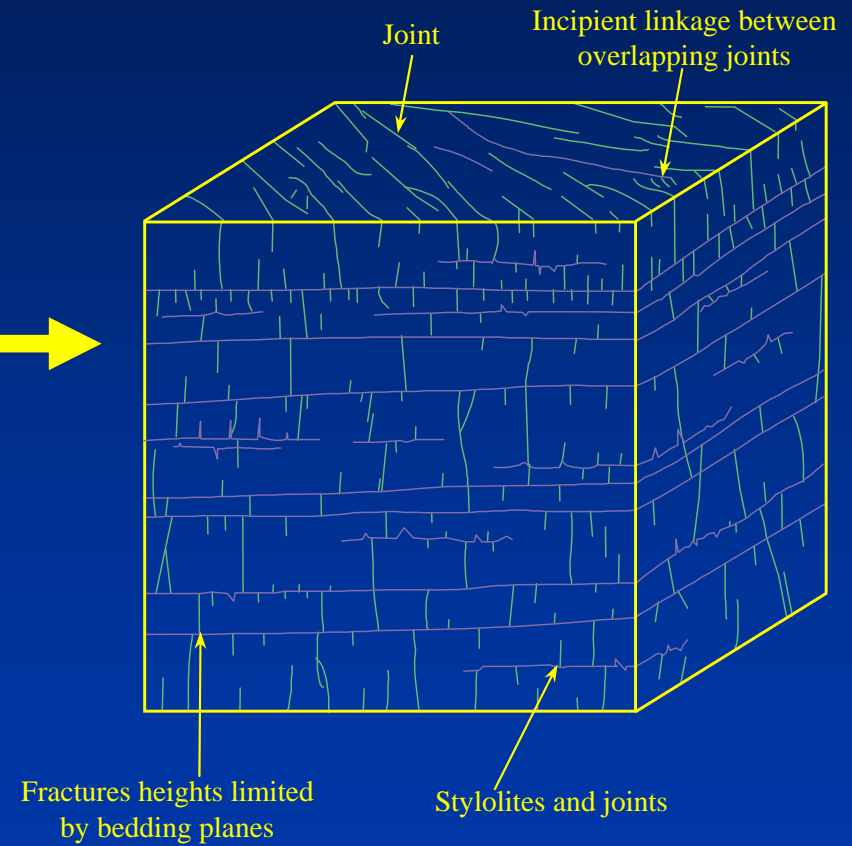
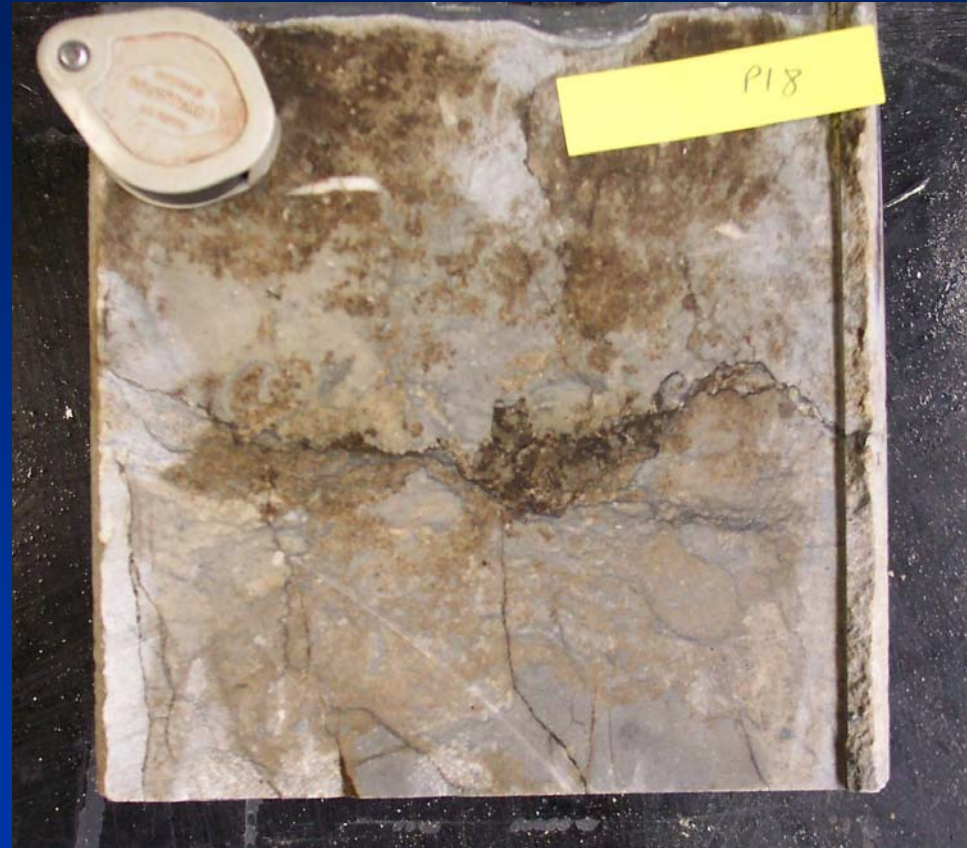


# Case 1: Permian Carbonate



# Case 1: Group 1 Fractures, Fine Scale



Stylolites, + associated steep tension gashes,  
and fine veins

# Case 1: Group 2 Fractures, Larger Scale



Tectonic joints and small fault zones

# Case 1: Summary

- **Two fracture Groups identified**
  - \* a fine-scale mesh probably acting as 'matrix support'
  - \* a larger-scale potentially connected network
  - \* forms a fracture hierarchy, including clustering and (sub-seismic) faults

**NB COMMONLY SEEN IN OTHER CARBONATE CONTEXTS !**

- **Parameters: spacing, orientation, length, height, aperture, k**
  - \* for individual fractures and for clusters
- **Concepts for vertical and lateral variation in fracture density**

# Case 2: 3 Fracture Types

## TYPE 1 'Hairline macrofractures'

'fine, small aperture open fractures in pervasive dense arrays, obvious on image logs'

terminate against large stylolites or bedding

best developed in grainstones (25/ m; packstones 3 to 10 / m)

zones of enhanced fracture density 3 to 100m wide, and higher density close to faults

strike parallel to Shmax (Zagros NNE-SSW)

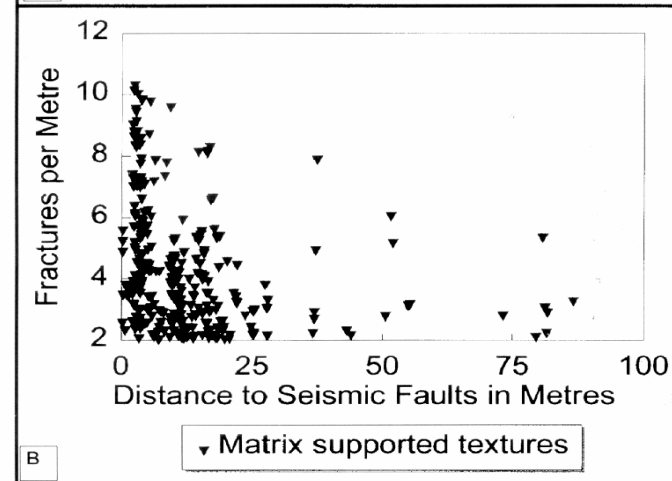
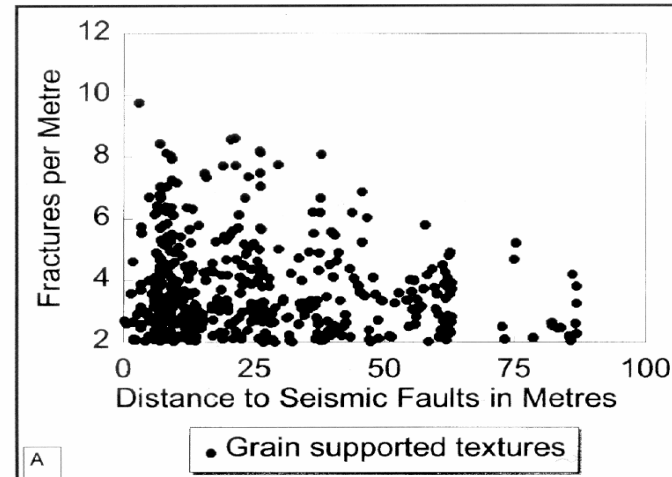
**main focus for modelling because associated with enhanced k - control reservoir response**



# Case 2: Type 1 Fractures vs Faults

Densities of 'hairline macrofractures' in horizontal wells (from image logs)

Wider fault damage zone (x 4) in grainstone facies compared to matrix-supported



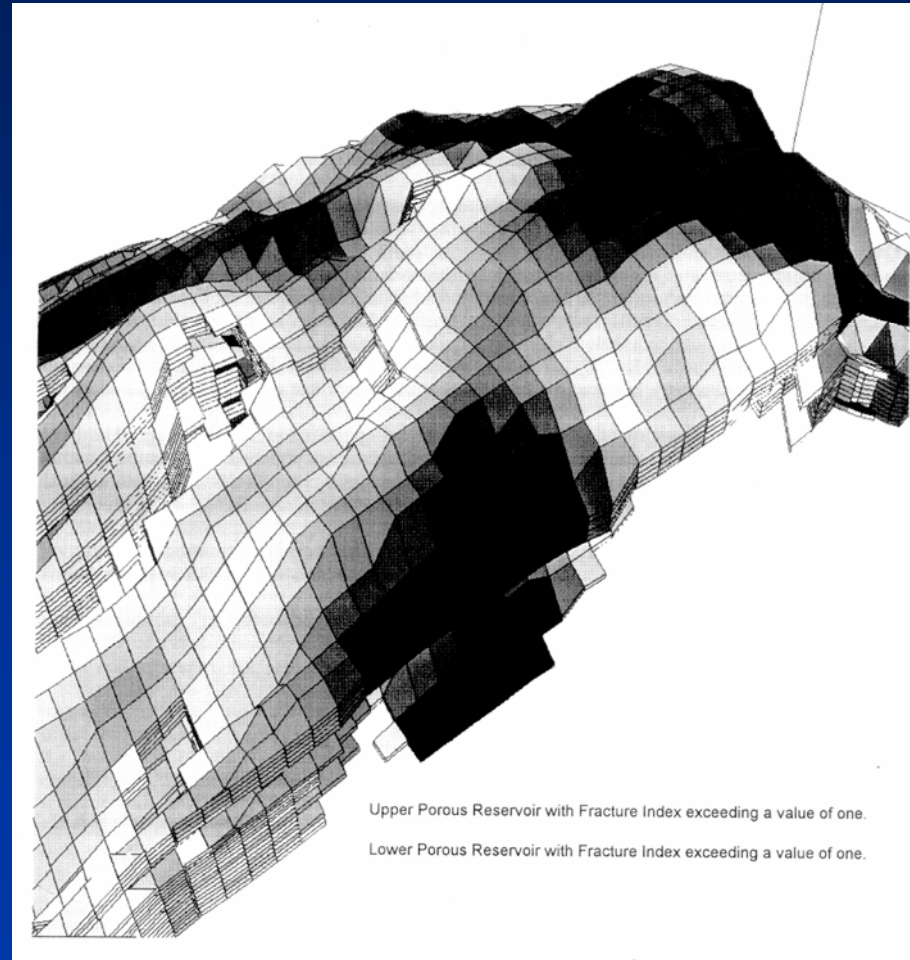
# Case 2: Fracture Density 'Index'

Example of fracture density index within the 3D model

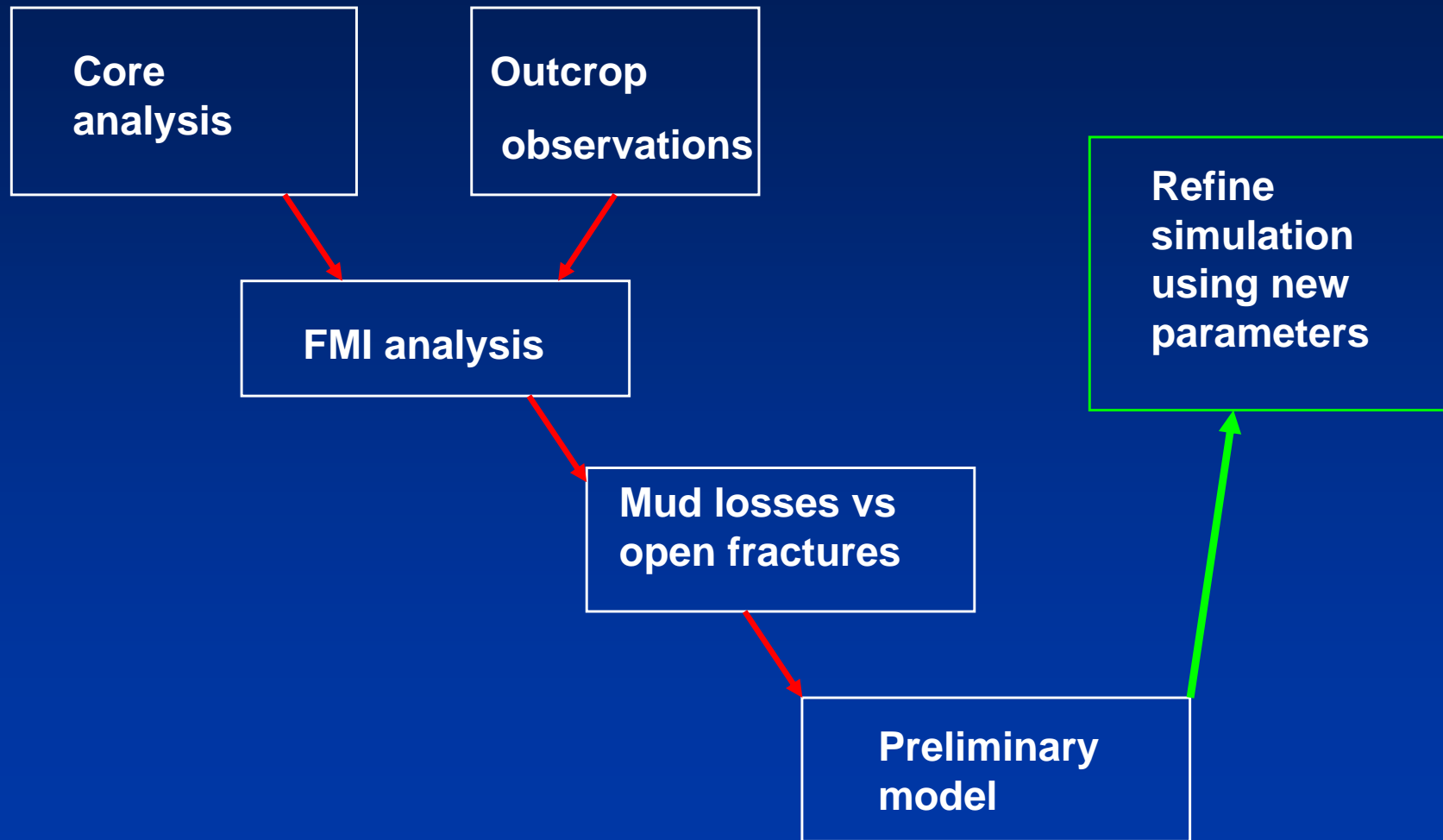
Darker cells = higher index

Cells 100m x 100 x 1.5 to 3m thick

See Ericsson,  
McKean and  
Hooper 1998



# Case 3: FRC Workflow



# Case 3: FMI Analysis

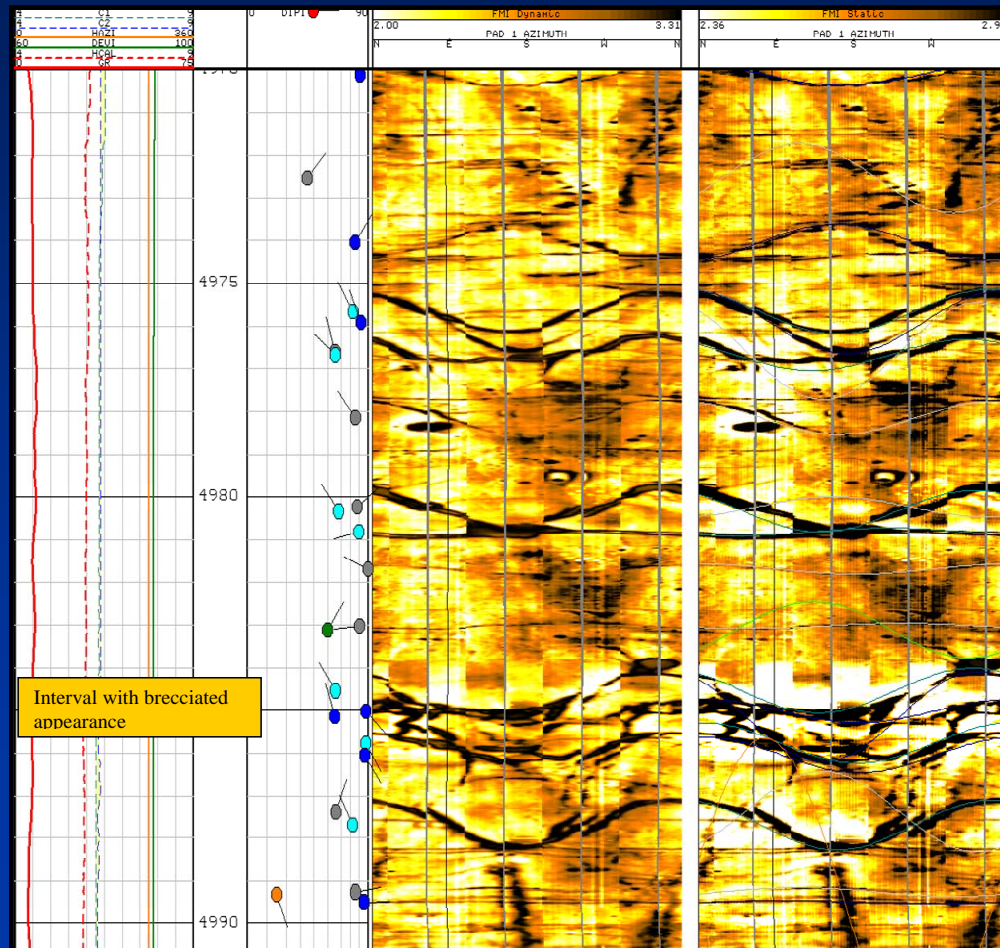
## FRACTURE PICKING

Cluster of conductive picks

These are the Type 4's – open fractures

Mainly NNW-SSE striking and at angles of  $<30^\circ$  to  $Sh_{max}$

= K enhancement



Dynamic Micro-resistivity

Static Micro-resistivity



# Case 3: Fracture Model

## CONCEPTUALISATION

Data constrained

Faults: extensive, provide vertical connectivity, dz thickness greater in low k zone

Joints: controlled by mudstone layers, limited H

High rock strength = high fracture density (tendency)

## + PARAMETERS

Type / spacing / thickness / orientation etc

