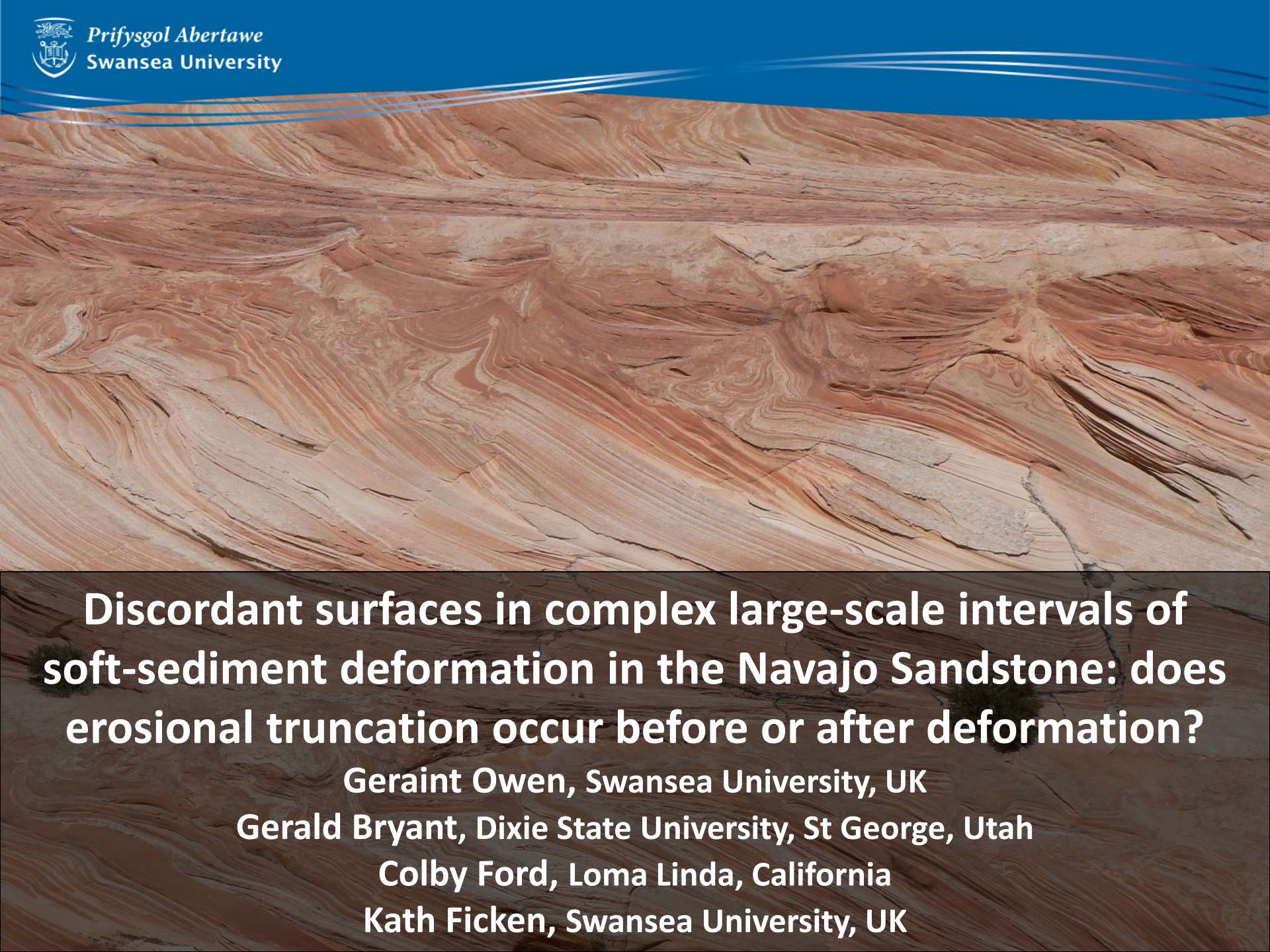
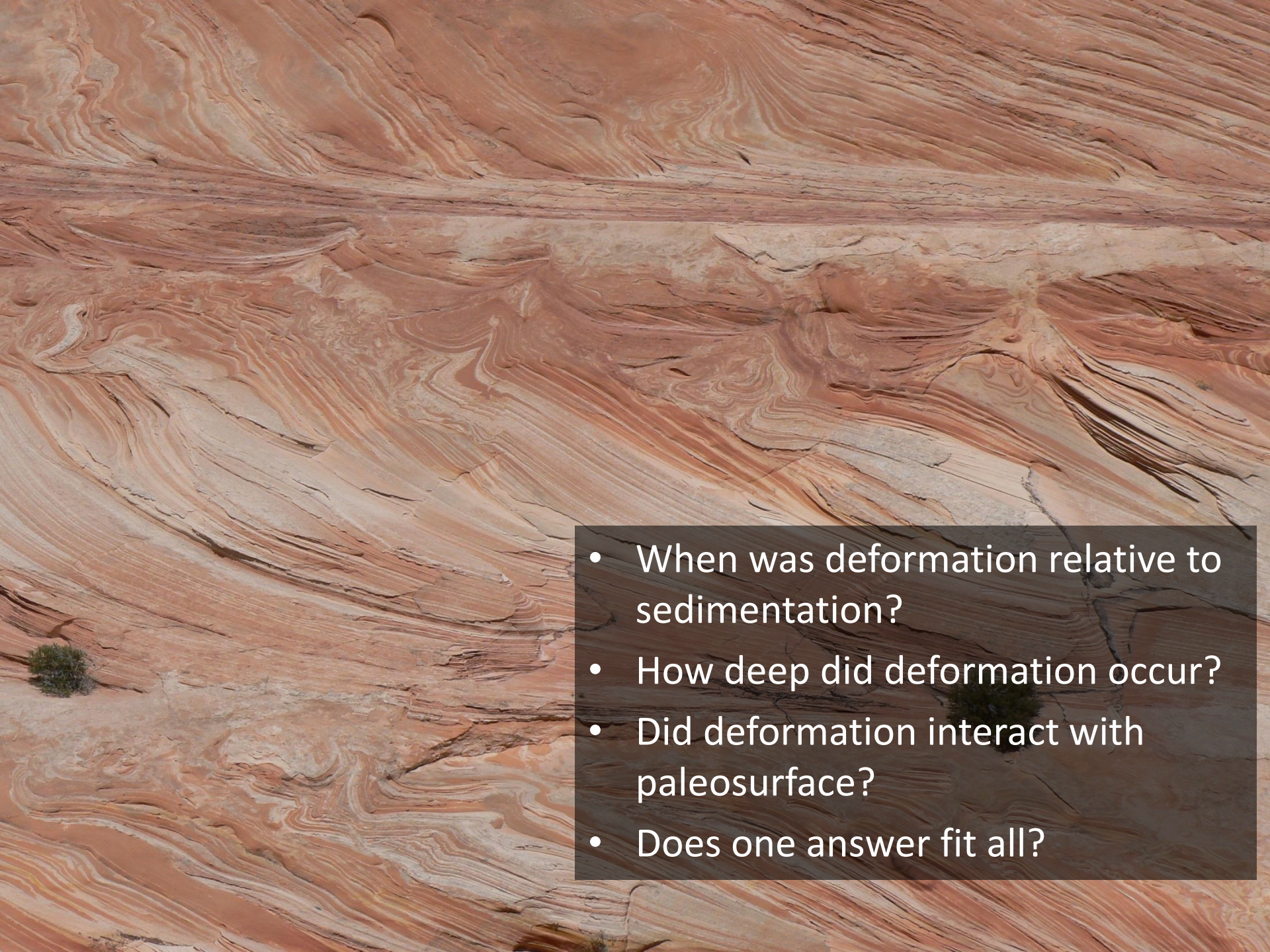


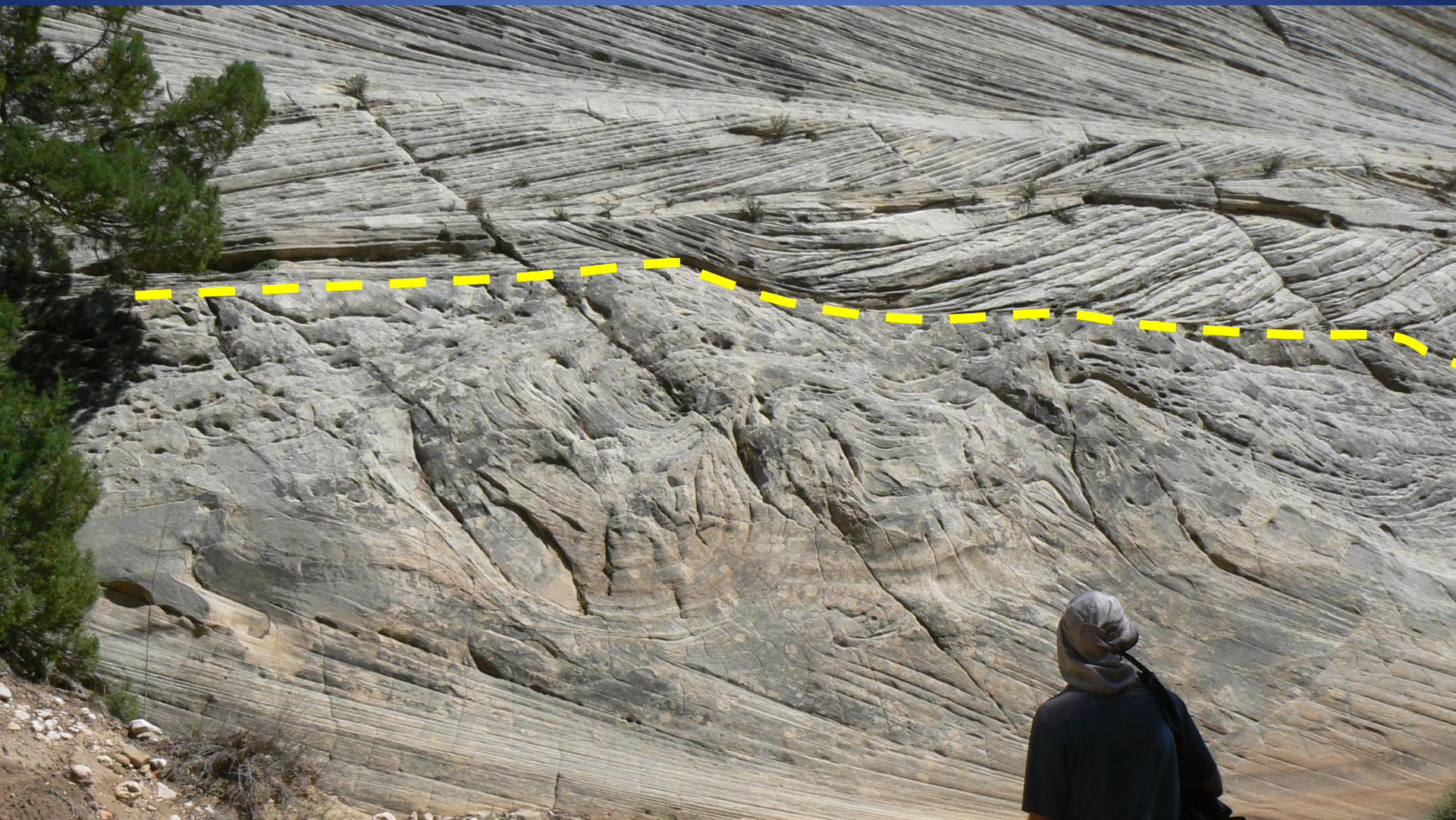
Discordant surfaces in complex large-scale intervals of soft-sediment deformation in the Navajo Sandstone: does erosional truncation occur before or after deformation?

Geraint Owen, Swansea University, UK
Gerald Bryant, Dixie State University, St George, Utah
Colby Ford, Loma Linda, California
Kath Ficken, Swansea University, UK

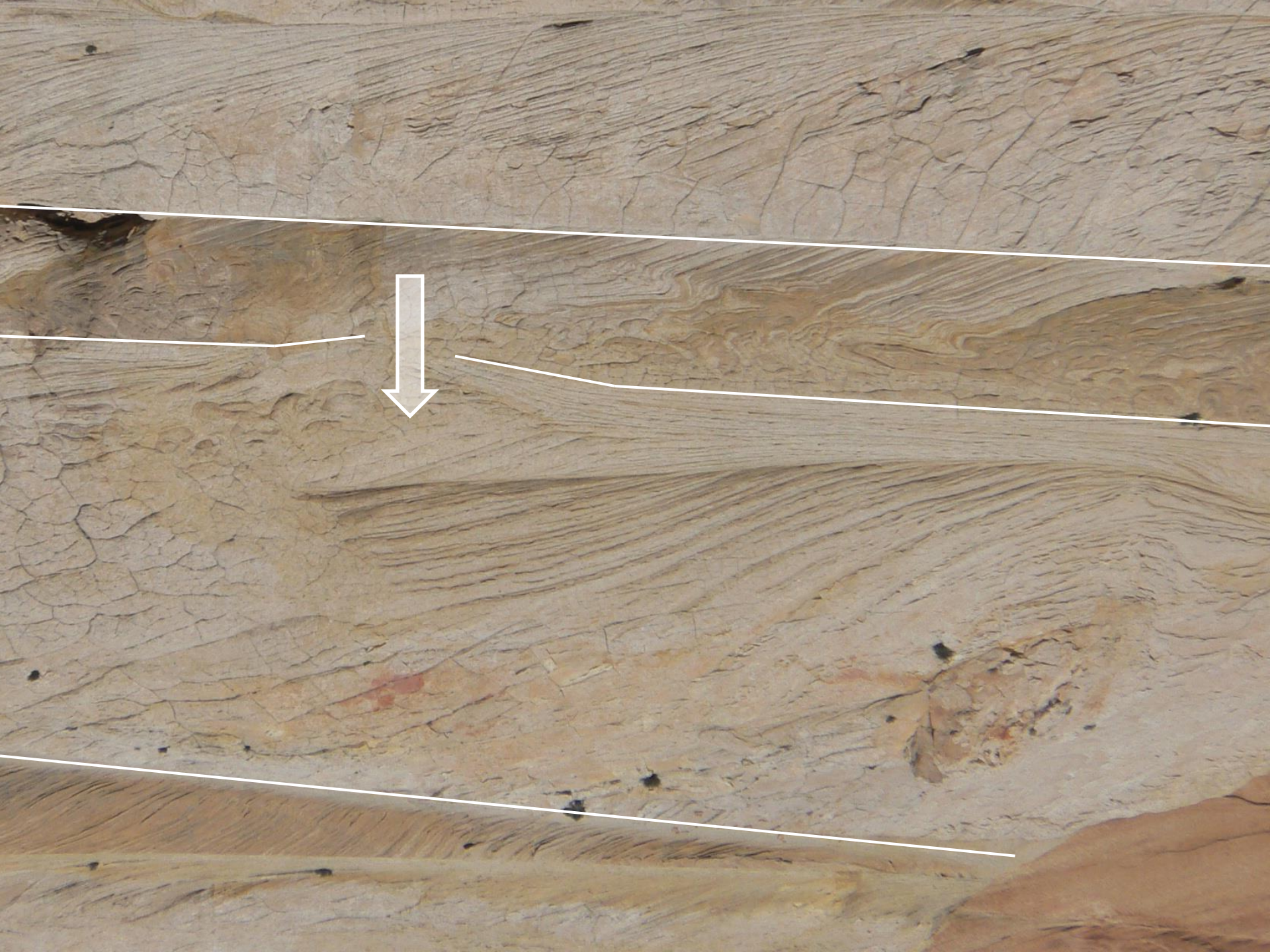


- When was deformation relative to sedimentation?
- How deep did deformation occur?
- Did deformation interact with paleosurface?
- Does one answer fit all?

Upward termination at discordant surface
Erosional truncation **after** deformation



How much sediment eroded?
Depth below palaeosurface?



Discordant surface deformed and breached

Pre-existing bounding surface
Erosion **before** deformation

Bounding surface resisted deformation Why?

Liquefaction

Fluidization

Mobilization by:

liquefaction

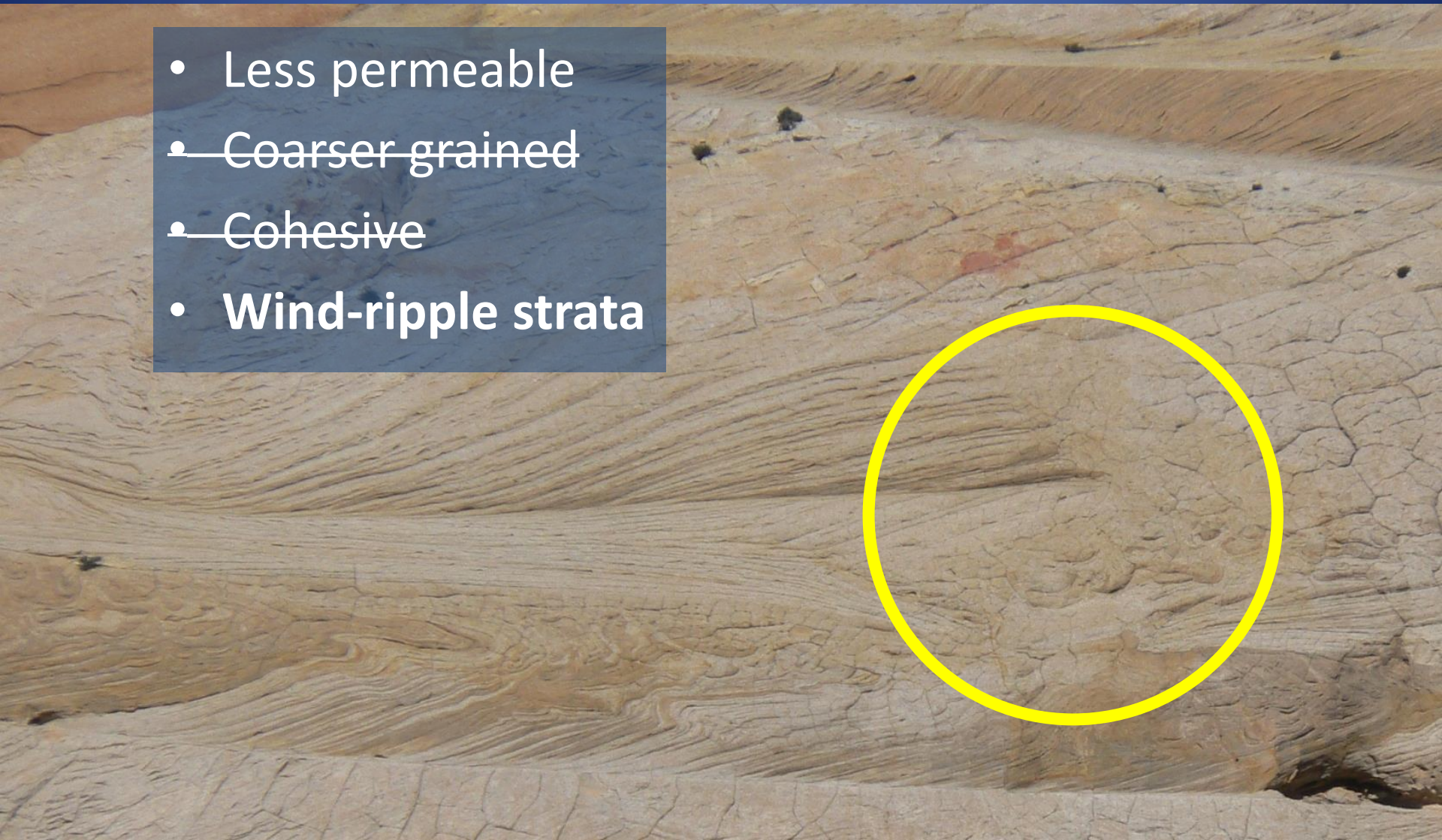
fluidization

Resistance to deformation & mobilization

- Less permeable
- Coarser grained
- Cohesive

Resistance to deformation & mobilization

Subtle permeability variations impede fluid flow



- Less permeable
- ~~Coarser grained~~
- ~~Cohesive~~
- **Wind-ripple strata**

Recognising pre-deformation bounding surfaces?

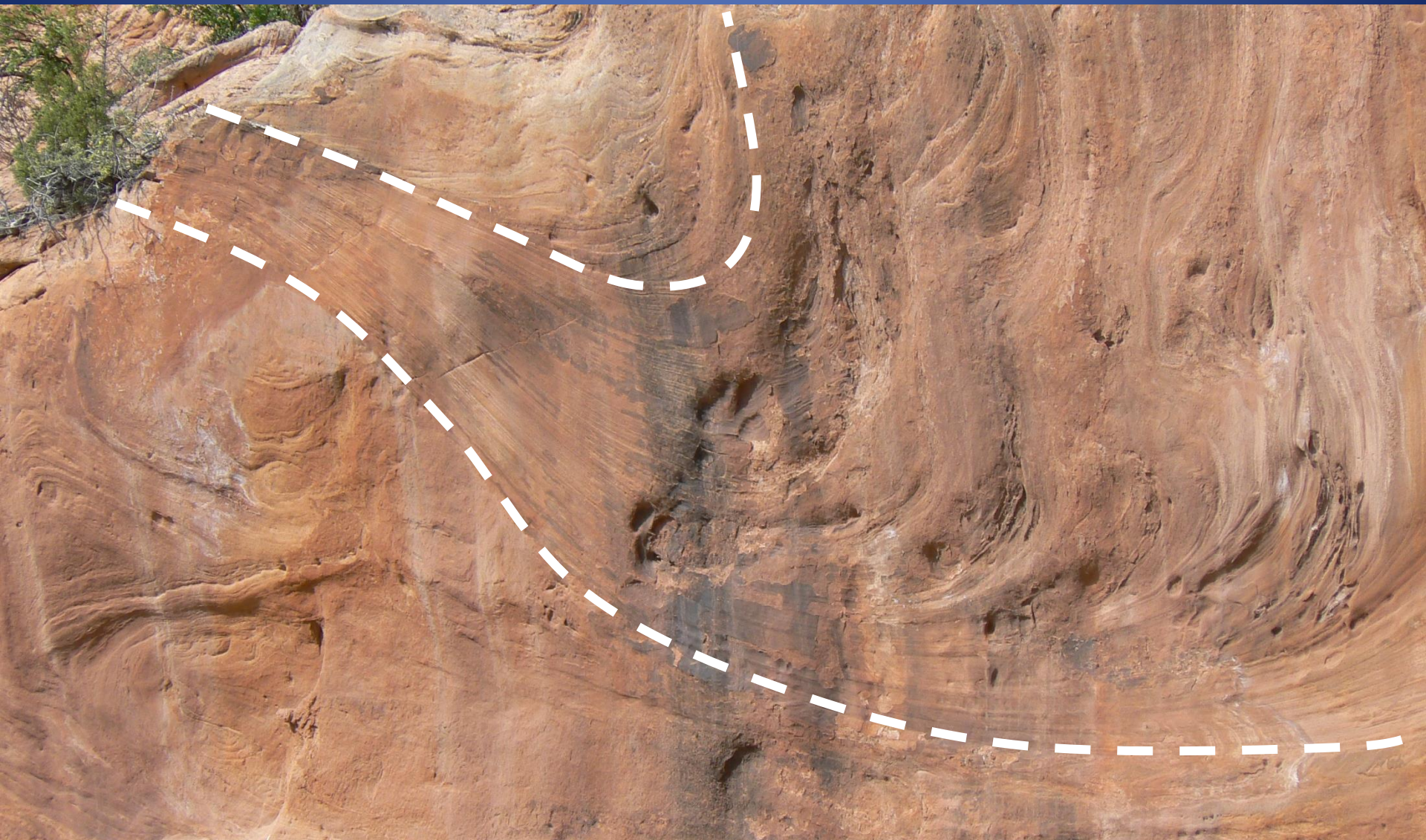
Pervasive fluidization beneath discordant surface

Pervasive fluidization beneath discordant surface?

Pervasive fluidization beneath discordant surface?

Pre-deformation surfaces: implications? Deformation well below active dunes

Deformed discordant surfaces
Erosion **before** deformation

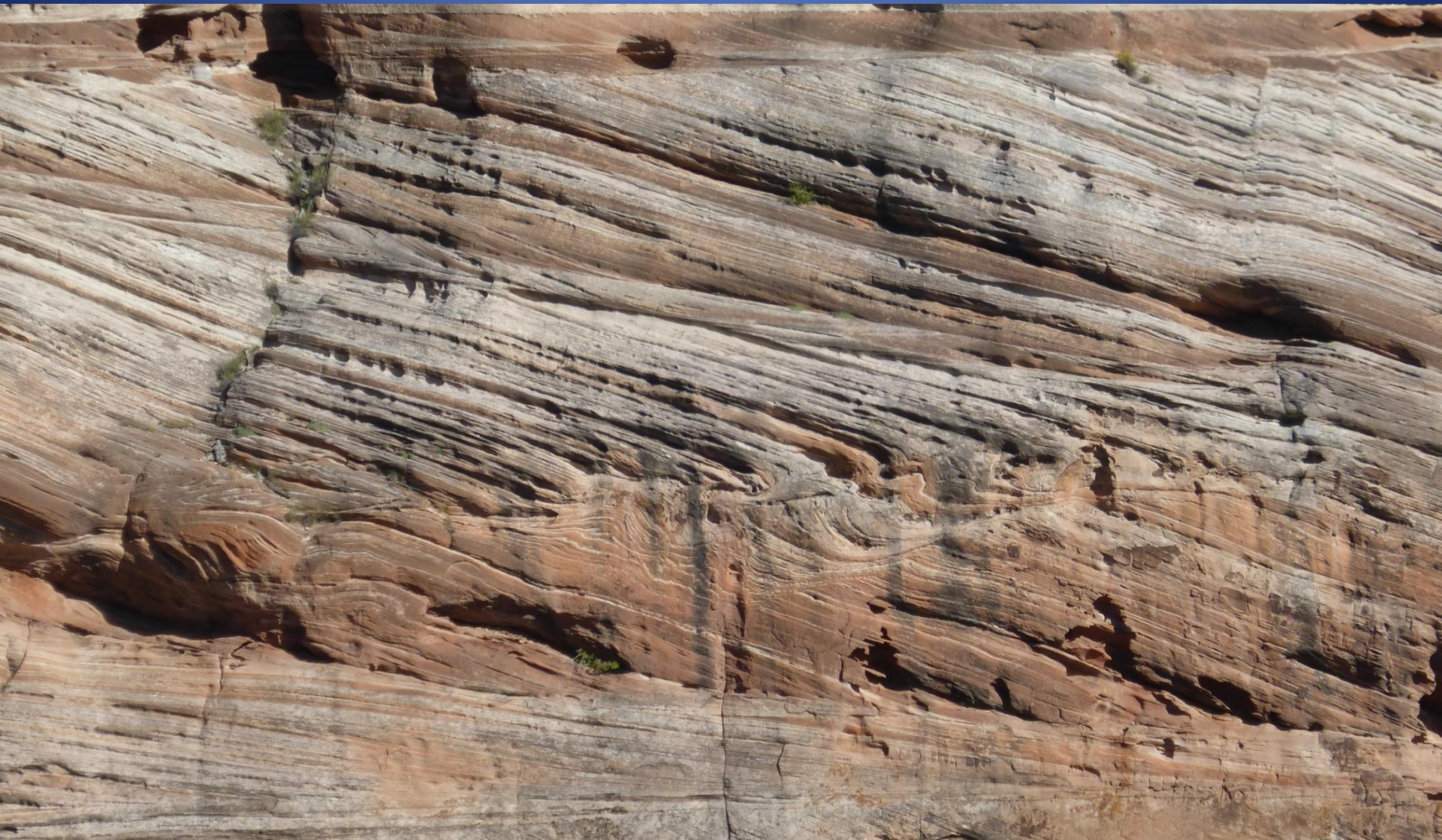


Bounding surface didn’t resist mobilization
Insufficient disruption to permeability

Discordant surface = palaeo-surface
Extruded outflow deposits

Discordant surface = palaeo-surface
Uncommon, isolated, shallow features

Discordant surface **formed by** deformation

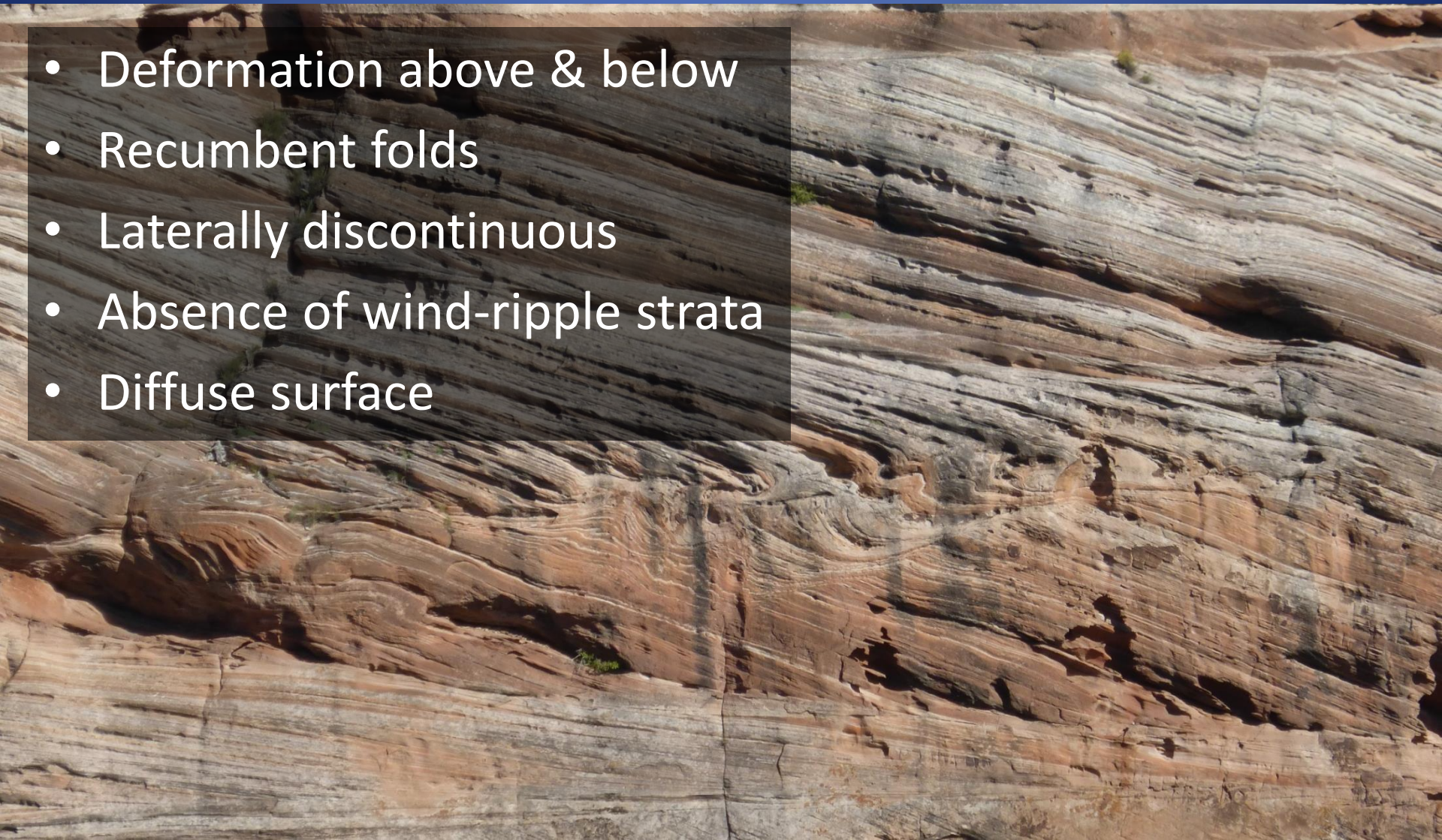


Discordant surface **formed by** deformation

Shear zones: lateral displacements

Discordant surface **formed by** deformation

Shear zones: criteria for recognition?



- Deformation above & below
- Recumbent folds
- Laterally discontinuous
- Absence of wind-ripple strata
- Diffuse surface

Discordant surfaces in complex SSD

- Erosion after deformation
- Deformation in sets of active surface dunefield

Discordant surfaces in complex SSD

- Erosion before deformation; resisted mobilization
- Erosion before deformation; became deformed

Discordant surfaces in complex SSD

- Erosion before deformation; resisted mobilization
- Erosion before deformation; became deformed
- Deformation in **buried** cross-strata

Discordant surfaces in complex SSD

- Erosion after deformation
- Erosion before deformation; resisted mobilization
- Erosion before deformation; became deformed
- Deformation at palaeo-surface
- Surfaces formed during deformation

One origin or several?

- Deformation at different depths relative to active surface dunes
- Different types of SSD?
- Or different levels in the same event horizon?