

PLANETARY GEOLOGIC MAPPING USING ARCGIS PRO: A TUTORIAL SERIES FOR STUDENTS.

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Introduction: With geographic information system (GIS) technology evolving toward the adaptation of ArcGIS Pro in place of ArcMap, there is a need to shift geologic mapping efforts into the new ArcGIS Pro interface. A natural transition will occur as students receive training and current mappers begin new projects, and adopting ArcGIS Pro will alleviate the worry of creating map products in a software platform that will not continue to be supported by ESRI.

With respect to functionality, ArcGIS Pro provides more powerful processing capabilities for large datasets like those used in planetary mapping and integrates standard planetary geographic coordinate systems. However, many processing tasks and tools have been shifted in the new software, creating a need for updated mapping tutorials to highlight the changes and help new and existing mappers navigate ArcGIS Pro.

Mapping Tutorials: At the broadest scale, the workflow for any geologic mapping effort consists of five fundamental steps: (1) selecting an appropriate base layer upon which mapping will be conducted; (2) identifying units and drawing geologic contacts; (3) delineating geologic or tectonic features; (4) applying appropriate symbology; and (5) finalizing the map product for presentation and/or publication. Traditional geoscience curriculum includes geologic mapping in field courses as well as upper division classes. It also links mapping efforts to interpretations of depositional environment, stratigraphic context, structural regime, and geologic history.

The tutorials presented here are designed to complement geoscience coursework and offer users—both students and members of the planetary mapping community—an opportunity to conduct mapping in the ArcGIS Pro interface. The level of detail provided in the tutorials assumes that the user has no experience using ArcMap or ArcGIS Pro, an assumption intended to make them suitable for undergraduate students with little to no previous mapping experience. The tutorials would be ideal for students enrolled in a planetary geoscience class or an introductory GIS course.

The target body and datasets for tutorials are designed to showcase high-resolution planetary imagery by utilizing data returned from the Context Camera (CTX) and the High Resolution Science Experiment (HiRISE) onboard the Mars Reconnaissance Orbiter (MRO). Although users can choose to map on any HiRISE base image, four suggested images are provided that illustrate the utility of geologic mapping for interpretation of depositional processes on Mars.

The tutorials, originally designed for student users, are relevant introductions to ArcGIS Pro for planetary mappers who have conducted mapping on other target bodies and/or wish to quickly complete a primer as they upgrade from ArcMap.

Tutorial 1 – Planetary Mapping Project Creation in ArcGIS Pro: This workflow guides the user through creating a new project in ArcGIS Pro and configuring settings for the geographic coordinate system and a custom projected coordinate system. Mappers also prepare and import high-resolution imagery for mapping and link the project to online map products available from the USGS, for example, WMS server products.

Tutorial 2 – Importing Symbology and Creating Linear and Point Features in ArcGIS Pro: Once the project is set up, users are guided through the steps necessary to import USGS standardized planetary symbology. The processes for creating and editing point and linear features in ArcGIS Pro are documented, with special attention to the processes for identifying and editing geologic contacts.

Tutorial 3 – Creating Geologic Map Units Using Polygons and Topology Tools: When geologic contacts are satisfactorily created, users are provided tutorial steps to download and import the USGS Planetary Geologic Mapping Python toolbox. The workflow includes running the Topology Check and Build Polygons tools to turn linear contacts into geologic units and add symbology as needed for interpretation.

Tutorial 4 – Adding Map Elements and Exporting Maps for Publication: The final tutorial in the series helps users prepare their maps for publication by creating a layout in ArcGIS Pro and adding essential map elements such as scale bars and north arrows.

Next Steps: Recent survey results published by the USGS identified the need for tutorials and training opportunities and suggested sustained, innovative approaches from all stakeholders to ensure that the methodologies of planetary geologic mapping are communicated to new and current mappers [1]. These tutorials, available from the author and archived at www.tntechsedgeology.org/tutorials, are a response to the recommendations provided by the USGS. Feedback from all users is encouraged and welcome.

References: [1] Skinner, J.A. et al. (2019) *USGS Open-File Report 2019-1012*, 40 p.