GSYMBLIB: A GEOLOGIC MAPPING SYMBOL LIBRARY AND DEVELOPMENT ENVIRONMENT FOR QGIS.

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Introduction: Geologic mapping is one of the thematic mapping which relies most on symbology to communicate its content. An accurate chosen color scale is critical for an effective visual perception of the stratigraphic relationships of the mapped units. Different line styles communicate the type of contact between units and also de different types of linear features which can be represented as a line at a given scale. Lastly, point units indicate localized features, as for example a peak or a pit.

Modern geologic mapping is mostly crafted in Geographic Information System (GIS) which provide also real-time visualization, rendering and printing capabilities. It is thus important to have symbol libraries to properly describe in GIS the wide range of information that can be included in a geologic map. As of today, no specific digital format standards for geologic symbology are available and every GIS package relies on different implementations.

Geologic mapping symbology in QGIS: QGIS is a desktop GIS part of the family of OSGeo Free Open Source Software for Geospatial (FOSS4G). Through the years, several solutions have been proposed to solve the problem of dressing geologic maps for QGIS and Free Open Source Software systems. 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[1]. In 2017, Daven Quinn published the complete FGDC Geologic Patterns for the Web in SVG format[2]. In 2019, GeoProc.com published FGDC-4-QGIS patterns on GitHub[3].

Starting from version 3, QGIS greatly improved its capabilities in the graphical representation of geospatial information, both in the interactive displaying and in the design of printable cartography through *map templates*. Complex styles can be designed directly into QGIS through the functionalities and the graphical interface of the *Style Manager* and symbols, line styles and patterns can be individually exported and imported thanks to an xml based `qgis_style` format.

The gsymblib project: The gsymblib project aims to gather all the necessary styles, patterns, colors, and fonts for a complete representation of geologic maps in QGIS, facilitating also the process of growing and improving the library by collaborative efforts.

Gsymblib brings into QGIS a geologic mapping symbology which is:

- *ordered:* families (for example different agencies standards) of symbols are kept separated.

- *documented:* every symbol/line/pattern has always an id and description.

- *incrementally improvable/upgradable:* new single symbols or group of symbols can be added to the library, or some symbols can be fixed individually.

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 (Figure 1). Moreover, the filtering capabilities of QGIS *Style Manager* avoid cluttering the symbology selection GUI by isolating the styles of the same family.
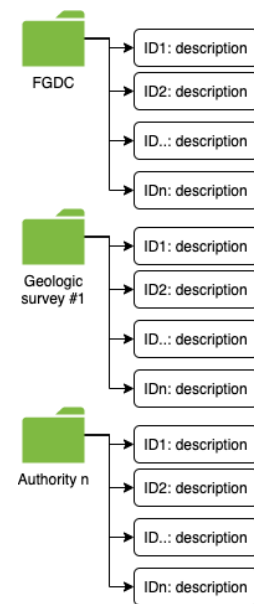

Figure 1: Symbol families are separated into distinct folders, each one of them representing an institution or specific project. This way, different representation of the same element (e.g. a normal fault) can be included in the same library.

Each symbol or style is defined by three elements: 1) the graphic definition 2) an alphanumeric ID and 3) a description of the symbols, and all this information are nested into the tree of a `qgis_style` XML file (see Figure 2).

Another feature of gsymblib is that new styles can be added or updated without touching other the elements of the library, facilitating contributions of even just one style.

25.094: Raised rim of larger impact crater, planetary—Hachures point into crater

fgdc, geology, gsymblib-1.0.0

Figure 2: The ID, description and style family tags are displayed passing the pointer over (hovering) a symbol in the QGIS Style Manager. This specific case reports the symbol 25.094 from FGDC from gsymblib version 1.0.0, describing the raised rim of an impact crater.
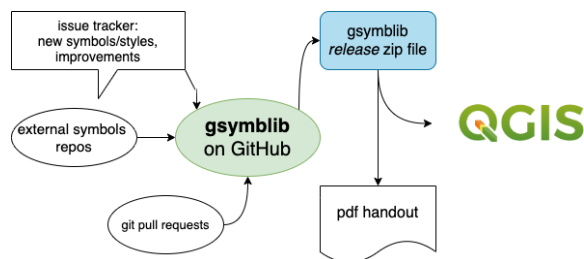

Figure 3: The different elements of the gsymblib project hosted on GitHub. New symbols and fixes can be proposed and submitted through the issue tracker thanks to specialized category tags, or directly into the main repository through pull requests. A build system parses the single style files, imports external styles and generates the updated library with a pdf handout.

gsymblib availability, structure and functions: 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 input styles and assembling them into the final library (figure 3). The building process is automated through the GNU/Make tool. During building, each style is processed, tagging is 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*[2].

Figure 3 synthesize the elements of the project and their relationship. The GitHub repository contains all the scripts to build the library from scratch and also the most up-to-date version of the library for immediate use which can be downloaded from the *releases* section of the repository and used immediately. Instructions for installing the latest release are described on the GitHub landing page of the project.

Conclusions: The gsymblib project aims to organize a suite of symbols, patterns and styles required for a complete representation of earth and planetary geologic maps in QGIS. Symbols and styles of a specific institution or agency can be included in the catalog so that styles for the same element can co-exist. The development on GitHub makes it possible to organize the work collaboratively and contribute incrementally and asynchronously to the library and scripts. 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. The XML format of 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.

References: [1] Stefan Revets. *QGIS Geology Symbology*. 2016. URL: https://sourceforge.net/projects/qgisgeologysymbology/ (visited on 04/19/2021). [2] Daven Quinn. *FGDC Geologic Patterns for the Web*. 2021. URL: https://davenquinn.com/projects/geologic-patterns/ (visited on 04/19/2021). [3] GeoProc.com. *QGIS Geology Symbology*. 2019. URL: https://github.com/BC-Consulting/FGDC-4-QGIS (visited on 04/19/2021).