**USGS ASTROGEOLOGY TERRESTRIAL ANALOG SAMPLE COLLECTION: 2022 UPDATE.** A. L. Gullikson[1] , T. A. Gaither[1], J. A. Skinner Jr.[1], S. R. Black[1], H. C. Buban[1], [1]United States Geological Survey, Astrogeology Science Center, 2255 North Gemini Drive, Flagstaff, AZ 86001 (agullikson@usgs.gov).

**Introduction:** The U.S. Geological Survey (USGS) Astrogeology Science Center (ASC) has established the Terrestrial Analog Sample Collection (TASC), a collection aimed to preserve the scientific legacies of pioneering planetary scientists Dr. Eugene Shoemaker and Dr. David Roddy, and make these important/unique samples available to the community [1].

The TASC comprises three individual sample collections (Meteor Crater, Flynn Creek crater, and Shoemaker) (**Figure 1**) and can be found at: https://www.usgs.gov/centers/astrogeology-science-center/science/terrestrial-analog-sample-collections.


**Figure 1.** Examples of ASC Flynn Creek and Meteor Crater sample collections. A) A drill core from Flynn Creek crater. FC79-12 refers to the drill core ID, information in lower left indicates the depth this core was collected. B) Meteor Crater drill cuttings. Each bag is labeled with its drill hole number and the depth it was collected.

These samples include drill cores and cuttings, unique and irreplaceable geologic hand samples, thin sections and billets, and associated data and documentation.

These sample collections are excellent terrestrial analogs for geochemical and geophysical studies of planetary impact cratering dynamics, such as complex impact crater formation and morphology, impact-induced hydrothermal systems, impact melting of sedimentary targets, and mineral shock metamorphism [1]. Given the modern financial and logistical difficulties inherent in conducting thorough sampling campaigns at impact sites, continued preservation of these geologic collections and increasing access to the samples by the planetary community will maximize the prior financial and scientific investments of the USGS and NASA.

The ASC is working to preserve, maintain, and make these samples and data accessible to the science community, as well as further advance our understanding of impact cratering processes. In addition to ongoing maintenance and curation, one of the program priorities for FY22 is to make data and samples from Meteor Crater more accessible to the community. Here we describe current efforts related to Meteor Crater research and plans for updated publications.

**Meteor Crater Sample Collection Research:** Meteor Crater, located in northern Arizona, is one of the best preserved and easily accessible impact sites on Earth. Scientific investigations of this crater have led to improvements in our understanding of impact mechanics, cratering dynamics, and ejecta distribution [e.g., 2-6]. In addition, this site has a rich history as a terrestrial analog that has been used for training astronauts, scientists, and engineers [e.g., 7-9].

In the 1970s Dr. David Roddy conducted a rotary drilling campaign at Meteor Crater, along the rim, flanks, and surrounding ejecta blanket [10]. This work resulted in collecting over 2,500 m of drill cuttings from 161 drill holes. These samples are currently stored on the USGS Flagstaff campus and can be accessed electronically through the USGS Astrogeology website. This site includes an interactive map and links to drill hole documentation and database, as well as sample request forms.

**Lithostratigraphic analysis of the Meteor Crater ejecta blanket:** A field-based model for crater excavation and ejecta emplacement has been formulated through a lithostratigraphic analysis of the internal structure of the Meteor Crater ejecta blanket [11]. This work utilized the ASC TASC Meteor Crater sample collection through analyzing drill cuttings from drill holes situated along five different transects, extending outward from the rim of the crater.

The extent of lithologic mixing within the ejecta blanket was quantified by identifying ejecta facies that represent mixtures of target rocks and impact melt. These data were used as a representation of the complete ejecta blanket, including possible internal structures and lateral and vertical variations in the lithologic composition (**Figure 2**), to better understand the complexity of the ejecta emplacement process. The results of this work are currently under review and will be published in a peer-reviewed journal in the near future.

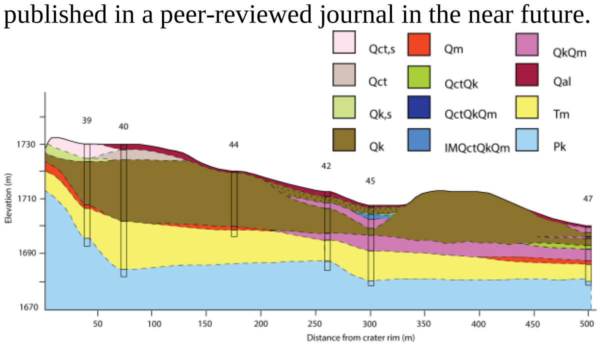


**Figure 2.** Cross-section of the southwest transect. Each column within the cross section represents one of the analyzed drill holes, the drill hole ID numbers are above the corresponding column. Labeled units are: Qct = ejected Coconino; Qk = ejected Kaibab; Qm = ejected Moenkopi; IM = impact melt; Qal = alluvium; Tm = Triassic Moenkopi; Pk = Permian Kaibab. Facies names with more than one unit represent lithologic mixing.

**Meteor Crater SIM-series publication:** The first geologic map of Meteor Crater was completed by Shoemaker in 1959 and released in a USGS Open-File Report (OFR) (**Figure 3**) [2]. The geologic map details the contacts between ejected target rocks, bedrock, allogenic and authigenic breccia, and more recent units, such as talus, lakebed deposits and alluvium. As important as this geologic map is, the main focus of the OFR was impact mechanics, and therefore the map was published as an ancillary product.

ASC is currently working to publish this geologic map posthumously as a USGS Scientific Investigation Map for the planetary community. The map will be updated with modern data sets (e.g., a higher resolution basemap), and linework, symbology, and map typologies will be updated to both maintain Shoemaker's original observations and interpretations, and meet the current Federal Geographic Data Committee standards [12]. We will also compile Shoemaker's original geologic descriptions with current knowledge to produce a

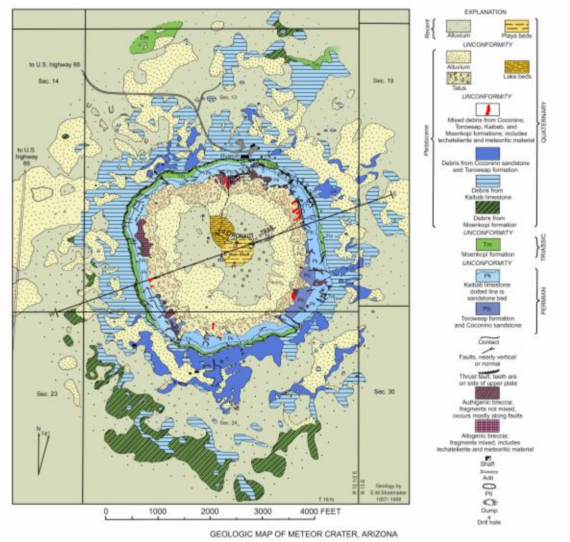


**Figure 3.** Geologic map of Meteor Crater by E. M. Shoemaker [2]. The original map was produced in black and white, colorized version is by [8].

geology-focused map text document that will accompany the map.

**Summary:** The ASC continues to maintain the TASC following the policies of the USGS Geologic Collections Management System, which provides necessary criteria for proper sample preservation. ASC encourages the use of these collections for scientific research and samples are available for checkout through the ASC website. Current research utilizing these samples includes a lithostratigraphic analysis of the ejecta blanket at Meteor Crater. In addition, ASC is preparing the posthumous publication of the Geologic Map of Meteor Crater by E. M. Shoemaker using modern data and current formatting standards. The forthcoming map includes a geologic-focused map text document, which was not part of the original publication.

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