



# The Strabo Ecosystem



EarthCube



Hannah Blatchford



Noah Phillips



Julie Newman  
Andreas Kronenberg



Basil Tikoff  
Nick Roberts  
Alex Lusk  
Randy Williams



Doug Walker  
Jason Ash  
Nathan Novak  
Jessica Good Novak



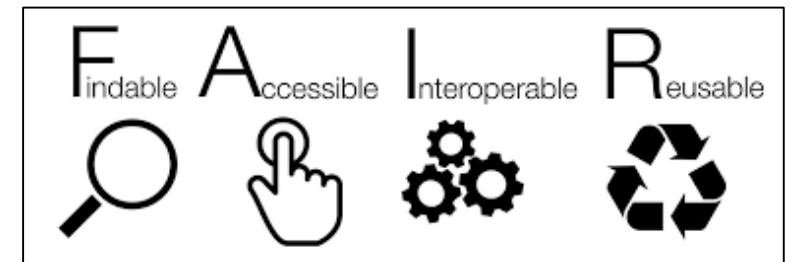
Ulrich Mok  
Matej Pec



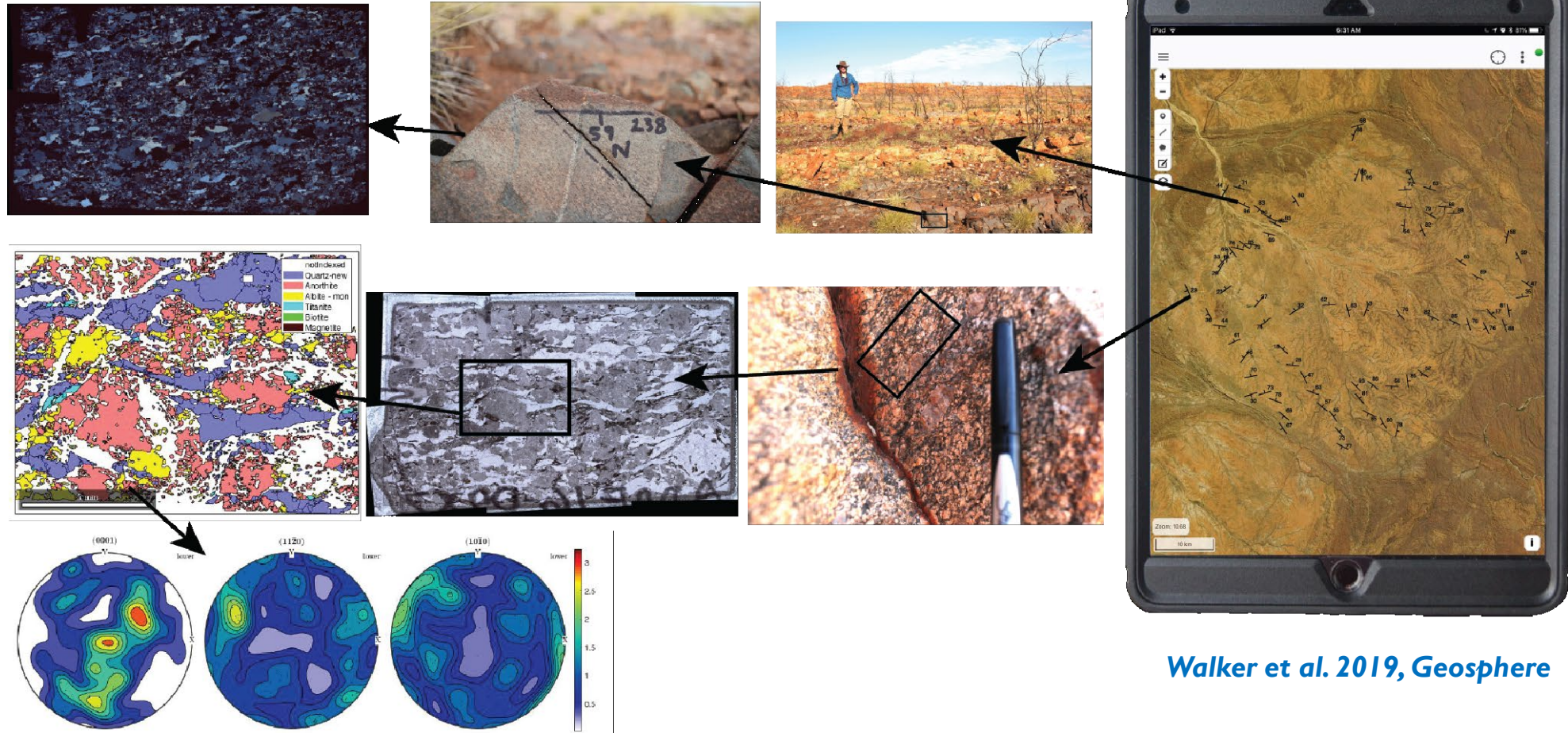
# What is StraboSpot?



- A series of applications and associated databases for collecting, storing, sharing, and querying geologic data
- Software are designed (*or being designed*) for **field**, **microstructural**, and **experimental** data sets
  - Completely open source and open API
- **Goal:** Make field, microstructural, and experimental data increasingly FAIR



# This is what we are trying to do: Bring in everything we do at a variety of spatial scales

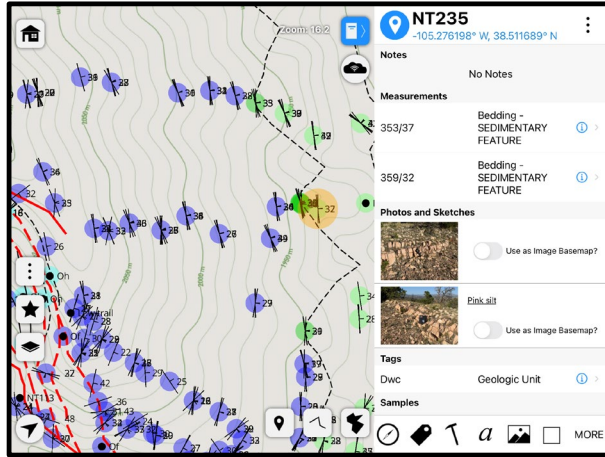


*Walker et al. 2019, Geosphere*

We do this with spots. Spots are points, lines or polygons that contain information. Spot data is primarily organized hierarchically.

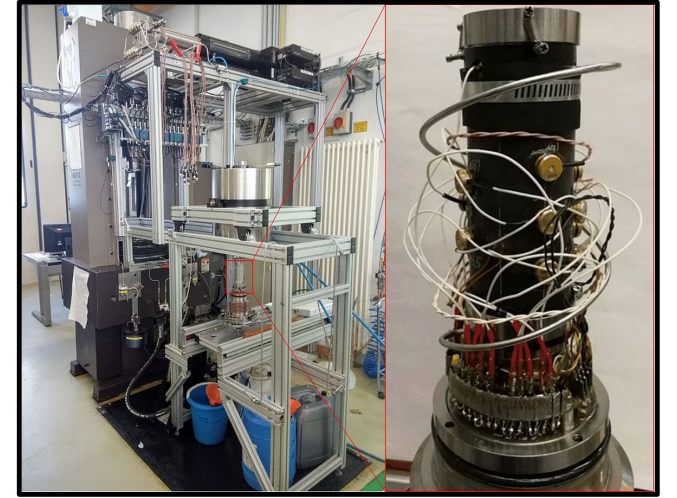
# The Strabo Ecosystem – one database, 3 applications

## StraboSpot Field

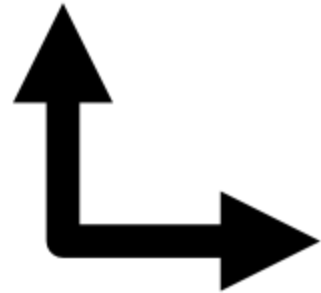
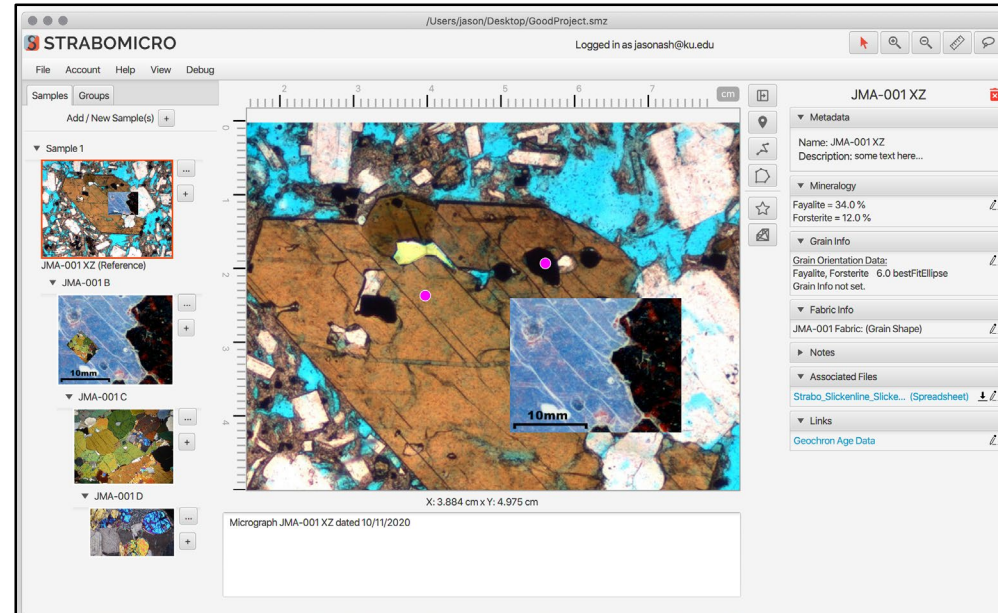


*Field context for  
experimental samples*

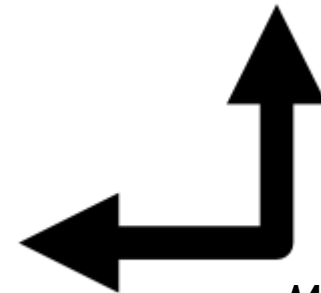
## StraboExperimental



## StraboMicro



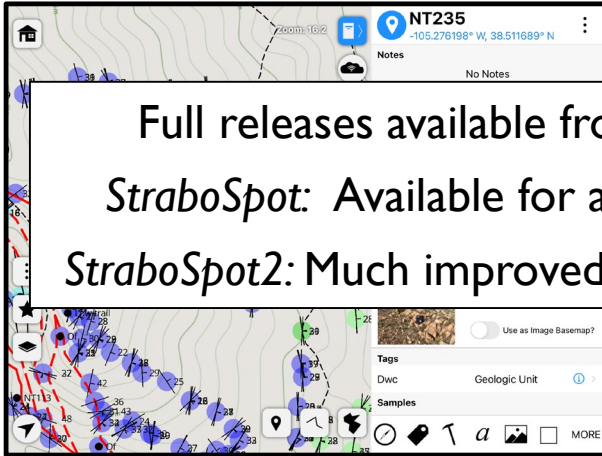
*Field context for natural  
samples*



*Microstructural  
observations: Pre- and  
post-experiment*

# The Strabo Ecosystem

## StraboSpot Field

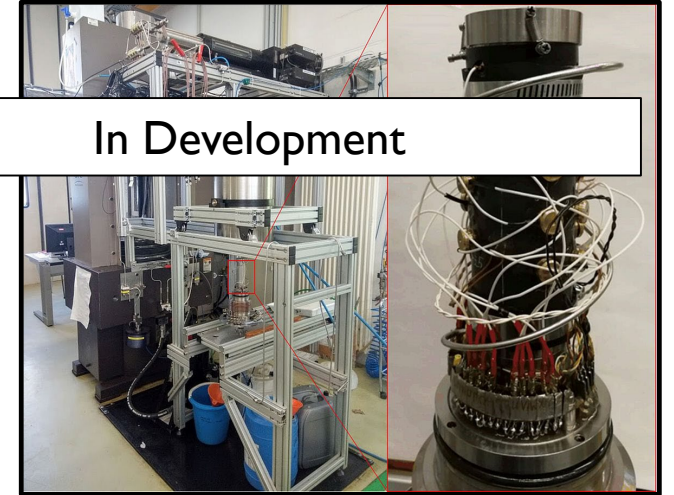


Full releases available from app stores -  
*StraboSpot*: Available for all mobile devices  
*StraboSpot2*: Much improved interface for iPads



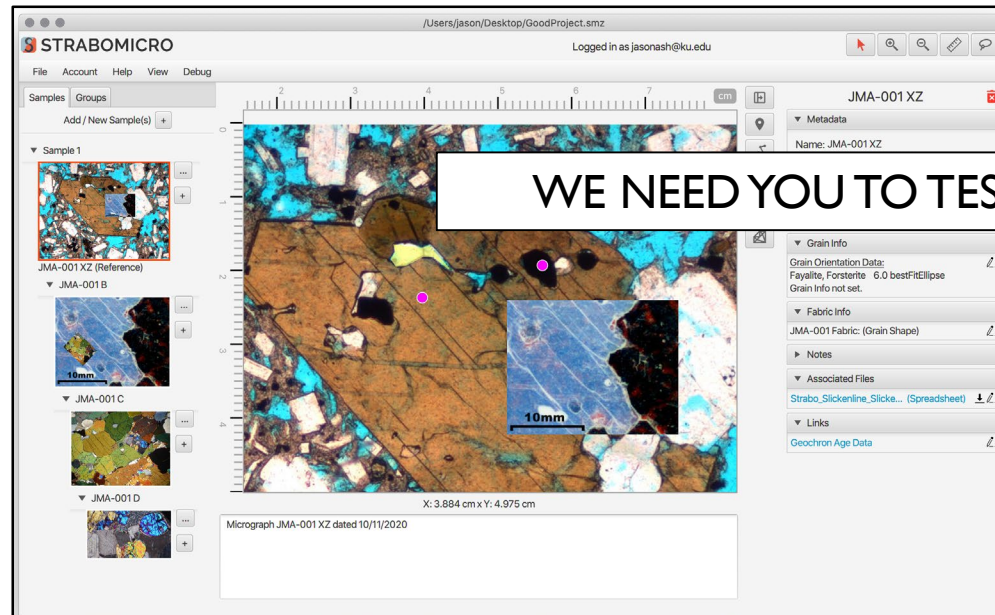
*Field context for experimental samples*

## StraboExperimental

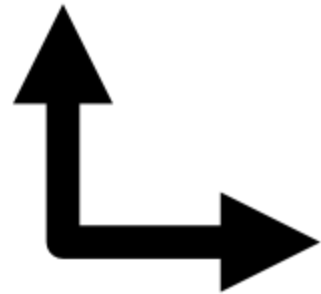


In Development

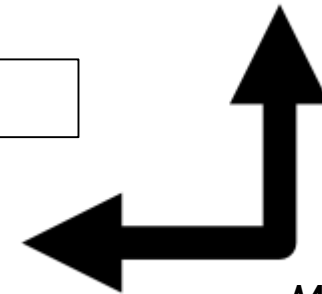
## StraboMicro



WE NEED YOU TO TEST IT!!!



*Field context for natural samples*



*Microstructural observations: Pre- and post-experiment*

# StraboSpot: Mobile Field Application

## ***Community Buy-In***

Over 4500 Users

~3,000 Projects

>450,000 Spots Over 6 Continents (*missing Antarctica*)

>650 Custom Maps Uploaded

***Interested?*** Download StraboSpot2 from the app store

Visit the YouTube channel



# StraboMicro

- Image and petrographic data management system
- Hierarchical image organization
- **Option to store on a shared database**
- **Maintains association with field data**

The screenshot displays the StraboMicro application window. The title bar shows the file path: `/Users/hannahblatchford/Desktop/Skjelvika_retro_eclo_pod.smz`. The user is logged in as `blatc005@umn.edu`. The interface is divided into several sections:

- Left Sidebar:** Contains a 'Samples' tab and a 'Groups' tab. Under 'Samples', there is a list of samples including NW1949A, NW1949B (with a thumbnail image highlighted in a red box), and NW1949C. Under 'Groups', there are sub-groups for NW1949B (Reference) and NW1949C, each containing sub-samples like NW1949B\_T01 through NW1949B\_T05 and NW1949C\_Q01 through NW1949C\_Q03.
- Central Image Viewer:** Displays a petrographic image of a rock sample. A red arrow points to a specific feature. The image is overlaid with a scale bar in centimeters (0 to 4 cm). The dimensions of the image are given as X: 2.714 cm x Y: 3.044 cm.
- Right Panel:** Contains a search bar for 'Add Data' with a search by data type (e.g., mineral name, grain size, etc...). Below this is a section for 'Existing Data' with expandable categories: Project/Dataset Metadata, Sample Metadata, Spot Metadata, and Mineralogy/Lithology. The Mineralogy/Lithology section is expanded, showing a table of mineral percentages and lithology information.
- Bottom Panel:** Contains 'Detailed Notes' and 'Spot Notes'. The 'Spot Notes' section shows a note: 'Cpx layer in pod-rim half of sample. Folded.' The 'Lithology Notes' section shows: 'retrogressed equivalent of 1949A'. The 'Fold Notes' section shows: 'rootless folds of cpx (associated with pod core mineralogy of (NW1949A)).'

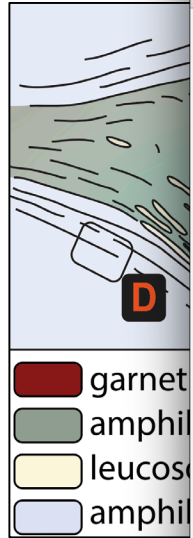
Mineralogy:	
Titanite	< 1.0 %
Ilmenite	< 1.0 %
Quartz	= 5.0 %
Biotite	= 4.0 %
Plagioclase	= 30.0 %
Clinopyroxene	= 5.0 %
Hornblende	= 55.0 %

Lithology:	
Amphibolite (Metamorphic)	



# StraboMicro

## A four-sample example



**STRABOMICRO** | Logged in as blact005@umn.edu

Samples | Groups | Add / New Sample(s) +

- NW1949A
- NW1949B
  - NW1949B\_T01
  - NW1949B\_T02
  - NW1949B\_T03
  - NW1949B\_T04
  - NW1949B\_T05
  - NW1949B\_Q01
  - NW1949B\_Q02
  - NW1949B\_Q03
- NW1949C
- NW1949D

**NW1949B (Reference)**

Detailed Notes: [\(details\)](#)

**Spot Notes** [\(edit\)](#)  
Cpx layer in pod-rim half of sample. Folded.

**Lithology Notes** [\(edit\)](#)  
retrogressed equivalent of 1949A

**Fold Notes** [\(edit\)](#)  
rootless folds of cpx (associated with pod core mineralogy of (NW1949A).

StraboSpot Web | app.strabospot.org/indexWeb.html#/app/map

StraboSpot | Spots | Attributes | Maps | Project | Help | User

StraboSpot Web | app.strabospot.org/indexWeb.html#/app/image-basemaps/16555663318063

StraboSpot | Spots | Attributes | Maps | Project | Help | User

**Skjelvika retrogressed eclogite pod**

Longitude: 6.681965

Latitude: 54.674367

Geologic Unit





# StraboMicro

A four-sample example

Reference photomicrographs

Dynamic scale

Positions of associated micrographs

The screenshot shows the StraboMicro application window. On the left is a sidebar with a sample list: NW1949A, NW1949B (expanded to show NW1949B\_T01, NW1949B\_T02, NW1949B\_T03, NW1949B\_T04, NW1949B\_T05, NW1949B\_Q01, NW1949B\_Q02, NW1949B\_Q03), NW1949C, and NW1949D. A red box highlights a reference photomicrograph for NW1949B. The main window displays a large photomicrograph of a rock sample with a dynamic scale at the top (0 to 4 cm) and a vertical scale on the left (0 to 3 cm). A red arrow points to a specific location on the image. The bottom of the window shows a 'Detailed Notes' section with 'Spot Notes', 'Lithology Notes', and 'Fold Notes'. The right sidebar contains a metadata panel for 'NW1949B -> relic cpx layer (folded)', including 'Add Data' search, 'Existing Data' sections for Project/Dataset, Sample, Spot, and Mineralogy/Lithology (listing Titanite, Ilmenite, Quartz, Biotite, Plagioclase, Clinopyroxene, and Hornblende), and 'Links'.

Add data as points, lines, polygons

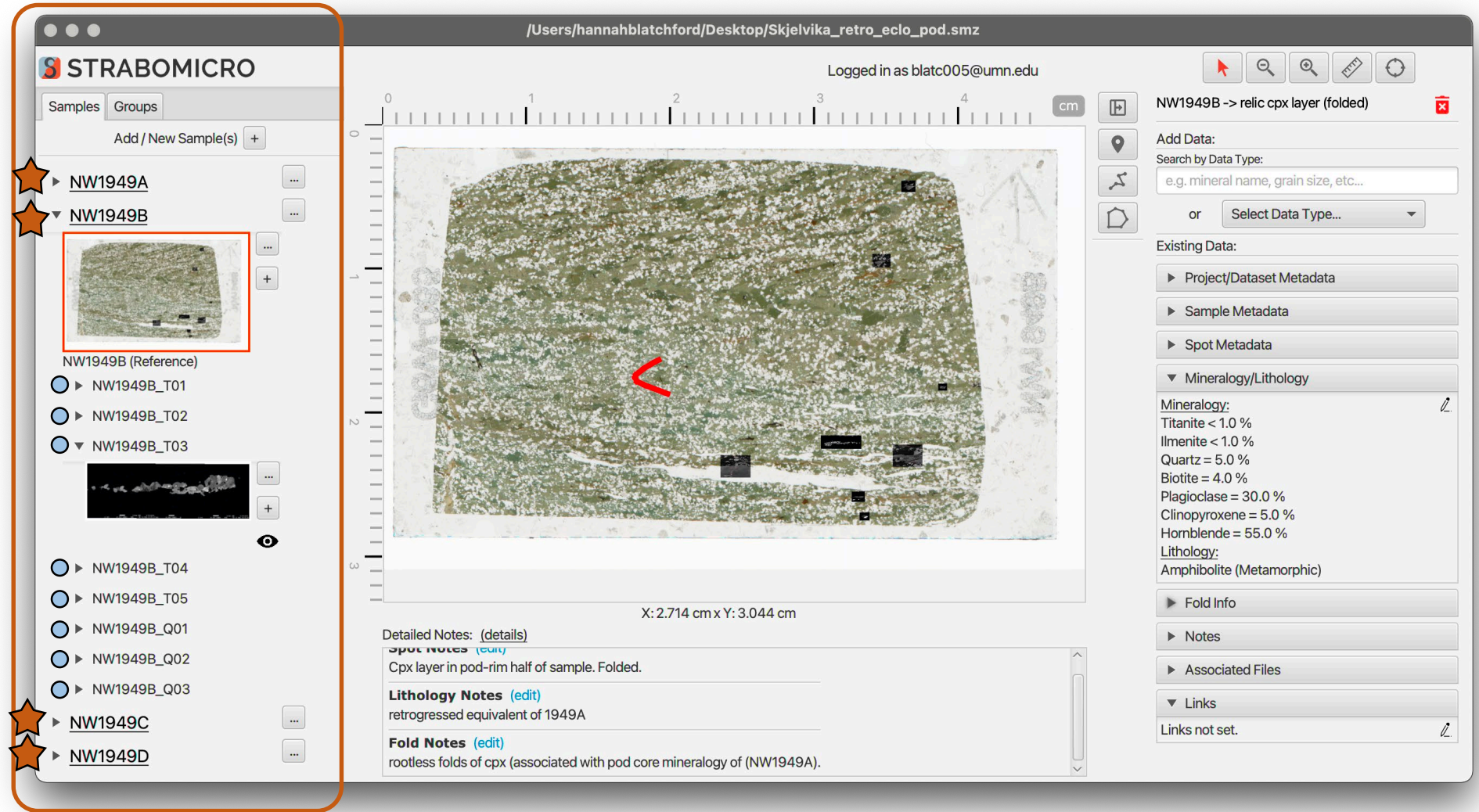
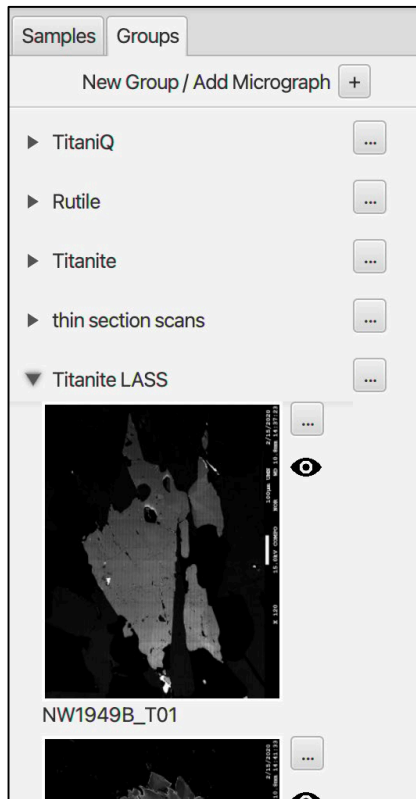
Details of selected data



# StraboMicro

## A four-sample example

### Image hierarchy and grouping



Reference micrograph



Associated micrograph



# StraboMicro

## A four-sample example

### Modals

Add Data:  
Search by Data Type:  
e.g. mineral name, grain size, etc...

or **Select Data Type...**

Existing Data:

- Project
- Sample
- Micrograph
- Mineralogy/Lithology
- Fabrics
- Clastic Deformation Bands
- Grain Boundaries / Contacts
- Intragranular Structures
- Veins
- Pseudotachylyte
- Folds
- Faults and Shear Zones
- Extinction Microstructures
- Fractures
- Notes
- Associated Files
- Links

3\_1\_SupplementaryData... (Spreadsheet)

STRABOMICRO  
Logged in as blact005@umn.edu

Samples Groups  
Add / New Sample(s) +

NW1949A

NW1949A (Reference)

NW1949A\_R01

NW1949A\_R02R03

NW1949A\_R04

NW1949A\_R05

X: 1.843 cm x Y: 2.932 cm

Detailed Notes: [\(details\)](#)

**Polish Description** [\(edit\)](#)  
0.05 um colloidal silica

Add Data:  
Search by Data Type:  
e.g. mineral name, grain size, etc...

or **Select Data Type...**

Existing Data:

- Project/Dataset Metadata
- Sample Metadata
- Micrograph Metadata
- Mineralogy/Lithology
- Fabric Info
- Associated Files

Mineralogy:  
Ilmenite = 1.0 %  
Rutile < 1.0 %  
Plagioclase = 23.0 %  
Hornblende = 20.0 %  
Diopside = 25.0 %  
Garnet = 25.0 %  
Lithology:  
Other: grt + cpx rock (retro eclogite) (Metamo...

Fabric Info

- foliation**  
Foliation, Primary, Penetrative; Defined by: composition; Composition: Layers: grt + pl 2.0mm, cpx + hbl + pl 3.0mm;

3\_1\_SupplementaryData... (Spreadsheet)

3\_3\_SupplementaryData... (Spreadsheet)



# StraboMicro

HOME ABOUT ACCOUNT API SOFTWARE HARDWARE SEARCH HELP TEACHING LOGGED IN AS: BLATC005@UMN.EDU (LOGOUT)

My StraboMicro Projects:

**Skjelvika retro eclo pod**  
 Upload Date: June 21, 2022, 02:27:41 pm EDT | **Public?**

	Num Micrographs	Num Spots
<a href="#">View</a> <a href="#">Download</a> <a href="#">Share</a> <a href="#">Delete</a>	37	1

## Collaborative data management

Upload Project to Server

Uploading your project to the StraboSpot.org database allows you to back up your project data, as well as share project data with the StraboSpot community. To access your uploaded project, please visit the My Data section at StraboSpot.org.

Uploading Project... 14%

File > upload project

Open Shared Project File

Due to the fact that StraboMicro project files can be quite large and difficult to share, this interface has been created to allow StraboMicro users to share project files using a small, simple code. To open a project shared by another user, simply enter the code into the box below and click Next. The project file will be downloaded and opened automatically. **Please be aware that this system DOES NOT allow two users to work on the same project.** The project file downloaded using this code is unique and not tied to the original file. To share your own project file with others, please visit the strabospot.org website and go to My Data to share your uploaded StraboMicro projects.

File > open shared project file

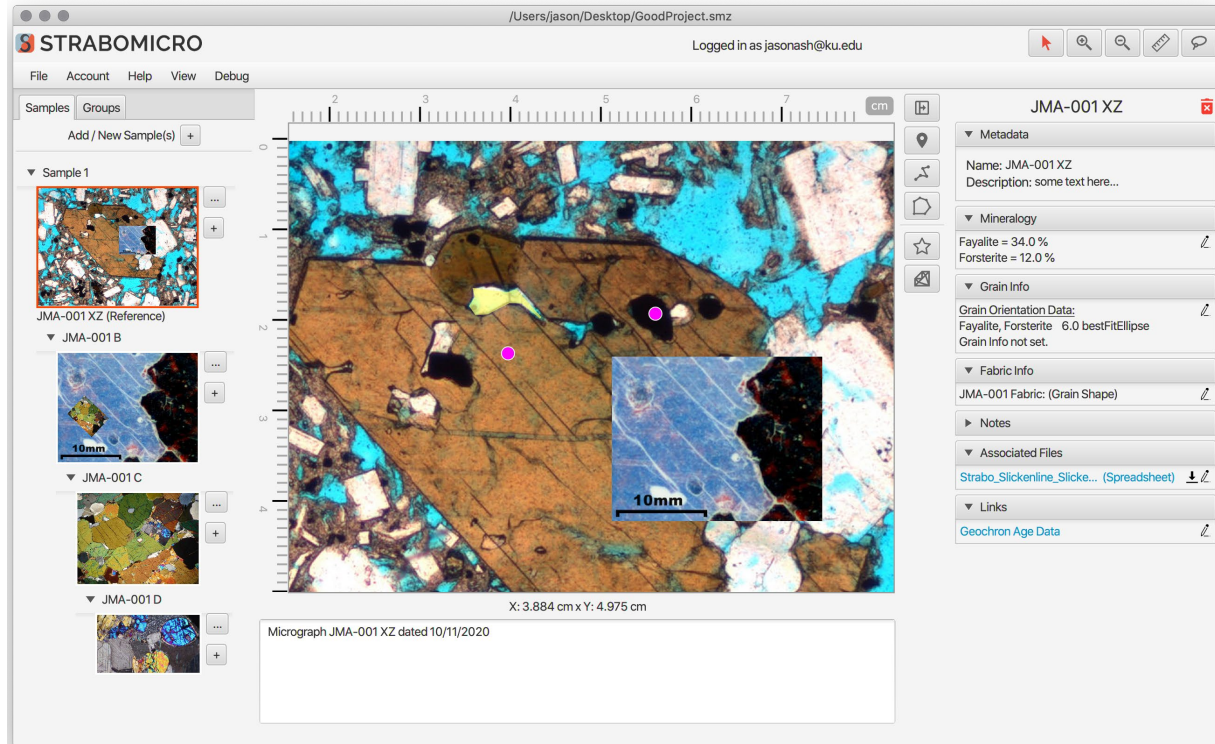
Share StraboMicro Project File:

Due to the fact that StraboMicro project files can be quite large and difficult to share, this interface has been created to allow StraboMicro users to share project files using a small, simple code. To share this project with another user, simply copy and paste the code below and send it to the intended recipient. The recipient can then use the File -> Open Shared Project File option in the StraboMicro application to open this project. **Please be aware that this system DOES NOT allow two users to work on the same project.** The project file downloaded using this code is unique and not tied to the original file.

To share this project file, use the following code:

**6-digit code**

# Strabo Micro



## Current: Image Management System

- Metadata
- Field (or experimental) context; orientation
- Scale tracked between images
  - Nested images
- Basic data description
- Any image, or spot within an image, may be linked to associated data (e.g., SEM, probe)

## Future: Data reporting

- Deformation Microstructures
- Sedimentary Petrology
- Igneous and Metamorphic Petrology

**AVAILABLE for testing NOW!**

at [StraboSpot.org](https://StraboSpot.org) → software

**STRABOMICRO** Logged in as emnelson8@wisc.edu

Samples Groups Spots Tags

Add / New Sample(s) +

▼ 17SD2\_3

17SD2\_3 XPL (Reference)

▼ 17SD2\_3\_11x

17SD2\_3\_90x

17SD2\_3\_89x

17SD2\_3\_88x

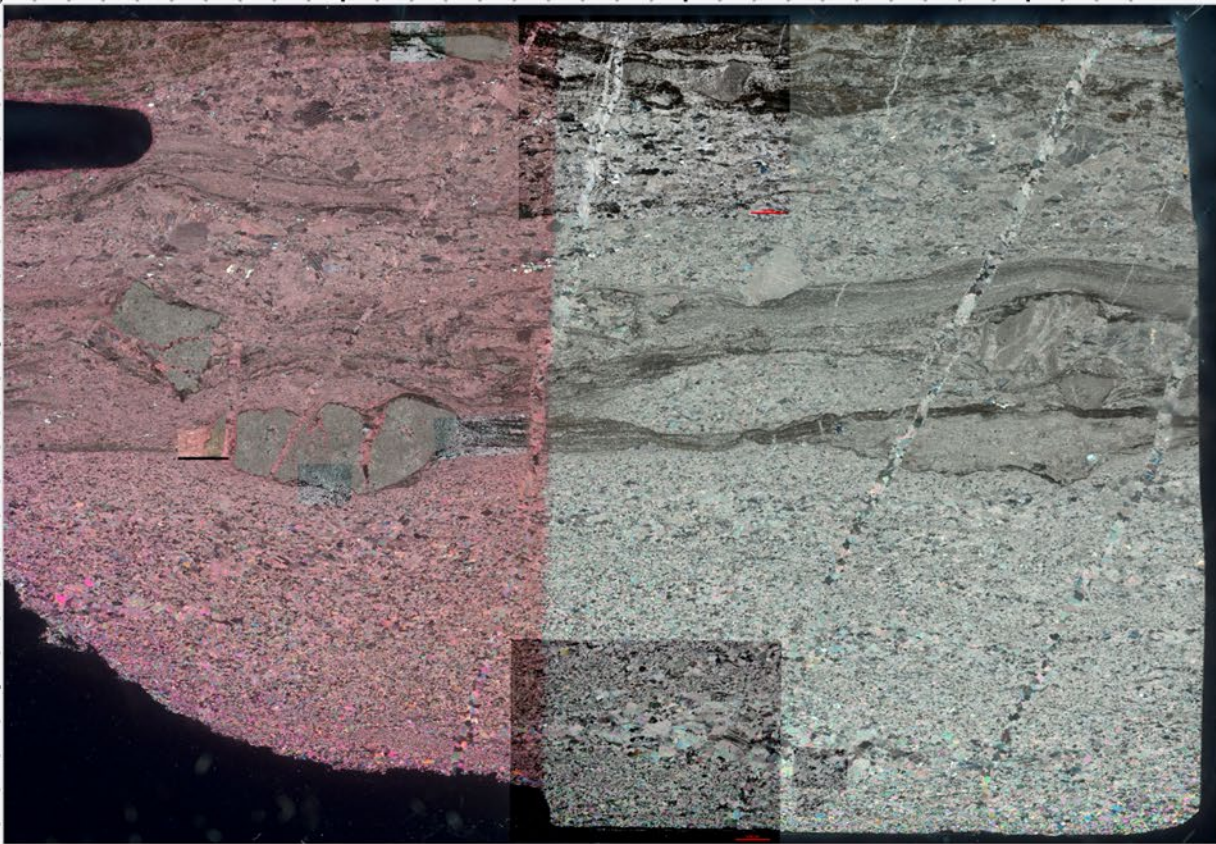
17SD2\_3\_87x

17SD2\_3\_70x

▼ Coarse Calcite Phase Map

Microprobe WDS

0 1 2 3 cm



X: 1.009 cm x Y: 2.425 cm

17SD2\_3 XPL

Add Data:

Search by Data Type:

e.g. mineral name, grain size, etc...

or Select Data Type...

Existing Data:

- Project/Dataset Metadata
- Sample Metadata
- Micrograph Metadata
- Mineralogy/Lithology
- Vein Info
- Associated Files
- Links

Detailed Notes: [\(details\)](#)

**Sample Notes** [\(edit\)](#)

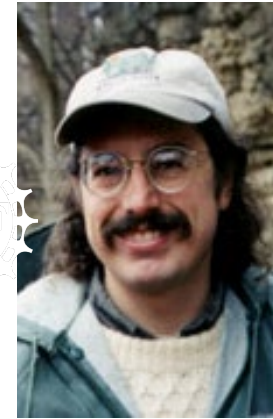


**Questions? Comments?**

**StraboSpot & StraboMicro**



# StraboExperimental / LAPS



EarthCube



**Matej Pec  
Ulrich Mok**

**Andreas Kronenberg  
Noah Phillips  
Julie Newman  
Hannah Cunningham**

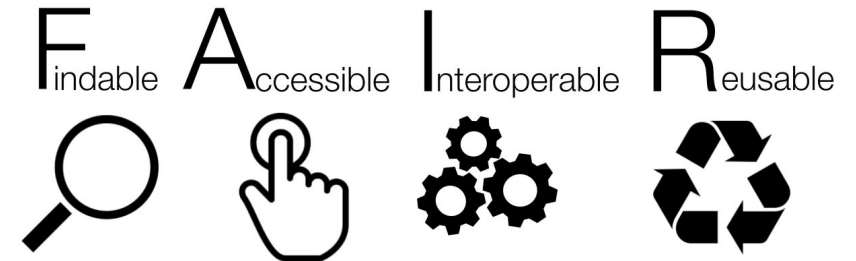
**Basil Tikoff  
Jason Ash**





## Practical GeoScience Data Challenges

*To publish my work, I need to make **data** and **procedures** publicly available.*



- *Which **repository** is suited for me?*
- ***Ease of Use?***
- ***Longevity of Storage?***
- ***Private** access (if I am not ready to share the data yet)*
- ***Upload / Download Capability***
- *Can I **search** effectively for similar datasets*
- *External access – API for **data mining**?*



## What is StraboExperimental?



An **digital** repository for experimental information and data. As part of the Strabo Ecosystem, it utilizes features from Strabo Micro **in addition** to capabilities specifically designed for experimental data.

## What is LAPS?



LAPS is a framework for preparing and storing experimental data **locally**. It comprises a set of instructions and workflow tools for gathering and organizing experimental results. Functionality includes **upload** capability to **StraboExperimental** via API.



# StraboExperimental



  
Experimentalist

  
Facility

Experiments



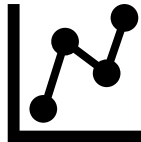
Analytics



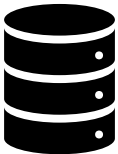
Processing/  
Modelling




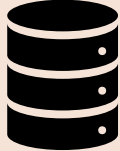

Publication



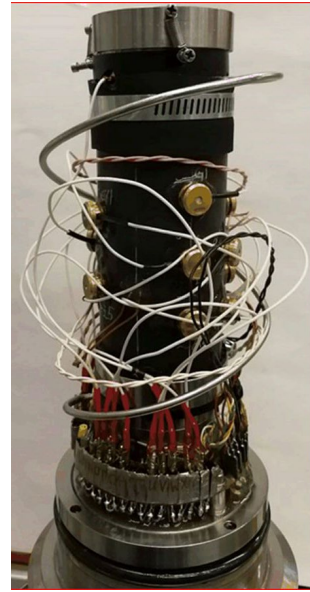
Descriptions + Records + Data



Digital Repository



## Experimental Records - Metadata



	A	B	C	D	E	F	G
63							
64	Time	Sd - Deviat	Confining	Pore Press	ea - Axial S	er - Radial	ev - Volum
65	sec	MPa	MPa	MPa	%	%	%
66	0.0001	1.0235	120	43	-0.0005	-0.0028	-0.0062
67	0.1	1.0205	120	43	-0.0015	-0.0008	-0.0032
68	0.2	1.0212	120	43	-0.0028	0.0047	0.0067
69	0.3	1.0222	120	43	-0.0019	0.0004	-0.0012
70	0.4	1.0219	120	43	0.0015	-0.0067	-0.012
71	0.5	1.0248	120	43	0.0018	-0.006	-0.0101
72	0.6	1.0223	120	43	-0.0039	0.007	0.0101
73	0.7	1.0237	120	43	0.001	-0.0053	-0.0096
74	0.8	1.0247	120	43	-0.0038	0.0058	0.0077
75	0.9	1.0207	120	43	0	0.0001	0.0001
76	1	1.0215	120	43	0.0002	-0.0052	-0.0103
77	1.1	1.0245	120	43	-0.0041	0.0069	0.0096
78	1.2	1.0228	120	43	0.0012	-0.0056	-0.0099
79	1.3	1.0197	120	43	-0.0029	0.0036	0.0044
80	1.4	1.0235	120	43	0.0015	-0.006	-0.0104

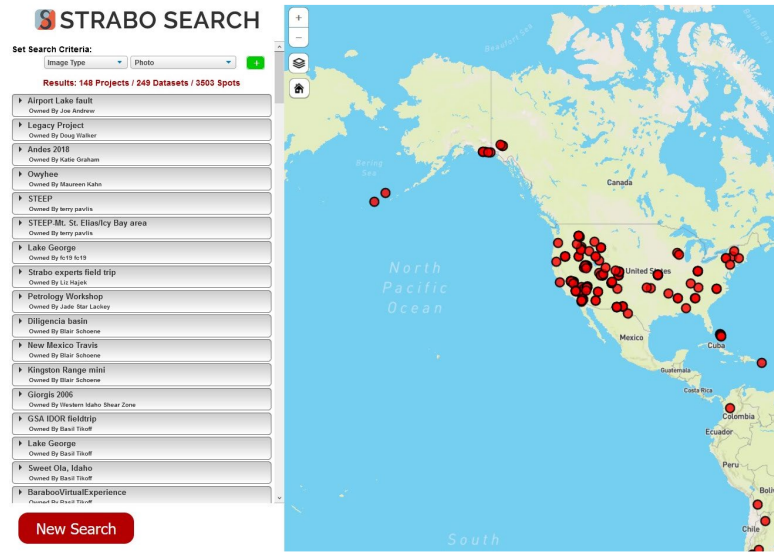
**Data Structure**

*Community Development of Vocabulary and Metadata Structure*

## Online Interface - Features

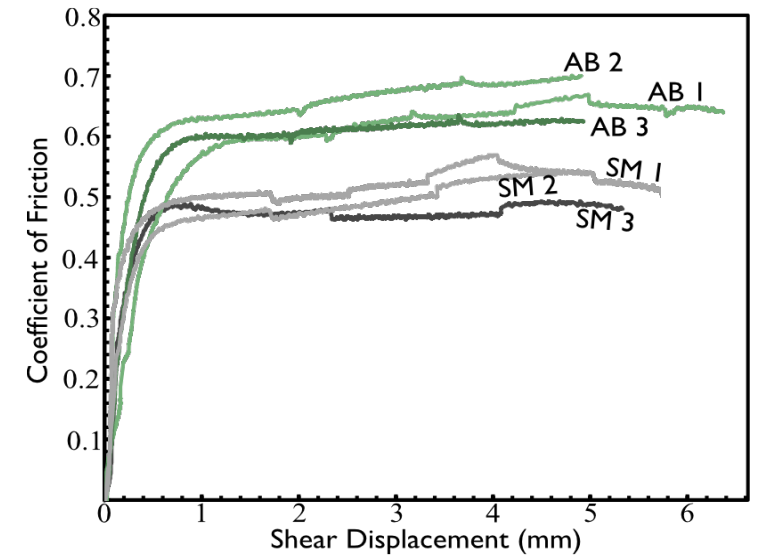
	A	B	C	D	E	F	G
63							
64	Time	Sd - Deviat	Confining	Pore Press	ea - Axial Ser	- Radial	ev - Volun
65	sec	MPa	MPa	MPa	%	%	%
66	0.0001	1.0235	120	43	-0.0005	-0.0028	-0.0062
67	0.1	1.0205	120	43	-0.0015	-0.0008	-0.0032
68	0.2	1.0212	120	43	-0.0028	0.0047	0.0067
69	0.3	1.0222	120	43	-0.0019	0.0004	-0.0012
70	0.4	1.0219	120	43	0.0015	-0.0067	-0.012
71	0.5	1.0248	120	43	0.0018	-0.006	-0.0101
72	0.6	1.0223	120	43	-0.0039	0.007	0.0101
73	0.7	1.0237	120	43	0.001	-0.0053	-0.0096
74	0.8	1.0247	120	43	-0.0038	0.0058	0.0077
75	0.9	1.0207	120	43	0	0.0001	0.0001
76	1	1.0215	120	43	0.0002	-0.0052	-0.0103
77	1.1	1.0245	120	43	-0.0041	0.0069	0.0096
78	1.2	1.0228	120	43	0.0012	-0.0056	-0.0099
79	1.3	1.0197	120	43	-0.0029	0.0036	0.0044
80	1.4	1.0235	120	43	0.0015	-0.006	-0.0104

**Form Input of Experimental & Analytical Data**



The screenshot shows the 'STRABO SEARCH' interface. On the left, there is a search criteria form with fields for 'Image Type' and 'Photo'. Below the form, a list of search results is displayed, including 'Airport Lake Basalt', 'Legacy Project', 'Andes 2018', 'Owyhee', 'STEEP', 'STEEP-Mt. St. Elias/Icy Bay area', 'Lake George', 'Strabo experts field trip', 'Petrology Workshop', 'Diligencia basin', 'New Mexico Travis', 'Kingston Range mine', 'Georgia 2006', 'GSA 180N fieldtrip', 'Lake George', 'Sweet Ole, Idaho', and 'Baraboo/Virtual Experience'. On the right, a map of North America is shown with numerous red circular markers indicating the geographic locations of the data points. A 'New Search' button is located at the bottom left of the interface.

**Search, Filter and Download Data**



**Plotting Experimental Data from Multiple Sources**





## *Next Steps*

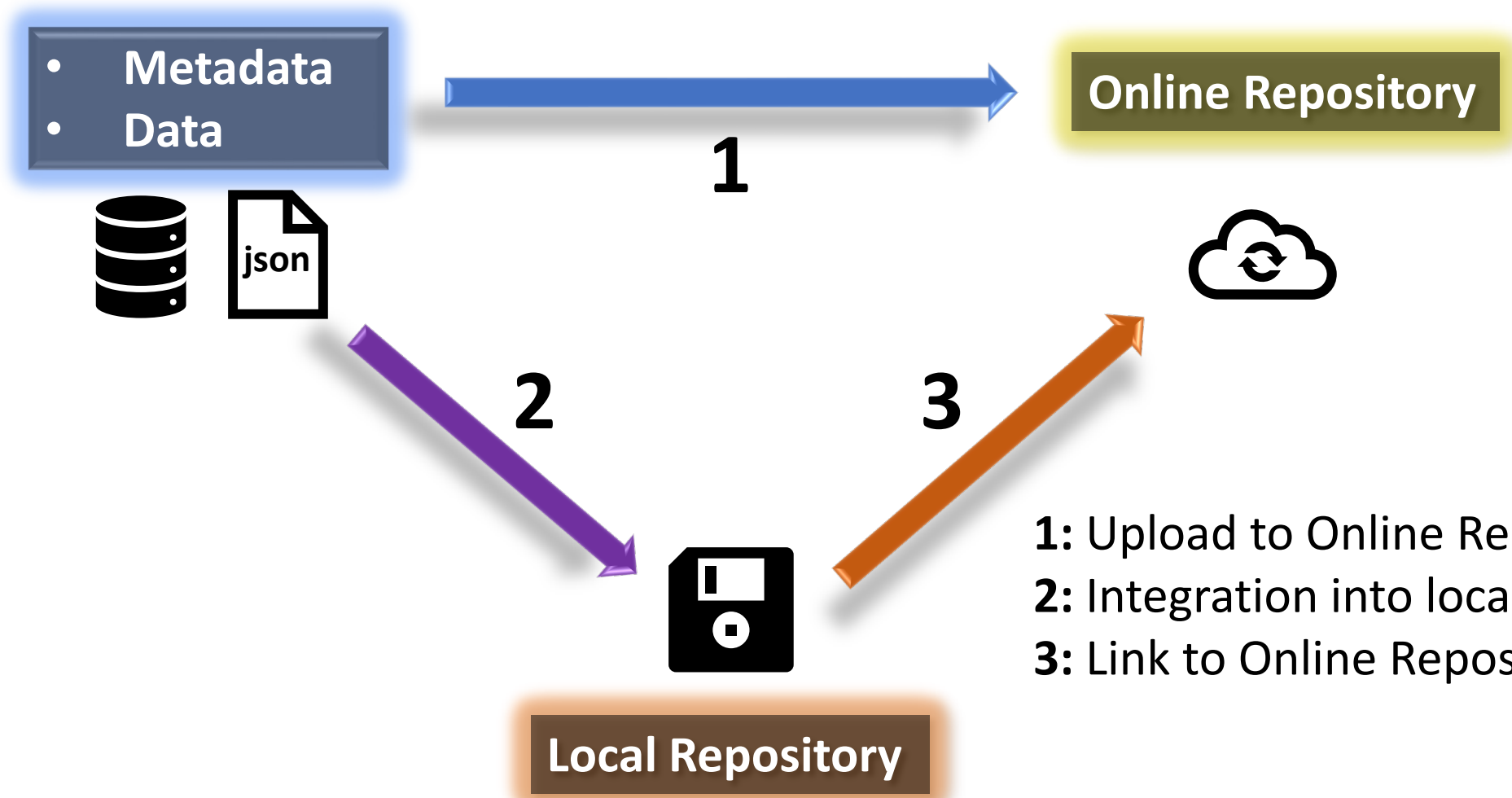
Add to Apparatus Repository

Sample & Procedures

Data Structure

Data Input



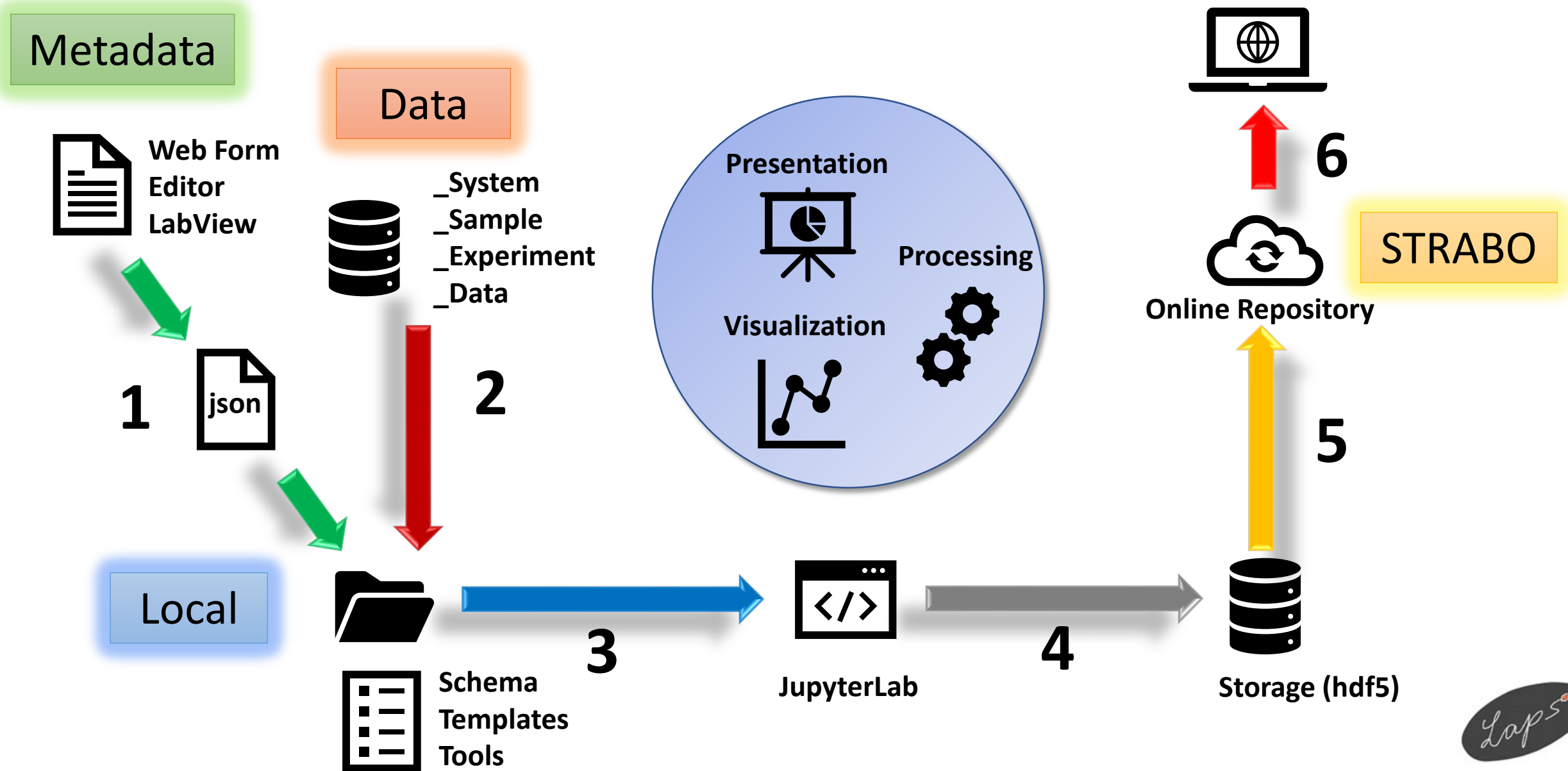


- 1: Upload to Online Repository
- 2: Integration into local Workflow
- 3: Link to Online Repository (API)

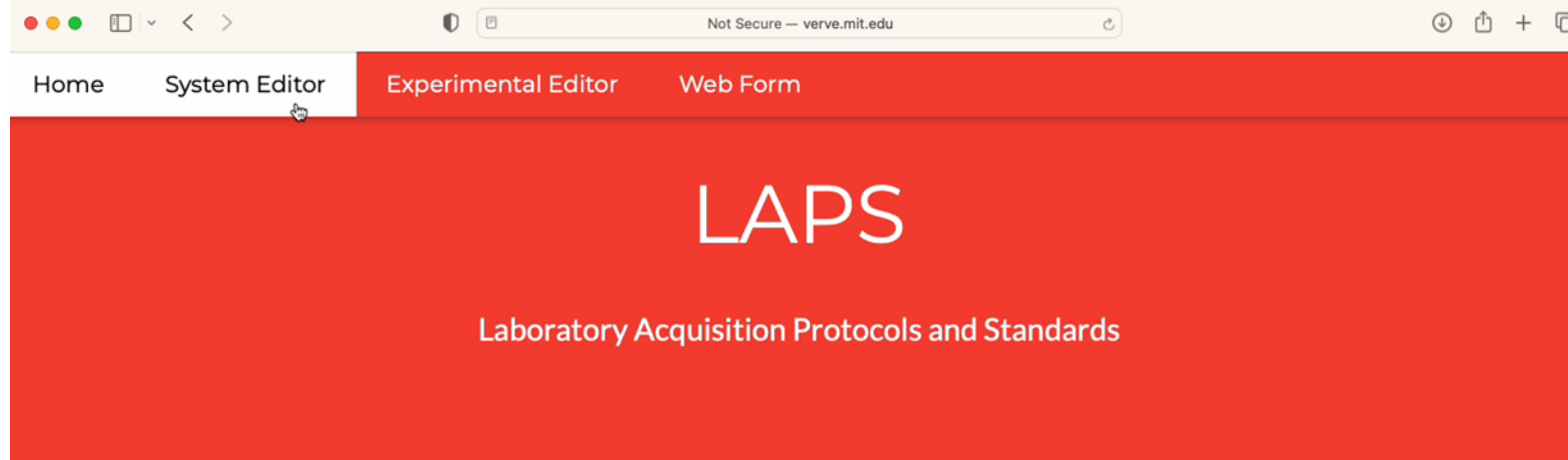


# LAPS\* - Workflow Details

\*Laboratory Acquisition & Protocol Standards



# LAPS - Demo I: General Input Form



## Introduction

The LAPS project intends to establish a simple, yet effective way to describe equipment and experiments across a variety of testing rigs and devices. Its purpose is to facilitate interlaboratory communication and standards in experimental Geophysics. In addition, the objective of LAPS is to prepare experimental data to be stored in the [STRABO](#) digital data repository.

**Current Status of Work:** Using conventions from the STRABO vocabulary and lab specific requirements we outline which information is necessary in a 'system profile': a snapshot of features, hardware and data format that follows a given structure and a set of attributes. To maintain data integrity, profiles should be validated against a 'schema' and saved as json text files.

At this point the schema is still in an experimental stage. Also, there is currently no 'back-end' database where profile information is stored. It remains as json file only. Furthermore, technology issues on how data is being accessed (either using REST-API or GraphQL or otherwise) is being deferred to a later point. Ultimate goal is to establish a schema that is acceptable for the community and to possibly integrate it into Strabo or compatible system.



### NEWS

5/2020: LAPS receives NSF funding - Award# (FAIN): 1948453

7/2020: Experimental Deformation Data Workshop at Digital EGU Meeting

12/2020: [LAPS presentation at AGU 2020](#)

04/2021: EGU Townhall Presentation: Introduction to StraboExperimental

12/2021: AGU Townhall Presentation: Progress in StraboExperimental Development

10/2022: [MIT EAPS Presentation: Progress in StraboExperimental Development](#)

10/2022: AGU 2022: TH531 - Cyberinfrastructure Tools for Microscopy and Experimental Rock Deformation Data



# LAPS - Demo II: Loading Templates



Not Secure — verve.mit.edu

Home System Editor Experimental Editor **Web Form**

## LAPS Editor

Introduction System Sample Experiment Data All

Categories

System Sample Experiment **Data**

### Data Form

- Image Data
- Time Series Data
- Measured Parameters

### Reference Keys

References for User, Equipment, Sample and Experiment

User ID	Experiment ID	Sample ID	Machine ID
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**Datasets**

Parameters, Analytical Data, Microstructures, Time Series Data

Load External Schema:

no file selected



# LAPS - Demo III: JupyterLab/Python Tools



The screenshot displays the Anaconda Navigator application interface. At the top, a file browser window shows the directory structure for 'ExampleData'. Below it, the Anaconda Navigator main window is visible, showing a sidebar with navigation options like 'Home', 'Environments', 'Learning', and 'Community'. The main area displays a grid of application tiles for various tools:

- DataSpell**: An IDE for exploratory data analysis and prototyping machine learning models.
- JupyterLab 3.4.4**: An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.
- Jupyter Notebook 6.4.12**: Web-based, interactive computing notebook environment.
- Qt Console 5.3.2**: PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.
- Spyder 5.3.3**: Scientific Python Development Environment. Powerful Python IDE with
- VS Code 1.69.0**: Streamlined code editor with support for development operations like debugging.
- Datalore**: Kick-start your data science projects in seconds in a pre-configured environment.
- Deepnote**: Deepnote is a notebook built for collaboration. Create notebooks in your

At the bottom right of the Anaconda Navigator window, there is a 'Launch' button.





## Complementary to Strabo Experimental

- Local Solution Only
- Single Test Repository (File/hdf5 based)
- Use Community Metadata Standards
- Browser Based Entry Forms
- Software + User Readable File Format (json)
- Open Source
- Reusable Templates
- Integration into existing Laboratory Workflows
- Multiple Datasets per Test
- Ready for Use 2023

# Comparison - Table



	STRABOEXPERIMENTAL	LAPS
Digital Repository	✓	✓ (single Test only)
Access/User Management	✓ (online)	✗ (offline)
Community Standards	✓	✓
Structured Data	✓	✓ (json+hdf5)
Open Source	○	✓
Data Entry Forms	✓	✓
Database	✓	✗
External Data References	✓	✓
Strabo Integration	✓	✗
API	✓	✓
Open Science Ready	✗	✗
Availability	2024	2023





**Questions? Comments?**

**StraboExperimental & LAPS**

