

3D paleoseismology to obtain net slip-rate for lateral strike slip faults with a reverse component

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geomodels
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0. Problem

Plates convergence → active faults

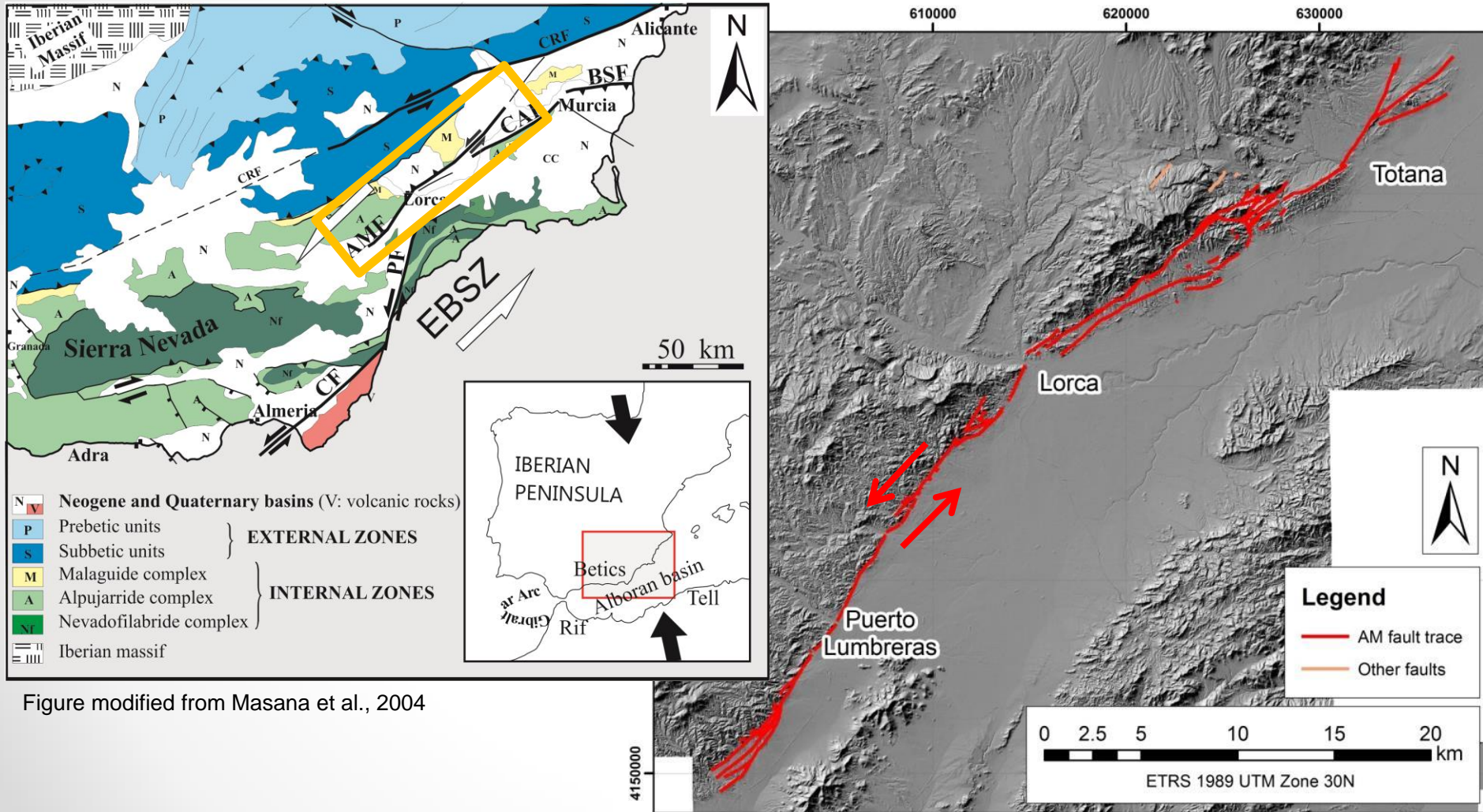
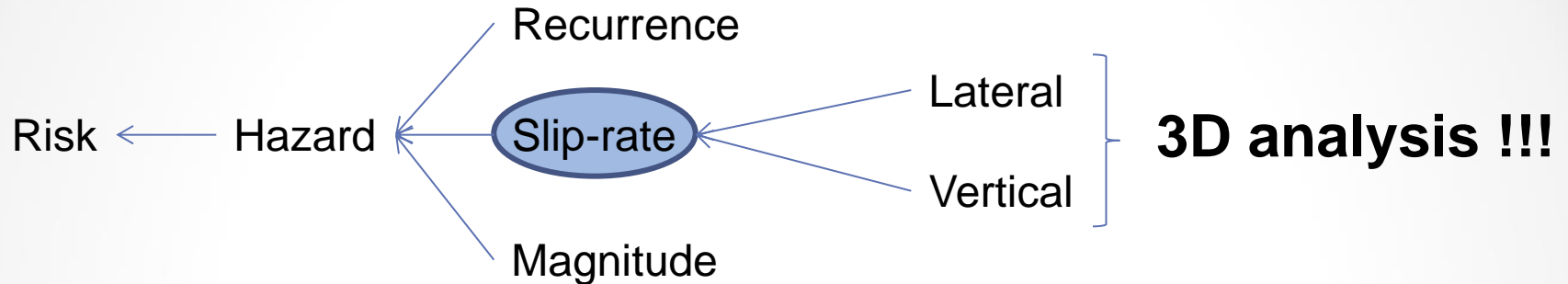


Figure modified from Masana et al., 2004

The Alhama de Murcia fault, Iberian Peninsula

0. Problem

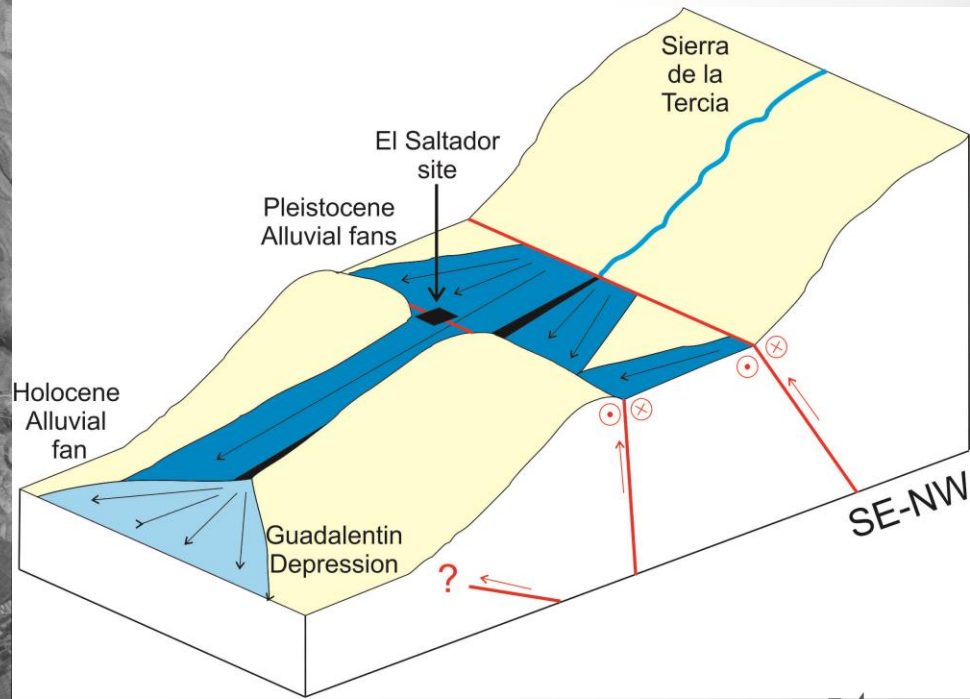
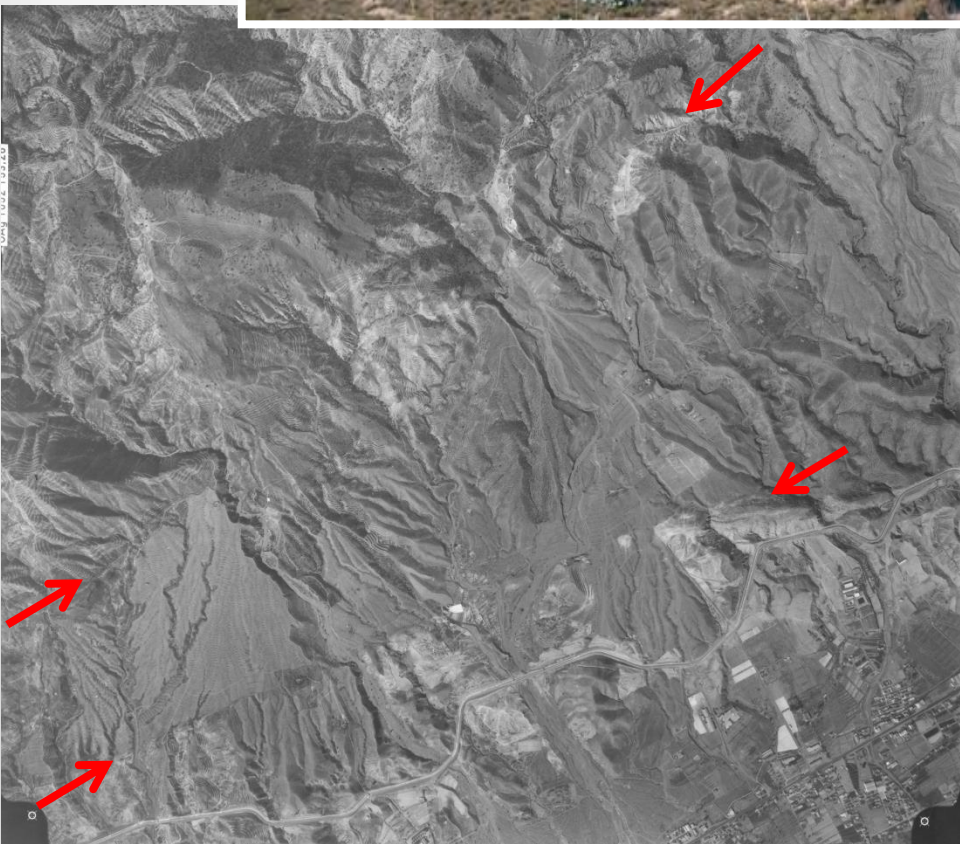


No pure active faults

AMF background:

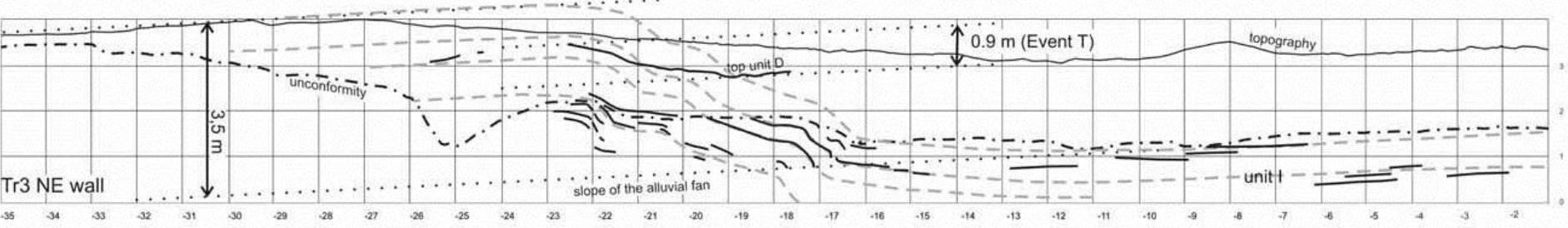
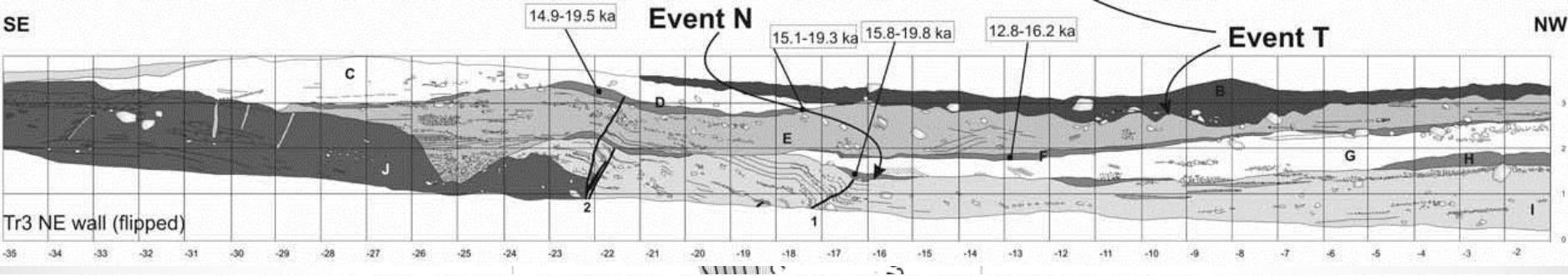
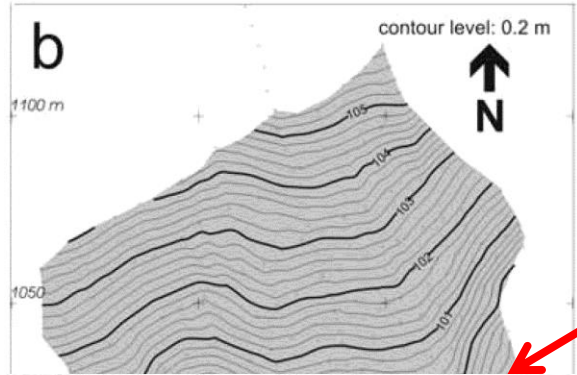
- Vertical: 0.04-0.35 mm/yr (Masana et al., 2004)
- Lateral: 0.21 mm/yr (Martínez-Díaz et al., 2003)
- 3D Paleoseismology

1. Trenching site, structural and stratigraphic setting



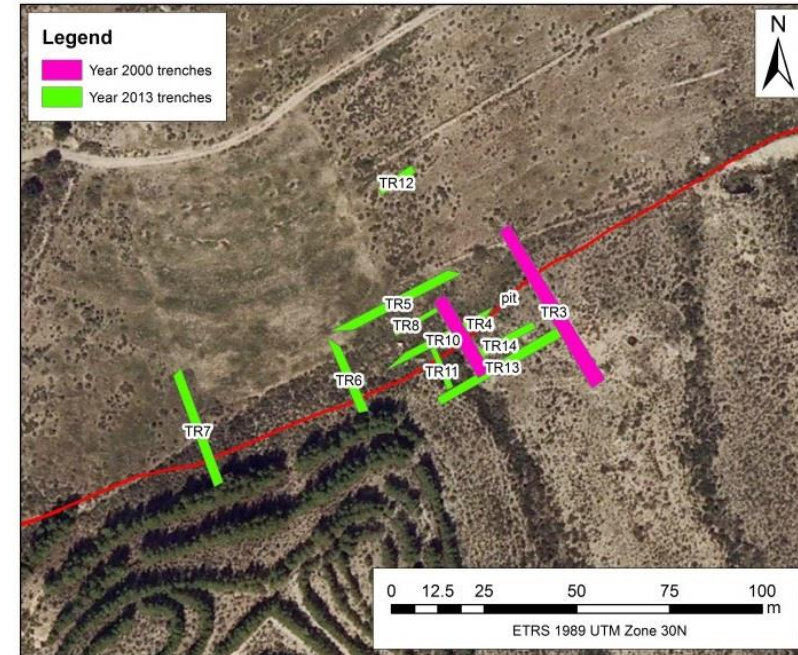
2. Paleoseismological background

Masana et al., 2004: Perpendicular trenches → Vertical component



3. 3D-Trenching

Find the same linear feature at both blocs of the fault to measure the offset due to fault activity



First time in Iberian Peninsula !!!

4. Linear features

- Alluvial fan sedimentation → CHANNELS
- Reference lines/Reference points in the buried channels
 - Channel thalweg
 - Margin (curvature/facies)

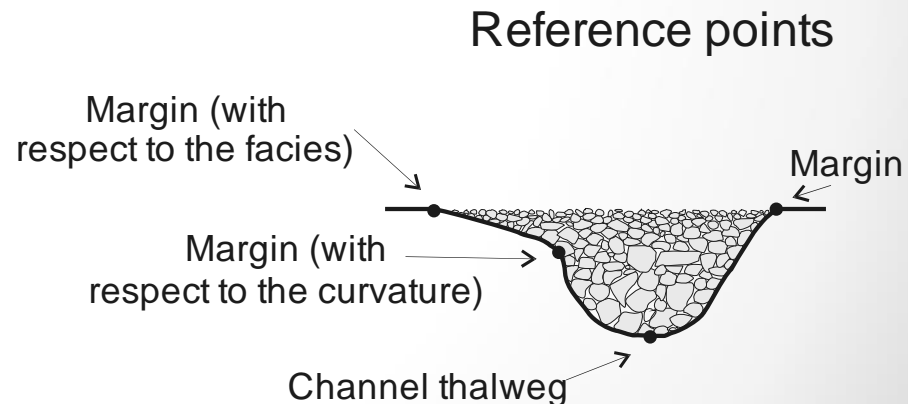
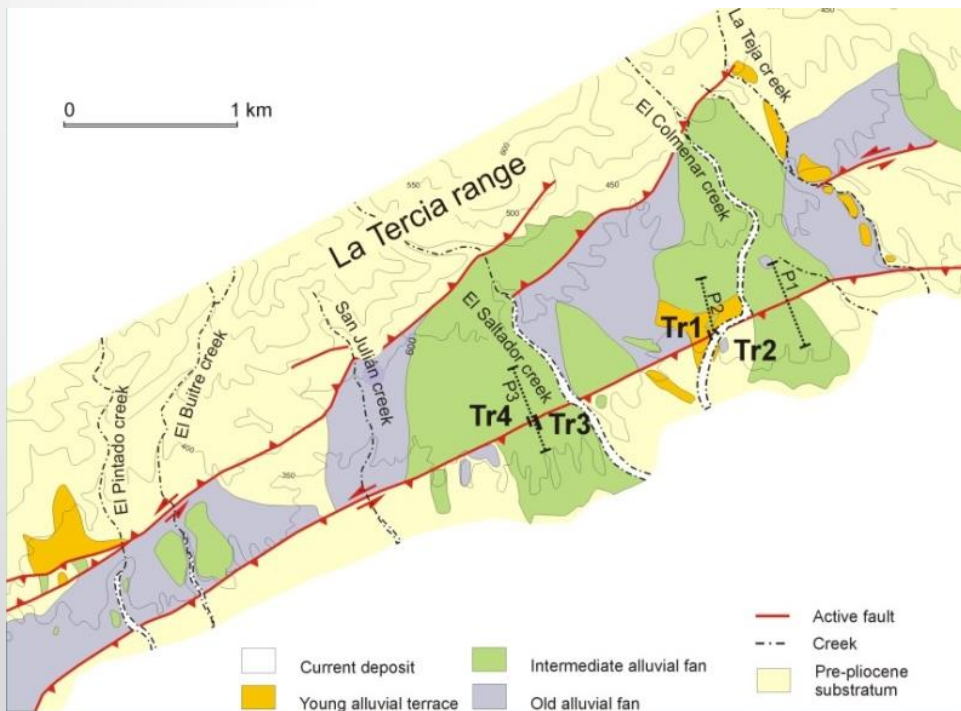
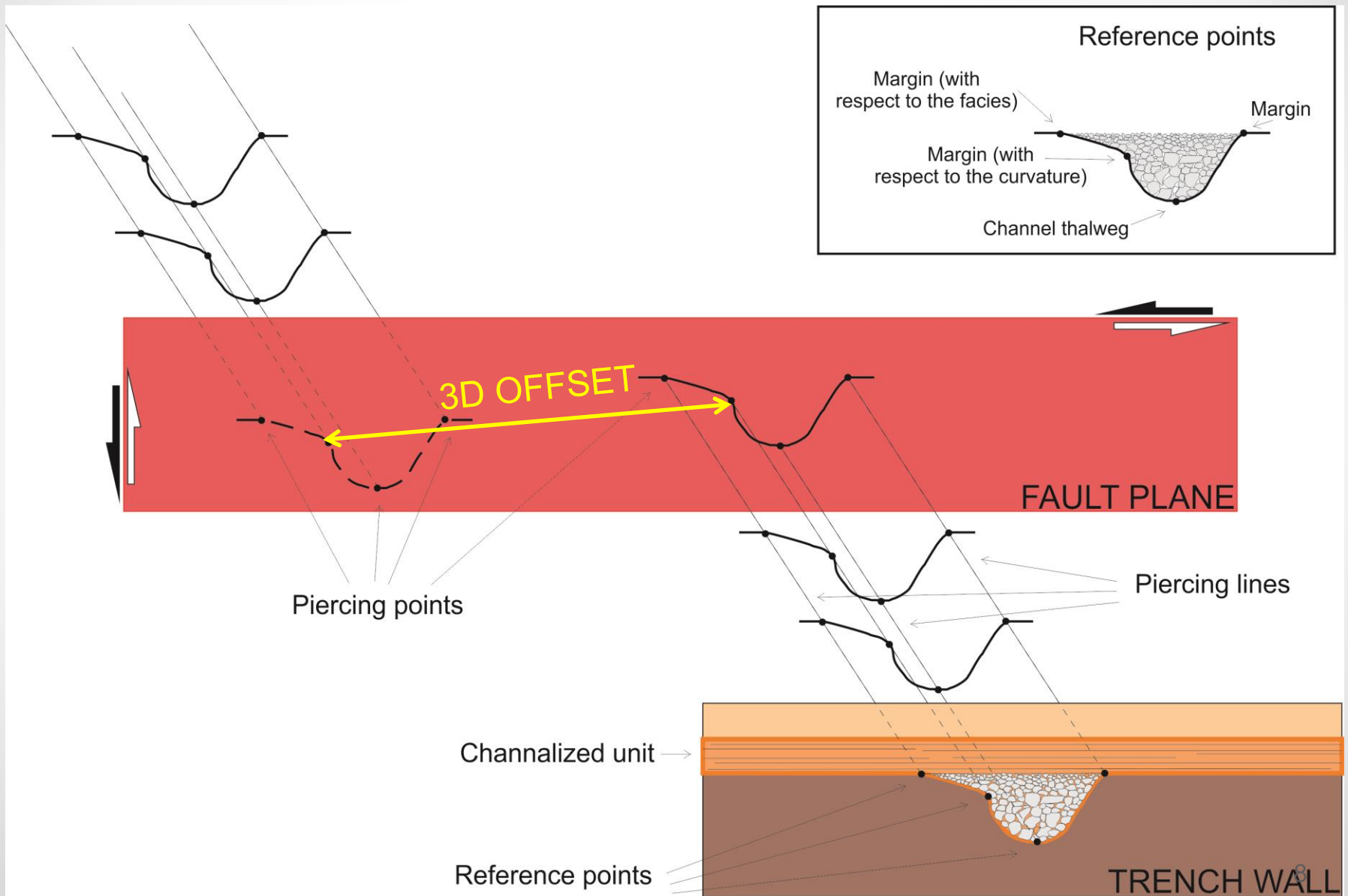


Figure from Martínez-Díaz et al., 2003

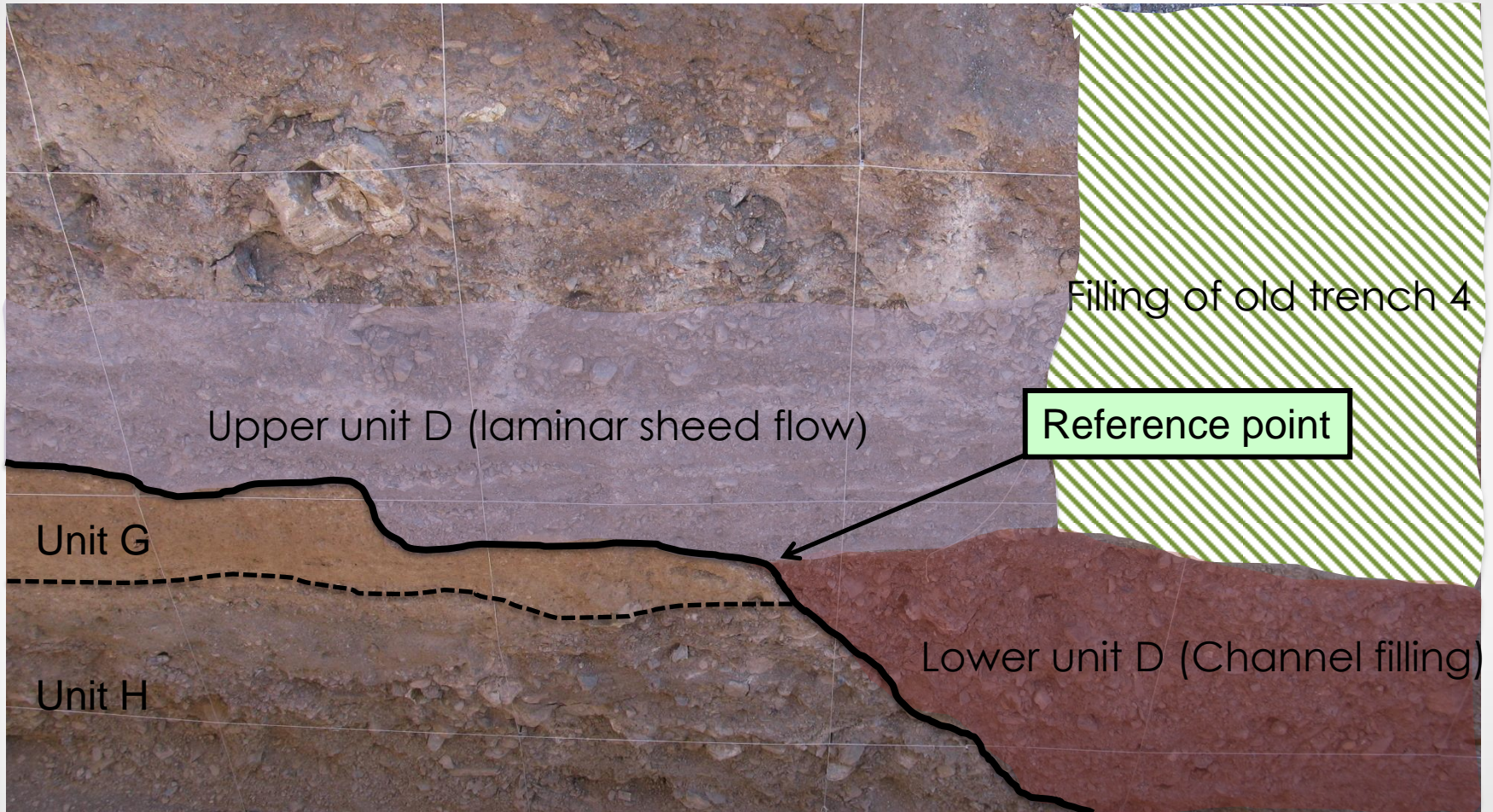
5. Reference points/Piercing lines



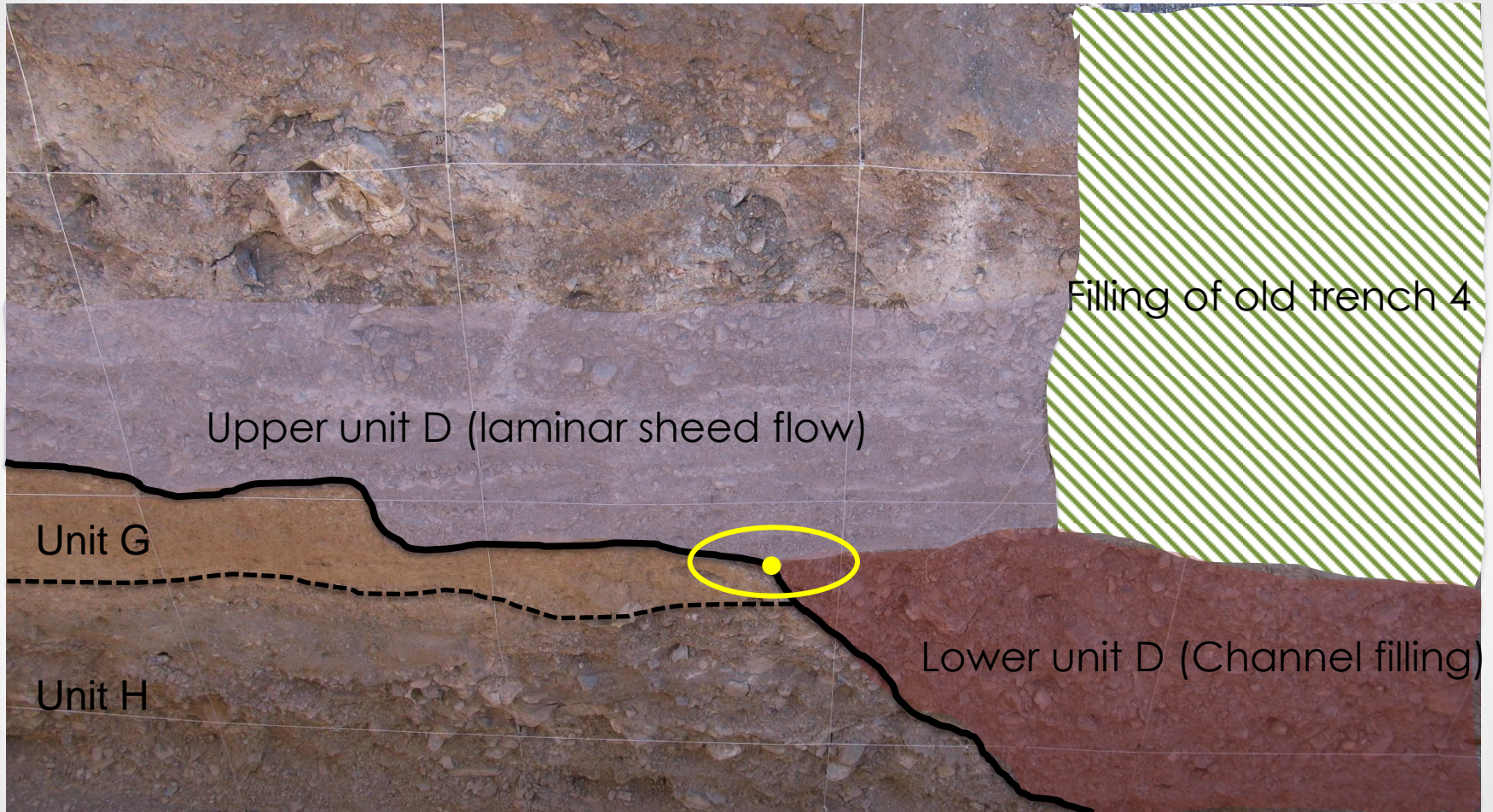
5. Reference points/Piercing lines



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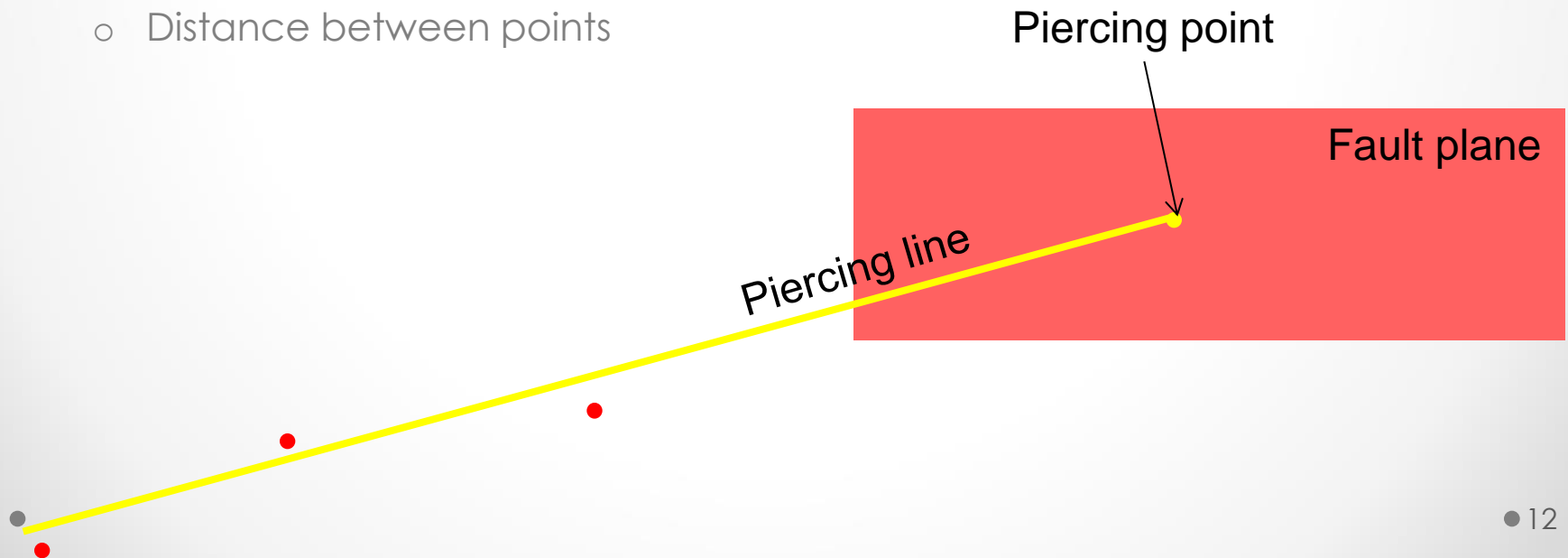
6. Data acquisition



GPS Leica Zena 5 + centimetric error (x, y, z)

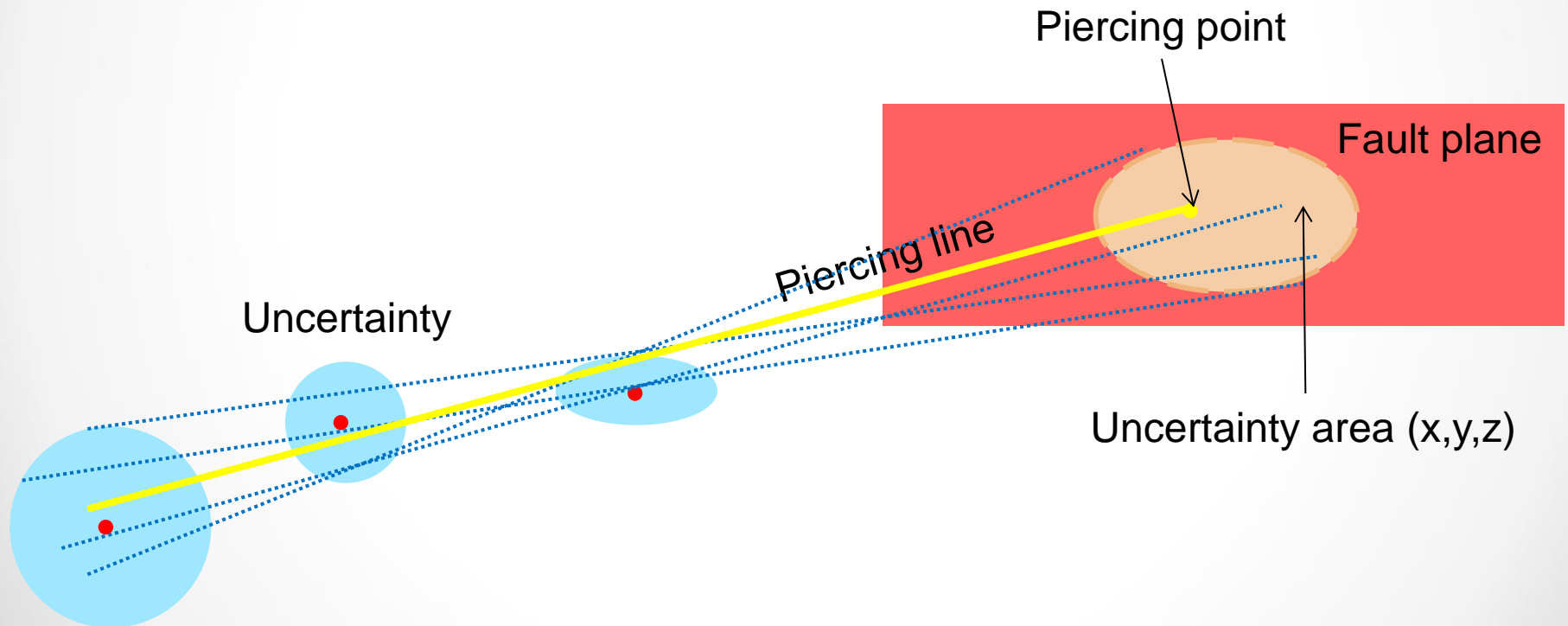
7. Mathematical steps (programming)

- Reference points \rightarrow piercing line
 - 3D Fit line
- Piercing line \rightarrow Piercing point
 - Point intersection between piercing line and fault plane
- Two piercing points \rightarrow 3D Distance
 - Distance between points

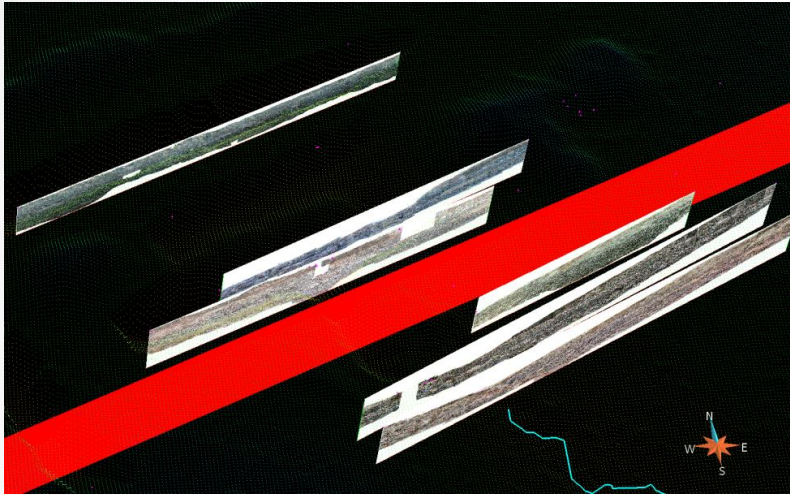


7. Mathematical steps (error)

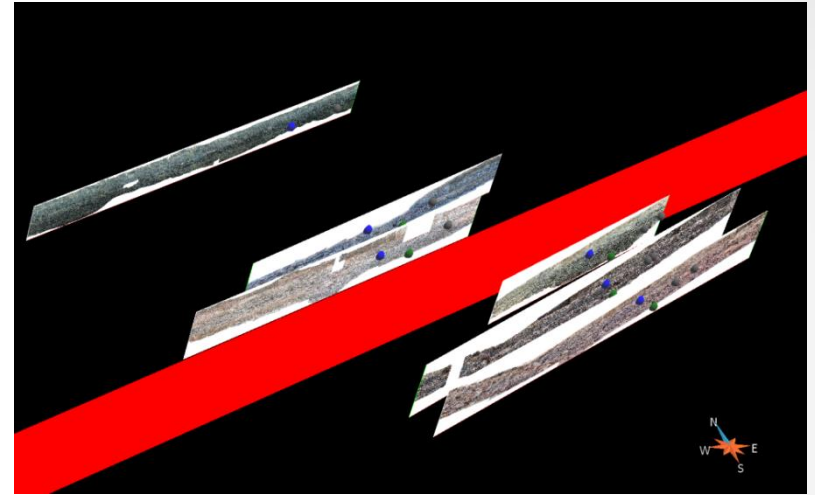
- Same steps for hundreds of combinations of points within the error ellipse (Monte Carlo)



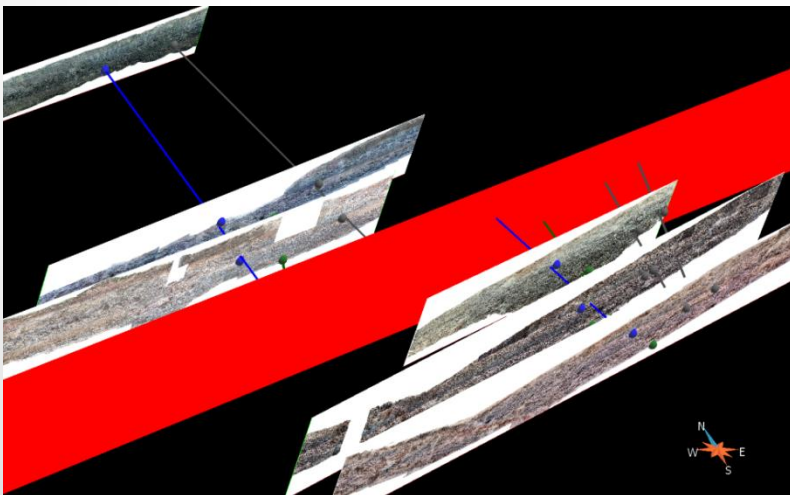
8. 3D Visualization



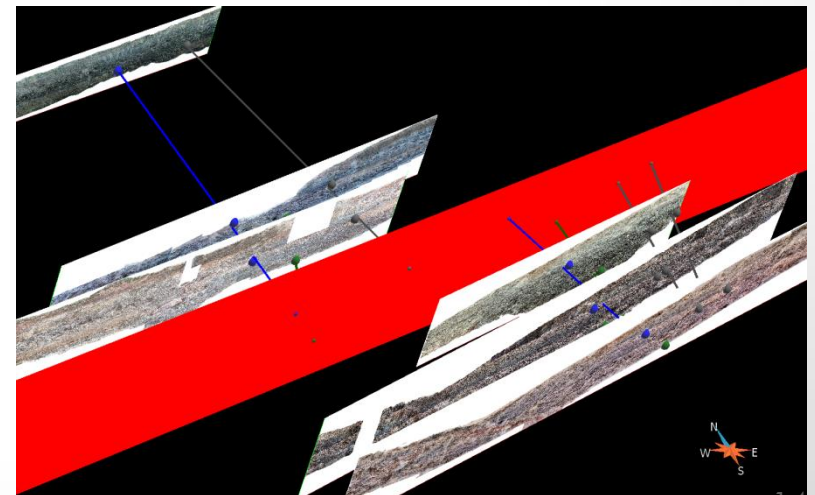
Fault/DEM/trenches walls



Reference points (\pm errors) GPS in the field



Best 3D fit line for every group of reference points



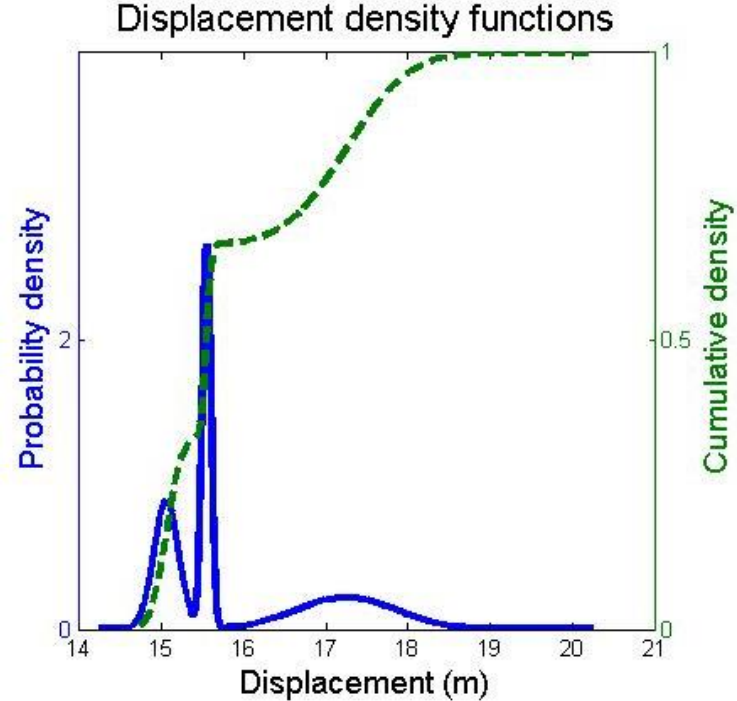
Intersection of the lines with the fault plane

8. 3D Visualization

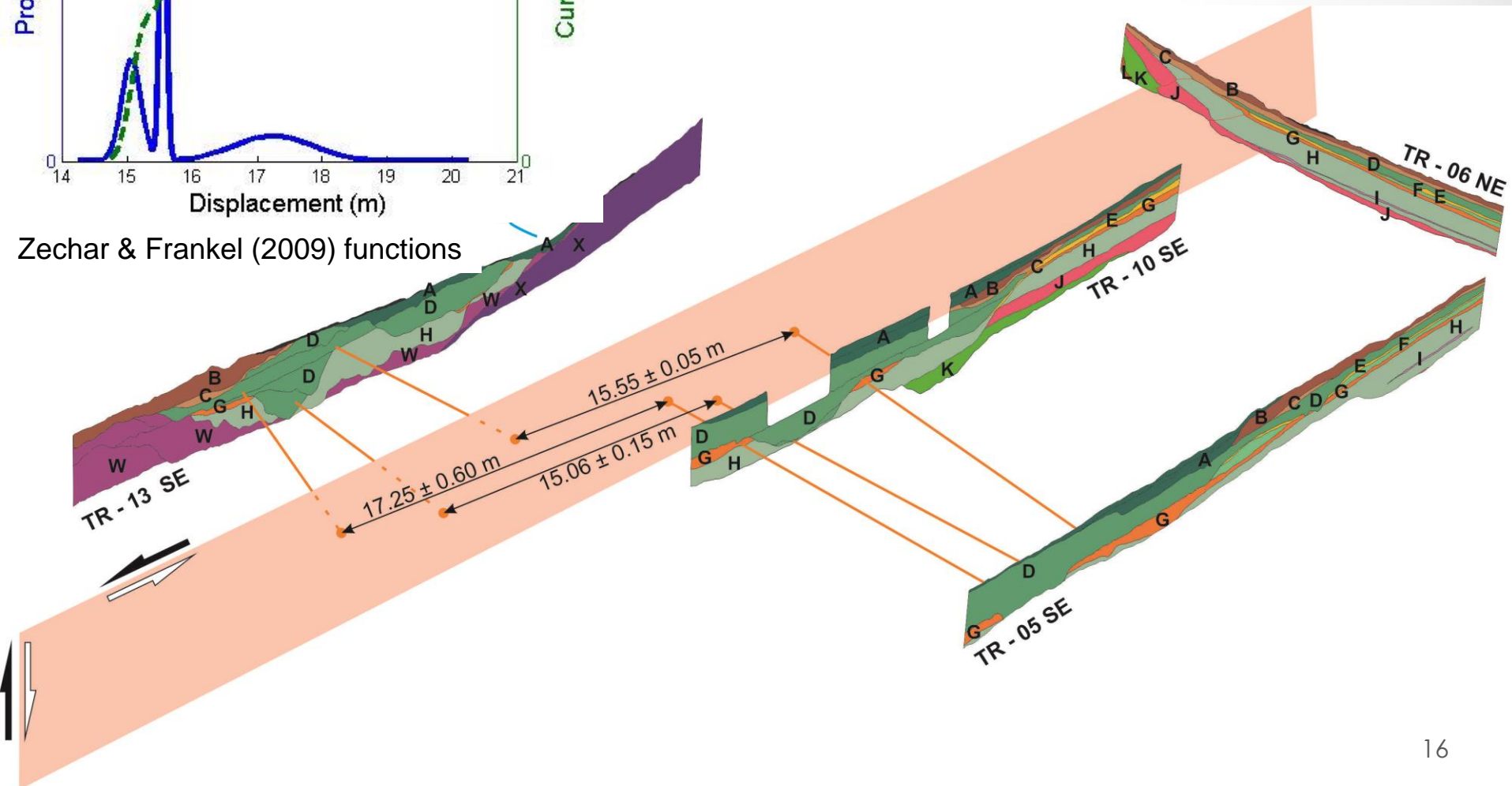
Vídeo visualization

9. 3D Offset

- Total offset (2σ):
15.95 (15.24 – 18.54) m



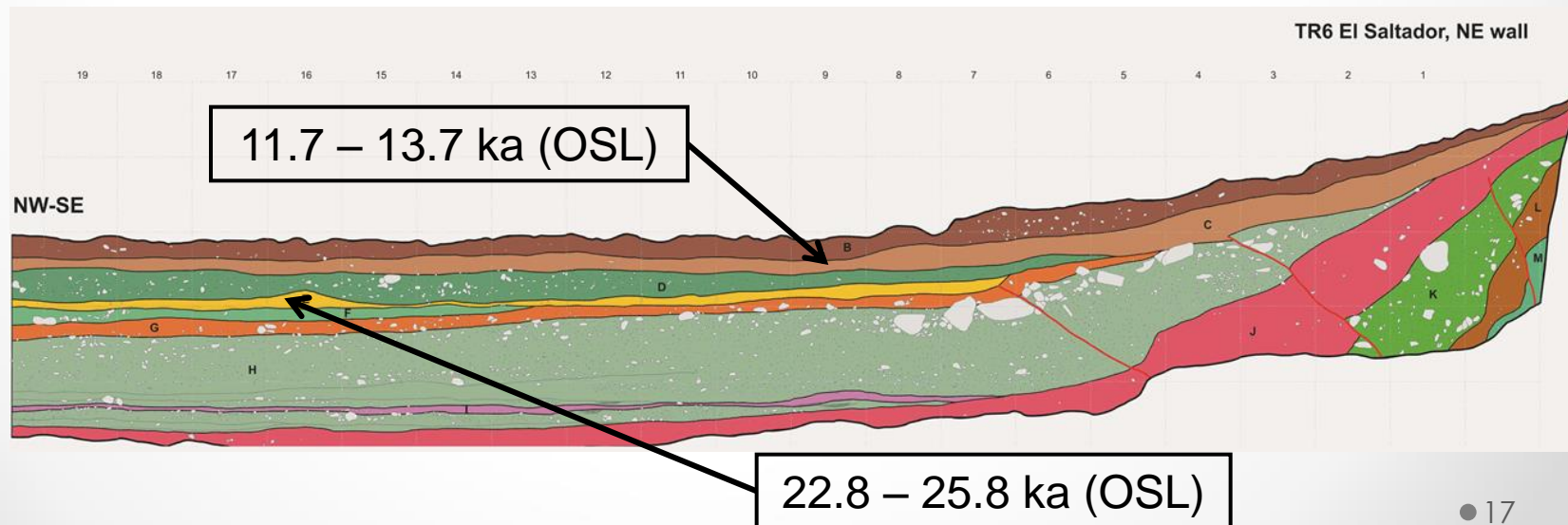
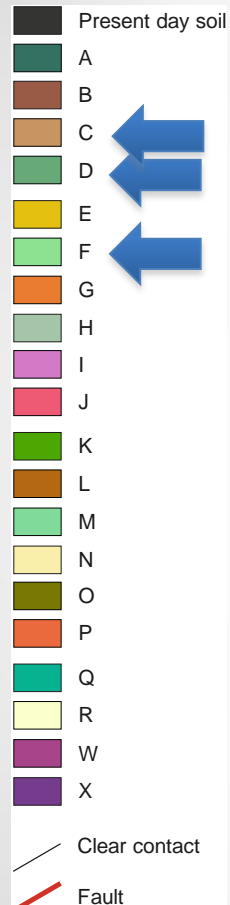
Zechar & Frankel (2009) functions



10. Age control

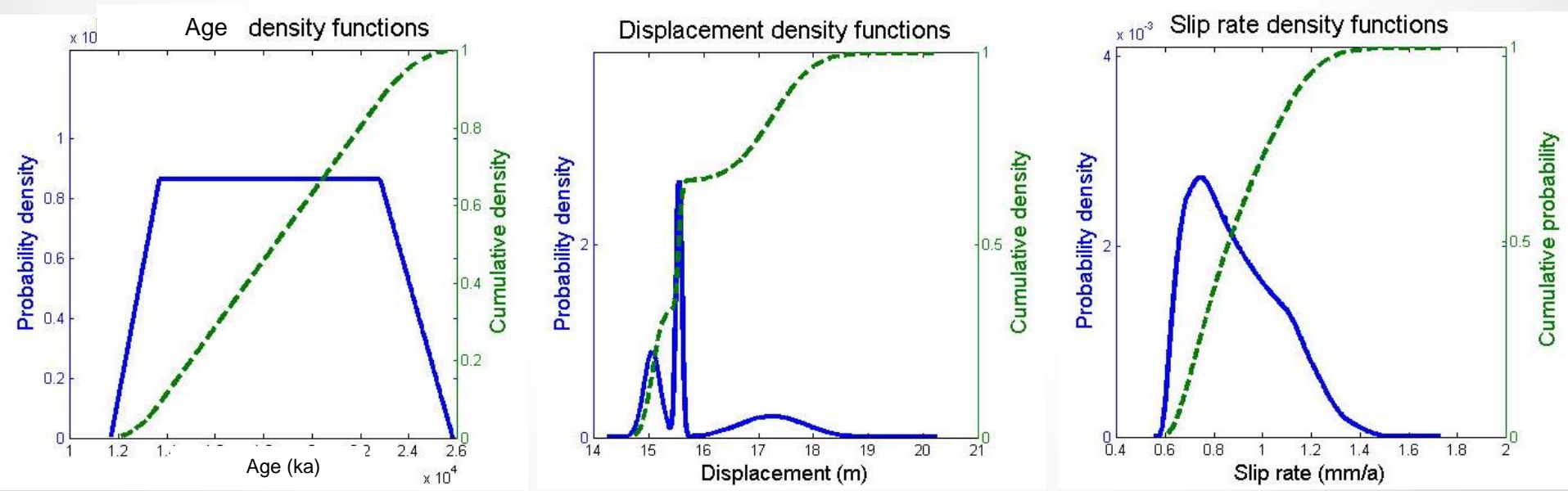
- Methods: ^{14}C , OSL, U/Th, (AAR)
- Upper unit C $\rightarrow 12.7 \pm 1.0$ ka
- Lower unit F $\rightarrow 24.3 \pm 1.5$ ka

Unit D $\rightarrow 13.7$ - 22.8 ka



11. Slip-rate

- Zechar & Frankel (2009) probabilistic functions
- Unit D : **13.7-22.8 ka** (OSL)
- Mean **total offset** unit D (mean & 2σ bounds):
15.95 (15.24 – 18.54) m
- **Total slip-rate** (mean & 2σ bounds):
0.89 (0.66 – 1.32) mm/yr



Thank you very much!!



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