Workbench for Imaging Spectroscopy Exploration and Research (WISER)
A Free Customizable Extendable Visualization and Analysis Tool for Imaging Spectroscopy Data

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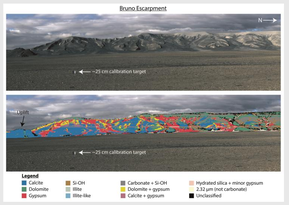
For more information or to download, please visit http://wiser.caltech.edu.

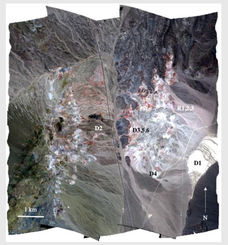
Motivation

- Imaging spectroscopy (aka hyperspectral imaging): Increasingly widespread in Earth, environmental, and planetary science, but most image processing software is for 2D datasets with no spectral dimension
- We develop WISER, a non-commercial software with open-source plugins, to enable wider data use, facilitate visualization, and develop and share codebases for students and the public without license fees

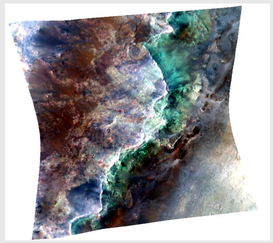
Example imaging spectroscopy datasets



Greenberger et al. (2020), JGR: Planets, Figure 8



Cuprite, NV (AVIRIS-NG) Thompson et al. (2020)

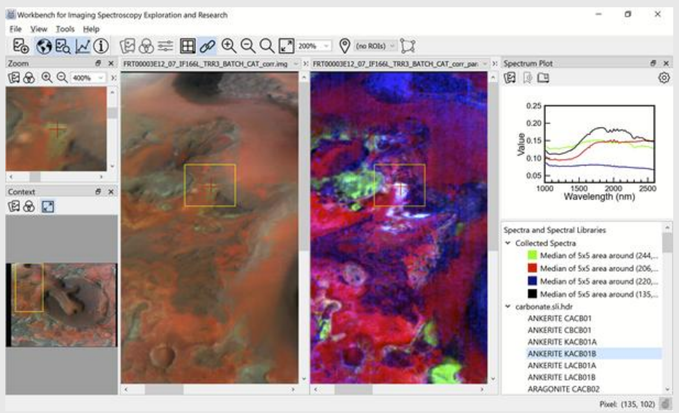


Mars (CRISM FRT00009D44)

Workbench for Imaging Spectroscopy Exploration and Research (WISER)

- User-friendly, responsive interface for visually exploring imaging spectroscopy data, coupled with ability to do sophisticated operations
- **Free** for non-commercial users; open-source as of December 2025
- Implemented in **Python 3**; leverages Python libraries widely used in scientific computing
- Supports **user-implemented plugins** for integrating **custom processing**
  - Can expose graphical workflows
- Supports .img/.hdr, TIFF/Geotiff, netCDF, PDS 3/4, and JP2 files
- Support for display of and go-to geographic and projected coordinates

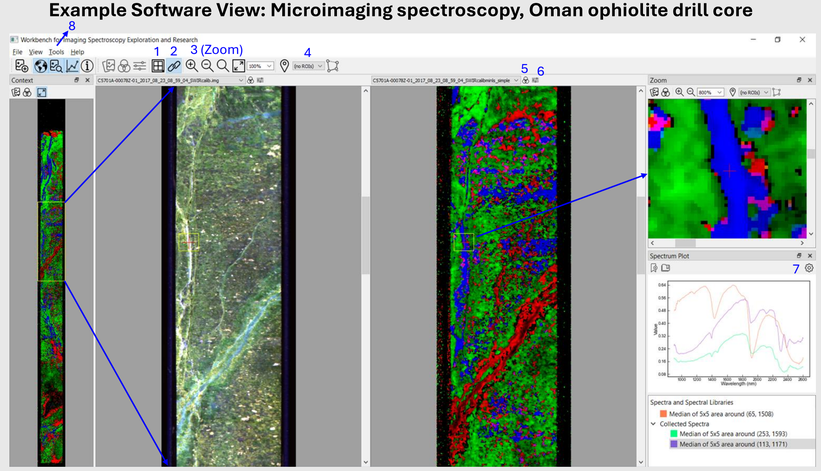
Exploring CRISM data from Mars with WISER



Past, Present, and Future Software Development

- WISER has been **developed over the last six years** with support from the Schmidt Academy for Software Engineering
- Current funding comes from **NASA PDART** award #80NSSC25K7044
- **New features are ongoing**, focused on making the software faster, more responsive, and easier to use, with community feedback informing improvements and bug fixes
- WISER is now **open-source**, so please join our mailing list (discover how at wiser.caltech.edu) and contribute!

Example Software View: Microimaging spectroscopy, Oman ophiolite drill core

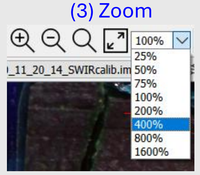


(1) Grid view

Display as many images as you want!

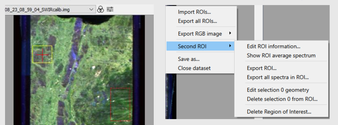
(2) Link images in grid view to scroll and zoom together

(3) Zoom

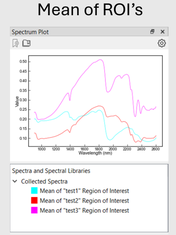


Customize the zoom level in main and zoomed windows

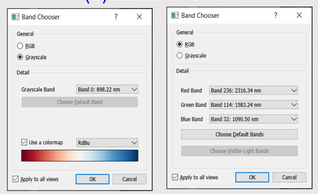
(4) Regions of interest (ROI)



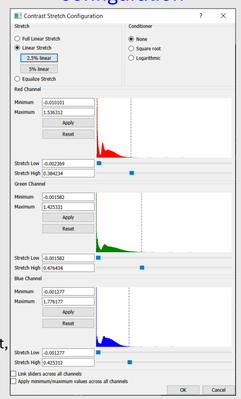
Mean of ROI's



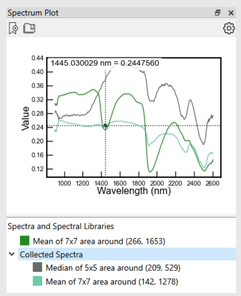
(5) Band chooser



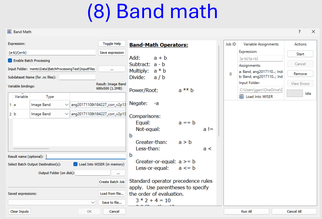
(6) Custom stretch configuration



(7) Interactive spectral plot window

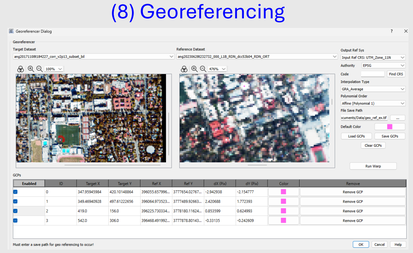


(8) Band math

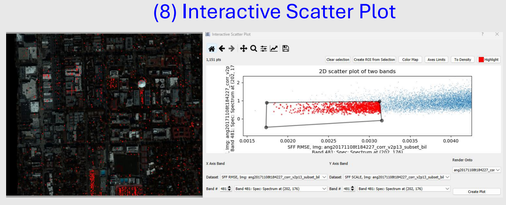


- Supported math operations: arithmetic, power/root, comparisons/conditionals, trig, dot product
- Expressions can be saved for future use
- Has batch mode to operate on whole folders

(8) Georeferencing



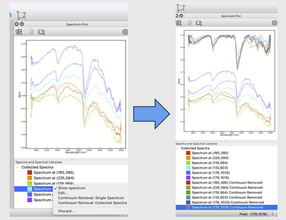
(8) Interactive Scatter Plot



Custom Plugins

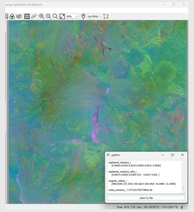
- WISER plugins allow users to extend WISER's capabilities with their own workflows via exposing graphical components
- Plugins can be accessed through multiple interface points, including the **context menu**, **tools menu**, and **band-math expressions**, allowing integration directly within standard workflows
- Plugins have controlled access to WISER application state, enabling custom actions that stay consistent with internal data
- A **public plugin repository** is available for community use and contribution, with the aim of expanding shared tools for hyperspectral analysis. It can be found on GitHub here:
  - Ehlmann-research-group/WISER-Plugin-Repository
- The following tools started out as plugins but later became permanent pieces of WISER:

Continuum Removal



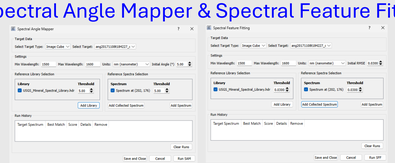
The continuum removal feature was originally developed as a plugin by A. Wang, but has since been added as a permanent part of WISER

Principle Component Analysis



The principal component analysis feature was originally developed as a plugin by S. Azad, but has since been added as a permanent part of WISER

Spectral Angle Mapper & Spectral Feature Fitting



The spectral angle mapper and spectral feature fitting features were originally developed as plugins by D. Nea and have since been added as permanent parts of WISER

WISER Is Open-Source – Installers Available

- WISER is publicly available for download and contribution. The GitHub repository is *Ehlmann-research-group/WISER,* and installers are also freely available
- Open-source means that the source code is transparent, reviewable, and open to contributions from the broader imaging spectroscopy community
- We plan on expanding community involvement to support a sustainable contributor base
- Individuals interested in contributing can refer to the *CONTRIBUTING.md* guidelines in the repository for instructions on recommending features, reporting issues, submitting code improvements, or creating documentation

Building a WISER Community

- Future webinars and workshops for using WISER and creating plugins
- More updates via WISER's Twitter and LinkedIn
- Active involvement in GitHub contributions and discussions
- We are looking for testers! Email wiser@caltech.edu if interested!