Changes In Field Mapping In The Last Five Years From The Perspective Of The Mapper

John Tudek, J. Wayne Perkins, Derek L. Spurgeon
West Virginia Geological and Economic Survey

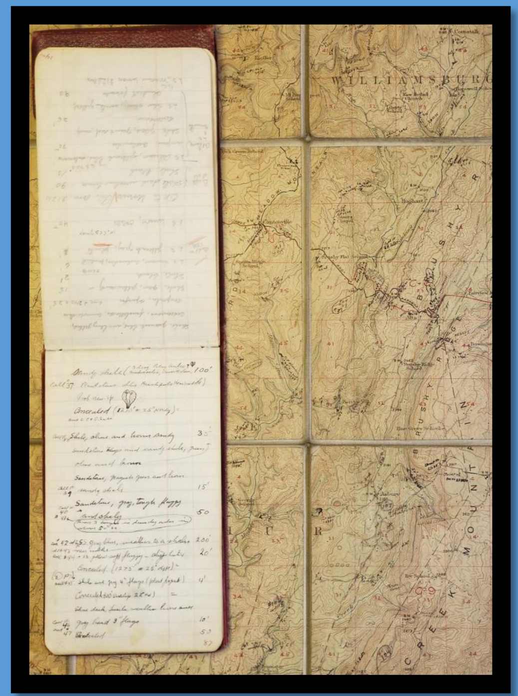
Abstract

Geologic mapping, field-data collection, and map construction at the West Virginia Geological and Economic Survey is continuously undergoing tremendous changes. Starting with paper notebooks and PDAs for collecting vector data, mapping at the Survey has transitioned to cell phones and tablets as the primary method to collect and evaluate data in the field. Over the same period, advances in consumer technology, revolutions in digital data (LIDAR), changes in map requirements and the inclusion of new criteria to accommodate seamless mapping in support of the U.S. Geoframework Initiative have all changed the way data are integrated into a map. These changes have been the driving force behind the iterative advances in our workflow. The most substantial changes have been in the automated collection of data through commercial software such as ESRI Field Maps(™), digital basemaps in the field, and the digitization of supplemental note-taking through the use of tablets. Field Maps allows for the real-time collection and evaluation of data and reduces in-office paperwork. Digital note-taking through tablets with stylii and note-taking apps create a permanent digital repository of notes and annotated photos stored as .pdfs. This presentation will discuss the evolution of WVGES collecting practices and comment on what the future holds for the agency. It will focus on the tools we have selected, their advantages and our continuing search for the next generation of tools. It will also touch on the "growing pains" associated with using new technology - both hardware and software - out in the field and the changes we have had to make in office to accommodate each new iteration. This process is summarized by a perpetual technology innovation cycle of idea - testing - deployment driven by need and technological change. This loop is perhaps more familiar to the software developer than the traditional geologist - another sign of the growing interrelationships between geology and other fields of science and engineering.

A brief look of how the collection of field data has evolved at WVGES

Fieldwork back in "the olden days"

- Paper notebooks
- Paper maps and colored pencils
- Brunton compass
- Location pinpointed from map
- Hand drawn geological draft maps
- Hand drawn outcrops
- Print photos and slides stored in filing cabinets
- Topo maps based off older aerial photos



Historic field notes and maps remain valid. However, challenges exist in associating them with modern projects including:

- Sites inexactly located compared to GPS precision
- Notes may refer to landmarks that no longer exist

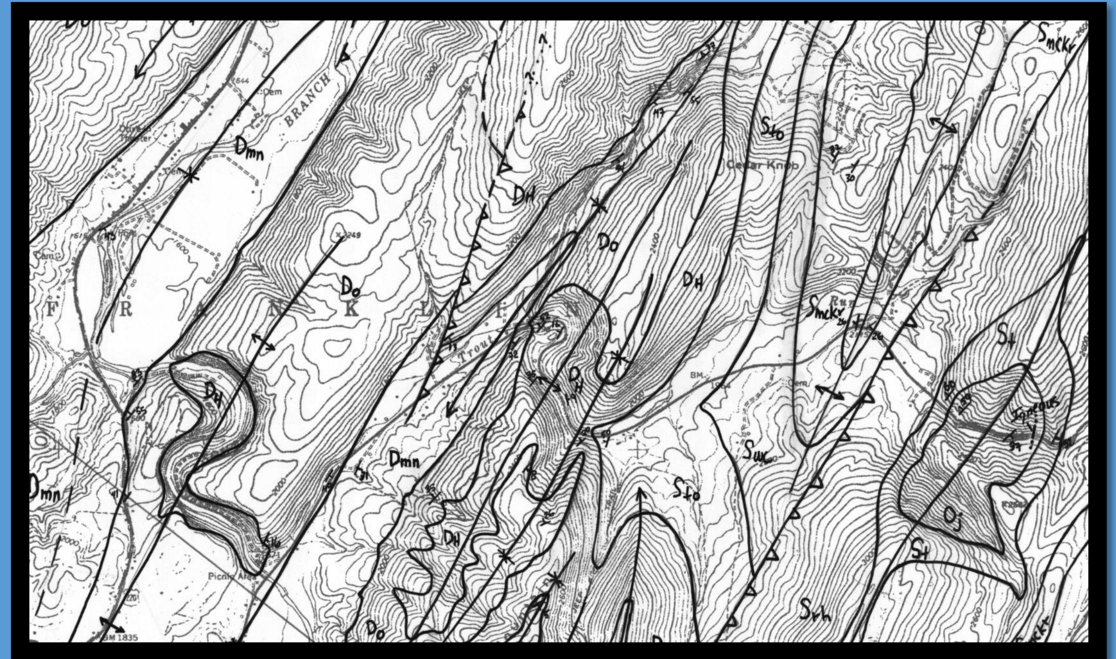
If historic notes can be georeferenced, the site may not be revisitable due to:

- Urbanization
- Erosion / overgrowth
- Landscape beautification

Oftentimes, these historical data remain the only record of bedrock exposure.

Fieldwork several years ago

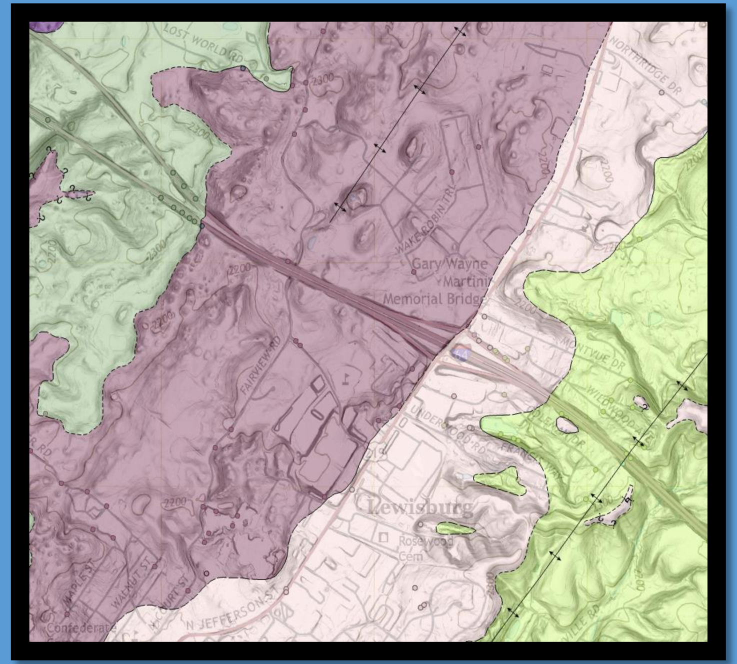
- GPS coordinates – UTM coordinates
- Waterproof field notebooks
- Using ArcGIS to draw lines
- Digital photos stored on a computer
- Photo size 5-10 MB
- Field locations digitally added to ArcGIS in the office, usually without field notes
- Introduction of PDAs / Tablets
- Topo maps revised extensively since 2000



A portion of the draft map of The Franklin Quad around 2010. This is a scan of a physical map with hand-drawn lines. These lines would eventually be digitized and entered into a GIS program for publication as a paper map.

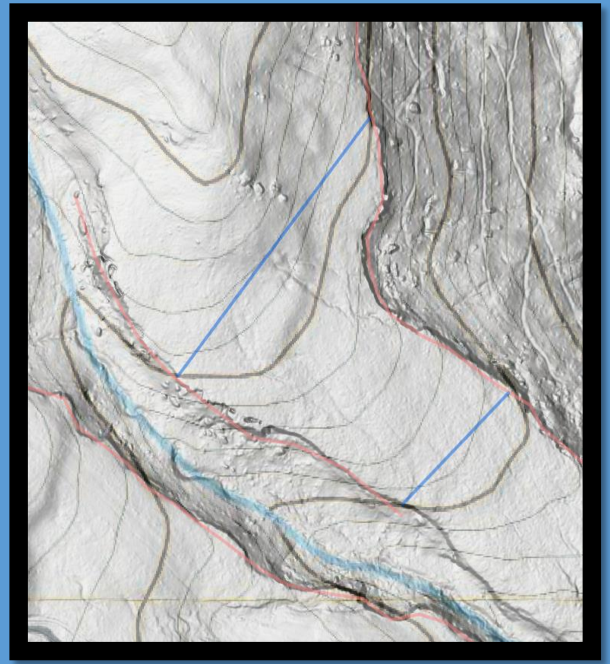
Fieldwork today

- Location collected by tablet and added to online database / Field Maps app
- Geolocated field notes
- Digital supplemental notes saved as .pdfs *(Inkredible app)*
- Digital photos integrated into database or supplementary notes
- Photos directly annotated
- Photos >10MB
- LIDAR-based mapping
- Pre-fieldwork office time necessary to set up software each year
- Stylli based tablets

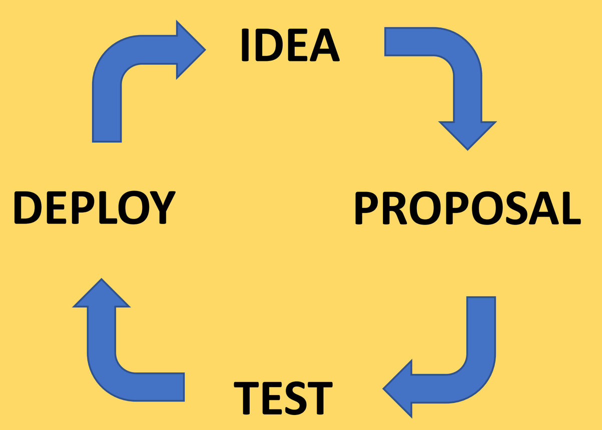


Left: A portion of the Lewisburg Quadrangle, 2022, showing numerous sinkholes obvious through LIDAR but underrepresented on topographical maps

Right: A portion of the Bruceton Mills Quadrangle, 2023, showing long sandstone cliffs. These cliffs occur on remote, private lands with difficult access.

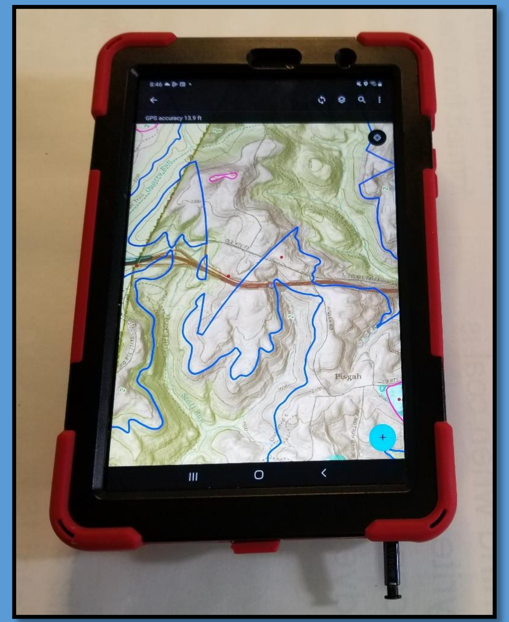


Fieldwork Advances are Iterative



IDEA: A new method is suggested due to internal or external influences (ex. GeMS – Geologic Map Schema).
PROPOSAL: One or more ways to implement the new method are suggested.
TEST: The method is tested on a small scale. The method could be a success, require revision or be discarded in favor of a new method.
DEPLOY: Once successful, the new method is exposed to the entire mapping team. This, in turn, frequently suggests another idea.

Current field mapping device – Samsung Galaxy A with S-Pen



Specifications

- Model Number: SM-P200
- Screen Size: 8.0"
- Internal Memory: 32 GB
- External SD card slot: available (max 512 GB)
- Android version 11
- Software:
  - Field Maps
  - Inkredible Pro
  - GPS Status
  - Adobe Reader

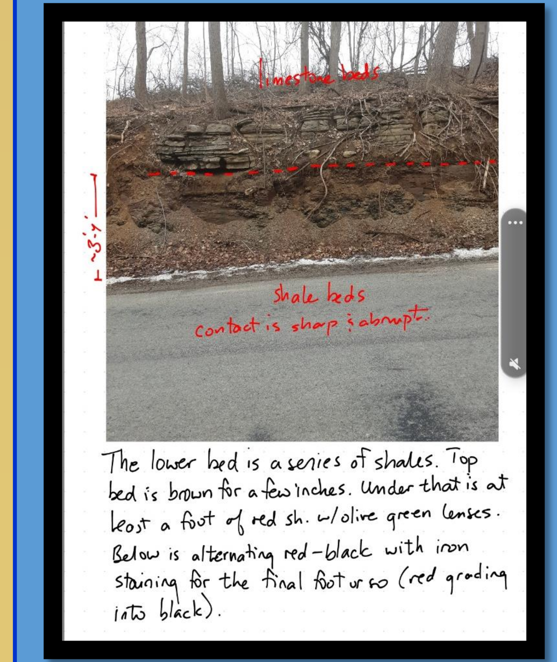
How is working with a tablet different than a field notebook or PDA?

Benefits	Challenges
Can see the map evolve in real time overlain on LIDAR	Software (ESRI) bugs and improvements can break functionality
Handwriting easier than typing on a screen	Tablet OS upgrades can break functionality
Voice to text (when not next to highway)	Employees need to be trained and updated on software
Can annotate photos directly	Network unavailability in remote areas
Integrate nearby mappers' data	Dependent on battery life

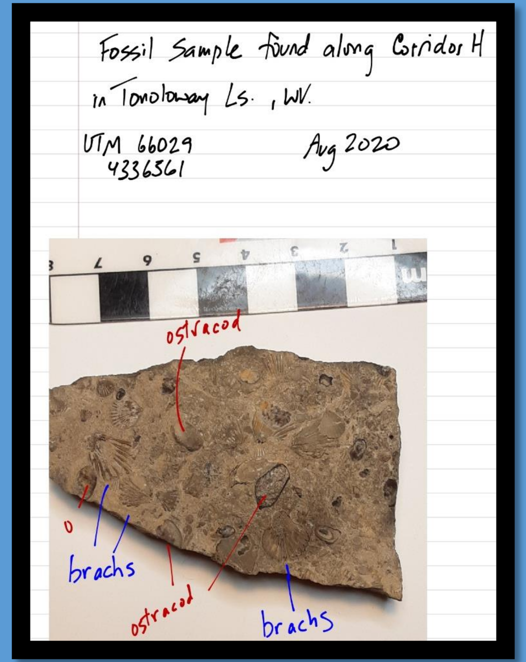
This project was partially funded through the award of STATEMAP project G22AC00605-00. STATEMAP is part of the National Cooperative Geologic Mapping Program of the United States Geological Survey.

Advantages of the stylus-based tablet

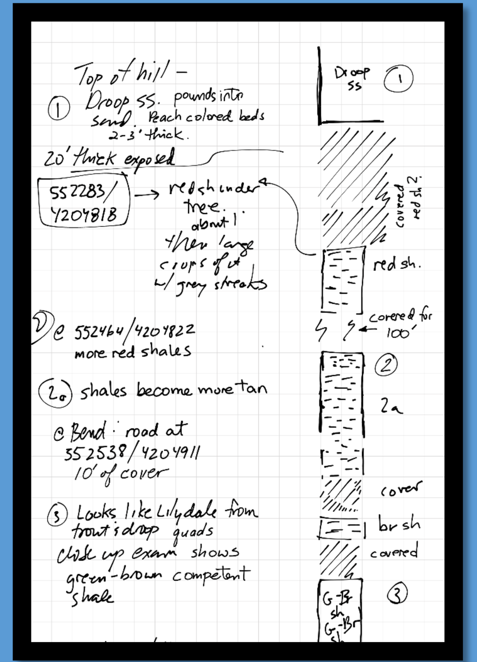
Mappers at the Survey have the option of using a stylus-based tablet (Samsung Galaxy Tab A) for mapping. When used in conjunction with a note taking app like Inkredible Pro, the tablet holds certain advantages over a paper-and-pen field notebook as well as simply entering data into a tablet form.



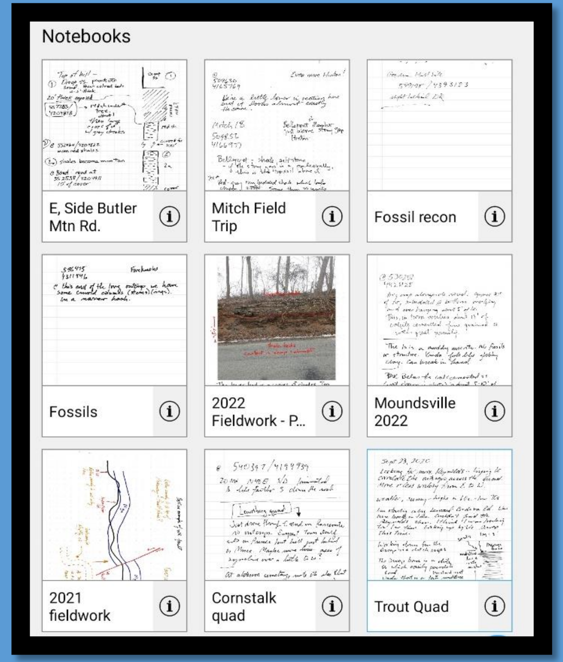
Annotating photos with geologic data is faster and more accurate than sketching.



Annotating photos of fossils found in the field is more meaningful and does not require drawing skills.

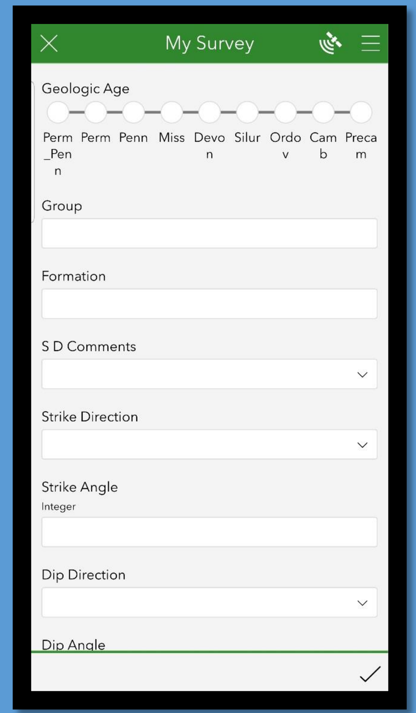


Customizing each page's background allows the user to tailor each page to the data



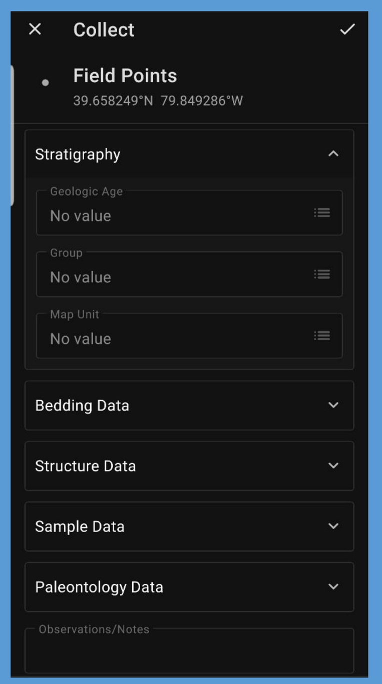
Whole field seasons are saved as a .pdf and kept with other data from that project.

Improving and iterating on the Forms for use in ESRI Field Maps

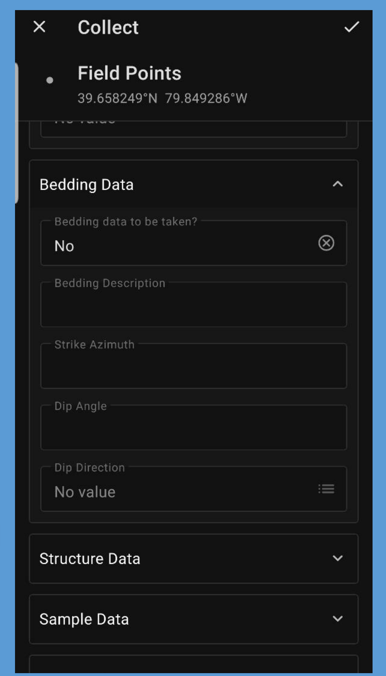


With the GeMS requirement in our mapping deliverables, it was necessary to redesign our data collection process. Over the course of several months, we redesigned both the interface and back-end, incorporating lessons from previous iterations. Among the changes are:

- Expanded ways to input data. Text can now be typed, handwritten, or spoken.
- Text fields were made longer to incorporate more description.
- Redesigned layout to prioritize most important fields.
- Added nested layers.
- Sections categorized by keys for improved manipulation.



Left: The main screen of the new form, as seen on a cellphone. The cellphone is preferred as the collection device because it is more portable, utilizes cell signal to upload data in the field and takes better photos.



Right: the expanded bedding data menu, showing all the subentries.

Current Record Layout

The top portion contains the basic information about the geologic unit at the data point as well as the user and timestamp.

The center portion contains descriptive data, divided into sections (blue box). Each section contains a key (circled) marking that it contains data. If necessary, additional subdivisions can be appended to the record.

The bottom portion contains several fields not visible in the user interface for Field Maps (yellow box). These fields show geographic accuracy and hardware information.