

Technology in the Geoscience Classroom

(writ large: Classroom, Lab, and Field)

Steve Whitmeyer *(James Madison University)*

...with input and help from Declan De Paor, Mladen Dordevic,
Callan Bentley, Chris Atchison, and many others!



Google earth

Data: NOAA, US Navy, NSA, USGS
Image: Landsat
Image: U.S. Geological Survey
Image: PGC/NASA



JAMES
MADISON
UNIVERSITY



Technology in the Geoscience Classroom

Things to ponder:

1. Technology developers assume that their creations enhance student learning
2. Educators want evidence that the technology is improving student learning
3. Students' have their own expectations
4. The broader reach of technology-facilitated education

Technology in the Geoscience Classroom



Levels of technology in education:

1. Passive observation – “eye candy”
2. Student-driven investigation facilitated by technology
3. Real-time “instantaneous” feedback integrated with student-driven investigation

...with examples from the classroom, lab, and field

Technology in the Geoscience Classroom

Built with MaRGEE tool:
<http://geode.net/margee/>
(Dordevic & Whitmeyer, 2015)



*Tectonic model
Rifting of Gondwa*



Technology in the Geoscience Classroom

GEODE Google Earth for Onsite and Distance Education

JAMES MADISON UNIVERSITY

Pangaea Breakup

Dark

0 Ma

12/ 0
151 BCE

Controls

- Toggle Blue Background Visibility
- Toggle Grid Visibility
- Toggle Present-day Plate Boundaries

Continents

Select the continents that you want to view:

- Africa
- Antarctica
- Australia
- Europe
- India
- North America
- South America

Other Features

Select other features that you want to view:


- Virginia
- Hot Spot Volcanos
- Mountain Belts
- APW paths

Animations

Use time slider control at upper left of main window, or chose an animation to run:

- North Atlantic
- Equatorial Atlantic
- Indian Ocean
- Southern Ocean
- Centered on Africa
- Centered on Eastern North America
- Centered on India

References



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Image IGBAO
Image U.S. Geological Survey

The classic Atlantic mountain belts correlation question...



Pangaea breakup: GEODE.net/Pangaea

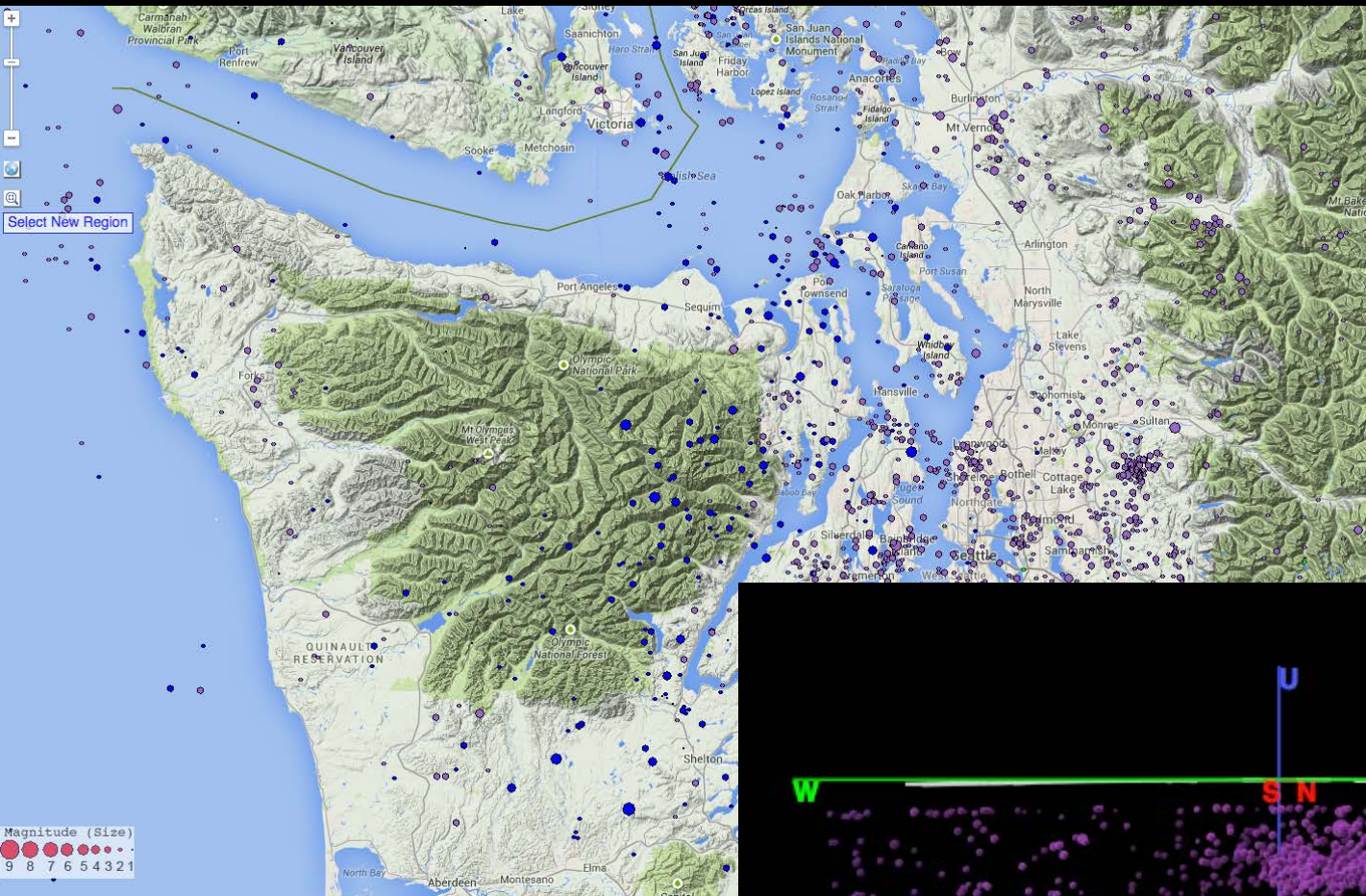
Technology in the Geoscience Classroom



<http://csmres.jmu.edu/Geollab/Whitmeyer/web/visuals/GoogleEarth/VAquakes.mov>

Fault plane model from 2011 Virginia Earthquake aftershock data

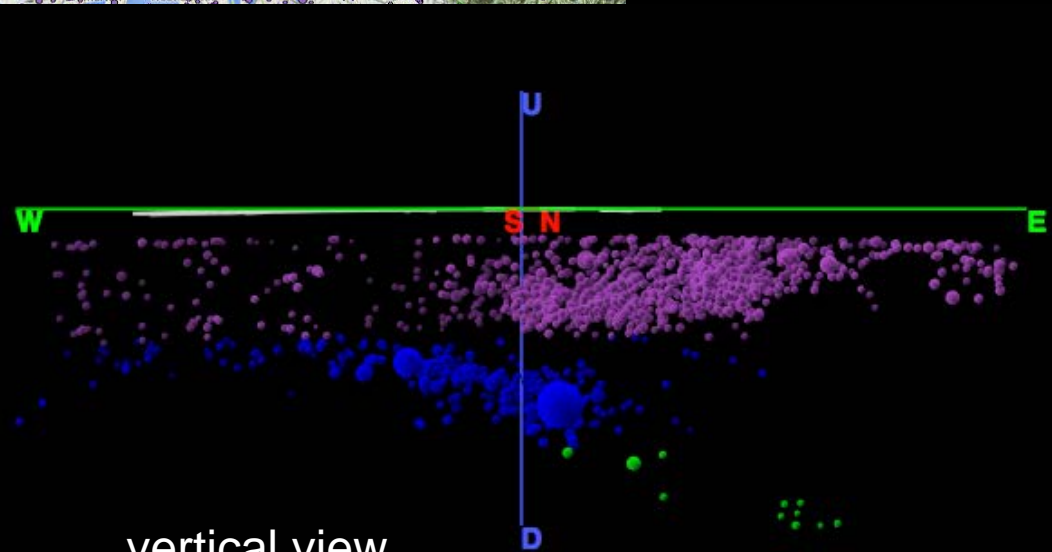
Technology in the Geoscience Classroom



*Inquiry-driven
models*


IRIS Earthquake Browser

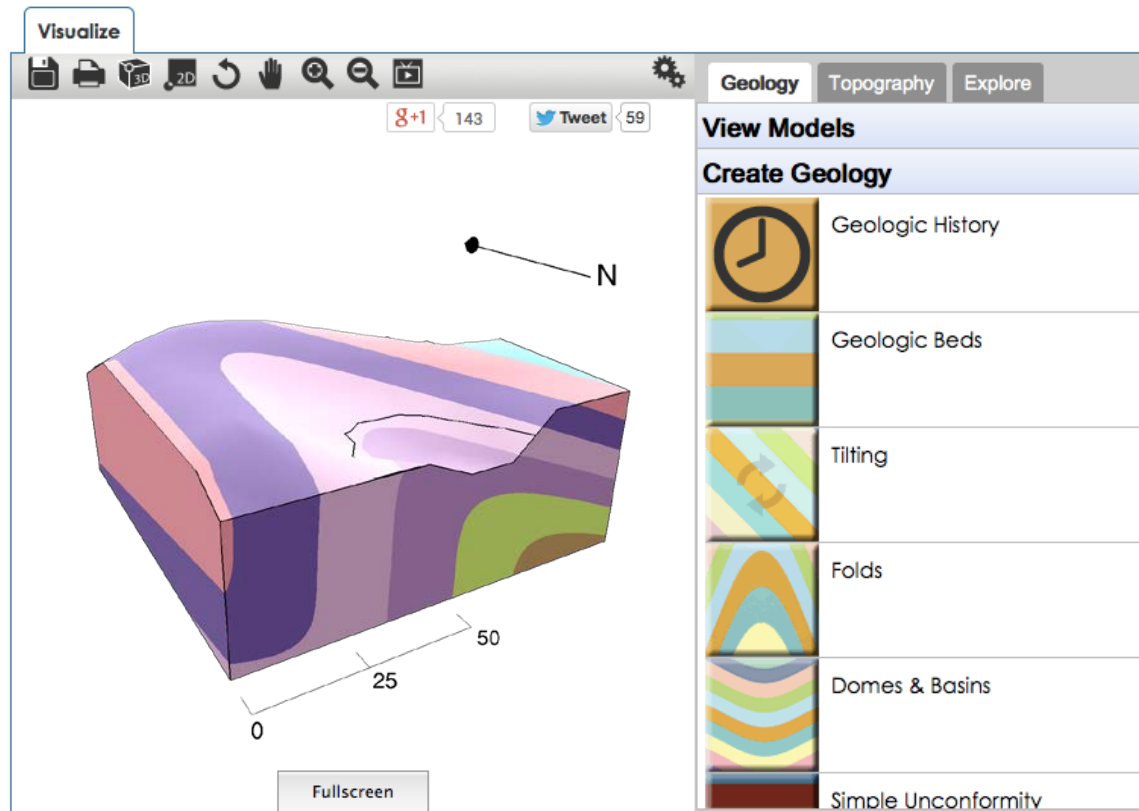
<http://www.iris.edu/ieb>



vertical view

Technology in the Geoscience Classroom

 Visible Geology ^{BETA}



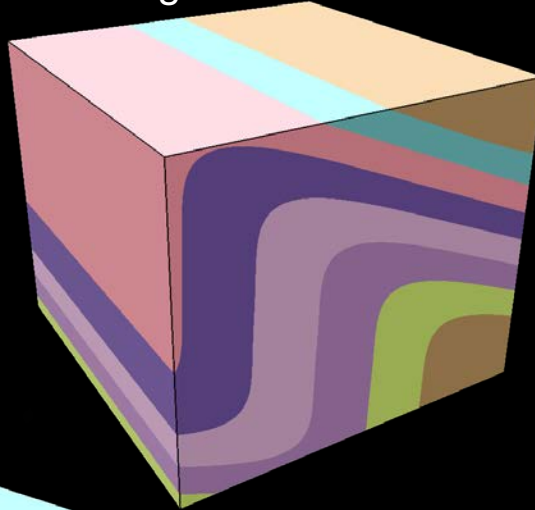
<http://app.visiblegeology.com/>

Inquiry-based, student-driven exploration of 3D models

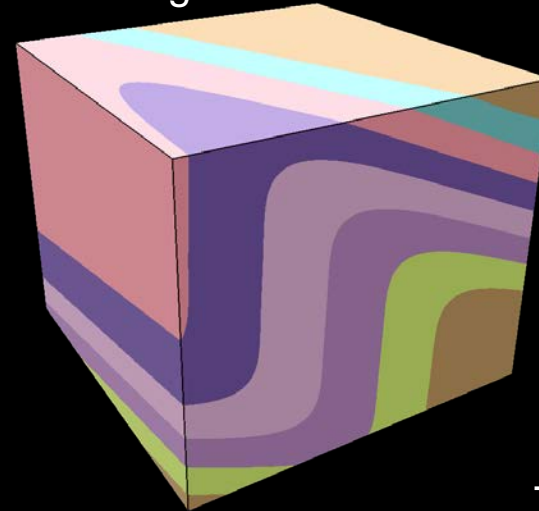
Technology in the Geoscience Classroom

<http://app.visiblegeology.com/>

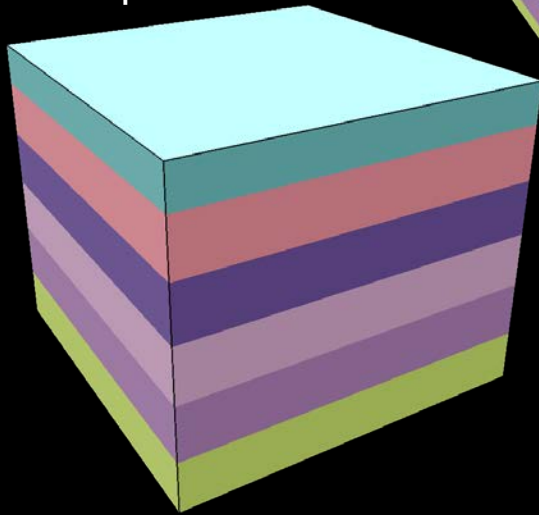
T2. Folding



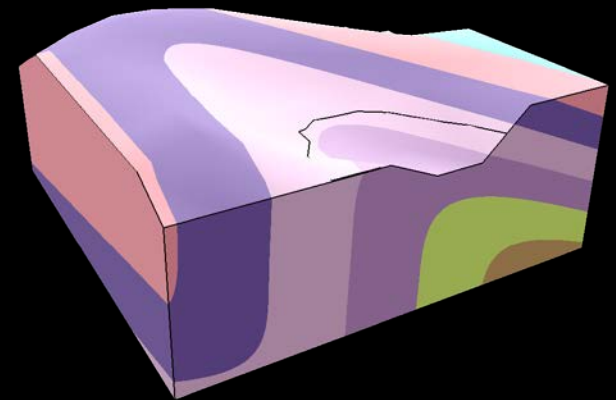
T3. Tilting



T1. Deposition



T4. Erosion

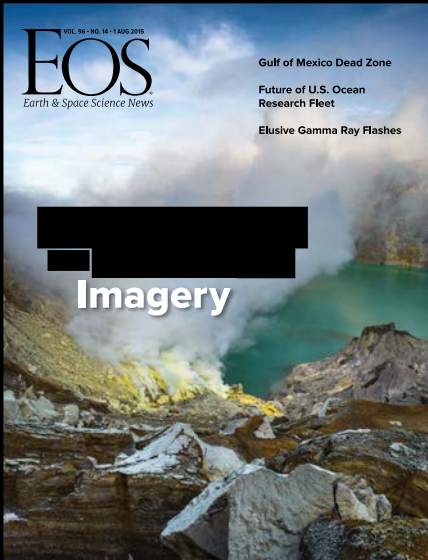


Describe...

Evaluate!

Inquiry-based, student-driven exploration of 3D models

Technology in the Geoscience Classroom



Eos: August 2015

EarthQuiz

<http://earthquiz.net>



Feedback Home | Play | Add | Browse | Diagnostic | Help | About us Declan Submit

Score: 0 Question: 1/1

Part I

These mountains which join two very large bodies of inland water, separate almost all of Russia from the Middle East

- The Urals
- The Zagros Mountains
- The Caucasus Mountains

Part II

Now guess the location of the feature by clicking on the map below or dragging the placemark

Options

Question courtesy of: Declan De Paor

© Anton Lavrov Terms of Use Report a problem

Exercises with real-time feedback

Technology in the Geoscience Classroom

The screenshot displays the EarthQuiz web application interface. At the top, navigation links include 'Feedback', 'Home', 'Play', 'Add', 'Browse', 'Diagnostic', 'Help', 'About us', and 'Declan'. A secondary navigation bar contains 'Show Question View', 'Map', and 'Satellite'. The main content area is split into three sections:

- Question Panel:** Shows 'Score: 0' and 'Question: 1/1'. Part I asks for mountains separating Russia from the Middle East, with options: 'The Urals', 'The Zagros Mountains', and 'The Caucasus Mountains'. Part II asks for the location on a map, with a 'Submit' button and options for 'Remove a wrong answer', 'Location hint', and 'Refresh'.
- Map:** A satellite view of the Caucasus region with a red line and a green pin indicating the target location. A smaller inset map shows the broader region with a green pin.
- Feedback Panel:** A blue box titled 'Good Work!' showing 'Question: 1/1', 'Part I score: 75.0/75', 'Part II score: 24.9/25', and a 'TOTAL SCORE' of '99.9/100 points!'. A green 'Finish!' button is at the bottom.

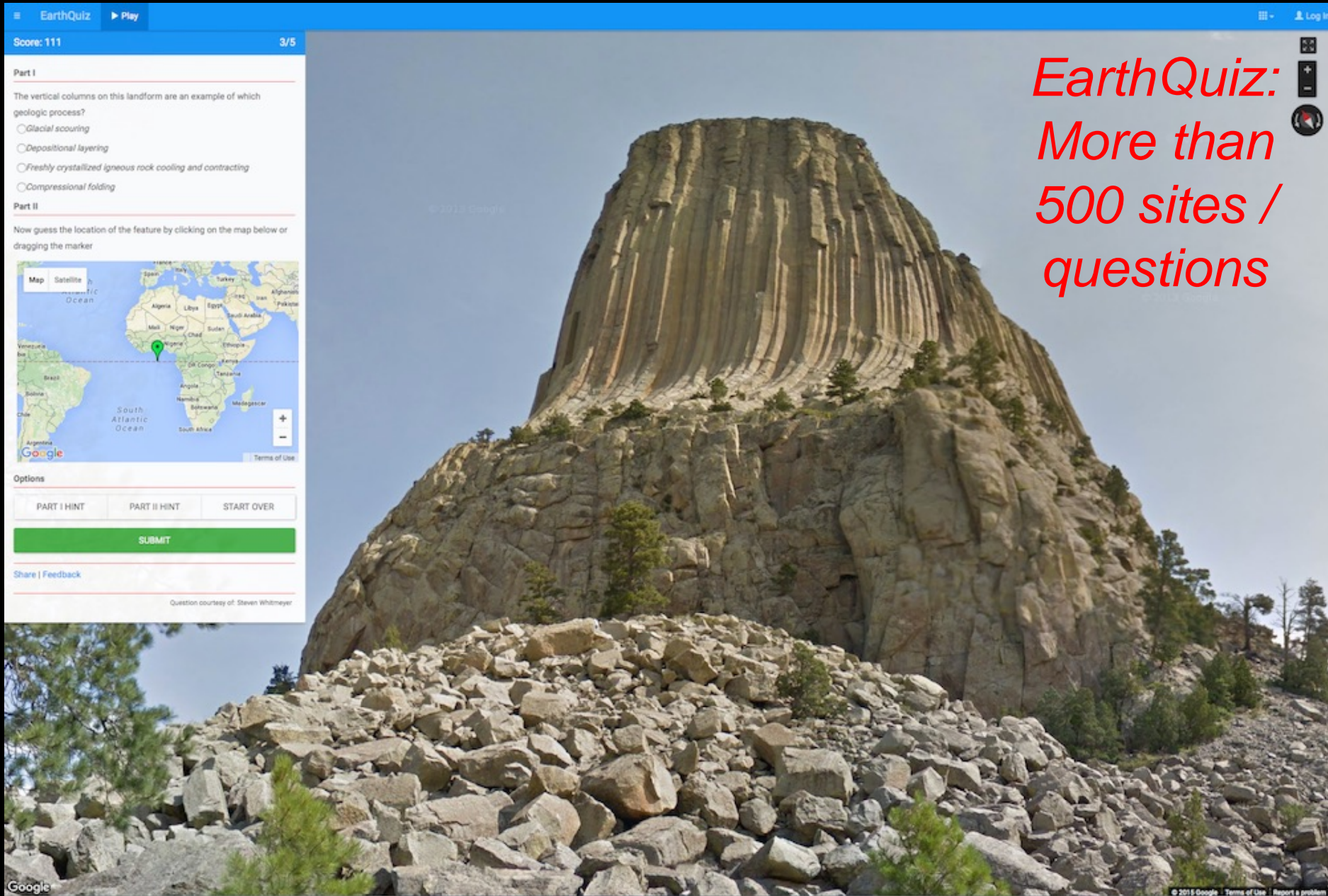
At the bottom of the map, there are links for 'Imagery ©2014 TerraMetrics', 'Terms of Use', and 'Report a map error'.

EarthQuiz



Exercises with real-time feedback

Technology in the Geoscience Classroom



The screenshot displays the EarthQuiz interface. At the top, it shows 'EarthQuiz' and 'Play' buttons. The user's score is 111 out of 3/5. The question asks: 'The vertical columns on this landform are an example of which geologic process?' with four options: 'Glacial scouring', 'Depositional layering', 'Freshly crystallized igneous rock cooling and contracting', and 'Compressional folding'. Below the question is a map of Africa with a green marker indicating the location of the landform. The interface includes 'PART I HINT', 'PART II HINT', 'START OVER', and a green 'SUBMIT' button. A 'Share | Feedback' link is also present. The question is credited to Steven Whitmeyer.

Score: 111 3/5


Part I

The vertical columns on this landform are an example of which geologic process?

- Glacial scouring
- Depositional layering
- Freshly crystallized igneous rock cooling and contracting
- Compressional folding

Part II

Now guess the location of the feature by clicking on the map below or dragging the marker



Options

PART I HINT PART II HINT START OVER

SUBMIT

Share | Feedback

Question courtesy of Steven Whitmeyer

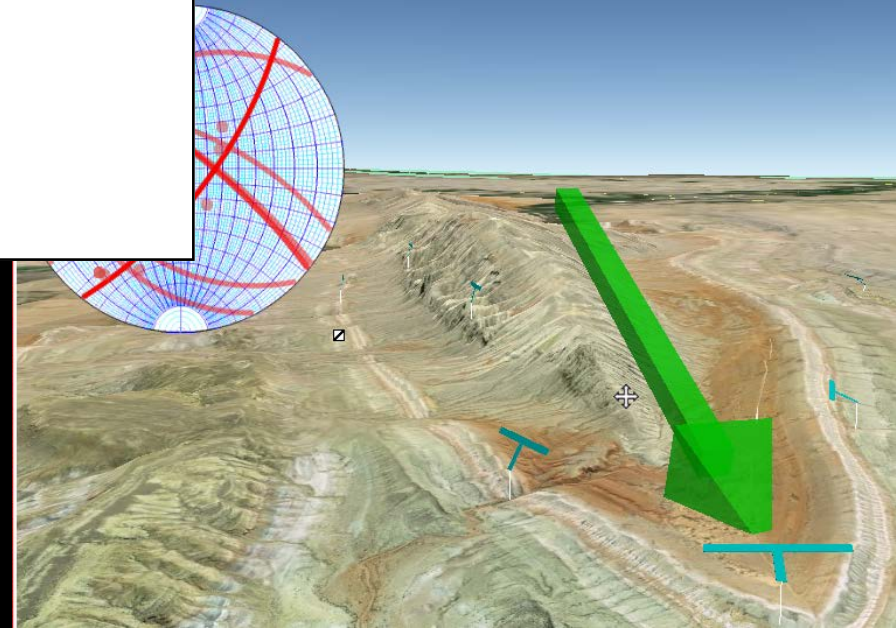
© 2015 Google

*EarthQuiz:
More than
500 sites /
questions*

Fold Analysis Challenge



www.geode.net/fac



Sheep Mountain Anticline

*Google Earth Plug-in or
Stand-alone GE application*

Technology in the Geoscience Classroom

Things to ponder:

1. Technology developers assume that their creations enhance student learning
2. Educators want evidence that the technology is improving student learning
3. Students' have their own expectations

Students expect technology-facilitated, inquiry-based learning.

Instructors need to assess its effectiveness.

Technology in the Field



Paper?

or
Digital?

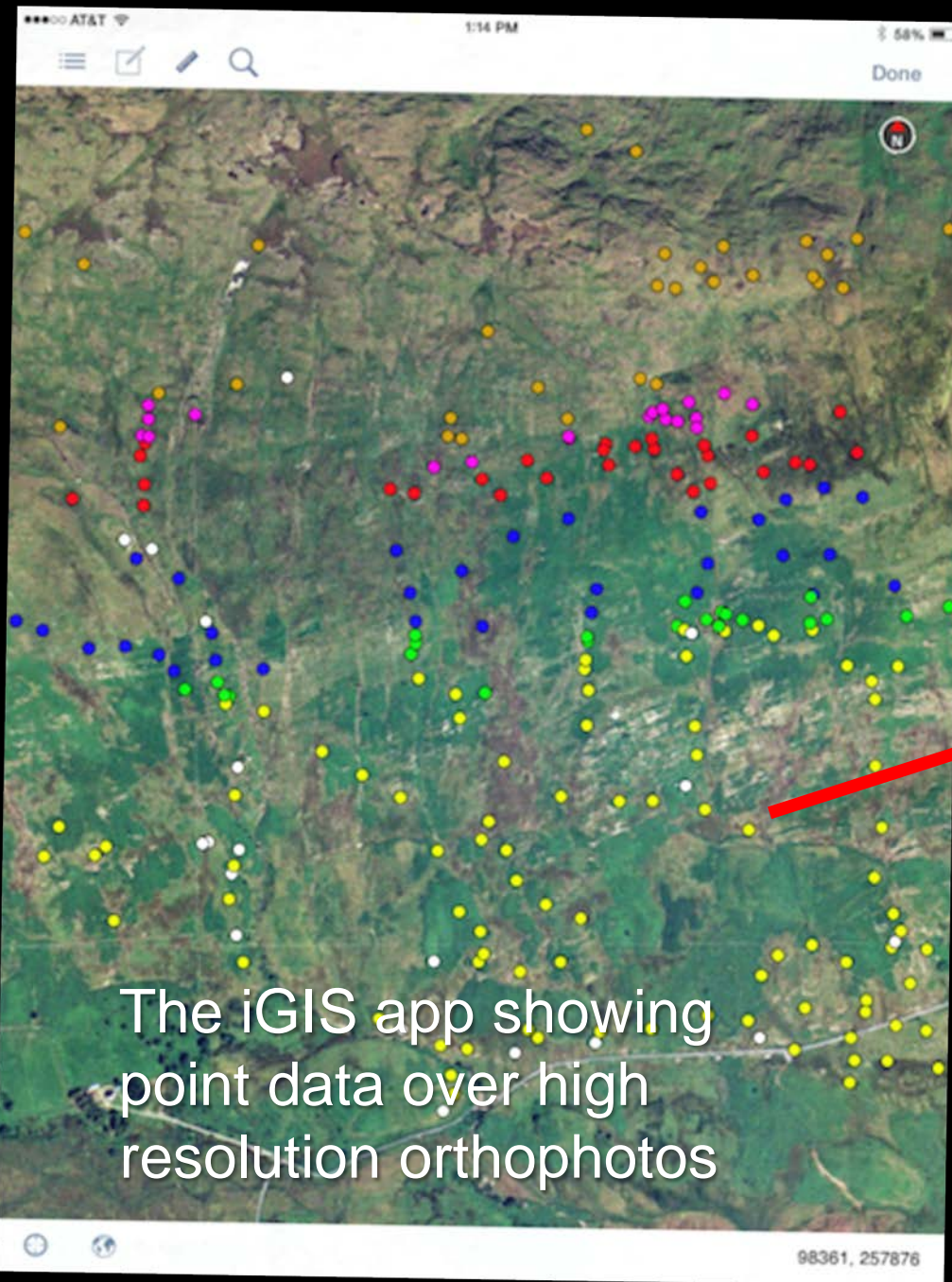
Technology in the Field

Digital mapping
& data collection
in the field

*Mapping geology
with an iPad, iGIS,
and ArcGIS*



Field Data



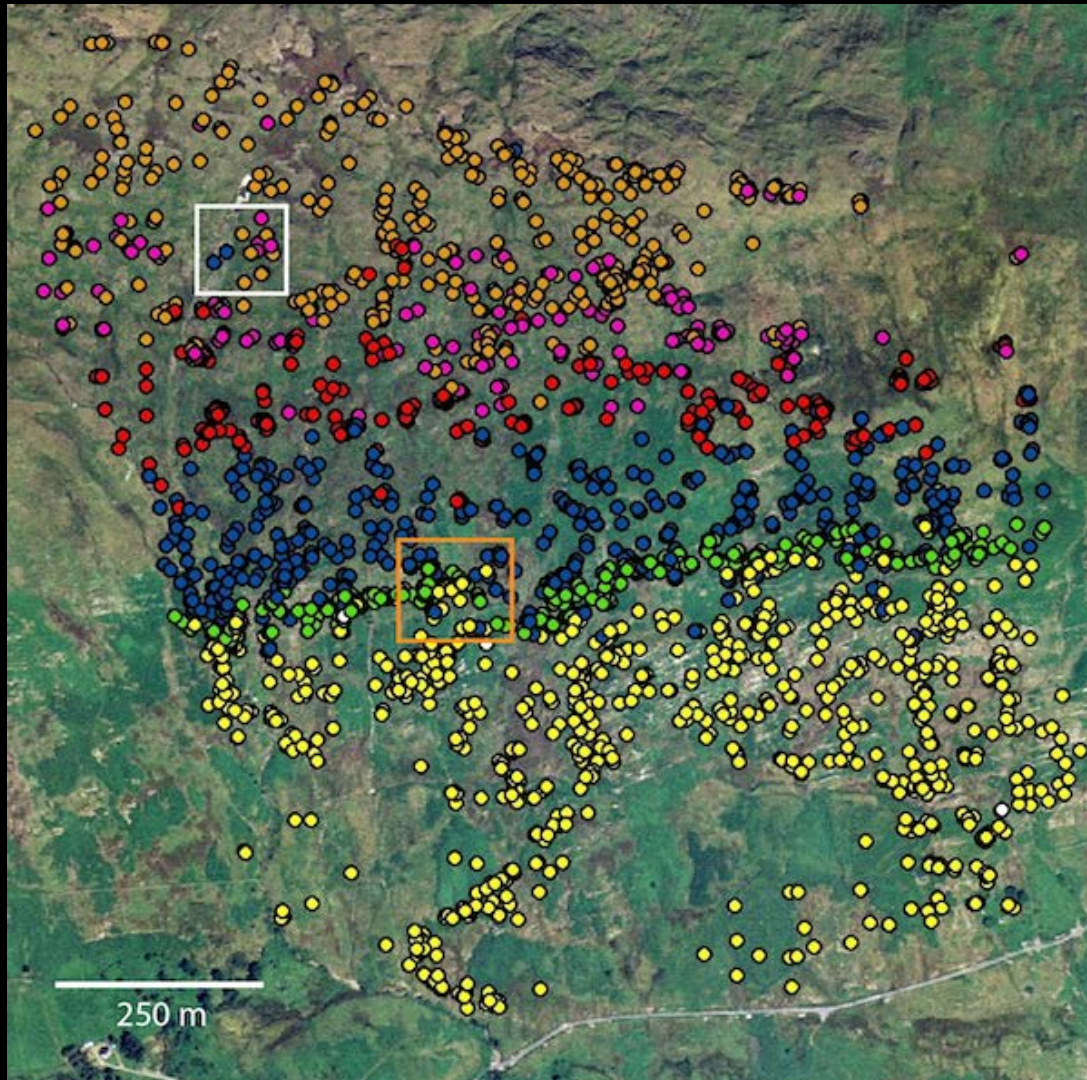
The iGIS app showing point data over high resolution orthophotos

The screenshot shows a data table overlay on the map. The table has a dark background with white text. The title is 'Features' with 'Lg' and an 'Edit' button. The table contains the following data:

Features	
STUDENT	
STRIKE	66
DIP	82
DIPDIR	S
UNIT	Lg
NOTES	Red shale

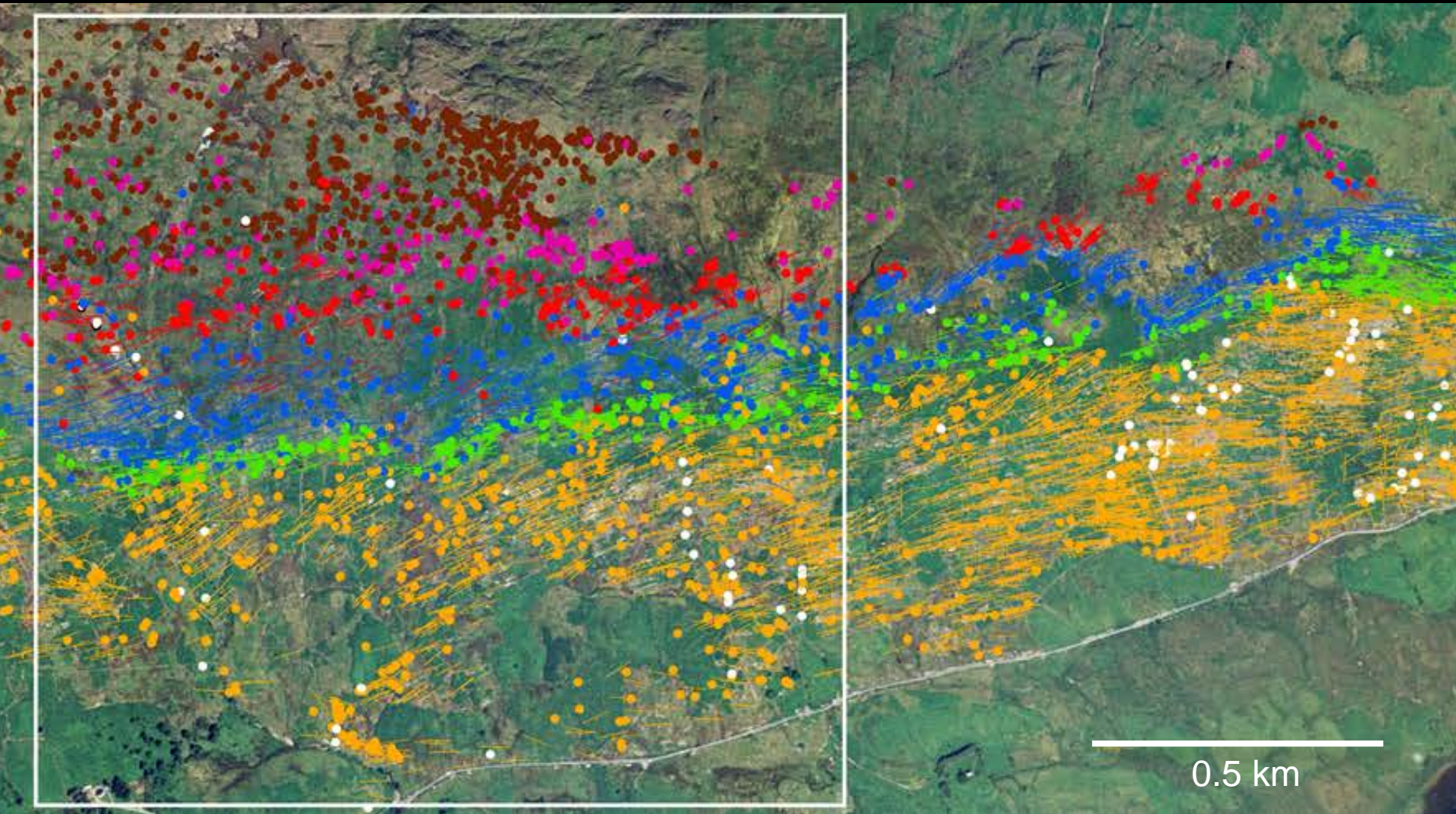
Simple GIS shapefile data table for outcrop data collection in iGIS

Crowdsourcing Field Data Collection



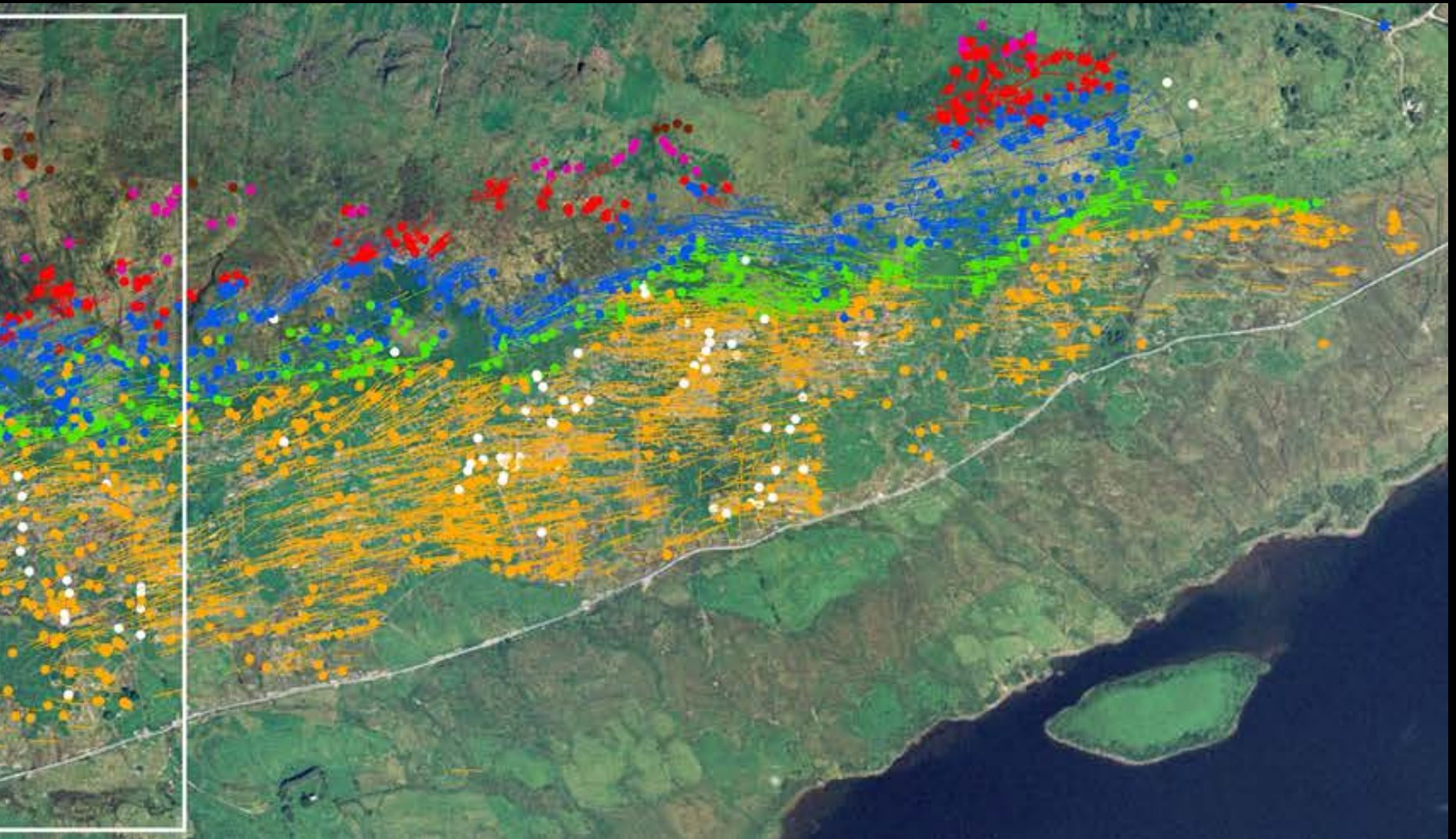
Outcrop data collected by 14 student teams during 4 day digital mapping project at JMU Ireland Field Course in 2014

Crowdsourcing Field Data Collection



6 years of data from the digital mapping project

Crowdsourcing Field Data Collection



6 years of data from the digital mapping project



	1	2	3	4	5	Mean
<i>My prior experience with ArcGIS was:</i>	<i>Nonexistent</i>	<i>Very little</i>	<i>Moderate</i>	<i>Considerable</i>	<i>Extensive</i>	2.15
<i>My prior feelings specific to this exercise were</i>	<i>Great discomfort</i>	<i>Slightly apprehensive</i>	<i>Neutral</i>	<i>At-ease and comfortable</i>	<i>Highly motivated</i>	2.97
<i>My prior skill level with this exercise was</i>	<i>Completely unskilled</i>	<i>Basic</i>	<i>Competent</i>	<i>Skilled</i>	<i>Expert</i>	2.34
<i>My knowledge gains from this exercise were</i>	<i>Nonexistent</i>	<i>Very little</i>	<i>Moderate</i>	<i>Considerable</i>	<i>Extensive</i>	3.77
<i>My feelings after this exercise were</i>	<i>Great discomfort</i>	<i>Slightly apprehensive</i>	<i>Neutral</i>	<i>At-ease and comfortable</i>	<i>Highly motivated</i>	3.66
<i>I found this exercise to be:</i>	<i>Not valuable at all</i>	<i>Only slightly valuable</i>	<i>Moderately valuable</i>	<i>Useful</i>	<i>Essential</i>	4.18
<i>My skill level after this exercise was</i>	<i>Completely unskilled</i>	<i>Basic</i>	<i>Competent</i>	<i>Skilled</i>	<i>Highly skilled</i>	3.49
<i>My overall learning from this exercise was</i>	<i>Nonexistent</i>	<i>Trivial</i>	<i>Moderate</i>	<i>Considerable</i>	<i>Extensive</i>	3.77

Assessment data for six years of digital mapping exercises; mean of responses, n=167. Significant gains were recorded in Feelings, Skill Level, and Knowledge. Assessment template from Pyle (2009).

(Whitmeyer & De Paor, 2014)

Technology-Enhanced Field Access

Smart glasses can pair wheelchair students with agile students at the outcrop

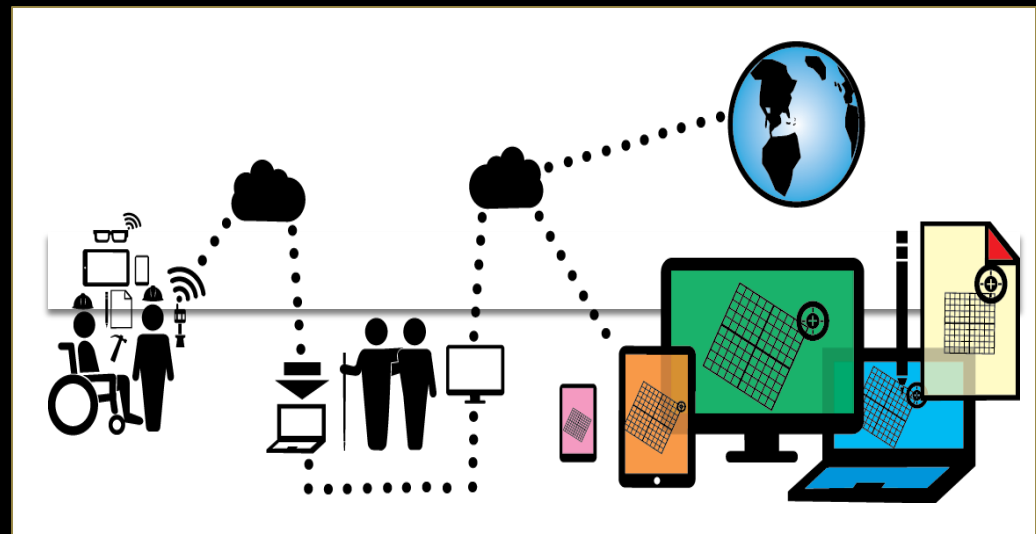
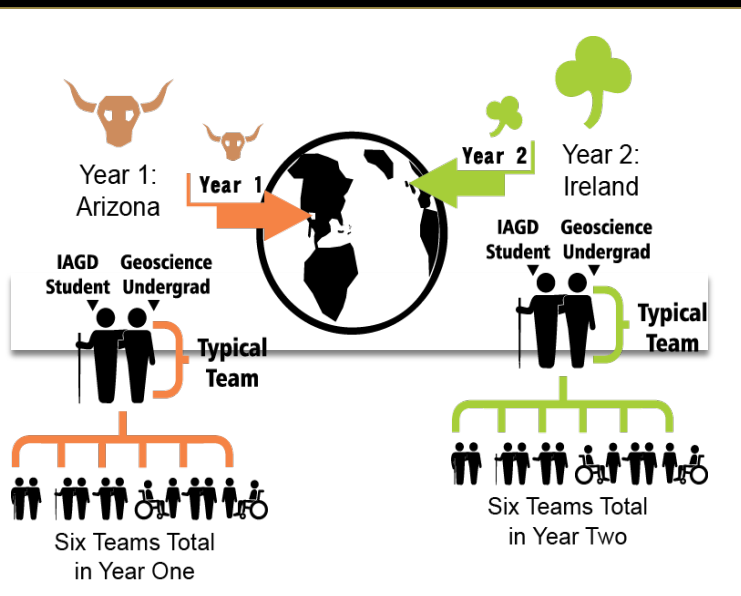


MiKayla Briere

Real-time video conferencing in the field –
Facilitating field access for SWD

Technology-Enhanced Field Access

GEOPATH: Inclusive Field-Based Geoscience Undergraduate Research Opportunities for All



The program will feature a cohort of six teams over two years conducting field research in Arizona and Ireland.

Learn more and apply to participate at:
www.theiagd.org/geopath

