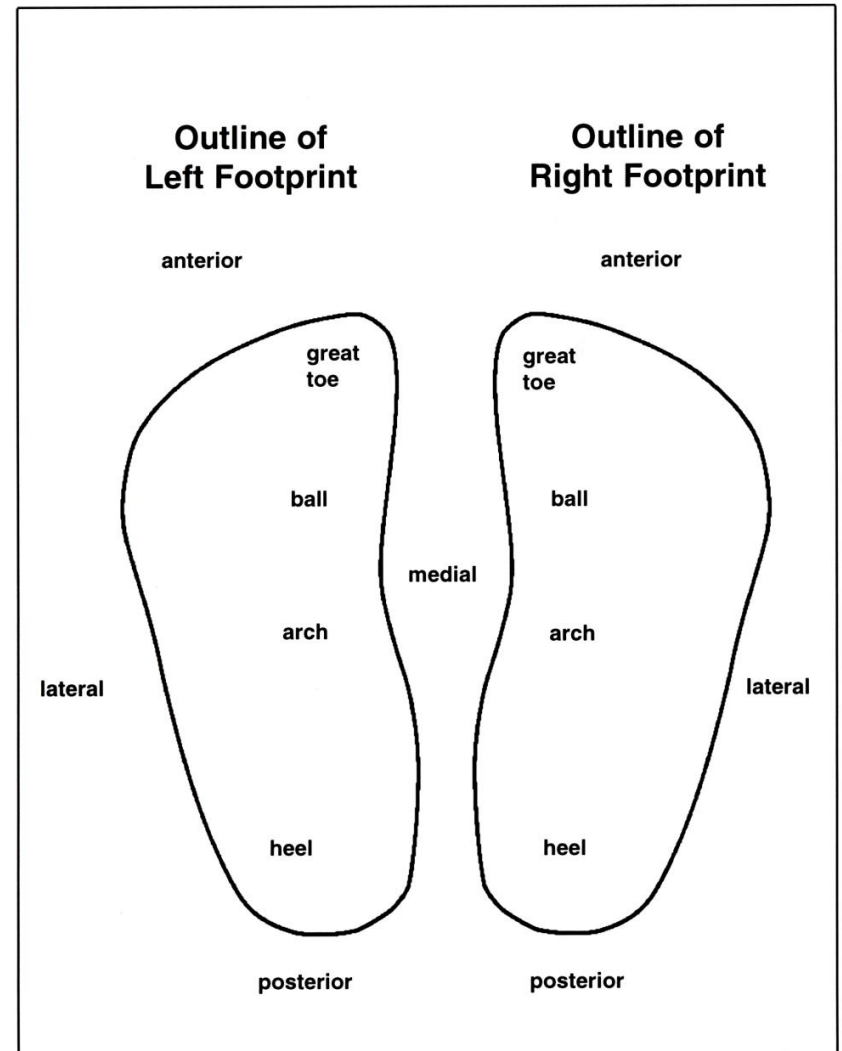
Trackway before final cleaning of tuff surface and with fill still in prints. Roots growing in Layer 1 are visible on the surface and penetrating tuff at the edge of Fault 1.



Trackway during final cleaning of prints. G2/3-28 covered by absorbent paper (top) to assist in drying of damp fill from shelter leak during rain storm.



Footprint Tuff with hipparion prints, east of hominid trail.
Bedacryl darkening and halo around hipparion prints is visible.



Outline of left and right footprints with terminology used to describe location of conditions.

DEFINITIONS OF CATEGORIES FOR CONDITION RECORDS (1995-1996) [2011]

G1-1: Right/Left/Indeterminate

Inventory number of print given in 1978-79 and attribution to left or right foot; where attribution was not known, the print is designated as 'indeterminate.' Attribution is based on 1978-79 descriptions.

Location

Location of print on the Site G trackway, defined by sector of trackway:
 Southern sector of trackway
 Middle sector of trackway
 Northern sector of trackway

And by 1995 or 1996 trench number (trenches 1-7).

Excavation and Reburial History

History of excavation or exposure and reburial of each print, defined as:
 Exposed by natural weathering;
 Excavated and reburied in 1978 and/or 1979;
 Re-excavated and reburied in 1992 and 1993, for preliminary assessments;
 Re-excavated and reburied in 1995 or 1996, for conservation.

Re-excavated and reburied in Feb. 2011, for assessment

1978-1979 Description

Description of the print from the Laetoli monograph: M.D. Leakey and J.M. Harris, **Laetoli. A Pliocene Site in Northern Tanzania**. Oxford Science Publications, 1987, 491-494.

1995/1996 [2011] Conditions

General condition: Assessment of general condition is based on condition of the print in 1995 or 1996 **relative to its condition in 1978 or 1979**, as determined by in situ assessment of the 1995/96 condition compared to photographs and casts of the prints in 1978/79. **[Feb. 2011 condition is based on condition of the print in Feb. 2011 relative to its condition in 1995.]** Defined as exhibiting:

Minor alteration (good condition): print shows little change from its original (1978-79) [1995] condition; loss of resolution (that is, the fine detail) due to the presence of Bedacryl or slight weathering and minor embedding of particles from the overburden are the most common changes.

Moderate alteration (fair condition): print shows moderate change from its original (1978-79) [1995] condition, generally as a result of increased weathering or cracking of tuff, embedding of particles, or root damage, or a combination of minor conditions.

Significant alteration (poor condition): print shows significant change from its original (1978-79) [1995] condition, generally as a result of root damage, extensive weathering of tuff, severe embedding of particles, and insect activity; alteration may be the result of minor impacts by several phenomena or a major impact of one phenomenon.

Tuff Conditions:

Weathering: Tuff that is mineralogically and physically altered by natural processes; weathered tuff has a higher clay content than unweathered tuff, and is visually distinguished by its prominent network of polygonal cracks and by its darker color and coarse texture. Weathering is often characterized in the written record as being slight, moderate or severe. This condition was most common and severe in the Northern sector of the trackway.

Cracking: Fine fractures or breaks in the surface of the tuff; cracking occurs primarily in the unweathered or slightly weathered tuff and is to be distinguished from polygonal cracking characteristic of weathered tuff. Cracks may contain calcite veins.

Losses: Loss of tuff as determined by lighter color, indicating a fresh break or abrasion on the surface, and by comparing the print in situ with 1978-79 casts and photographs.

Detached/loose tuff: Areas or fragments of tuff that were fully or partially separated from the underlying tuff; common in areas of weathered tuff.

Powdering: Surface tuff that easily disintegrated with the slightest mechanical action (such as brushing); may be related to the mineralogical composition of the tuff microstratigraphy and to advanced weathering. This condition was most prevalent in the Northern sector of the trackway.

Other tuff conditions: (Conditions rarely encountered)

Void: an empty space in the tuff resulting from separation between the tuff

microstratigraphy, apparently caused by penetration of root mats between layers, or, it is inferred, by other extraneous causes such as burrowing insects; usually detected by tapping the surface and hearing a hollow sound. Only found in G2/3-7 and G1-29.

Disruption: area of tuff where the continuity of the surface was interrupted or breached as a result of stump or root penetration or from another external force (such as a spear point in the case of G2/3-18 and 21).

[Mechanical damage: Physical damage to the tuff as a result of excavation to print G2/3-27]

Conditions related to 1978-79 [1995] interventions:

Bedacryl conditions:

Bedacryl: A synthetic resin (polymethacrylate ester) used to consolidate and harden the prints prior to molding in 1978-79. On the southern trackway, Bedacryl was identifiable as a very distinct darkening of the tuff surface creating a halo around the print. On the northern trackway Bedacryl was identifiable primarily as “stringers,” a flexible polymeric material that was visible stretched between cracks of weathered tuff.

Deteriorated or missing Bedacryl: Bedacryl that had disintegrated, blistered, lifted or been lost from the surface of the tuff. Distinct patches of loss of Bedacryl at the bottom of prints was found in G1-25, G2/3-18 and G2/3-30, and may be the result of removal during the molding process in 1979.

Embedding: Fine particles of sand and other particles/fines from the 1978-79 [1995] overburden which were impressed in the tuff or in the Bedacryl layer; deeply embedded particles were not removed. The degree of embedding recorded was that encountered after the initial cleaning; subsequent cleaning of the prints often removed additional embedded particles.

Silicone: Fragments or residue of white silicone rubber from molding the trackway in 1978/79.

Excavation tool marks: Visible traces of score marks or incisions in the tuff as a result of excavation with chisel, dental pick or other implements in

1978-79. Such marks were frequently obscured by the layer of Bedacryl and embedding, but may be noted when they could be seen in 1978-79 documentation in the Comparison with 1978-79 cast/photograph section.

Inventory number on tuff: Inventory number of print marked on the tuff surface with permanent ink in 1979. Inventory numbers of prints excavated in 1978 were not marked on the tuff.

Other conditions related to 1978-79 interventions: (Conditions rarely encountered)

Plastic fragments: Remnants of plastic, possibly from the 1978-79 reburial. These remnants are to be found mainly in the fly-over Polaroids.

Yellow staining: Localized discoloration of the tuff, from cellulose nitrate used to adhere detached tuff or consolidate tuff surface was detected in prints excavated in 1978 (as identified by IR spectroscopic analysis of samples taken from G1-14 and G2/3-6); see also Bedacryl above. Found only on the Northern trackway sector.

Root damage:

Surface roots: Root (>1mm diameter) or rootlet (< 1mm diameter) remaining on the tuff surface after initial excavation and cleaning of print. Surface roots were recorded since they were visible at the time of recording; some left impressions in the tuff and were recorded accordingly. All surface roots were later removed.

Root mat: Area of interwoven rootlets, usually from grasses and shrubs, found on the tuff or Bedacryl-coated surface, or an area with abundant rootlets.

Remnant stump: A stump left in situ in 1978/79 or 1995/96. The 1978-79 stumps were rotten and left only a void with bark, such as in G1-30 and 32 (see also 1995/96 Interventions: Root Treatment).

Penetration point: The point where a root penetrated the tuff surface. **[Penetrating hair roots in tuff or Bedacryl layer]**

Root impression: An imprint in the tuff resulting from the growth of a root along the surface of the tuff.

Subterranean root: A root or portion thereof that had penetrated below the tuff but was not removed (subterranean roots that were removed are defined as treatments: see [1995/96 Interventions: Root Treatment](#)).

Insect activity:

Non-specific: Areas of surface tuff marred by small ant holes, or insect trails (a combination of tuff fragments and particles from the overburden that have bonded together). This condition does **not** refer to fossil termite burrows, which were recorded as part of the microstratigraphical study by Craig Feibel. Found only on the Northern sector of the trackway

Cut-worm pupal cases: Small lunette-shaped craters (average 1cm diameter x 0.5cm deep) found on the tuff surface; some of the casings contained larvae, commonly known as cut-worms (identified as Coleoptera). The craters are natural casts formed around the pupal cases. Confined to the Northern sector of the trackway.

1995/1996 [2011] Interventions:

Consolidation/stabilization:

A treatment applied to stabilize powdery and loose tuff by injecting an aqueous consolidant, Acrysol WS-24 (a methyl and ethyl methacrylate copolymer), into the disrupted area; dispersions ranged from 10% to 50% in water (v/v).

Fills:

A treatment to replace lost material or fill voids in the tuff from root removal or decay in order to prevent collapse of the void under the weight of reburial overburden and discourage insect activity. Composition of mixtures varied depending on localized conditions, but all were based on a mixture of Acrysol WS-24 and a filler such as sieved soil and tuff or fumed silica.

Reattachment:

Detached tuff was re-adhered with solutions of varying concentrations of Paraloid B-72 in organic solvent. [\[Detachment of tuff on fault 1 and mechanical damage to margin of print G2/3-27 in 2011 could not be re-attached since conservation materials were not available; these were protected, marked and reburied. \]](#)

Root treatment:

- Surface roots or rootlets were always removed, but are not shown as a treatment on the graphics.

- Cut root or stump: exposed, cut, and sometimes routed, end of a root that penetrated the tuff and was left in situ because it could not be removed without damage to the tuff.

- Subterranean root removed: subterranean root that was removed by hand with a scalpel and tweezers.

Other 1995/1996 Interventions

Bedacryl removed: Bedacryl was removed from the surface of hominid prints G1-26 and G2/3-25 and hipparion prints B8 and C2 with acetone applied with brushes or in a cotton poultice

Insect trail removed: Recent insect trails attached to the tuff surface were removed from the heel of G1-6 and from two areas in G1-13. This was done at the request of the palaeoscientists who felt the trails obscured the morphology of the prints and consequently their interpretation. They were removed with a scalpel and a dental pick, after which the area was consolidated with a 25% dispersion of Acrysol WS-24 in water.

Sample taken: Samples of Bedacryl and yellow staining taken for analysis.

Comparison with 1978-79 Cast/Photograph

Recorded in written form are observations made in the field on any changes noted between the print in situ and the 1978-79 cast (if available) and 1978-79 [\[1995\]](#) photographs. 1978-79 photographs were taken by L. Robbins, T. White, P. Jones, and J. Reader.

Notes

Other observations noted in the field, such as description of excavated fill material, or comments pertinent to the condition or documentation of the print.

G1- 36: Right print 1995 recorded conditions [2011 recorded conditions]

Location Southern sector of trackway, trench 1
Excavation and Reburial History Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]
1978-1979 Description Well preserved right footprint. The toes have been overprinted subsequently by an indeterminate animal print.



Cracking along fossil burrows

Cracking in heel of print

1995 Condition

General condition: Minor alteration/good. [Moderate alteration/Fair]

Tuff Conditions:

Weathering: none

Cracking: Hairline cracks transect heel and are evident on the burrows in anterior portion. [Incipient cracks noted in 1995 in heel and along the fossil termite burrows in the anterior portion have propagated]

Losses: Minor loss of tuff surface noted outside medial and lateral margins of print.

Detached/loose tuff: none

Powdering: none

Other: none

Conditions Related to 1978-79 [1995] Interventions:

Bedacryl: Bedacryl found throughout the print and surrounding it; deterioration of Bedacryl in heel area and anterior to arch. [Bedacryl visible as darkening on floor of print and yellow halo around print]

Embedding: Slight embedding of fine particles in Bedacryl layer on the floor of the print. [Moderate embedding and adherence of sand grains]

Silicone: none

Excavation tool marks: Tool marks visible in the arch and heel portions of print.

Inventory number on tuff: 1979 label ("1-36") visible on tuff surface. Barely visible; largely obscured by adherent sand]

Other: none

Root damage: A few rootlets on the surface, which did not penetrate the Bedacryl layer. [Hair roots primarily penetrating in cracks of tuff or Bedacryl layer]

Insect activity: none

1995 Interventions

Consolidation/stabilization: none

Fills: none

Reattachment: none

Root treatment: Surface roots removed. [Penetrating hair roots were not removed]

Other: none

Comparison with 1978-79 Cast/Photograph

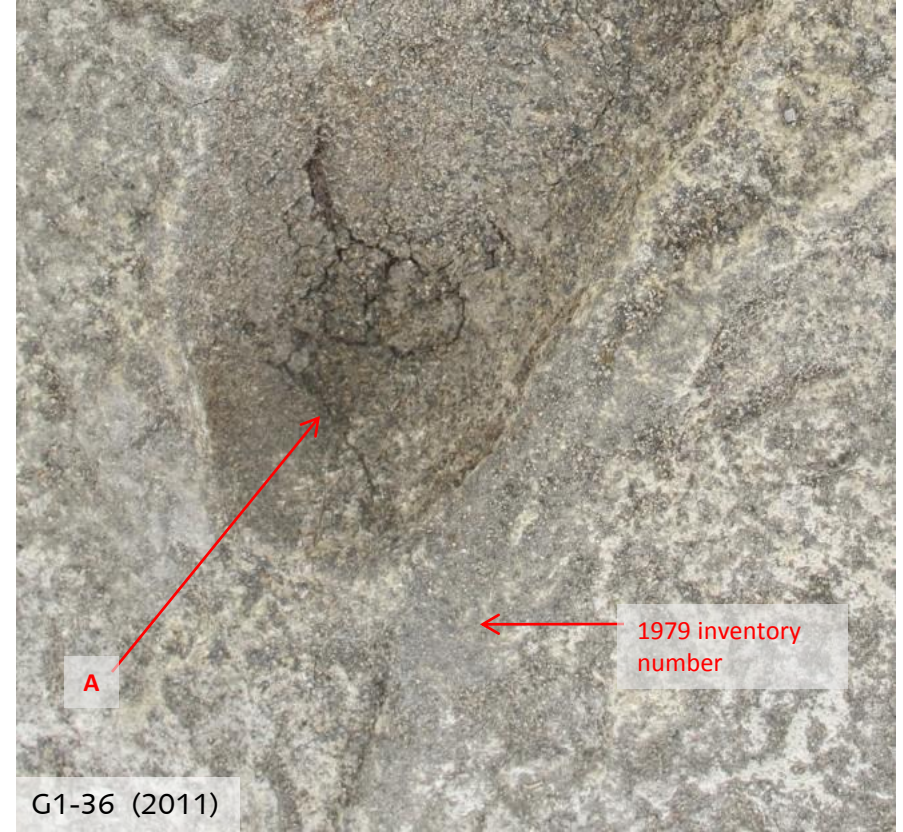
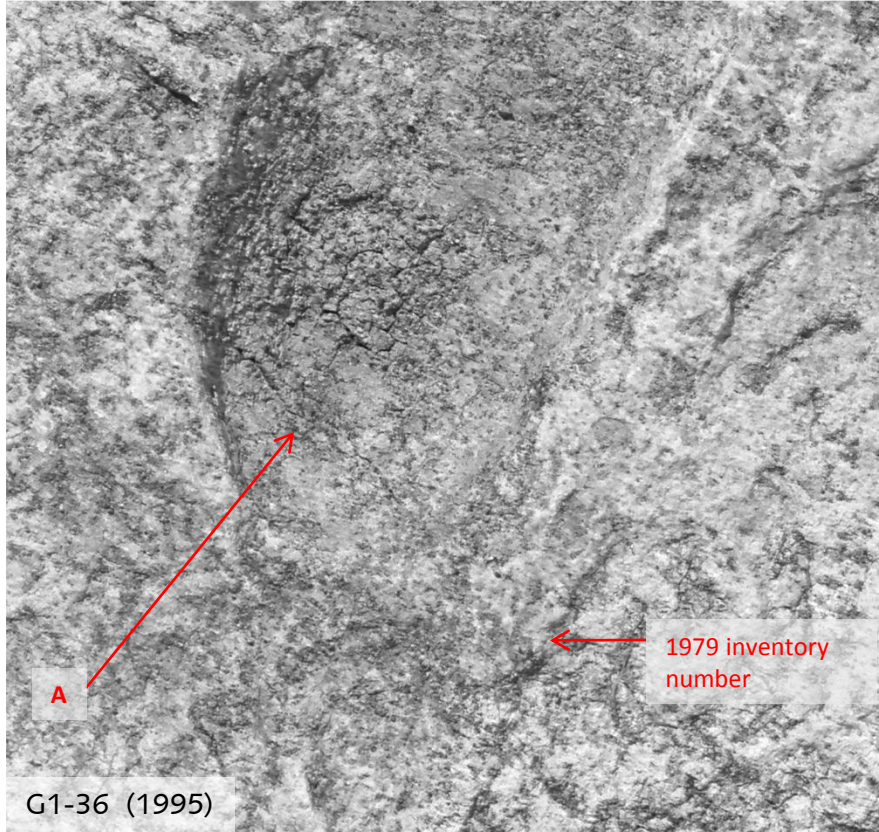
Comparison with the 1979 cast and photos showed loss of resolution of features on the floor of the print due to Bedacryl coating. Tool marks clearly visible in the arch and heel portions of the cast and photos were muted in the print *in situ*; tool marks in the anterior portion of the print were not visible *in situ*. The transverse crack in the heel was visible in both the cast and the footprint *in situ*. [see Cracking above]

Notes

[Print was not cleaned to the same level as in 1995]



Comparative photos of G1-36 in 1995 and 2011



Close-up of the heel of G1-36 in 1995 and 2011. Transverse crack in heel (A) was visible in 1995 and was noted on photos and cast from 1979. Incipient cracking (possibly weathering) in heel recorded in 1995 has increased.

G1- 37: Left print 1995 recorded conditions [2011 recorded conditions]

Location Southern sector of trackway, trench 1
Excavation and Reburial History Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]
1978-1979 Description Well preserved complete left footprint.

Cracking
outside lateral
margin



Adhered fines
outside
posterior
margin

1995 Condition

General condition: Minor alteration/Good. [Minor alteration/Good]

Tuff Conditions:

Weathering: Slight weathering of tuff on medial margin near arch; and outside of the print margins.

Cracking: none. [Cracking outside lateral anterior margin of print]

Losses: none

Detached/loose: none

Powdering: none

Other:

Conditions Related to 1978-79 [1995] Interventions:

Bedacryl: Bedacryl covered surface of print and extended outside medial margin in area of the arch. Bedacryl deteriorated slightly in the heel, with minor losses, and toe/ball area. The layer appears to have been thickly applied. [Bedacryl visible as darkening on floor of print and yellow halo around print]

Embedding: Embedding of fine particles in Bedacryl layer. [Minor embedding beyond what was already documented in 1995 and adherence of fines on tuff adjacent to lateral posterior margin]

Silicone: Very minor traces of silicone outside print.

Excavation tool marks: Excavation artifacts are evident over much of the floor of the print.

Inventory number on tuff: 1979 label ("1-37") barely visible on tuff surface. [Not visible; obscured by adherent fines]

Other:

Root damage: Rootlets primarily on the surface; a few penetrated into the Bedacryl layer; one root penetrated tuff near center of print. [Hair roots penetrated tuff or Bedacryl layer in anterior portion]

Insect activity: none

1995 [2011] Interventions

Consolidation/stabilization: none

Fills: none

Reattachment: none

Root treatment: Surface roots removed. [Fine rootlets and hair roots penetrating Bedacryl layer or tuff not removed]

Other: none

Comparison with 1978-79 Cast/Photograph

Comparison with the 1979 cast and photos showed slight loss of resolution of fine details on the surface due to Bedacryl and particles embedded in the Bedacryl layer. Excavation tool marks were less visible in situ.

Notes

[Print was not cleaned to the same level as in 1995]



Comparative photos of G1-37 in 1995 and 2011. Morphology of print is difficult to discern in photos; dashed outline is drawn for clarification, but is only an approximation.

G1-38: Right print

1995 recorded conditions [2011 recorded conditions]

Location

Southern sector of trackway, trench 1

Excavation and Reburial History

Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]

1978-1979 Description

Right footprint, incomplete owing to the heel having been truncated by a small fault.



Crack on fault

Inventory number

1995 Condition**General condition:** Minor alteration/Good. [Minor alteration/Good]**Tuff Conditions:****Weathering:** Slight weathering of tuff at the point where the fault intersected the print.**Cracking:** Fine surficial cracks at the fault intersection (not visible in photograph). [Slightly raised tuff at fault line has a new crack perpendicular to the fault line]**Losses:** Minor abrasion of tuff surface outside posterior print margin; appears to be an old loss.**Detached/loose tuff:** none**Powdering:** none**Other:** none**Conditions related to 1978-79 [1995] Interventions:****Bedacryl:** Bedacryl covered the print and surrounding tuff surface. Patches of deteriorated Bedacryl on floor of print. [Bedacryl visible as darkening on floor of print and yellow halo around print.]**Embedding:** Severe embedding of fine particles in the area of weathered tuff and along medial margin; slight embedding on the remainder of the print surface. [Minor embedding and adherence of sand grains on floor of print and outside lateral margin]**Silicone:** Traces of silicone outside print margin.**Excavation tool marks:** Tool marks visible outside medial margin near fault line.**Inventory number on tuff:** 1979 label ("1-38") visible on tuff surface. [Number visible]**Other:** none**Root damage:** Root penetrated the wall of the fault where it intersected the print, but did not go directly into the floor of print. Rootlets on surface of print. [A few rootlets in anterior part penetrating tuff and cracks]**Insect activity:** none**1995 [2011] Interventions****Consolidation/stabilization:** none**Fills:** none**Reattachment:** none**Root treatment:** Surface roots removed. [Fine rootlets and hair roots penetrating Bedacryl layer or tuff not removed]**Other:** none**Comparison with 1978-79 Cast/Photograph**Comparison with the 1979 cast and photos showed distinct loss of resolution of features on the print surface due to Bedacryl and embedding of fine particles covering the surface of the print. Tool marks visible in the cast on the floor of the print were obscured *in situ*.**Notes**

The overburden was wet when print re-excavated. [Print was not cleaned to same level as in 1995]



Comparative photos of G1-38 in 1995 and 2011

G1-39: Left **1995 recorded conditions** [2011 recorded conditions]

Location Southern sector of trackway, trench 1
Excavation and Reburial History Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]
1978-1979 Description Complete left footprint. The big toe has left a small unusually circular depression 29mm long and 25mm wide instead of the rather broad, oblong impressions usually made by the big toe in the G-1 trail. There is also a small ridge behind toes 2-5 where the ash has been pushed up against the ball of the foot. A print of the hipparion foal has impinged marginally on the anterior impressions of toes 2-5.



<p>1995 Condition General condition: Minor alteration/Good. [Moderate alteration/Fair]</p> <p>Tuff Conditions: Weathering: Slight weathering of the tuff along the lateral margin of print. Cracking: none. [Incipient cracking visible on the island of tuff west of the heel in 1995 has widened and cracks have propagated. Cracking in the heel and lateral margin of the print occur principally in the same area where weathering and cracking of Bedacryl layer were noted in 1995. Cracks were free of sand grains indicating opening occurred as a result of drying from re-excavation.] Losses: Minor loss of tuff outside margin of great toe and lateral margin of print. Detached/loose: none Powdering: none Other:</p> <p>Condition Related to 1978-79 [1995] Interventions: Bedacryl: Bedacryl covered the surface of the print and surrounding tuff. It was slightly deteriorated along the lateral print margin with numerous hairline cracks in Bedacryl layer, and outside the anterior margin. [Bedacryl visible as darkening on floor of print and distinct yellow halo around print] Embedding: Slight embedding noted in Bedacryl layer (not shown on graphic). [Moderate embedding and adhered sand grains] Silicone: Minor traces of silicone outside print margins. Excavation tool marks: none Inventory number on tuff: 1979 label ("1-39") visible on tuff surface. [Number partially visible] Other:</p> <p>Root damage: Rootlets, less than 1mm diameter, weaved in and out of the Bedacryl layer and a few penetrated the tuff along the lateral side, forming a root mat in the lateral heel portion. [Rootlets and hair roots penetrated tuff and cracks in heel and arch area]</p> <p>Insect activity: none</p>
<p>1995 Interventions Consolidation/stabilization: none Fills: none Reattachment: none Root treatment: Roots removed. [Penetrating rootlets or hair roots were not removed] Other: none</p>
<p>Comparison with 1978-79 Cast/Photograph Comparison with the 1979 cast and photos showed slight loss of resolution of surface features. Slight weathering already visible in 1979 photos.</p>
<p>Notes [Print was not cleaned to the same level as in 1995]</p>

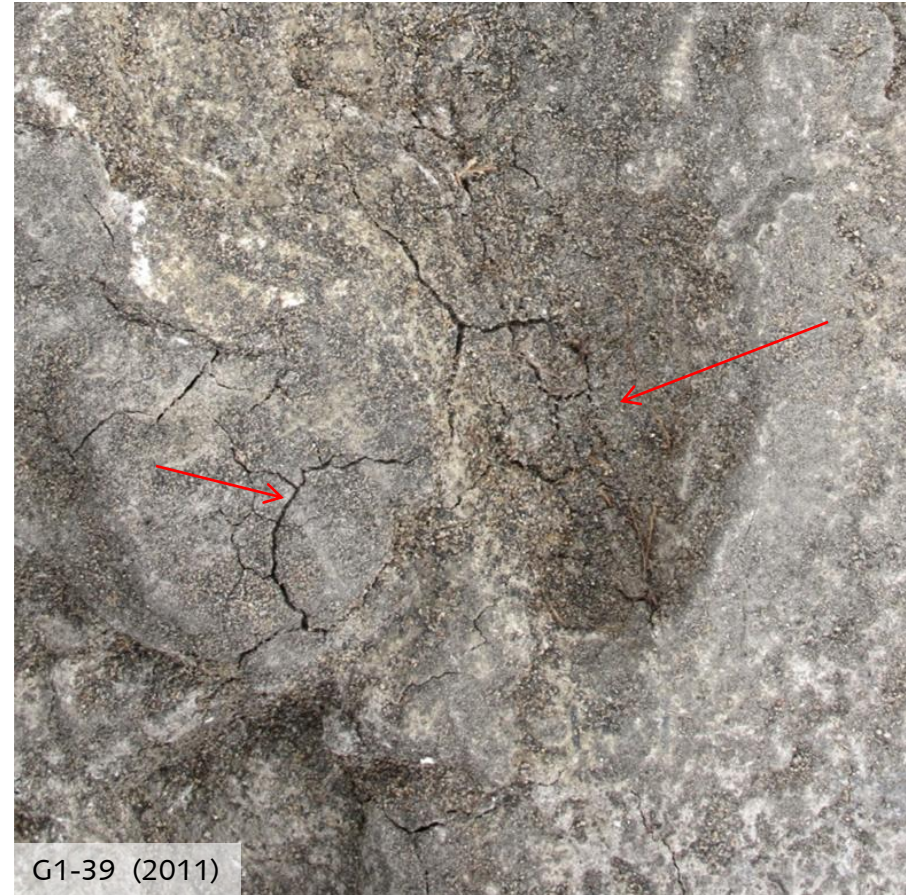
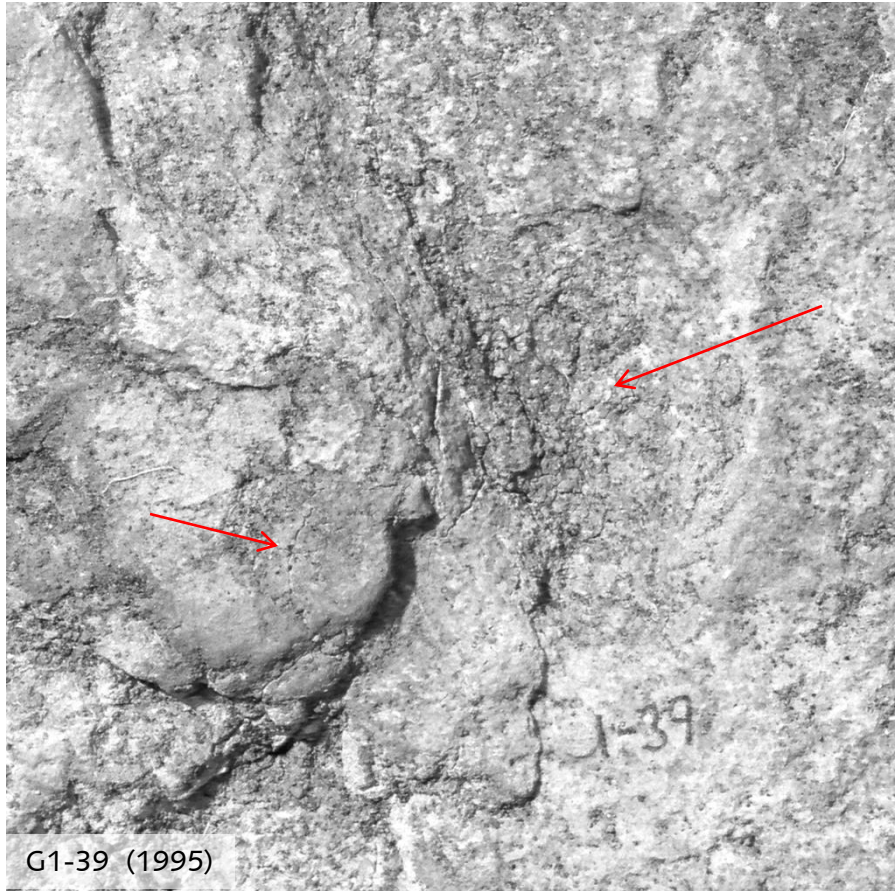


G1-39 (1995)



G1-39 (2011)

Comparative photos of G1-39 in 1995 and 2011



Close-up of the heel of G1-39 in 1995 and 2011. Incipient cracking on raised island of tuff and weathering along lateral margin and floor of heel, visible in 1995 and 1979 photos, increased and propagated on re-excavation and drying in 2011.

Location
Southern sector of trackway, trench 1.
Excavation and Reburial History
Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]
1978-1979 Description
Particularly well preserved dual right footprints with drag marks in front of G-2.



Cracking in anterior part of print

Mechanical damage

1995 Condition

General Condition: Minor alteration: Good. [Moderate alteration/Fair]

Tuff Conditions:

Weathering: none

Cracking: Network of fine cracks, < 1mm wide, in tuff underneath deteriorated Bedacryl in anterior and posterior portions. [Network of cracks and deteriorated Bedacryl noted in 1995 in the anterior portion of print correspond with area of increased cracking in 2011]

Losses: Minor surface abrasion on rim of termite tunnel outside posterior medial print margin. [Mechanical damage, from excavation, to rim of fossil termite burrow on anterior lateral margin.]

Detached/loose tuff: none

Powdering: none

Other: none [Mechanical damage from excavation to rim of fossil termite burrow on lateral margin]

Conditions related to 1978-79 [1995] interventions:

Bedacryl: Bedacryl covered the print and the tuff surrounding it. The Bedacryl was deteriorated at the bottom of the anterior half and deteriorated and partially lost near the posterior margin. The Bedacryl layer was relatively thick. [Bedacryl visible as darkening on floor of print and yellow halo around print]

Embedding: Slight embedding of fine particles in the Bedacryl layer, especially in the deteriorated areas. [Moderate embedding and adherence of sand grains, especially in anterior portion of print]

Silicone: none

Excavation tool marks: Not visible due to Bedacryl layer (see Comparison below)

Inventory number on tuff: 1979 label ("2-27") visible on tuff surface beyond the heel margin. [Not visible; obscured by adherent fines]

Other: none

Root damage: Extensive network of rootlets (shown on graphic as root mat) weaved in and out of the Bedacryl layer especially in the areas where the Bedacryl was deteriorating (anterior half and posterior margin), but did not appear to penetrate the tuff. [No rootlets in print]

Insect activity: none

1996 Interventions

Consolidation/stabilization: none

Fills: none

Reattachment: none

Root treatment: Surface rootlets were removed. Where fine rootlets had worked their way into the Bedacryl layer and were well adhered, they could not be removed without risking loss of Bedacryl and were, therefore, left.

Other: none [Fragments of damaged rim were placed adjacent to the rim from which they were broken for reattachment in the future. Damaged area was covered with a small piece of geotextile and labeled 'Damage' prior to reburying the print]

Comparison with 1978-79 Cast/Photograph

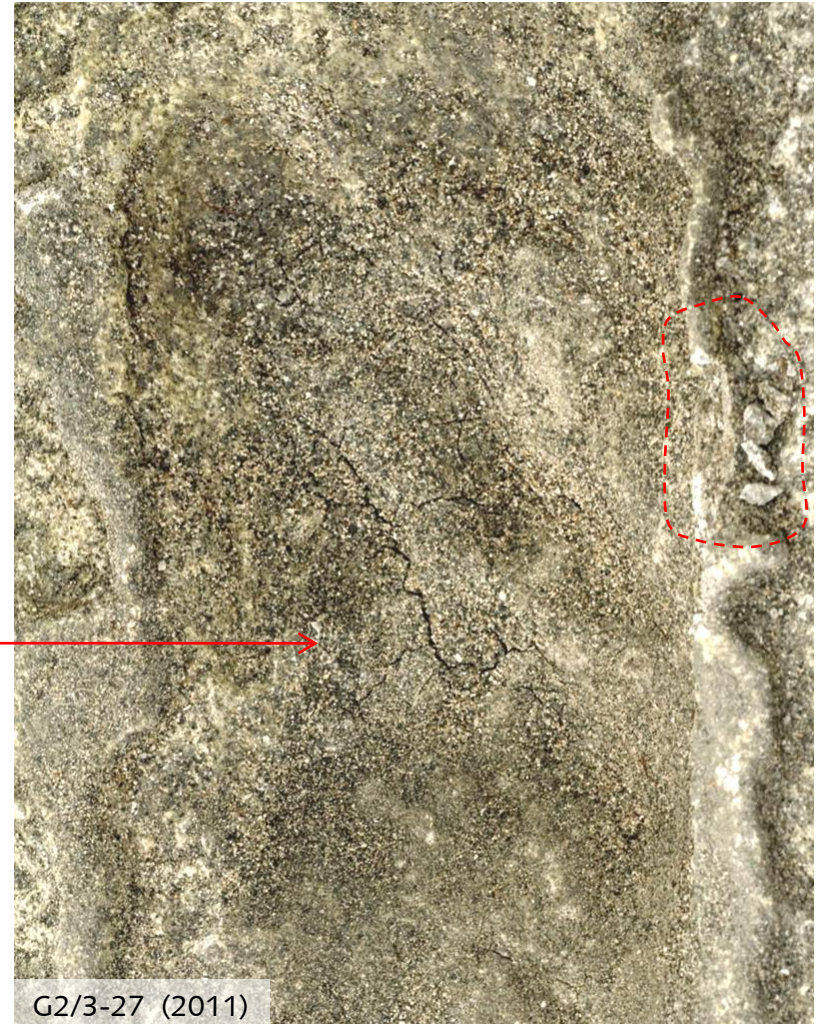
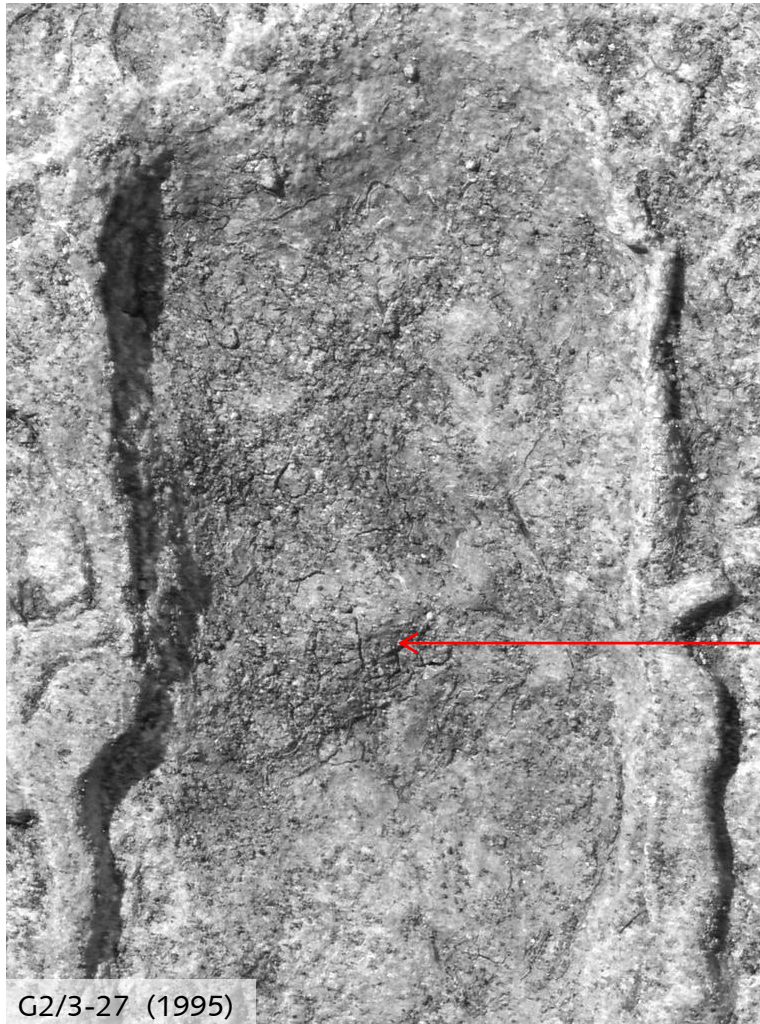
Comparison with 1979 cast and photos showed loss of resolution of features due to the thick layer of Bedacryl, especially the deteriorated areas. Excavation tool marks, which can be seen to cover the floor of the print in cast and photos, are obscured *in situ*. A crack in the anterior portion is muted *in situ*.

Notes

The field cast showed several surface irregularities, which were related to the repairs of the master mold, carried out in 1995. [Print was not cleaned to the same level as in 1995]



Comparative photos of G2/3-27 in 1995 and 2011



Close-up of the anterior portion of G2/3-27 in 1995 and 2011. Incipient cracking and weathering recorded in 1995 has enlarged and propagated on re-excavation and drying in 2011. Dashed line marks the area of mechanical damage to fossil termite tunnels; fragments are adjacent to broken area.

G/3-28: Left 1995 recorded conditions [2011 recorded conditions]

Location

Southern sector of trackway, trench 1.

Excavation and Reburial History

Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]

1978-1979 Description

Left footprints in similar condition to 2/3-27, also with a scuffmark in front of the G-2 print.



Incipient cracking on margins

Cracking on tuff surface

1995 Condition

General Condition: Minor alteration: Good. [Minor alteration/Good]

Tuff Conditions:

Weathering: none

Cracking: A crack with a calcite vein traversed the anterior and central portion of the prints. Minor cracks in the tuff along prints' margin. [Incipient cracking at the margins near center of print and on the tuff surface outside the anterior medial margin of the print]

Losses: Minor loss of the tuff surface where Bedacryl had deteriorated near center of medial margin.

Detached/loose tuff: none

Powdering: none

Other: none

Conditions related to 1978-79 [1995] interventions:

Bedacryl: Bedacryl throughout the prints and surrounding tuff; patches of Bedacryl on the floor and medial margin of the prints had begun to deteriorate and crack with minor areas of loss, exposing a lighter colored tuff underneath. [Embedding and areas of deteriorated Bedacryl coincide, possibly leading to greater adherence of particles. Yellow halo around print]

Embedding: Fine particles from the overburden adhered to Bedacryl layer, especially on the floor of the print. [Extensive adherence of sand and fines on floor of print were not cleaned. See Note below]

Silicone: Traces of silicone on anterior margin.

Excavation tool marks: none

Inventory number on tuff: 1979 label ("2-28") visible on tuff surface beyond the heel margin. [Obscured by adherent fines]

Other: none

Root damage: Tiny rootlets weaved in and out of the Bedacryl layer, and two roots, approximately 1-2mm in diameter, penetrated the tuff on the anterior portion, without causing damage or disruption of the tuff. [Hair roots penetrated tuff and/or Bedacryl layer in anterior part of print; a few in heel area]

Insect activity: none

1996 Interventions

Consolidation/stabilization: none

Fills: none

Reattachment: none

Root treatment: Surface rootlets removed. [Penetrating hair roots were not removed]

Other: none

Comparison with 1978-79 Cast/Photograph

Comparison with 1979 cast and photos showed slight loss of resolution of fine details on the print surface due to the layer of Bedacryl and particle embedding in that layer. The calcite vein that traversed the print was clearly visible in the cast and in photographs. [Floor of print not sufficiently cleaned to see calcite vein in anterior portion of print]

Notes

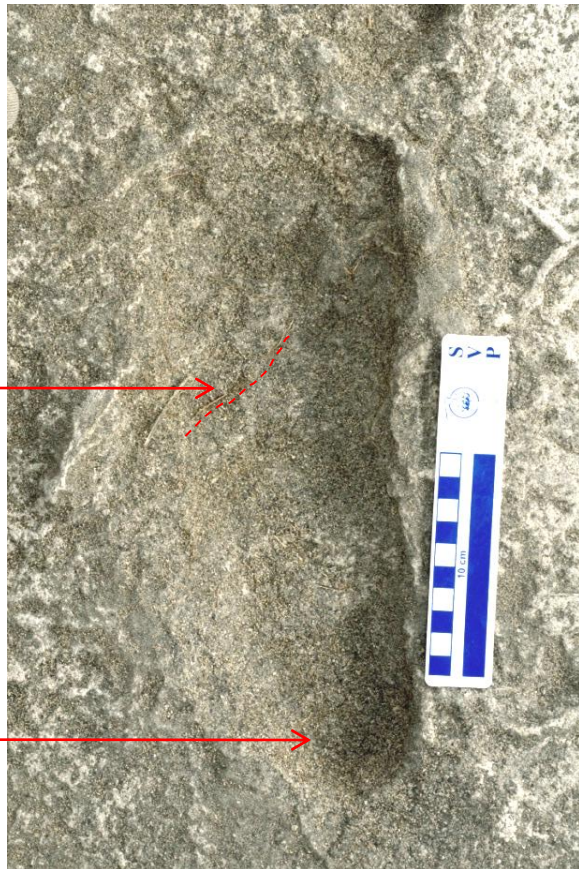
The field cast showed surface irregularities between G2/3-27 and G2/3-28 that are related to the repairs of the master mold carried out in 1995 from which the field cast was made. [Print not cleaned as fully as others due to dampness of fill from rain]



Comparative photos of G2/3-28 in 1995 and 2011

G2/3-29: Right 1995 recorded conditions [2011 recorded conditions]

Location Southern sector of trackway, trench 1.
Excavation and Reburial History Excavated and reburied in 1979; re-excavated and reburied in 1995. [Re-excavated and reburied in Feb. 2011]
1978-1979 Description Less well preserved dual right footprints. The toe impressions are not defined in either print.



Rootlet penetrating tuff (larger root to the left is windblown fragment)

Incipient cracking

1995 Condition General Condition: Minor alteration: Good. [Minor alteration/Good]
Tuff Conditions: Weathering: none Cracking: none [Incipient cracking in heel of print, possibly associated with cracked Bedacryl noted in 1995] Losses: none Detached/loose tuff: Small fragment of detached tuff outside anterior print margin. Powdering: none Other: none
Conditions related to 1978-79 [1995] interventions: Bedacryl: Bedacryl detected throughout the prints and surrounding tuff. Deteriorated patches on floor of prints. Bedacryl was applied thickly and was cracked. [Bedacryl visible as darkening on floor of print and yellow halo around print] Embedding: Moderate embedding of fine particles adhered to Bedacryl layer within prints' margins and in low points of the surrounding tuff. [Moderate embedding beyond what was already noted in deteriorated Bedacryl in 1995] Silicone: Traces of silicone outside anterior margin of prints. Excavation tool marks: Not visible due to Bedacryl layer (see Comparison below) Inventory number on tuff: none Other: none
Root damage: Numerous rootlets on surface only. [Hair roots penetrate tuff and/or Bedacryl layer on floor of print. One rootlet runs across anterior portion of print weaving in and out of tuff]
Insect activity: none
1996 Interventions Consolidation/stabilization: none Fills: none Reattachment: Loose fragment of tuff outside anterior margin reattached with Paraloid B-72 [®] Root treatment: Surface rootlets removed. [Penetrating hair roots were not removed] Other: none
Comparison with 1978-79 Cast/Photograph Comparison with 1979 cast and photos showed loss of resolution on floor of the prints. Fine features, including tool marks clearly evident in the posterior portion of the cast, were obscured due to the thick layer of Bedacryl and fine particles of overburden embedded in the coating. Although consistently applied to all the well-preserved 1979 prints, no inventory number was visible <i>in situ</i> , nor could it be ascertained on the available photos.
Notes [Print was not cleaned to the same level as in 1995]



G2/3-29 (1995)



G2/3-29 (2011)

Comparative photos of G2/3-29 in 1995 and 2011



Close-up of heel of G2/3-29 in 1995 and 2011 showing incipient cracking in heel in 1995 slightly enlarged in 2011

Location
Southern sector of trackway, trench 1.
Excavation and Reburial History
Excavated and reburied in 1979; re-excavated and reburied in 1995. Re-excavated and reburied in Feb. 2011
1978-1979 Description
Presumed left footprints in which the anterior part has been cut through by a small fault and is now offset by 36 mm.



Rootlet in crack

Cracking on lateral margin and floor

1995 Condition

General Condition: Minor alteration: Good. [Moderate alteration/Fair]

Tuff Conditions:

- Weathering: Slight weathering along the lateral margin and bottom of the prints.
- Cracking: Hairline cracks near center of prints. [Cracking and/or weathering of tuff or Bedacryl visible on floor and lateral margin; embedding obscures floor of print]
- Losses: none
- Detached/loose tuff: Area of tuff along fault line beyond posteromedial margin was fragile and loose.
- Powdering: none
- Other: none

Conditions related to 1978-79 [1995] interventions:

- Bedacryl: Bedacryl throughout prints and surrounding tuff south of the fault. Bedacryl was not identified north of the fault. The Bedacryl layer was missing outside the lateral margin and was deteriorated or missing in patches inside the prints near the center; missing Bedacryl probably removed during the molding operation in 1979. [Bedacryl layer not visible distinct from heavy embedding of sand; darkened yellow halo around print]
- Embedding: Moderate embedding throughout the prints and the surrounding tuff, especially in anterior part north of fault. [Severe and extensive embedding in floor of print]
- Silicone: Traces of silicone outside medial margin.
- Excavation tool marks: none
- Inventory number on tuff: none (see Comparison)
- Other: none

Root damage: Rootlets on surface; one rootlet penetrated Bedacryl layer in anterior portion. [Rootlet visible in crack along lateral margin penetrating embedded floor of print]

Insect activity: none

1996 Interventions

- Consolidation/stabilization:** Loose tuff along edge of fault outside the prints' margin was stabilized with 4% Acrysol WS-24®.
- Fills:** none
- Reattachment:** none
- Root treatment:** Surface rootlets were removed.
- Other:** none

Comparison with 1978-79 Cast/Photograph

Comparison with 1979 cast and photos showed loss of resolution of details on floor of print due to Bedacryl and fine particles embedded in the coating. Inventory number, which is visible on photos, was not seen *in situ* due to embedding.

Notes

The 1979 overburden and tuff in this area was very damp when excavated in 1995. [Print was not cleaned to the same level as in 1995]



G2/3-30 (1995)



G2/3-30 (2011)

Comparative photos of G2/3-30 in 1995 and 2011



Close-up of G2/3-30 in 1995 and 2011 showing incipient weathering and hairline cracks in 1995 enlarged in 2011

Excavation of the reburial monitoring trench

In 1995, a replica reburial for monitoring purposes was established approximately 15 meters east of the southern end of the hominid trackway. Briefly, the intent of the monitoring trench was to replicate the footprint reburial, and through periodic re-excavation allow inferences to be drawn about conditions on the trackway itself. In 1997 one quarter of the trench was assessed and published.* In February 2011, the entire trench was re-excavated. Because of rain, the process of re-excavation and documentation had to be hastened, and at the end of the re-excavation rain flooded the trench, essentially destroying it. Nonetheless, some valuable conclusions can be drawn; however, with the re-excavation of the trackway itself, their value is different than originally intended - as a window onto the conditions pertaining in the buried trackway. It is nevertheless of interest to examine the results of the monitoring trench in light of the actual conditions in the re-excavated trackway.

Although the monitoring trench replicated the design, methodology, and materials of the trackway reburial, it differs in two important aspects. The trench is dug into a clay stratum, derived from unstratified, presumably aeolian tuff. Mineralogically, this stratum is more heavily weathered and richer in clay minerals than even the weathered tuff of the northern part of the trackway. Thus, it shows greater impermeability and plasticity when wet, and extensive cracking when dry. It was expected, therefore, that a more moist environment would pertain in the monitoring trench than on the trackway; at the time of its establishment soil moisture increased with depth to a saturated value of 20 volume percent at a depth of 45 cm.

The second important difference between the monitoring trench and the trackway reburial was that the acacia trees growing adjacent to the monitoring trench were deliberately not killed in order to assess the behavior of roots in relation to the reburial materials, especially the root inhibitor Biobarrier, which acts to deflect root growth away from it, but does not otherwise harm or kill vegetation.

By 2011 the trees that had been allowed to remain at the edge of the trench had grown to a height of 3-4m for the largest, an *Acacia seyal*, with a trunk at the base of 15cm diameter which sent out an extensive network of roots into the trench. Penetration into the monitoring mound was by lateral roots through small gaps between Biobarrier and the polypropylene geotextile used in the reburial, as a divider and above Layer 1, and from below the floor of the trench, thus circumventing the Biobarrier.

Roots invading the trackway burial similarly entered via gaps or below the Biobarrier that was vertically placed on the excavated trench walls. Therefore, as a preventive for root intrusion, it is essential that no gaps exist or roots will ultimately circumvent the Biobarrier. Roots are attracted to the looser and damp fills of the reburial and are tenacious in finding their way in. It is important to remember, however, that Biobarrier was always intended only as a second line of defense in the reburial; the first line of defense must be removal of trees in the vicinity of the reburial.

Triangular recesses with sharply defined edges and score marks at the edges were cut into the clay-rich floor of the trench to allow determination of susceptibility of the tuff to deformation under the reburial overburden. The triangles retained their form and score marks with only slight softening of the edges. There was no slumping or deformation from mechanical load of the reburial fill. Embedding in the floor of the triangles and surrounding tuff was severe.

The floor of the trench showed reticulated cracking. This had been noted already in 1995 and again in 1997, and ascribed to drying out of the clay-rich tuff upon (re-)excavation. In the area excavated in 1997 cracking was more pronounced in 2011; as seen on the trackway itself, incipient cracking or weathering in 1995 increased or had propagated. The network of cracks could be seen most clearly on removal of the pieces of geotextile that had been laid on the floor. Around the geotextile, cracks were essentially invisible because of infilling with the first layer.

Various indicator materials had been used in the monitoring trench: root and stem sections that had been implanted in the floor of the trench, cotton cloth and iron nails, and samples of footprint tuff treated with a number of different chemical consolidants. The organic materials, cotton cloth and root and stem samples had deteriorated completely and the iron nail was heavily corroded, all due to the aggressive, wet environment. There was no evidence of termite activity.

The treated blocks of footprint tuff were unchanged, except for a sample containing fumed silica and acrylic dispersion that had yellowed markedly. Fumed silica with Acrysol WS-24 was used to fill voids in 1996 on the trackway.

The main lessons to be drawn from monitoring trench are:

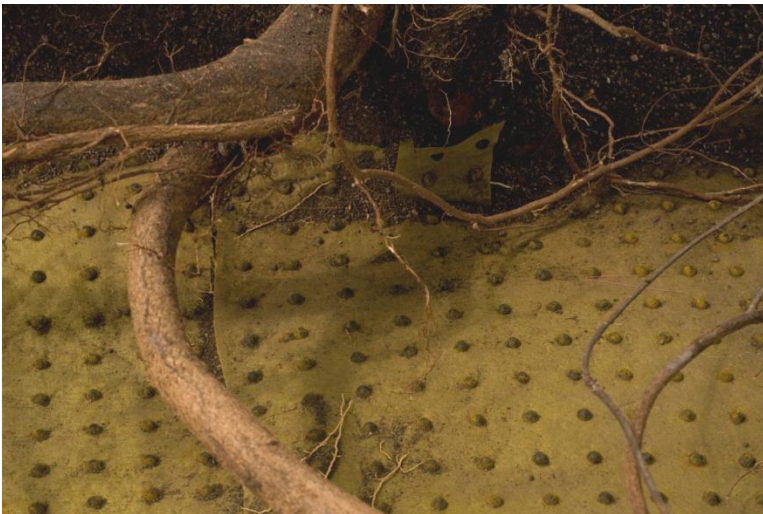
- Biobarrier is effective as a root excluder, but any gaps will allow lateral invasion of roots;
- the loose fills of a reburial are strong attractors for roots, as is moisture, both of which migrate laterally through the unexcavated soil; therefore limiting ingress of moisture into the reburial and removing vegetation further away from the trackway are both essential;
- the incised triangles indicated that deformation or slumping from mechanical load of overburden is negligible;
- continued cracking of the tuff is again related to very damp conditions and drying on exposure, thus reinforcing the importance of reducing moisture that enters the trench laterally (the monitoring trench is not protected by the drainage system and in fact lies within the drainage catchment).

•Agnew, N. and Demas, M., *Conservation and Management of Archaeological Sites*, 2004, Vol. 6, pp. 295 -304)

Monitoring trench



The buried monitoring trench as it appeared before re-excitation in 2011. The *Acacia seyal* had grown far larger than the other *Acacia drepanolobium* around the trench.



Roots of the *Acacia seyal* are seen growing and spreading just above the Biobarrier, avoiding contact with it.



As in the trackway reburial, roots are entering the trench laterally through gaps and tend to follow the surface of the geotextile, as seen here.



Quadrants 1 and 2 of the trench after removal of geotextile and Layer 1.

Monitoring trench

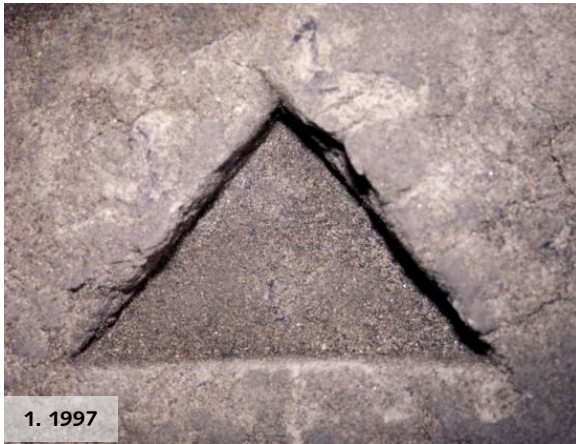


Monitoring trench floor with objects as laid out in 1995 (left) and as re-excavated in 2011 (right). Quadrant 1 (in box left) was excavated in 1997.

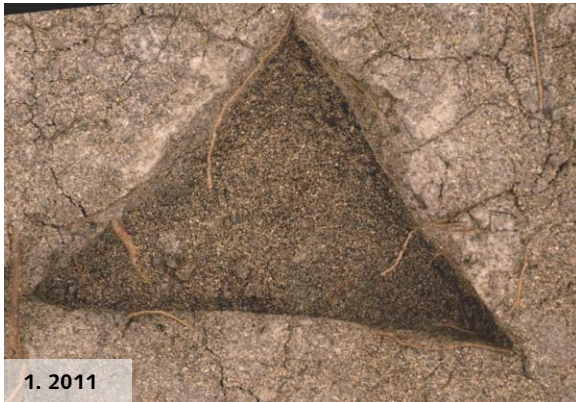


Quadrant 1 as established in 1995 (left), excavated in 1997 (center) and re-excavated in 2011 (right). Weathering and cracking of tuff floor can be seen in the 1995 photo around the geotextile and treated block.

Monitoring trench



Monitoring triangles 1,3 and 4. Cracking of tuff has increased since 1995. The form, edges and score marks are little changed but obscured by embedding.



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