UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

ZGE 373/3 – Seismic Data Processing
[Pemprosesan Data Seismik]

Duration: 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **SIX** printed pages before you begin the examination.
*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **ENAM** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instruction: Answer all **FOUR** questions. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab semua **EMPAT** soalan. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

1. (a) Write short notes on the following topics:
[Tulis nota ringkas tentang tajuk-tajuk berikut:]

(i) The importance of deconvolution in seismic data processing
[Kepentingan dekonvolusi dalam pemprosesan data seismik]
(25/100)

(ii) Inverse filtering
[Penurasan songsang]
(25/100)

(b) Let the desired output be (0, 0, 1, 0). Set up a matrix equation for wavelet (1, -2, 3). Compute the shaping filter and apply it. Calculate the error energy of the actual output.
[Andaikan output dikehendaki adalah (0, 0, 1, 0). Tulis satu persamaan matrik bagi gelombang kecil (1, -2, 3). Hitung penuras pembentukan dan guna operator tersebut. Hitung tenaga ralat bagi output sebenar.]
(50/100)

2. (a) Measure the traveltimes corresponding to offset values of 1, 2 and 3 km in Figure 1 and do the following computations:
[Sukat masa perjalanan yang bersepadan dengan ofset 1, 2 dan 3 km di dalam Rajah 1 dan lakukan pengiraan berikut:]

(i) Compute the velocity above the reflector.
[Hitung halaju di atas pemantul.]

(ii) Estimate the depth of the reflector.
[Anggarkan kedalaman pemantul tersebut.]

(iii) Use a trial velocity of 2000 m/s, determined the NMO correction (Δt_{NMO}) at offsets 1, 2 and 3.
[Guna halaju cubaan 2000 m/s, tentukan pembetulan gerak keluar normal (Δt_{NMO}) pada ofset 1, 2 dan 3 km.]
(60/100)

(b) Write short notes on the following topics:
[Tulis nota ringkas tentang tajuk-tajuk berikut:]

(i) Velocity scan
[Pengimbas halaju]
(20/100)

...3/-

(ii) Velocity spectrum
[Spektrum halaju]

(20/100)

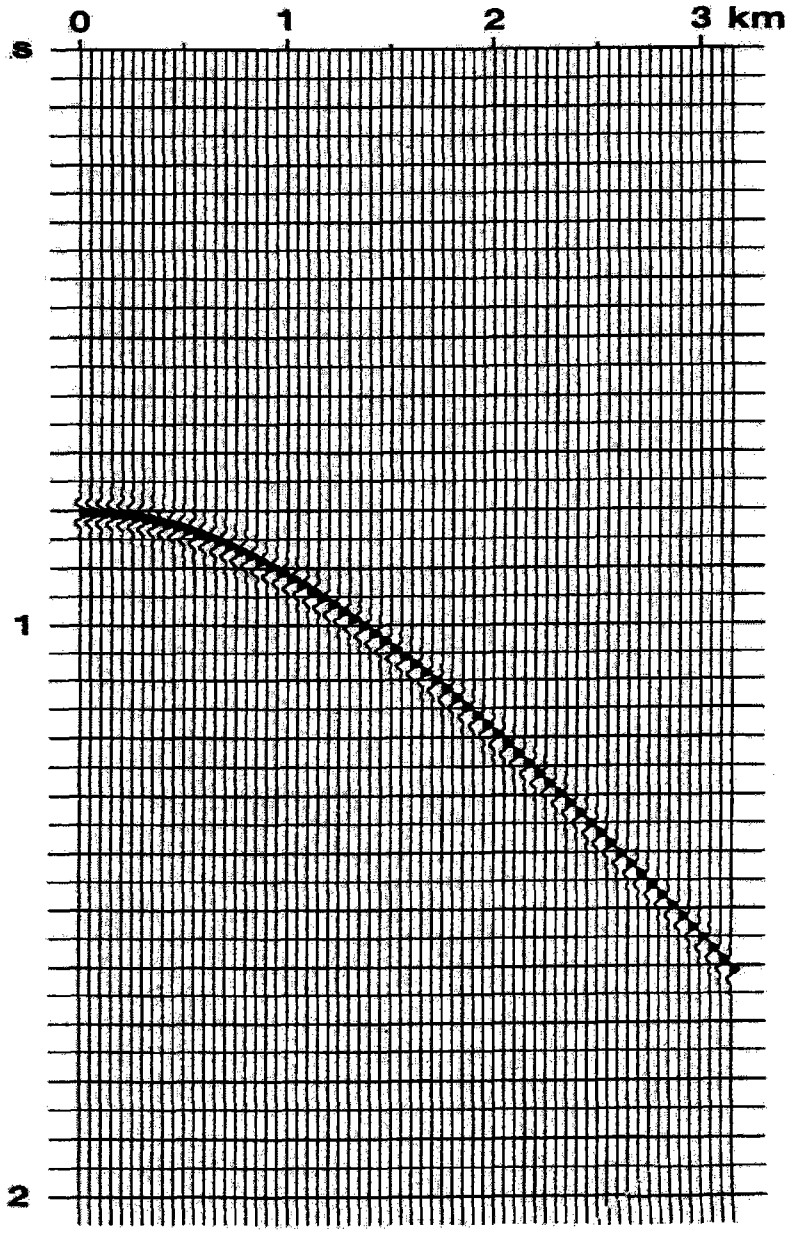

Figure 1 *[Rajah 1]*

3. (a) Reflection time data often are affected by irregularity in the near-surface. Describe some kinds of the near-surface irregularity. Then, discuss the ways to remove distortions resulted from the irregularity from the reflection data.
[Data masa pantulan sering dipengaruhi oleh ketidak-teraturan di permukaan-dekat. Huraikan jenis-jenis bagi ketidak-teraturan permukaan-dekat itu. Selanjutnya, bincangkan cara-cara menghilangkan herotan-herotan yang diakibatkan oleh ketidak-teraturan tersebut dari data pantulan.]

(20/100)

(b) Using illustrations shown in Figures 2 and 3, explain the idea of residual static correction. Also, explain the meaning of the term 'surface-consistent' and give a reason of why the term usually is a good assumption, and thus as a key assumption in static correction.
[Berpandukan kepada ilustrasi yang ditunjukkan pada Rajah 2 dan 3, jelaskan idea bagi pembetulan statik sisa. Juga, jelaskan erti bagi sebutan 'surface-consistent' dan berikan alasan mengapa sebutan tersebut biasanya merupakan sebuah pengandaian yang baik, dan sehingga menjadi pengandaian utama pada pembetulan statik.]

(50/100)

(c) The modeled traveltimes t'_{ij} for residual static correction is usually expressed as follows:
[masa-perjalanan termodel t'_{ij} untuk pembetulan statik sisa biasanya dinyatakan seperti berikut:]

$$t'_{ij} = s_j + r_i + G_k + M_k x_{ij}^2 \qquad (1)$$

Explain the meaning of each term in the above equation.
[Jelaskan maksud bagi setiap sebutan pada persamaan di atas]

(30/100)

4. (a) Using an appropriate diagram, describe the basic principles of migration.
[Berpandukan kepada gambarrajah yang sesuai, jelaskan prinsip asas bagi migrasi.]

(50/100)

(b) Measure the apparent dip $(\Delta t / \Delta x)$ of the reflector on the zero-offset section in Figure 4, at point A_1, A_2, A_3. By using an appropriate equations, compute the horizontal and vertical displacement due to migration. Note that the trace spacing is 30 meters.
[Ukur kemiringan ketara $(\Delta t / \Delta x)$ bagi pemantul yang terdapat dalam keratan offset-sifar (Rajah 4), pada titik A_1, A_2, A_3. Dengan menggunakan persamaan yang sesuai, hitung sesaran mendatar dan menegak yang diakibatkan oleh migrasi. Perhatikan bahawa jarak antara setiap surihan adalah 30 meter.]

(50/100)

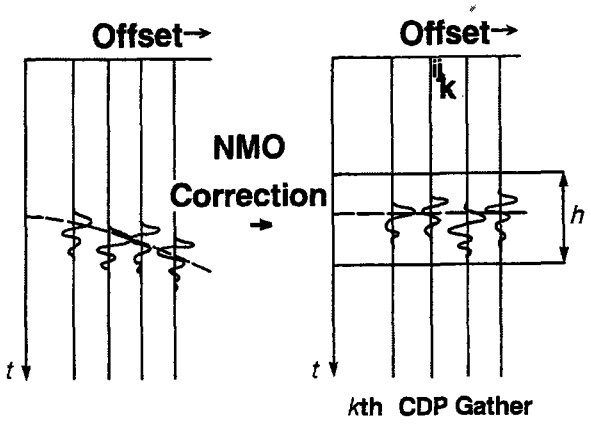

Fig. 2. Picking traveltime deviations from NMO-corrected gathers.

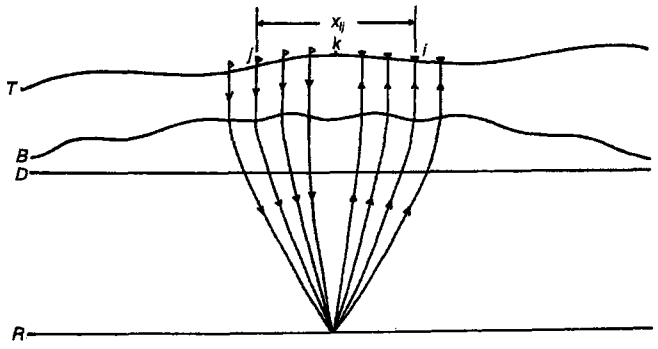

Fig. 3. Surface-consistent statics model to establish the traveltime model equation (1) . Here, T = topographic layer, B = base of weathering layer, D = datum to which static corrections are made, R = deep reflector, j = shot station index, i = receiver station index, k = midpoint location index, x_{ij} = offset between the shot and receiver stations.

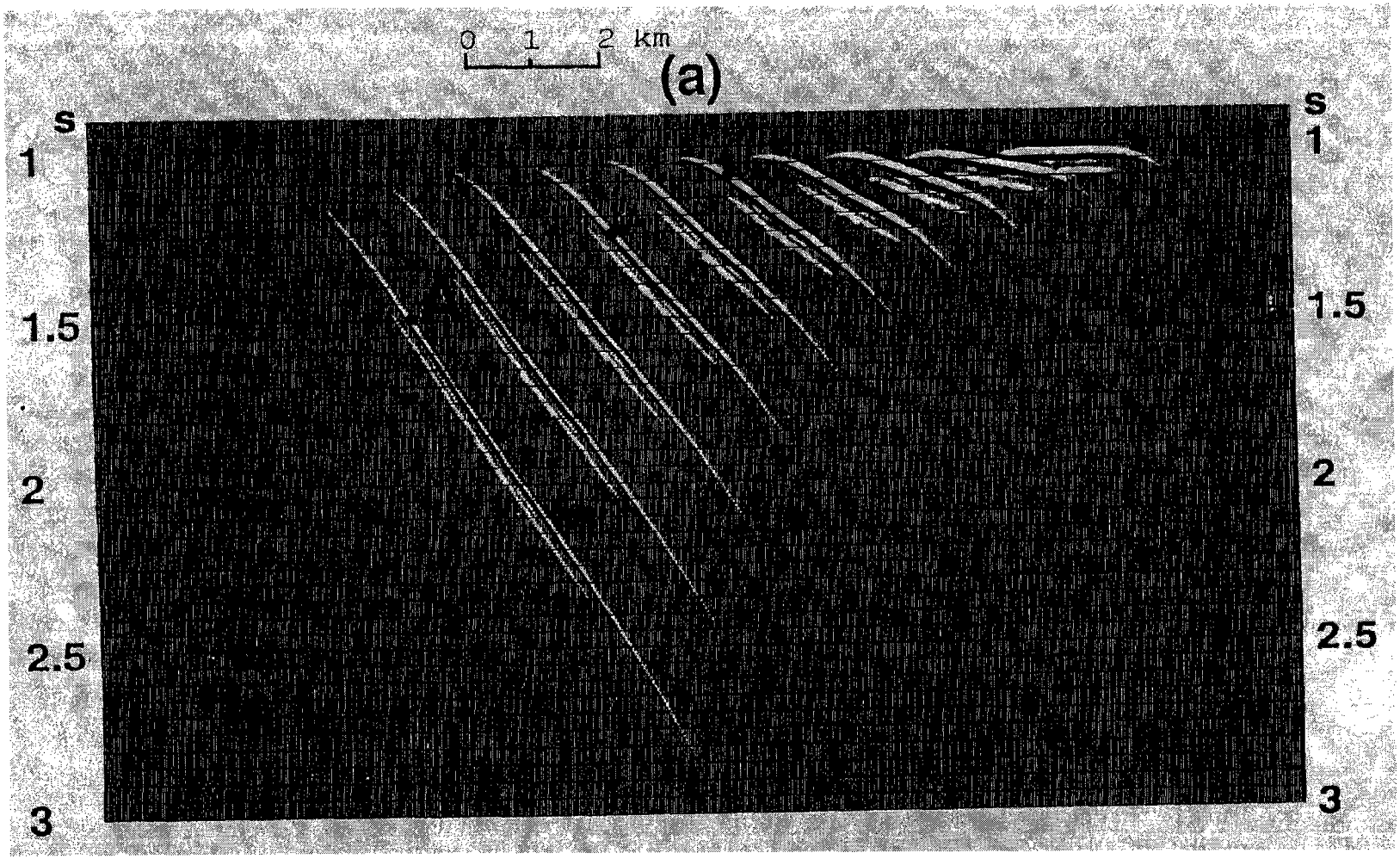

Figure 4. Zero-offset section with trace spacing of 30 m. Velocity for the reflector is assumed constant at 2800 m/s