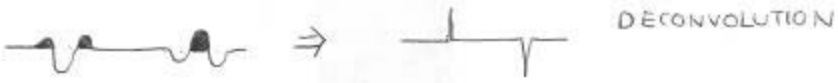
GEOPHYSICS 224 FINAL EXAM 2005

SOLUTION

1(a) See notes. Amplitude of a reflection varies with offset, and gives information about S-wave velocity and Poisson's ratio. This can give an indication of the presence of hydrocarbons.

1(b) Deconvolution attempts to remove the effect of a seismic pulse that is relatively long in time

pulse



Deconvolution is needed to sharpen the detail in a seismic section and allow closely spaced reflections to be separated.

1(c) RECORDING IS MADE DIFFICULT BY:

- ⇒ S-wave never a first arrival
- ⇒ need a 3-component geophone
- ⇒ don't travel in liquids (e.g. sea)

S-WAVES CAN BE USED WHEN

- ⇒ some reservoirs do not exhibit an P-wave anomaly
- ⇒ S-waves allow imaging through gas clouds
- ⇒ P-S conversions used in AVO

1(d) See notes. Small, near surface, structures cause variable delay from trace-to-trace. They disrupt the continuity of the reflection and can prevent stacking.

Remove with (a) mathematical approach
(b) refraction survey

1(e) PRE-STACK: every trace is migrated individually before stacking. Computer intensive.
POST-STACK: stack first, then migrate. Less processing time on computer.

POST STACK is quicker
PRE-STACK is slower, but much better at imaging structures with a relatively steep dip.

1(f) See notes.

2(a) Density of ore body greater than host rock

(b) $x_{1/2}$ to SW $\sim$ 200 m

$x_{1/2}$ to NE $\sim$ 400 m

average $\sim$ 300 m

(c) $x_{1/2} = 0.766\ z \quad \Rightarrow \quad z = 390$ m

(d) $g_z^{max} = \frac{GM}{z^2} = 6 \times 10^{-5}\ ms^{-2}$ (from map)

$z = 390\ m \Rightarrow M$ = mass excess $= 1.36 \times 10^{11}\ kg$

(e) $M = \frac{4}{3}\pi a^3 \Delta\rho$ $\quad \Delta\rho = 500\ kg\ m^{-3}$

$\Rightarrow a =$

(f) Non uniqueness: more than one model can fit the same data set. In this example two buried spheres with same M, but different combinations of $\Delta\rho$ and a with give identical gravity anomalies.

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3 (a) Layer $1 \rightarrow 2$ shows velocity decrease (- polarity)
$2 \rightarrow 3$ shows velocity increase

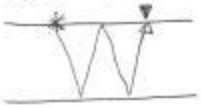
(b) $v_1 = 1760\ m\ s^{-1}$
$z_1 = 400\ m$

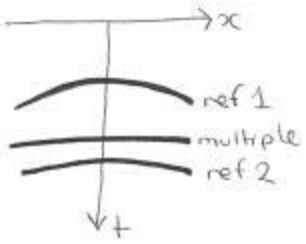
(c) $V_{rms,2} = 1623\ m\ s^{-1}$

(d) $v_2 = 1505\ m/s$; $z_2 = 422\ m$

(e) 21 - fold

(f) multiple will have -ve polarity





4(a) Induced magnetization

Atoms are aligned by an applied magnetic field. In diamagnetism, the magnetic dipoles oppose the applied field. In paramagnetism, they re-inforce the applied field. Induced magnetization dissappears if applied field is removed.

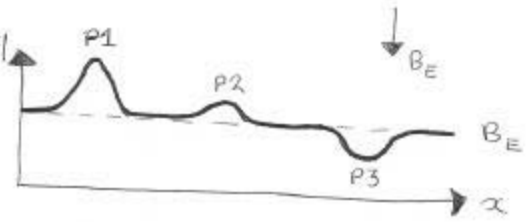
Remnant magnetization – when paramagnetism is strong, the atoms can interact and cause permanent magnetization. This magnetization will remain when the applied field is removed.

4(b) UPWARD CONTINUATION: mathematical technique to compute magnetic field at a different elevation, compared to that at which the data was collected.

Used to combine ground magnetic and aeromagnetic data. Can also act as a filter to remove short wavelength magnetic anomalies from the data

4(c) TIME CORRECTIONS – as well as measuring magnetic fields coming from the rocks, magnetic surveys will also detect magnetic fields that originate in the Earth's magnetosphere. These external fields vary with time and should be removed from the survey data with a base station that continually records at a fixed location.

4(d)



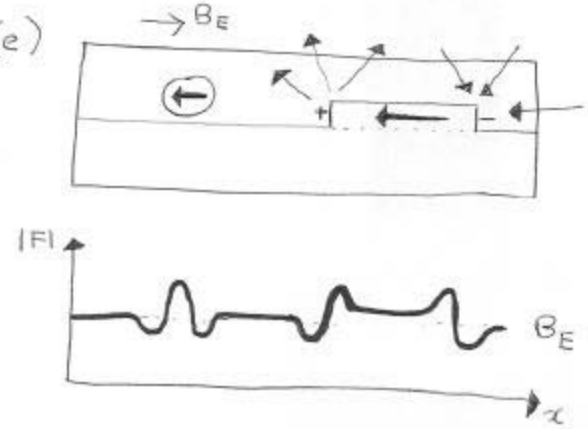
→ consider effect of a monopole at the top of each pipe.

P2: anomaly ¼ magnitude of P1 anomaly

anomaly is wider than P1 anomaly because the top of the pipe is deeper.

P3: anomaly has opposite sign, but same width as P2.

4(e)



4(f) Results would be different on an east-west profile