

School/Team Name: \_\_\_\_\_ Team # \_\_\_\_\_

Student Names: \_\_\_\_\_

# GeoLogic Mapping

## Regional Science Olympiad Tournament

### UT at Austin - March 28, 2015

Event supervisor: Enrica Quartini



- *All answers must be written **clearly** within the space provided in the **answer sheet***
- *You may detach the pages of the test and answer sheet but **must** return them **stapled back together** in the right order*

**YOUR ORDER OF STATIONS IS: 1, 2, 3**  
**You have 17 minutes per station**

**DO NOT OPEN**  
**until instructed to do so**

## **STATION 1: YAVAPAI COUNTY, ARIZONA MAP**

**The following questions refer to profile B-B':**

- 1) Along profile B-B', which units are Quaternary?
- 2) Along profile B-B', which units are strictly igneous?
- 3) Along profile B-B', which units are strictly sedimentary?
- 4) Along profile B-B', what terms best defines unit "sm"?
  - a) pyroclastic fall deposit
  - b) ignimbrite
  - c) volcanoclastic unit
  - d) igneous rock
  - e) reworked sedimentary unit
- 5) Along profile B-B', which rock unit is definitely an *intrusive* igneous rock?
- 6) What clue did you use to differentiate the types of igneous rocks and answer question 5)?
  - a) crystal size
  - b) color
  - c) type of contact with surrounding units
  - d) tectonic structures within the unit
  - e) tectonic structures around the unit
- 7) Where did you get that clue from?
  - a) map
  - b) map margins
  - c) cross section
  - d) magnetic declination
  - e) legend
- 8) Draw a cross section along B-B'. Assume the following:
  - a) the Quaternary units are flat thin covers of the *underlying crystalline rocks*
  - b) the Green Gulch Volcanics are dipping vertically

**The following questions refer to Box 1**

- 9) What geologic structure affects unit "ga"?
- 10) List two clues that helped you answer question 9)
- 11) Is the structure you identified in question 9) symmetric?
- 12) What clue helped you answer question 11)?
- 13) Draw a simple cross section of that structure along a ~NW-SE profile, that *only includes formation "ga", "br", and qp*

- 14) An overturn anticline fold affects:
- a) units "sb" and older
  - b) units "sb" and younger
  - c) only unit "sb"
  - d) only units younger than "sb"
  - e) only units older than "sb"

**The following questions refer to Box 2**

- 15) What's the dipping angle of formation "Mr"?
- 16) Report the orientation of formation "Mr" on a stereonet
- 17) What and how many types of thicknesses of formation "Mr" can you read from the map?
- a) true thickness only
  - b) apparent thickness only
  - c) both apparent and true thickness
  - d) cannot read the thickness unless the formation dip is given
  - e) none of the above
- 18) Measure the true thickness of formation "Mr"
- 19) a. How are formations "Mr" and "Dm" dipping relative to each other?
- b. Draw a block diagram of Coyote Canyon to illustrate your answer to question 19) a.
- 20) What type of contact exists between formations "smb" and "Thb"?
- a) a fault, but it is not possible to assess whether normal or reversed
  - b) overturned fault
  - c) normal fault
  - d) reverse fault
  - e) thrust
- 21) What information did you use to answer question 20)?
- a) lithology type of both formations
  - b) age of the formations
  - c) geological structures affecting the formations
  - d) orientation of the formations
  - e) surrounding topography
- 22) What does the dotted line represent?
- 23) Which formation is the oldest in Box 2?
- 24) Which formation is the youngest in Box 2?

**The following questions refer to Box 3**

25) Answer T (True), F (False) or N (Not enough information) to the following statements:

- a) unit "gb" was deposited after the syncline, and syn-depositional with gdp
- b) the syncline predates the emplacement of units "gdp" and "gb"
- c) the fault postdates the syncline and is coeval to "gdp"
- d) the emplacement of unit "gb" postdates unit "qp" and predates "gdp"
- e) the emplacement of "qd" is coeval to "Ths"

26) What geological principle did you use to answer question 25)?

- a) law of superposition and principle of original horizontality
- b) law of cross-cutting relationship and principle of lateral continuity
- c) principle of original horizontality and principle of lateral continuity
- d) law of super position and cross-cutting relationship
- e) all of the above

## **STATION 2: AUSTIN, TEXAS MAP**

**Note:** Use the map's supplementary material to answer some of the questions

- 27) What is the projection of the map?
- 28) What **type** of *projection* is it?
- 29) Which plane is the axis of that type of projection aligned with?
- 30) What does this projection type *preserve*?
- 31) What is the general orientation of units and faults in the map?
- a) NW-SE
  - b) N-S
  - c) NE-SW
  - d) NNE-SSW
  - e) NNW-SSE
- 32) Locate where are the highlands and lowlands on the map:
- a) N
  - b) NE
  - c) SE
  - d) SW
  - e) Central
- 33) What information did you use to answer question 32)?
- 34) What are the latitude and longitude coordinates of Rutherford Ranch, in the SW corner of the map, close to Onion River?
- 35) What is the most fossiliferous unit within Fredericksburg Formation?
- 36) Which paleo-environment was the unit of question 35) deposited in?
- 37) One of the units within the Fredericksburg Formation hosts Austin's main water reservoir. Identify and report the name of that unit.
- 38) Mention three key characteristics of that unit that helped you identify it as a water reservoir.
- 39) What aquifer type forms within the geologic unit in question 37?
- 40) Which location is likely to be within the recharging area of the aquifer that feeds Barton Spring (located approximately ~ 30° 15' 00" N, 97° 47' 00" W)?
- a) ~ 30° 00' 00" N, 98° 00' 00" W
  - b) ~ 30° 5' 00" N, 98° 45' 00" W
  - c) ~ 30° 10' 00" N, 98° 45' 00" W
  - d) ~ 30° 30' 00" N, 97° 47' 00" W
  - e) ~ 30° 22' 00" N, 97° 45' 00" W

- 41) What could be used in the field to assess your answer to question 40) ?
- a) Fracking
  - b) Inclimeters
  - c) Gradiometers
  - d) Graduated steel pipes
  - e) Dyes
- 42) The Eagle Ford Group is a well-known oil reservoir. What type of reservoir is it?
- a) Conventional reservoir
  - b) Deep-ocean reservoir
  - c) Sealed reservoir
  - d) Unconventional reservoir
  - e) Capped reservoir
- 43) What method of oil production is adopted for that type of reservoir (from question 42)?
- a) Water Flooding
  - b) Fracking
  - c) CO<sub>2</sub> sequestration
  - d) Tight grid drilling
  - e) Passive seismic
- 44) What is the period of unit "Qwl"?
- 45) What is the epoch of the Fredericksburg Formation?
- 46) What type of contact exists between unit "Ki" and "Ko"?
- a) Paraconformity
  - b) Disconformity
  - c) Nonconformity
  - d) Angular unconformity
  - e) It is not an unconformity
- 47) If units "Ki" and "Qt" were in contact, what type of contact would that be:
- a) Paraconformity
  - b) Disconformity
  - c) Nonconformity
  - d) Angular unconformity
  - e) Not an unconformity

## **STATION 3**

### **MAP COMPONENTS**

- 48) What scale has the best resolution?
- a) 1:65500
  - b) 1:250000
  - c) 1:24000
  - d) 1:240
  - e) 1:2000
- 49) What components of a geologic map are absolutely necessary to make correct interpretations?
- a) map, cross section
  - b) map, legend
  - c) map, correlation map
  - d) map, correlation map, legend
  - e) map, source of geologic data, cross section
- 50) Justify your answer to question 49)
- 51) What information is always part of the legend?
- a) unit names, fossil content, grain size
  - b) unit names, lithologies, temporal relationship between units
  - c) unit names, lithologies, grain size, temporal relationship between units
  - d) lithologies and temporal and spatial relationship between units
  - e) unit names and temporal and spatial relationship between units
- 52) Transform the following coordinate: 87° 30' 6" to decimal degrees

### **GEOLOGIC COMPASS**

**Refer to Figure 1, panels A-E to answer some of the following questions**

- 53) What type of compass is the geologist using in panel A?
- 54) Which end of the needle do you read a measurement from in the compass in panel A?
- 55) The geologist in panel A is using the water table intersection with the outcrop as an approximation of:
- a) strike of the intersecting lineation
  - b) trend of the bedding surface
  - c) strike of the bedding surface
  - d) dip of the bedding surface
  - e) plunge of the intersecting lineation

- 56) What else do geologists use to help approximate that same feature when taking measurements in the field?
- a) field notebook or clip board
  - b) pencil, twig, or pen
  - c) ruler
  - d) coin
  - e) both a and b
- 57) What is the geologist in panel A measuring?
- a) trend of the intersecting lineation
  - b) trend of the bedding surface
  - c) plunge of the intersecting lineation
  - d) strike of the bedding surface
  - e) dip of the bedding surface
- 58) What type of compass is the geologist in panel B using?
- 59) What is the geologist in panel B measuring?
- a) trend of tectonic cleavage
  - b) trend of the clast
  - c) plunge of the clast
  - d) plunge of the tectonic cleavage
  - e) clast size
- 60) What is the geologist in panel C measuring?
- a) plunge of the bedding surface
  - b) strike of the bedding surface
  - c) plunge of the intersecting lineation
  - d) dip of the bedding surface
  - e) dip of the intersecting lineation
- 61) Identify the components of the compass in panel D
- a) Compass needle \_\_\_\_
  - b) Lift pin \_\_\_\_
  - c) Bull's-eye level \_\_\_\_
  - d) Clinometer level \_\_\_\_
  - e) Compass scale \_\_\_\_
  - f) Clinometer scale \_\_\_\_
  - g) Index pin \_\_\_\_
- 62) In panel D, component "f" is used to take what type of measurements?
- a) strike and dip
  - b) plunge and trend
  - c) trend and strike
  - d) plunge and dip
  - e) strike and plunge



63) Identify the components of the compass in panel E:

- a) metric measurer \_\_\_\_\_
- b) orienting arrow \_\_\_\_\_
- c) direction of travel arrow \_\_\_\_\_
- d) index line \_\_\_\_\_
- e) compass line \_\_\_\_\_
- f) compass wheel \_\_\_\_\_
- g) baseplate \_\_\_\_\_
- h) magnetic needle \_\_\_\_\_

64) Which part of the compass in Panel E has to be rotated to the proper position for dip or plunge measurements?

65) T#1 **Select and order** the correct steps to take a plane measurement using the right hand notation:

- a) find the direction of dip
- b) read the number on the clinometer scale
- c) level the bull's-eye level
- d) align the bottom edge of the compass with the plane
- e) write the measurement as strike/dip/dip direction
- f) read the number on the compass scale
- g) level the clinometer
- h) align the side of the compass with the plane
- i) identify the direction of strike
- j) write the measurement as strike/dip

# Figure 1

