



IMAGING THE LSBB ENVIRONMENT FROM GPR DATA, ALONG THE TUNNEL AND FROM THE SURFACE

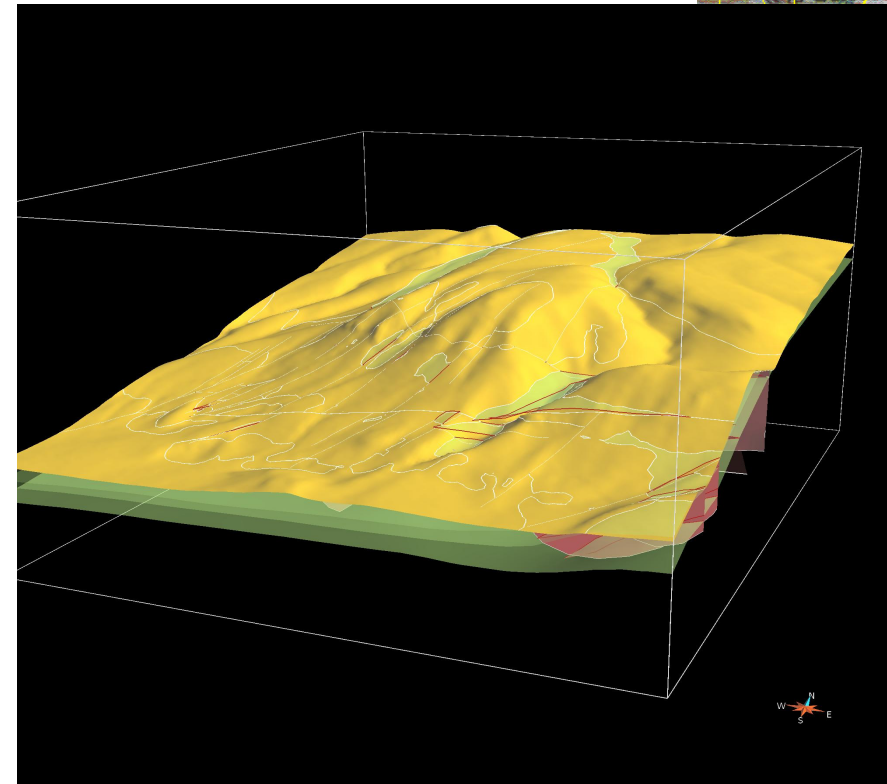
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Charles Danquigny⁽²⁾ and Christophe Emblanch⁽²⁾**

(1) UPPA, FR 2952 IPRA, F-64012 Pau

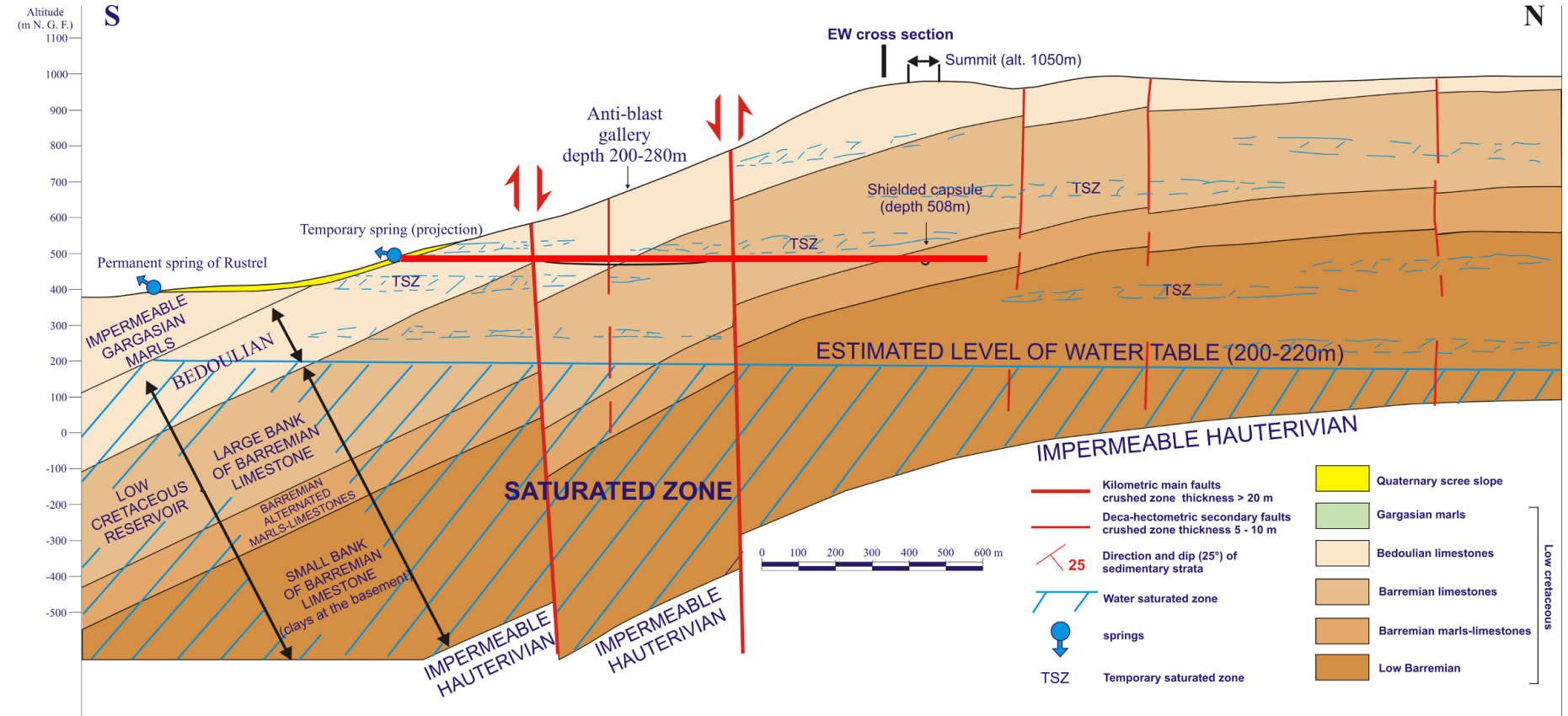
(2) UAPV, UMR 1114 EMMAH, F-84000 Avignon



The « Grand Mountain » massif



The « Grand Mountain » massif

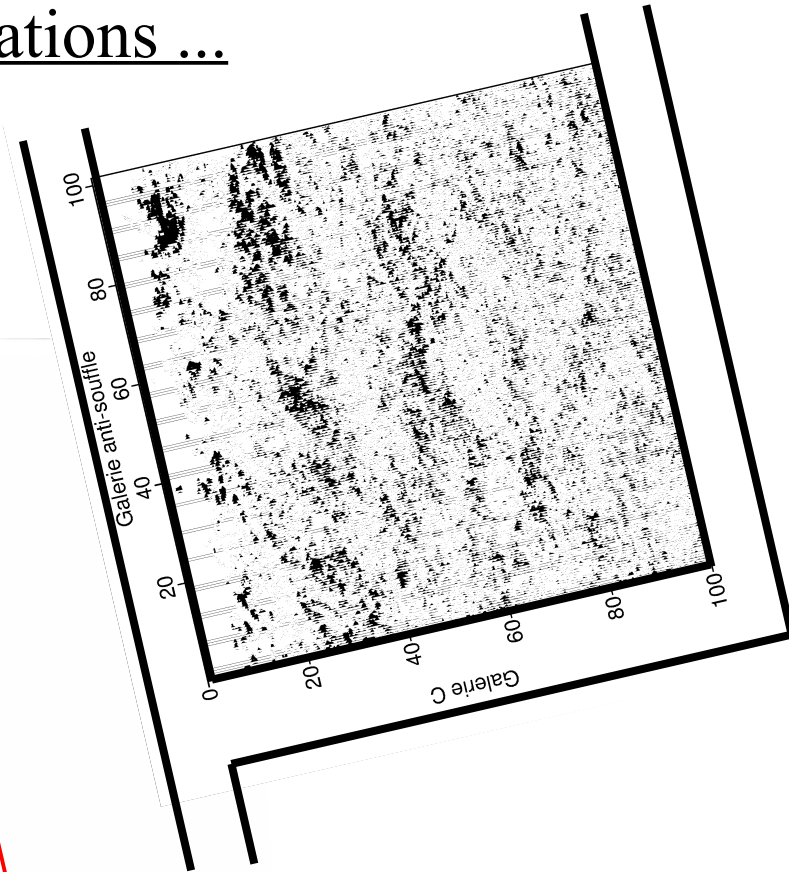
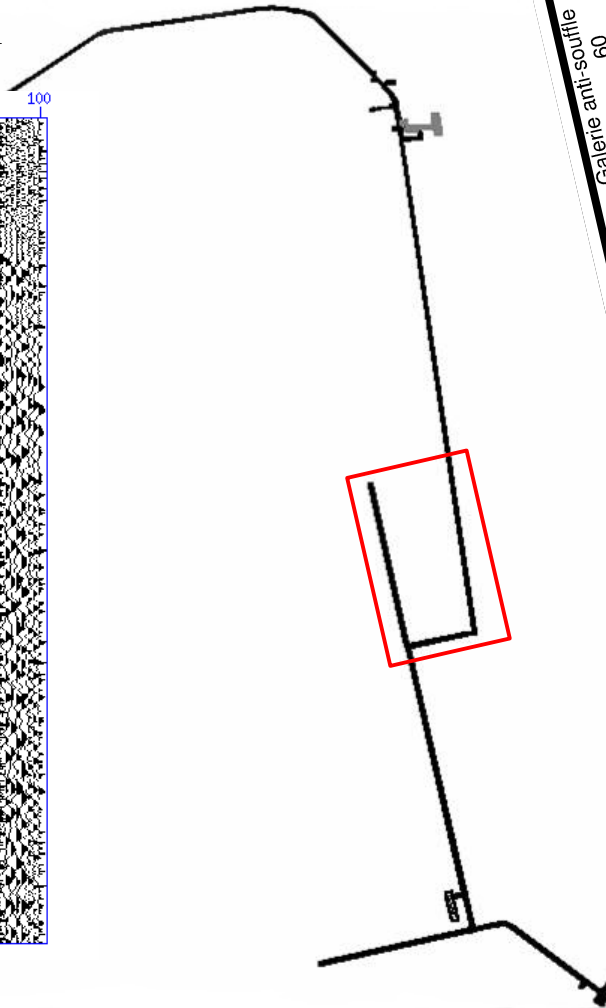
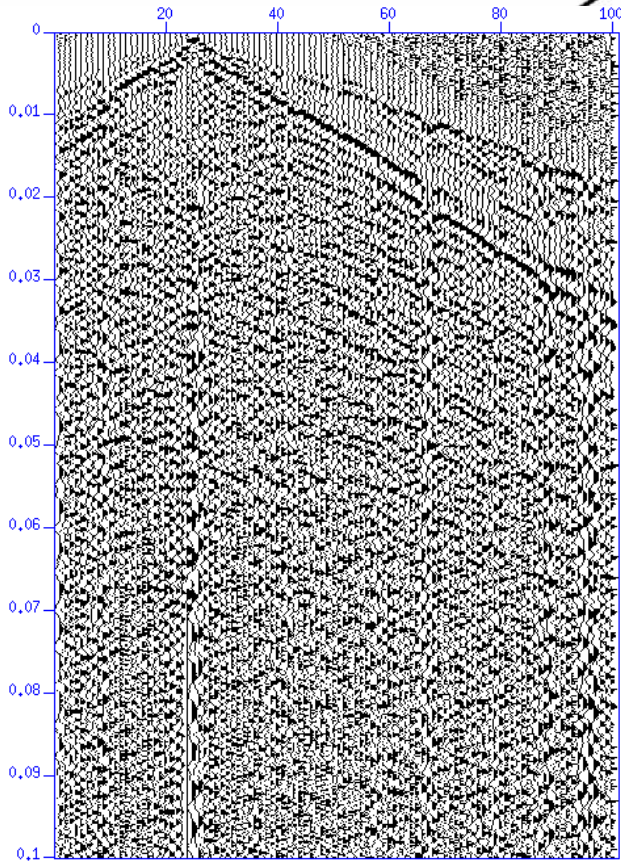


Small scale seismic investigations ...

$$\lambda = v / f$$

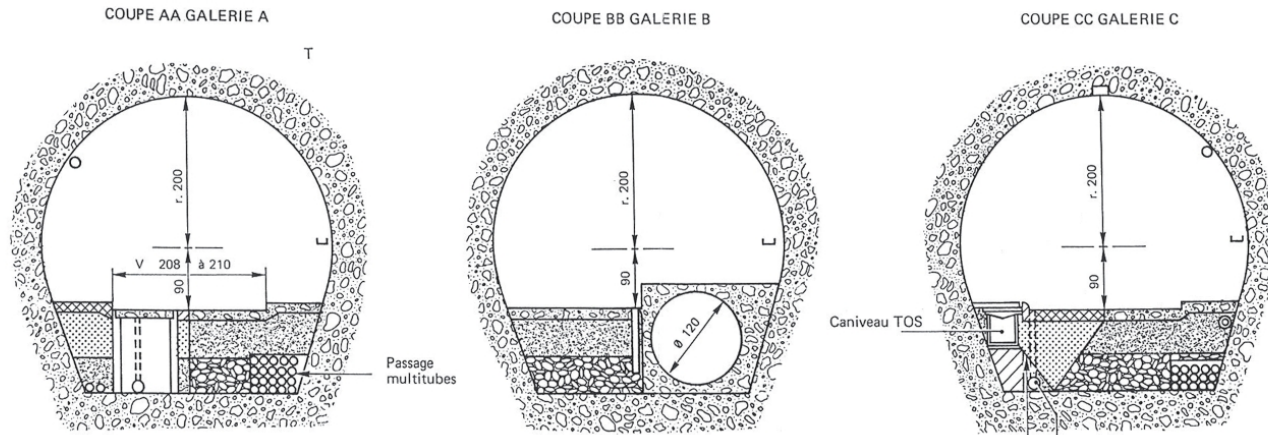
$4000 \text{ m/s} < v < 5000 \text{ m/s}$ and $f = 100 \text{ Hz}$

$40 \text{ m} < \lambda < 50 \text{ m}$

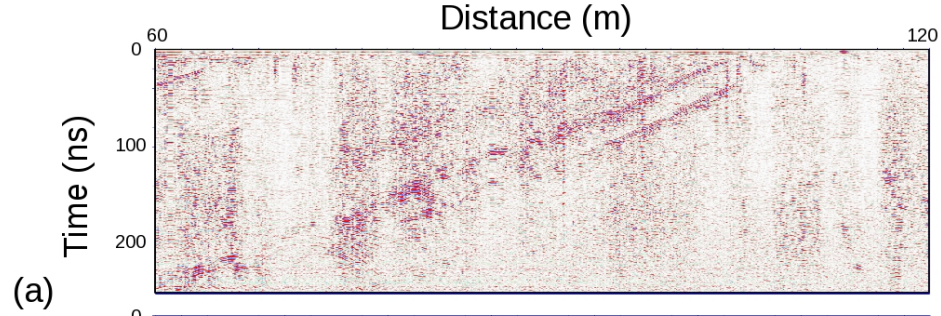


GPR investigations inside the tunnel

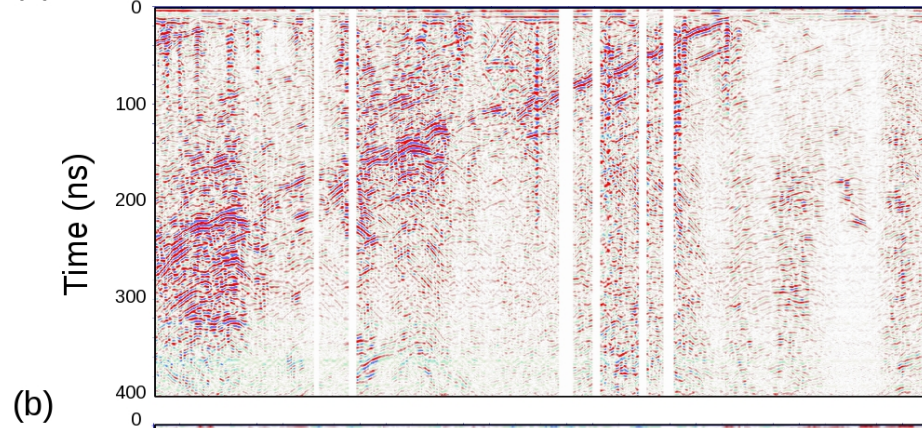
$6 \text{ cm/ns} < v < 12 \text{ cm/ns}$ and $50 \text{ MHz} < f < 800 \text{ MHz}$, $2 \text{ m} < \lambda < 0,1 \text{ m}$



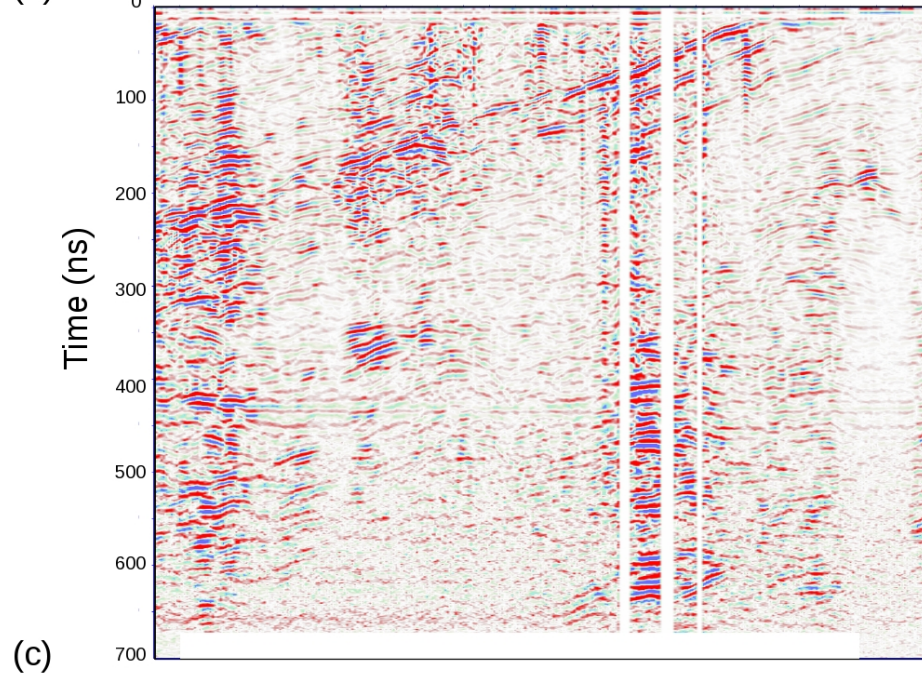
500 MHz



250 MHz



100 MHz



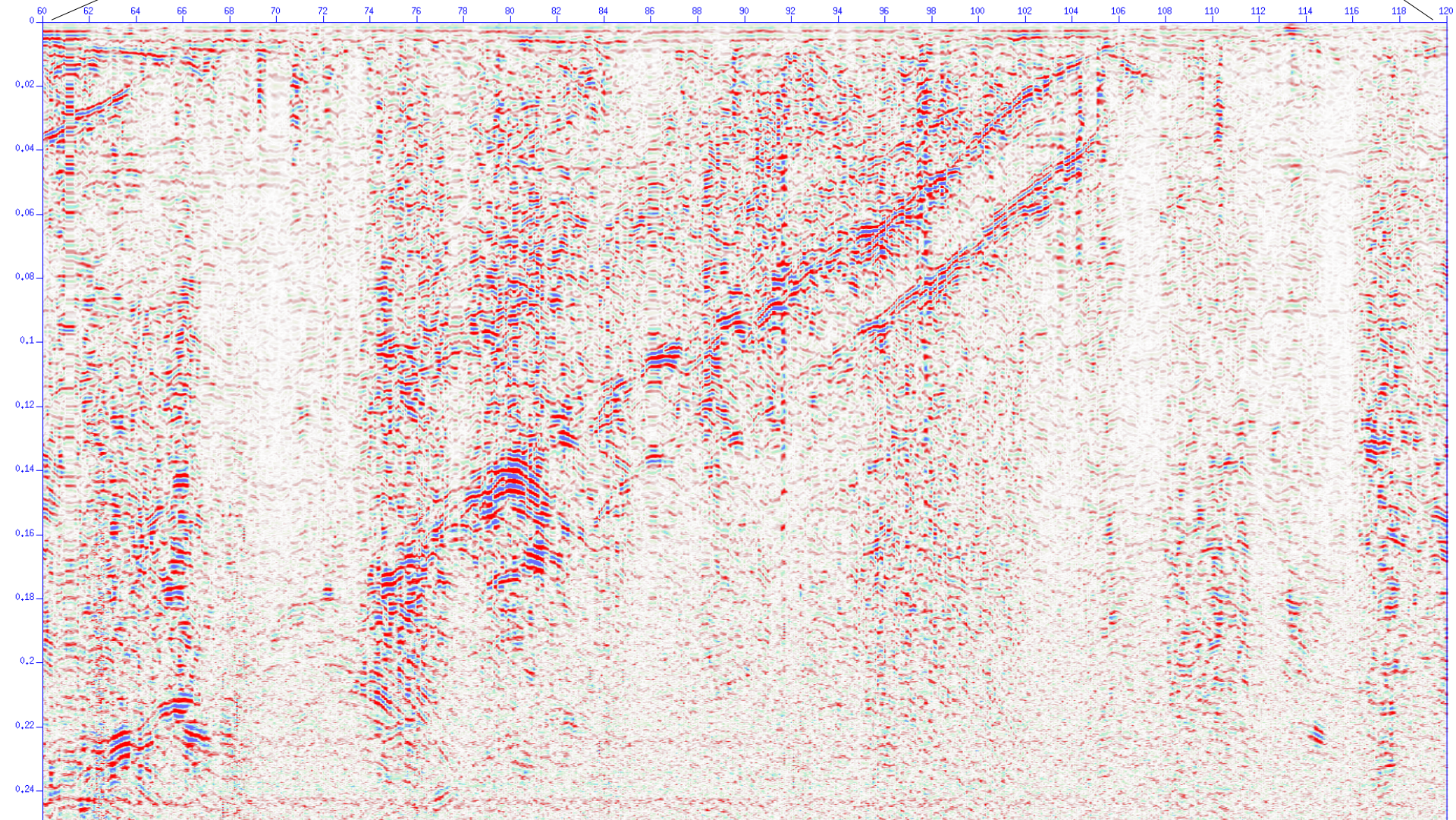
500 MHz

Distance (m)

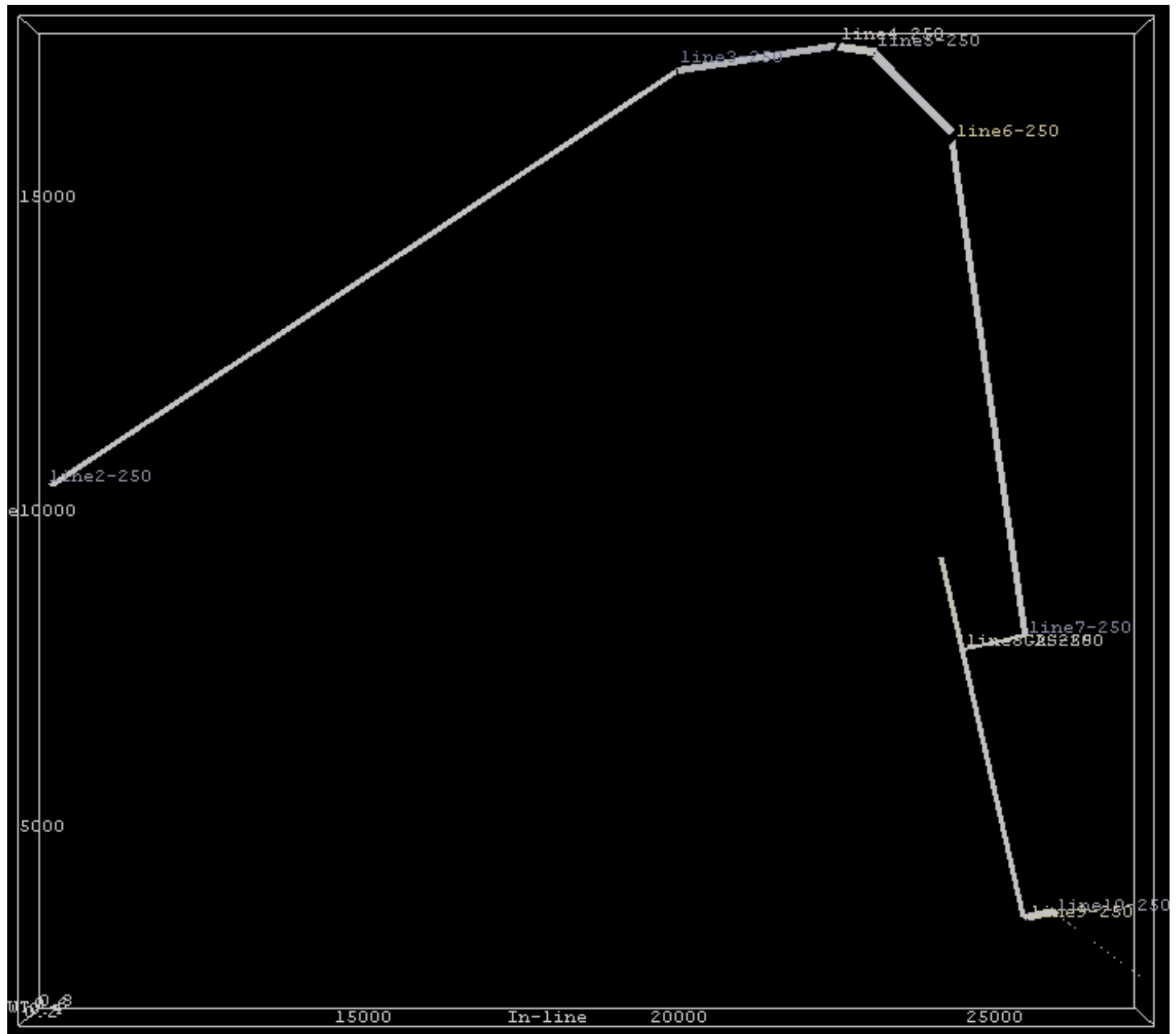
120

Time (ns)

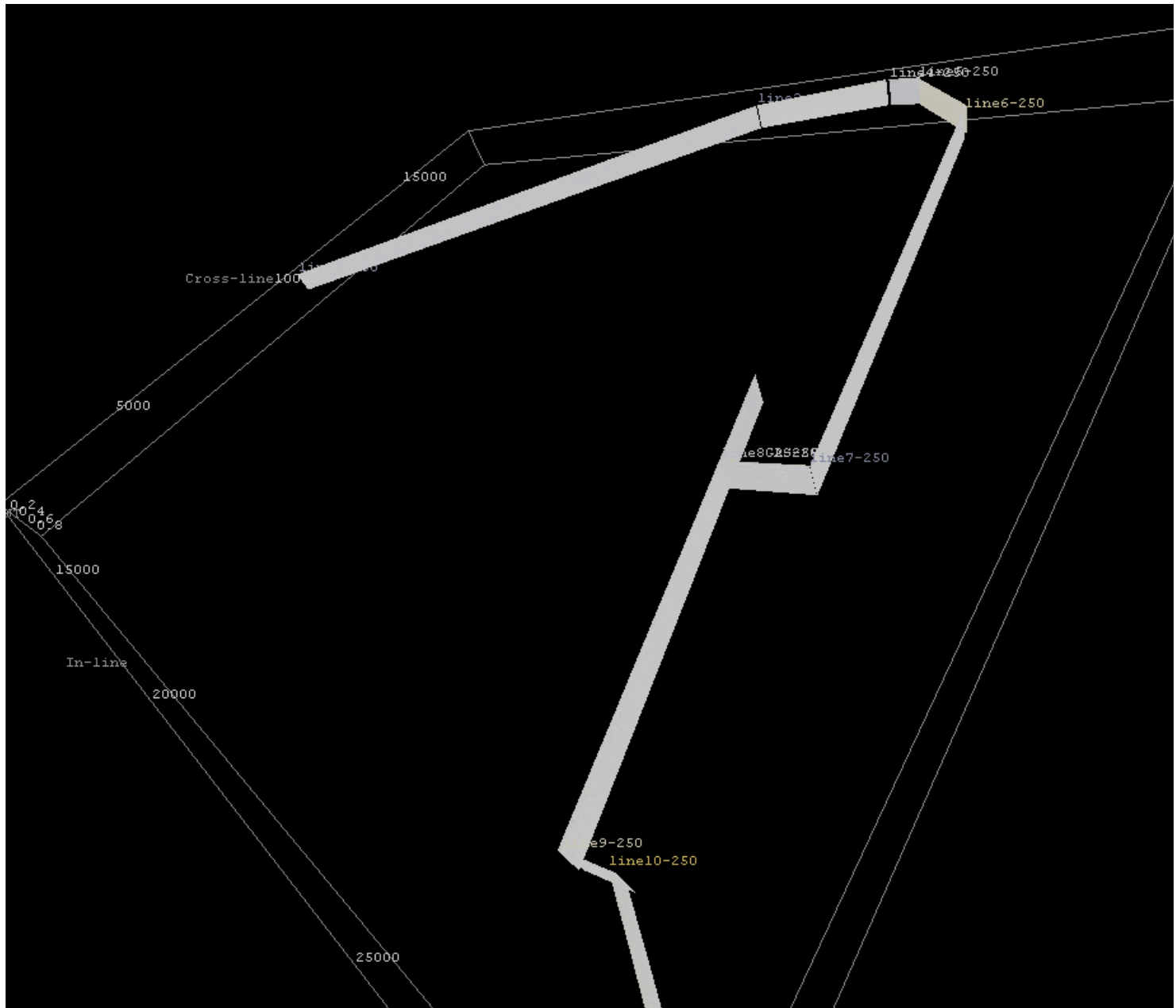
(a)



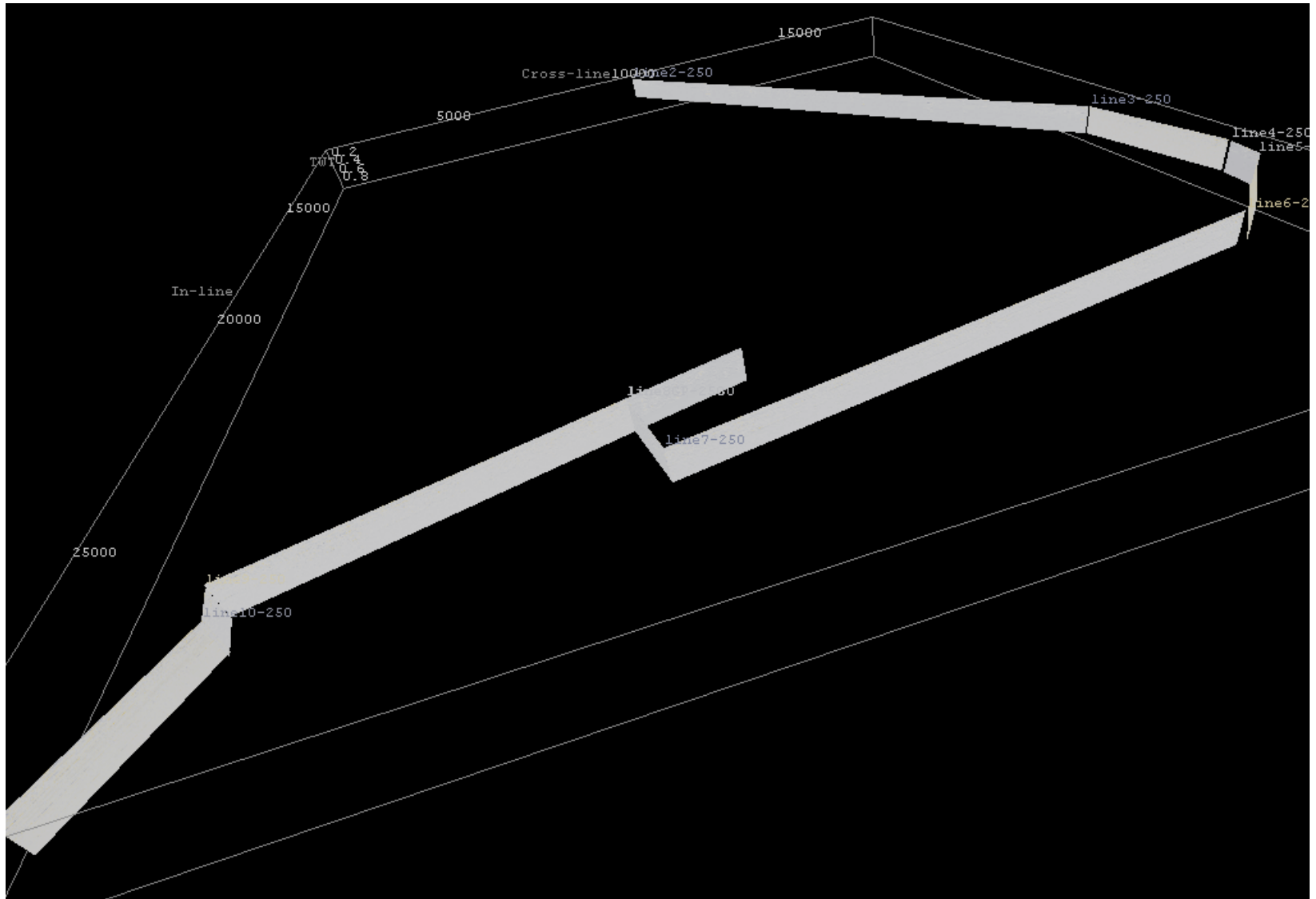
GPR investigations inside the tunnel



GPR investigations inside the tunnel



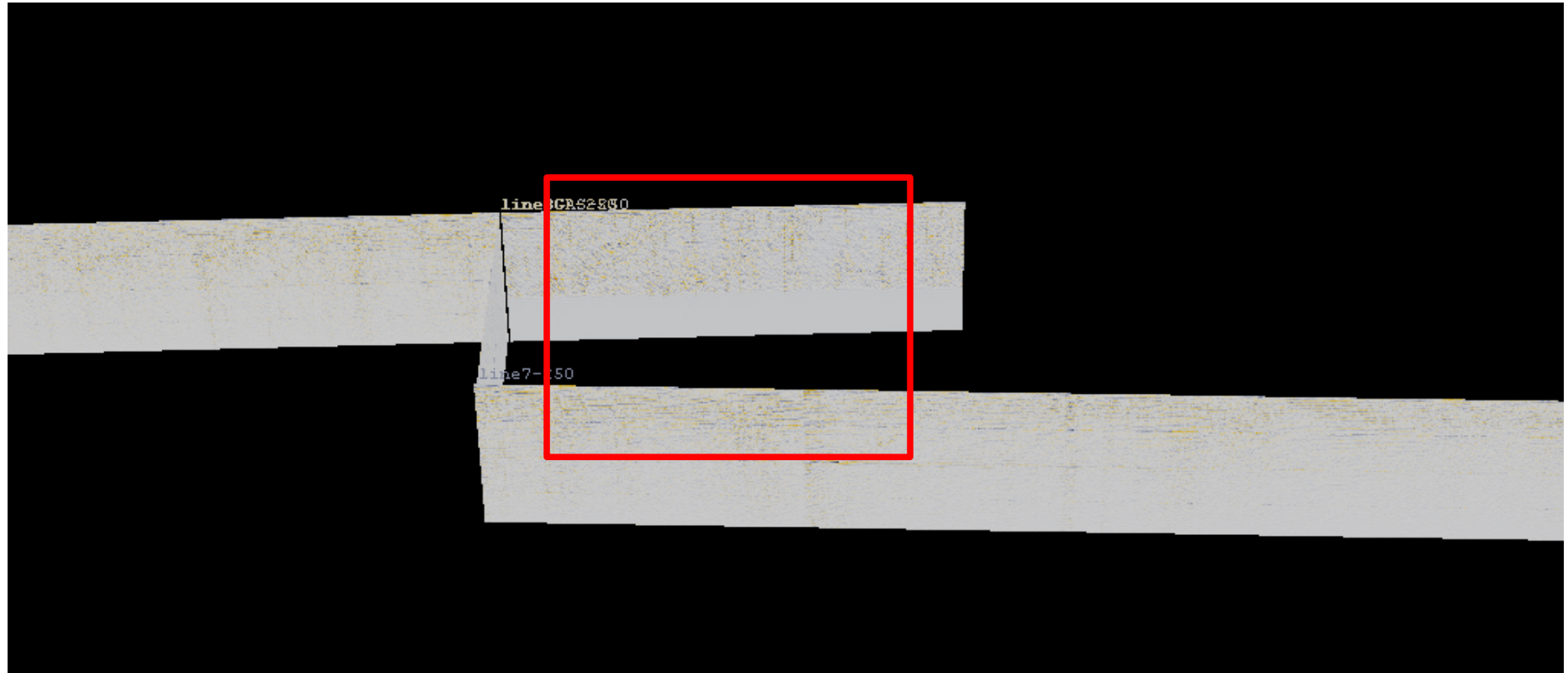
GPR investigations inside the tunnel



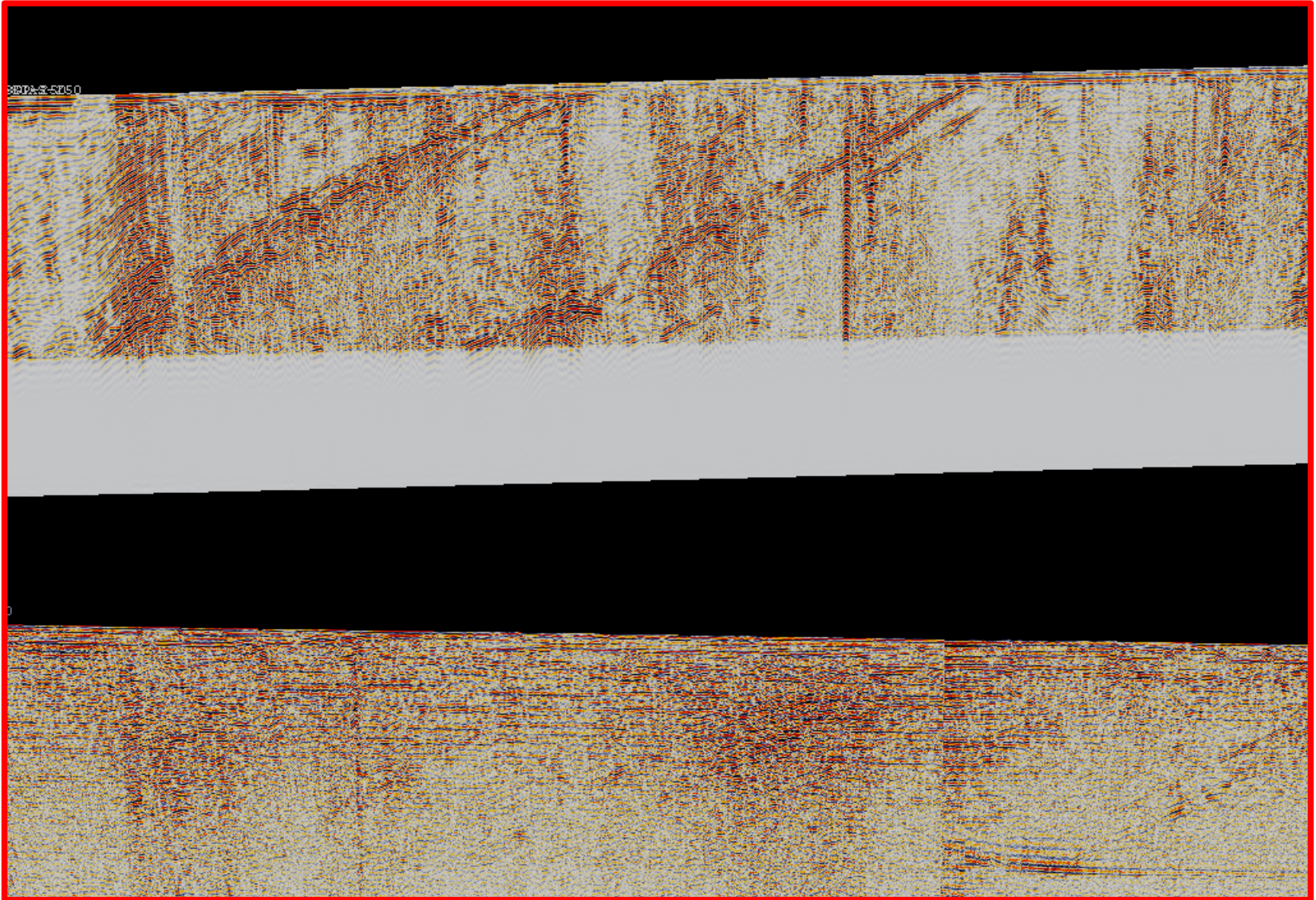
GPR investigations inside the tunnel



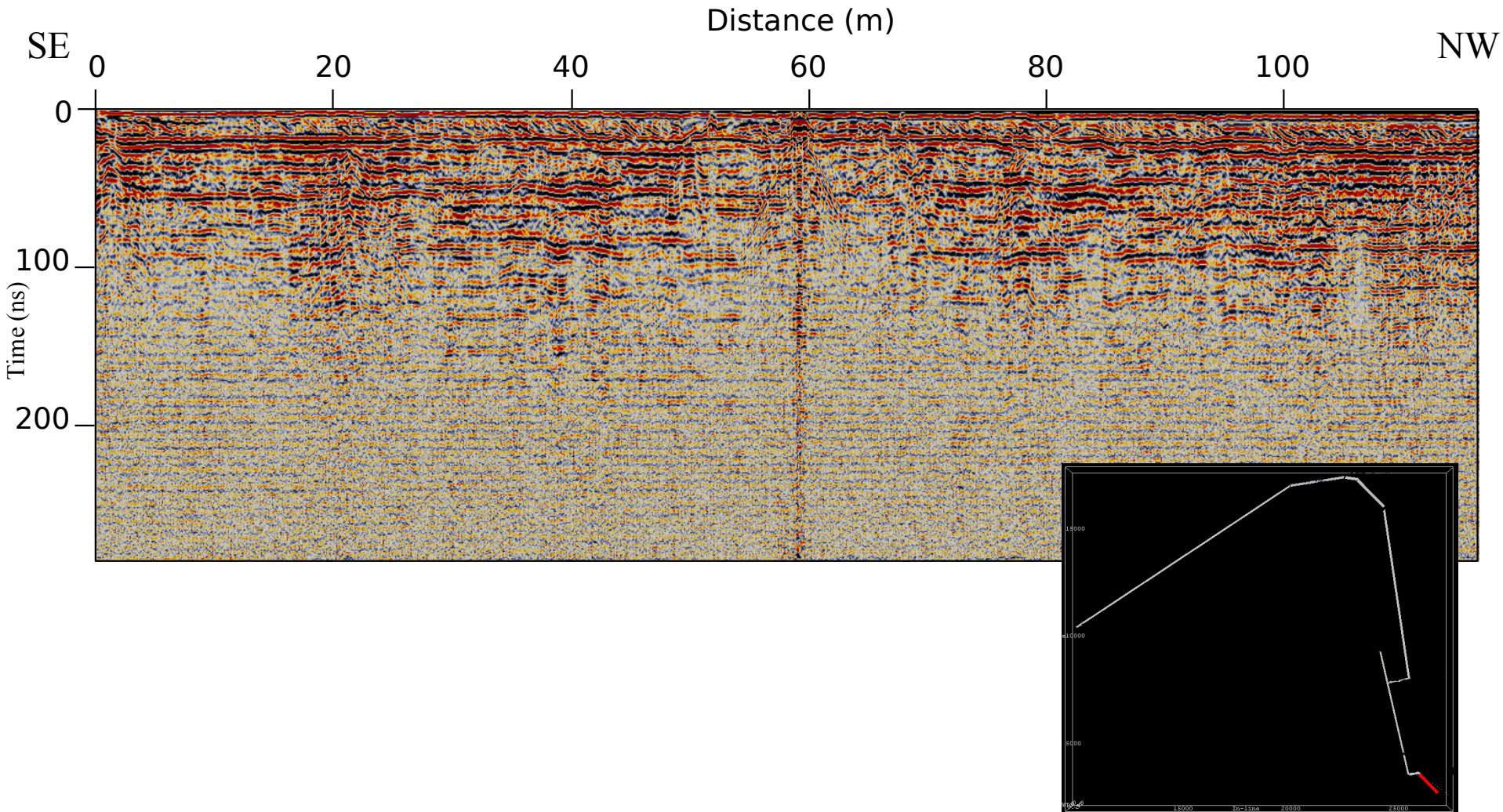
GPR investigations inside the tunnel



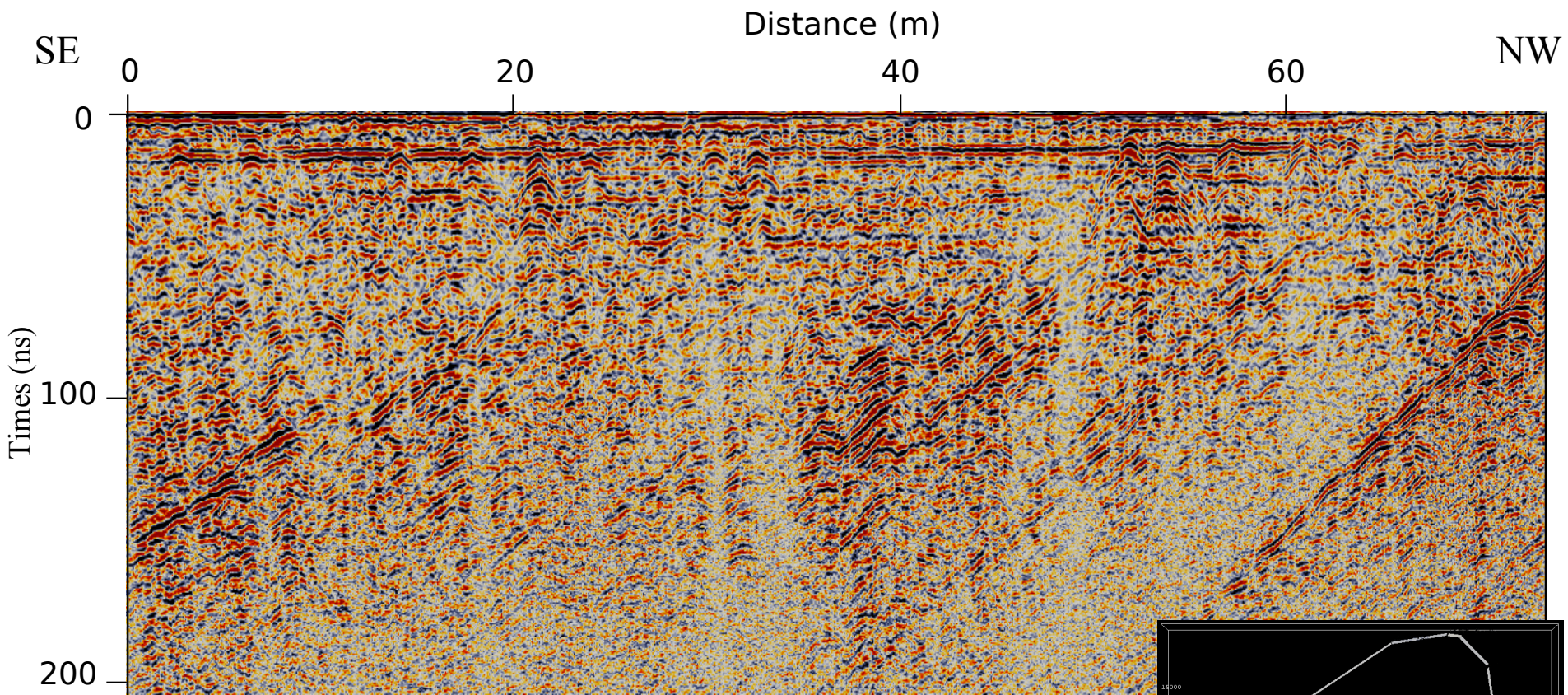
GPR investigations inside the tunnel



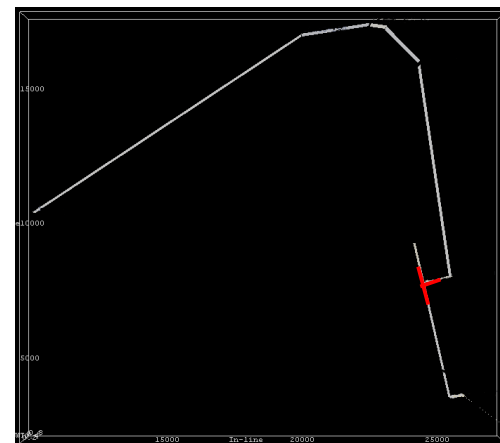
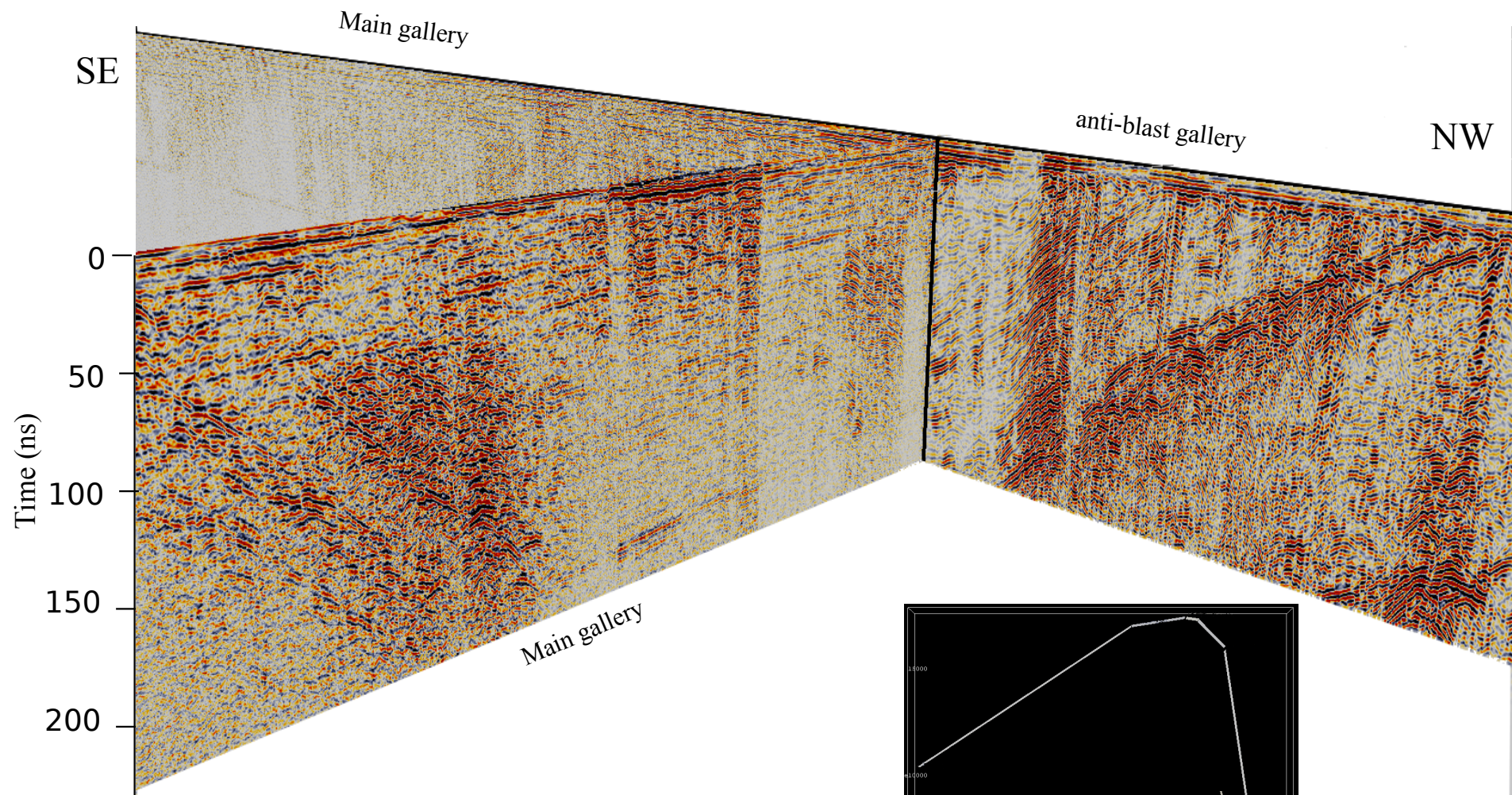
GPR investigations inside the tunnel



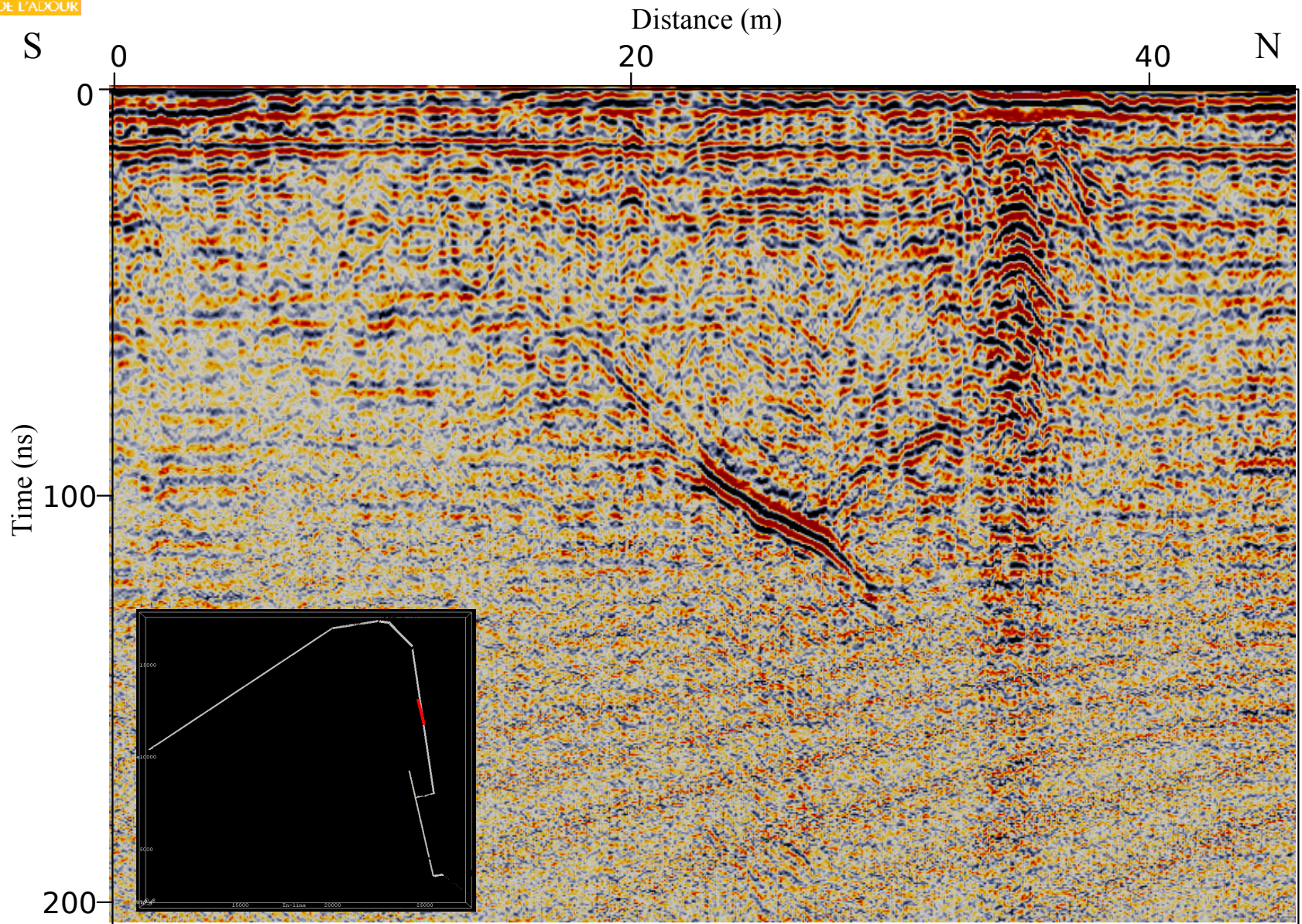
GPR investigations inside the tunnel



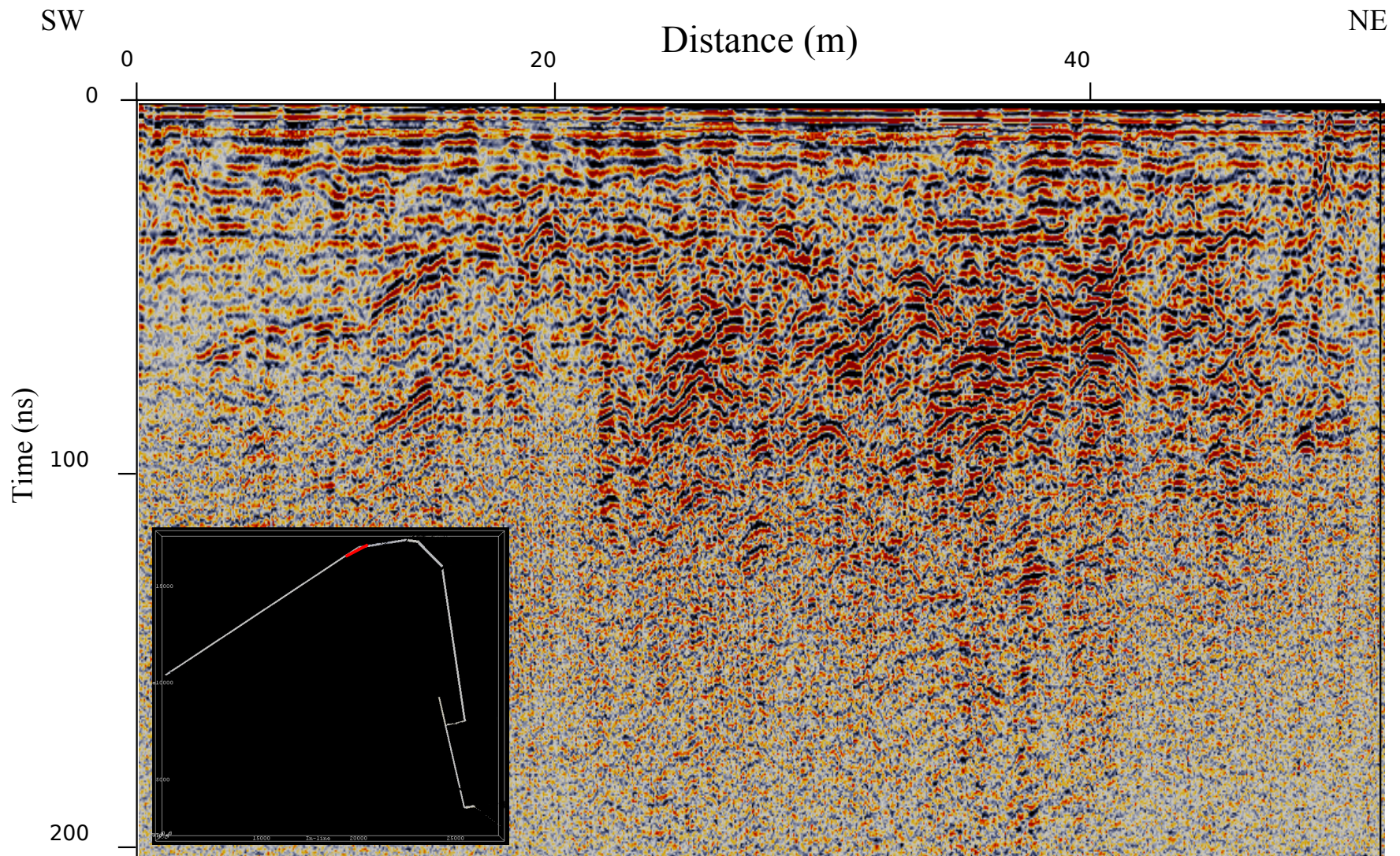
GPR investigations inside the tunnel



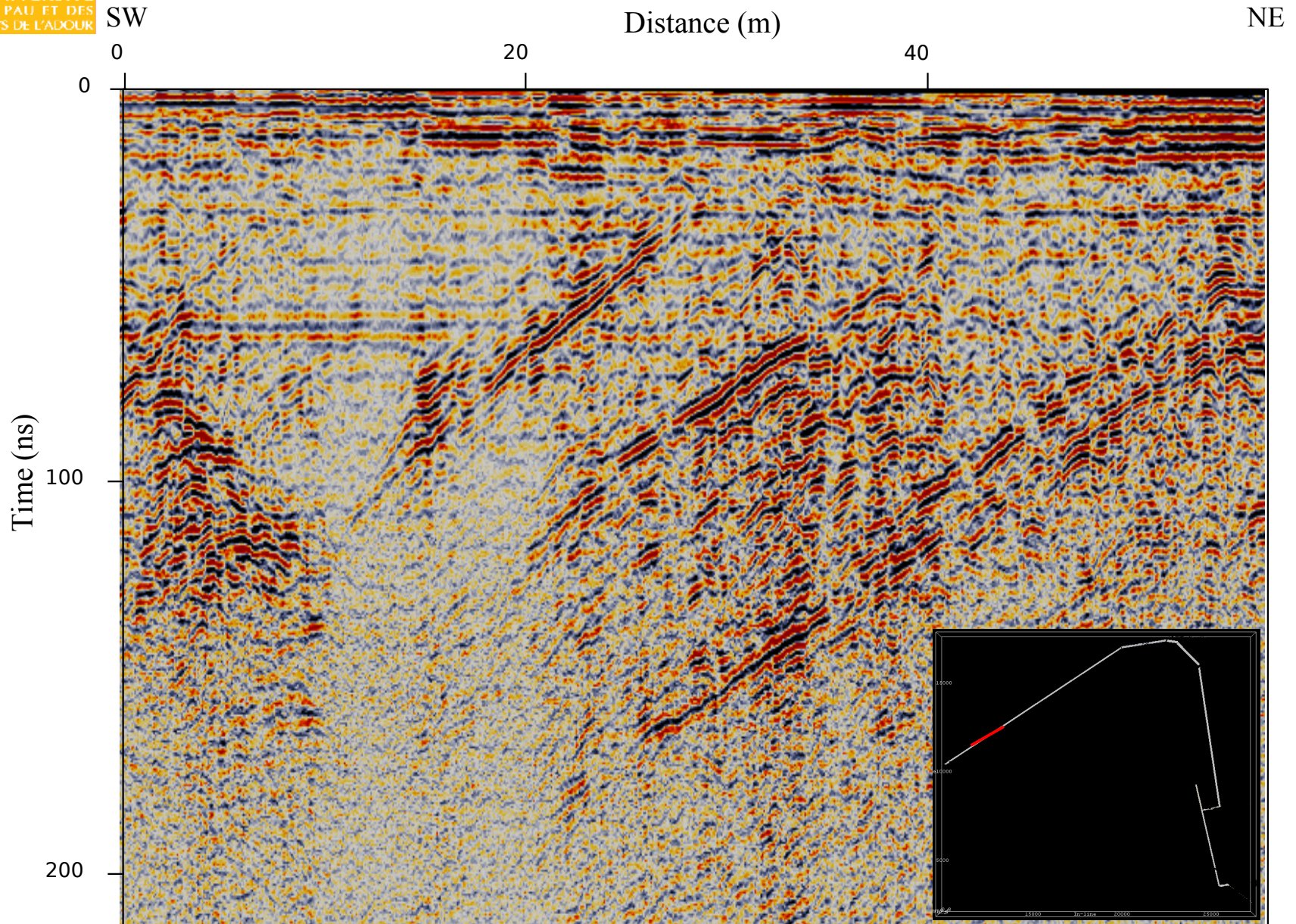
GPR investigations inside the tunnel



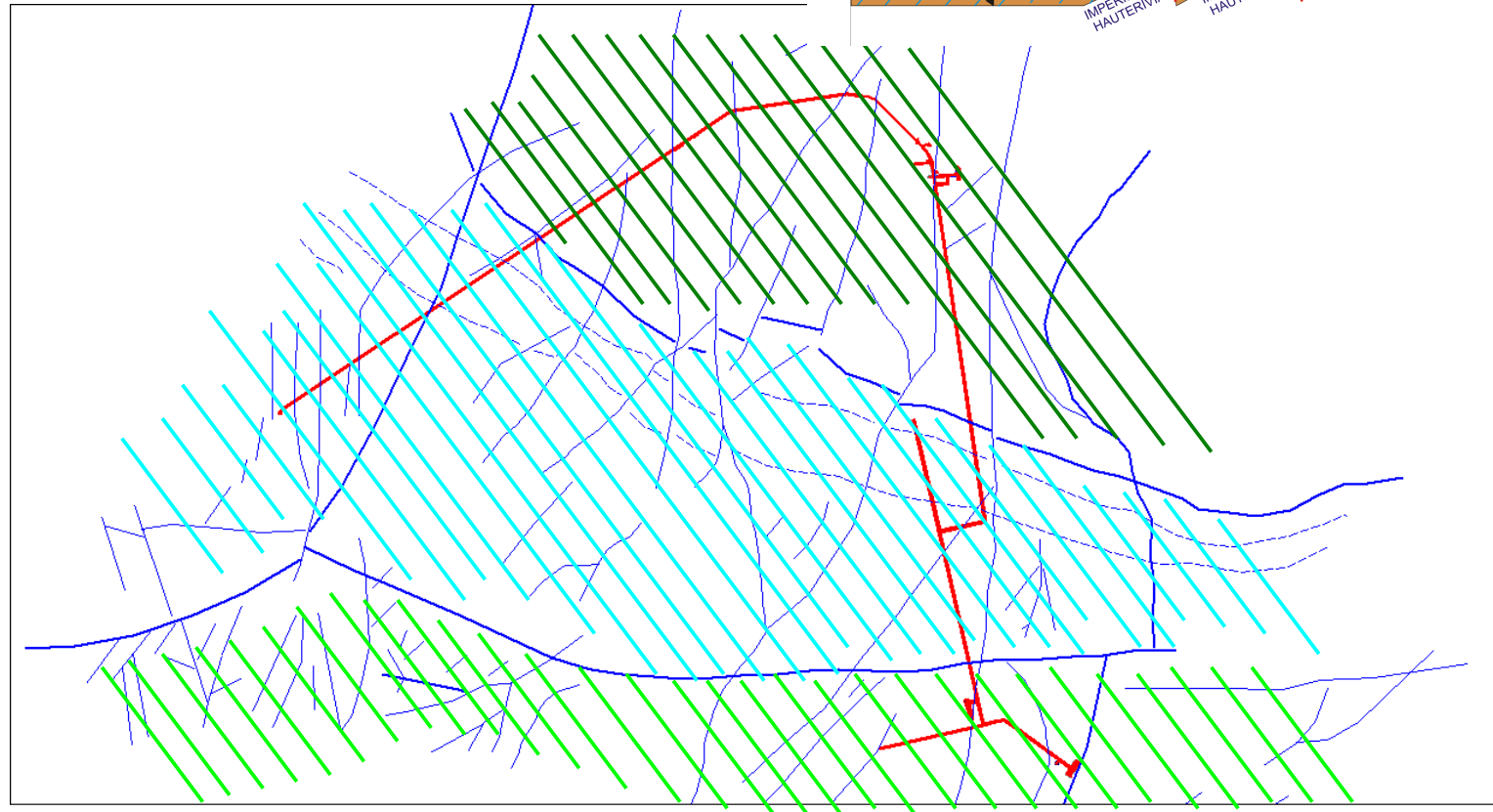
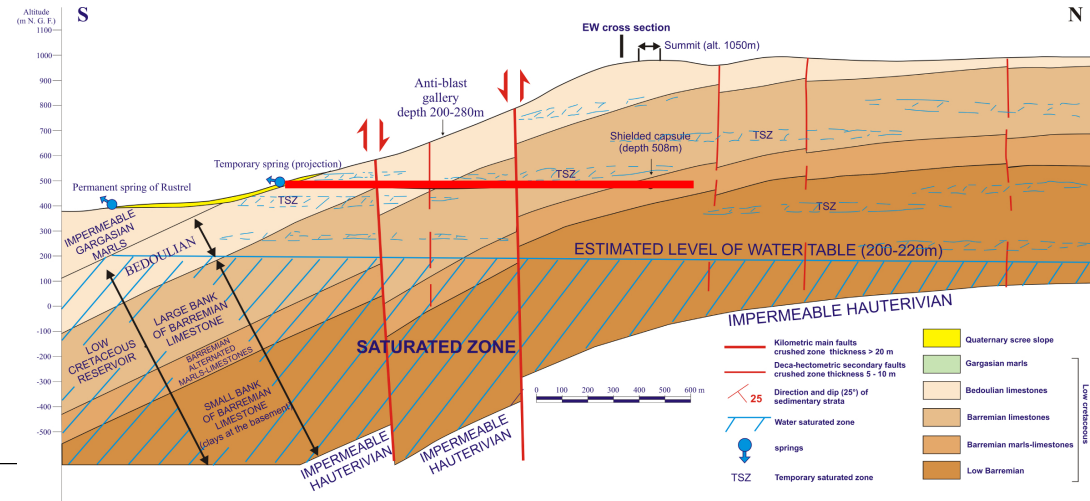
GPR investigations inside the tunnel



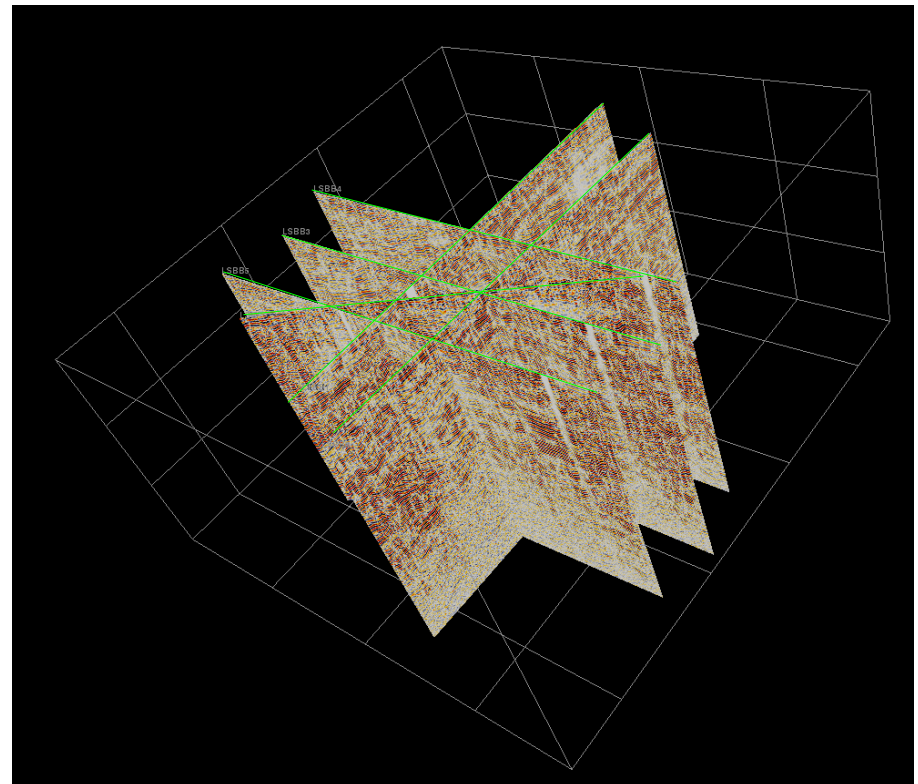
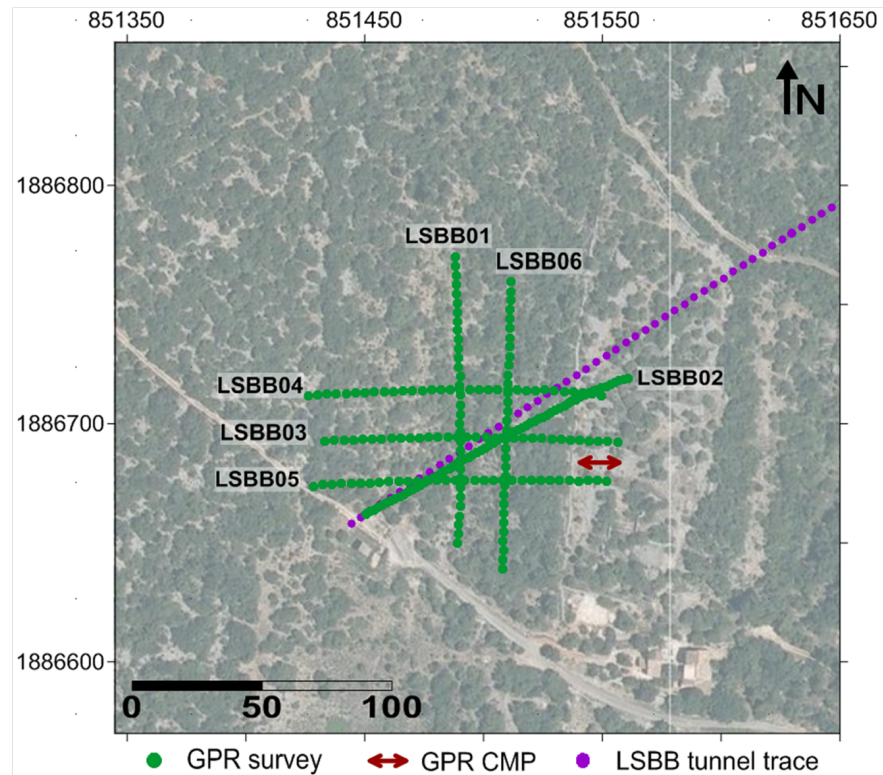
GPR investigations inside the tunnel



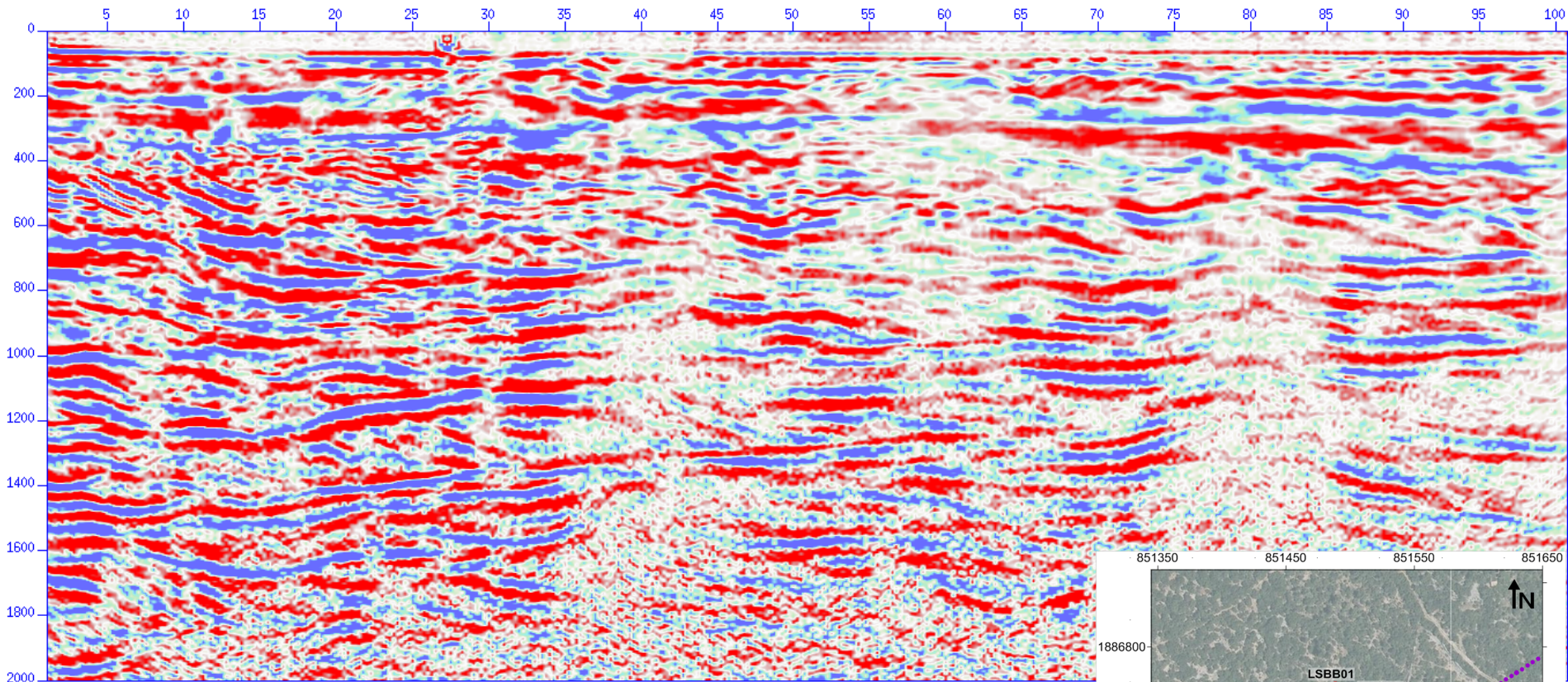
GPR investigations inside the tunnel



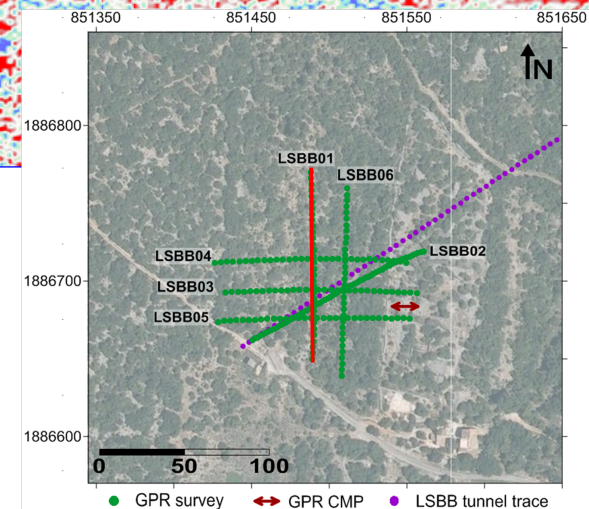
GPR investigations above/inside the tunnel



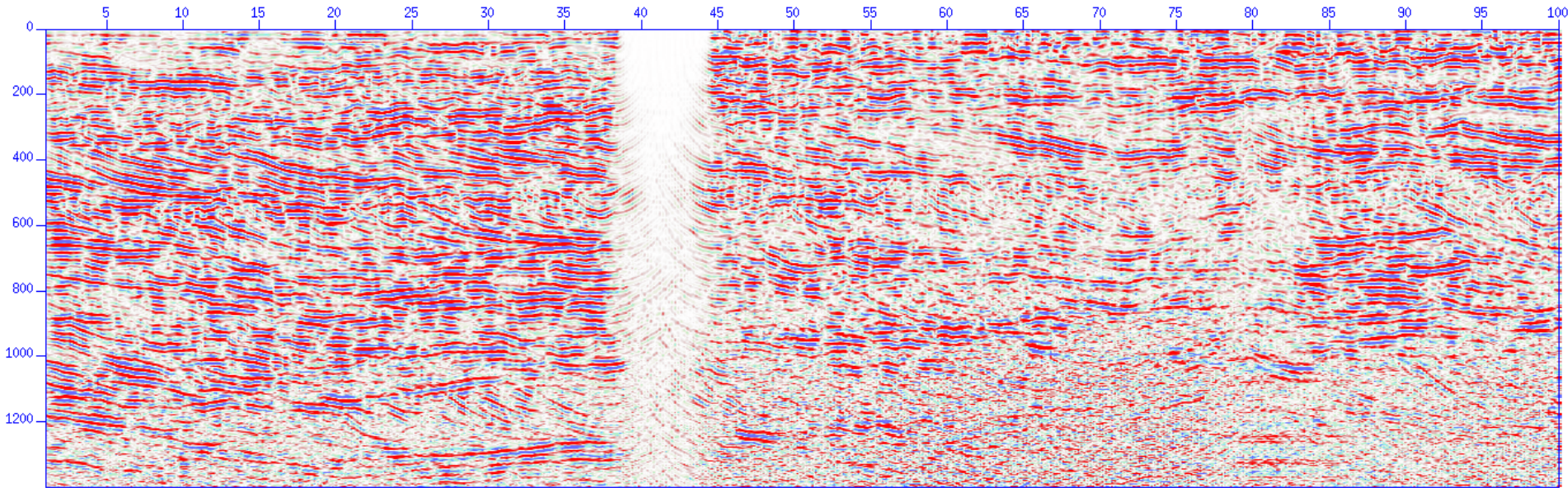
GPR investigations above the tunnel



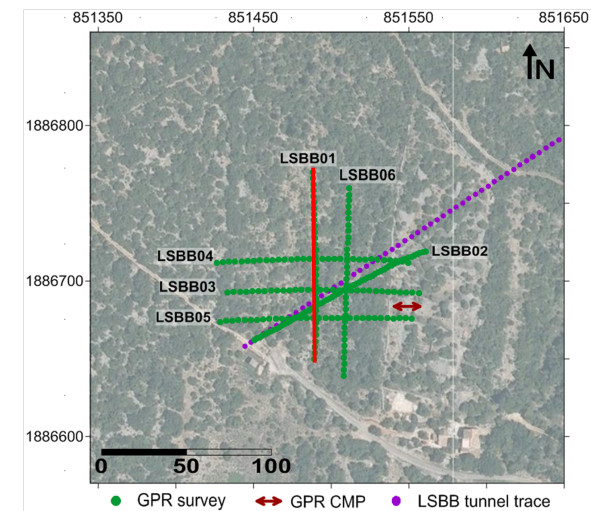
Unshielded 50 MHz (RTA)



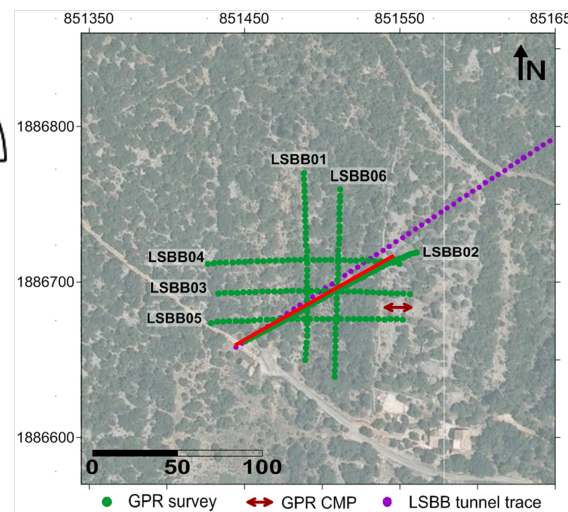
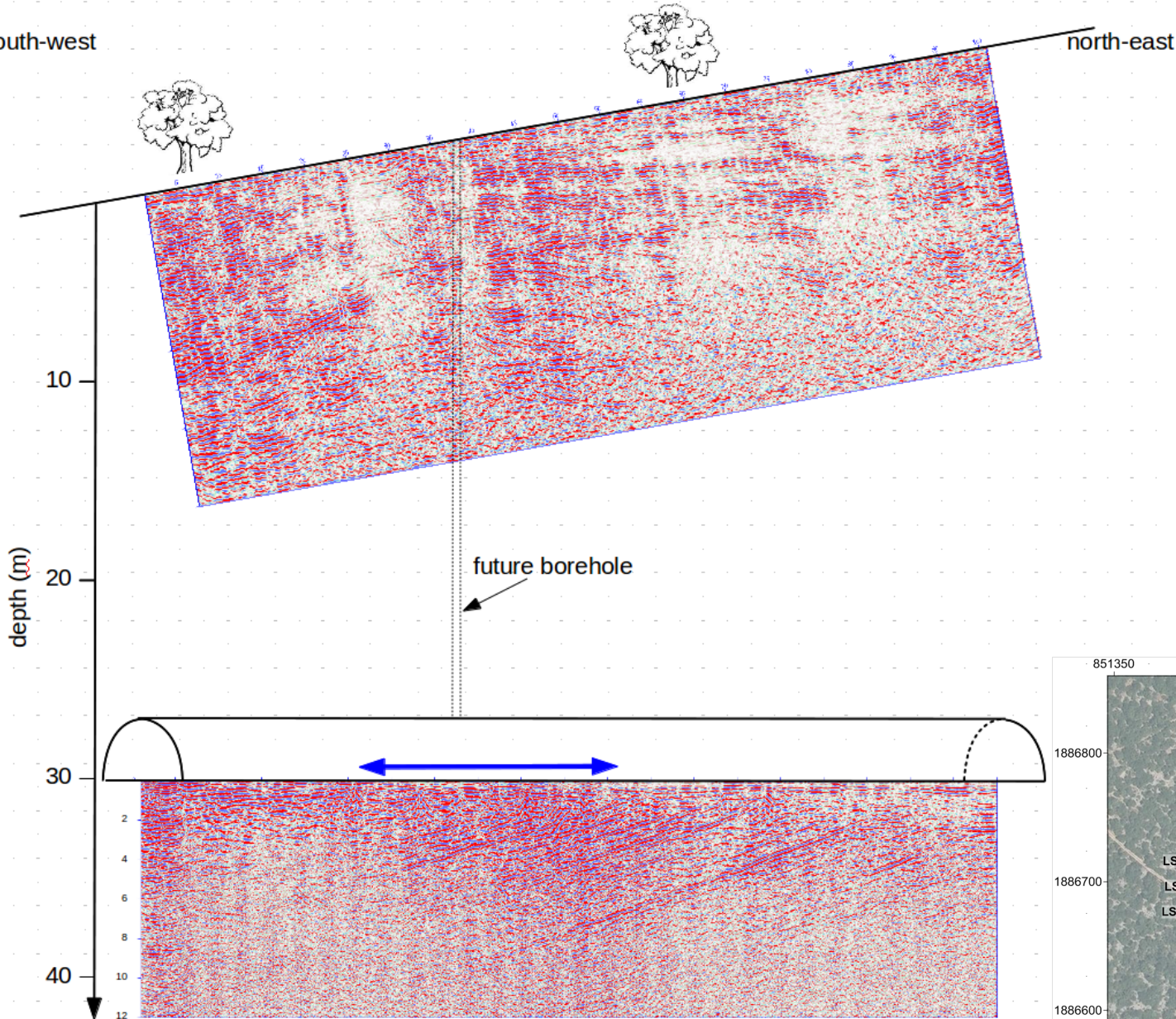
GPR investigations above the tunnel



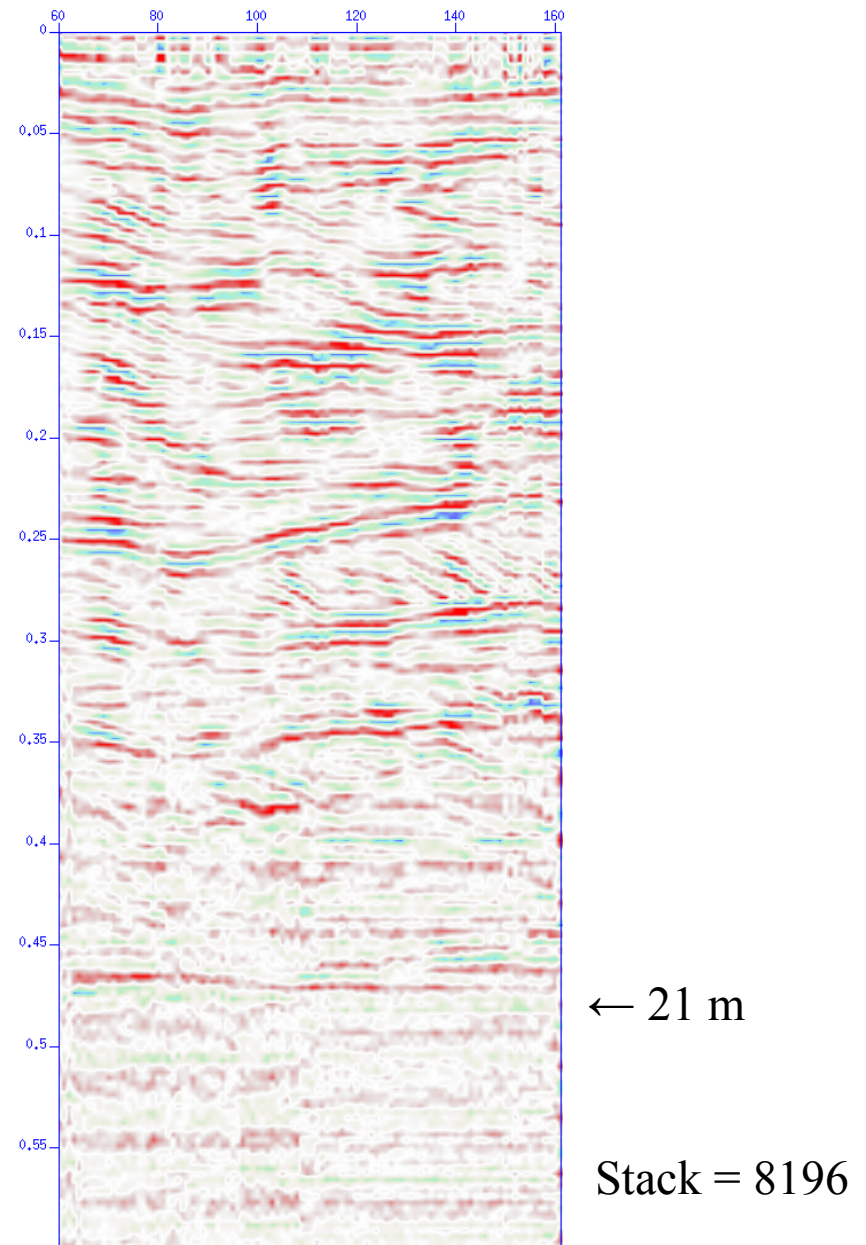
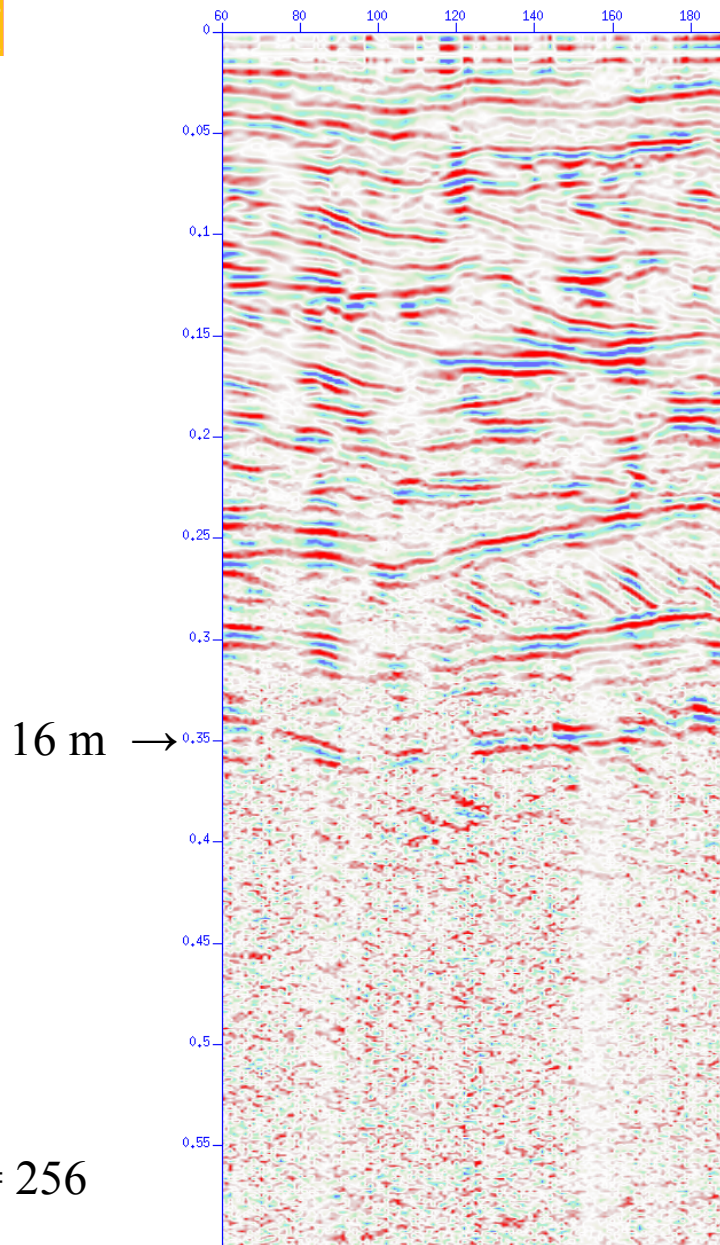
Shielded 250 MHz



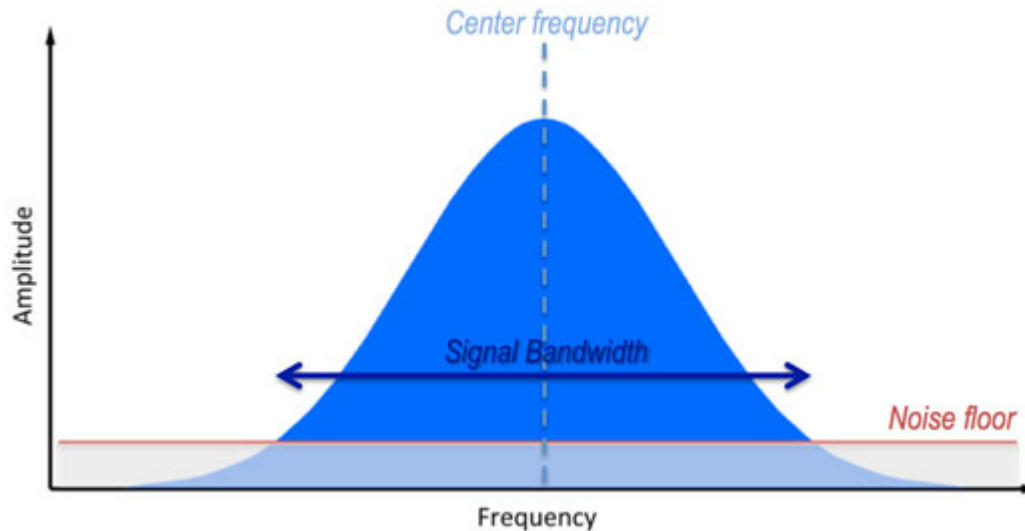
GPR investigations above/inside the tunnel



How to increase GPR depth investigation

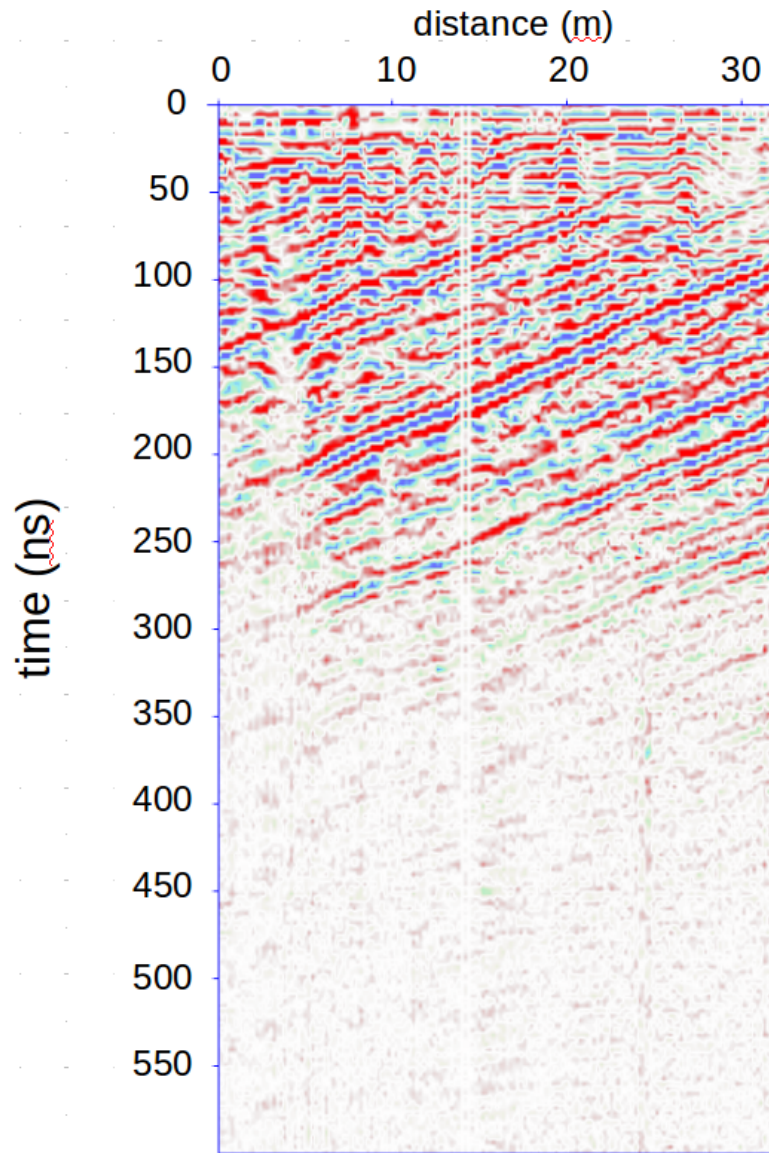


How to increase GPR depth investigation

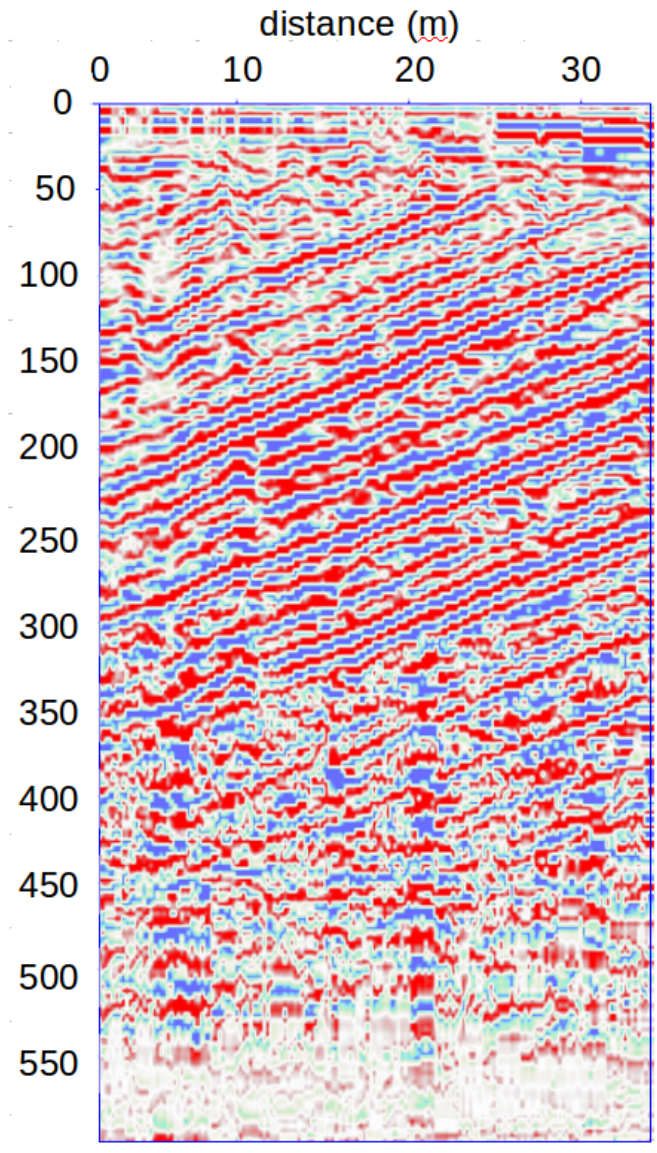


- Increase the speed of acquisition in order to increase the stack Parameter (signal to noise ratio increase)
- Increase the bandwidth of the antennae (resolution)

How to increase GPR depth investigation

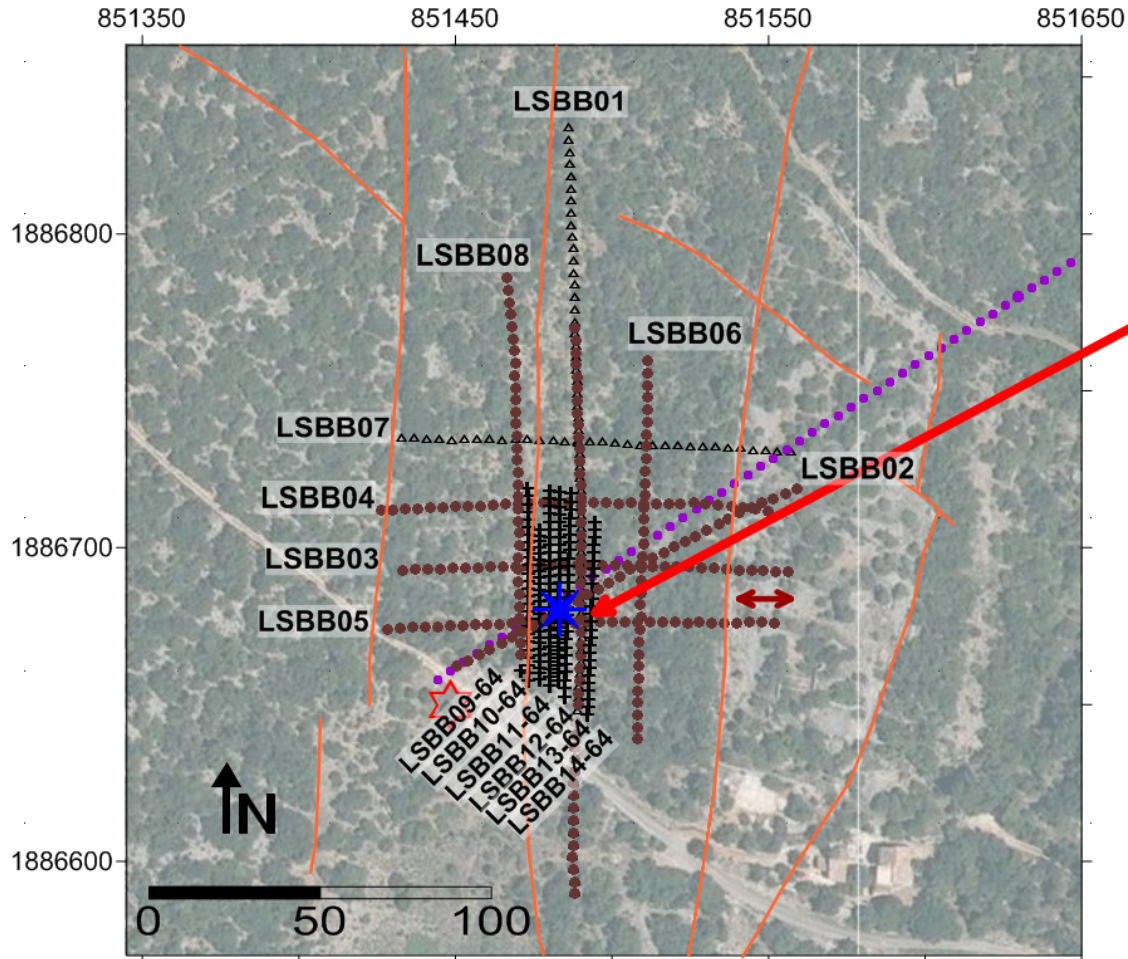


Parameter stack = 256



Parameter stack = 16384

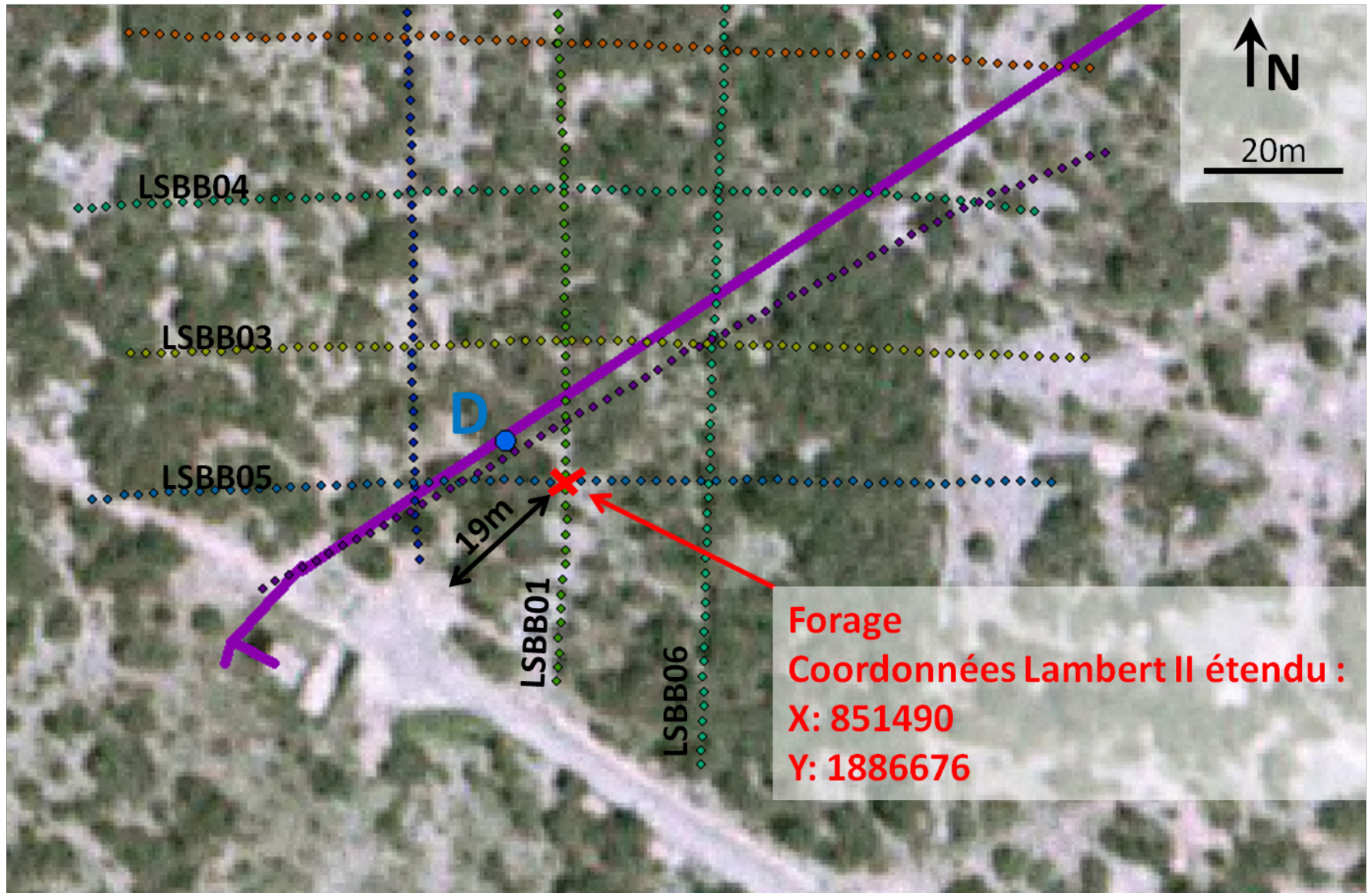
Future borehole



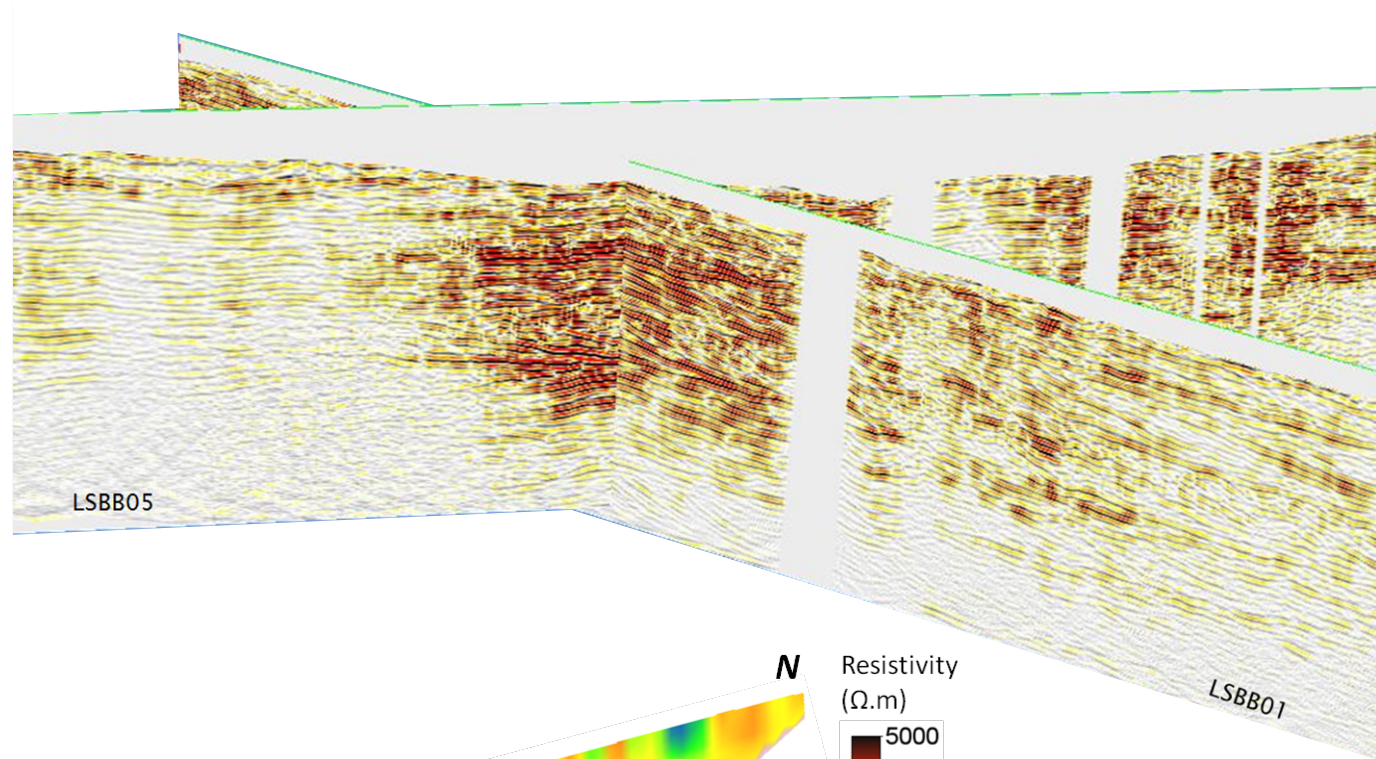
Forage
Coordonnées Lambert II étendu
X: 851490
Y: 1886676

- ▲ Only ERT surveys
- ERT and GPR surveys
- ↔ GPR CMP
- LSBB tunnel trace
- ☆ Emergency Exit of the LSBB
- ★ Flow point D (inside LSBB, 35m underground)
- Possible structural features detected by aerial photo
- + Only GPR survey

Future borehole



Future borehole



LSBB01-252m

