Estimation of Dynamic Rupture Parameters

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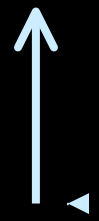
Slip-weakening Distance ?

Fracture Energy ?

k ?

Yield Stress ?

Initial Stress ?



Strain Energy ?

Velocity-weakening Distance ?

Characteristic Length ?

Slip-weakening Distance ?

Fracture Energy ?

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Yield Stress ?

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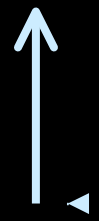

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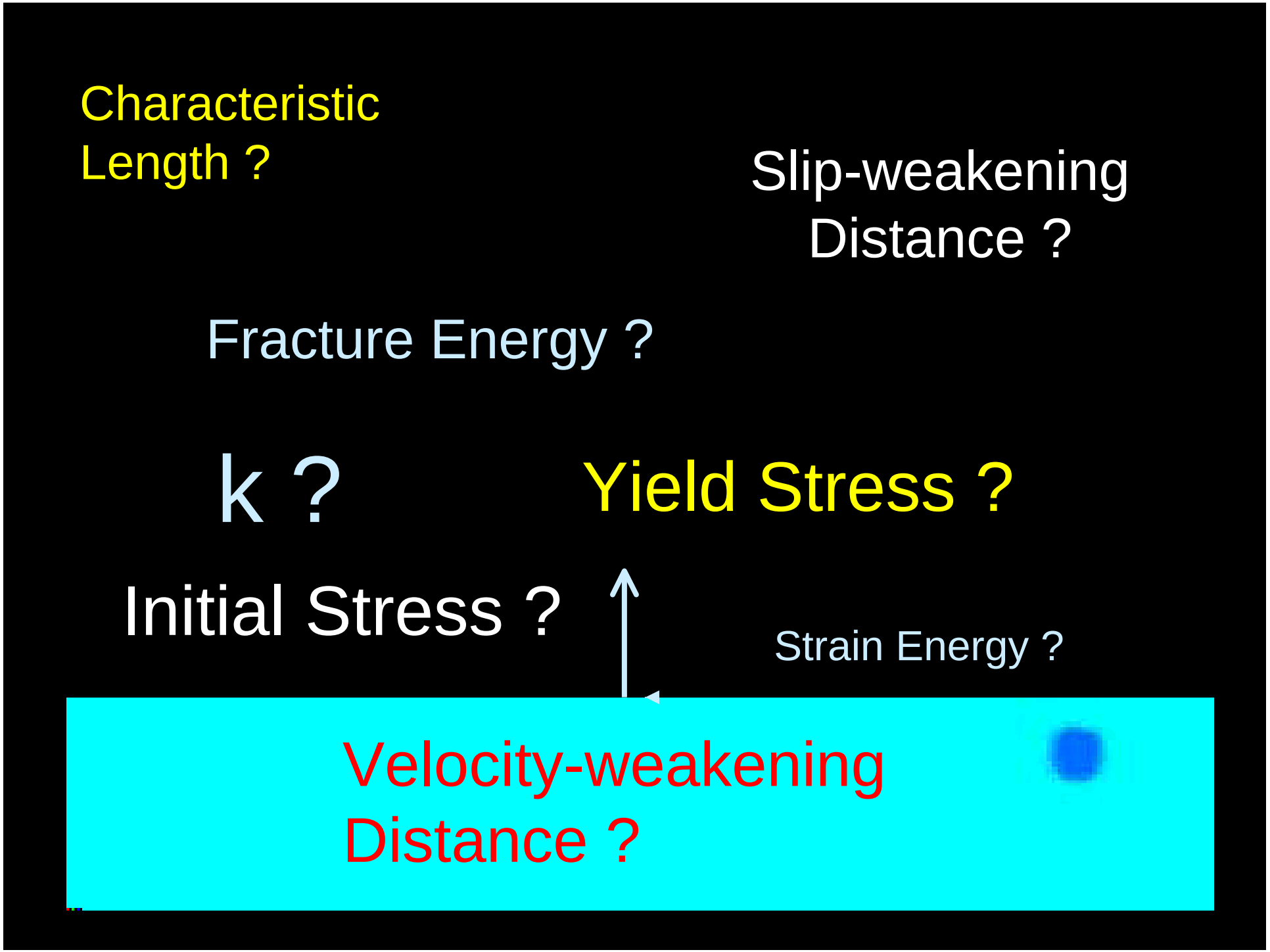
Characteristic Length ?
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Characteris
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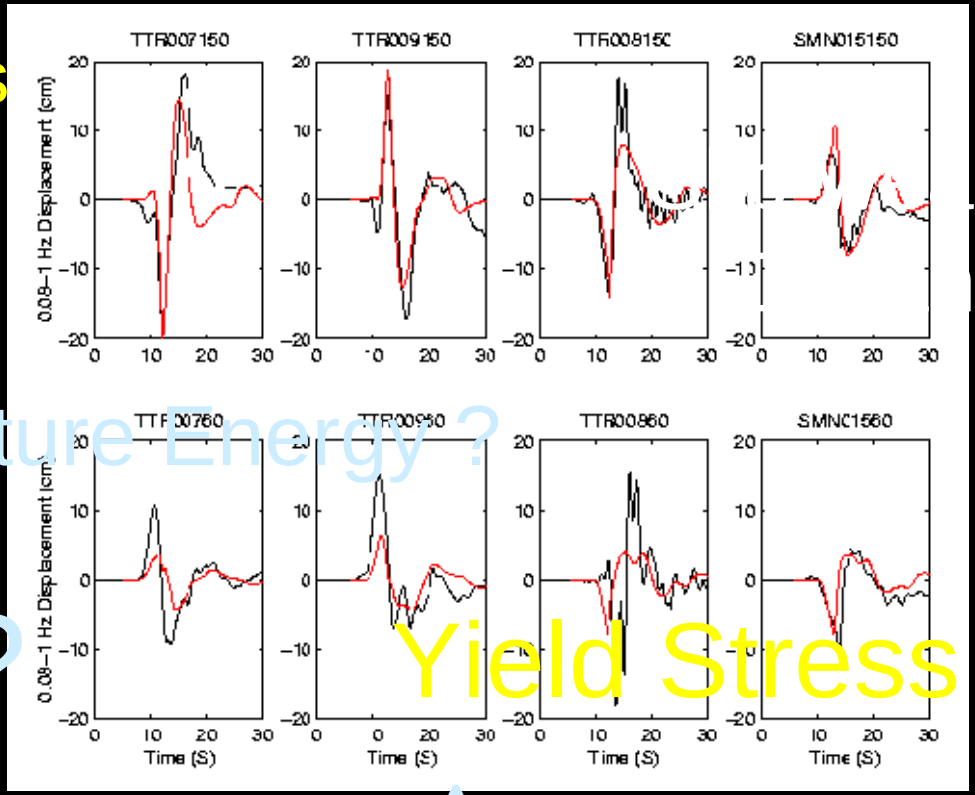


kening
ce ?

Fracture Energy ?

k ?

Yield Stress ?

Initial Stress ?

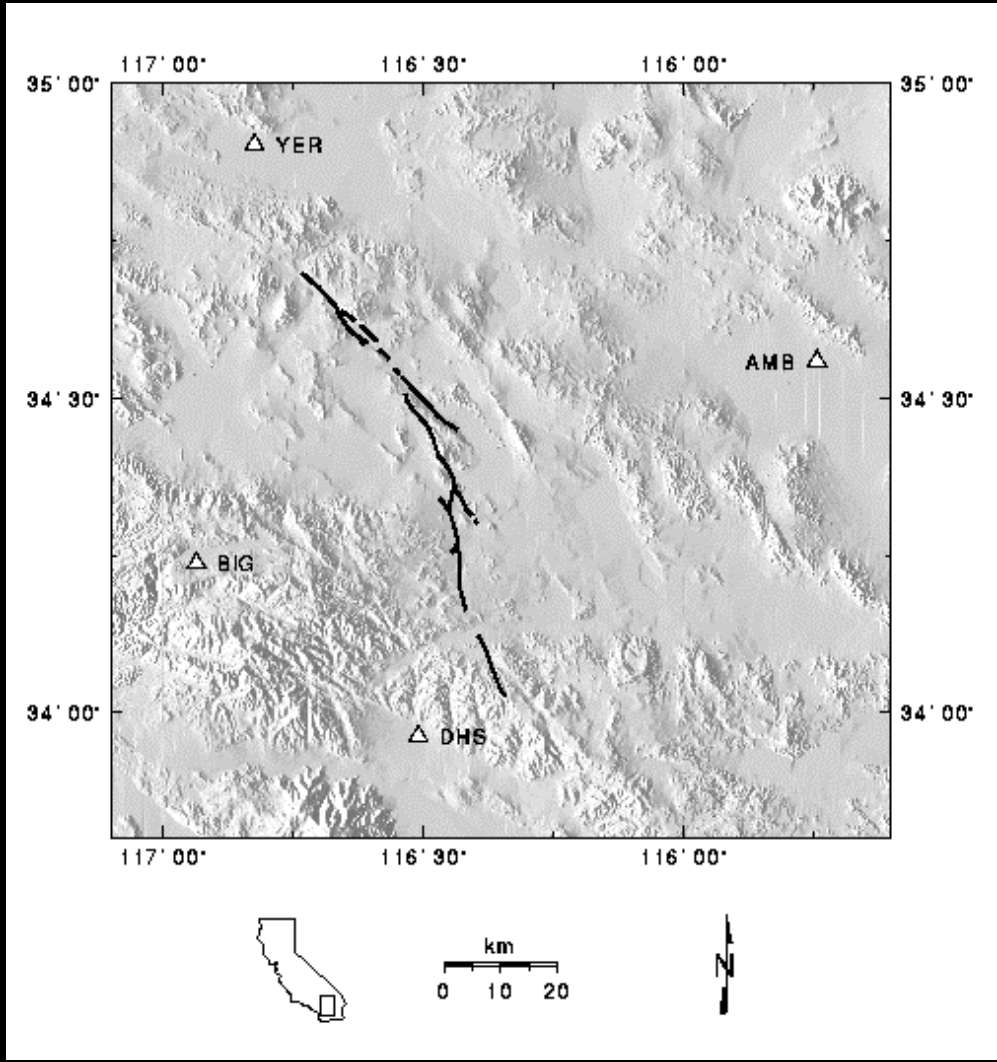
Strain Energy ?

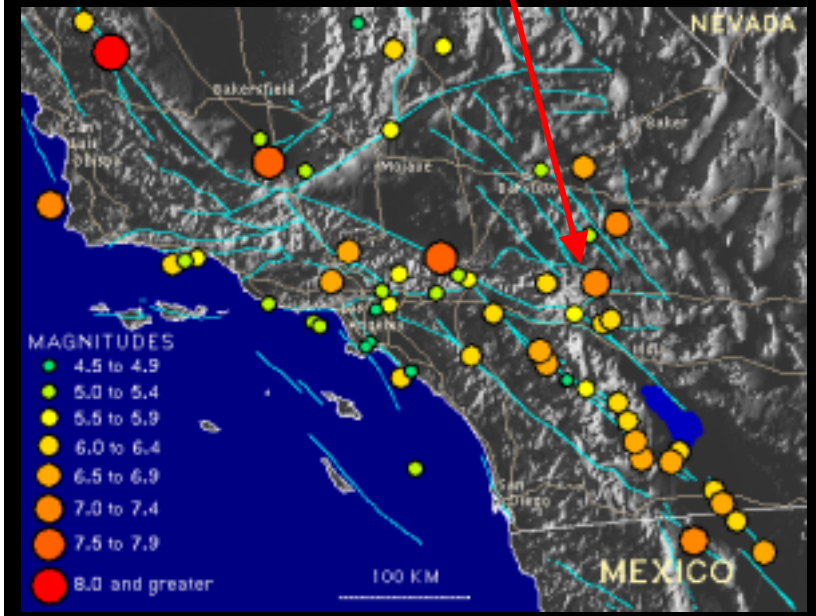
Velocity-weakening
Distance ?

Friction - Strength – Stress

Possible to Estimate Separately ?

Fault and station location

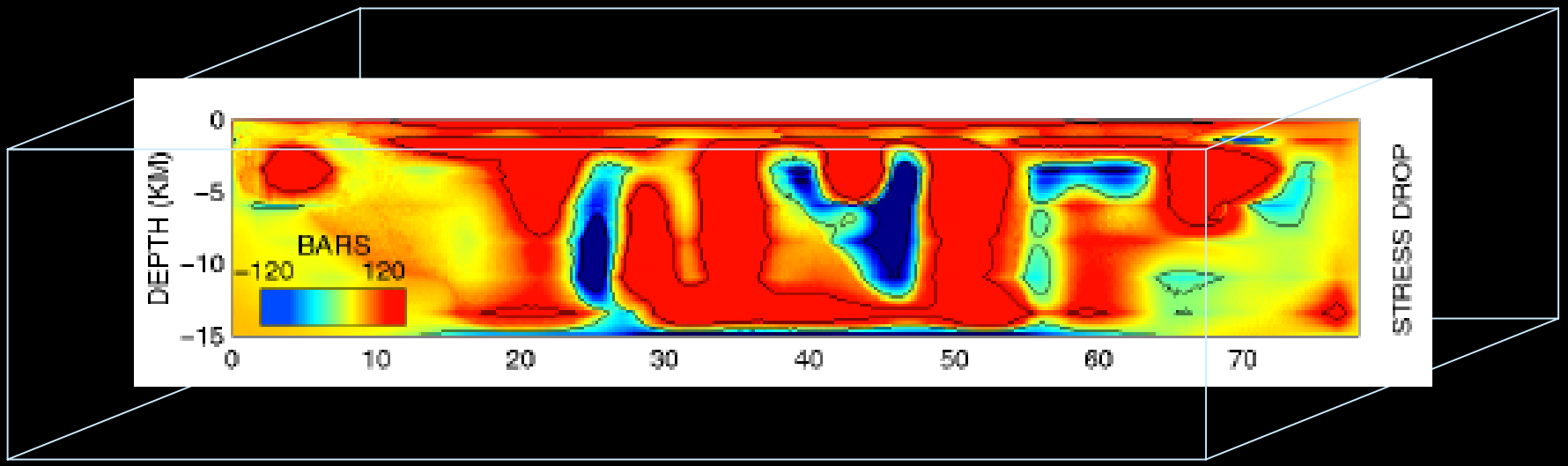




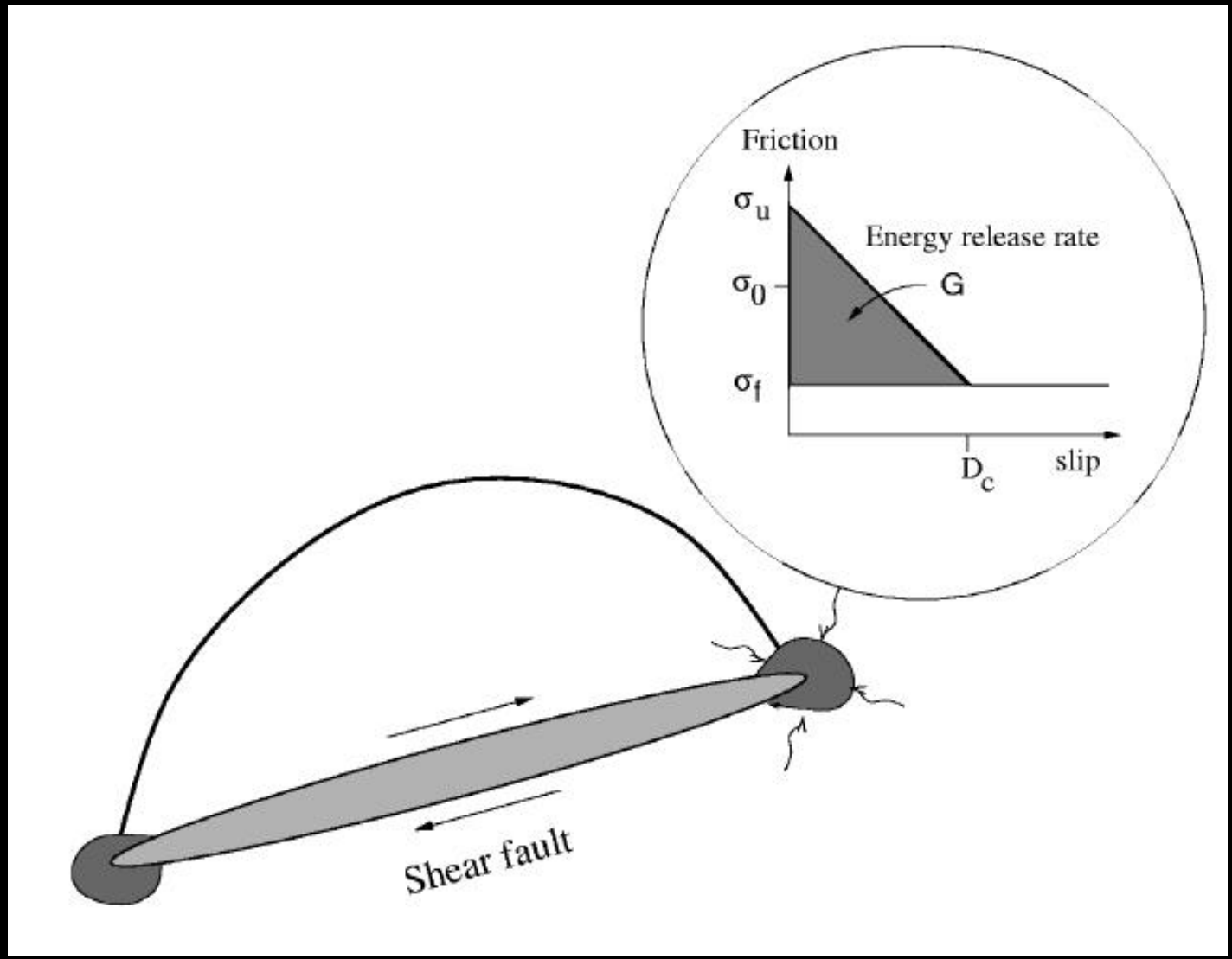
Model and Initial Stress Computation

a) Compute moment distribution M_{ij} from Wald & Heaton's kinematic slip inversion

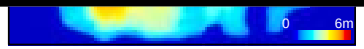
b) Find stress distribution S_{ij} in equilibrium with M_{ij}



Fracture Energy Versus Strain Energy



Three Equivalent Dynamic Rupture Models



(c) Spatially−variable Dc

Initial stress

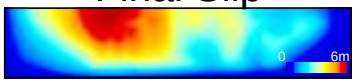
T_e=11.4 MPa

Yield stress

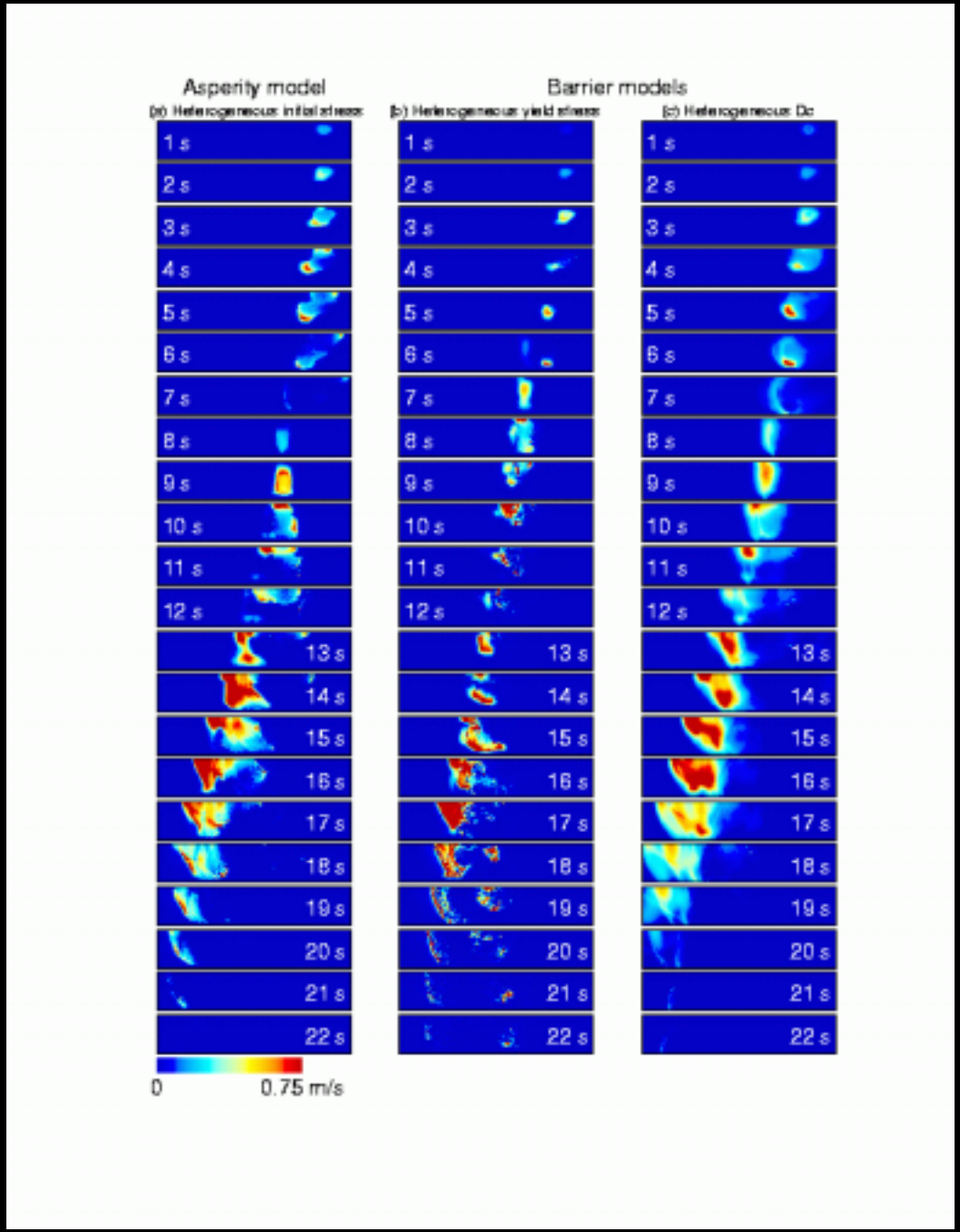
T_u=12.5 MPa

Slip weakening distance

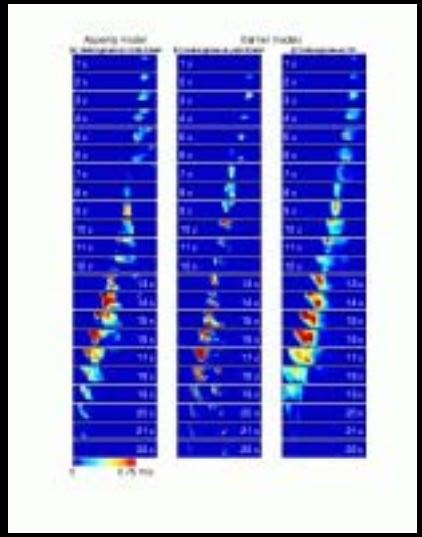
Final Slip

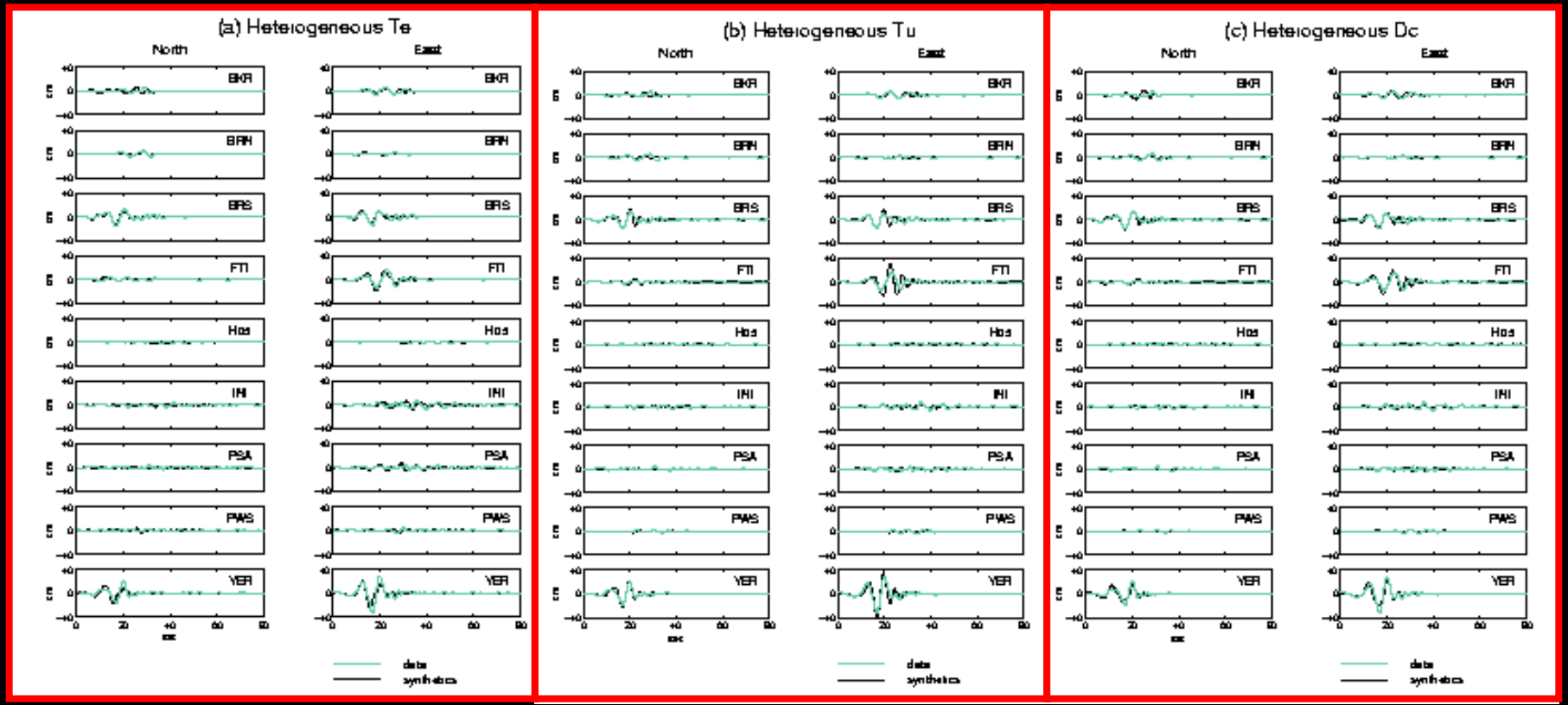


Comparison of Dynamic Rupture Propagation

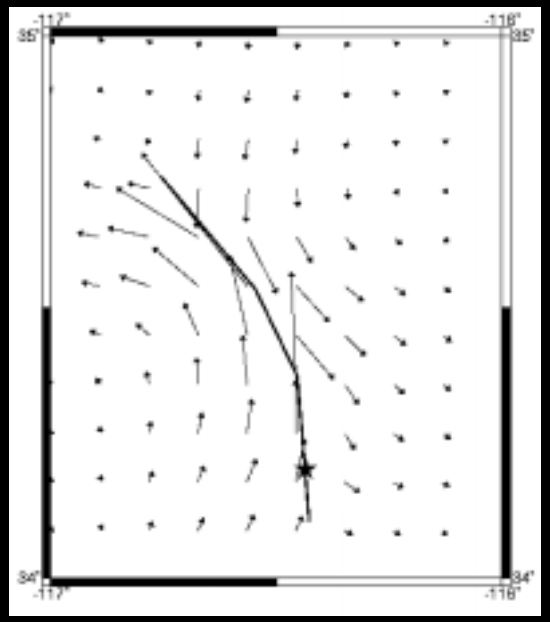


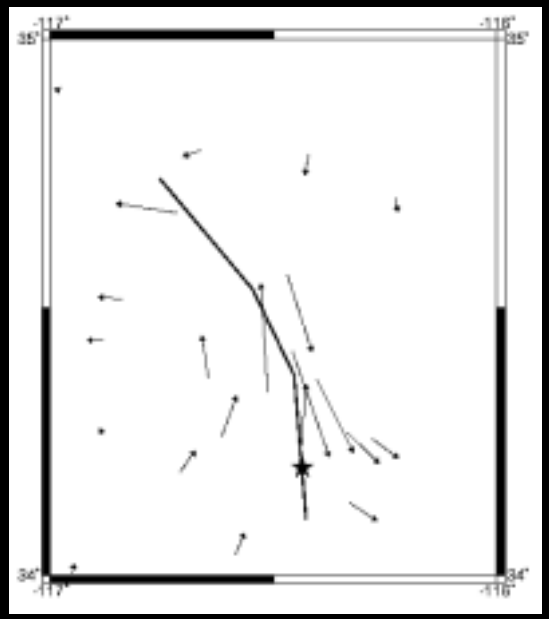
Accelerograms Versus Synthetic Ground Motion From Inversion of Dynamic Rupture

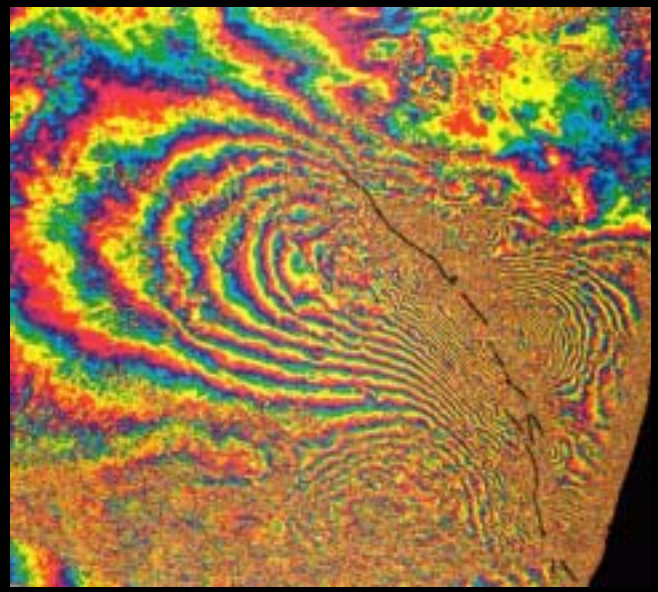




Surface Slip

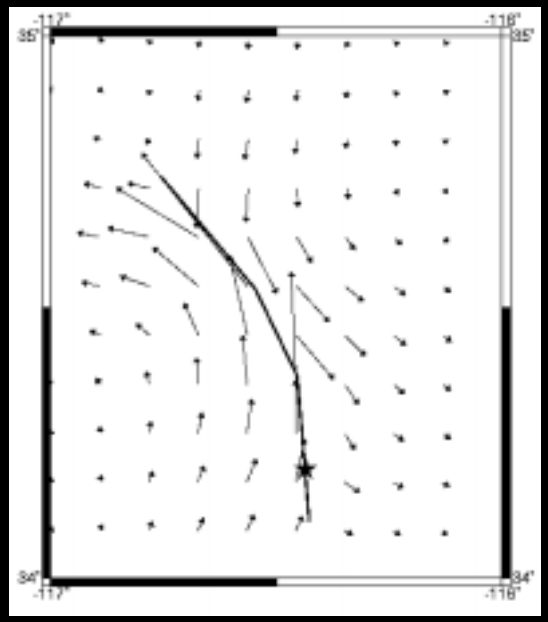


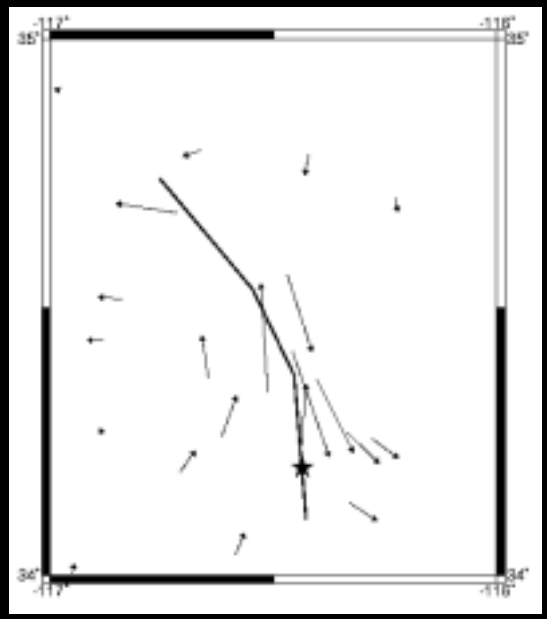




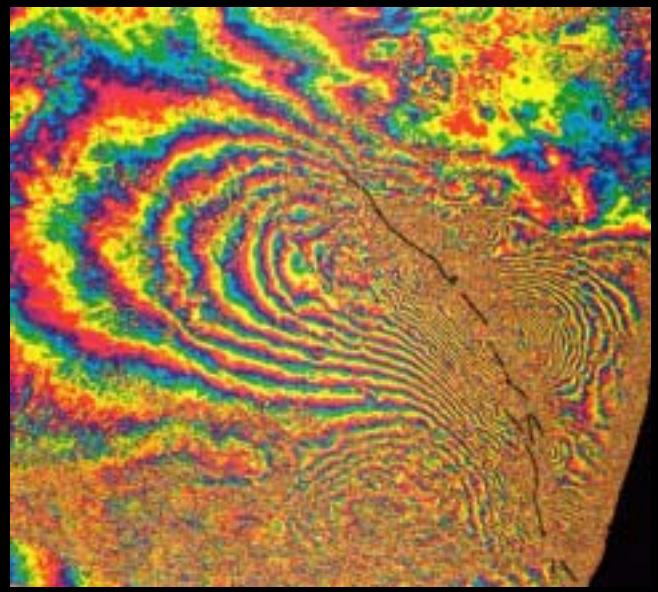
InSAR

GPS





Surface Slip



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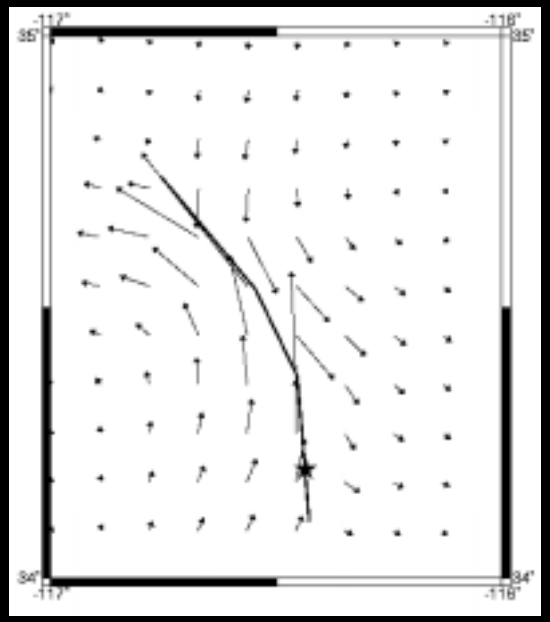
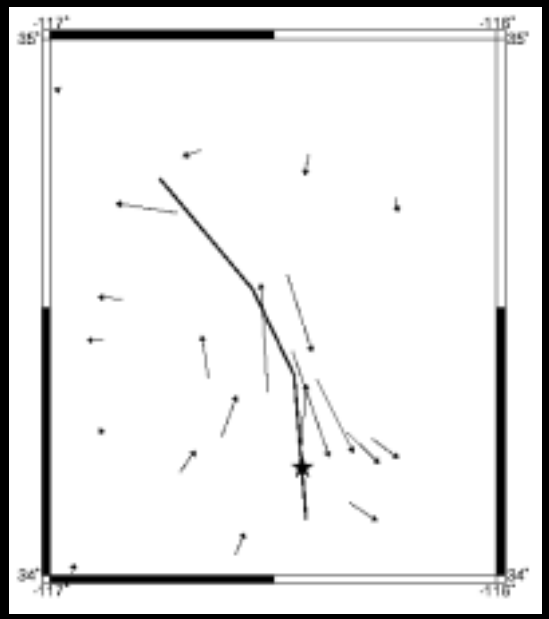
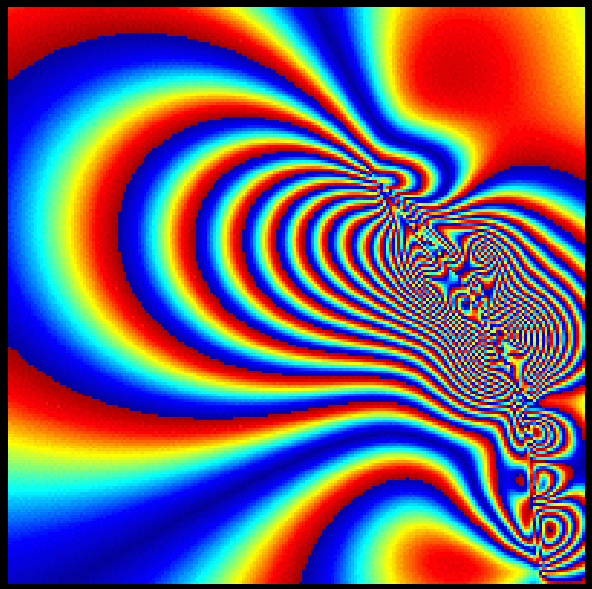
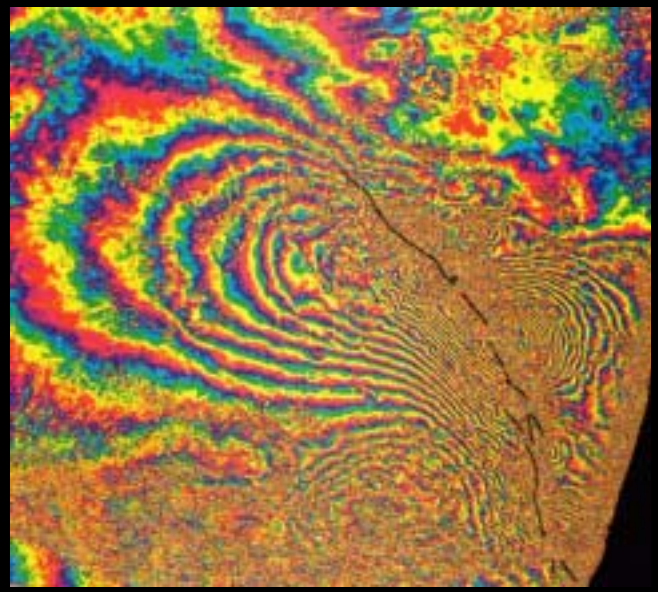




Surface Slip





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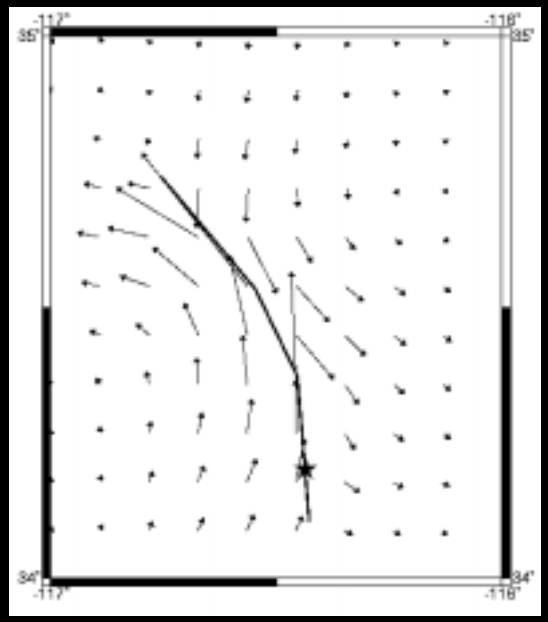

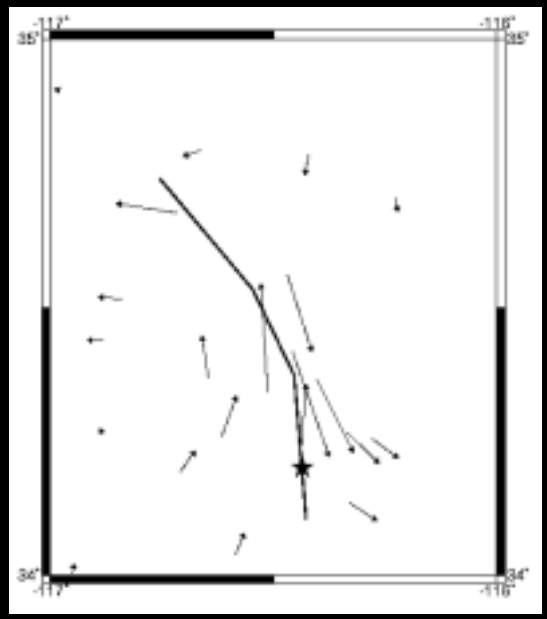

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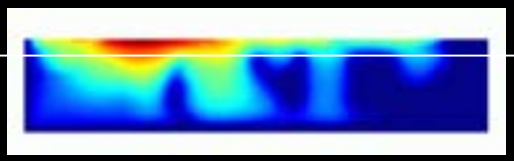
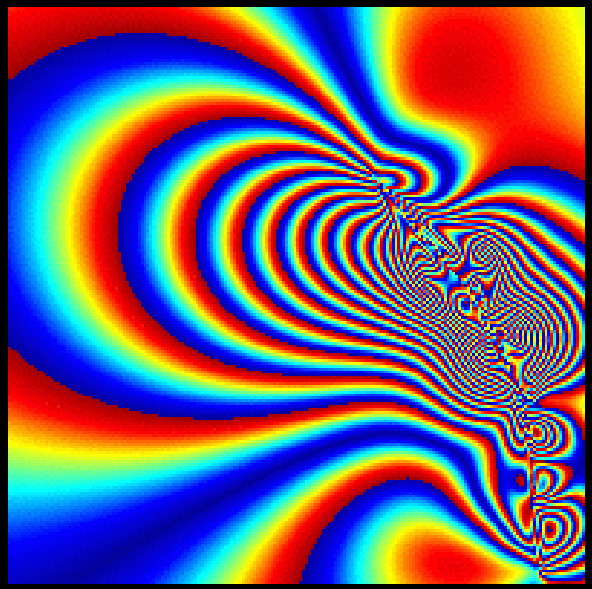
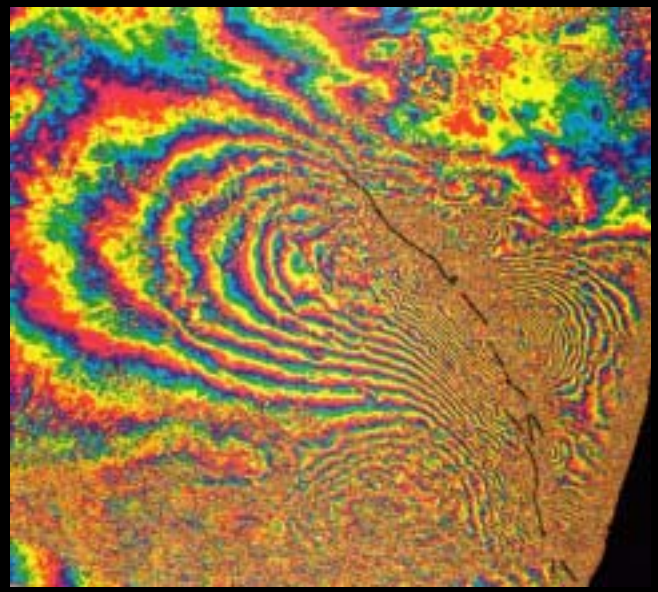






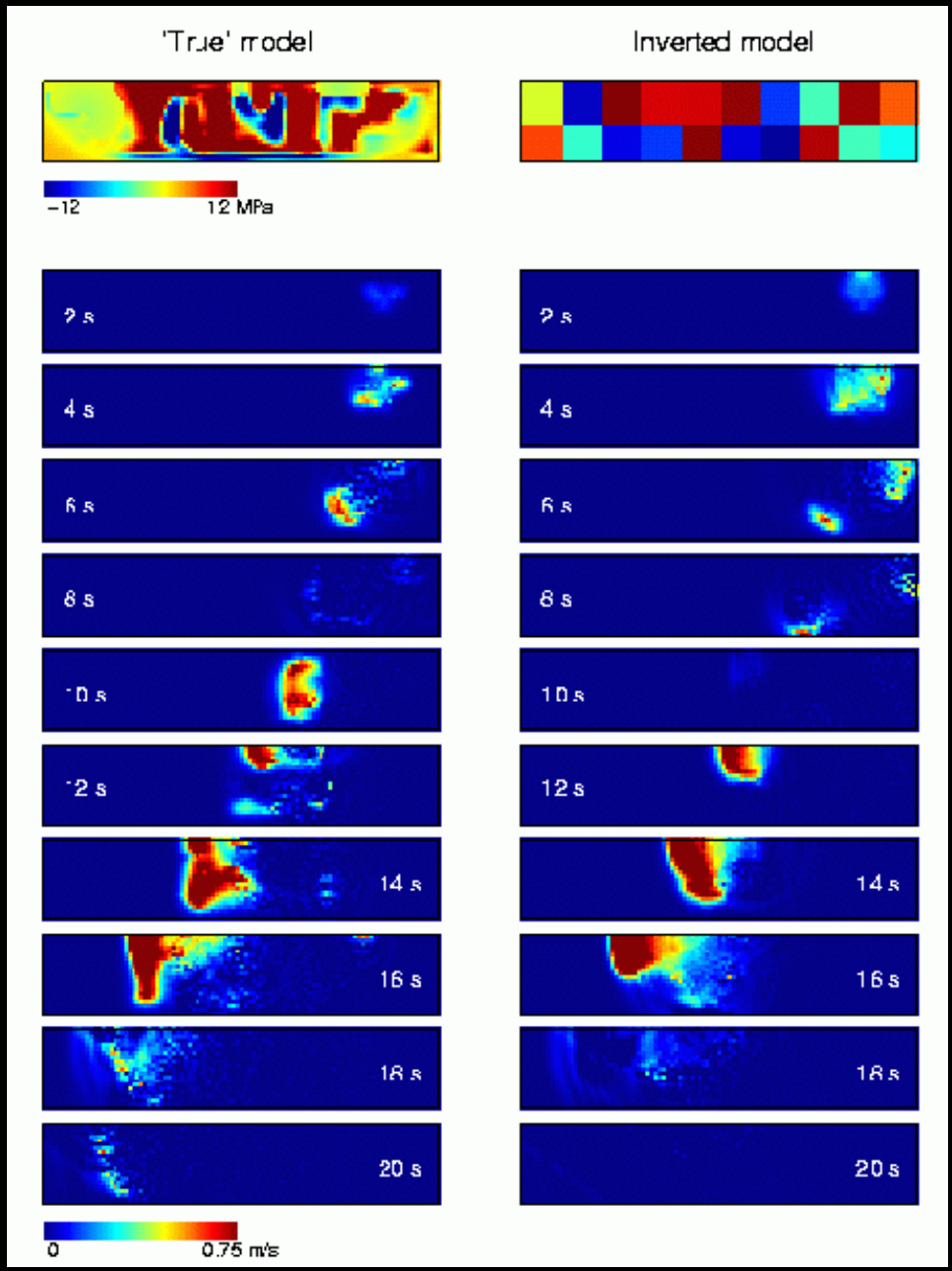
InSAR

Summary

Summary

Accelerograms constrain rupture propagation, fracture energy, but *not* D_c, T_e, T_u, through waveform modeling

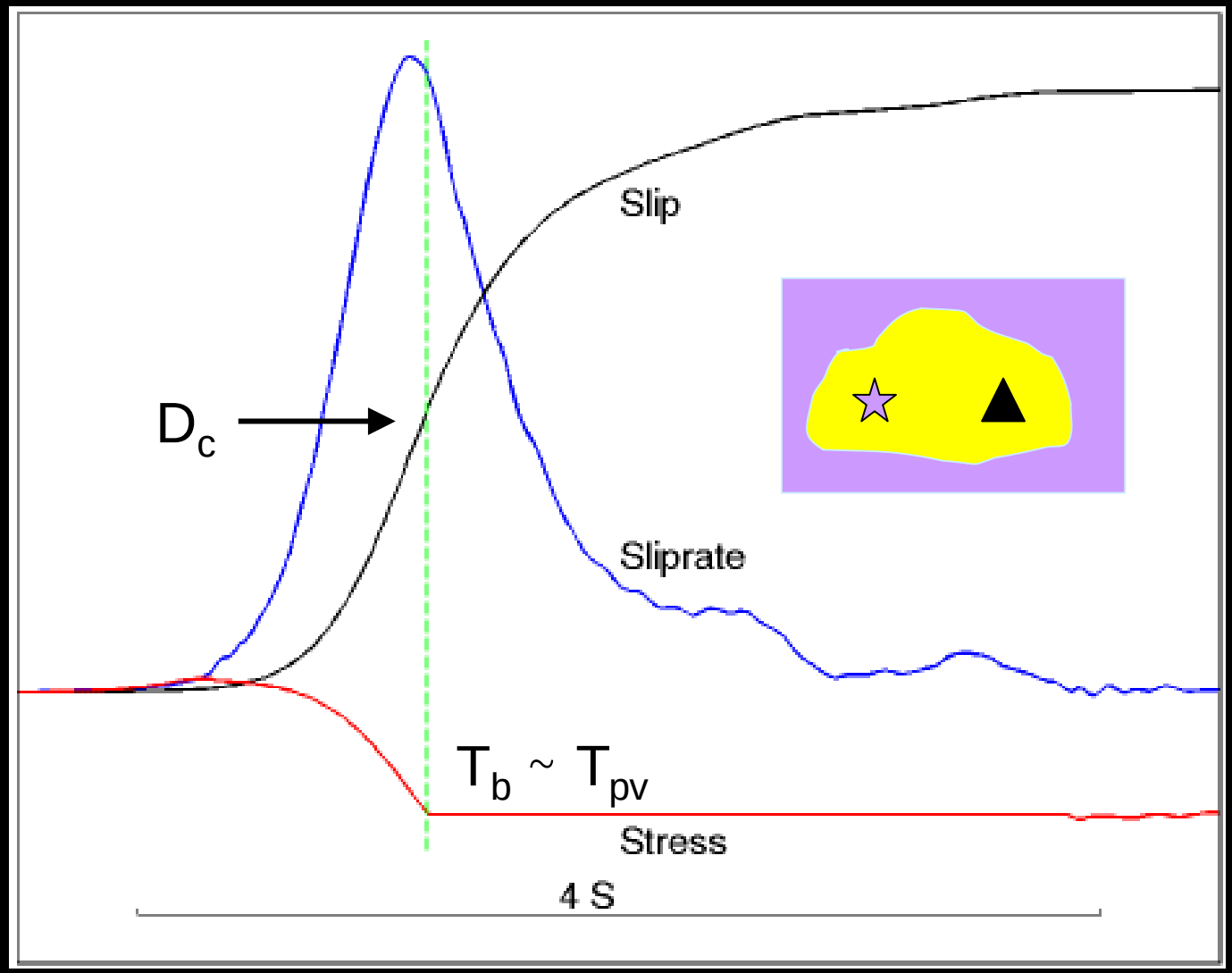
Inversion of Dynamic Rupture



Friction

Possible to Estimate Directly ?

Mikumo, Olsen, Fukuyama & Yagi (2002): Slip(T_{pv}) ~ D_c



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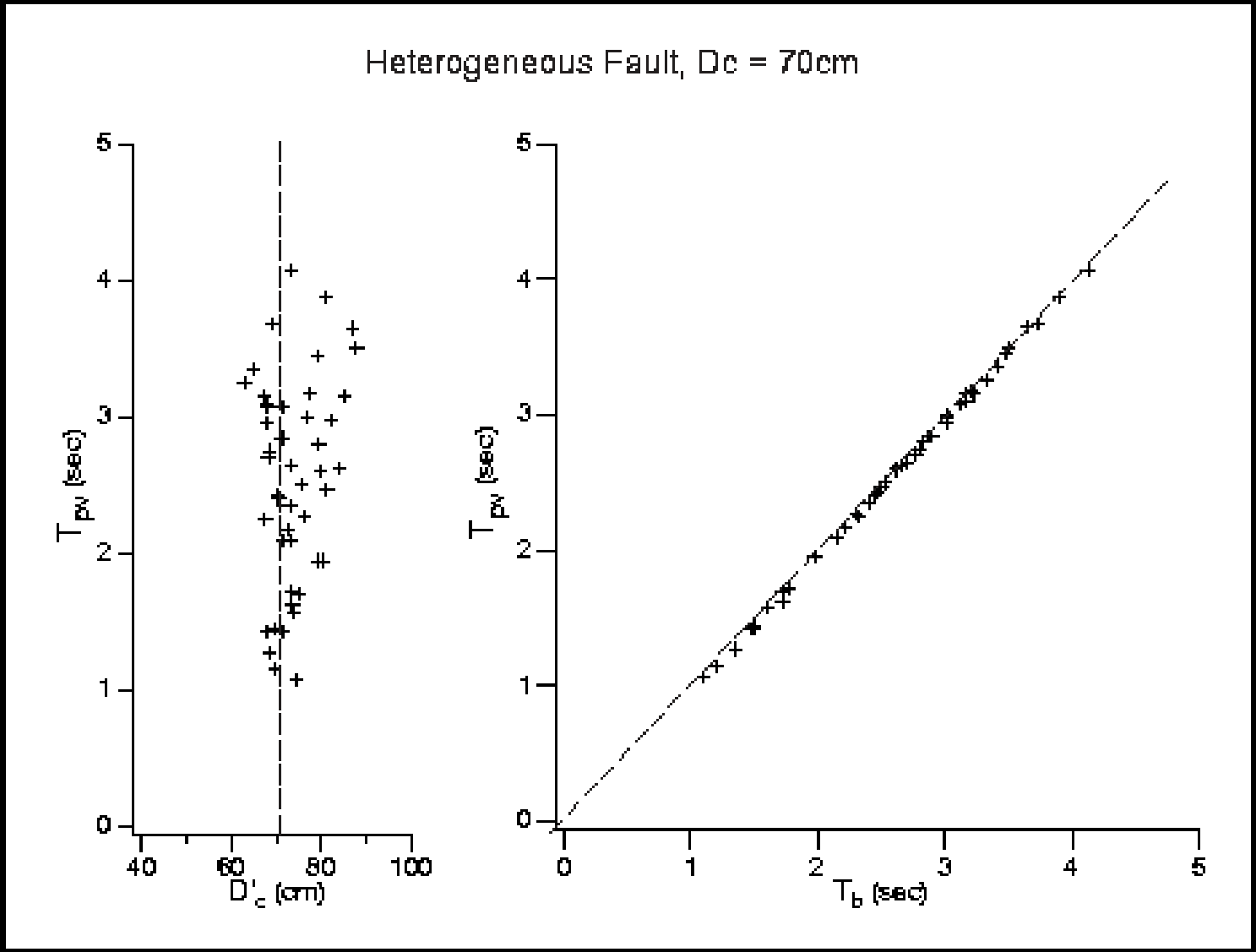
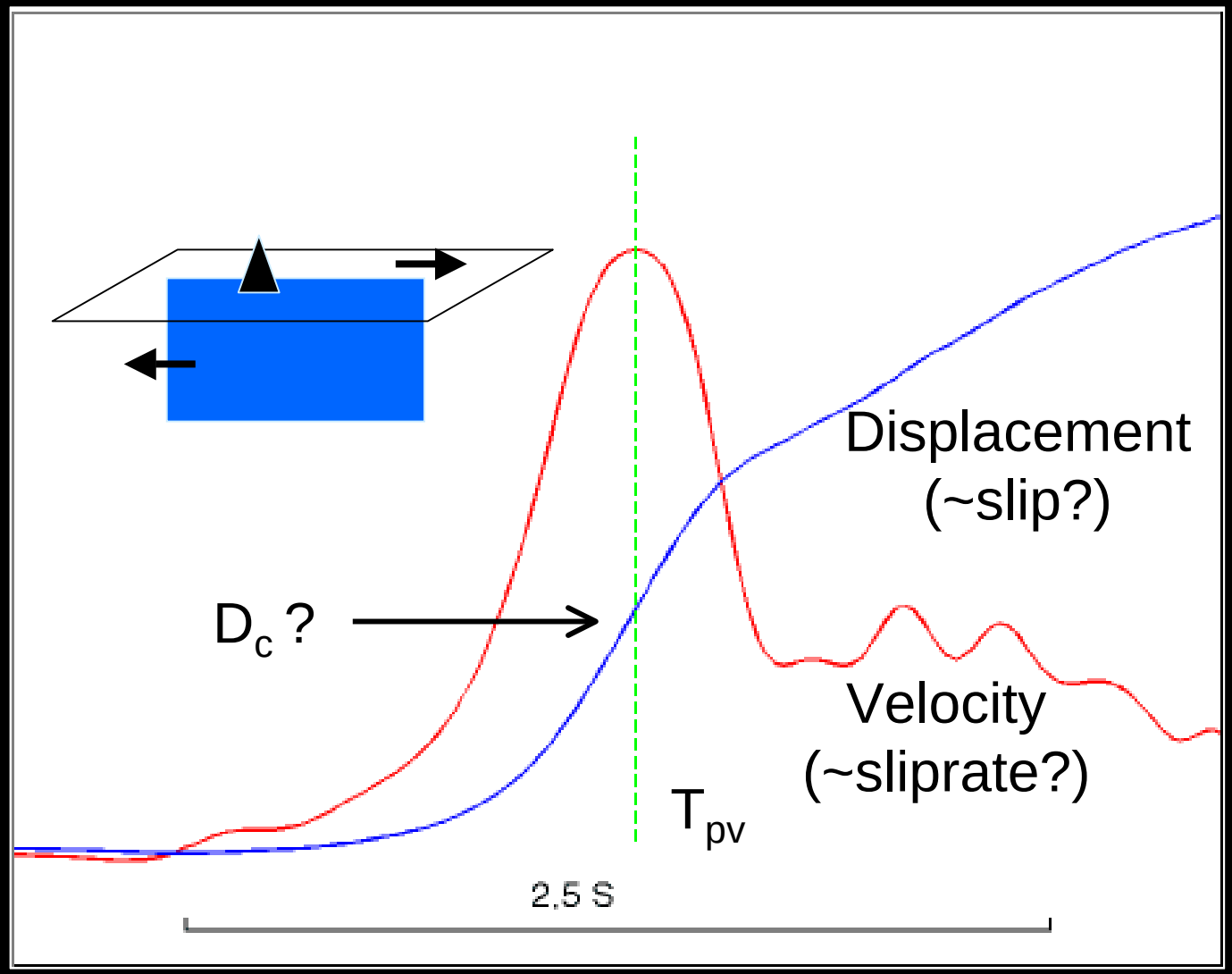
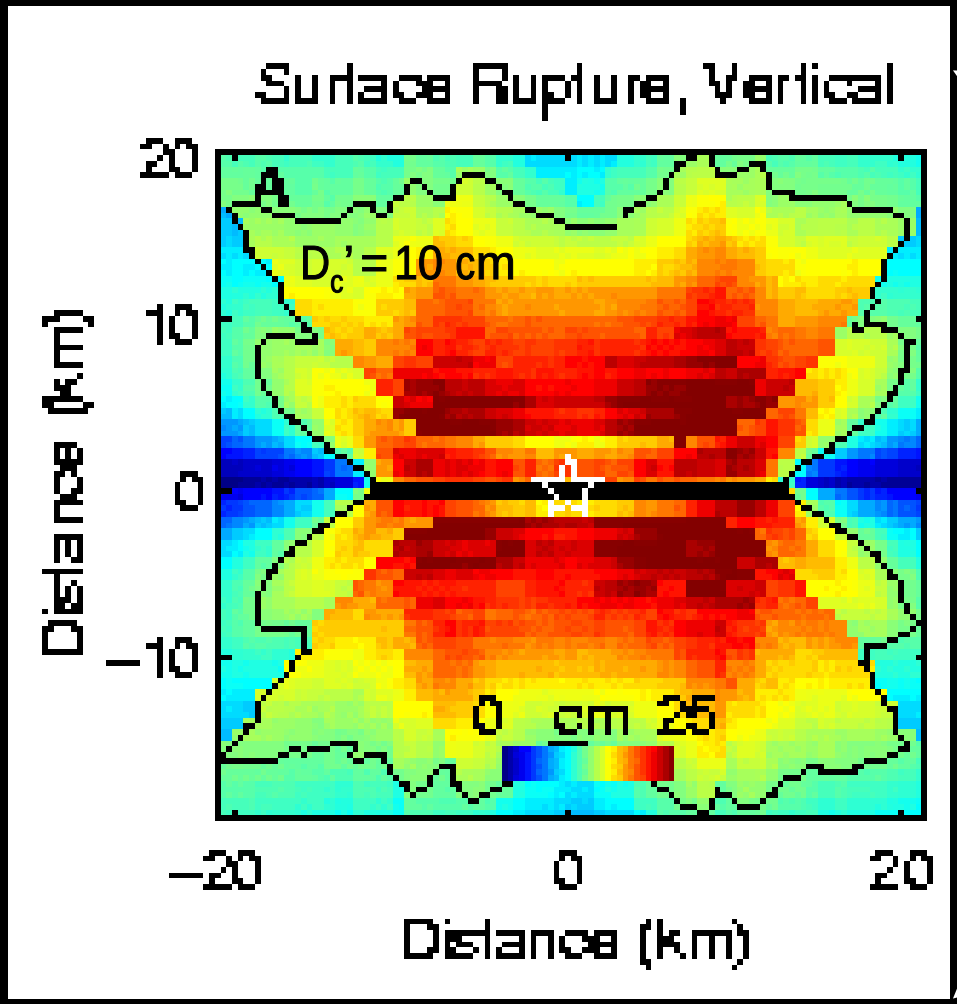


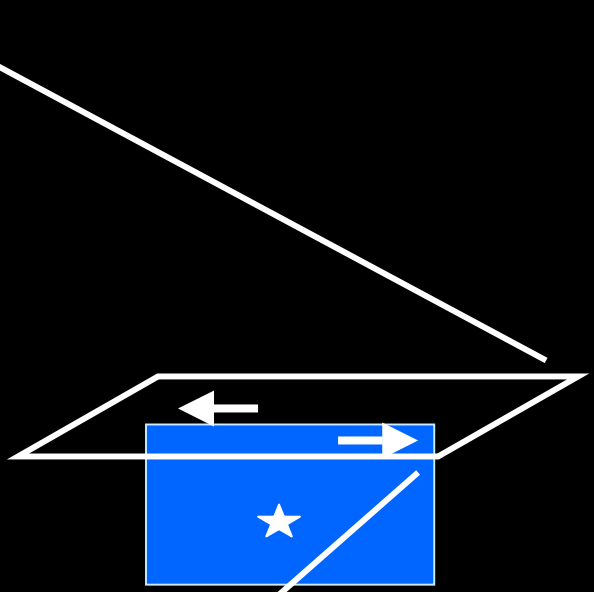
Displacement (T_{pv}) ~ D_c Near Fault ??



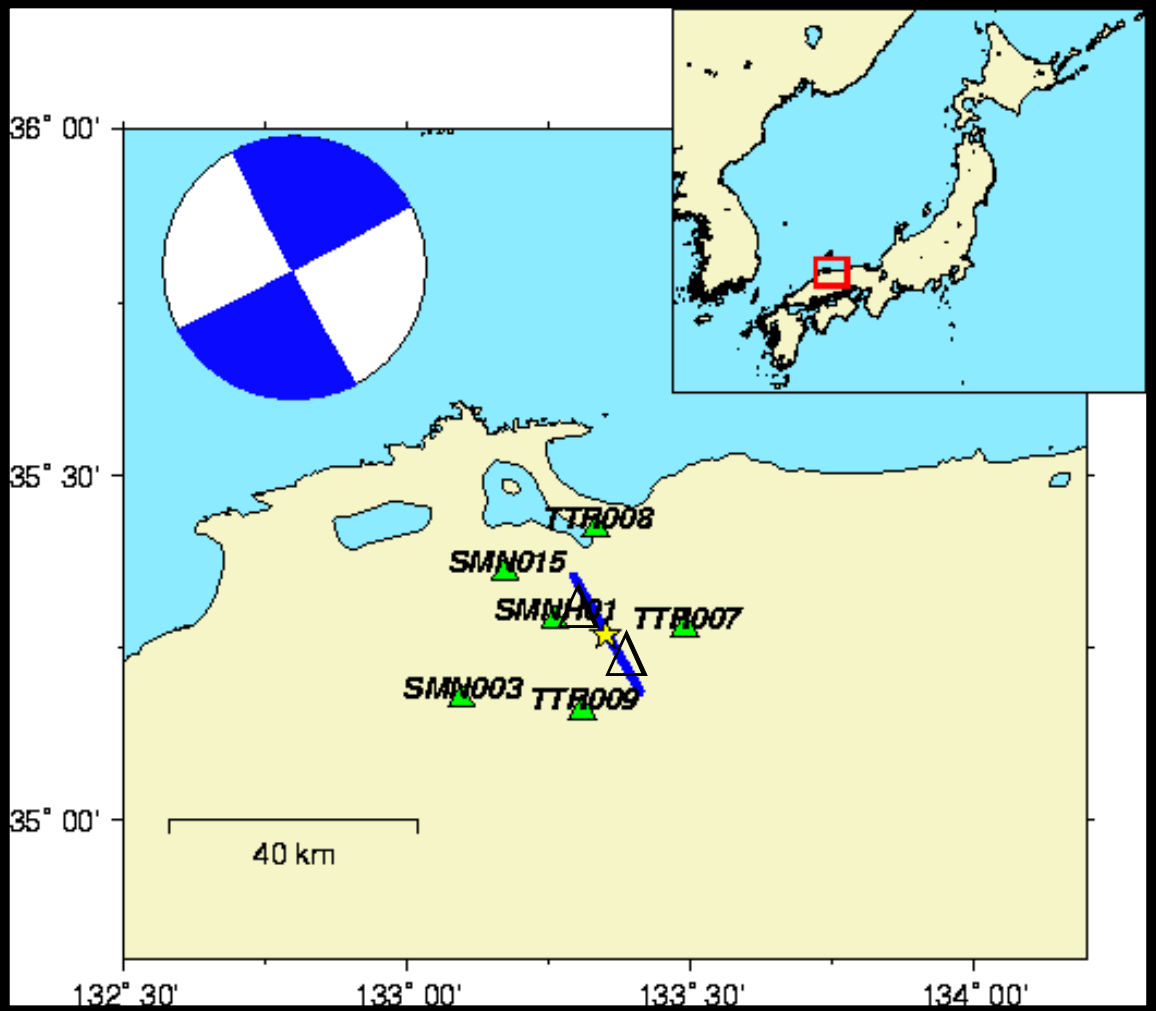
Homogeneous Initial Stress:

Vertical Fault, Surface Rupture (D_c=20 cm)

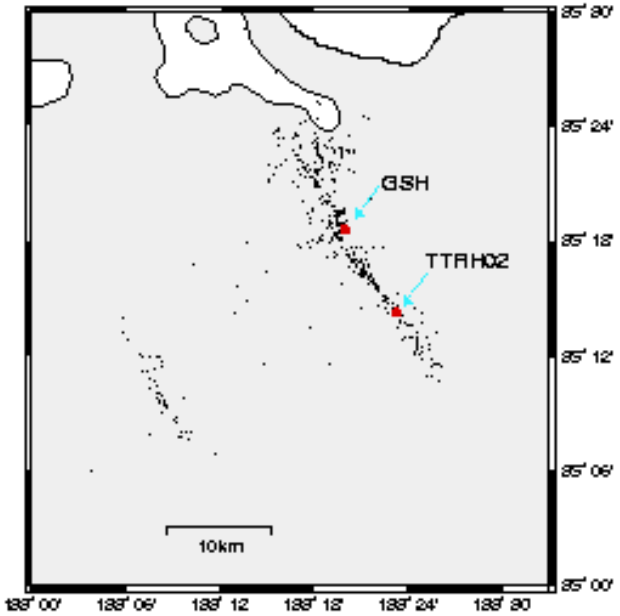


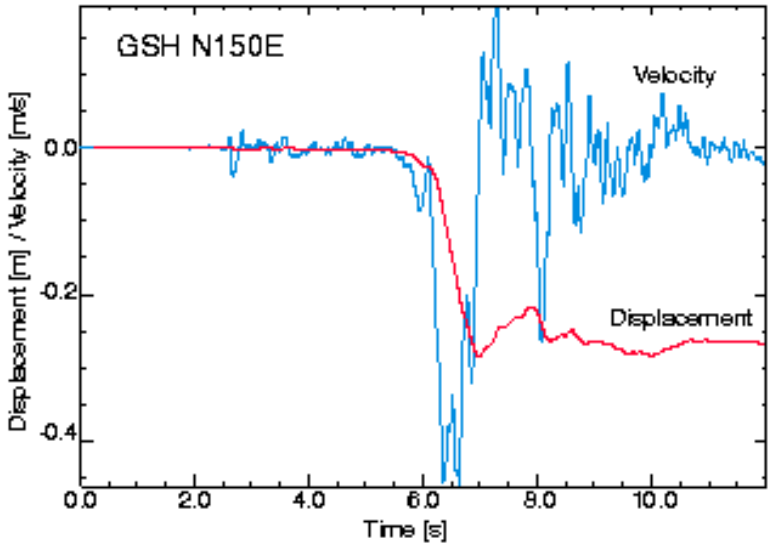


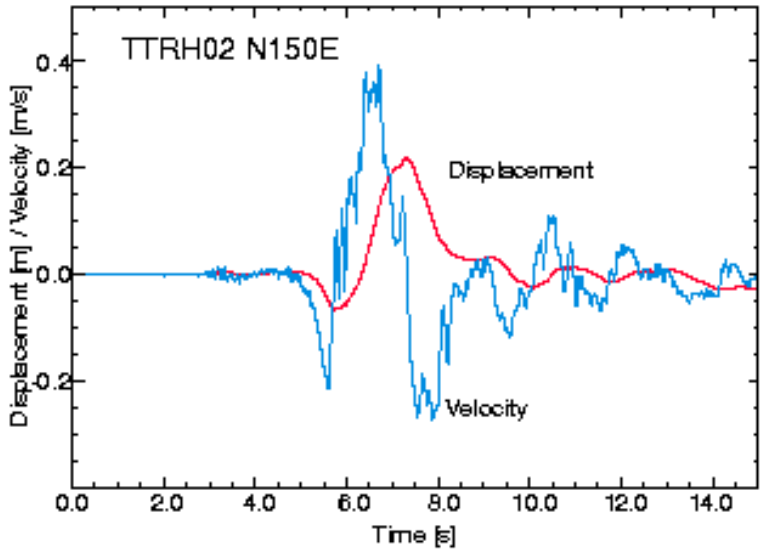
2000 M_w 6.6 Tottori Earthquake



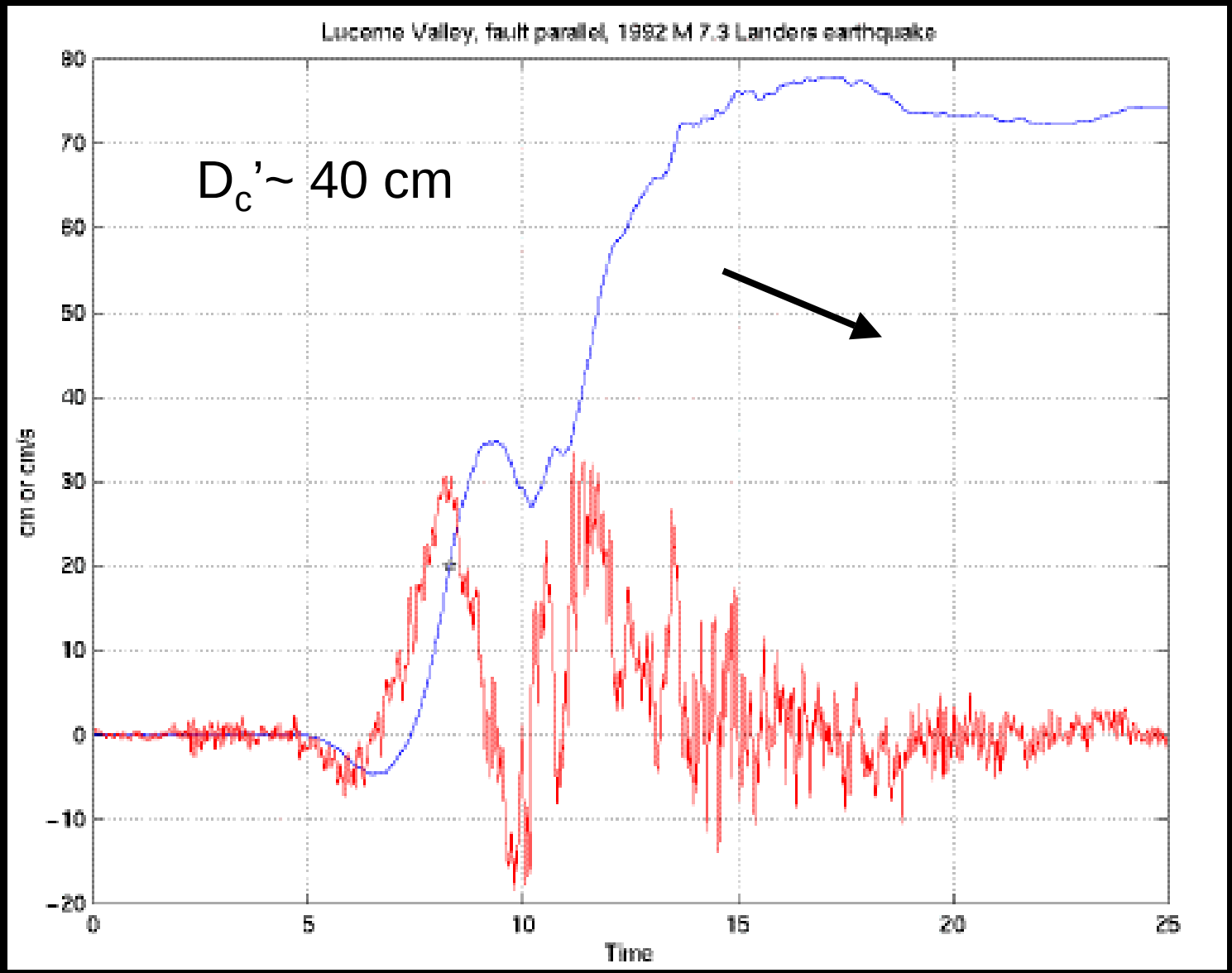
TTRH02 & GSH: D_c'~25-40 cm







Lucerne Valley from 1992 M_w 7.3 Landers



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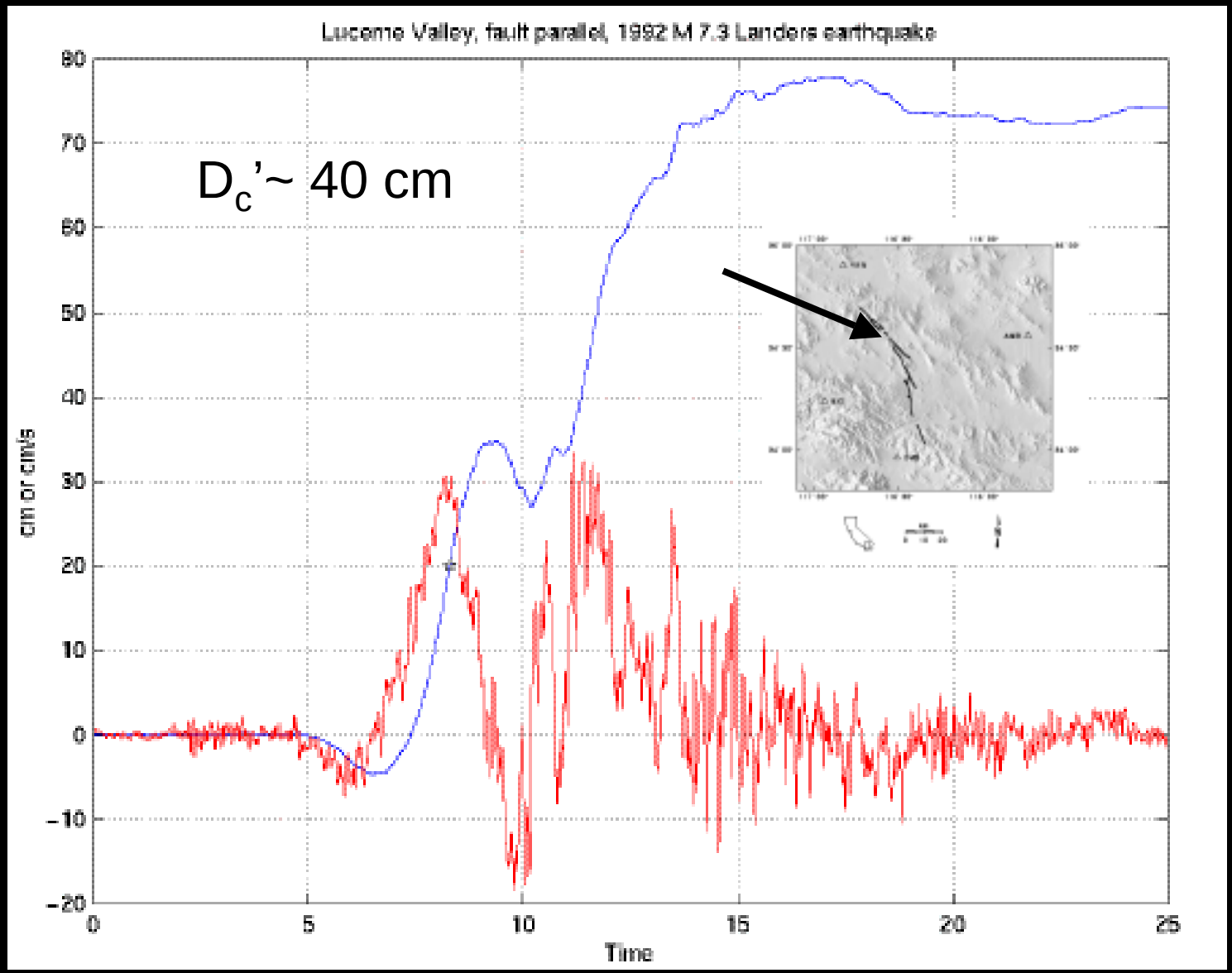


Summary

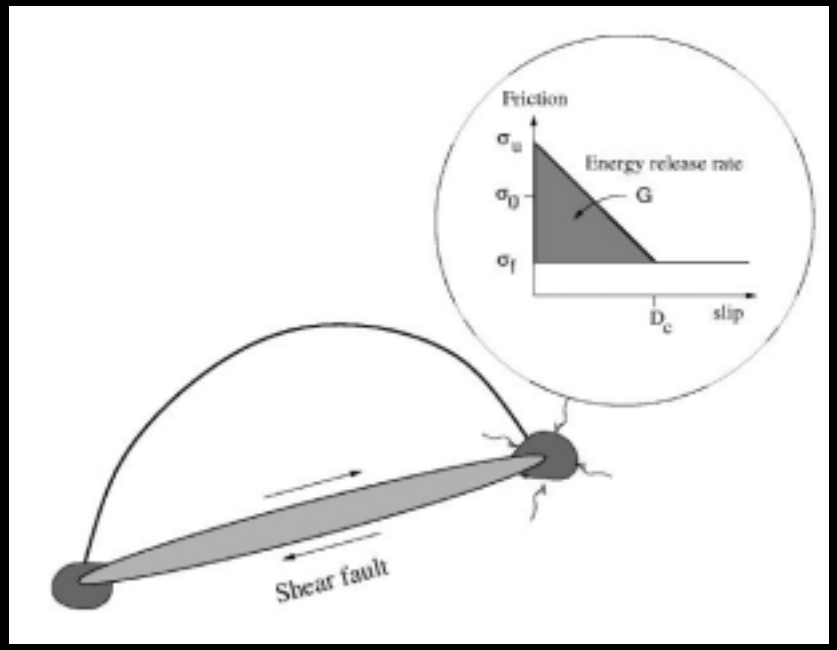
Summary

Measurement of D_c from near-fault strong motion data within factor of 2

Rupture Propagation

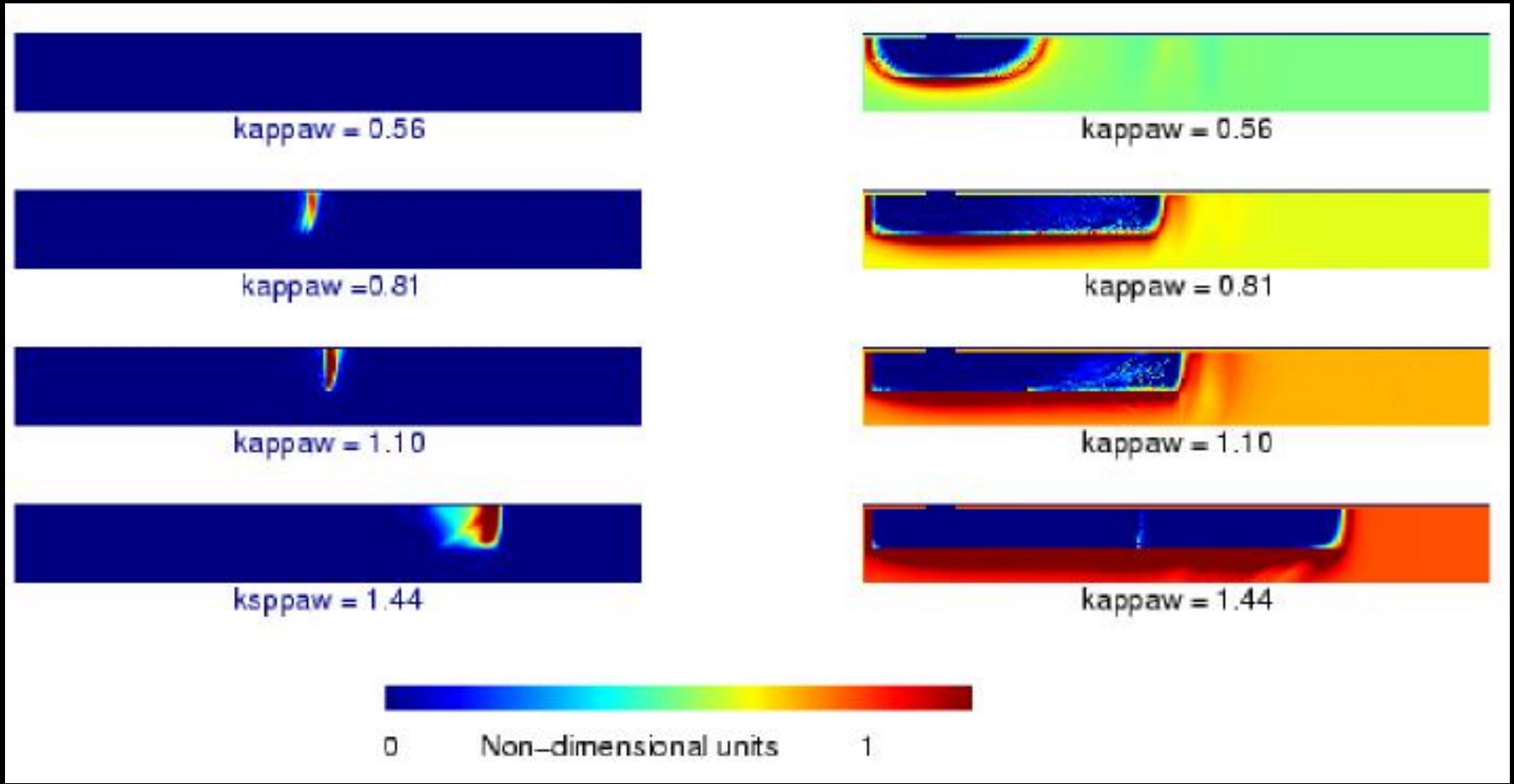
Possible to Characterize by
a Single Parameter ?

Fracture Energy Versus Strain Energy:



$$\kappa = \frac{T_e^{\,2}\, L}{\mu\, T_u\, D_c}$$

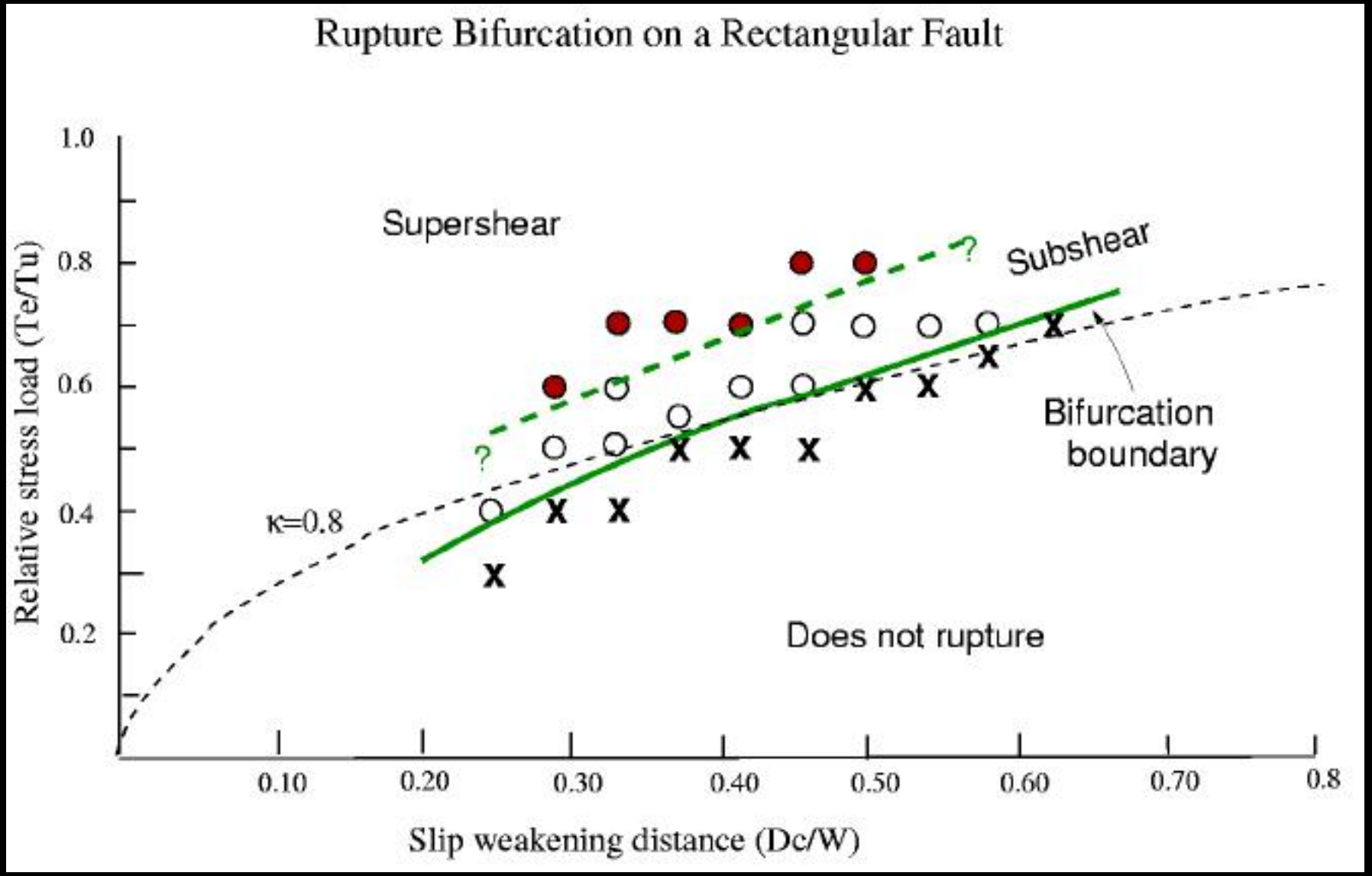
Critical Rupture Propagation



Rupture Bifurcation

$\kappa < \kappa_c$	no rupture
$\kappa_c < \kappa < 1.5\,\kappa_c$	$V_r < V_s$
$\kappa > 1.5\,\kappa_c$	$V_r > V_s$

Rupture Bifurcation



Summary

Summary

Non-dimensional number k characterizes rupture propagation