

Cartographic Symbolization in Geologic and Geomorphologic Maps – Update for Planetary Science

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... since 1962 lots of **high-quality, standardized, refereed geologic maps** of planetary bodies were funded by NASA and coordinated by the USGS/ASC.

... also **huge number** of maps with geologic and geomorphologic content were created **outside USGS** as result of scientific investigations and published **within peer-reviewed journal articles**.



... by **complexity** of planetary surfaces, **diversity** between different planet, and the **varied resolution** of the data base mapping is a highly **interpretative work**.

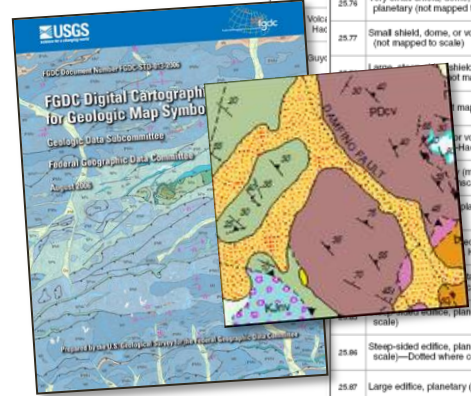
... **Uniform, precise, and well documented base data** are fundamental to make qualitative observations.

... the **derived data**, that means the maps, should also be **homogenous** and **understandable**.



... Visualizing planetary maps the community make use of the FGDC standard document (2006) for symbols, colors etc.

... but,
did this standard covers really
the needs for our planetary maps?



Federal Geographic Data Committee
FGDC Digital Cartographic Standard for Geologic Map Symbolization
FGDC Document Number FGDC-STD-013-2006
Appendix A

22—PLATE-TECTONIC FEATURES (continued)				
REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS*	NOTES ON USAGE†
22.25	Continental slope—Accurately located. Rectangles point downslope		line weight: 2.0 mm dash height: 0.75 mm; width: 1.5 mm	May also be shown in other colors.
22.26	Continental slope—Approximately located. Rectangles point downslope		line weight: 2.0 mm dash height: 0.75 mm; width: 1.5 mm	

25—PLANETARY GEOLOGY FEATURES (continued)				
REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS*	NOTES ON USAGE†
25.27	Continent		all line weights: 2.0 mm	
25.28	Outlet point		all line weights: 2.0 mm	
25.29	Outlet point		all line weights: 2.0 mm	
25.30	Dike		all line weights: 2.0 mm	
25.31	Marginal line		line weight: 2.0 mm	
25.32	Marginal line		line weight: 2.0 mm	
25.33	Volcanic dome, edifice, or circular scarp, planetary (mapped to scale)—Hachures point downslope		all line weights: 2.0 mm hachure height: 1.25 mm; spacing: 1.25 mm	
25.34	Very small shield, dome, or volcanic construct, planetary (not mapped to scale)		all line weights: 4.0 mm	
25.35	Small shield, dome, or volcanic construct, planetary (not mapped to scale)		all line weights: 4.0 mm	
25.36	Large shield, dome, or volcanic construct, planetary (not mapped to scale)		all line weights: 3.75 mm circle diameter: 4.0 mm	
25.37	Volcanic construct, planetary (mapped to scale)—Hachures point downslope		all line weights: 3.75 mm circle diameter: 4.0 mm	
25.38	Volcanic construct, planetary (mapped to scale)—scarp		all line weights: 2.0 mm hachure height: 1.25 mm; spacing: 3.75 mm	
25.39	Volcanic construct, planetary (not mapped to scale)		all line weights: 2.0 mm circle diameter: 2.0 mm	
25.40	Volcanic construct, planetary (not mapped to scale)—Bar and ball		all line weights: 1.25 mm circle diameter: 2.0 mm	
25.41	Volcanic construct, planetary (mapped to scale)—scarp		all line weights: 2.0 mm hachure height: 1.25 mm; spacing: 3.75 mm	
25.42	Volcanic construct, planetary (not mapped to scale)		all line weights: 2.0 mm circle diameter: 2.0 mm	
25.43	Steep-sided edifice, planetary (not mapped to scale)—Dotted where concealed or buried		all line weights: 2.0 mm short dashes: 0.5 mm; spacing: 2.0 mm	
25.44	Large edifice, planetary (not mapped to scale)		all line weights: 2.0 mm circle diameter: 15.0 mm	

Q1 Does **FGDC** standard provides **enough variability** to represent the data within currently needed maps?

Q2 How **needs** and **requests** from the community could take into account **as best as possible**?

Q3 What **recommendations** the mapping community need to **improve** planetary **maps**?



Answering these questions,
and determining the most representative symbol collection

we defined a stepwise approach....



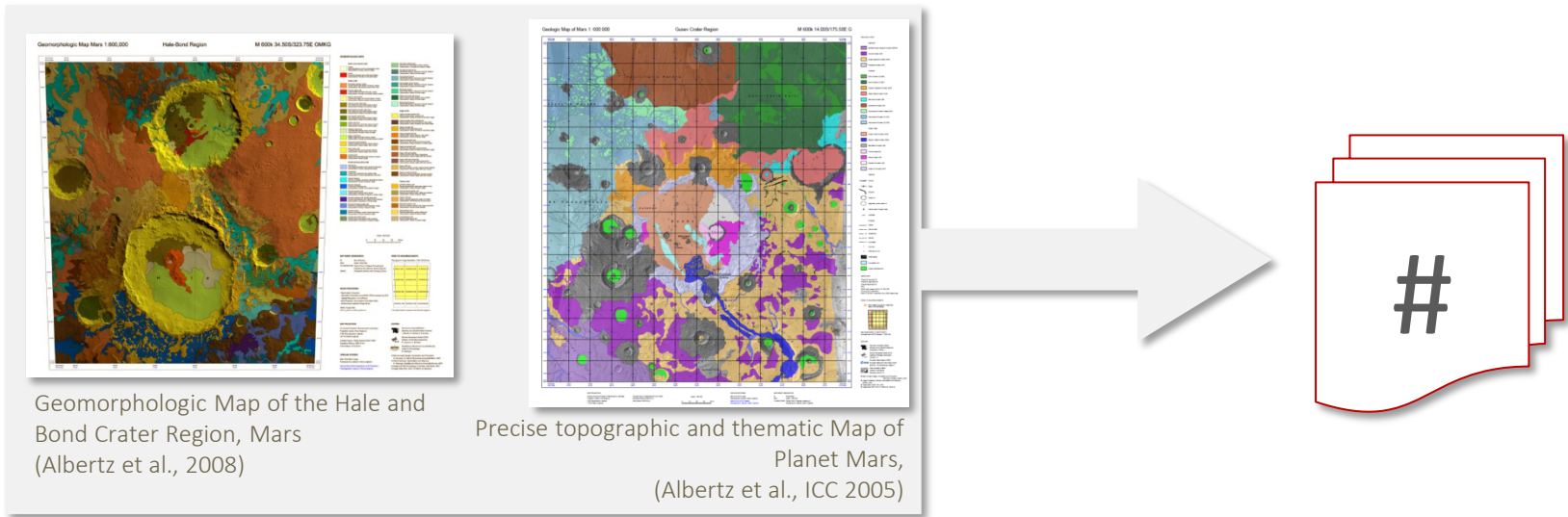
M1 Statistical **review** of **existing symbol** sets.

Symbols showing in USGS products were counted, and grouped.



M1 Statistical **review** of **existing symbol** sets.

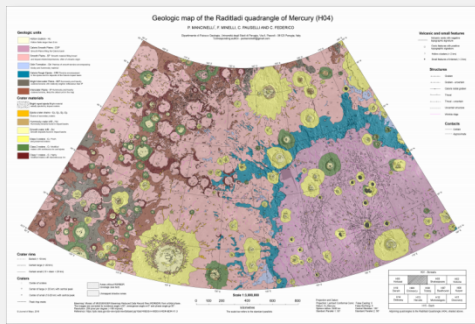
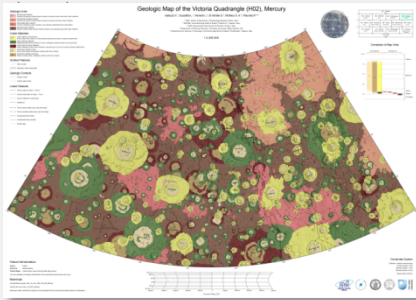
Enlarge statistic by individual maps within scientific publications.



M1 Statistical review of existing symbol sets.

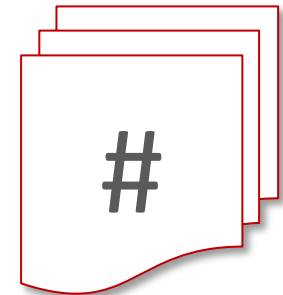
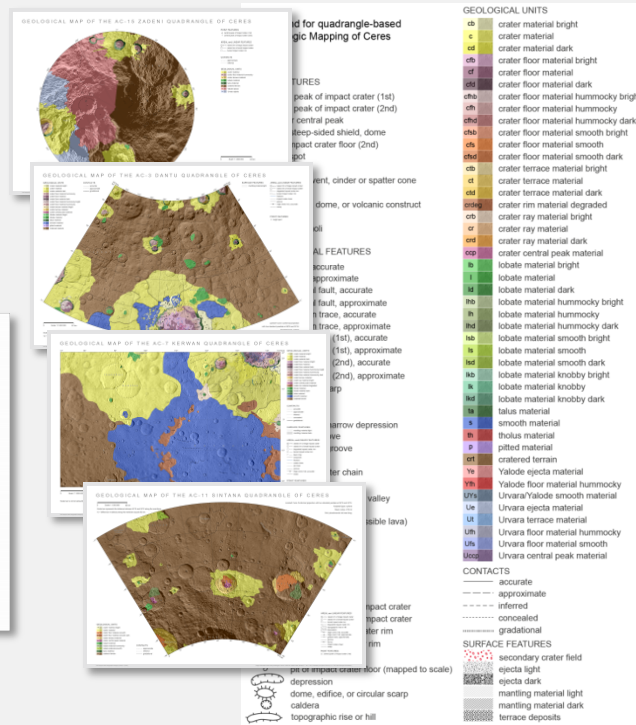
Enlarge statistic by mapping programs for Ceres and Mercury.

Galluzzi, V. et al (2016) Geological Map of the Victoria Quadrangle



Mancinelli, P. et al (2016) Geological Map of the Raditladi Quadrangle (H04), Mercury

Overview of Geological maps and symbols of Ceres, generated within the Dawn Mission



M2 Establish a **representative symbol** set.

Members of mapping community will review the result of M1.

... identify,
if further symbols are needed,
or
if symbols are too individual
than usable for a standard.



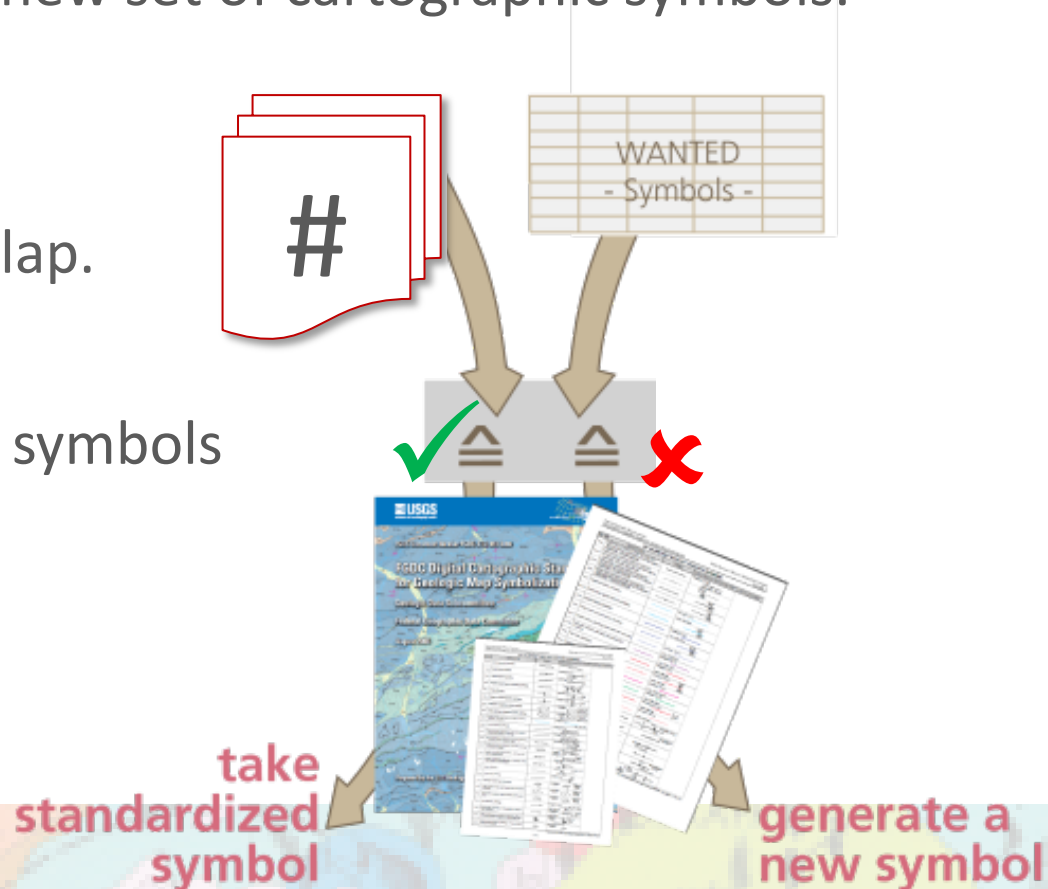
M3 Update cartographic symbols

Result from M2 will form a new set of cartographic symbols.

... compare with FGDC, determining how they overlap.

... complete with terrestrial symbols – if exist.

... create new symbols.

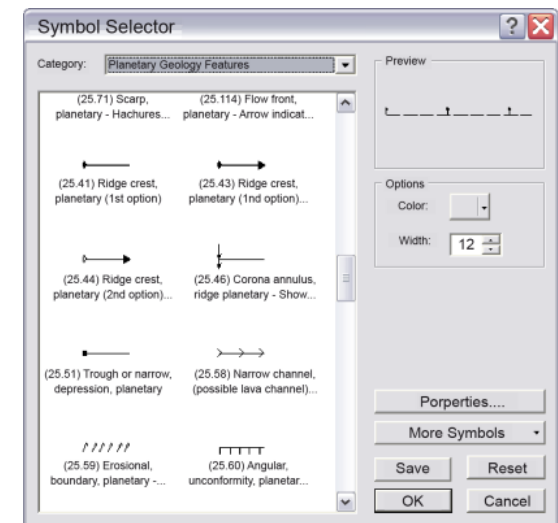


M4 Implementation into GIS

(Carto-)graphically formulated symbol will be implemented into GIS to increase the usability for the planetary mappers.

... this mimic an already existing application* of the planetary symbol set for ArcGIS

... but will enlarge for other GIS, e.g., QGIS.



**new symbol set
available in GIS**

*see Nass, A. et al. (2011) PSS, Vol. 59(11-12)

M5 **Distribute** the symbol set

Reaching as many planetary users as possible,
the symbol recommendations will promote and provide
... within workshop and conference contributions,
... via institute websites,
... cross links to international organizations and initiatives.

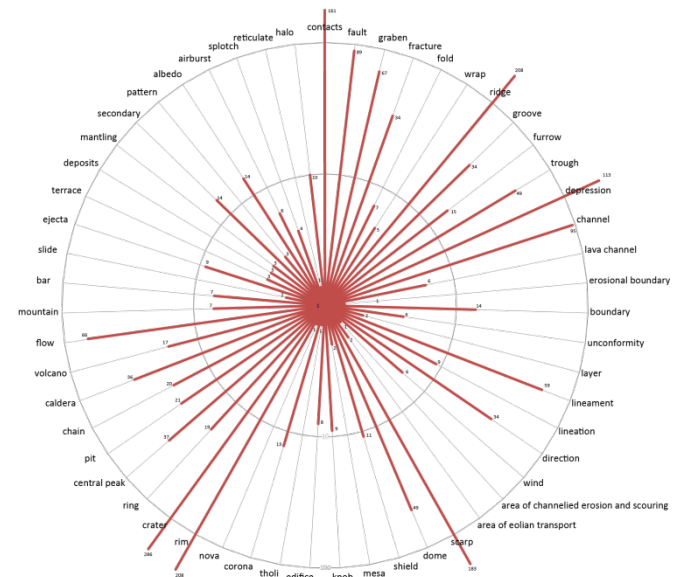


... gives the **first realistic** hint to the **most described** and used objects.

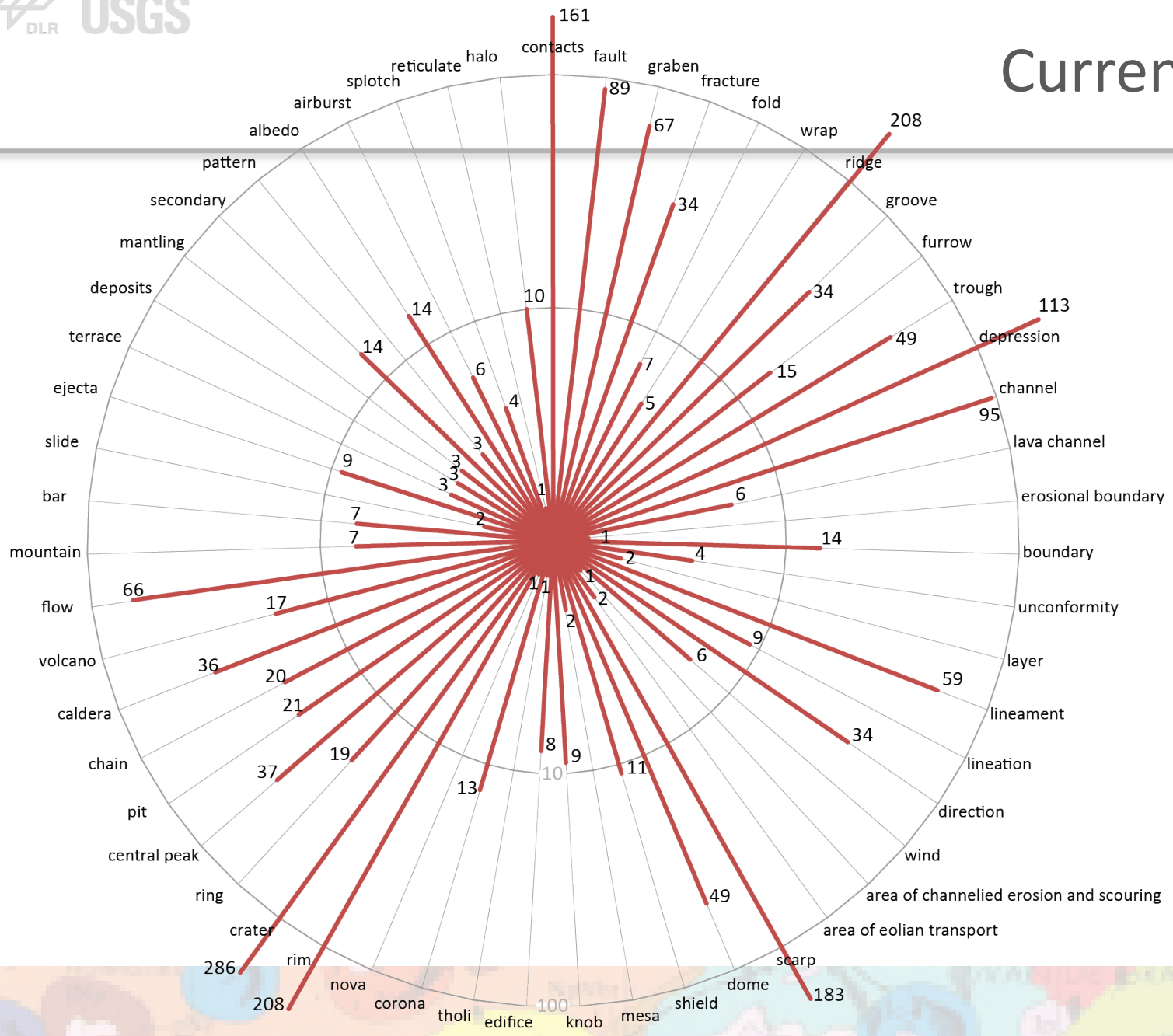
... considered **154** of the **242** available geological maps sheets.

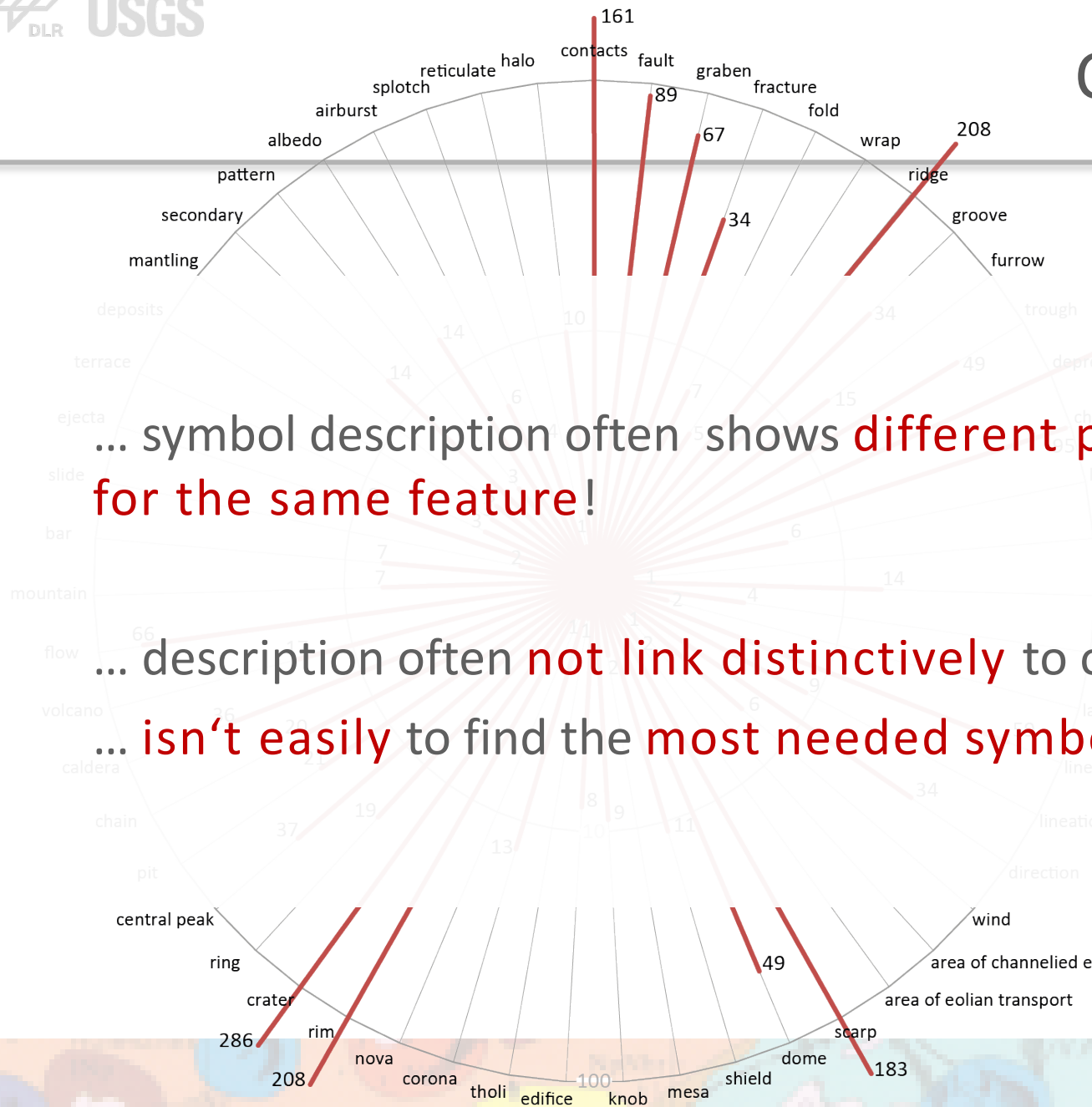
... **531** different symbol **descriptions**.

... listed symbol in legend
mean = 12, max. = 30, min. = 1



Current Status





... symbol description often shows **different phrasing** for the same feature!

... description often **not link distinctively** to one symbol.

... **isn't easily** to find the most needed symbols.

A1 merge symbols with predefined attribute values characterizing planetary objects in the **data model**.

... enables a consistent use of surface-/ object-characteristic and cartographic visualization.

... ongoing approach
see poster tonight #7041
and

van Gasselt & Nass (2011) PSS, 59(11-12)

1. Selection of the surface-type

Coded value domain
Structures_impact
Description: Impact-related
Field type: Structures
Split policy: Short integer
Merge policy: Default value

Code	Description
10	crater rim
20	ejecta outline
30	...

Coded value domain
Structures_eolian
Description: Eolian Structures
Field type: Short integer
Split policy: Default value
Merge policy: Default value

Code	Description
10	streaks
20	...
30	...

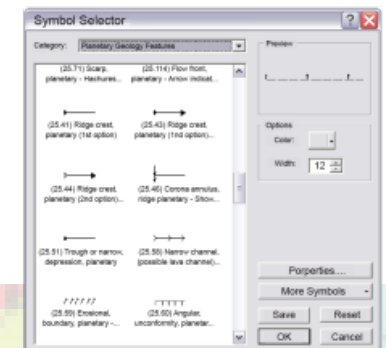
Coded value domain
Structures_general
Description: General Structures
Field type: and Lineations
Split policy: Short integer
Merge policy: Default value

Code	Description
10	furrow
20	ridge
30	...

Coded value domain
Structures_mass
Description: Mass-Wasting
Field type: Structures and Lineations
Split policy: Short integer
Merge policy: Short integer

Code	Description
10	...
20	...
30	...

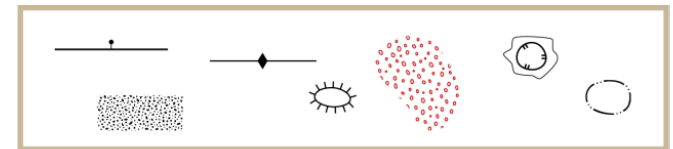
2. Selection of the corresponding symbol



A2 convert and save **symbols** in **open format**, e.g. *svg.

... gives the possibility to join the symbols to the data model and makes is independent from a specific software environment.

... already discussed in Nass, A. et al. (2011) PSS, Vol. 59(11-12)



```
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enable-background="new 0 0 595.28 841.89" ml:space="preserve">
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.
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</g>
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</g>
</svg>
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Additional tasks

A3 color recommendations for geologic units of different **planetary bodies**.

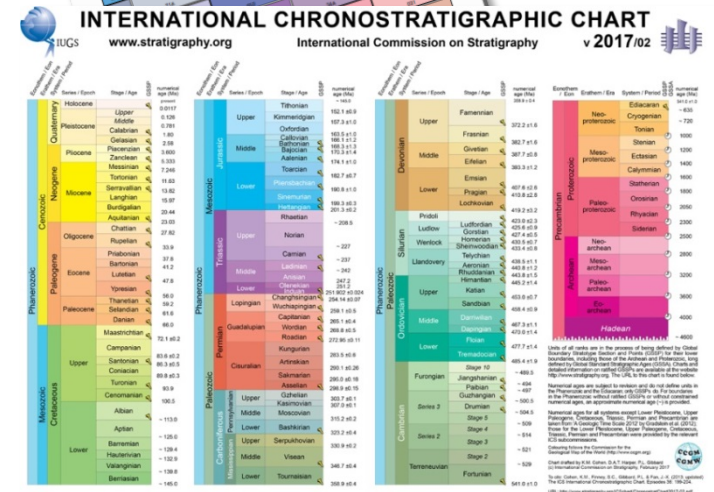
... simplifies the generation of time- and color scale.

... make stratigraphy between different bodies more comparable – if it is possible!

... contact to International Stratigraphic Committee!



FGDC standard (left) and www.stratigraphy.org (down)



To conclude, the next steps are:

1. **Enlarge statistic** by **representative maps** outside USGS.
2. **Establish** a digital **collection** of **most used symbols** for geological planetary maps, and **share** this with the **community**.
3. **Discuss color recommendation** for geological units of different planetary bodies and chronological epochs.



A critical review of the existing standard for geological features in planetary sciences is important

... **simplify** the GIS-based **conduction** of geologic maps.

... to enable **understandable** and **comparable** maps.

If you as experienced mapper in planetary science like to volunteer, please contact us!





Thank you for your attention!

Questions?

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