

GEOPHYS 242: Near Surface Geophysical Imaging

Class 2: Land and Shallow Marine Near-Surface Problems

Wed, April 6, 2011

- Rugged topography, large velocity variations, and hidden layers
 - Review of near-surface imaging technologies and case histories
- 1) During this class, we shall review seismic wave propagation in the simplest velocity model that we discussed last time, and then we will discuss about the complex situation: rugged topography, large velocity variations, and hidden layers.
 - 2) We will review a few cases that apply the near-surface imaging methods to address the statics problems. Land problems versus shallow marine problems, any advantage of OBC survey geometry?
 - 3) For different types of near-surface structures, we shall discuss what imaging techniques should be applied.

Near-Surface Imaging Techniques:

- 1) Delay-time solution (**traveltimes, layer models**)
- 2) Generalized Linear Inversion (**traveltimes, layer models**)
- 3) Refraction Traveltime Migration (**traveltimes, map refractors**)
- 4) First-arrival traveltome tomography (**traveltimes, grid models**)
- 5) Refraction Interferometric Migration (**wavefield, map refractors**)
- 6) Early-arrival waveform tomography (**wavefield, grid models**)
- 7) Surface-wave dispersion curve inversion (**wavefield, local 1D model**)

Rugged Topography:

Causing elevation statics, and breakdown of some imaging techniques

- Conventional refraction interpretation may fail
- Delay-time solution may fail
- Traveltime tomography is ok
- Waveform tomography: be careful about the free-surface implementation
- Surface wave inversion may fail

Large Velocity Variations:

- Wavefront raytracing may be not accurate enough
- Large vertical velocity variations – Delay-time may perform better

- Surface-wave inversion may perform better
- Large lateral velocity variations – Traveltime tomography may perform better
- Waveform tomography should be ok, however, CFL condition (FD) may slow down the forward modeling speed because of fine grids required.

Hidden Layers:

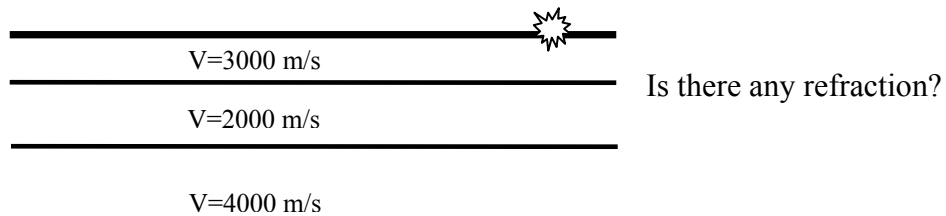
- All refraction traveltimes methods fail
- First-arrival traveltimes tomography may be ok for isolated low velocity zone
- Surface-wave dispersion-curve inversion should be ok
- Waveform tomography should be ok

Review: Seismic wave propagation in the simplest near-surface velocity models

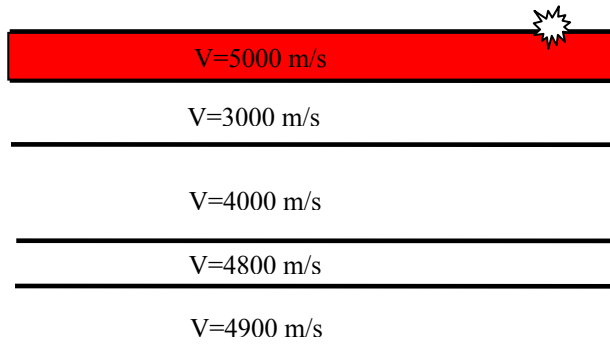
Case 1:



Case 2:

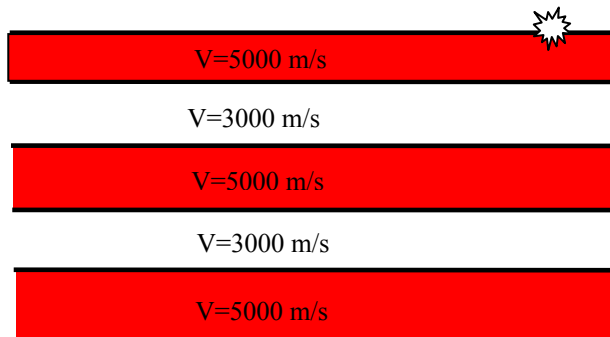


Case 3:



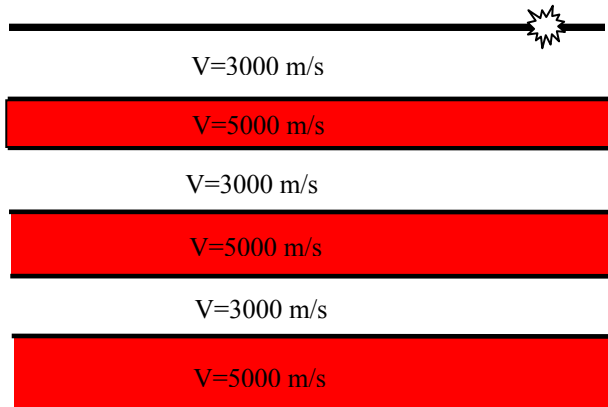
Is there any refraction?

Case 4:



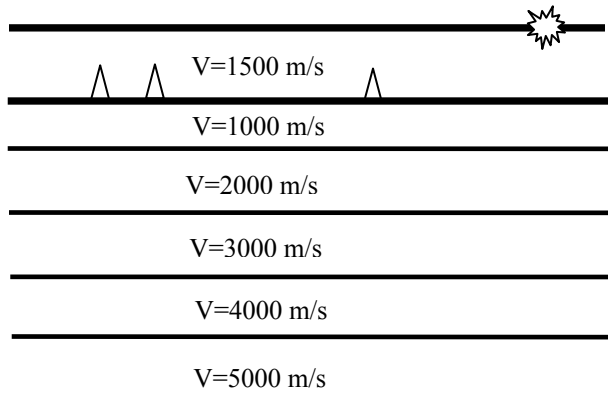
Is there any refraction?

Case 5:



Is there any refraction?

Case 6:



Is there any refraction?