Team # _____

TBL 2 individuals – HIGH-RESOLUTION MAGNETIC SURVEY IN LOCATING ABANDONED BRINE WELLS IN HUTCHINSON, KANSAS

Part 1: Multiple Choice (10 points)

1. What is the diagnostic physical property for this case study?
    A. Conductivity
    B. Magnetic susceptibility
    C. Dielectric permittivity
    D. Iron content

2. An electromagnetic (EM) method was used to successfully locate an abandoned brine well, but this paper uses a magnetic survey. According to the paper, why was a magnetic survey preferred?
    A. Significant EM anomalies may be caused by objects other than brine wells
    B. Forward modeling indicated that magnetic anomalies from brine wells were very large and easy to identify
    C. The penetration depth of EM methods for this application is poorly understood
    D. All are correct

3. What type of data were measured?
    A. Vertical component of the magnetic field
    B. Total component of the magnetic field
    C. High-resolution magnetic field data
    D. Monopole magnetic field data

4. "Anomaly" in this paper refers to
    A. Interfering signals from the noise
    B. Measured data significantly different from the general background
    C. Unexpected readings from the instrument (like a dropout)
    D. Any red spots on a data map

5. A drifting correction was deemed unnecessary because:
    A. The amplitudes of the magnetic anomalies were many times larger than any variations in the Earth's magnetic field
    B. Total component magnetic field measurements do not require drift corrections
    C. Measurements were already corrected for the sensor locations
    D. Kansas is at a latitude where drift is negligible

6. In this paper, “monopole” is used to describe

A. The origin of the magnetic field
B. The shape of anomalies measured by this type of instrument
C. Magnetic anomalies that are strictly positive
D. The shape of the magnetic anomaly produced by brine wells

7. The strength of an anomaly can be influenced by

A. Size (diameter, length and thickness) of well casings
B. Depth of wellhead
C. Height of magnetometer above the surface
D. All of the above

8. What methods were used to determine whether the monopole anomalies observed on maps were due to brine wells?

A. Geophysical inversion
B. The magnitude of monopole anomalies were compared to those produced by previously discovered brine wells
C. Holes were dug at the locations of anomalies to find the brine wells
D. C and D are correct

9. The presented survey was successful in finding the brine well casings, but it also discovered some other metallic objects, like junk metal and short pipes. What feature do you expect those scraps likely to have on a magnetic data map?

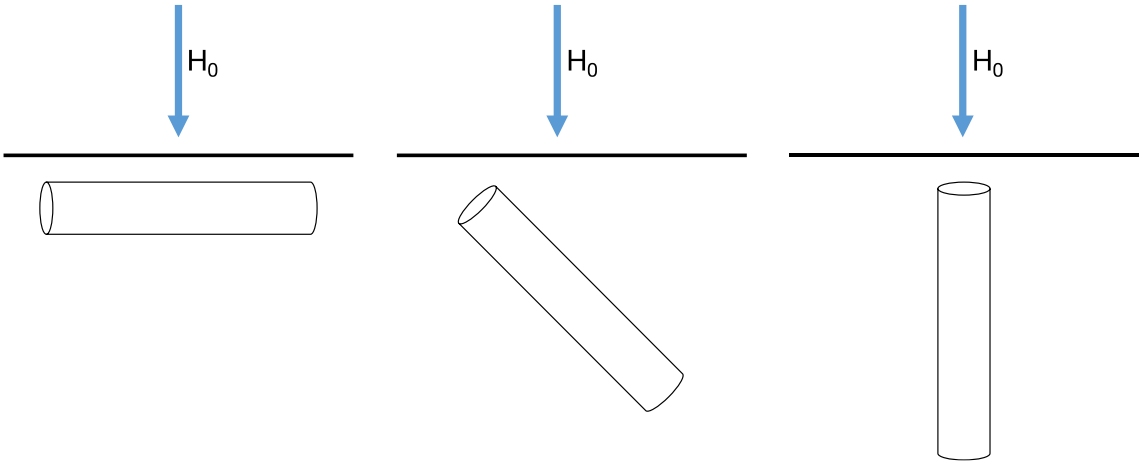
A. Same anomaly
B. Dipole anomaly
C. Negative anomaly
D. Weak anomaly

10. The authors concluded that an 8-inch steel case can generate a 12000 nT anomaly and a 2.5 or 4-inch pipe can generate a 2000 nT anomaly. What in the following would be the most effective method to use this information for targeting?

A. Smooth the data map to remove signals from small near-surface objects
B. Invert the strong anomalies to imaging subsurface well casings
C. Upward continuation
D. Remove a broad-scale background field from the total field maps

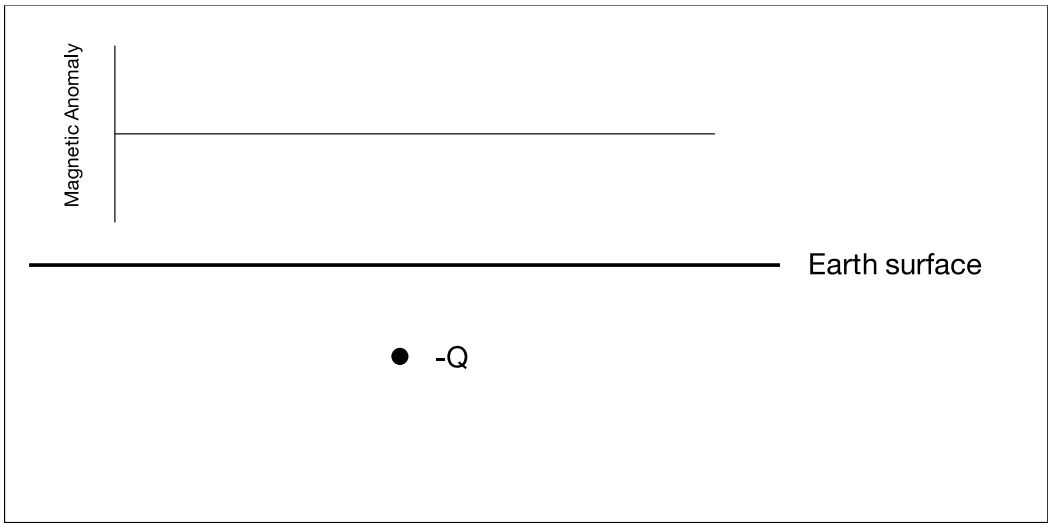
Part 2: Short Answer (10 points)

11. The paper refers to "monopole" anomaly. However, in physics, a magnetic monopole doesn't exist. Why is "monopole" a valid concept here (GPG Link)? Convey your answers by showing the sign and distribution of magnetic charges for the following circumstances.



12: The diagram below shows a magnetic positive charge below surface. Sketch the expected total field magnetic anomaly. Earth field is vertically down (Inclination: 90 degree).

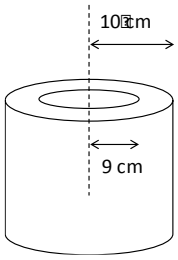
13. Draw a magnetic negative charge below surface and the associated field lines. On top of the surface, draw the expected total field magnetic anomaly. Does a positive monopole or a negative monopole better predict the field data?



14. Use GPG to:

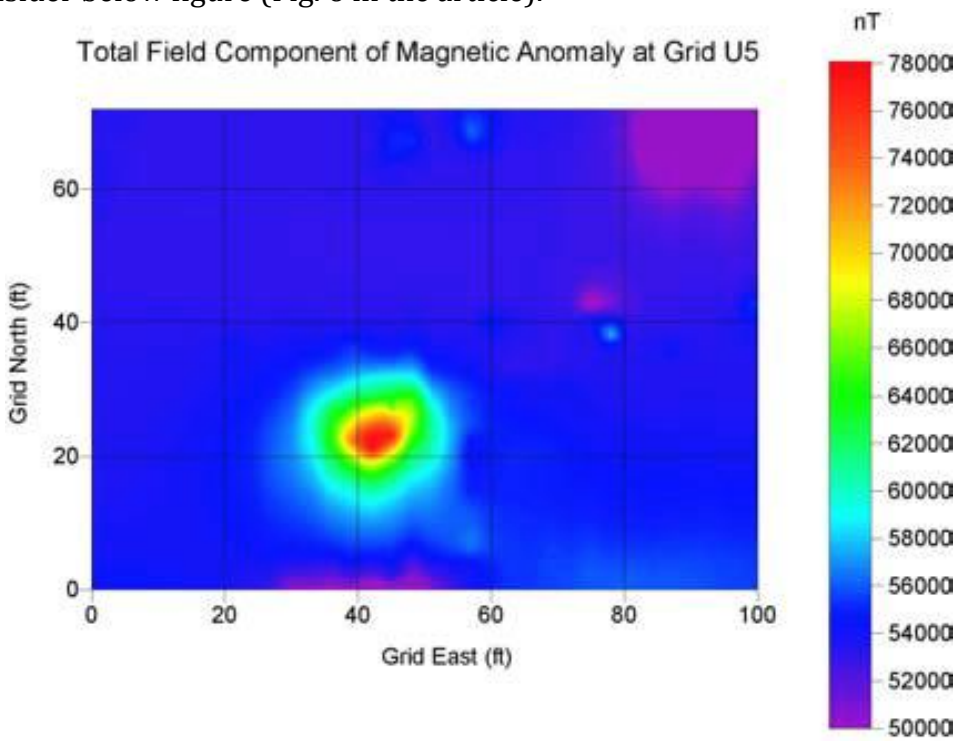
a) Compute the total magnetic charge on the top of the pipe. Assume the following parameters.

κ=150
B_0=55,000 nT (assume vertically downward, I=90°)



b) Predict the value of the total magnetic anomaly (Bt) at a height of 1m above the pipe?

15. Consider below figure (Fig. 6 in the article).



a) What is the peak amplitude of the anomaly?

b) Estimate the depth of burial from the half-width of the anomaly. Note that the sensor height was 2.5ft

c) How does the amplitude of the anomaly compare with the theoretical amplitude in questions 14b?

d) How might you account for these differences in amplitude?