GIS-BASED DATA STRUCTURE FOR GEOLOGICAL MAPPING OF CERES —
ONE GLOBAL MAP COMPOSED OF 15 MAP SHEETS. A. Naß and the Dawn Mapping Team
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Introduction: One aim of the NASA Dawn mission is to generate global geologic maps of the asteroid Vesta and the dwarf planet Ceres. The geological mapping campaign of Vesta was completed and published, e.g. [1], but mapping of Ceres is still ongoing. The tiling schema for the mapping project based on recommendations by [2], and is divided into two parts (for Ceres described in [3]): four overview quadrangles (Survey Orbit, 415 m/pixel) and 15 more detailed quadrangles (High Altitude Mapping HAMO, 140 m/pixel). The first global geologic map based on survey images [4]. This served as basis for generating a more detailed view of the geologic history and also for defining the chrono- stratigraphy and time scale of the dwarf planet [5]. The most detailed view can be expected within the 15 quadrangles based on HAMO resolution and completed by the Low Altitude Mapping (LAMO) data (35 m/pixel). For the interpretative mapping one responsible mapper was assigned for each quadrangle. Once the mapping is finished, all datasets must be mergable in ESRI’s ArcGIS™.

Purpose: Derive regional and global valid statements out of the map quadrangles is already a very time intensive task. However, another challenge is how the 15 individual mappers can generate one homogenous GIS-based project (w.r.t. geometrical and visual character) representing one geologically-consistent final map. This was already mentioned for mapping of Vesta in [6].

Within this contribution a template will be presented which was generated for the process of the interpretative mapping project of Ceres to accomplish the requirement of unifying and merging individual quadrangle. The template

1. accommodates the requirements for data storage and database management (e.g., [7]),
2. it uses standards for digitizing, visualization, data merging and synchronization,
3. it based on new technological innovations within GIS software and the individual requirements for mapping Ceres, and
4. on developments regarding symbology and framework described in [8] and [9].

Mapping template: The mapping template is based on the ArcGIS format file-geodatabase (FGDB) and splitted in three main layers: 1) basis data layer (msl): includes map graticules and the different quadrangle boundariesand 3) geologic mapping layer (gml): contains the layers into which the planetary features will be mapped. Furthermore, the Ceres FGDB includes:

- 5 feature classes representing specific types of geologic features: PointFeature, LineFeature, Geo-Contact, SurfaceFeature (thin deposits or surficial geomorphological objects), and basic GeoUnits (all vector based).
- Subtypes and Domains are hierarchical, or domain-controlled, attributes that are coordinated within each FC. By this a thematic/genetic and predefined description of the objects is managed.
- Cartographic symbols follow [10] as far as possible. For the implementation into ArcGIS, we used a predefined symbol set [8] that will be modified and expanded for the individual quadrangle mapping of Ceres. 
- Speciality: the colors for the geological units were defined by individual needs and requests within the mapping team. The color choice was based on established color values used in geologic maps, e.g., generated by USGS.

Furthermore the mappers were supported by

- different instruction documents,
- a metadata template based on standardized metadata keywords, e.g., defined in [11], [12].
- extra template (in a vectorbased software) arrange all map components (legend, map title, grid, projection information etc.) uniformly in a predefined map sheet.

The template is also useable in open source software QGIS and could be transfer to databasesystems like PostgreSQL.

Review and Open Questions: The mapping template has served as a necessary basis for the mappers to generate their individual but comparable maps, and thus gives the possibility to merge the 15 quads in the future to one global map (see figure 1). The current status and general information of the mapping project are summarized in [13]. Because the creation of the mapping template was and is an iterative process which is still in progress, there are still some topics (focus on
GIS and cartographic visualization) to discuss on the way to a homogenous and comparable map layout. These are:

1. boundary regions of all quads have to be strongly reviewed to enable a consistent description of Ceres.
2. map scale and minimum dimension of the objects have to be checked for a homogenous global result despite the different mapping/interpretation style of the mapper.
3. map boundaries defined by the HAMO atlas schema have to be consistent, independently of whether or not important objects are fully included.
4. color schema was generated by defining one color for each of the units expected by the mappers. It has to decided very carefully if additional colors for individual and regional phenomena should be used.
5. same font type, and font size, as well as the same status of nomenclature (approved by the IAU) should use.
6. an updated version of the already existing feature catalog (done by Katrin Krohn, DLR) and the generated global map legend could be combined to describe the different units and features generically and visually. This will provide a first global view of the objects and units on Ceres and could be used for more detailed investigation.

**Summary:** The template for (GIS-base) mapping presented here directly links the generically descriptive attributes of planetary objects to the predefined and standardized symbology in one data structure. Using this template the map results are more comparable and controllable. Merge and synchronize the individual maps will be far more efficient, and first possible. The template can be adapted to other planetary body, and/or be used within future discovery missions (e.g., Lucy and Psyche which was selected to explore the early solar system by NASA) for generating reusable map results.

**References:**


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