

Tree Mold Inventory and Monitoring Protocol Craters of the Moon NM & Preserve



Background

History: Tree Molds and Lava Trees have been described in the literature from all periods of park history. For example, they are mentioned in the March 1924 National Geographic article “*Among the Craters of the Moon*” by Robert Limbert, which was published just before the May 1924 Monument designation. As another example, tree molds were prominently featured in the 1963 park publication “*Geology of Craters of the Moon National Monument Idaho*” by Harold Stearns, the same geologist who had written the scientific justification for Monument designation for the USGS. Because volcanic activity tends to destroy organic remains, the presence of these trace fossils in the lava has been a curiosity to both the visitor and the scientist alike for almost 100 years.

Previous Study: An initial exploration and reconnaissance survey for tree molds was conducted in 2001 and 2002 by the park geologist and documented 141 tree molds. Of these 141 tree molds, 11 showed some anthropogenic damage/disturbance. Several dozen tree molds are within only a few meters or feet from an established trail. At the time of the initial survey (2001-2002), none of the damage was severe even after more than 75 years of park use, suggesting that most visitors have at least some appreciation of and respect for this remarkable resource. Worthy of note is that less than 10% of the tree molds found and inventoried during this initial survey were shown on any of the topographic or geologic maps of the area.

Definition of a fossil: “Any remains, trace, or imprint of a plant or animal that has been preserved in the Earth’s crust since some past geologic or prehistoric time; loosely, any evidence of past life.” (AGI Glossary of Geology)

Definition of a Mold: “An impression made in the surrounding earth or rock material by the exterior or interior of a fossil shell or other organic structure

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[e.g., a tree]—a complete mold would be the hollow space with its boundary surface.” (AGI Glossary of Geology)

Description of Tree Molds: Tree molds are found in association with a number of the lava flows in Craters of the Moon National Monument and Preserve (CRMO). Tree molds are impressions in the solidified lava that form as trees are enveloped by the lava flows, begin to burn, release water and other vapors that quickly cool the surrounding lava, and leave behind a mold of the charred tree (Fig. 1.) and occasionally some carbon residue (Fig. 2.).

Generally, tree molds preserve impressions of the cracked, partly burnt wood but do not preserve bark or other textures that would aid in identification of the tree species. This preserved pattern of charred wood often looks like a tire tread pattern (Fig. 1.) and can look somewhat like bark. Tree molds can be both vertical (where the tree remained standing as it burned resulting in a columnar shaped hole in the lava) and horizontal (where the tree fell as it burned resulting in a linear mold in the lava); see figures 3 & 4.



Fig. 1. CRMO Tree Mold

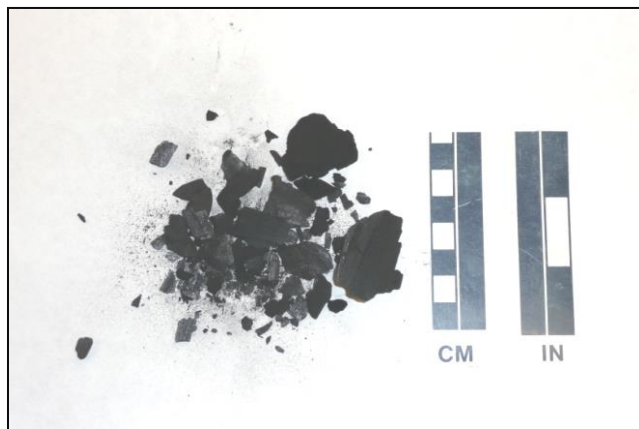


Fig. 2. Charcoal from CRMO Tree Mold



Fig. 3. Vertical Tree Mold



Fig. 4. Horizontal Tree Mold

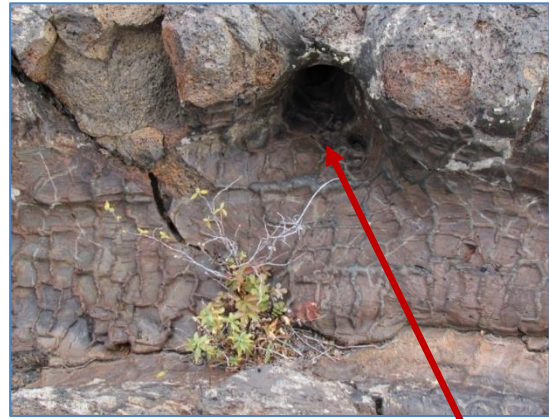
The deepest vertical tree molds in CRMO are about 3 meters (~10 ft.) in depth and the largest diameter trunks preserved as tree molds are about 1 meter (~39

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inches) in width. Some tree molds provide evidence of more than a dozen tree limbs coming off the original tree. In the northern end of the Monument about 150 tree molds were mapped prior to 2010. Currently the two lava flows with the largest number of mapped tree molds are the Blue Dragon and Trench Mortar Flat flows.



Large Diameter Tree Mold



Tree Mold with Limb evident

Some of the tree molds that formed on Trench Mortar Flat stand up in vertical relief above the surface because the flow that coated and surrounded the tree deflated leaving the already solidified lava around the tree frozen in place.



Tree Molds that stand in vertical relief above the surface on Trench Mortar Flat.

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Law and Policy Mandates

National Park Service Management Policies 2006, 4.8.2.1 states that

- *“Paleontological resources...will be protected, preserved, and managed for public education, interpretation, and scientific research.”*
- *“Superintendents will establish programs to inventory paleontological resources...”*
- *The Service will take appropriate action to prevent damage to and unauthorized collection of fossils. To protect paleontological resources from harm, theft, or destruction...”*

Public Law 111-11 Mar. 30, 2009 SEC. 6302

- *“The secretary [of Interior] shall manage and protect paleontological resources on Federal land using scientific principles and expertise.”*
- *The Secretary [of Interior] shall develop appropriate plans for inventory, monitoring, and the scientific and educational use of paleontological resources, in accordance with applicable agency laws, regulations, and policies.”*

Project Goals:

- (1) Generate a systematic inventory of the tree molds found within Craters of the Moon National Monument and Preserve over time.
- (2) Once the inventory has established the location and condition of a tree mold, the fossil site should be revisited periodically (suggest every 10 years) in order to monitor any changes in the condition of the fossil resource.
- (3) If degradation of the fossil condition has occurred, determine an appropriate mitigation.

Data Acquisition

Data Recording: All data shall be entered on the hard copy data sheets (Appendix I) while in the field, and post field session into the GIS data base. UTM coordinates will be acquired using a GPS unit with an averaging mode for a minimum of 100 averaged position fixes. If differential correction is made, those coordinates will be so designated in the data tables generated.

Search Pattern: The survey party will conduct systematic searches of the area adjacent to the edges of the pahoehoe lava flows (approximately 50 m). Unless there is evidence to suggest that the lava flow may have impinged on an old topographic high, it is unlikely to find any tree molds in the interior of a flow because they would be completely buried or destroyed. However, larger areas (e.g. Trench Mortar Flat), should be explored if the eruptive fissure spawned a sheet flow, which may have spread out over a large area in a relatively thin sheet.

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Photos: Take at least one photo of each tree mold in each survey year. The photo(s) should convey the general appearance of the tree mold so that it will be recognizable to another surveyor. If any noticeable damage has occurred, at least one photo should illustrate the damage. A North arrow should be included in at least one photo of each tree mold. Bring a folding reflector if possible to help illuminate interior of tree molds. Photos should be uploaded to the folder for the current survey year within the folder “Tree_mold_photos” within a week of the survey date. Photo names should indicate the tree mold number and survey date. A photo of tree mold 12 taken on June 29, 2012, would be labeled “TM12_62912.” A second photo of tree mold 12 taken on the same date would be labeled “TM12_62912_2.”

Data Entry

Site #: Sites or tree mold occurrences will be numbered in the sequential order of survey starting with 1. Follow with an “R” if it is a revisit.

Survey Date: Enter the date the site is being inventoried.

Photo: Insert at least one photo for each tree mold for each survey year. Click on the “Insert” tab at the top of the Excel window and choose “Object” (on the far right side of the menu). In the Object pop-up window, choose the tab “Create from File” and click on “Browse” to navigate to a photo (it should already be saved in the photo folder according to the protocol above). An icon for the photo should appear on the spreadsheet. Resize the icon so that it fits in the designated cell for photos for the photographed tree mold.

Quad/Flow: Enter the name of the 7-½ minute Quad that the site lies on and the name of the flow that the tree mold is found within.

UTM-N & UTM-E: Enter the UTM coordinates from the GPS unit in the appropriate column (Use NAD-83 datum). Be sure it has averaged enough points.

V or H: Enter a “V” if it is a vertical tree mold or an “H” if a horizontal tree mold.

D or L: Enter depth in meters for a vertical tree mold or length in meters for a horizontal tree mold.

aW (m): Enter the average width of the tree mold in meters.

Limb #: Enter the number of limbs that are discernable branching off from the mold of the main trunk.

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Condition:

- Enter “P” for pristine, i.e., no apparent damage
- Enter “SD” for some observable deterioration or damage that appears to be anthropogenic in origin. Damage must involve less than 25 % of the tree mold
- Enter “MD” for Major damage if damage involves more than 25 % of the tree mold
- Enter “V” for apparent vandalism, such as an attempt at collection.
- Place an asterisk (*) next to the condition symbol if it has changed since the previous survey year (e.g. SD*, MD*, V*)

Geologist: Enter the last name of the survey party chief.

Notes: record any description of damage or other observations

Tree Mold Database

An initial survey of tree molds in the monument was conducted in 2001 and 2002 by Doug Owen, park geologist, and the data was compiled in an Excel spreadsheet. A second survey was conducted in 2012 by Emily Carbone, GeoCorps intern. The 2012 data was added to the original spreadsheet, and the format was altered slightly. In addition, an ArcGIS geodatabase was established to store the same information. The Excel document, geodatabase files and an additional folder of photos are stored in a folder labeled “Tree Molds,” which can be found on the shared drive at (W:) > Resource Division > Geology Projects > Tree Molds.

Excel Spreadsheet:

All data from all tree mold surveys will be stored in the Excel document titled “Tree_Molds.” A separate sheet will be created within the document for each survey year. The original Excel document created in 2001 included the following columns: Site #, Quad/Flow, UTM-N, UTM-E, V or H, D or L, aW (m), Limb #, Condition, Photo, On Topo, Date, Geologist and Notes. This format was altered slightly in 2012 so that the columns read as follows: Site #, Survey Date, Photo, Quad/Flow, UTM-N, UTM-E, V or H, D or L, aW (m), Limb #, Condition, Geologist and Comments (see “Data Entry” section of protocol for column descriptions). This data should be collected on a GPS unit and/or on a hard copy of the Excel table (or in a field notebook) in the field and then transferred to the Excel document within a week of the survey date.

The columns labeled “V or H” and “Condition” should be formatted with a pick list for each cell to preserve consistency of data. To determine if a column is formatted

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with a pick list, click on a cell within that column. If an arrow with a drop-down menu appears next to the selected cell, the cell is formatted with a pick list. The “V or H” pick list selection should include the letters “V” and “H.” The “Condition” selection should include “P,” “SD,” “SD*,” “MD,” “MD*,” “V” and “V*.” If there is no pick list established in these columns, simply copy the entire column from the previous survey year’s sheet and paste it in the current sheet. *(If copying the column from the previous survey sheet does not work or if it is necessary to create a different pick list, create a new pick list using following these steps: Select the entire column, click on the “Data” tab at the top of the Excel window, and click on the drop-down menu for “Data Validation.” Select “Data Validation,” and a pop-up window should appear. Under the “Settings” tab, click on the drop-down menu beneath “Allow:” and select “List.” Click on the spreadsheet icon that appears beneath the word, “Source,” and select the cells in the spreadsheet that include the options you want to include in the pick list. You may want to list the options, each with a separate cell, in the Key sheet (the first sheet of the Tree_Molds Excel document) and select these cells as the source cells for your pick list.)*

The first sheet of the document is a key with descriptions/instructions for each column, and the following sheets contain data from each survey year in increasing chronological order. Sheets should be labeled, “Survey # (YEAR)” (e.g. “Survey 1 (2001)”). Data from tree molds that have already been found should be copied from the previous year’s sheet and pasted into the current year’s sheet. The only fields that need to be altered for these tree molds each year are the survey date, photo and condition. In addition, any previously collected information, including GPS coordinates, that is found to be inaccurate or missing should be corrected/added. If new tree molds are found in a year, a new row for each new tree mold should be made beneath the last inventoried tree mold and labeled with the next consecutive site number. The discoverer of the tree mold will record the data required for each column listed above. (NOTE: Do not correct anything on previous years’ sheets. All corrections/additions should be made simply on the current year’s sheet.)

ArcGIS geodatabase:

A geodatabase is a collection of geographic datasets of various types. Geodatabases contain three primary dataset types: feature classes (location data), raster datasets (background image files) and tables. An ArcGIS geodatabase was determined to be a useful format to store tree mold data because of its capacity to store and display many types of data.

The tree mold geodatabase currently contains raster datasets for the CRMO topographic map and a table and feature class for each survey year. The following steps should be taken each survey year to import and organize data in the geodatabase:

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(Before completing any of these steps in ArcGIS, you will need to make sure there is a folder connection established with the Tree Mold Database folder in the Geology Projects folder on the shared drive. If the Tree Mold Database folder is not a visible option in ArcCatalog, you will need to establish a connection to the folder. To do this, right-click on “Folder Connections,” select “Connect Folder...” and navigate to the folder. You should now be able to open this folder in ArcCatalog and access the Tree Mold geodatabase inside.)

Import data from Excel document to geodatabase: After all of the data for the survey year has been added to the Excel document, you will need to import the current year’s sheet to the geodatabase. In ArcCatalog, right-click on the geodatabase, “Tree_Mold_Database,” choose “Import” from the menu that pops up, click on “Table (single) ...” and navigate to the current survey year’s sheet in the Excel document (“Tree_Molds”).

Create feature class from imported Excel table: In order to view your location data geographically, create a feature class using the coordinates from the table that you have imported to the geodatabase. In ArcCatalog, right-click on the table that you have uploaded, choose “Create Feature Class...” from the menu that pops up, and click on “From XY Table...” In the pop-up window, select “UTM-E” for the X Field and “UTM-N” for the Y Field. Click on “Coordinate System of Input Coordinates,” click on “Select...” and navigate to UTM NAD 83 Zone 12N (Projected Coordinate Systems > UTM > NAD 1983 > NAD 1983 UTM Zone 12N.prj). Under the Output section (still in the “Create Feature Class from XY Table” menu), click on the folder connection icon, navigate to the tree mold geodatabase and type in a name for the feature class (e.g. treemolds_2022).

Add photos as attachments in feature class: The photos inserted into the Excel spreadsheet will not transfer over to ArcGIS with the rest of the data, so you will have to add them separately. In ArcCatalog, right-click on the current year’s feature class. Select “Attachments” and then click on “Create Attachments.” Next, turn editing on and open the attribute table for the same feature class. In the attribute table, right-click on the small box to the far left in the row of the feature that you are adding the photo for. Select “Open Attachment Manager...” and click on “Add...” Then navigate to the photo (which you should have already saved in the photo folder, labeled as described above) and click “OK.” Remember to save your edits. To view attachments from a tree mold on the map, hit the “Identify” button on the toolbar and click on the point for that site; the attachment should be listed with a link.

Please Note: Most of the location data from the first survey was collected in NAD 27, but the coordinates for tree molds 135-148 were in NAD 83. All of the points from the first survey (including 135-148) were included in the projection from NAD

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27 to NAD 83 because they are part of the same set, but this is why the coordinates for these points from the first survey do not match up with their coordinates from later surveys. The coordinates from the most recent survey are accurate.

Other Database Files:

In addition to the protocol (this document), the Excel document and the ArcGIS geodatabase, the Tree Mold Database folder includes, a photo folder, the tree mold briefing sheet and a copy of the Excel document without photos (in case a smaller file size is necessary) and an ArcMap document (tree_mold_map_2012).

The ArcMap document includes the feature classes from each survey year, the topo raster datasets and the tables from the tree mold geodatabase; in addition, it includes a Roads & Trails layer and 2009 NAIP Imagery, which may be helpful in finding tree molds.