EGM703 – Advanced Active and Passive Remote Sensing

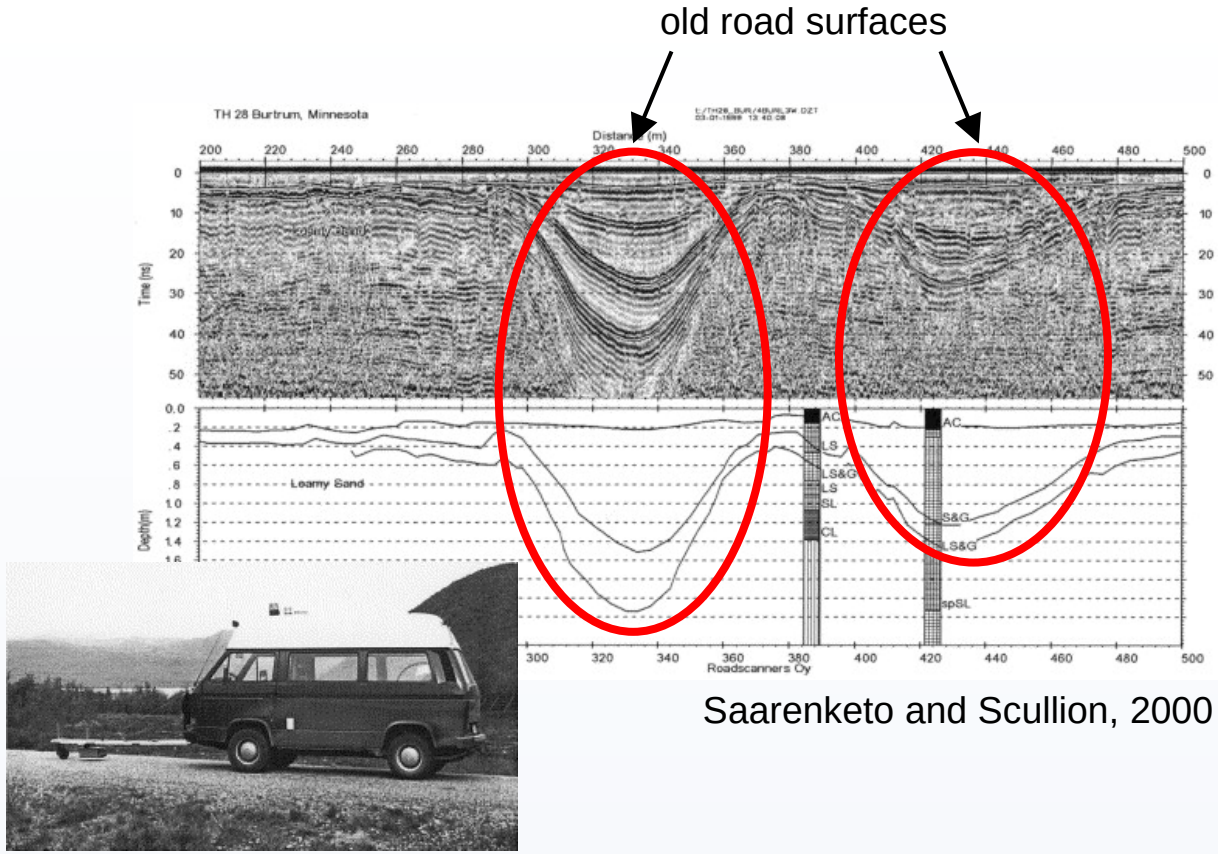
Week 5, Part 4: Other applications of GPR

Additional applications of GPR

1. Construction/Civil Engineering
2. Pollution monitoring/disposal
3. Geological mapping
4. Permafrost
5. ...and more!

Civil engineering

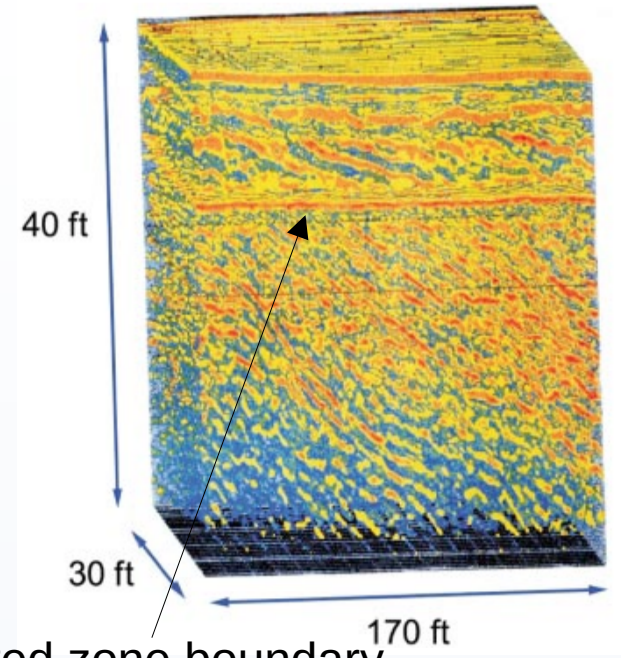
- In construction to map/identify buried objects:
  - Pipes
  - Wires
  - Contaminants
- Evaluate condition of existing structures, materials
- Road condition
  - Settling
  - Crack development

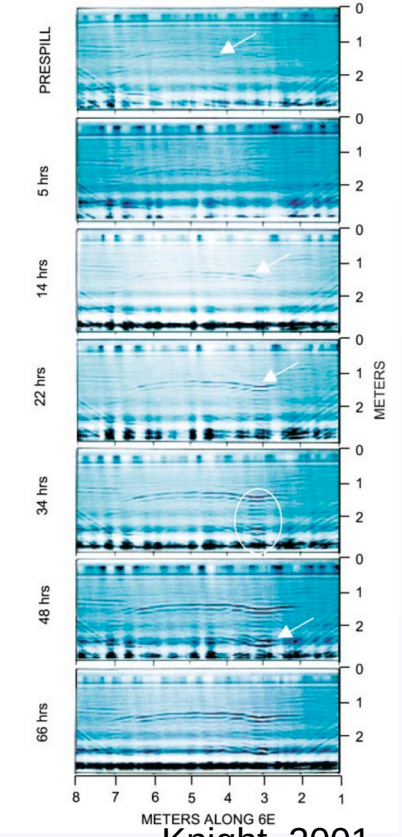


Saarenketo and Scullion, 2000

Pollution monitoring

- ε_r for many contaminants has high contrast to water ($\varepsilon_r = 80$)
  - Trichloroethylene: 3.42
  - Perchloroethylene: 2.28
- Can use GPR to detect:
  - Subsurface contaminants
  - Boundary between unsaturated/saturated zones
- Next steps: determine how to treat contaminant



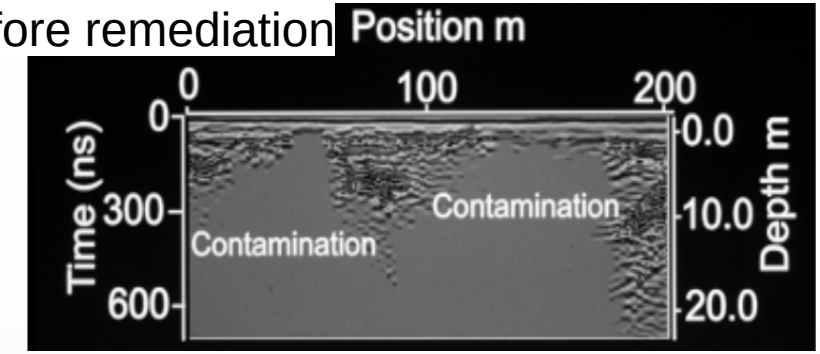


Knight, 2001

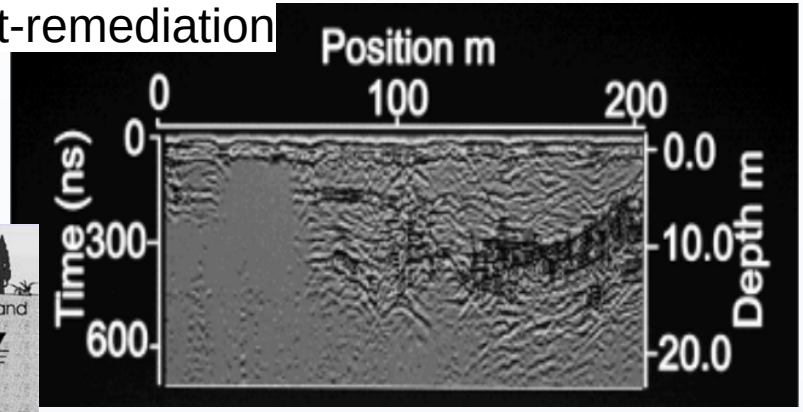
Pollution remediation

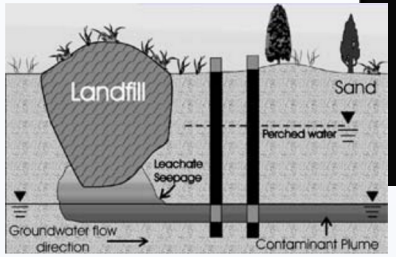
- Some pollutants increase conductivity, attenuation
- Example: dissolved chloride ions
- After remediation, reduced attenuation indicates effectiveness

Before remediation



Post-remediation

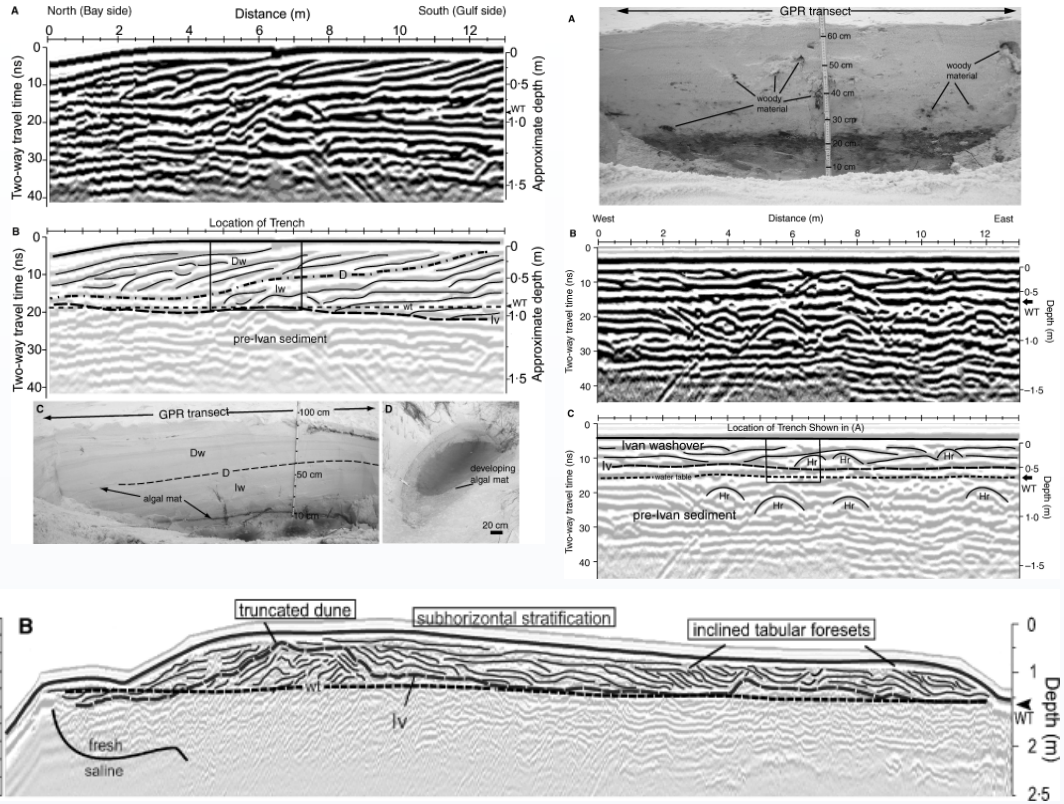




Annan, 2005

Sedimentology

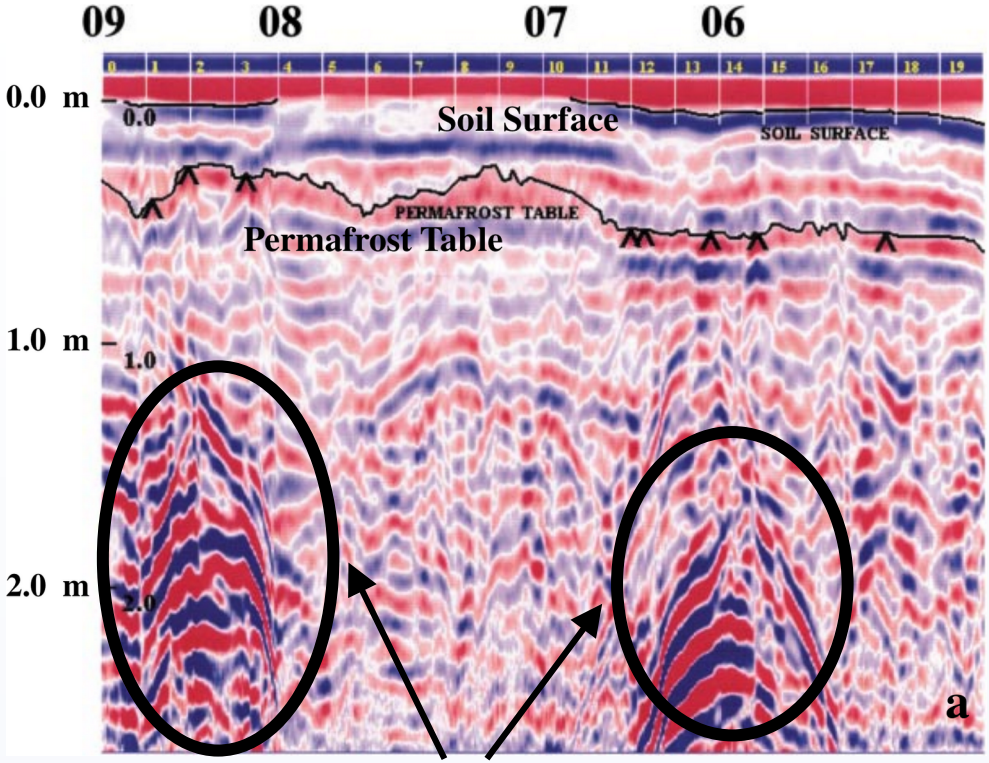
- Reconstructing past deposition, sedimentary processes
- Example: coastal changes after hurricanes
- Differences in erosion/deposition processes:
  - Coastline morphology
  - Vegetation type
  - Sediment properties



Wang and Horwitz, 2006

Permafrost

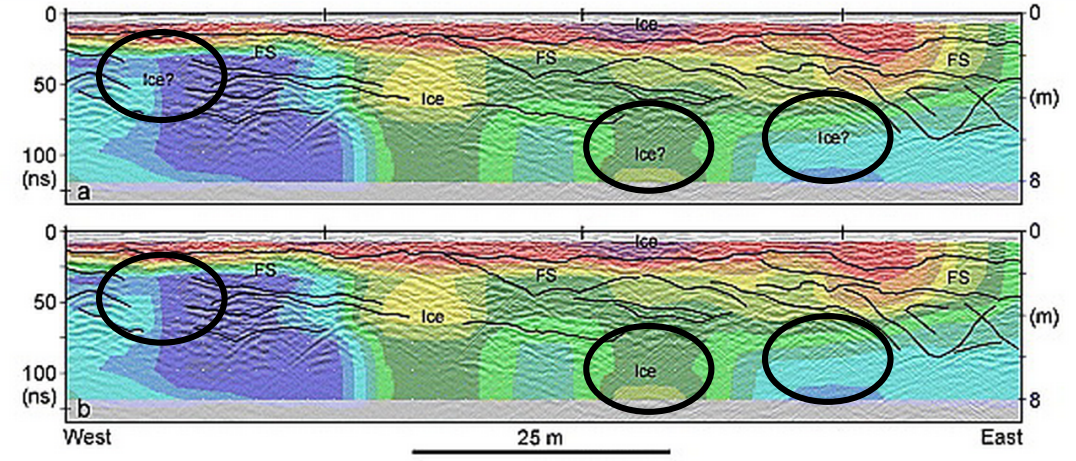
- Frozen ground: less attenuation relative to unfrozen ground
- Active layer: surface layer that thaws each summer
- Ice structures (wedges, lenses) increase scattering, decrease contrast between layers



Hinkel et al., 2001

Permafrost

- Electrical resistivity helps estimate water content, temperature, other properties
- Permafrost:
  - Sediment with low ice content: low resistivity
  - Sediment with high ice content: higher resistivity, lower than ice
- When combined with GPR, increases quality and interpretation about subsurface



De Pascale et al., 2008

Summary

- GPR has many applications beyond archaeology and glaciology
- Ability to study subsurface environment *in-situ*:
  - Buildings and construction
  - Contaminated environments
- Combination with complementary geophysical methods enhances interpretation, understanding

Additional resources

- Saarenketo and Scullion, 2000 [J. Appl. Geophys.]
- Knight, 2001 [Ann. Rev. Earth Planet. Sci.]
- Annan, 2005 [Hydrogeophysics]
- Wang and Horwitz, 2006 [Sedimentology]
- Hinkel et al., 2001 [Permafrost Periglac. Proc.]
- De Pascale et al., 2008 [J. Geophys. Res. Earth Surf.]