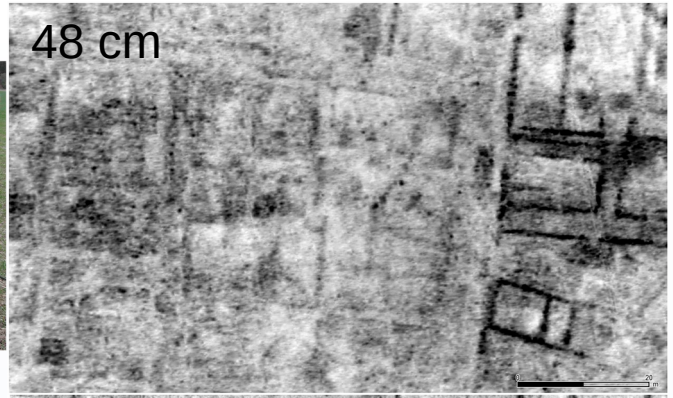
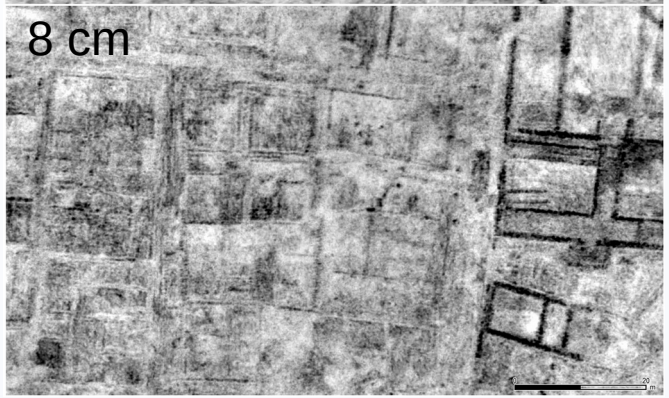
EGM703 – Advanced Active and Passive Remote Sensing

Week 5, Part 2: GPR Application: Archaeology

Why GPR for archaeology?

- GPR (and other geophysical methods):
  - Non-invasive
  - Comparatively fast, inexpensive
- Originally: tool for prospecting, followed by excavation
- Increasingly: primary data source
- Especially with modern multi-channel instruments
  - Single Tx, multiple Rx (“multi-static”)
  - Multiple Tx, Rx

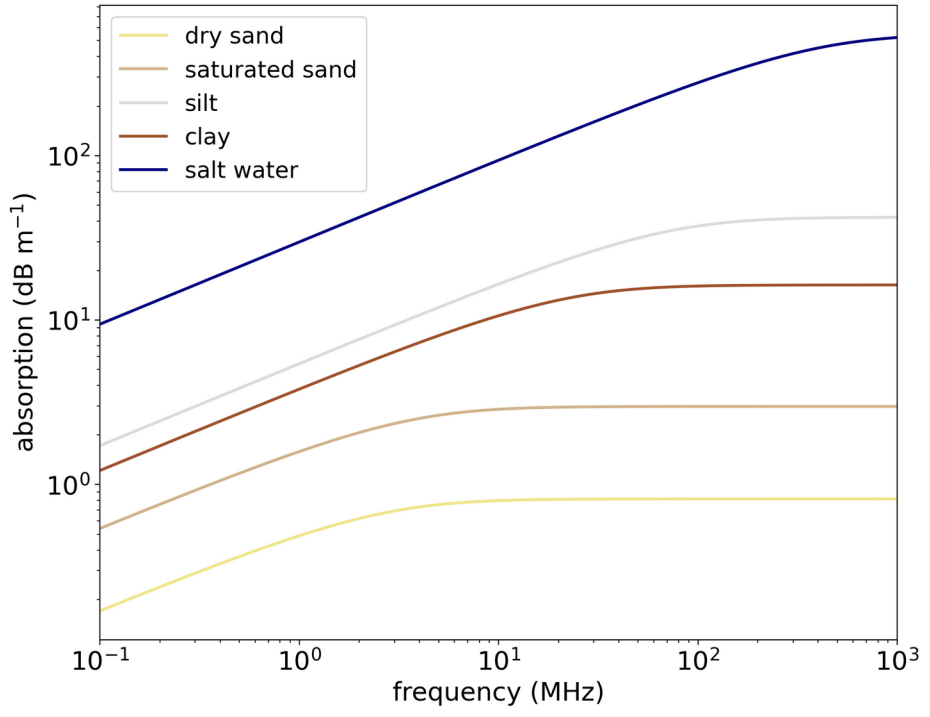




Trinks et al., 2018

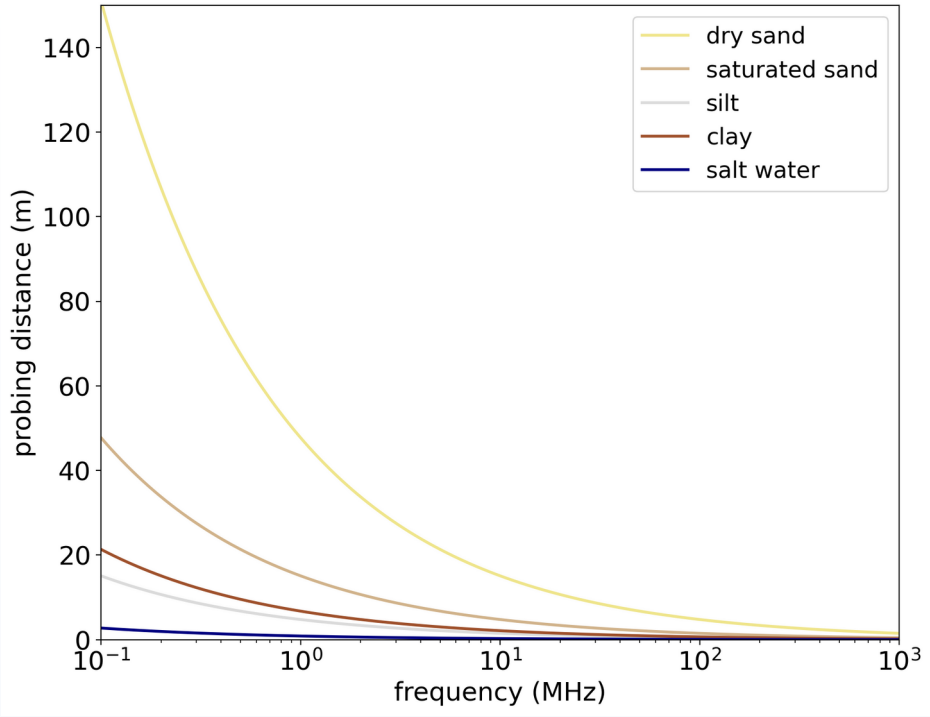
Soil properties

- Attenuation (absorption) increases with soil conductivity
- Resistive soils (low conductivity)
  - Sands
  - Gravels
- Conductive soils:
  - Silts, clays
  - Saltwater-saturated
- Remember: reflection strength depends on contrast between target, surrounding medium



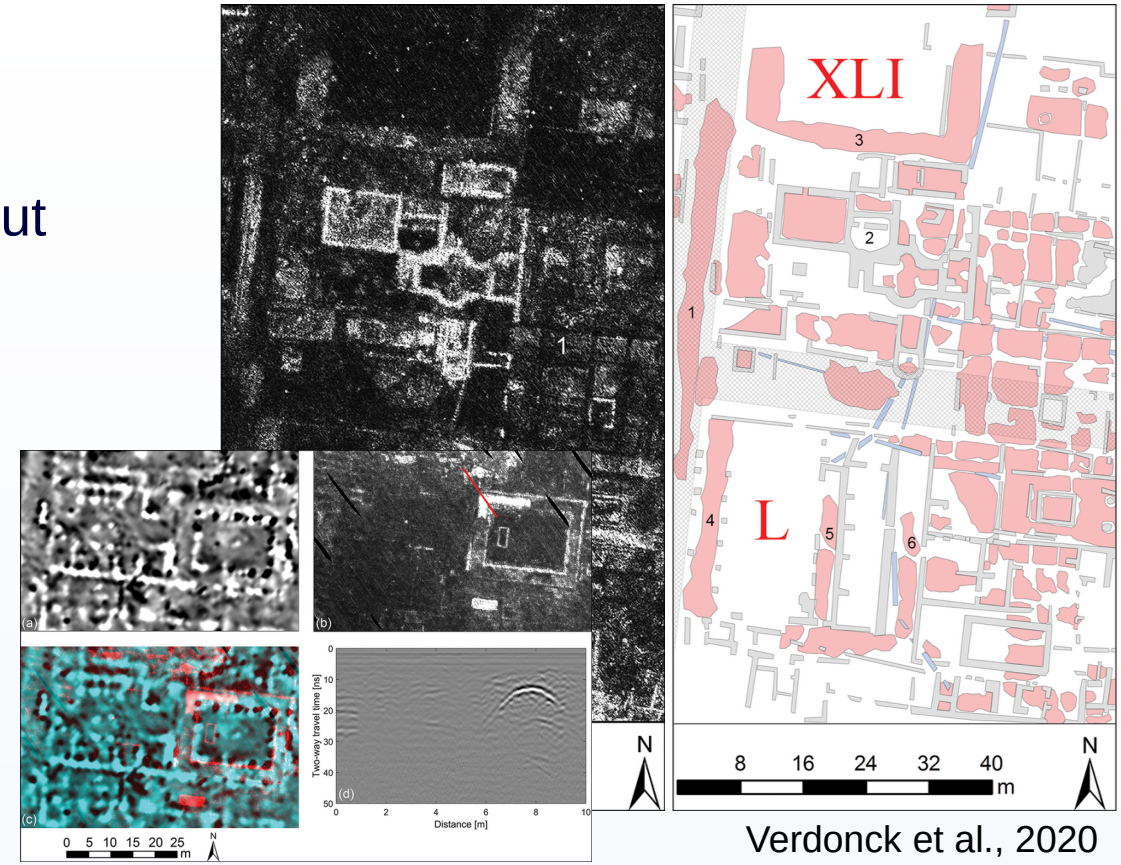
Survey depth

- Maximum survey depth depends on frequency, material
- Lower frequency: more depth
  - Also lower resolution
- Trade-off between maximum depth, resolution
- Note: for moist/saturated materials, Debye relaxation increases absorption above ~100 MHz



Falerii Novi, Italy

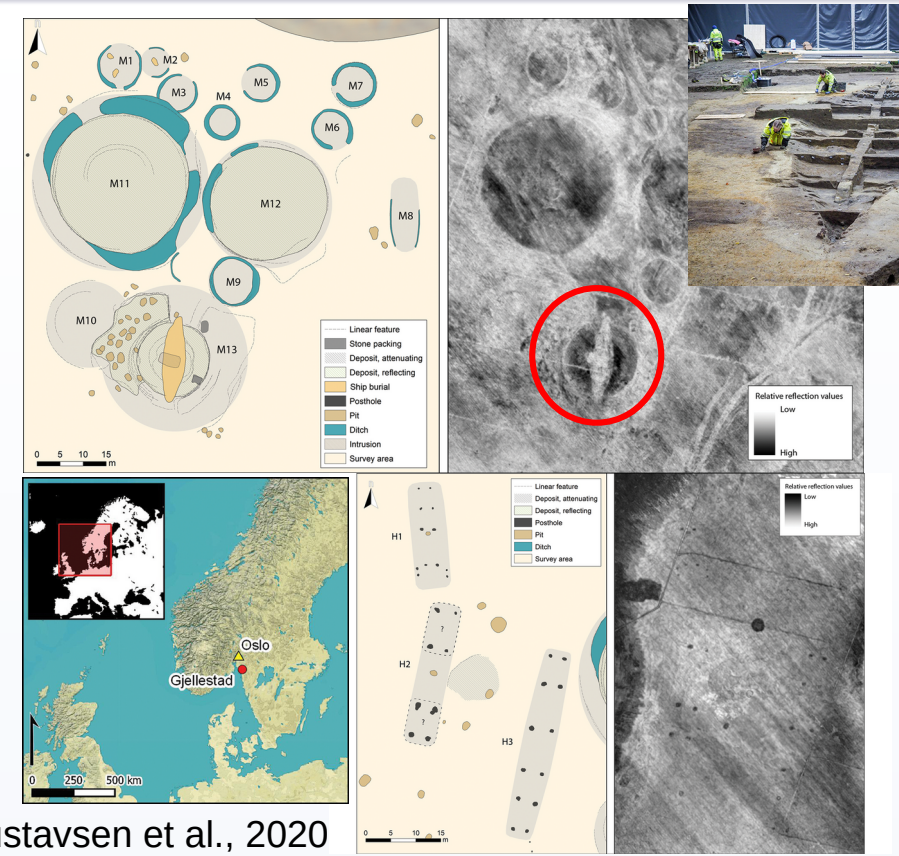
- GPR survey of complete Roman town
- GPR provides 3D “image” of layout
  - Walls/columns
  - Surfaces (e.g., floors)
  - Plumbing
- Can combine with other geophysical methods to improve interpretation/identification



Verdonck et al., 2020

Gjellestad, Norway

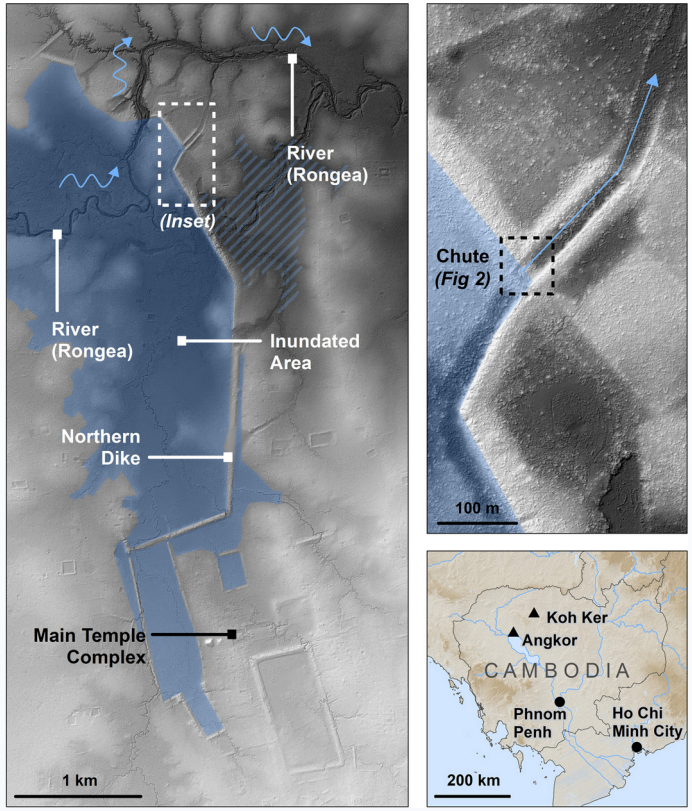
- Jell mound: large Iron Age funerary mound (5th century CE)
- Historical records: other funeral sites previously demolished
- GPR scans reveal:
  - Multiple burial mounds
  - Ship burial (19 m long, 5 m wide)
  - Houses, other structures



Gustavsen et al., 2020

Koh Ker, Cambodia

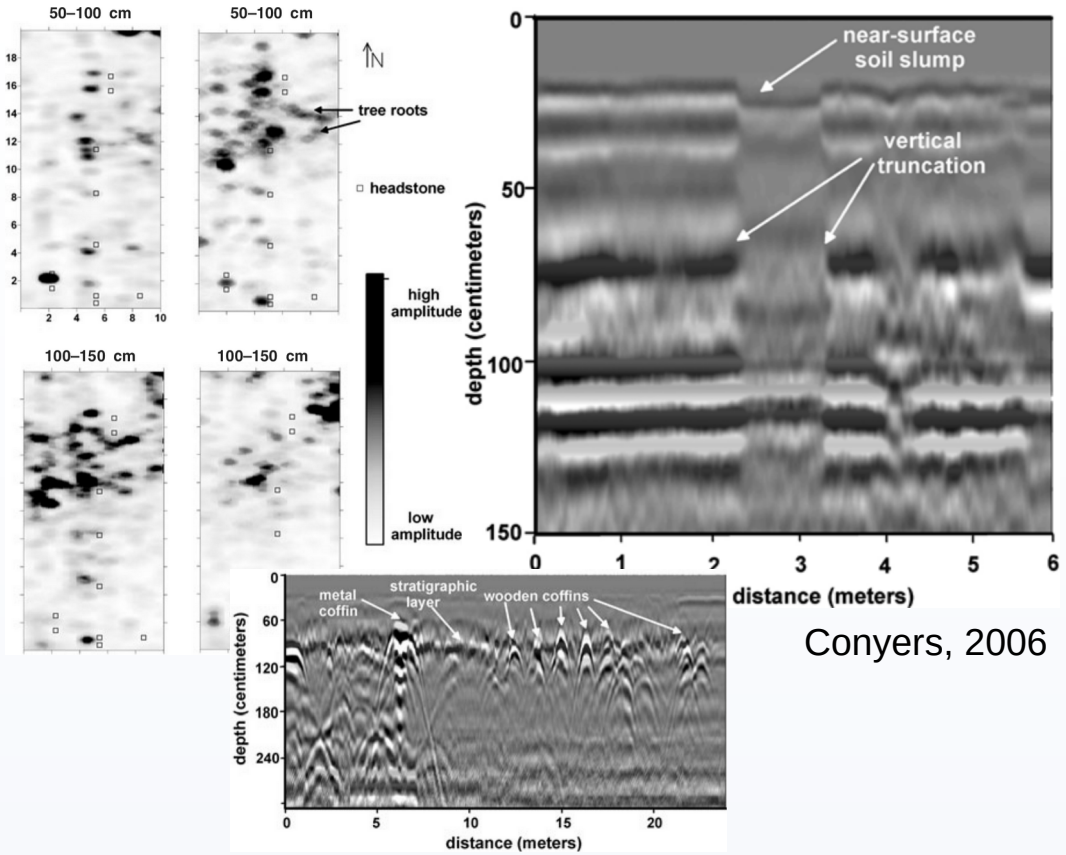
- Water management systems key in Khmer Empire
  - Large dikes/reservoirs built to provide stability
- Evidence for overtopping
- GPR surveys used to estimate spillway capacity indicate it was insufficient



Moffat et al., 2020

Unmarked graves

- Graves produce recognizable signatures in GPR:
  - Sedimentary layer differences in grave shaft
  - Surface signature (slump)
  - Caskets
- Example: unmarked graves at “Residential Schools” in Canada



Conyers, 2006

Summary

- GPR is an effective tool for archaeological investigation:
  - Prospecting
  - Mapping spatial relationships
- Choice of frequency depends on survey area, depth, desired resolution
- Many applications, from mapping settlements to individual graves

Additional resources

- Trinks et al., 2018 [Archaeological Prospection]
- Verdonck et al., 2020 [Antiquity]
- Gustavsen et al., 2020 [Antiquity]
- The Gjellestad Ship Excavation [Museum of Cultural History, U. Oslo]
- Moffat et al., 2020 [Geoarchaeology]
- Conyers, 2006 [Historical Archaeology]
- Geophysics and Unmarked Graves [W. T. D. Wadsworth]
- “How radar technology is used to discover unmarked graves at former residential schools” [CBC]