420k Lab #1 – Compass and Pace & Compass

Reading:

1) Measurement of Attitude and Location, p. 3-14. Appended to lab.
2) Compton, p. 16-21, 34-40, 75-80.
3) Web resources: see Lab 1 under www.geo.utexas.edu/courses/420k

Equipment (**Bring to Lab**):

Compass
Field notebook
Ruler with metric scale
Protractor
Calculator or tangent table
Clipboard

Lab Is Conducted Outdoors

For Lab 2 next week:

1) Know (memorize) the simplified time scale at the front of the lab manual. You must know all but the ages of the Periods and Epochs (the smaller numbers, not in bold, that are printed to the upper left of Period names and right of the Epoch names). You will be quizzed on it Friday next week and every subsequent Friday until the entire class can reproduce it perfectly. A blank template is provided for practice.
2) Have a hand lens and bring it to lab!

LAB 1:
USING A BRUNTON COMPASS & CONSTRUCTING A PACE AND COMPASS MAP

The compass is a very important tool for the field geologist. Today's lab is designed to familiarize you with its various applications and uses. Please read: p. 16-21 in Chapter 2 of Compton and the appended material entitled "Measurement of Attitude and Location".

Objectives: By the end of lab today you should know:

1. How to set the declination on a compass.
2. How to measure the strike and dip of a plane and how to record it consistent with the right-hand rule.
3. How to take a bearing and measure the bearing (or trend) and plunge of a lineation.
4. Your eye height and pace.
5. How to use a clinometer on a compass to measure heights.
6. How to apply some of these techniques to map objects using pace and compass measurements.

Procedures:

1. A. Magnetic Declination

Magnetic declination is a measure, in degrees, of the difference in the position of the **magnetic north pole** and the **geographic north pole** (**"true north"**). By convention, true north is the geographic reference for all bearings in map making. Because a compass measures bearings relative to magnetic rather than geographic north, a correction is required. This correction is made on the compass itself. By making this correction, the compass pointer is pointing to true north when the white end of the needle is pointing at 0^{o}. Magnetic declination varies around the globe and changes slowly with time. The proper local declination for setting a compass should be obtained from an isogonic chart or a recent topographic map of the area of interest. The magnetic declination in the Austin area is about 6.5^{o} East. This means that magnetic north is about 6.5^{o} east of true north. Verify this by examining the isogonic chart (Fig. 1-17) on page 11, of the reading passed out in class. Though a link on the Lab 1 web page you can track the magnetic pole through the past century!

B. Setting the Declination on the Compass

The declination is set by adjusting the small screw located to the right of the cover hinge. By turning the screw, the compass card (see Fig. 1-14 in the reading) is set to the appropriate declination. First, orient the compass so that the white end of the needle (or the yellow dot on some compasses) points at the index pin. In this position, the needle is aligned with the folding sighting arm ("pointer" of Fig. 1-14) and the compass is pointing at magnetic north. Next, turn the whole compass the proper number of degrees (6.5^o to the west in this case) so that the sighting arm points to true north. Now, adjust the small screw so that zero on the compass card lines up with the compass needle (the index pin should now point at 6.5^o on the W side of 0^o). The declination is now properly set.

2. Strike and Dip: (read p. 34-38 in Compton, p. 5-6 in appended reading).

A. Strike with a Quadrant Compass

To measure the strike of a plane, hold the compass with the mirror toward you and place the edge of the compass against the plane to be measured. ***Making sure that the edge of the compass stays in contact with the plane you're measuring,*** move the compass until the bull's eye level is centered. Read the compass card at the *white end of the needle* (which always points north), noting whether an imaginary center line through the compass (i.e. a line connecting sighting arm, index pin and mirror center line) lies to the west or east of the white end of the needle. This is the strike of the plane. Quadrant compasses show bearings, in degrees, relative to the four cardinal directions: N, E, S, and W. If the center line of the compass lies 30^o west of the white end of the needle then the strike is "north 30^o west" and is recorded as **N30W.** Reading the opposite end of the needle (or placing the opposite edge of the compass against the plane), the same strike could be recorded as "south 30^o east" or **S30E.** **Either of these is an equally valid measure of the strike of this one plane, but which should we choose?**

For consistency (and for computer programs that plot such measurements) there is a standard convention, called the **Right-hand Rule,** for choosing which of these bearings to record as strike. The right-hand rule uses another bit of information to make this decision, namely the direction the plane dips. Simply put, the direction of dip must always be to the right of (or clockwise from) the bearing we record as strike. So, if the plane in the example above dips westward, then the strike is **S30E**; if it dips eastward **N30W**.

B. Strike with an Azimuth Compass

The procedure is the same as that above for the Quadrant Compass, except that the bearing is recorded as an azimuth, i.e. a number between 0 and 360^o. You should get comfortable converting quadrant readings to azimuth and vice-versa, e.g. **N30W** is equivalent to **330^o** in azimuth; **S30E** is equivalent to **150^o**. 330^o and 150^o are equivalent strikes. To decide which to record, use the right-hand rule.

C. *Measuring Dip*

Dip is always measured at right angles to strike, thus we needn't measure the dip direction but only the amount of dip. We use the clinometer for this. Place the compass with the edge flat on the surface, *being sure that the edge is now perpendicular to strike*. Move the clinometer back and forth until the bubble is centered. *Read the 0-90 clinometer scale* (the 0-100 scale is % grade, not degrees!). This is the dip. Note the general direction of dip (i.e. N, S, E, W). Record the strike and dip in the following fashion: S30E/20S. This is a plane with a strike of south 30^o east

that is dipping southerly (more precisely, to the southwest) at 20°. The same measurement recorded in azimuth is 150/20S.
For shallowly dipping surfaces (less than about 12°) the raised ring on the back of the compass prevents the edge of the compass from freely touching the surface to measure strike. For such surfaces, the strike direction can be determined by: 1) setting the clinometer to 0°; 2) placing the compass on the surface so that the pointing arrow is horizontal and the glass face is vertical; 3) moving the compass on the surface, making sure the edge stays in contact with the surface, until the clinometer bubble is level; you have now found the strike direction; 4) to measure this direction, tilt the compass about the strike direction until the glass plate is horizontal (bulls eye level is centered) and read the white end of the needle, as directed above.

Measure and record the Strike and Dip of the following surfaces at the numbered station:

Station #	Planar surface	Strike/Dip
1.	Inclined Rock in Rock Garden	____________
2.	Inclined Granite Slab in Rock Garden	____________
3.	Aplite dike contact in polished slab, Rock Garden	____________
4.	Surface near fountain	____________
5.	Surface near fountain	____________

3. Bearing/Trend and Plunge: (read p. 38-40 in Compton, page 7-8 in appended reading)

A bearing is a direction from one point to another. As opposed to strike, a bearing always has a unidirectional sense. Thus when making a bearing (or trend) measurement of an inclined linear feature ("lineation"), align the sighting arm *in the direction of plunge* and the white end of the needle will indicate the proper bearing. The measurement is read the same way as strike. Bearings are always taken with the compass horizontal; *the bull's eye must be level*. Four methods of measuring a bearing are given in the reading from class; see page 13.

The plunge of a linear feature is the angle the feature makes with a horizontal surface. Plunge is measured like dip angle; as with the dip angle the plunge should be accompanied by a direction, usually given as the direction toward which the line is plunging. If the bearing is always recorded in the direction of plunge then a separate plunge direction isn't required. Bearing and plunge are recorded with a shorthand notion like that for strike and dip, e.g. N45W/30 means a lineation bears 45° west of north and plunges 30° toward the northwest. The same reading in azimuth would be 315/30.

Measure the bearing and plunge of the three features below.

Station #	Linear feature	Bearing/Plunge
6	Line on polished inclined Granite slab	____________
7	Intersection of bedding and broken face of slab, Rock Garden	___________

8	Hinge line of plunging fold, Rock Garden	____________

Measure the bearing to the following features from the station listed:

Station #	Feature	Bearing
9	ROTC Flagpole	_______________
10	Antenna atop west stands of stadium	_______________

4. Eye Height and Pace:

Measure your eye height (in the lab using the scale drawn on the blackboard) and your pace (on the course set up outside).

Eye Height	_______	m.	Pace	_______	m.
	_______	ft.		_______	ft.

5. Measuring heights using the clinometer: (Compton, p. 19)

Using the procedure outlined on page 19, Compton, measure the height of the flagpole in front of the ROTC building.

Recall: Height = (horizontal distance) x (tangent of vertical angle) + Eye height

Horizontal Distance	____________ft.
	____________m
Vertical angle:	____________°
Tangent Vertical Angle	____________
Height of the flagpole	____________ft
	____________m

6. Pace and Compass Map:

Equipment: Brunton Compass, protractor, ruler, calculator and clipboard. Graph paper provided.

Exercise: This exercise will help you develop skills in pacing and measuring bearings. Such skill are needed when mapping traverses, or the geology of an area in detail (see Compton, p.75-80). When performing an actual traverse in the field, all geologic information (strike and dip of formations, locations of contacts, etc.) is recorded in a field book. Distances and bearings of the traverse are plotted on graph paper at the time that they are measured.

The pace and compass course on the East mall consists of five numbered and flagged stations that you will plot on the graph paper provided.

Directions for completing a traverse (from Compton p. 76)

1. Start at station 0 and sight to station 1. Record the bearing in your notes. Pace the distance to Station 1. Record this distance. After reaching Station 1, take a reciprocal bearing on Station 0 to check your original bearing. For example, if the bearing to station 1 from 0 was N45E, the reciprocal should be S45W. You may want to repace the distance to check yourself.

2. Plot this information on your graph paper. All bearings should be plotted with respect to the North Arrow on the graph paper. Use your protractor to plot the bearing. Next, using the correct scale (1:500 or 1 cm = 5 m in this exercise) plot the distance you paced.

3. Continue until you return to station 0. Note the discrepancy between where you started and where you ended. This is referred to as the "closure error".