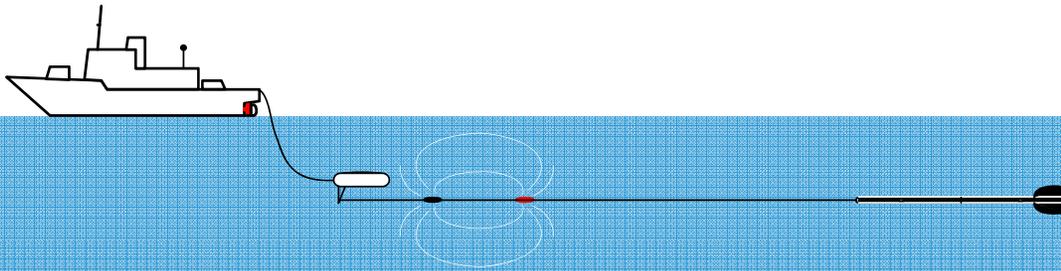


Electromagnetic Rapid Environment Assessment of sediment conductivities and structures



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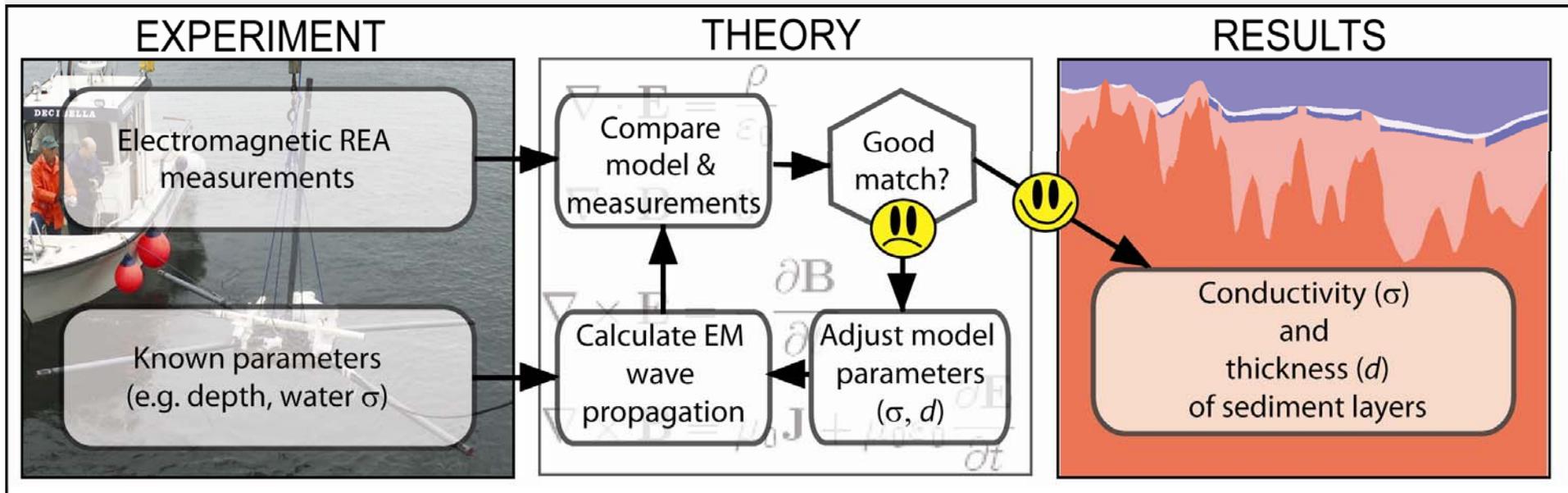
Purpose

- Marine controlled-source electromagnetic (CSEM) soundings can be used to study sedimentary structure and conductivity offshore.
- Rapid Environment Assessment (REA) provides important information in naval tactical support system about wave propagation in the area.
- Alternative/complementary technique to seismic methods (e.g. presence of gas pockets, carbonates).
- Important for environmental monitoring and pollution assessment.
- Oil and gas exploration

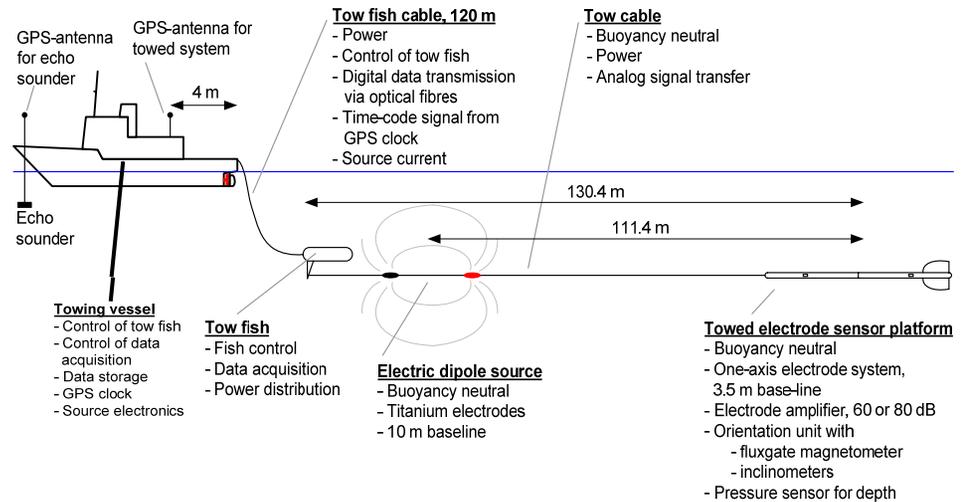
Model based inversion

Three requirements:

- ✓ Equipment to measure and transmit electric signals
- ✓ A forward wave propagation model
- ✓ An inversion technique which provides estimates of the environmental parameters

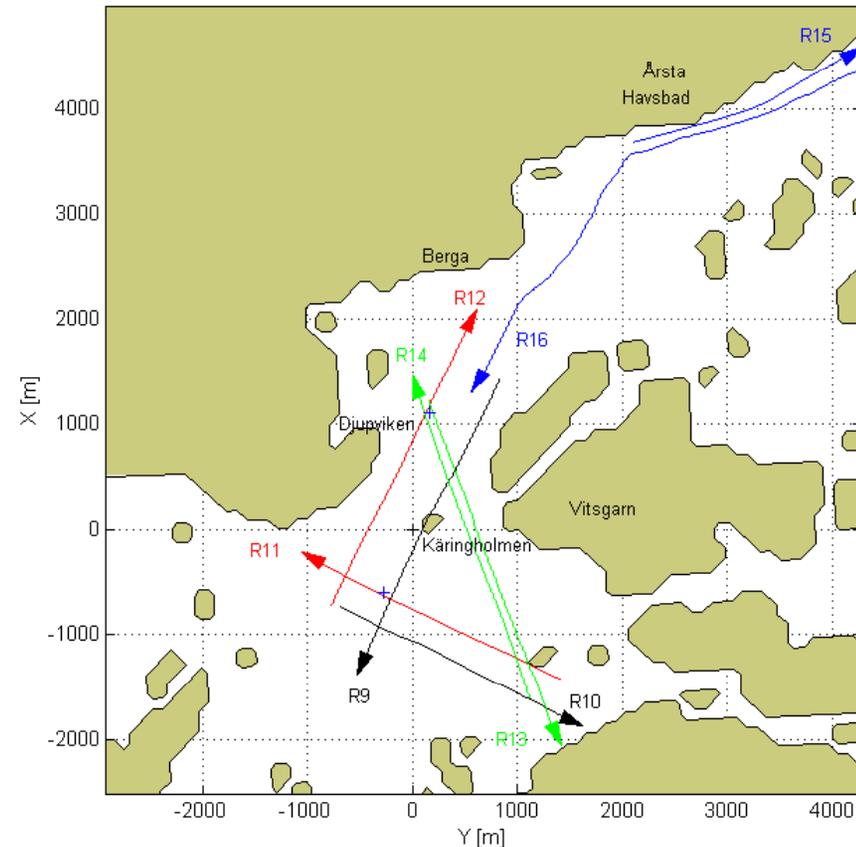


Experimental setup



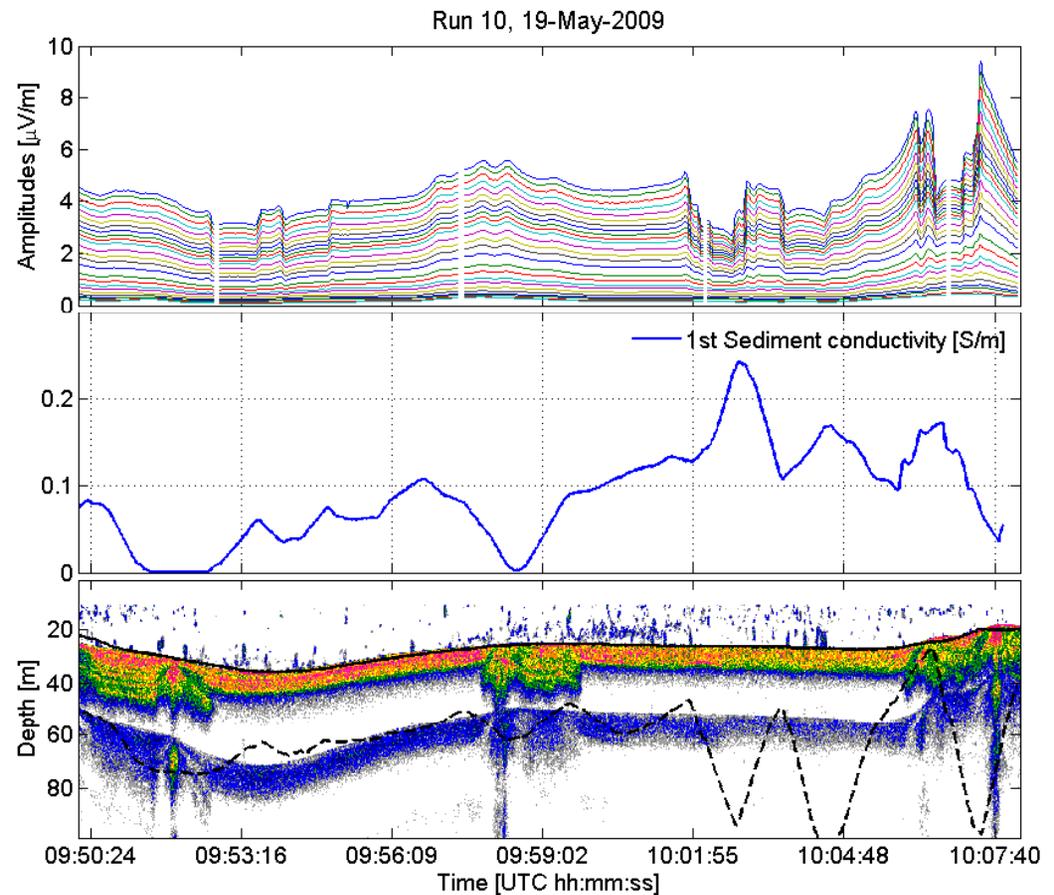
Field sea trial

- Field trial conducted in the Stockholm Archipelago
- Several types of topography
 - Relatively flat
 - Moderate slopes
 - Steep ridges
 - Mud or clay, sand, some bedrock exposures
- Areas with both slowly varying and strong lateral variations



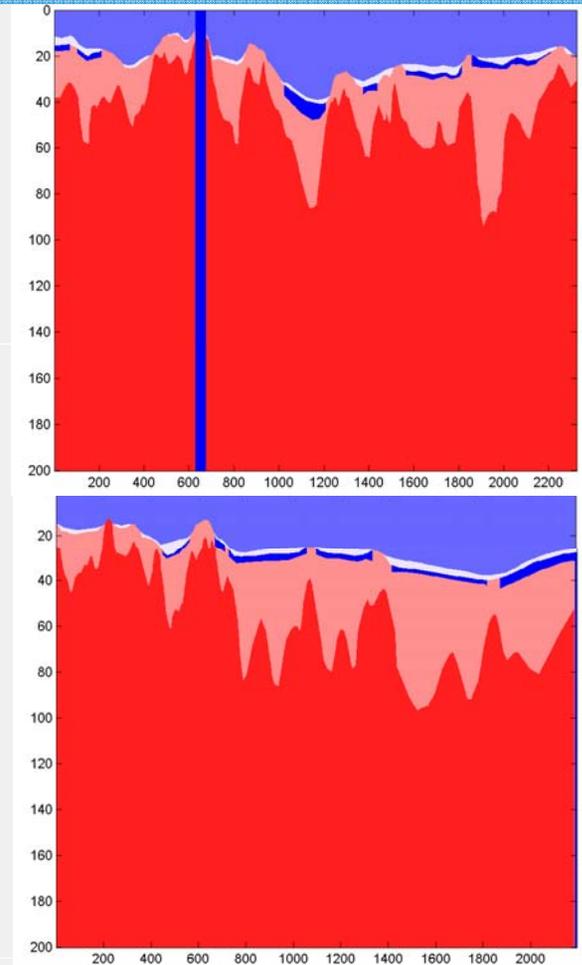
Experimental comparison

- Sediment conductivity varies from ~ 0.1 - 0.4 S/m
- Sediment thickness very variable
 - Echo intensity from the echo sounder shows mostly a relatively flat layer



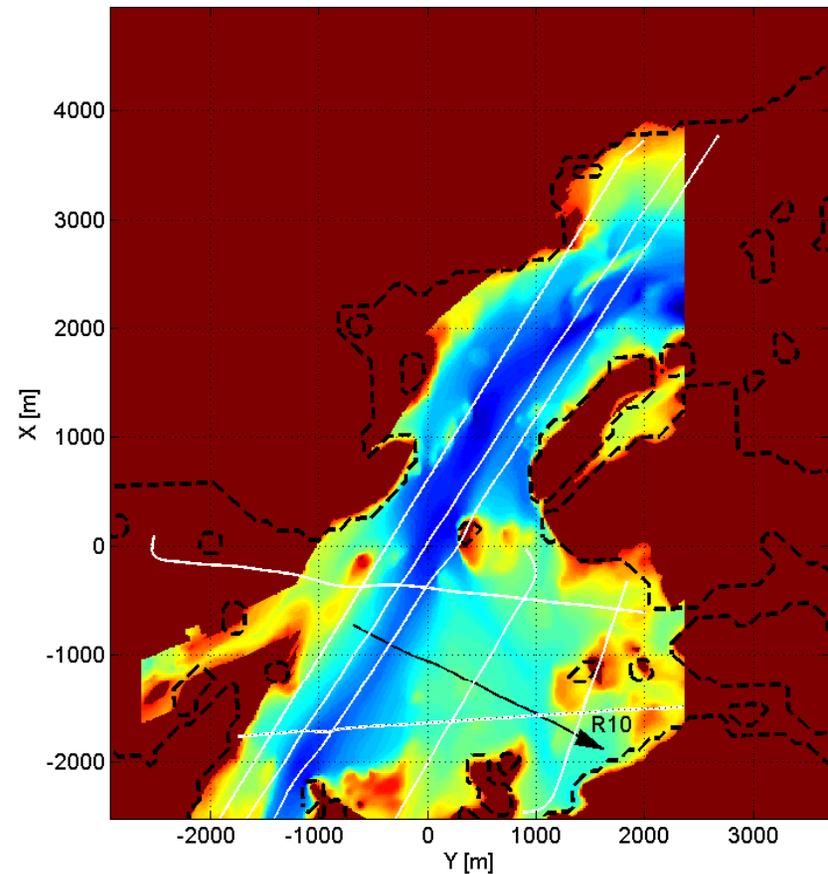
Sesmic investigation

- Sesmic investigation of the field trial area from 2004
- Shows a thin layer of postglacial clay on top of a deeper layer of more compact glacial clay
- The interface between the clay and bedrock is characterized by deep and rather narrow troughs
- Echo sounder not able to penetrate to the clay/bedrock interface



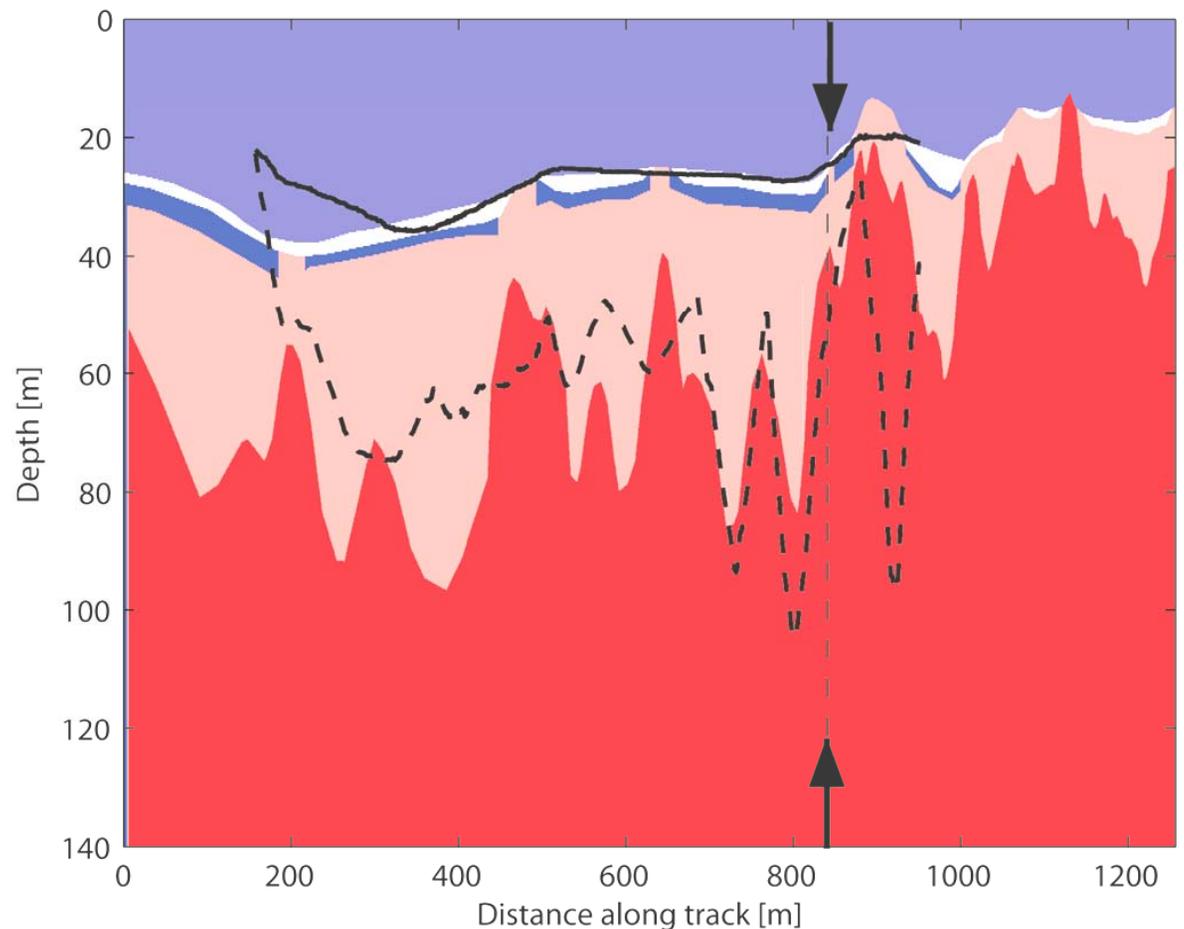
Tracks of seismic and REA trials

- The existence of seismic data not known at REA field trial
- Measurements tracks does not overlap
- However, possible to investigate statistical behavior of sediment interface based on both the REA results and seismic investigation



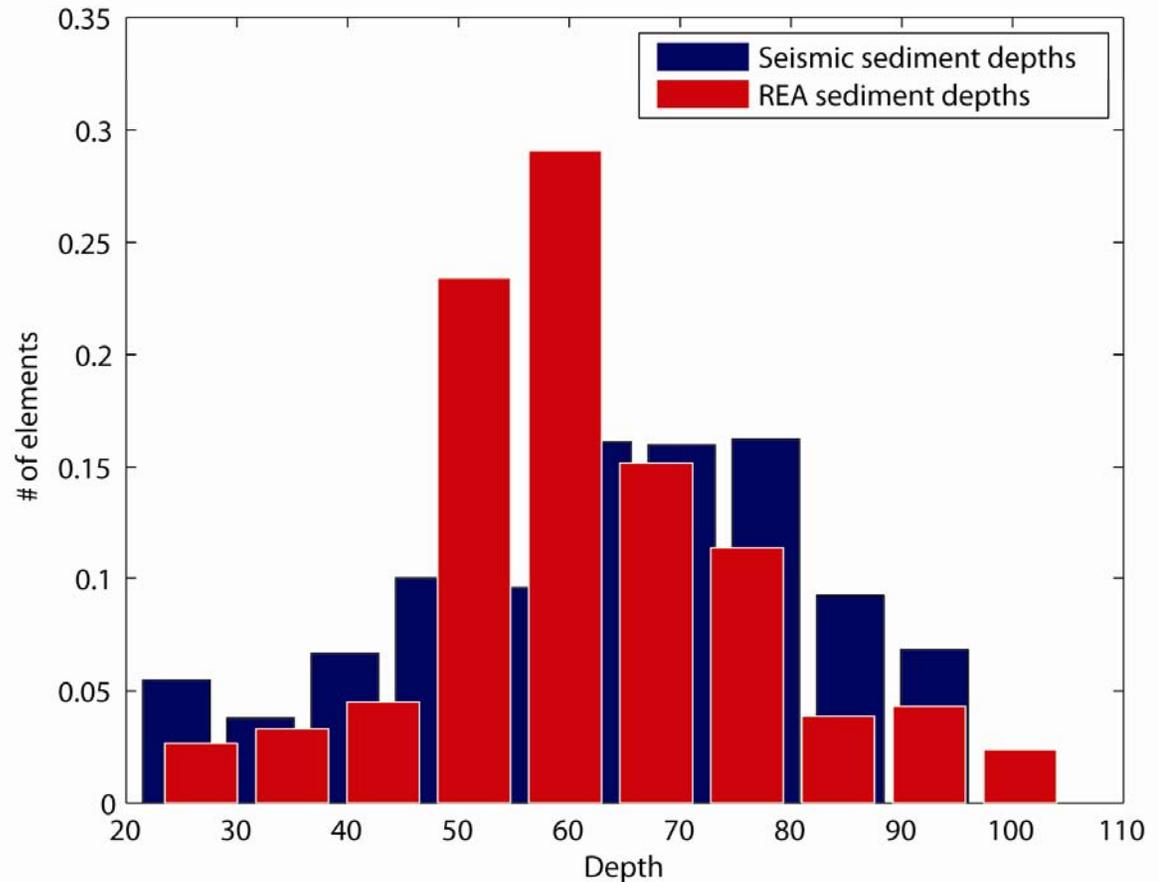
Projected REA results

- Results from R10 projected on top of closest seismic run
- Measurement tracks at an angle of each other
- Features in REA agree well at point of intersection



Statistics

- Histogram of the depth of the sediment/bedrock interface
- The two distributions fulfill Kolmogorov-Smirnov test at 95 % confidence level



Conclusions

- Multispectral frequency sounding
 - works well for small spatial scales and shallow depths
 - identifies the strongest electrical impedance contrast
- 1D REA
 - shows a sub-bottom structure characterized by strong variations (~100 m wide and ~40 m deep)
 - agrees well with previous seismic investigation from the area (although a direct comparison not possible)
- Future
 - REA efforts should perform 2D or 3D modeling due to inherent non-1D behavior of the environment (FOI models currently under development)
 - field trials should be conducted along the same tracks as seismic data