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A symbols library and development environment for Earth and Planetary geologic mapping

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Abstract:

Geologic mapping is a thematic mapping where the symbology plays a critical role in communicating the spatial and temporal relationship between the elements being mapped. Linear information representing surface features or different type of geologic contacts require specialized, often asymmetric symbols. Areal information is represented by shades and colours and relates with the body of rocks and terrain emplaced by a distinct process within a specific time span. Punctual information is related to key measurements, morphologic extremes and areal features too small to be mapped at a given scale. A geologic map with clear and coherent information therefore needs a well-designed symbol sets to produce a cartographic product which has to be usable in the mid-long term.

Modern geologic mapping is now mostly crafted in Geographic Information System (GIS) which provide also real-time visualization, rendering and printing capabilities. It is thus important to have the support for symbology of the final product directly within the GIS software being adopted for mapping and displaying.

Surprisingly, there are not many standards about digital formats for symbology in GIS. The only example is the OGC Styled Layer Descriptor (SLD) that can function as an interchange format, but it is still not spread among most commonly used GIS software. As a consequence of this, every GIS package relies on different implementations which are specific to the software and often even to different version of the same software. In this scenario, the of symbol-set to be shared among a scientific community or institution is very difficult.

The desktop GIS QGIS is part of the family of OSGeo Free Open Source Software for Geospatial (FOSS4G). QGIS offers some interesting feature related to symbology. Firstly, the use of eXtensible Markup Language (XML) for symbols and patterns allows a good flexibility in improving the capabilities with the software development but still maintaining backward compatibility. Then, the recent introduction of the resource sharing capability in the core package, allow to import symbol-set directly from the internet. Lastly, the *Style Manager* offers a user-friendly graphical user interface to develop symbols and patterns within the GIS desktop application.

Through the years, several solutions have been proposed to solve the problem of dressing geologic maps in QGIS. The first attempts date back to 2010 by Ryan Mikulovsky at UC Davis. An FGDC QGIS symbols library has been published in 2015 on SourceForge by Stefan Revets. In 2017, Daven Quinn published the complete FGDC Geologic Patterns for the Web in SVG format. In 2019, GeoProc.com published FGDC-4-QGIS patterns on GitHub. All these examples are specific to some aspects or some specification. Some library overlaps symbols with others and the tendency will be to import some of all of them and produce ‘local’ symbols libraries instead simply using existing ones.

This works aims to produce a system of symbol-set and a relative developing environment where new symbols or library of symbols can be added and kept ordered, and existing symbology can be improved collaboratively. The system, called *gysmblib*, is composed by the symbols library itself, a build system which assembles the library from single symbols, and a collaborative development environment where users can interact and submit/improve symbols and code in the network.

Since every institution or company from the international to the regional level has its symbology recommendation or standard, *gsymblib* keeps families of style separated, so multiple definitions of the same element can co-exist in the library. The use of textual tags offers the opportunity to filter off un-necessary symbols, keeping the symbology selection clutter-free during the mapping work. Symbol families are separated into distinct folders, each one of them representing an institution or specific project. This way, several representations of the same element (e.g. a normal fault) can be included in the same library without colliding. Another feature of *gsymblib* is that new single styles or symbols can be added or updated without touching other elements of the library. This facilitates individuals and institutions to collaborate at the incremental improvement a common library.

Gsymblib software scripts, the XML style library, and the SVG graphics are available from the GitHub collaborative development platform at the URL https://github.com/afrigeri/geologic-symbols-qgis. The software part of *gsymblib* is composed of python scripts dedicated to processing the single input styles and assembling them into the final library. The

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building process is automated through the GNU/Make tool. During building, each style is processed, textual tagging is being applied and a single XML library file is generated together with a folder of SVG symbols.

External style libraries can be ingested in this process. Currently, gsymblib imports and converts into the QGIS-compatible TinySVG 1.2 specifications all the FGDC geologic map pattern styles generated by Daven Quinns' *FGDC Geologic Patterns for the Web*. *Gsymblib* library can be downloaded for free and symbols are released under a Public Domain license (CC-0) which guarantees maximum compatibility with current and future implementations of the library in most used GIS.

Hosting on GitHub facilitates collaboration incremental asynchronous contributions to the symbols library and scripts. New symbols and fixes can be proposed and submitted through the GitHub issue tracker thanks to specialized category tags, or directly into the main repository through *pull requests* git mechanism.

In the first year, contributors from several countries completed all the 144 symbols defined in the Federal Geographic Data Committee (FGDC) Digital Cartographic Standard for Geologic Map Symbolization *Section 25 -- Planetary Geology Features*. Thus, at its current state, *gysmlib* can be used to produce planetary geologic maps, or basic geologic maps requiring the set of symbols included in the Section 25 of the FGDC Digital Cartographic Standard.

The XML format of QGIS symbols, and thus *gsymblib,* keeps doors open to further developments as exporting the styles as Styled Layer Descriptor (SLD) specified by the Open Geospatial Consortium (OGC) or converting and including the styles in other software projects dealing with the representation of geologic maps.

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