Virtual Geologic Mapping Exercise at Ben Levy, Ireland

This virtual mapping exercise focuses on a 0.75 square kilometer field area just west of the town of Clonbur in western Ireland (Figure 1; approximate latitude: 53.53˚, longitude: -9.40˚). The basic geology consists of a layered sequence of Silurian clastic rocks that are stratigraphically above Neoproterozoic schists. Units are transposed and offset by younger faults. Virtual field investigations and construction of a geologic map will be facilitated by using the Google Earth virtual globe. The exercise works best with the web version of Google Earth, which can be accessed using the Chrome, Firefox, Opera, or Edge browsers at the URL below:

https://earth.google.com/web/

Note that the web version of Google Earth does not work with Safari or Internet Explorer. The exercise will work on the desktop version of Google Earth, but some of the GE tools are located in alternate places and work slightly differently.
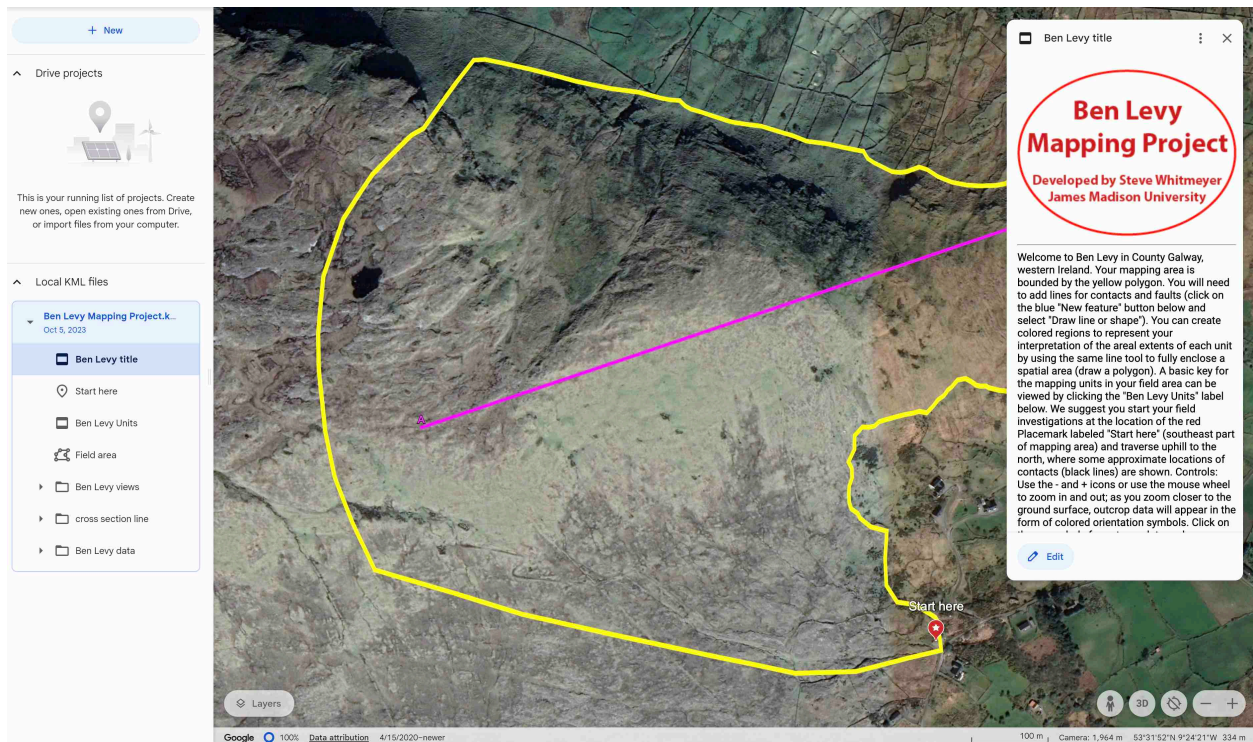

Figure 1: Ben Levy field area outlined by the yellow polygon, as seen in web Google Earth

The Ben Levy virtual mapping exercise makes use of a KML file of field data, which can be downloaded from the URL below:

https://educ.jmu.edu/~whitmesj/GEODE/Ben_Levy/Ben_Levy_Mapping_Project.kml

Exercise Tasks and Goals:

1. In Google Earth, virtually traverse the full field area, visiting outcrops (indicated by colored orientation symbols or dots) and collecting field data.
2. Build a geologic map in Google Earth by drawing contacts between lithologic units and drawing faults where necessitated by offsets in units. Draw polygons, colored by unit, to represent the interpreted regions for each lithologic unit. Fold axes and/or faults should be indicated. Upon completion, the full mapping area, as denoted by the large yellow polygon, should be colored. Neatness counts!
3. Interpret the geology of the field area by writing detailed descriptions of the lithologic units, constructing a cross-section that interprets the geology of the area, and writing a memoir/summary of the geologic history of the field area.

To investigate the field area, start by opening Google Earth in your web browser, using this web address: https://earth.google.com/web/. Once you are in Google Earth click on the "File" dropdown menu at the upper left side of the window, select "Import KML / KMZ file" (see Figure 2), and import the "Ben_Levy_Mapping_Project.kml" file from your computer. If you haven't downloaded the KML file to your computer yet, it is available here: https://educ.jmu.edu/~whitmesj/GEODE/Ben_Levy/Ben_Levy_Mapping_Project.kml. Once the KML file is loaded, your window should look similar to Figure 1.

Now you can start investigating the field area; the boundaries of the field area are indicated by the yellow polygon. We suggest that you start at the location of the red Placemark, entitled "Start here" (southeast region of the mapping area) and traverse uphill to the north. In Google Earth you can use the - and + icons (lower right in your window) or use your mouse wheel to zoom in and out. As you zoom closer to the ground surface, outcrop data will appear in the form of colored orientation symbols or dots. Click on these symbols for outcrop data and (sometimes) photos of the outcrop.

You might find it helpful to use <SHIFT>arrow keys to tilt and rotate your field of view. You can

also drag the white person icon (lower right of the window) to the roads for StreetView imagery of the landscape.
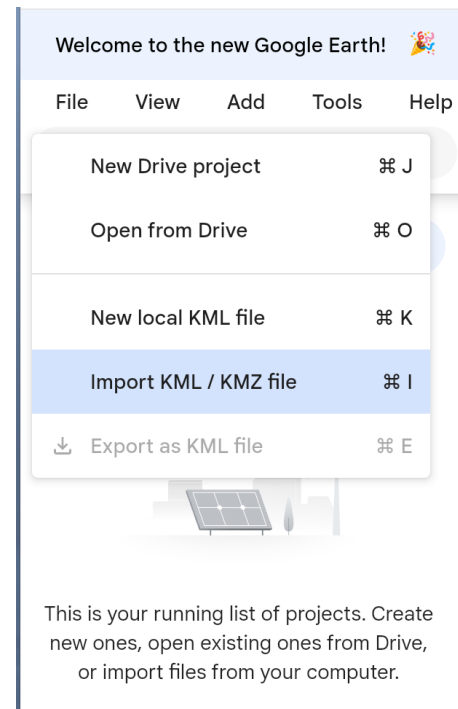

Figure 2. Loading a KML file in Google Earth

You will notice that the geologic field data only appears when you are zoomed close to the ground surface. A basic key for the mapping units in your field area can be viewed by clicking the "Ben Levy Units" label below the "New feature" button (also see Figure 6). However, you will need to visit the virtual outcrops to get details on the features of the lithologic units in order to complete your lithologic descriptions (see Exercise Deliverable #2 below.)

Figure 3. Examples of Placemark, black contact lines, and colored polygons for unit areas.

To complete your geologic map of the field area you will need to add lines for contacts and faults (click on the "Add" dropdown menu and select "Polygon"). You can create colored regions to represent your interpretation of the areal extents of each unit by using the same tool to fully enclose a spatial area (draw a polygon.) Note that you can mark key locations for use when drawing your geologic map by adding a Placemark from the same "Add" menu; see Figure 3 for examples. Note that all of the new features that you add will be viewable from any zoom extent. Thus, you can zoom in to draw your features or mark points with Placemarks and then zoom out to see how your map interpretation looks. Features can be edited by clicking on the feature and then clicking on the pencil "Edit" button in the pop-up balloon. Features can be deleted by clicking on the 3 vertical dots in the popup balloon, and then selecting "Delete".

Remember that a completed geologic map will have the full mapping area marked by contacts and faults that bound colored regions which represent your interpretation of the areal extent for each unit. There should be no blank space within the yellow boundary polygon once your map is completed.

Draft and final versions of your geologic map can be saved as KML files on your computer by clicking on the "File" dropdown menu and then selecting "Export as KML file" (see Figure 4). We suggest that you iteratively save multiple versions of your draft geologic map to backup your work. The final version of the KML file is what you will turn in as Deliverable #1.
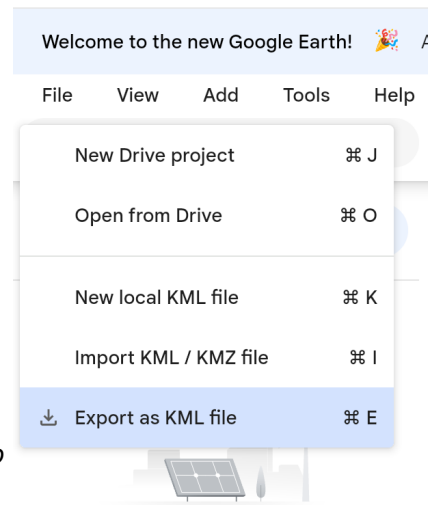

Figure 4. Example of how to save your geologic map as a KML file on your computer by clicking on the "File" dropdown menu and selecting "Export as KML file".

This is your running list of projects. Create new ones, open existing ones from Drive, or import files from your computer.

Once you have completed your geologic map, you will need to draw a vertical cross section interpretation of the subsurface geology. At the left side of your Google Earth window, there is a label entitled "cross section line", and if you click on the "eye" symbol, a purple cross section line will appear trending from west to east across the middle of the field area. You can use the blank cross section box included with this packet to draft your cross section, by loading the box into a drawing program like Illustrator, PowerPoint, or Google Slides. You can rotate the Google Earth view of the cross section line in the field area to horizontal on your screen and then zoom to match the length of the cross-section line to the width of the cross section box (see Figure 5.) That will help you to accurately transfer your contacts and unit areas from the Google Earth geologic map to the surface topographic trace (the curved line in the box in Figure 5) in your cross section box. If you are unclear on how to draw an accurate cross section that best represents the geology of your field area, please talk to your instructor.

Figure 5. Example of aligning the blank cross section box PDF image with the purple cross section line in Google Earth.

Exercise Deliverables:

1) The KML file of your completed geologic map of the Ben Levy field area.
2) Descriptions of the lithologic units in the field area. These descriptions will use data from the field area and expand on the basic descriptions in Figure 6. Additional units may need to be added to those listed in Figure 6.
3) A cross section from A (west) to A' (east) across the field area; you can use the blank cross section box included in this packet and load it into a drawing program (like PowerPoint, Illustrator, or Google Slides) to draw your geologic interpretation.
4) A neat and legible memoir/summary of the geology of your mapping area. Good memoirs start with the location and characteristics of a field area, present the field data and observations, and then discuss/interpret that data in a regional tectonic context.

Selected References:

Clift et al. 2004: Rapid tectonic exhumation, detachment faulting and orogenic collapse in the Caledonides of western Ireland. Tectonophysics, v. 384, p. 91-113. https://doi.org/10.1016/j.tecto.2004.03.009

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Williams & Harper 1991: End-Silurian modifications of Ordovician terranes in western Ireland. Journal of the Geological Society, v. 148, p. 165-171, https://doi.org/10.1144/gsjgs.148.1.0165
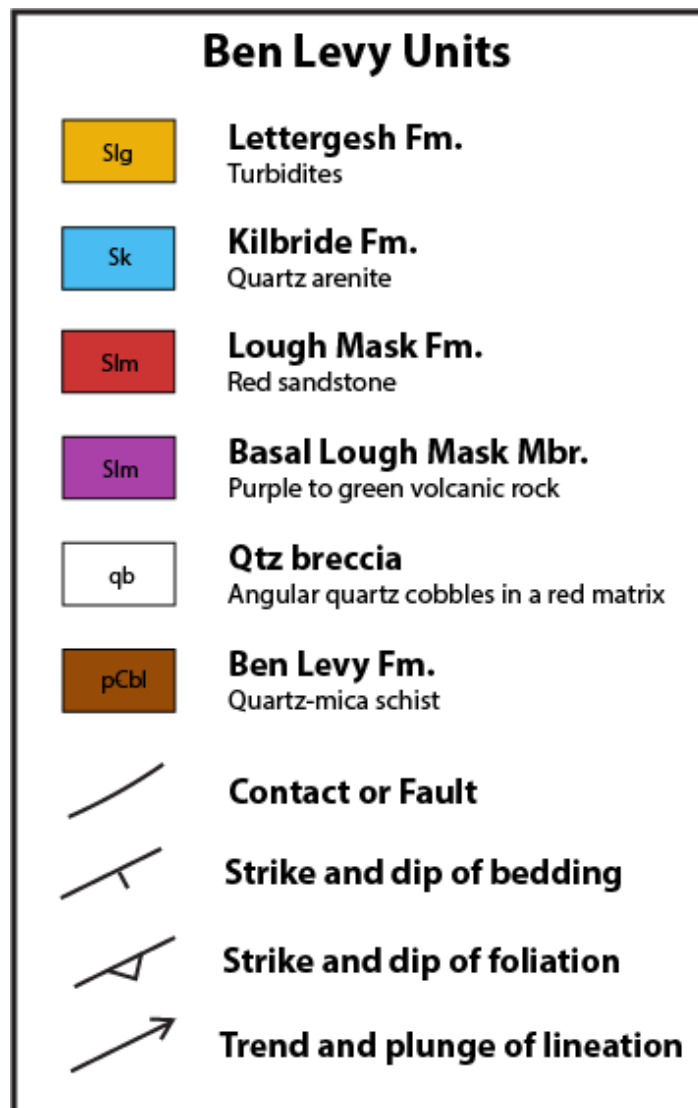
Figure 6: Lithologic units and symbology in the Ben Levy field area.