# A brief introduction to GPR
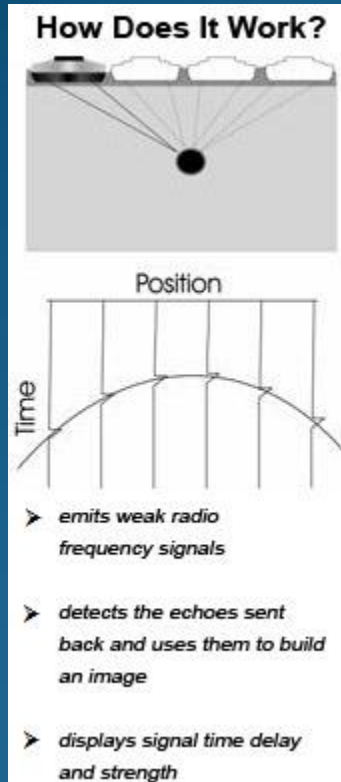
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Department of Physics

Forensic Archaeology: Search and Recovery Field Exercise

**How Does It Work?**

Position

Time

➤ emits weak radio frequency signals

➤ detects the echoes sent back and uses them to build an image

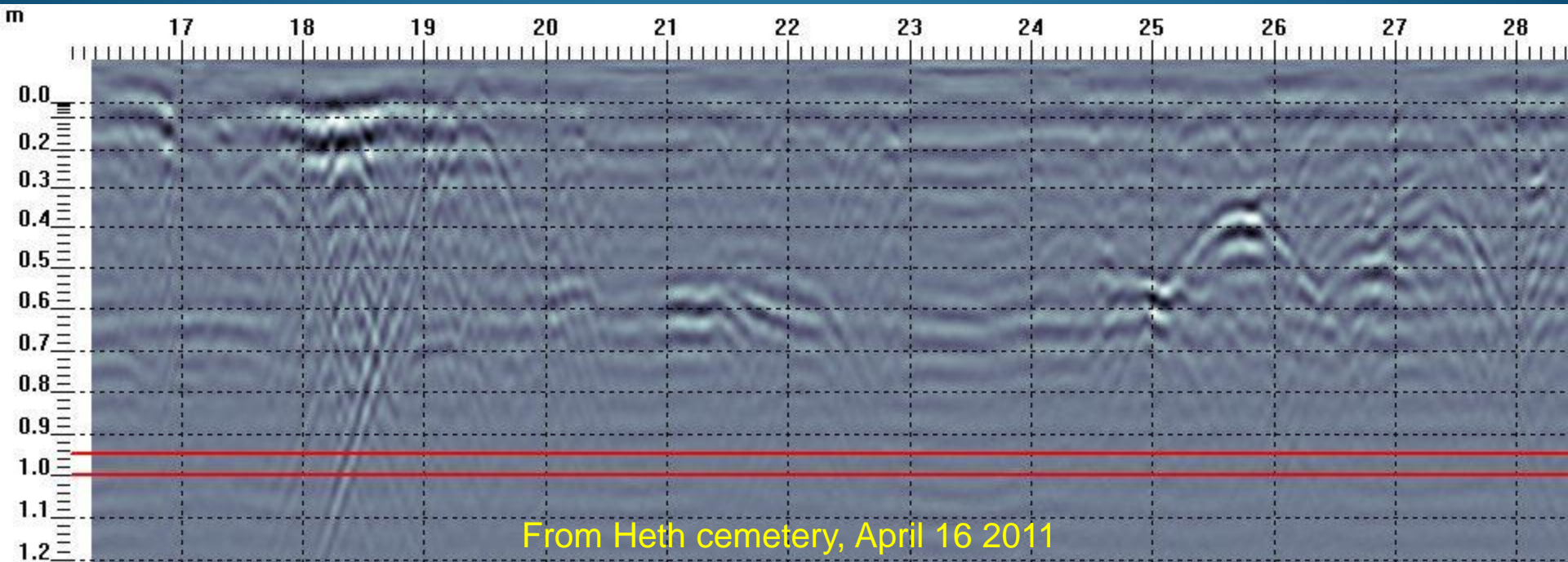➤ displays signal time delay and strength

What you see onscreen is a lot of "hyperbolae"

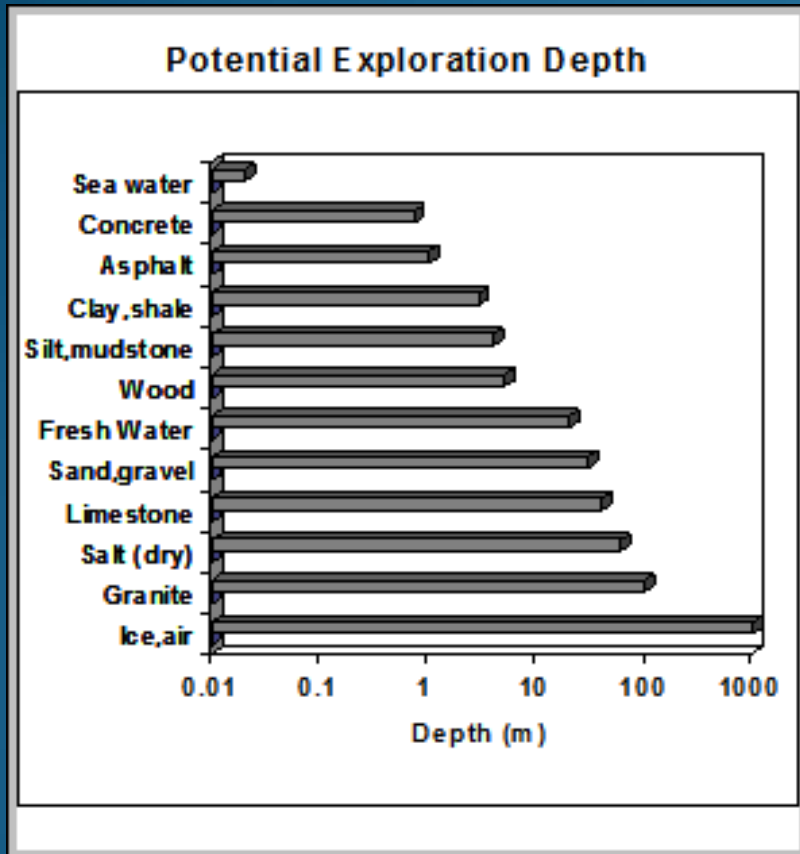These all represent reflectors of various sizes and shapes

Their shape does not necessarily correspond to what's down there—it gives clues about what's really there.

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## What you see onscreen is a lot of "hyperbolae"



From Heth cemetery, April 16 2011

# A brief introduction to GPR

What you see onscreen is a lot of "hyperbolae"

Coal remnant? Rock? Likely burials



From Heth cemetery, April 16 2011

These are best identified after data processing

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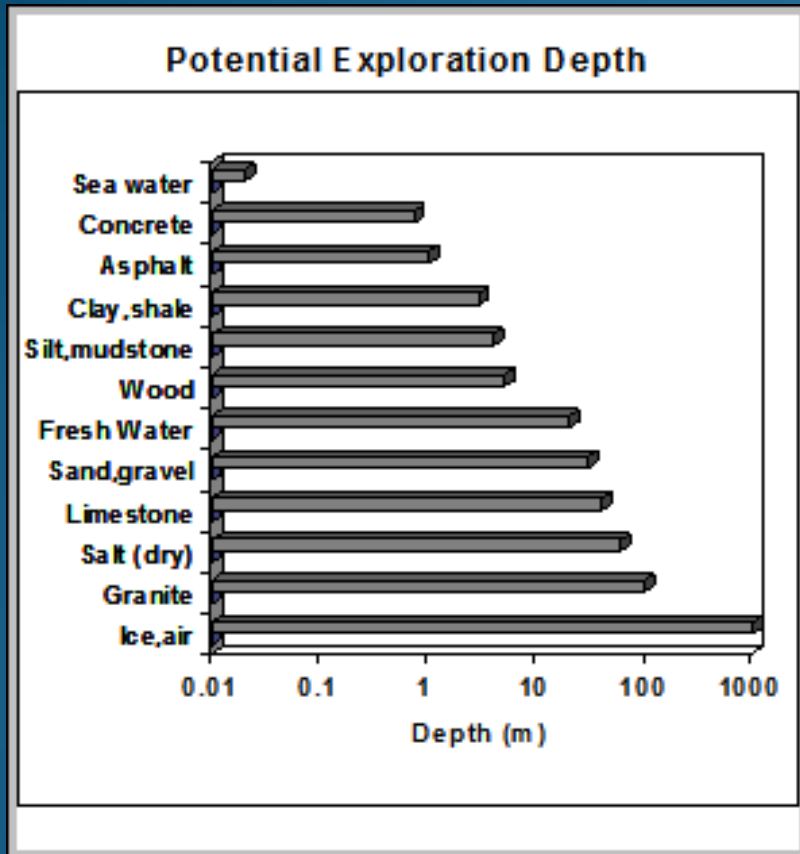

One must get used to both the potential for exploration as well as the depth limitations

It's always a tradeoff→the better the resolution the worse the penetration depth ☹

The depth also depends on the type of subsurface→the better the ground conducts electricity the worse the penetration depth

**Potential Exploration Depth**

Sea water
Concrete
Asphalt
Clay,shale
Silt,mudstone
Wood
Fresh Water
Sand,gravel
Limestone
Salt (dry)
Granite
Ice,air

0.01   0.1   1   10   100   1000

Depth (m)

Higher GPR frequency →
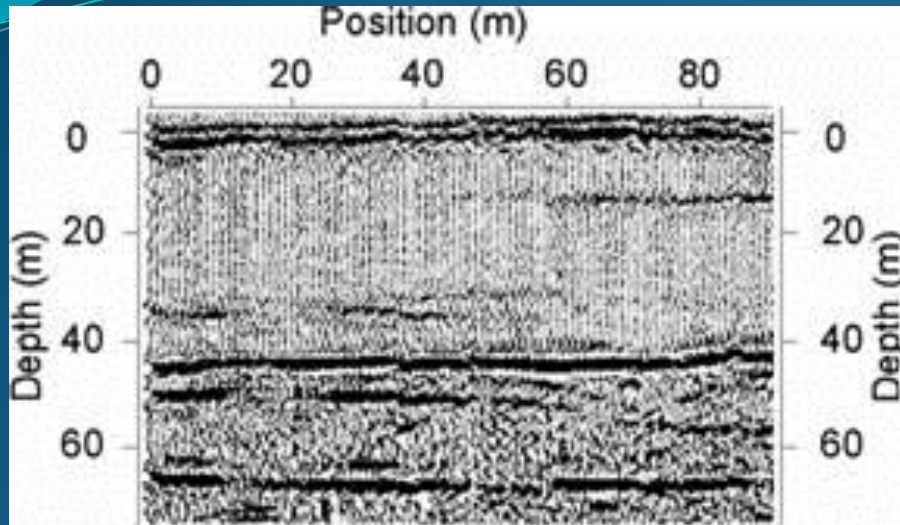  better resolution  ☺
  worse penetration depth  ☹

You need to choose the right frequency for the job

In clay-rich soil such as here in southwestern VA 100MHz works well for forensics
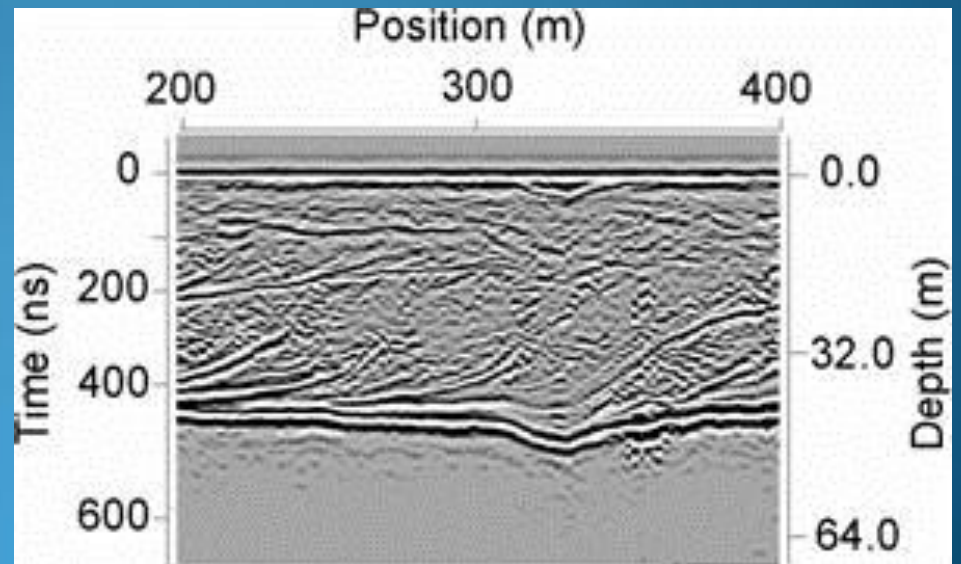  penetration to ~3 meters
  can resolve burials

500MHz has been used for penetrations ~1.3m (e.g. Heth Cemetery, April 16 2011)
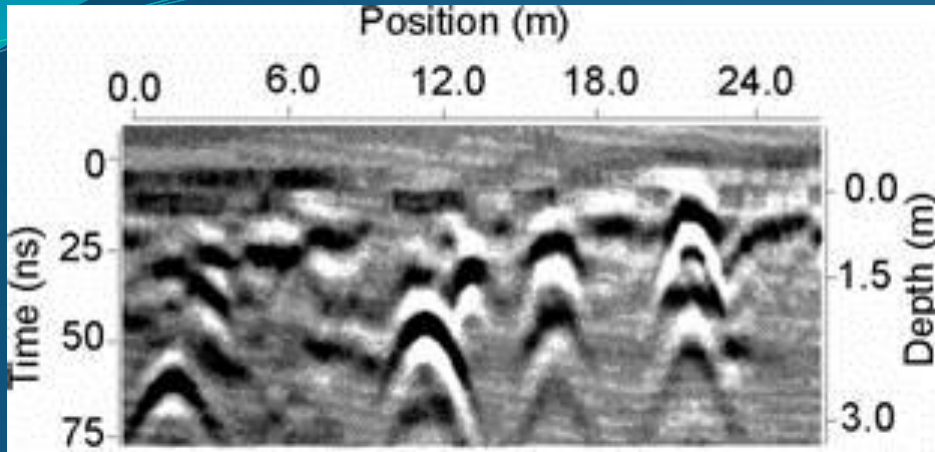
# A brief introduction to GPR



← Fractures in dry granite
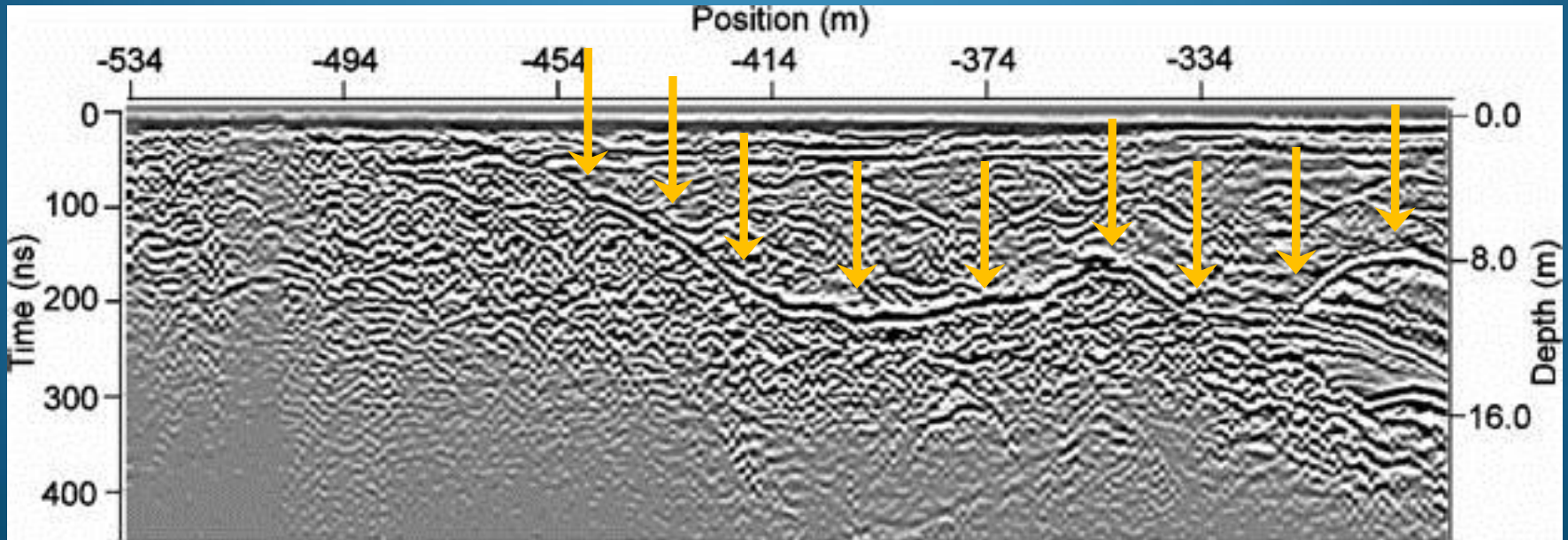
Bedding in wet sands

These simple cross section plots
come right off of the GPR instrument

# A brief introduction to GPR



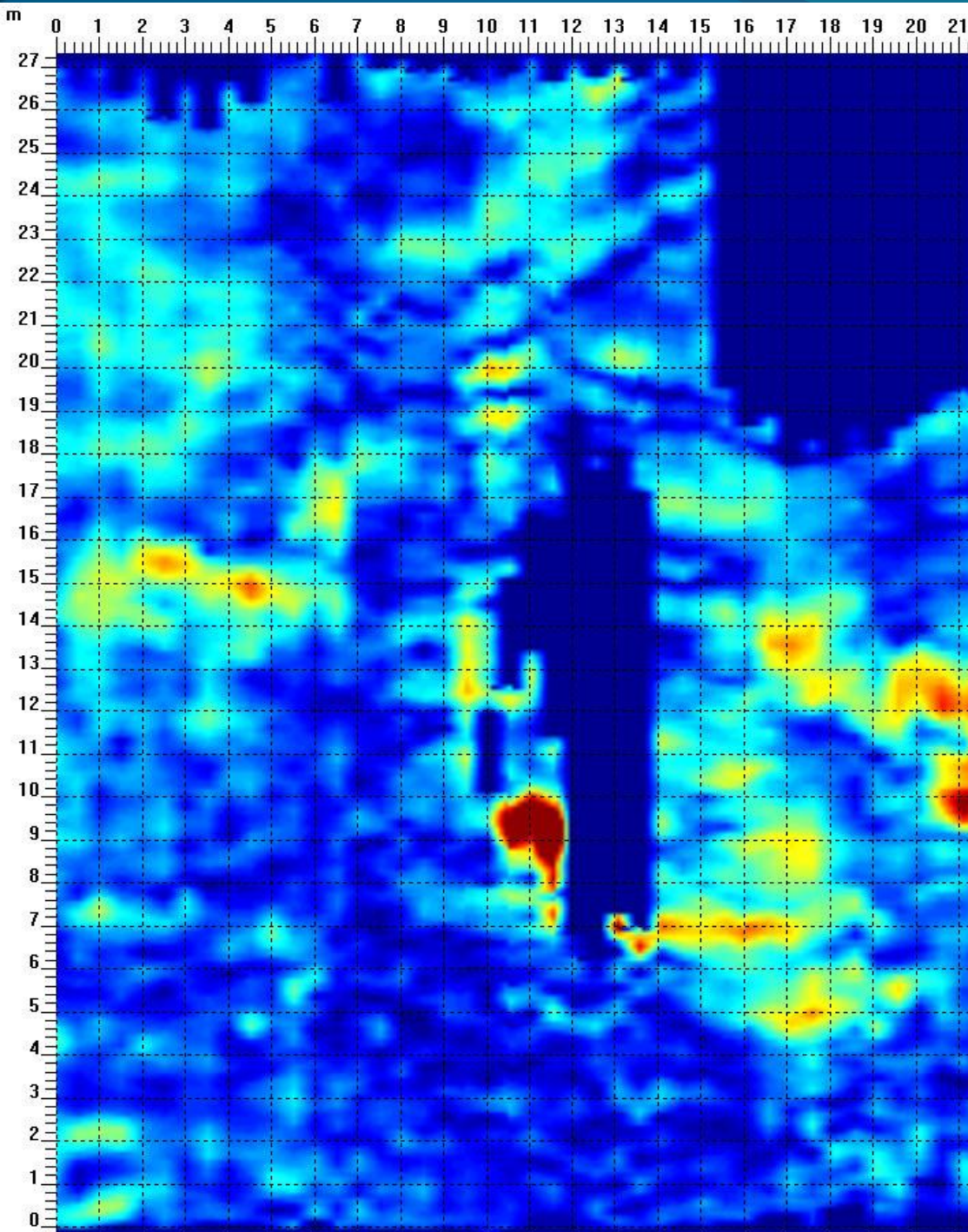Barrels in wet silty clay—note the hyperbolae

Bedding in wet sands

But your interest lies in things that originated from people…
…such as archaeological investigations.

William Letcher Homestead in Ararat, VA

This is what our eyes saw

This is what the
GPR saw
(100MHz antennae)

This type of plan view
data plot requires
some processing work

This is what we found when we dug at the "interesting" signals

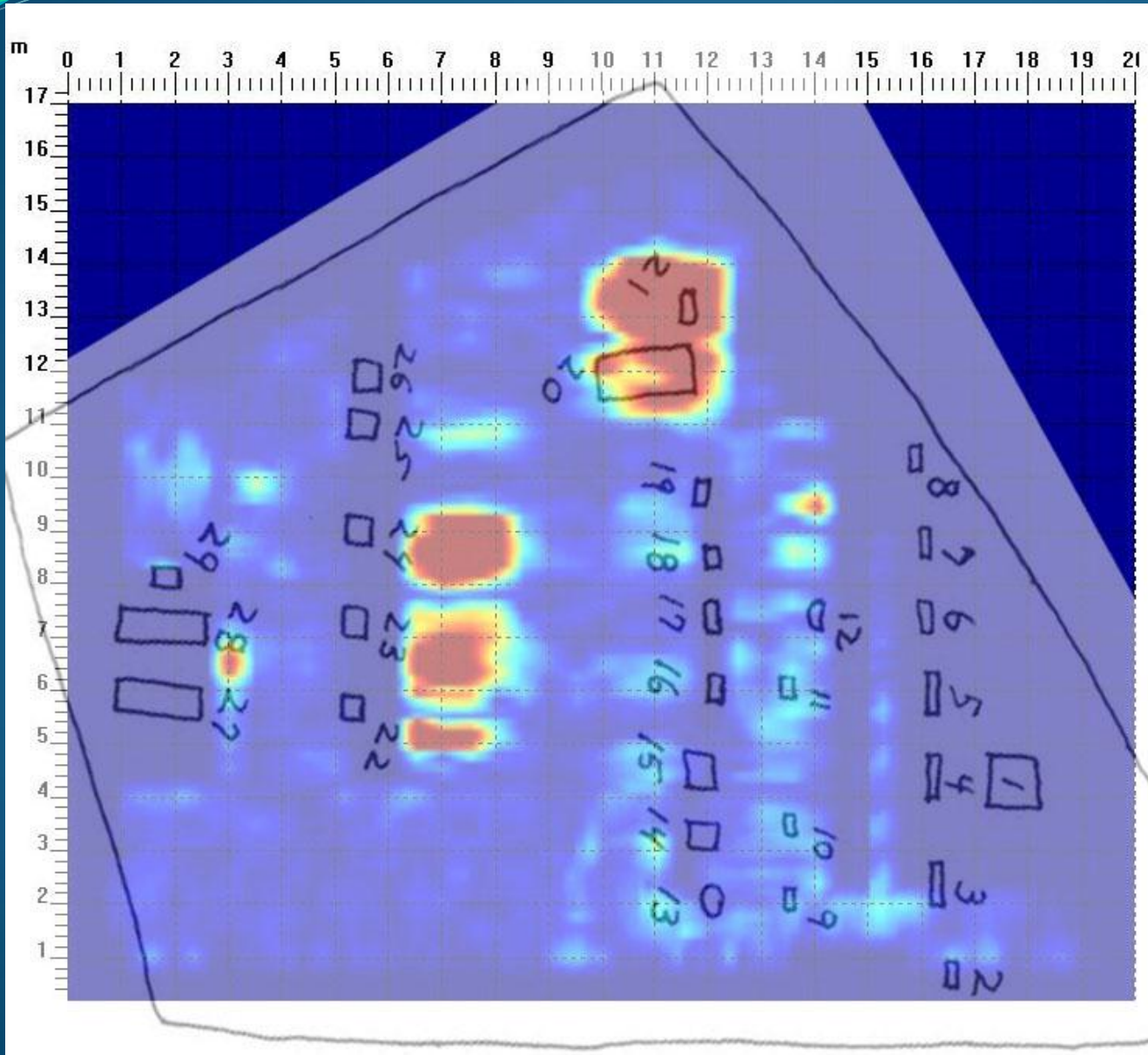This is what we found when we dug at the "interesting" signals

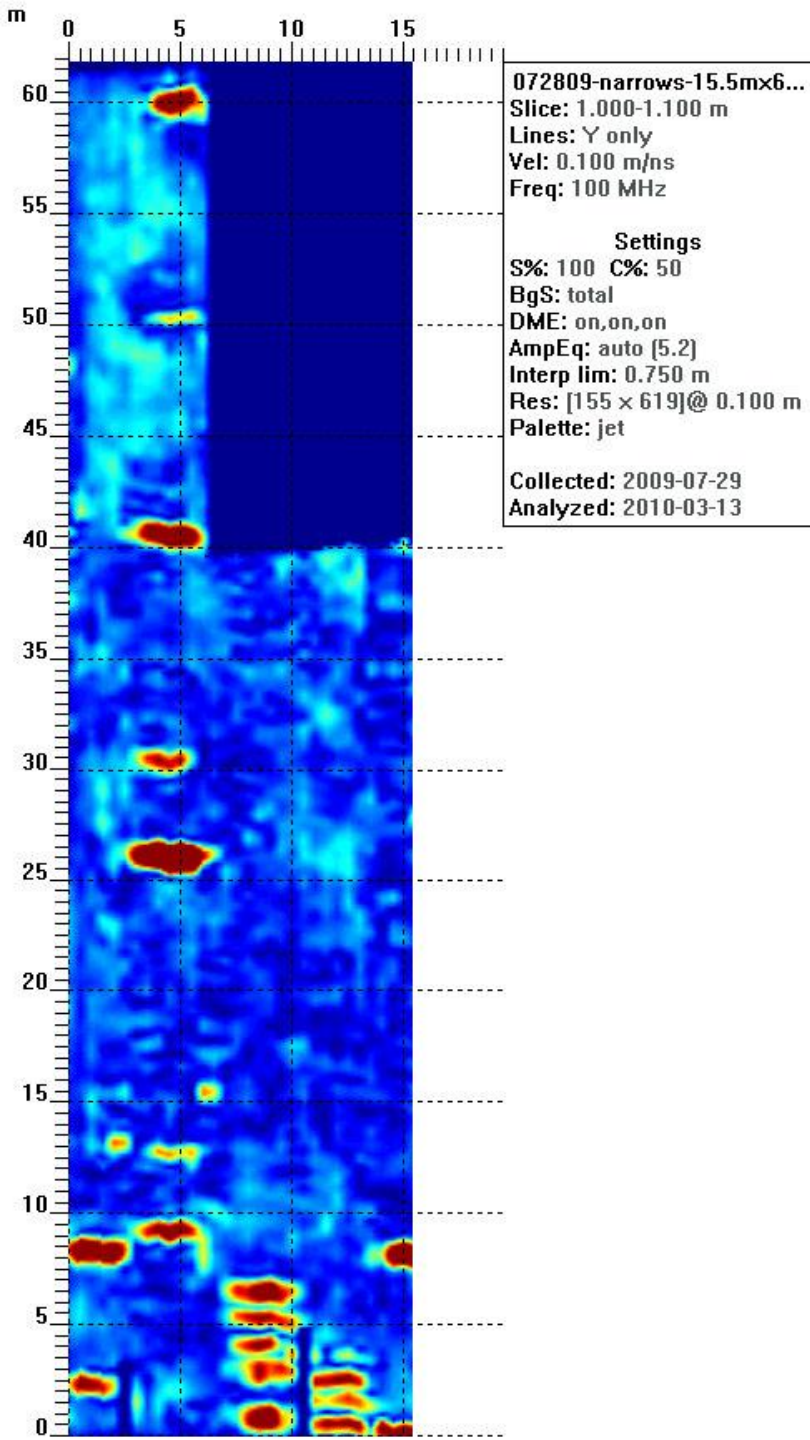This is what we found when we dug at the "interesting" signals

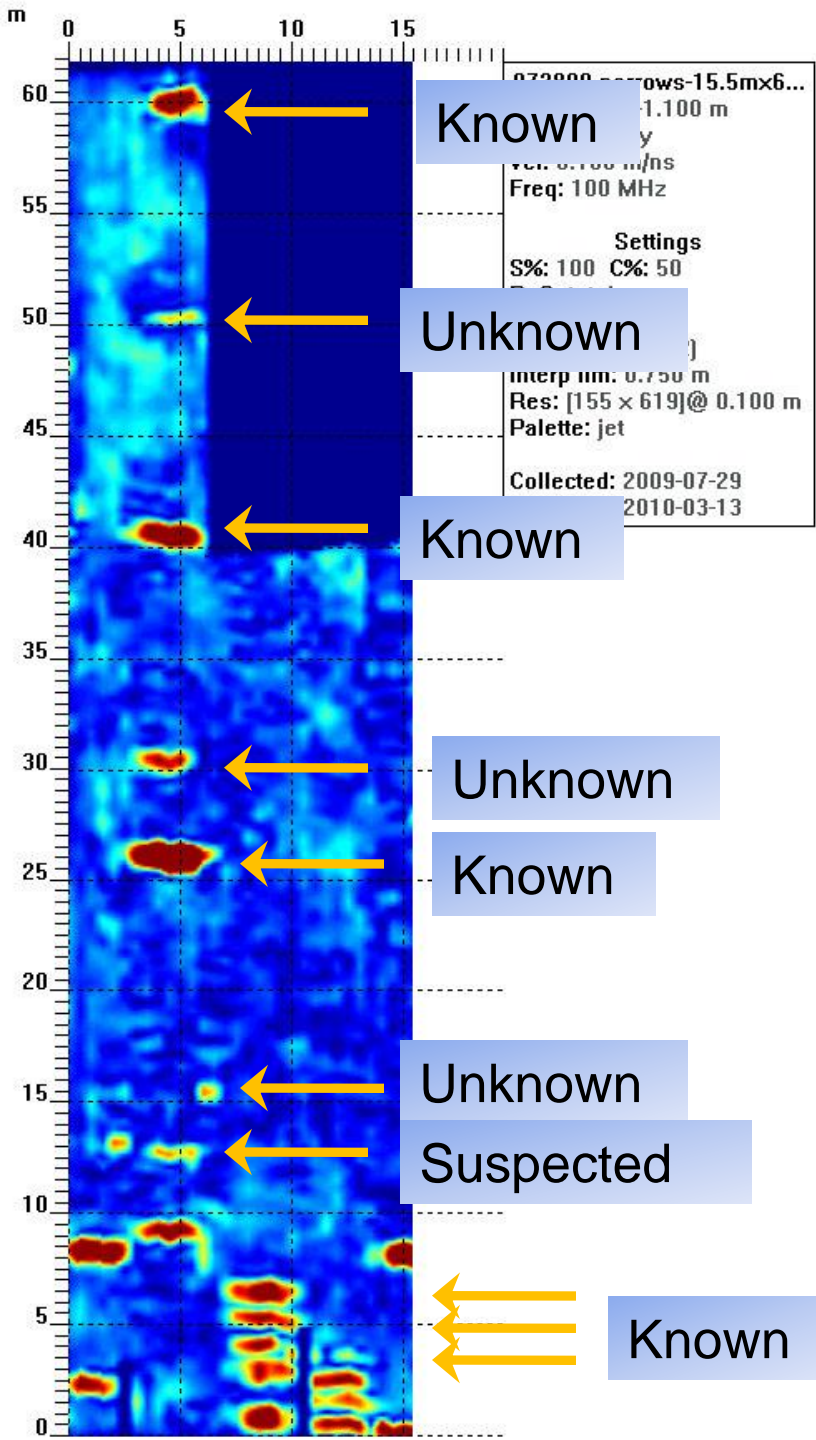But you're probably even more interested in a cemetery study…

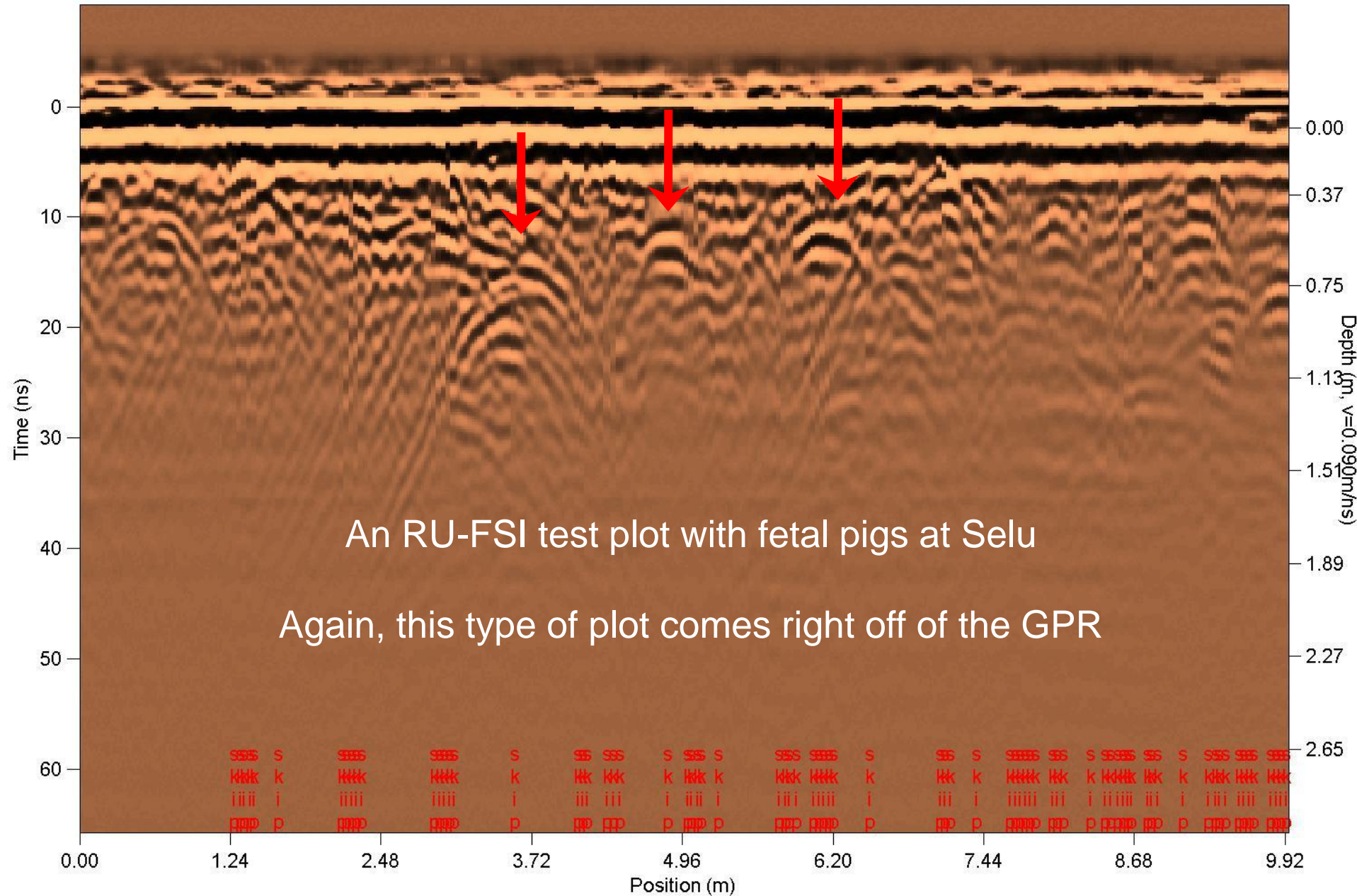This is the family cemetery at the Reynolds Homestead in Critz, VA

This is a cemetery in this general area that was looking to expand into supposedly-unused areas

The relevant thing here is that this was done in clay-rich ("bad") soil, soon after a very wet spring (even worse for GPR) 100MHz

Note the number of unknown burials

←Note also the detail on this unknown…
…smaller person buried on side.

An RU-FSI test plot with fetal pigs at Selu

Again, this type of plot comes right off of the GPR

So now it's your turn to use it!