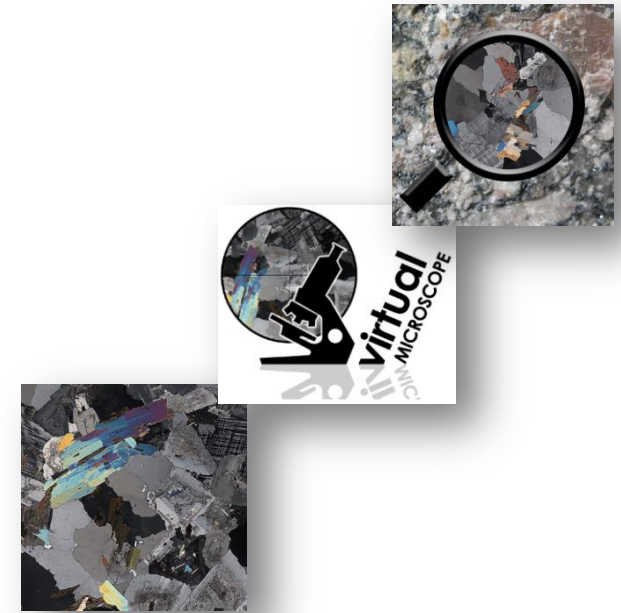


GeoLab:

Shared Digital Learning Resources for Petrology



Dr. Ronan Hennessy
School of Biological, Earth and Environmental Sciences
University College Cork

GeoLab  **The Geoscience e-Laboratory**
Developing Digital Teaching and Learning Resources for the Virtual Microscope
Funded by the National Forum for the Enhancement of Teaching & Learning in Higher Education

 University College Dublin
Ireland's Global University

 The Open
University

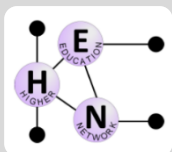
 **UCC**
University College Cork, Ireland

 Trinity College Dublin
The University of Dublin

 **NUI Galway**
University of Galway

 **NATIONAL FORUM**
FOR THE ENHANCEMENT OF TEACHING
& LEARNING IN HIGHER EDUCATION

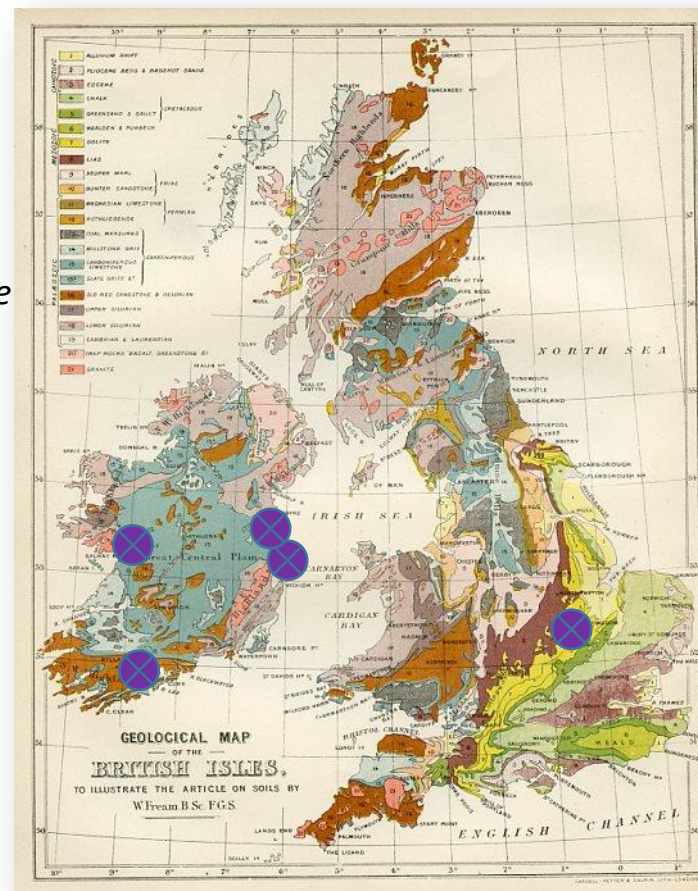
Higher Education Network Annual Meeting
Geological Society of London
Burlington House, London
17th January 2017



The Geoscience e-Laboratory (Ge-LAB): Developing Digital Teaching & Learning Resources for the Virtual Microscope

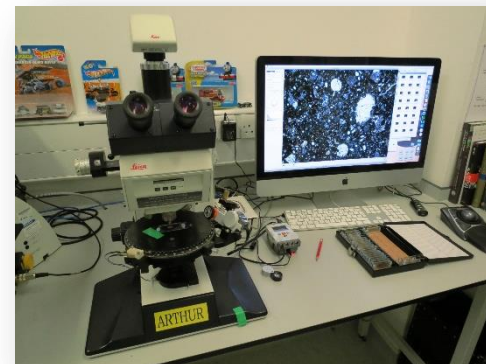
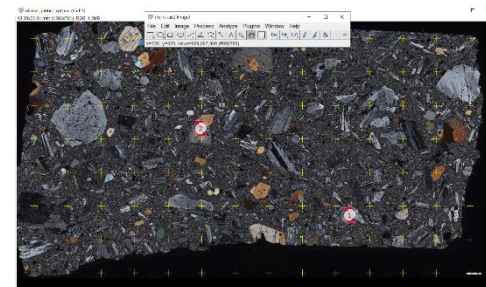
Project Partners:

- University College Cork (Lead)
 - School of Biological, Earth & Environmental Sciences
- National University of Ireland Galway
 - School of Natural Sciences
- University College Dublin
 - School of Earth Sciences
- Trinity College Dublin
 - School of Natural Sciences
- The Open University
 - Department of Environment, Earth & Ecosystems



Geoscience e-Laboratory (Ge-LAB) project designed to:

- deliver **teaching & learning resources** for geoscience programmes in Ireland which have an optical microscopy and petrology component
- introduce novel methods to deliver **technology enhanced learning (TEL)** programmes at the national geoscience centres
- provide students with unlimited **access to high-quality digital rock thin sections** and associated **learning support guides** to foster the development of essential petrological skills



Teaching & Learning Enhancement Fund

- **National Forum for the Enhancement of Teaching and Learning in Higher Education**
- Fund supports building **digital capacity** in higher education in Ireland
- To enhance teaching and learning for all students in higher education
- 2012 Report: ***“Teaching and Learning in Higher Education; A roadmap for enhancement in a digital world 2015-2017 ”***

<http://www.teachingandlearning.ie/>

Teaching & Learning Enhancement Fund

Report Recommendations:

1. Develop consistent & coherent **digital experience** for HE students
2. Engage with students & teachers to **develop their digital skills & knowledge**
3. Strengthen & support **collaboration** within different parts of **HE sector**
4. Develop **shared policies & infrastructure** that reflect emerging digital technologies
5. Develop a strong evidence base for **enhanced pedagogy**

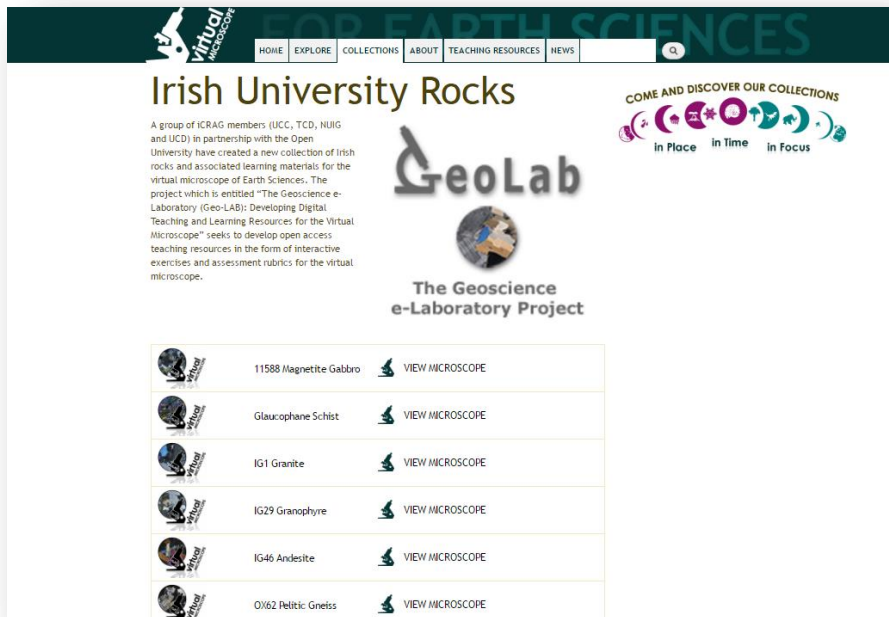
Petrology Programmes

GeoLab Modules by Institution have the potential to use the newly developed virtual microscope learning resources.













	UCD	TCD	UCC	NUIG	OU
Mineral Optics	GEOL20120 Mineralogy and Geochemistry	GL2206 Structure & Mineralogy GL3316 Mineralogy	GL3010 Crystallography, Optics and Mineralogy	EOS222 Optical Mineralogy of Minerals and Rocks	
Field Geology	GEOL30130 Field Geology				
Sedimentology	GEOL20010 Sedimentology GEOL30010 Sedimentary Environments	GL3326 Sedimentology	GL2011 Sedimentological Processes and Sedimentary Petrology GL3013 Sedimentary Environments	EOS223 Sediments and the Sedimentary Record EOS222 Ancient Earth Environments EOS422 Sedimentary Basins	S209 Earth Sciences S369 The Geological Record of Environmental Change
Structural Geology			GL2017 Structural Geology GL2023 Advanced Structural Geology GL2012 Structural Geology for Mineral Exploration	EOS2101 Geological Structures and Maps EOS417 Petrotectonics	S236 Understanding the Continents
Metamorphic Petrology	GEOL30110 Metamorphic Petrology		GL2012 Igneous and Metamorphic Petrology GL3027 Igneous & Metamorphic Petrology	EOS322 Metamorphic Petrology	
Igneous Petrology	GEOL30210 Igneous Petrology	GL3322 Crystalline Rocks 1: Igneous petrology GL3323 Crystalline Rocks 2: Igneous petrology GL4105 Global Igneous Petrology	GL4004 Advanced Igneous Processes GL6002 Igneous and Metamorphic Terrain Mapping	EOS321 Igneous Petrology	
Economic Geology	GEOL30060 Earth Resources and Applied Geology GEOL40260 Petrology and Ore Geology	GL4116 Economic Geology	GL4011 Economic Geology GL6013 Geology of Ore Deposits		

<http://www.geolab.ie/learning/>

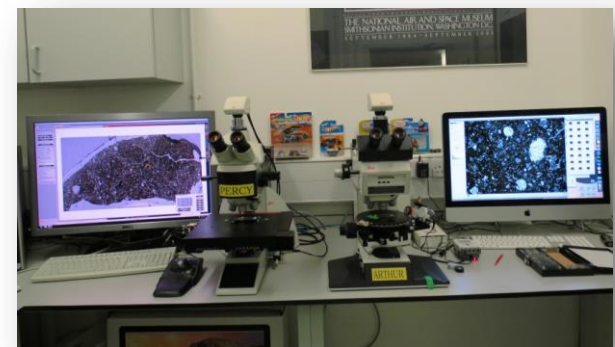
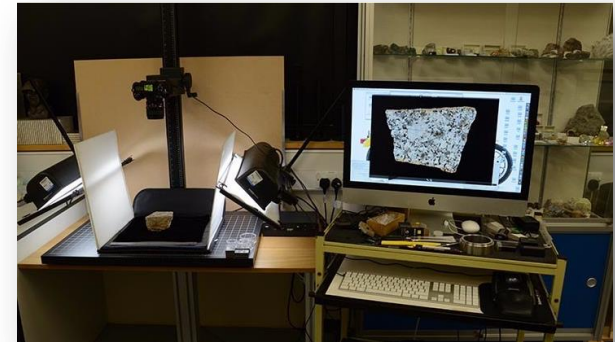
Open University Virtual Microscope Project



The screenshot shows the homepage of the Virtual Microscope project. It features a navigation bar with links: HOME, EXPLORE, COLLECTIONS, ABOUT, TEACHING RESOURCES, and NEWS. The main heading is "Irish University Rocks". Below this, a paragraph describes the project as a collaboration between iCRAG members (UCC, TCD, NUIG, and UCD) and the Open University, aimed at creating digital teaching resources. The GeoLab logo and "The Geoscience e-Laboratory Project" text are also present. A section titled "COME AND DISCOVER OUR COLLECTIONS" includes icons for "In Place", "In Time", and "In Focus". A table lists six rock samples with their IDs and "VIEW MICROSCOPE" links.

	11588 Magnetite Gabbro	 VIEW MICROSCOPE
	Glaucophane Schist	 VIEW MICROSCOPE
	IG1 Granite	 VIEW MICROSCOPE
	IG29 Granophyre	 VIEW MICROSCOPE
	IG46 Andesite	 VIEW MICROSCOPE
	O162 Pelitic Gneiss	 VIEW MICROSCOPE

- www.virtualmicroscope.org





www.geolab.ie

Deliverables

- Collection of **digital and openly accessible** petrological rock thin sections
- **Templates** for **exercises and assessments** via standard Internet browser (HTML5)
- E-tutorials (movies, PDFs) served via each university **VLE (Blackboard Learn)**
- Feedback on student **performance** and student/teacher **sentiment** towards TEL learning compared to ‘traditional’ petrology methods



Google Forms (G Suite for Education)

←

Extinction Angles

All changes saved in Drive

QUESTIONS

RESPONSES 2

IG1 Granite: Exercise One

Look at IG1 Granite under Crossed Polarised Light (CPL)
Here
http://www.virtualmicroscope.org/rock_sample?asset=115/index.html?x=18.09&y=10.72&zoom=0&s=0

This form is automatically collecting email addresses for University College Cork users. [Change settings](#)

Image and Annotate 1 *

http://www.virtualmicroscope.org/rock_sample?asset=115/index.html?x=20.13&y=7.62&zoom=0.23&s=1&rot=1°=9
Identify and annotate: Twinned Plagioclase, Quartz, Biotite

ADD FILE

Magnetite Gabbro: 360 Rotation 1 (Youtube)

http://www.virtualmicroscope.org/rock_sample?asset=115/index.html?x=18.09&y=10.72&zoom=0&s=0&rot=1°=44

plane polarised light;

Rotation 1

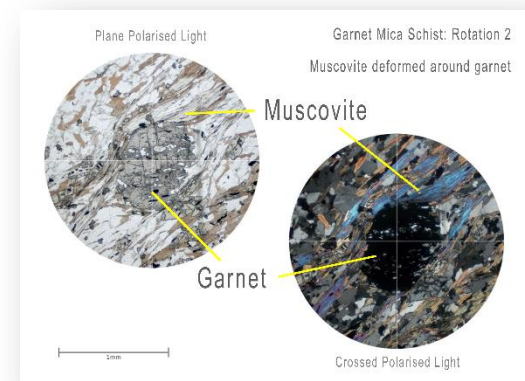
between crossed polars



All-in-one design tool for everyone

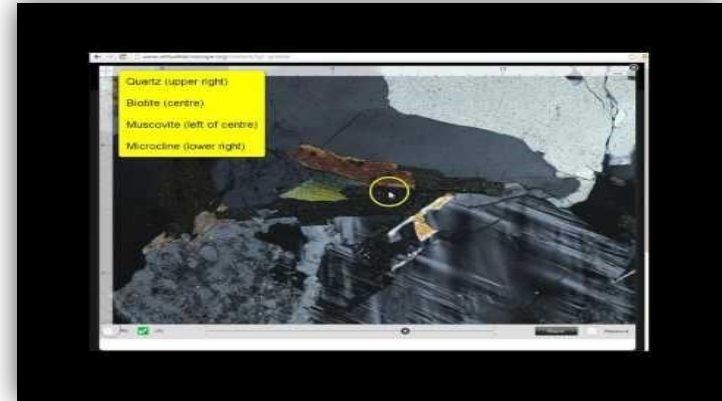
A full-featured screen capture tool, intuitive image editor, color picker, color palette, pixel-ruler, protractor, crosshair, whiteboard and more.

User friendly and full of features for creating your image, Suitable for software developers, graphic designers and home users.



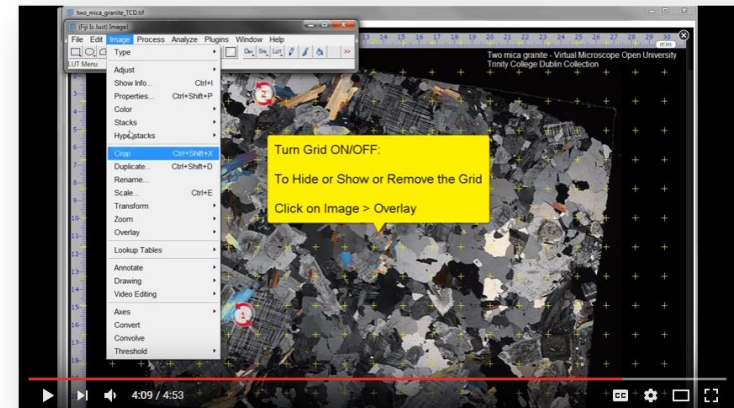
Instructional Movies - VM

- How-to Guides
- Annotated & Narrated
- Created with Screencast-O-Matic software



Software Tutorials

- Free Open Source Software (FOSS)
 - ImageJ
- GoogleApps



Promotion



Virtual Microscope for Earth Sciences



Garnet Mica Schist (P5217)

Place: Cleggan, Connemara, Co. Galway

Age: Neoproterozoic (Connemara Dalradian)

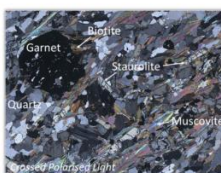
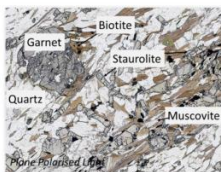
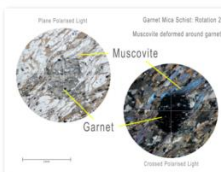
Minerals: Garnet, Biotite, Muscovite, Staurolite, Quartz

- o Staurolite zone of Connemara Dalradian Supergroup
- o Staurolite crystals grow transverse to the schistosity, and so grew after its fabric had developed.
- o Garnet crystals are augened by the schistosity.
- o Crenulations appear in quartz inclusion trails within the garnet porphyroblasts, showing that two phases of deformation had occurred before the garnet grew...
- o ...see lots more on the Virtual Microscope!



The Geoscience e-Laboratory

Developing Digital Teaching and Learning Resources for the Virtual Microscope



Sections of rock, sliced at 0.03mm thickness are mounted on glass slides – to make petrographic slides.

Petrographic slides are digitally imaged in varying polarised light conditions (PPL and XPL) and at 72 different illumination directions (5° intervals).

Collections of digital petrographic slides can be viewed and analysed on the Open University Virtual Microscope on PC, Smartphone or Tablet.

www.geolab.ie

www.virtualmicroscope.org

The Geoscience e-Laboratory (GeoLab): Developing Digital Teaching and Learning Resources for the Virtual Microscope. Funded by the National Forum for the Enhancement of Teaching and Learning in Higher Education under the Teaching and Learning Enhancement Fund (2015) Type B.



The Geoscience e-Laboratory (GeoLab) project is a digital teaching and learning resources development project led by University College Cork, in collaboration with University College Dublin, National University of Ireland Galway, Trinity College Dublin and the Open University.

Version: 2016



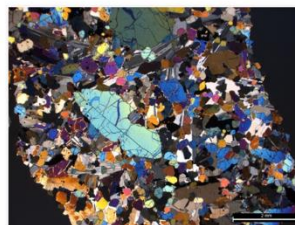
NASA Lunar Rock Collection



The Geoscience e-Laboratory

Developing Digital Teaching and Learning Resources for the Virtual Microscope

Funded by the National Forum for the Enhancement of Teaching & Learning in Higher Education



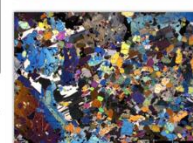
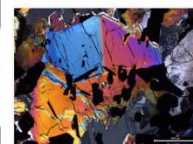
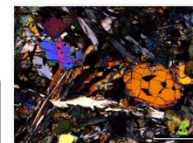
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Photomicrographs: Richard Unitt, UCC

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Version: 2016

Research-informed Teaching & Field Study

- Integrate Virtual Microscope into undergraduate teaching
- E.g. Connemara Field Studies Week – Uni. College Dublin





The Geoscience e-Laboratory
Developing Digital Teaching and Learning Resources for the Virtual Microscope


PROJECT OBJECTIVE VIRTUAL MICROSCOPE VM IRISH UNIVERSITY COLLECTION FIELD SITES

Geolab | Geoscience e-Laboratory

Developing Digital Teaching & Learning Resources for the Virtual Microscope

BROADSTRAND, COURTMACSHERRY

The coastal geology around the Seven Heads peninsula, County Cork provides excellent exposures to rocks of Upper Devonian to Namurian (Carboniferous) age. The peninsula is traversed by an complex faulted east-west trending syncline.



The study area is located on Quarry Point, a headland on the eastern side of the Seven Heads peninsula, situated on the south side of Broadstrand Bay. This area lies at the southern onshore extent of the Variscan tectono-sedimentary Rhechoermyan zone of southern Ireland and consists of a folded sequence of deepmarine siliciclastic rocks belonging to the Serpukhovian White Strand Formation (Higgs and Forsythe, 2007).

Shear Folding
Shear folding, which is also referred to as slip folding, involves shear along planes that are oriented approximately parallel to the axial plane of the fold structure. These planes, which are typically axial-planar cleavage planes, facilitate high-angle reverse slip leading to fold limb rotation and amplification.

Analysis of folded marine sedimentary rocks from the Variscan of southern Ireland at Quarry Point provides unambiguous microstructural evidence for reverse shear on chemically weakened cleavage domains. Significant silica loss in these cleavage domains, and as a consequence marked mechanical weakening, is seen as the primary cause for the reverse slip associated with the shear folding of these sedimentary rocks.

Thin sections cut from mudstone-siltstone-sandstone samples at an outcrop (Lat 51.613840°, Lon -8.687360°) at Quarry Point exhibit excellent fabrics that reveal the interplay between fabric development (cleavage) and folding during the regional Variscan tectonic episode. Thin sections reveal:

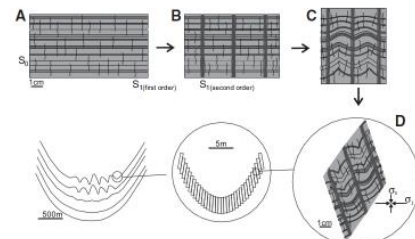


Figure 4. Deformation sequence at Broadstrand. A: Early first-order cleavage development. **B:** Development of second-order cleavage domains. **C:** Development of millimeter-scale buckling and high-angle reverse faulting. **D:** Regional and minor folding and localized shear folding of sandstone horizons by reverse simple shear across second-order cleavage domains.

Adoption and Sustainability

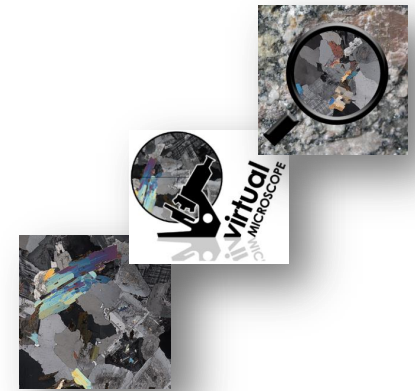


- Continuation into the Future:
 - Participation \ contribution by **all Irish geoscience centres** secure ✓
 - Potential adaptation to other **geoscience programmes** ?
 - Integration into **Blended & Distance Learning / Adult & Continued Education** ✓
 - **iCRAG**: Irish Centre for Research in Applied Geosciences 2015 – 2020 ✓

iCRAG IRISH CENTRE FOR
RESEARCH IN APPLIED
GEOSCIENCES

The Geoscience e-Laboratory (Ge-LAB):

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