

Reflection seismic 1 script

Educational Material

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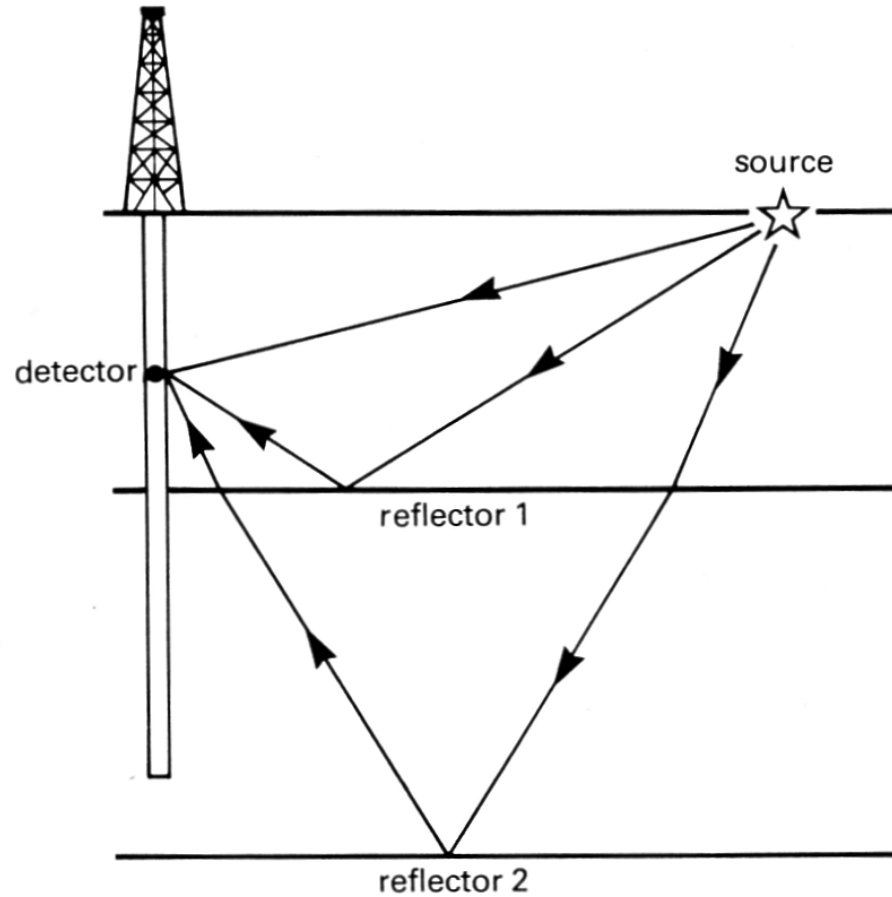
Related Methods

- **Borehole seismic**
 - **VSP**
 - **Cross-hole**
- **Combination of different methods:**
 - geology \Leftrightarrow seismic
 - Geotechnical \Leftrightarrow seismic
 - Seismo-electric method
 - Seismic-gravity-magnetics integration
- **NDT using ultrasonic reflection measurements**
- **Georadar**
- **Sidescan Sonar**

Related methods

- geology \Leftrightarrow seismic
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Vertical seismic profiling (VSP)



Advantages of VSP

Dept of receivers is known

-> accurate Velocity-depth -Model

Travel times are less:

-> Less attenuation

-> Improved resolution

**Improved distinguishing of
Primaries and multiples**

Direct measurement of the waveform

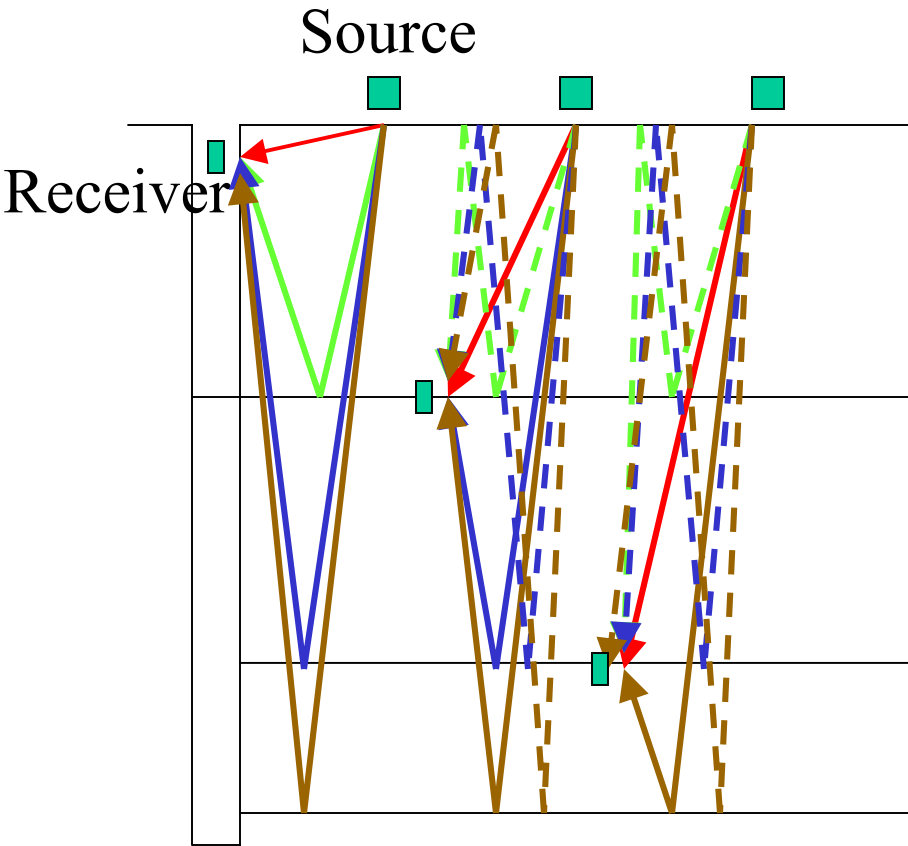
-> Improved deconvolution

VSP tools



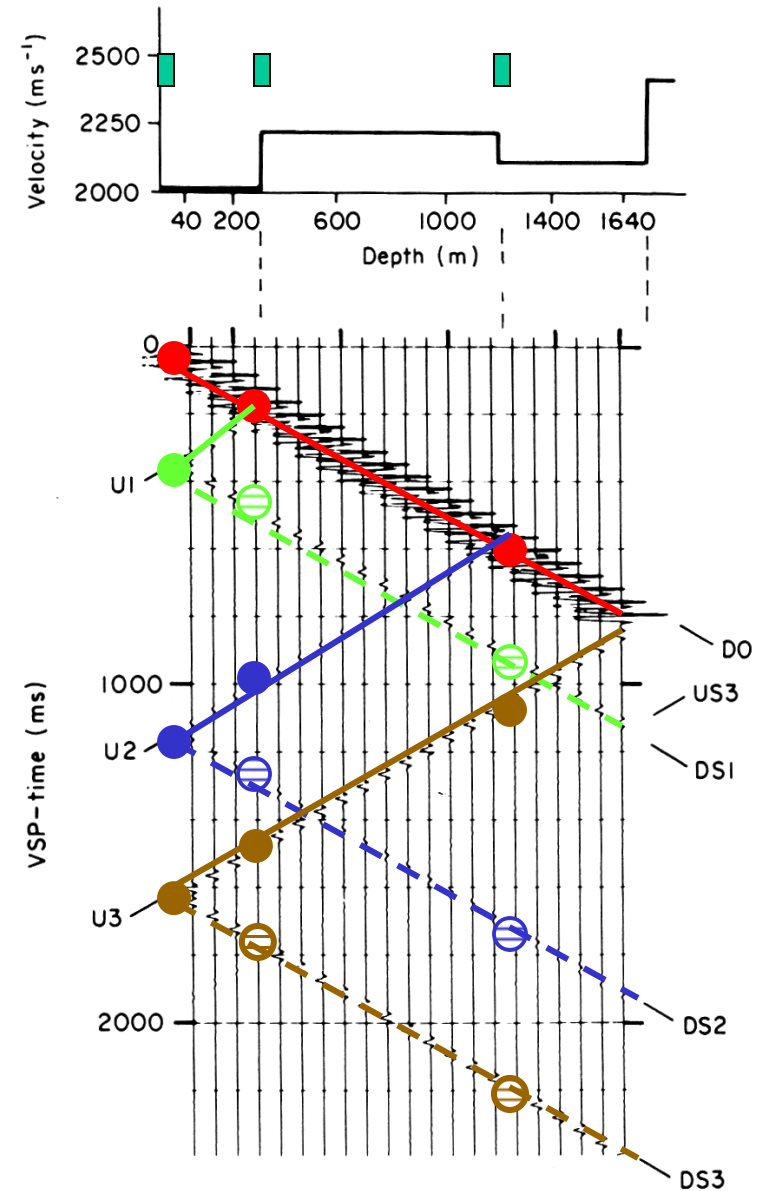
Geophone

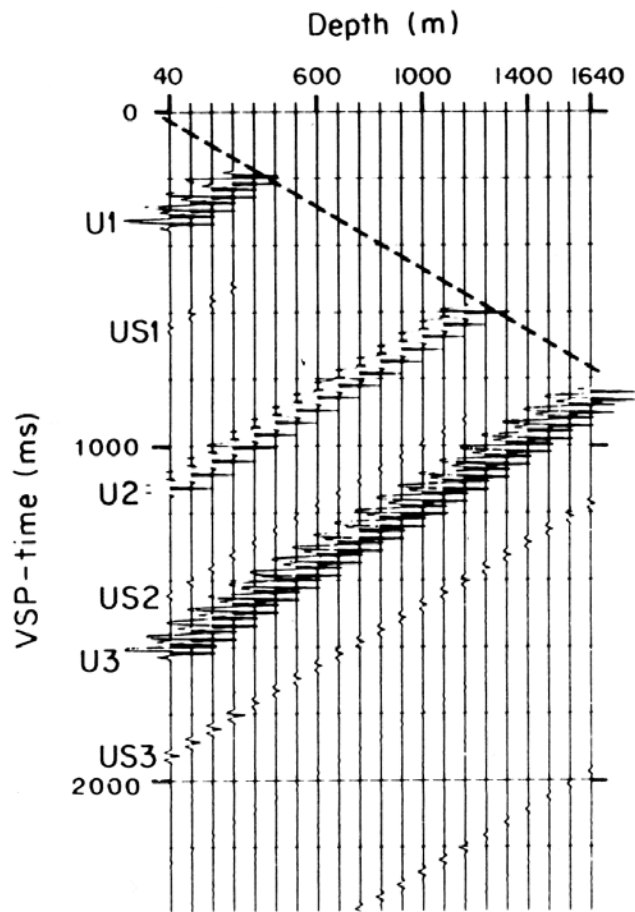
Synthetic zero-offset VSP record



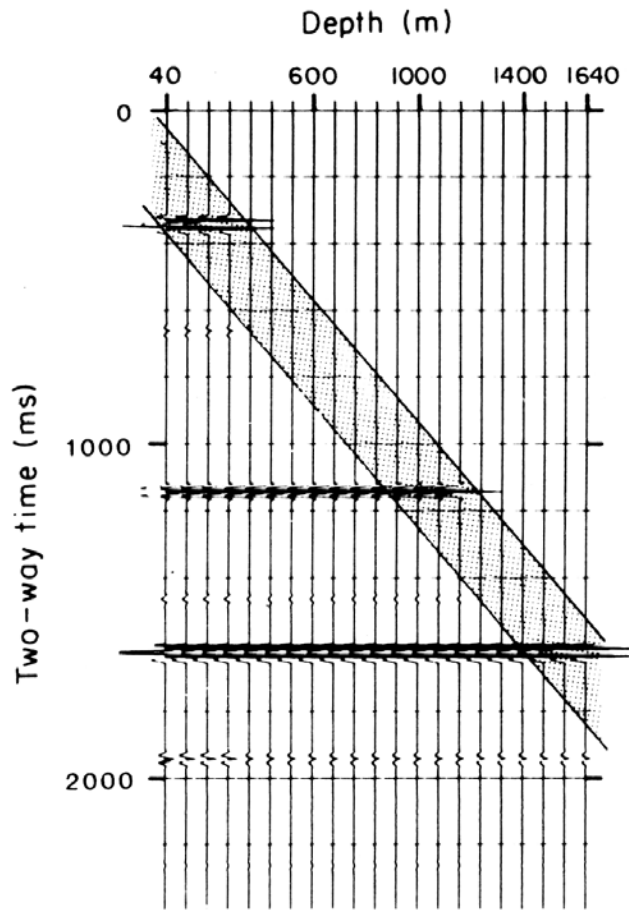
Upgoing waves:

- Primary refl. from interface 1
- Primary refl. from interface 2
- Primary refl. from interface 3





Downgoing waves removed by kf-filtering



Time shifting of the traces with the uphole time

Corridor stack

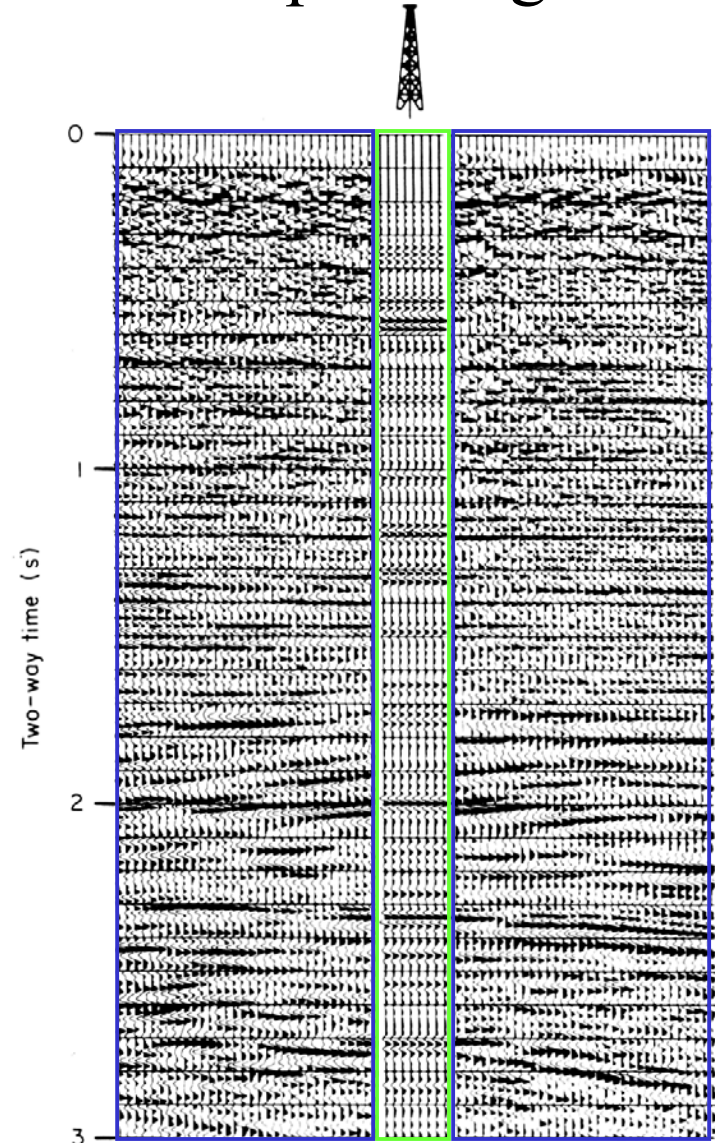


Stacked seismogram from shaded corridor

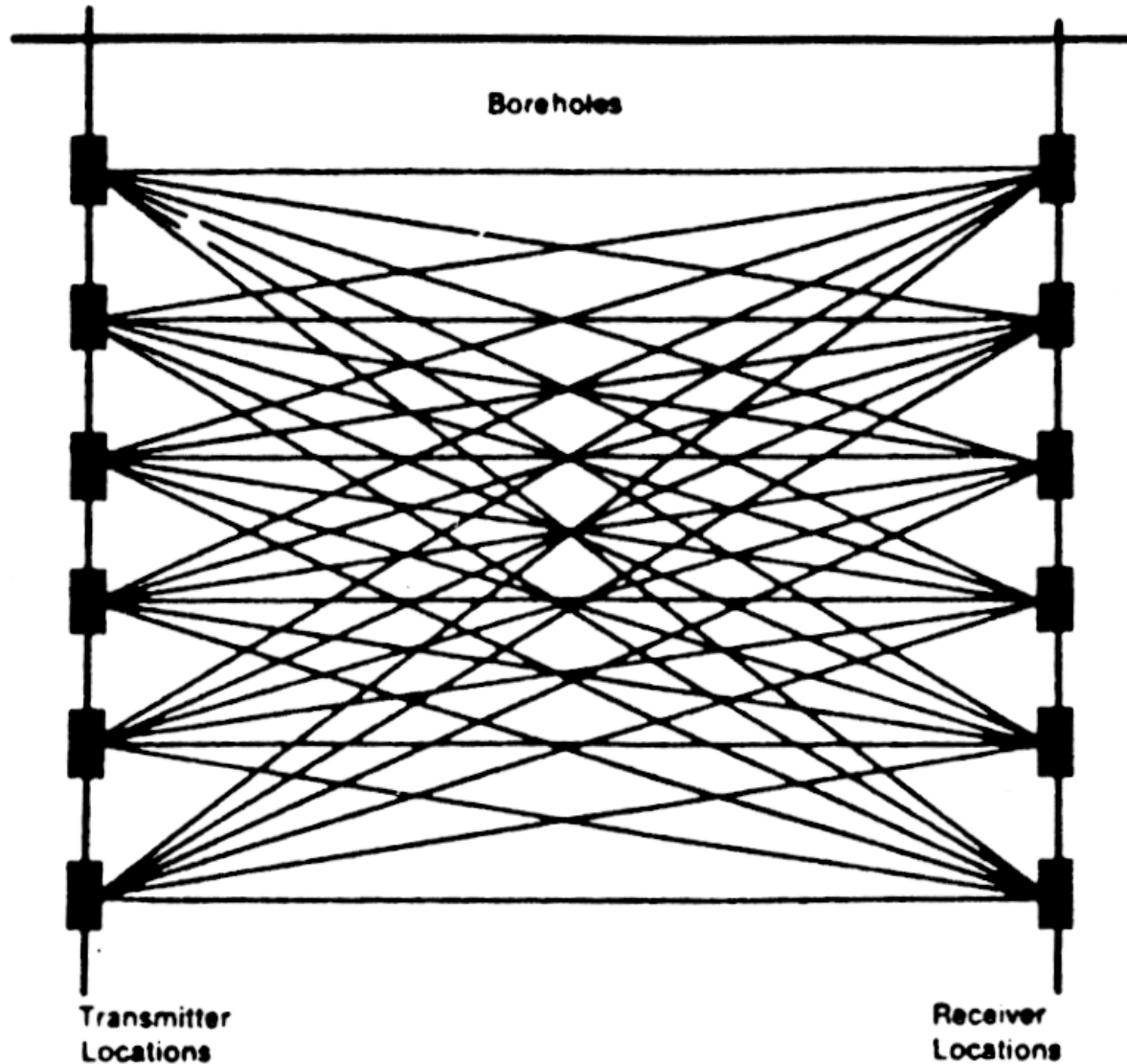
Comparison between VSP and surface profiling data

Corridor stack of the zero offset VSP section, Reproduced 8 times

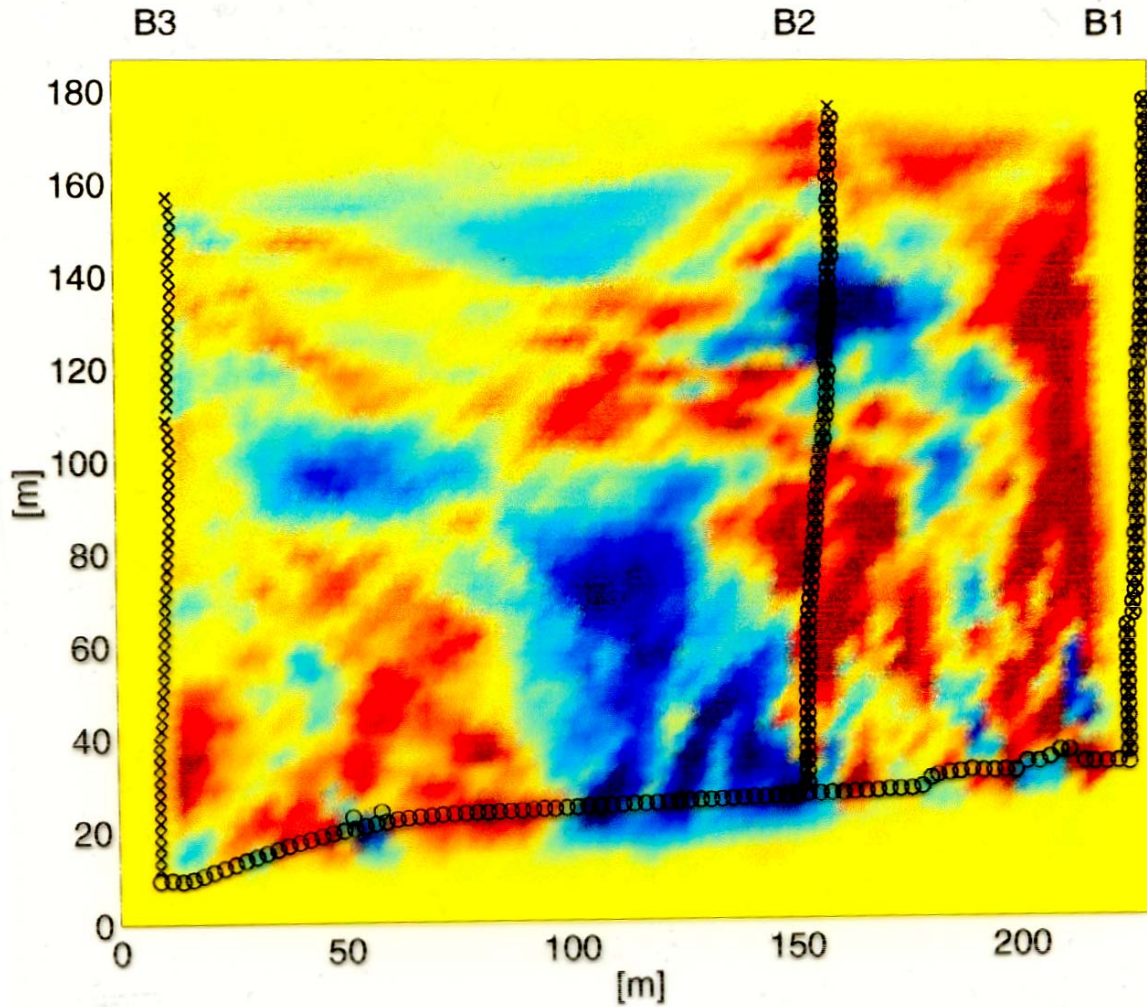
Conventional seismic section based on surface profiling data from the vicinity of the borehole site



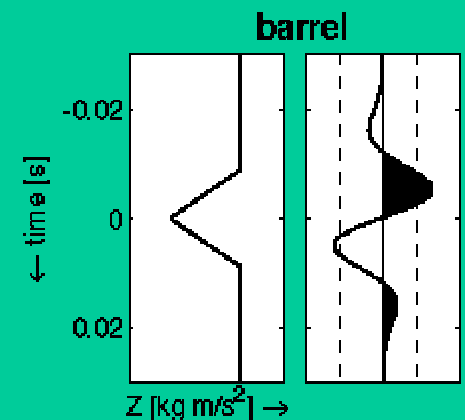
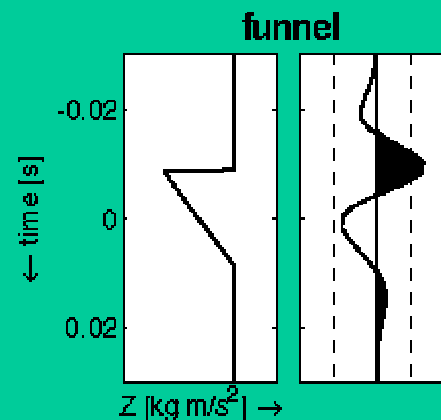
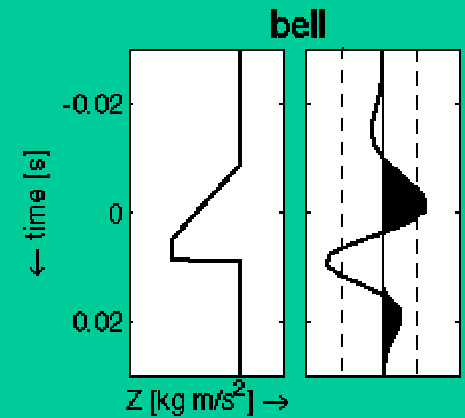
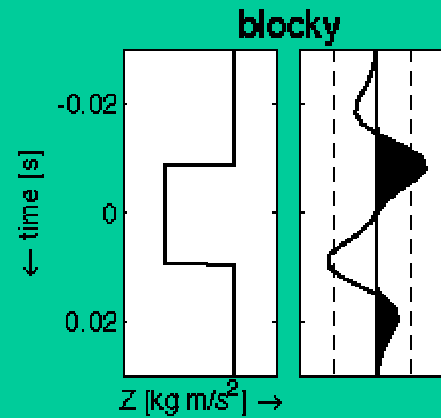
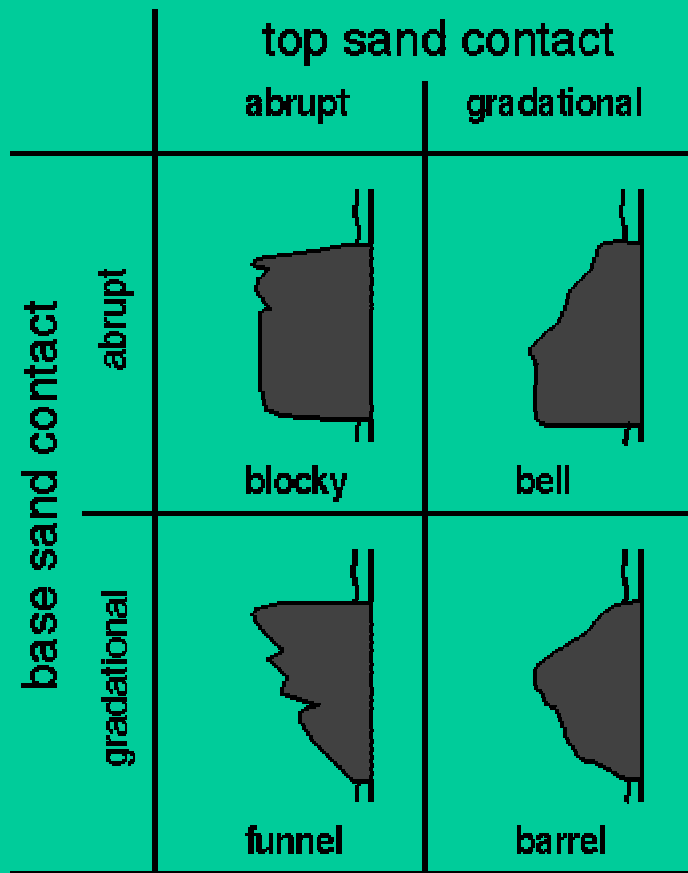
Crosshole tomography



Crosshole tomography example



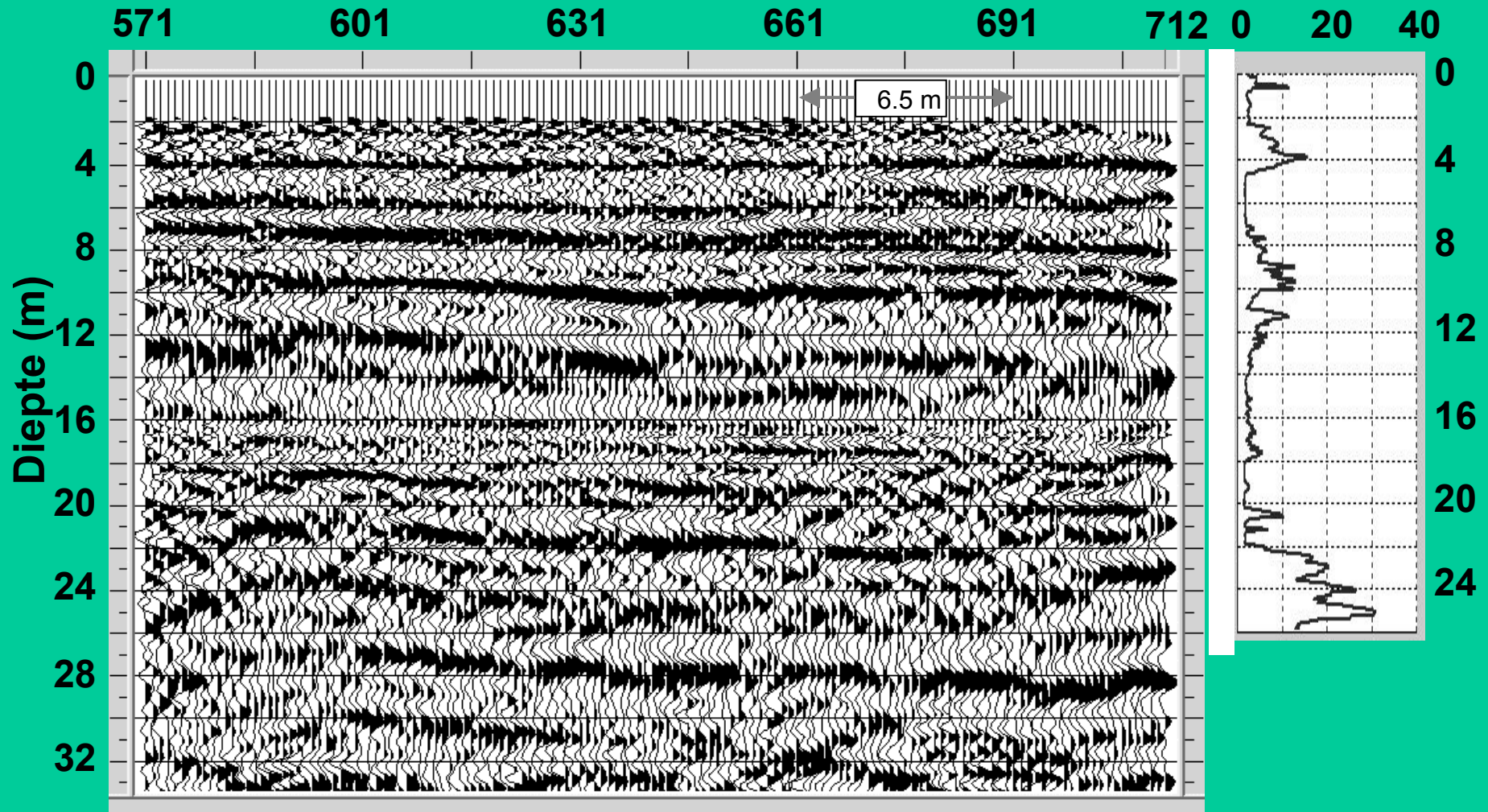
(Grimsel by H.R. Maurer)



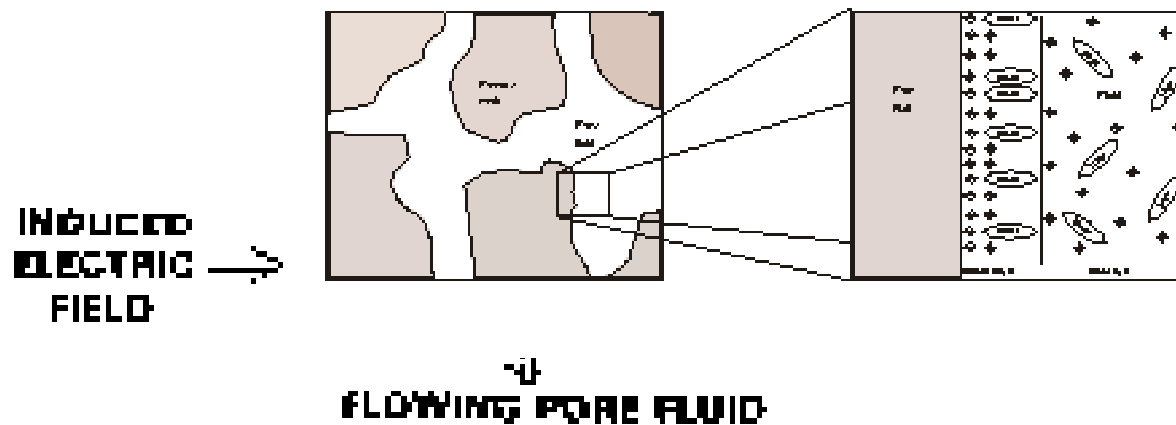
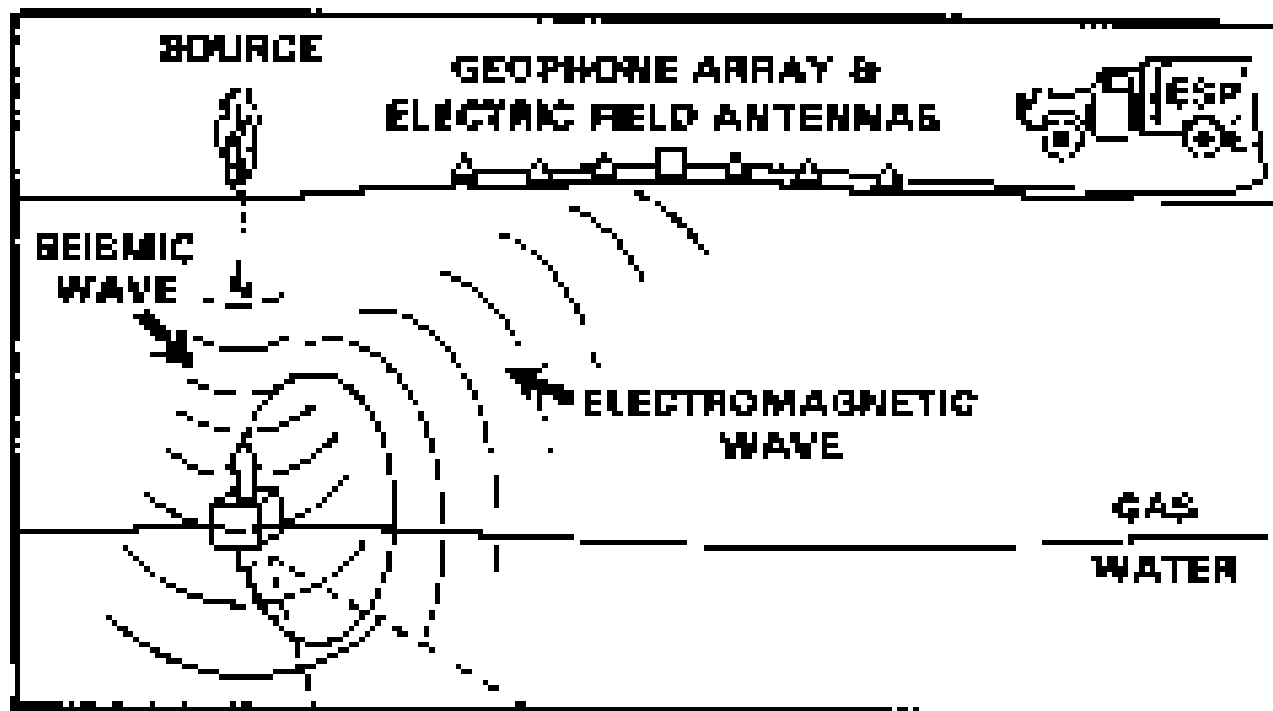
Geological boundaries and their seismic reflections (Verhelst, 2000)

S-wave seismology

Geo-technical

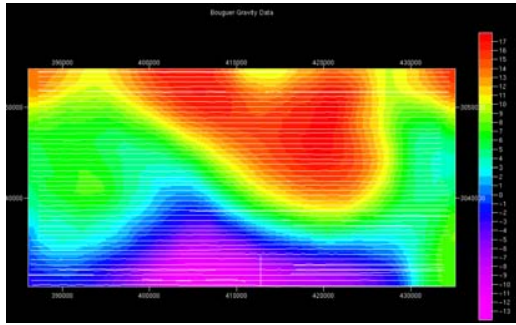


Integration of seismic and geotechnical measurements (Ghose, 2000)

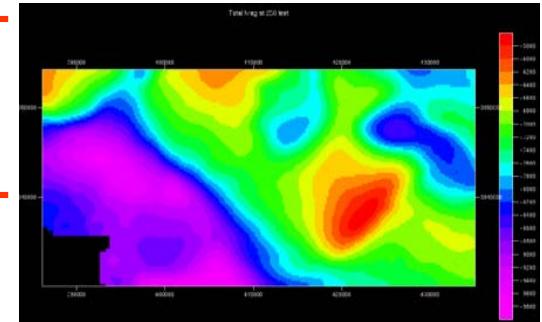


De seismo-electrical method (Thompson en Gist, 1993)

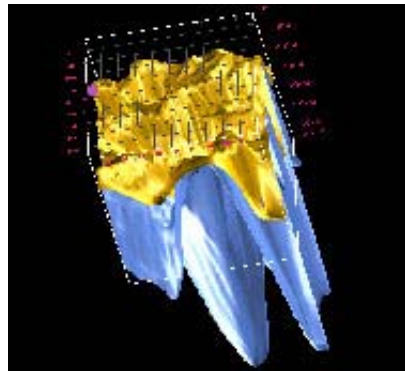
Potential Fields Technology enhancing streamer data



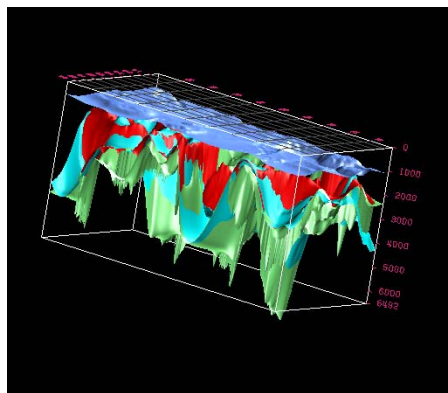
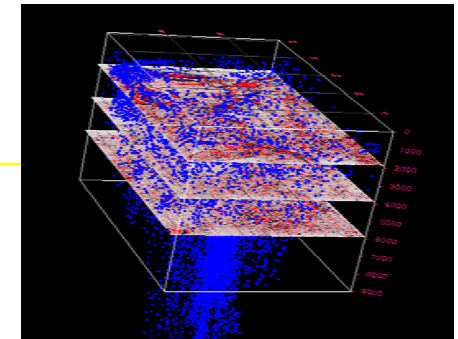
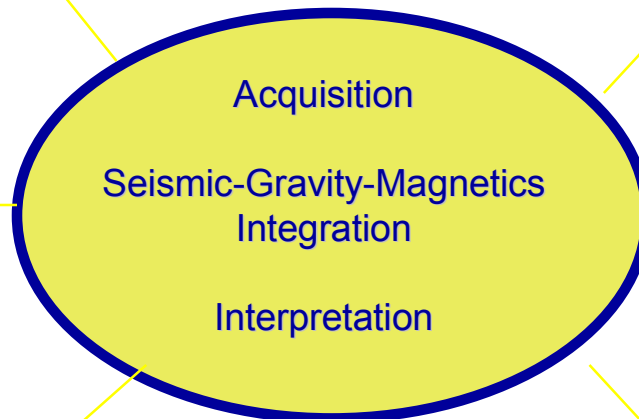
3-D Bouguer Gravity



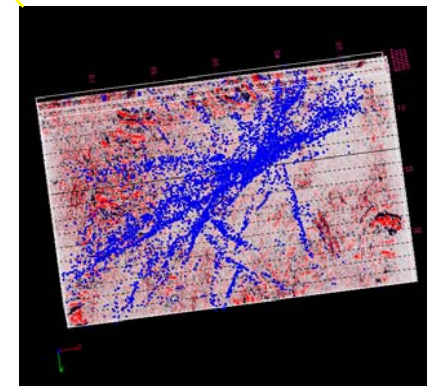
Multi-Level Aeromagnetics



Top & Base of Salt



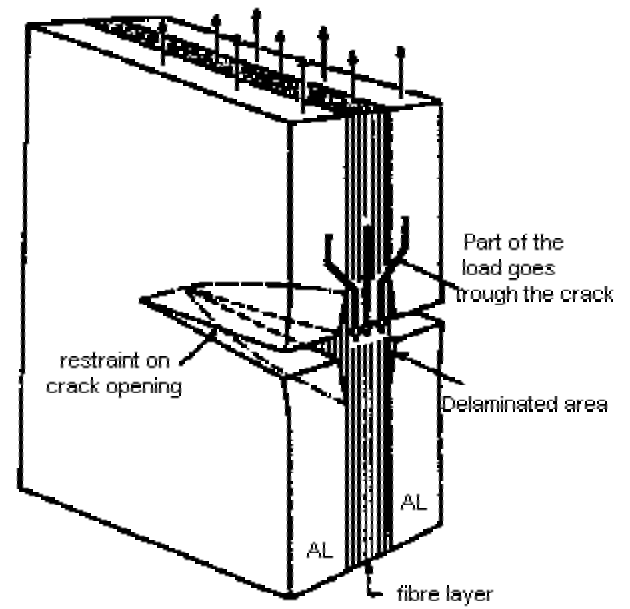
Salt and Sediment Defined



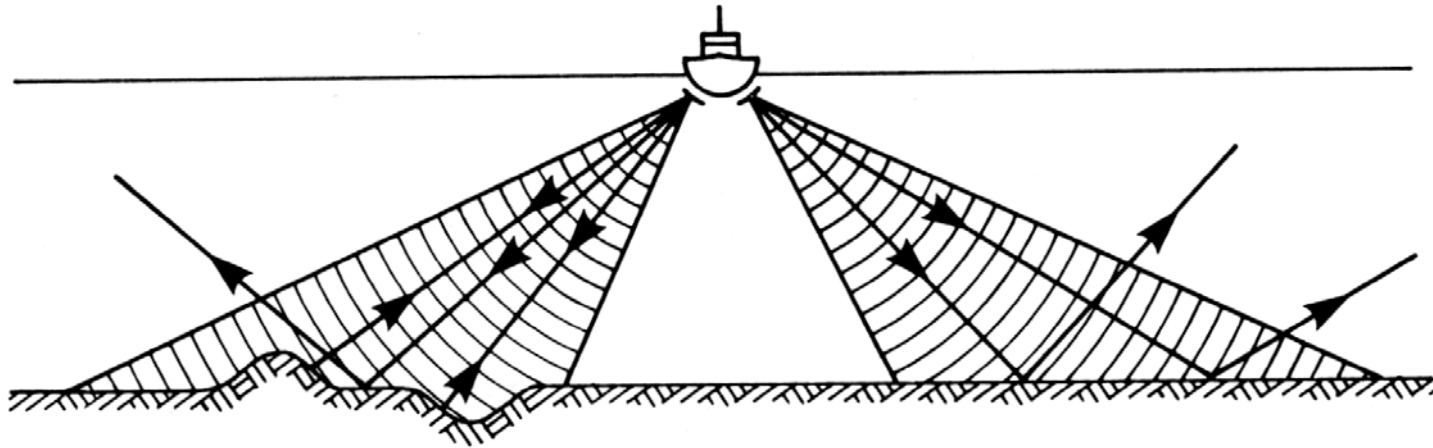
fiber-metal laminates



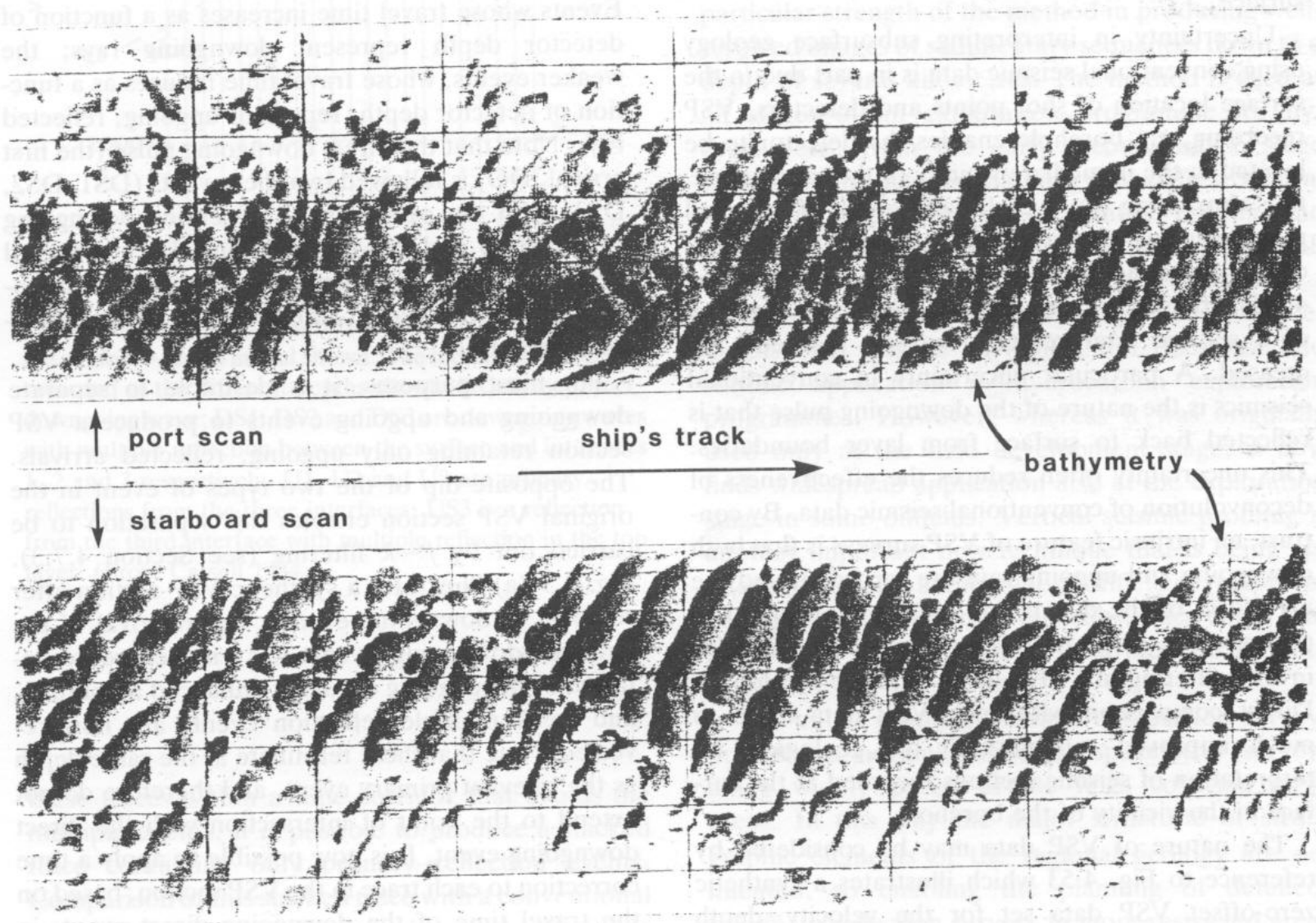
GLARE



Sidescan sonar

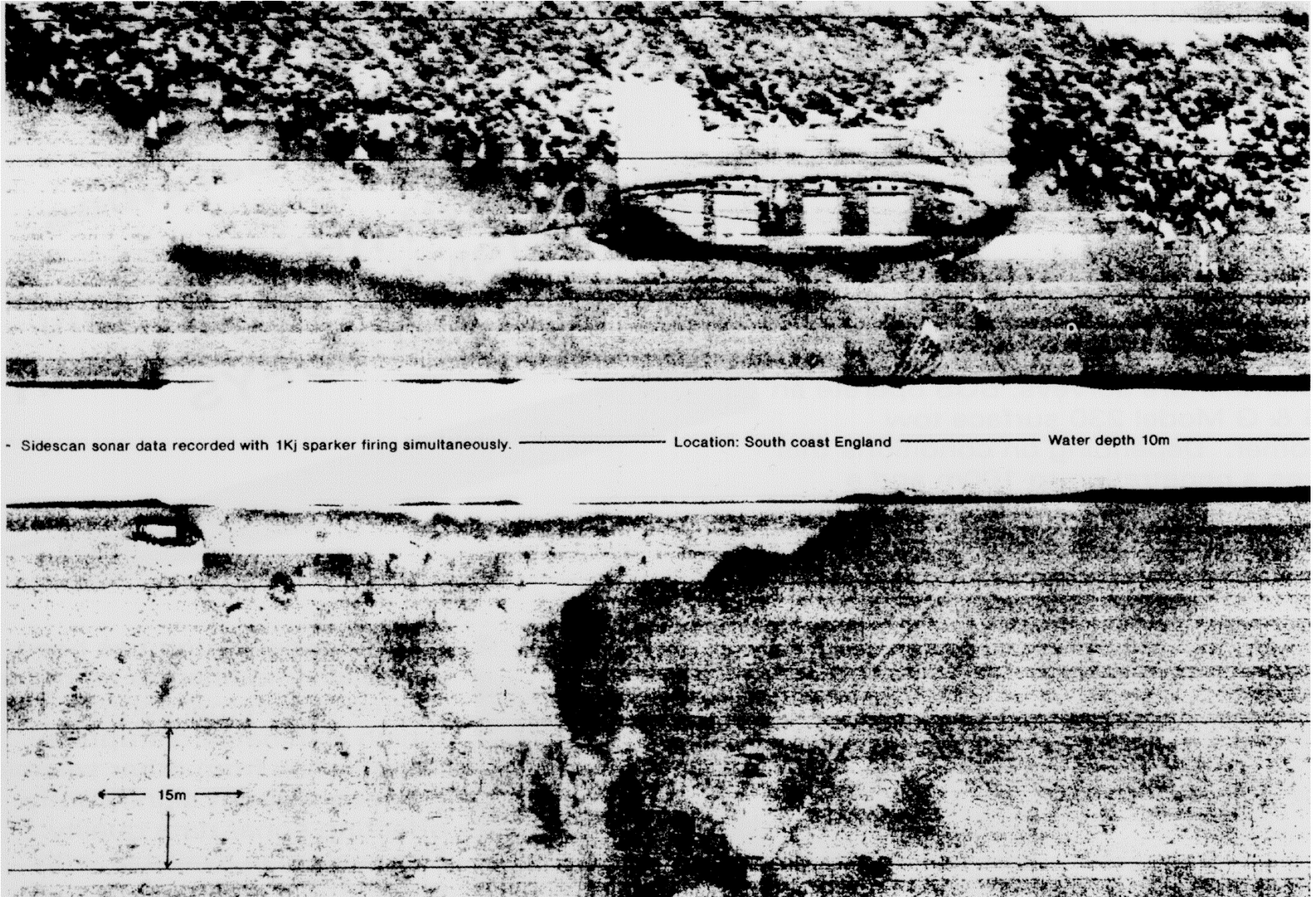


High frequency sound 30-110 kHz



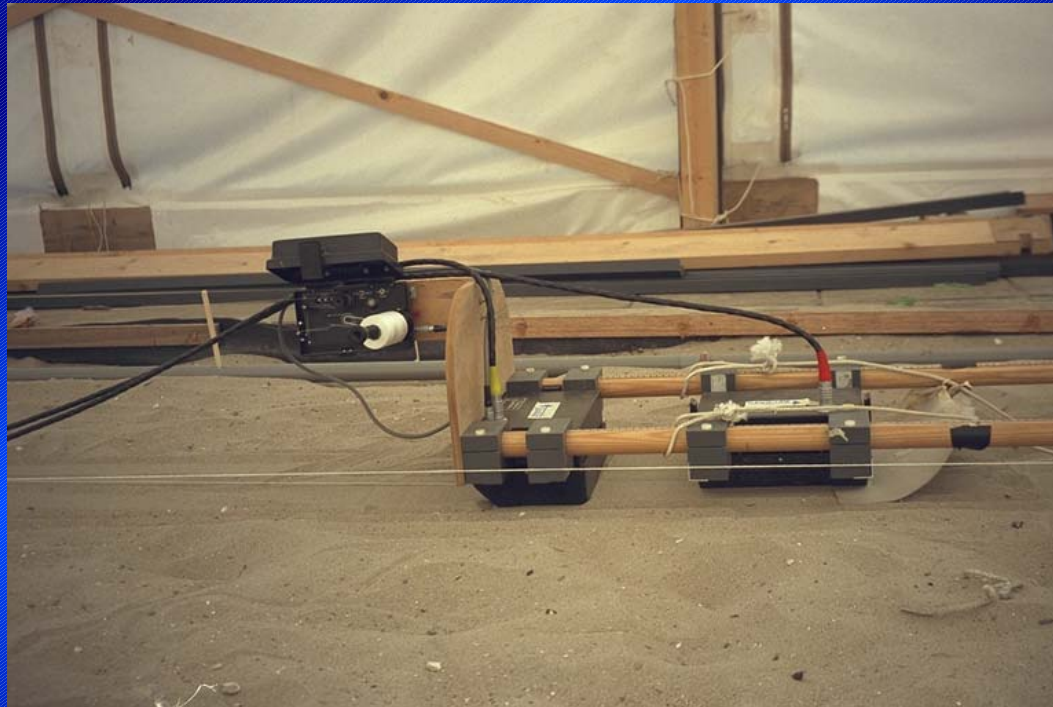
Sonograph showing linear sand waves in the southern North sea

Sidescan sonar data



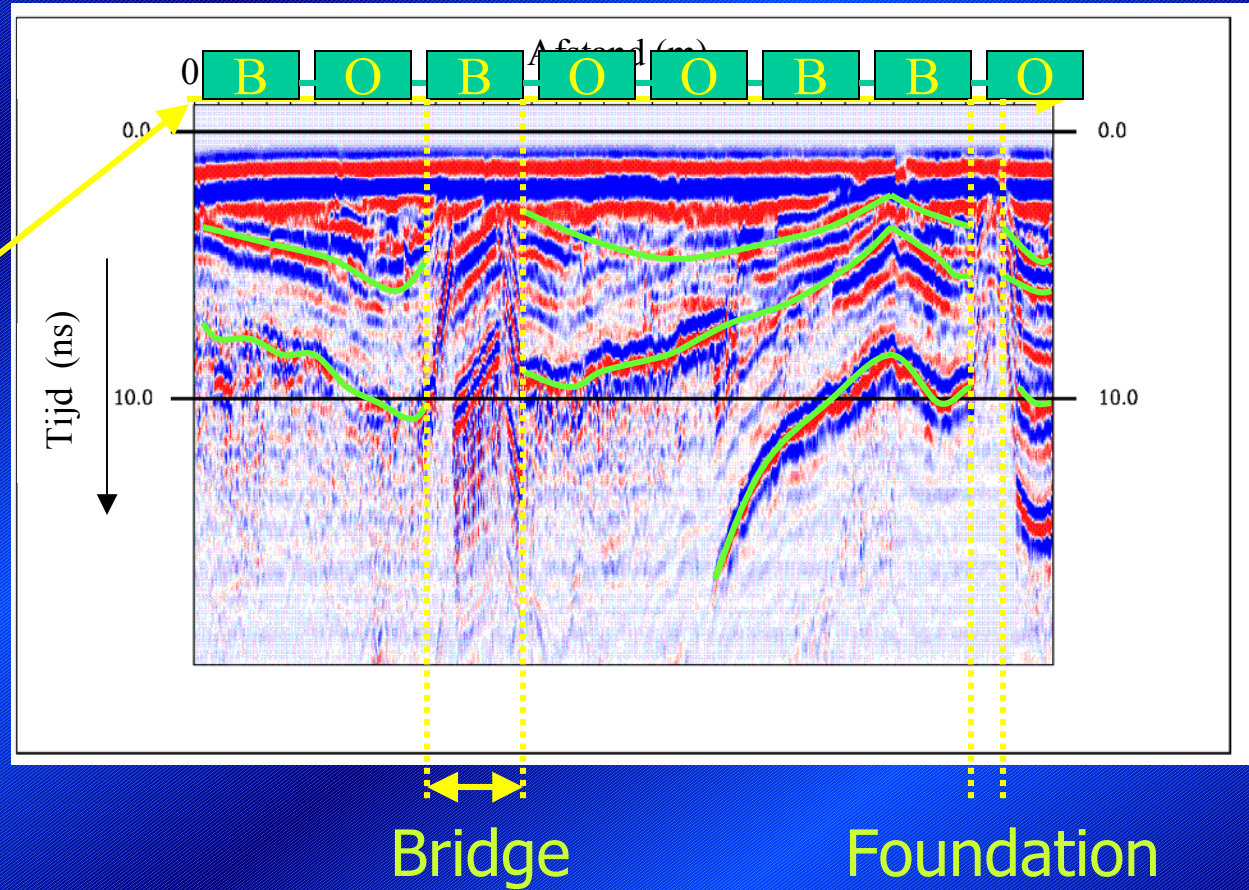
(Example British Geological Survey - BGS)

Three-dimensional imaging of Multi-component ground penetrating radar data



J. van der Kruk

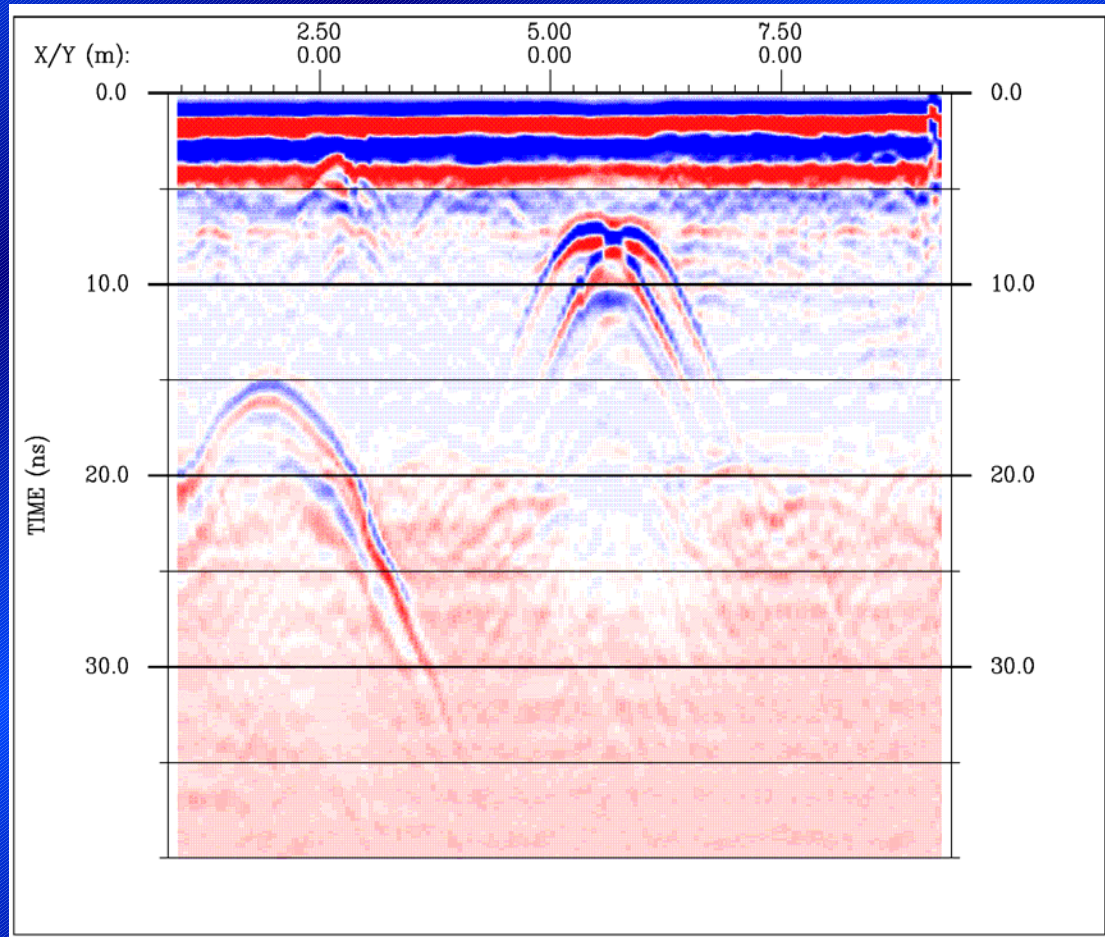
Estimation of thickness of asphalt on highway 16



Center frequency: 900 MHz

Identification of different asphalt layers

Detection of metal pipes



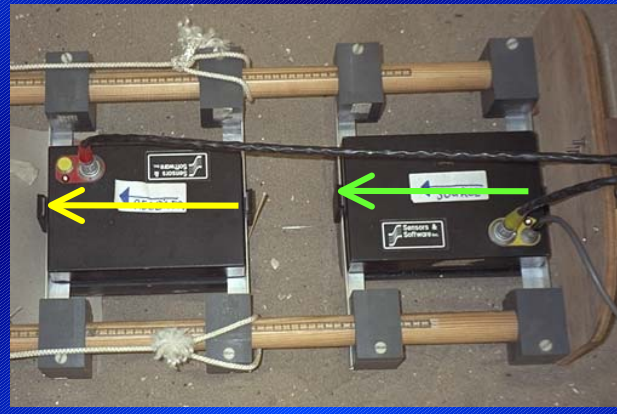
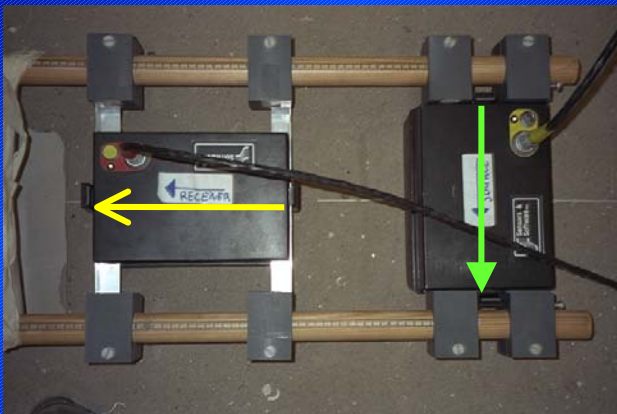
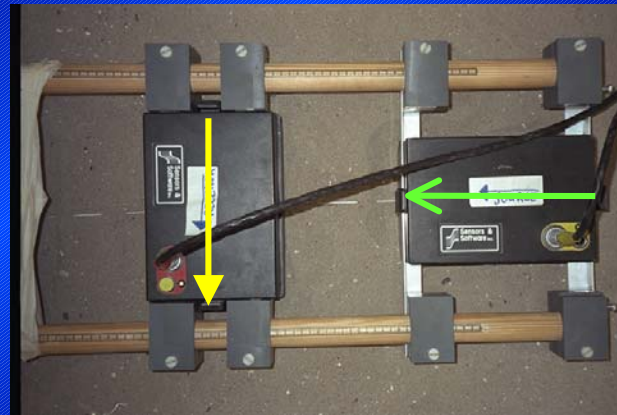
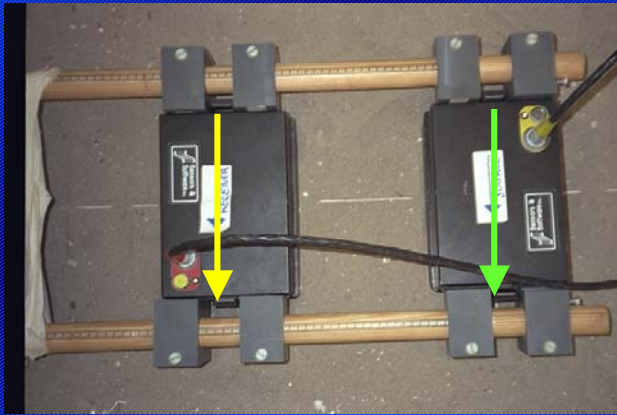
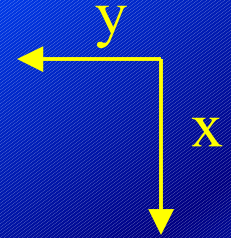
Center frequency: 450 MHz

Multi-component measurements

Source direction

x

y



Receiver direction

x

y

Multi-component Imaging Algorithm:

Measurement

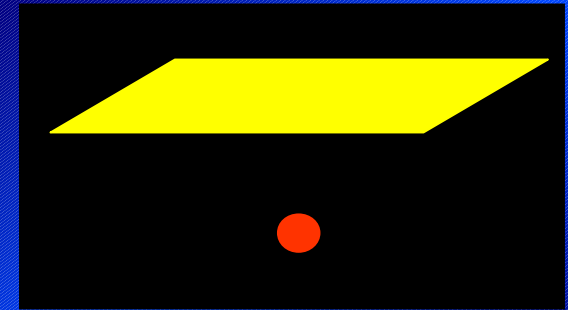
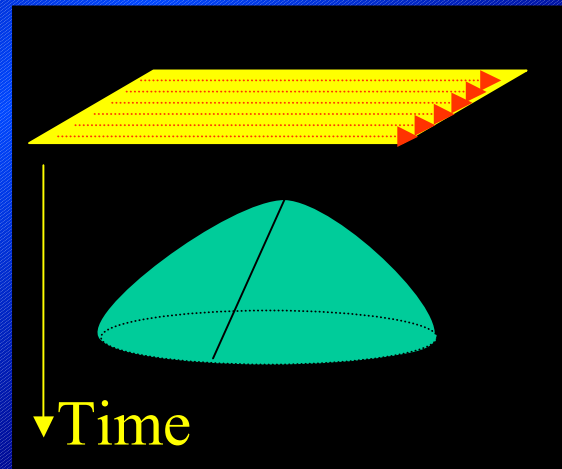
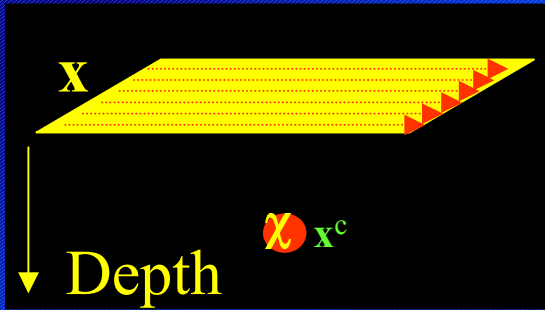
Imaging



Reality:

Measured data:

Obtained image:

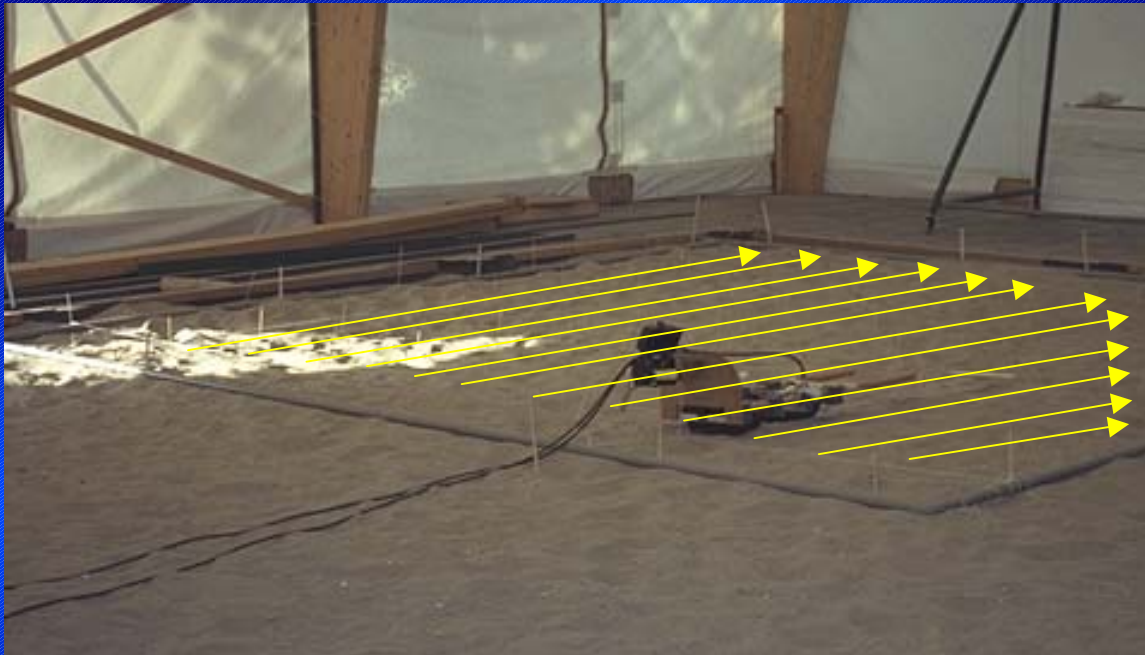


Object:

$\chi(x^c)$???

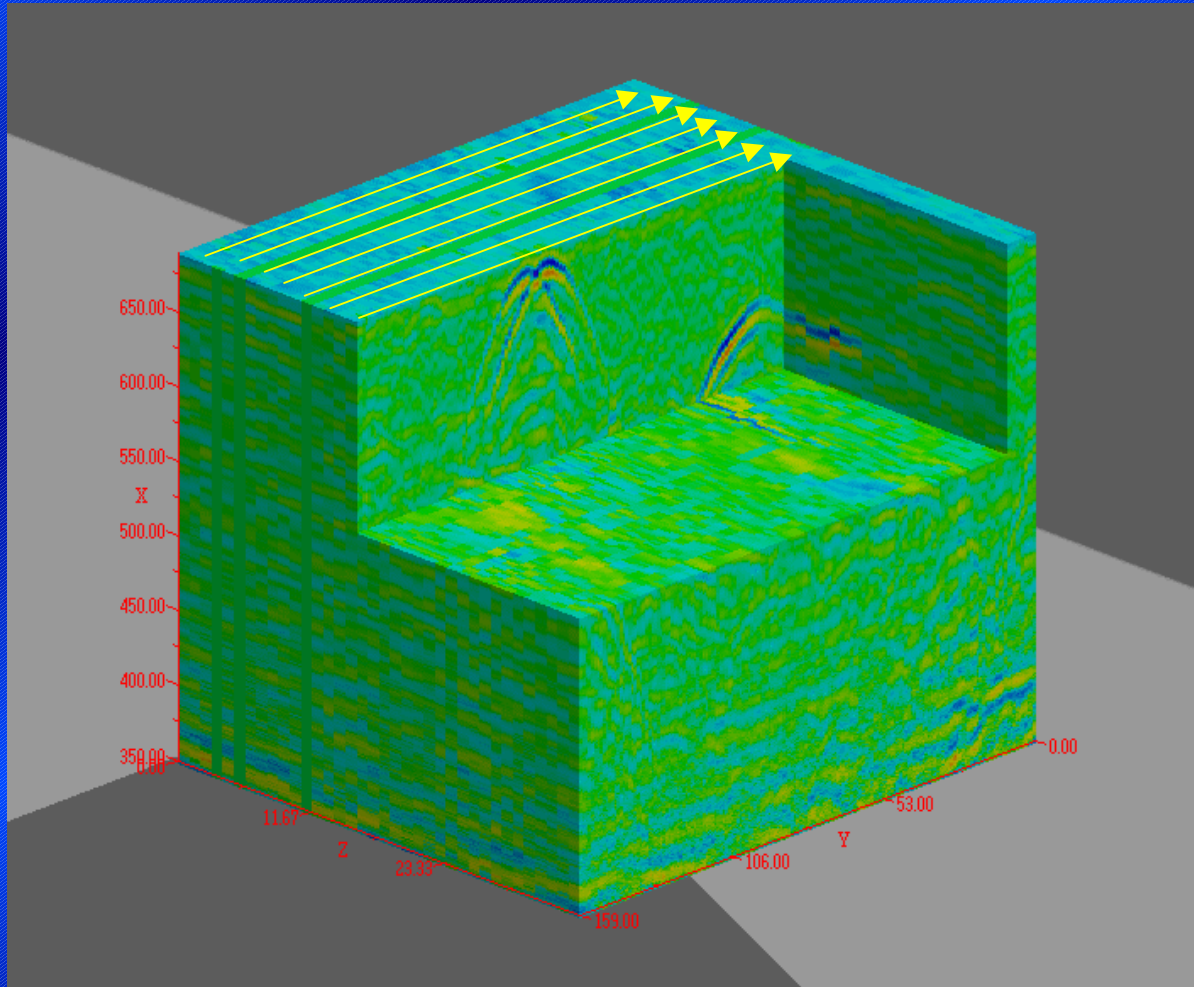
Experimental results

Reality: ??



Measurements
→

Measured data:



Imaging



Obtained image of the subsurface:

