**JoVE Earth Science Education Series**

**Title: Use of the Brunton Compass to Determine Spatial Orientation of Rock Layers**

*Notes to the authors are italicized and highlighted.*

*General note: JoVE is okay with shooting outdoors with the following caveats: it can’t be more than 250 words worth (5-7 steps), and it can be filmed on the same day if it’s within ½ hour drive of the laboratory. From your comments, I believe we can keep to these guidelines.*

Yeah, it’s tricky…. If during shoot day, wx is good,,, then I think that this would be very worthwhile.

1. **Overview**
   1. The role of geology is to understand the earth in four dimensions. One of the simplest tools in this endeavor is the Brunton compass.
      1. Title card.
   2. The Brunton compass, while over 100 years old, is still the primary tool for generating geologic field data. (**1.2.1**) *I’d like to include a quick introduction to the relevant components of the compass (the levels, index pin, clinometer, etc). If you think this would be valuable content for the video, could you write a short explanation of what would be useful?*

Yes…

The compass has several key parts, that should be physcally pointed out—

These are the compass needle, the sighting arm, the peep-hole, the index pin, the leveling bubble (clinometer), and the bull’s-eye leveling-bubble

* 1. (**1.2.2**) The compass is used to collect field data regarding the geometric orientation of planar rock surfaces, known as strike and dip. (**1.2.3**) This information is the fundamental data for generating geologic maps. (**1.2.4**)
  2. This video will demonstrate the proper way to measure strike and dip with the Brunton compass.
     1. WIDE: Establishing shot of location of test.

1. **Principles**
   1. Most rock units exhibit some form of planar surface or linear structure. Examples include bedding-, fault-, and joint-surfaces. (**2.1.1**) *Which of these formations (or other ones of note) could be photographed from the location you mentioned in your notes?*

Location shoot…very simple…. BEDDING…which is THE KEY feature that geologists measure strike/dip on.

* 1. The spatial orientation of these features form the raw data used to construct models for the origin of rock units. (**2.1.2**)
  2. Rock layers can be described as a planar surface in space. (**2.2.1**) Any angular deviation for the horizontal is known as “dip”. Dip is reported in degrees, with a range between 0 and 90. (**2.2.2**) The value is followed by the general direction of the dipping. (**2.2.3**)
  3. In addition to the deviation from the horizontal, geologists also measure the deviation of the rock surface from North, or, “strike”. (**2.3.1**) Strike can be visualized as the linear intersection of the horizontal plane and the surface being studied. (**2.3.2**) Strike is reported in degrees from North. (**2.3.3**)

1. **Setup of the Brunton Compass (filmed in lab)**
   1. Before measurements can be collected with the compass, the functionality of the components must be verified.
      1. Title slide.
   2. The needle must be unimpeded when held in the horizontal plane. If the compass has a restrictor button, verify that it is working properly.
      1. CU: Talent rotates compass in the horizontal plane, demonstrating free movement.
      2. CU: Talent demonstrates restrictor button. (Note to videographer: may not be available on filming day.)
   3. Check the bull’s eye level centering and uninterrupted function. The bubble is used to determine the horizontality of the compass.
      1. CU: Talent rotates the compass in 3D space to show the bubble can freely move.
      2. CU: Talent places compass on flat, horizontal surface, demonstrating its proper use.
   4. While the geographic North Pole is a static location, the magnetic north pole moves over time. Because of this, a declination pin is used to correct for the difference. The declination is found on a local topographic map, and the adjust the set-screw to the appropriate value.
      1. CU: Talent rotates compass in horizontal plane, showing needle movement.
      2. CU: Topographic map with declination values.
      3. CU: Talent adjusts set-screw.
2. **Collection of Measurements (filmed at site near CU Boulder)**
   1. Because natural surfaces are inherently rough, a representative, flat surface must be established. A way to create the surface is the place a notebook or clipboard onto the rock in a representative orientation.
      1. MED: A representative shot of natural rock, showing its roughness.
      2. MED: Talent places flat item onto the rock.
   2. Place the compass against the surface. Rotate the compass until the bubble is centered in the bull’s eye level. (TEXT: Important: Don’t lift the compass from the surface)
      1. MED: Talent place compass to the surface.
      2. CU: Talent rotates the compass.
      3. ECU: Bubble centers in level.
   3. With the bull’s eye leveled, the compass is now aligned in the horizontal plane. The strike is indicated by the compass needle. The value at either end of the needle is correct, but by convention, the value closer to North is used.
      1. CU: Reading of compass, showing value.
      2. ECU: Compass face with values visible. (Highlight the end of the needle closer to North.)
      3. CU: Talent records value in notebook.
   4. Dip is measured perpendicular to the strike. Set the compass on its side, aligned along the downward slope. Adjust the inclinometer until the bubble is leveled. The dip magnitude is indicated be the inclinometer. In addition, the general direction of the dip is notated.
      1. MED: Talent lays compass on its side, perpendicular to strike.
      2. CU: Talent turns inclinometer dial.
      3. CU: (Simultaneous with 4.4.2) Bubble centers in level
      4. ECU: Indicator is pointing to the dip value.
      5. MED-over the shoulder: Talent records the value and direction of dip.
   5. The process of collecting strike and dip values is continued for all rock units of interest.
      1. WIDE: Shot of surrounding area with multiple rock surfaces to analyze.

1. **Results (contains 1 field shot)**
   1. When taking measurements, it’s important to practice good technique and verify the compass is working properly. This will ensure good precision for the data.
      1. Reuse 4.4.2 and 4.4.3.
   2. The accuracy of the data is dependent on the uniformity of the natural surface. Taking multiple measurements of the same surface can increase the accuracy.
      1. MED (field): Example of surface undulations.
   3. Once the strike and dip values have been correctly recorded in the field, they are combined into geologic maps. These maps show the boundaries between rock units, and the strike and dip data provides the spatial orientation of each rock. Enough symbols should be included to show any variation within the unit.
      1. Figure 3, without strike and dip data.
      2. Strike and dip notation is added to the map, one at a time.
   4. *Figure 4 is the map key. I was wondering which of the features in Figures 3 and 4 are especially common/useful (as they pertain to strike and dip, specifically), and please explain the significance of each. With this info, I take a few steps to explain in some detail the significance of geologic maps.*

Fig 4 shows a list of numerous different kinds of “measurable” strike/dip features.  
Delineating all these different features is outside the scope of a video that should be focused on how to measure strike and dip of a surface.

Also-- Overturned and vertical bedding…. Should be obvious in meaning. (beds flipped upside down,,, and beds flipped on their side)

Discussion of the meaning of crumple structures, or crenulation cleavage , or foliation…would require the rudiments from a course in metamorphic petrology.

MY POINT,,, and the point of including that figure,,, is simply to show that there are a lot of rock features that can be thought of as “planar”…and measurable with S/D

* + 1. Figures 3 and 4 with author input.

1. **Applications**
   1. (**Lower Third: Application #1: Generating cross sectional maps**)

Once the geologic maps are created, geologic cross-sections can be generated. The information in the geologic map is extrapolated to determine the structure of rocks below the surface. In turn, this can provide information about the physical evolution about the area. *Note: We’re just briefly mentioning cross-sections here, and will go into detail in your other video.*

GOOD!—because any discussion of cross sections is outside the bounds of a video that should simply show someone how to use a brunton to measure strike/dip of a surface.

* + 1. Figure 3.
    2. Figure 3 rotates out of the plane of the screen, and Figure 5, matching the E-E’ lines.
    3. With last sentence, fade up dashed lines in Figure 5.
  1. (**Lower Third: Application #2: Identifying patterns of deformation**) Another use of geologic maps is identifying past orientations of stress…. *Would I be correct that this could help with identifying faults, or something along those lines? Also, are there any visuals we can use for this, either from what we have already, or something we can film/illustrate?*

Sure!—recognizing the location of faults is certainly something that geologic maps be used for!....but how to do this?---Hmmmm….that’s way outside the scope of a video that should simply show someone how to use a brunton to measure strike/dip of a surface.

Basically, you’re asking me for a description of how to USE geologic maps… well, get someone to do another video on that topic…wow,,, it’s a big one!

* 1. *Could you come up with one other real-world application of the compass/ strike and dip data/geologic maps? We can’t use the one that’s already in the Results section. Sometimes we can use JoVE articles, but sadly, we don’t have any applicable videos we can use*.

HMMMMmmmm.,…. Not sure of what you are getting at, or what the problem is here…

I provided three examples of how s/d data are used.

In a nutshell….ANYTHING geological that displays a planar surface (or one can approximate as a planar tangential to a surface) is something that you can theoretically measure strike and dip on!

And WHAT CAN YOU DO with measuring planar surfaces??--- gosh, I would say that this is fundamental data for the whole business of geology…which is to interpret earth structure (orientation of rocks at depth) and the evolution of earth features (e.g. changing rocks and environments though time). In sense, I feel like I’m getting asked --- What do geologists do?....because nearly everything they do, can at some point or some level make use of measurements of planar surfaces.

Don’t get me wrong… I LIKE big picture stuff…and I would be more than happy to say something about how S/D data are fundamental to understanding earth in 4-D (spatial and temporal history)…but my sense is that the point of this video is to show folks how to use a Brunton compass to make simple strike/dip measurements… and NOT to describe the broad scope of geological work.

1. **Summary**
   1. You have just watched JoVE’s introduction of the Brunton compass. You should now understand the setup of the compass, proper usage, and how to take strike and dip measurements. Thanks for watching!
      1. 4 quadrants with 1) 3.3.1 – free needle rotation 2) 4.2.2 – centering bull’s eye level 3) 4.3.2 – recording values 4) 5.3.2 – strike and dip values adding to geologic map.