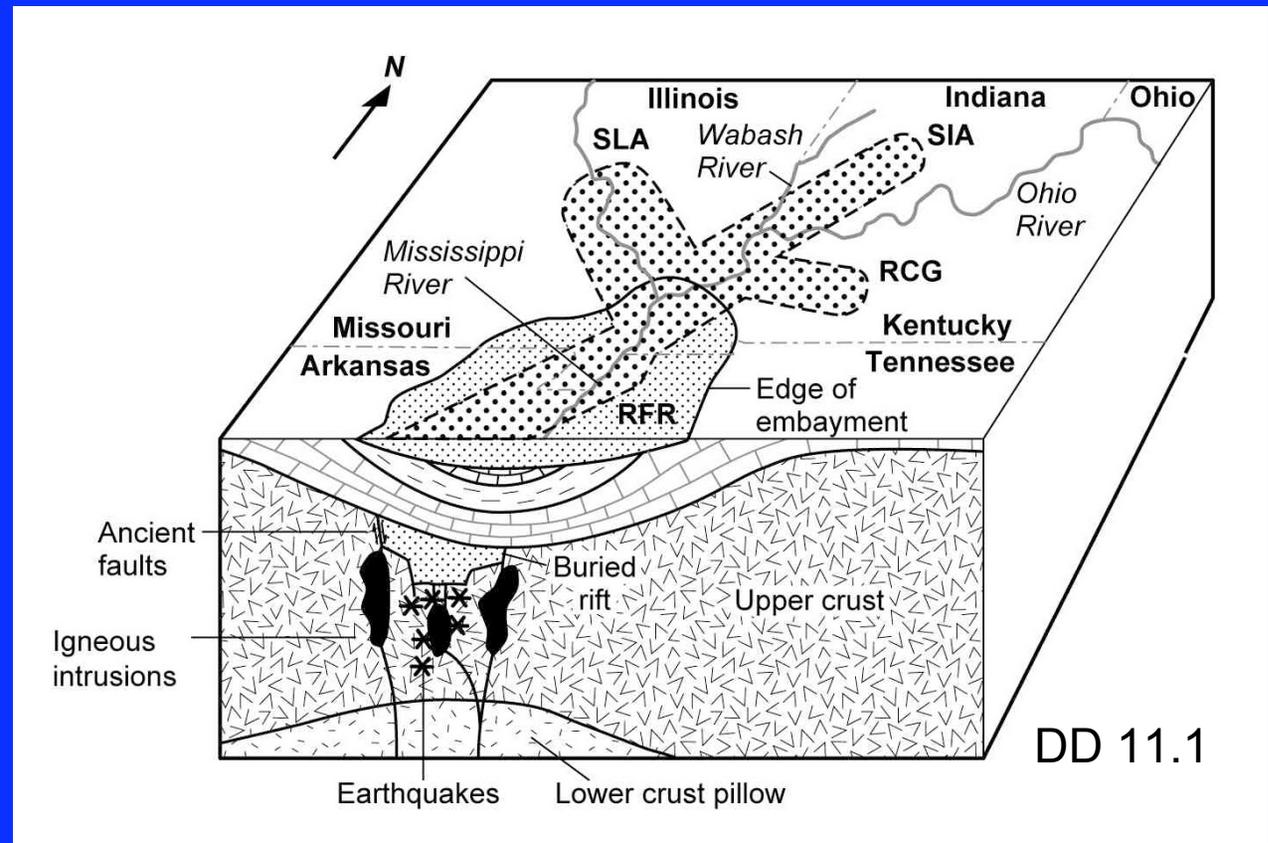


7. What's going on at New Madrid?

What's under the Reelfoot rift?

How can earthquakes happen there?

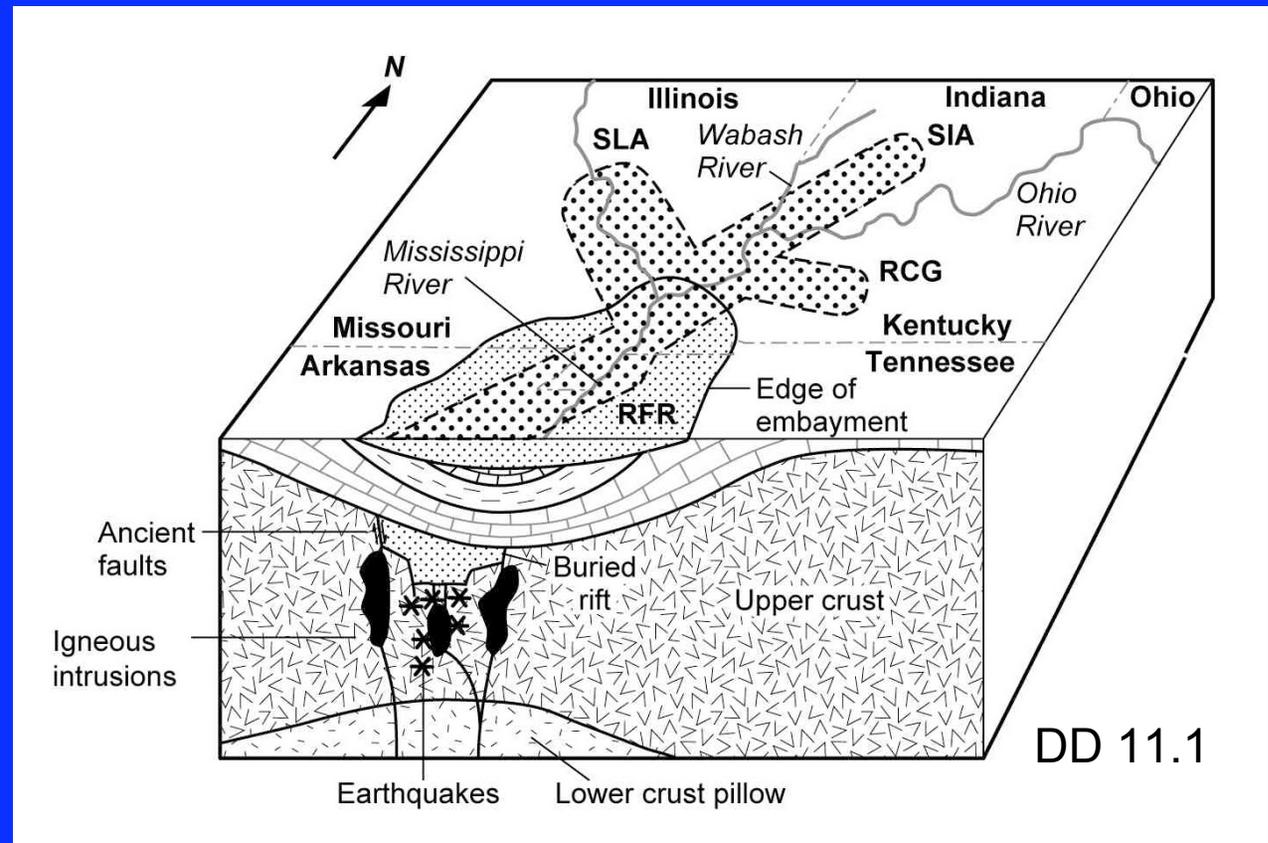
Why do earthquakes happen *there*?



Failed rift model

During rifting,
granite rocks
stretched & faulted,
leaving deep
Mississippi
Embayment wider
than rift itself

Over millions of
years, Embayment
filled with
thousands of feet of
sediment deposited
by Mississippi river
and its ancestors



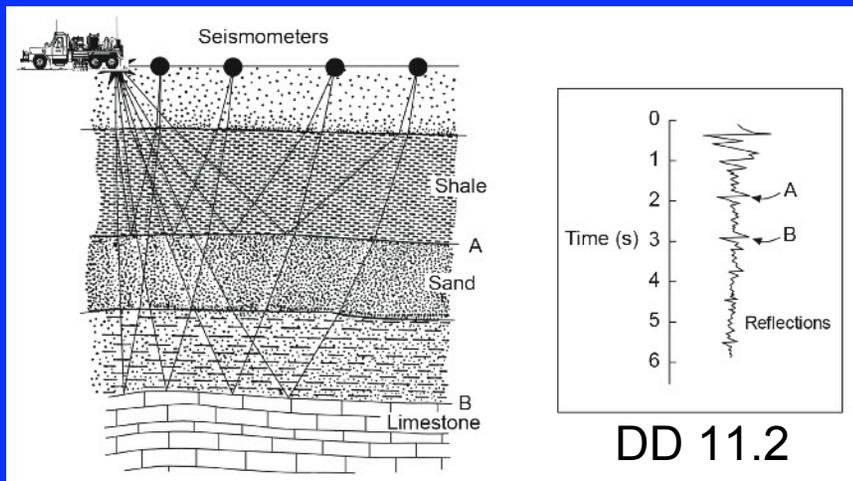
Simplification of complex reality:
“All models are wrong.
Some models are useful.”

Activity 7.1

What's in the mystery box?

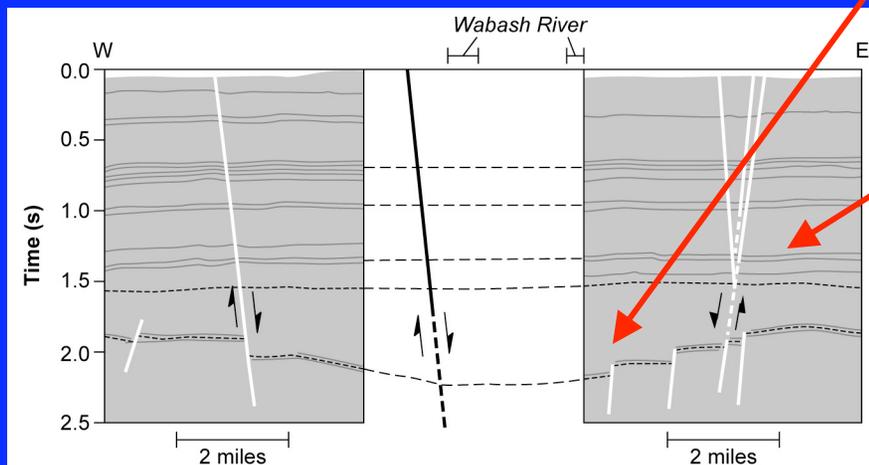
What did you do to try to find out?





Seismic reflection shows when waves that bounced off interfaces arrive

Deep reflector is “basement” - top of rocks pulled apart to form rift. Faults offsetting it probably formed during rifting and may be where earthquakes occur today



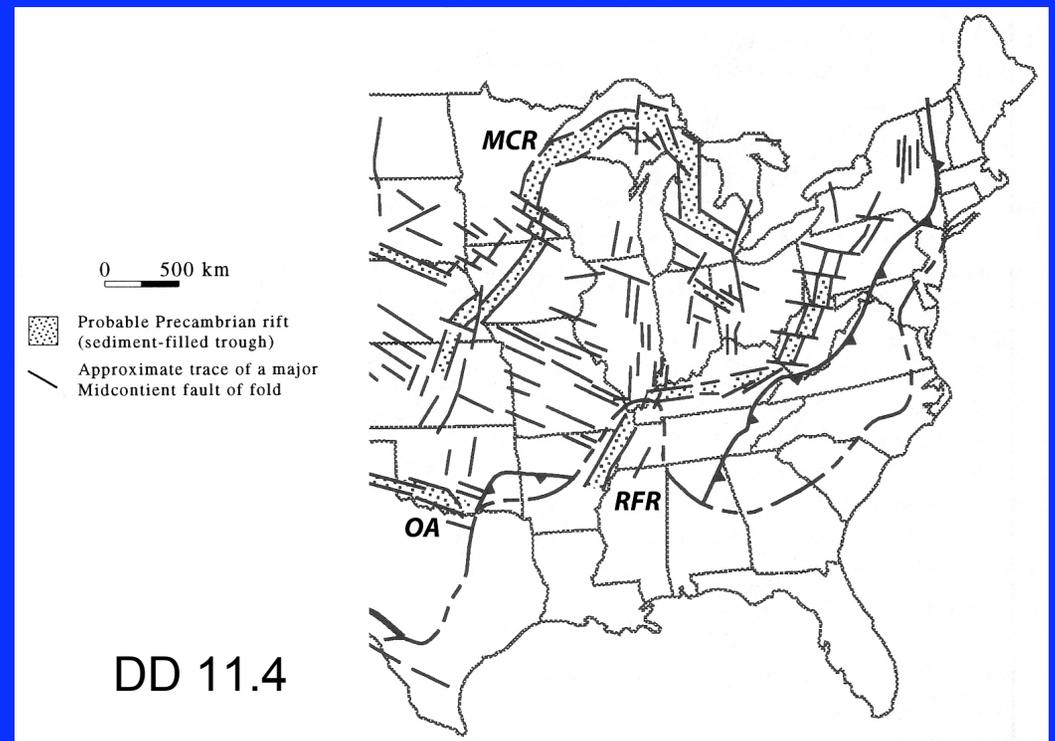
Shallower reflectors are sedimentary rocks that filled the rift over time. Fault offsets on these reflectors are less than at depth, so faults moved less since sediments deposited

Gravity and magnetic data show denser igneous bodies below basement

Implications: old faults don't heal, and so move occasionally when forces within continent are strong enough

What causes the earthquakes?

Plate interior contains many fossil faults: somehow forces within the plate (which we don't understand) are causing small motions on them



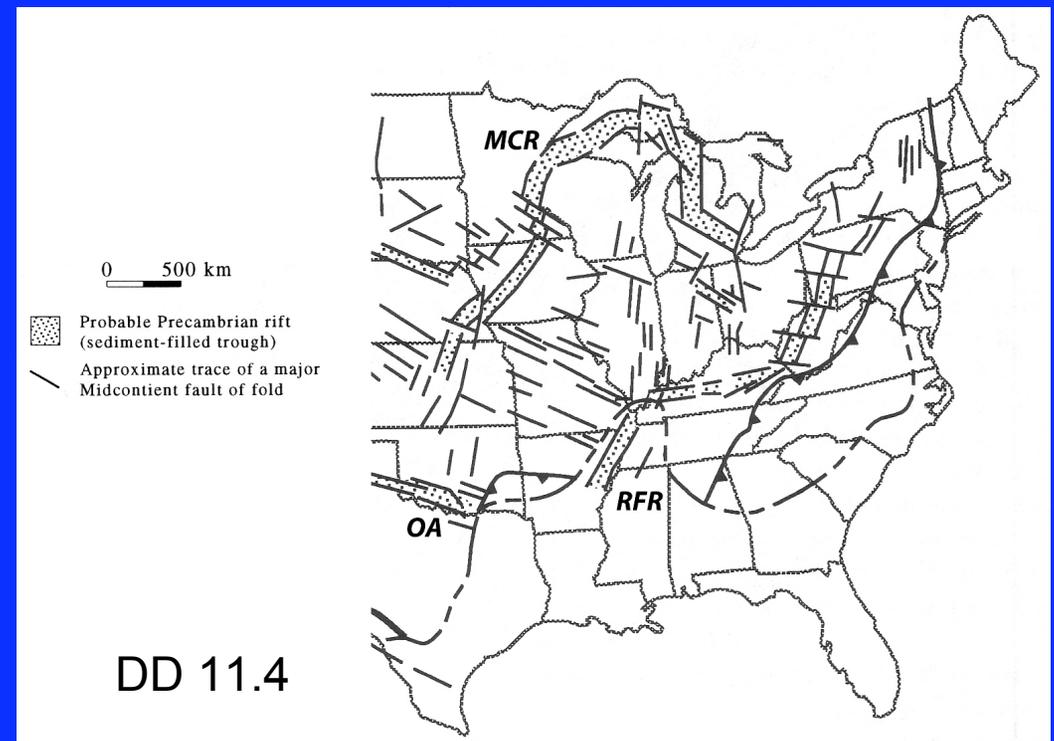
Like chunk of floating ice with cracks inside it

Activity 7.2: Why New Madrid?

Plate interior contains many fossil faults developed at different times with different orientations - like the MCR - so why do only a few appear active today?

Options:

- 1) Something special is making faults in the New Madrid area active
- 2) Different fault systems have been active at different times, and New Madrid is just the most active today



How could we try to tell the difference?

Problem: most possible forces are large-scale forces that affect most of central and eastern North America.

They may contribute to causing New Madrid earthquakes, but don't explain why in the past few hundred years earthquakes seem to happen more at New Madrid than other places.

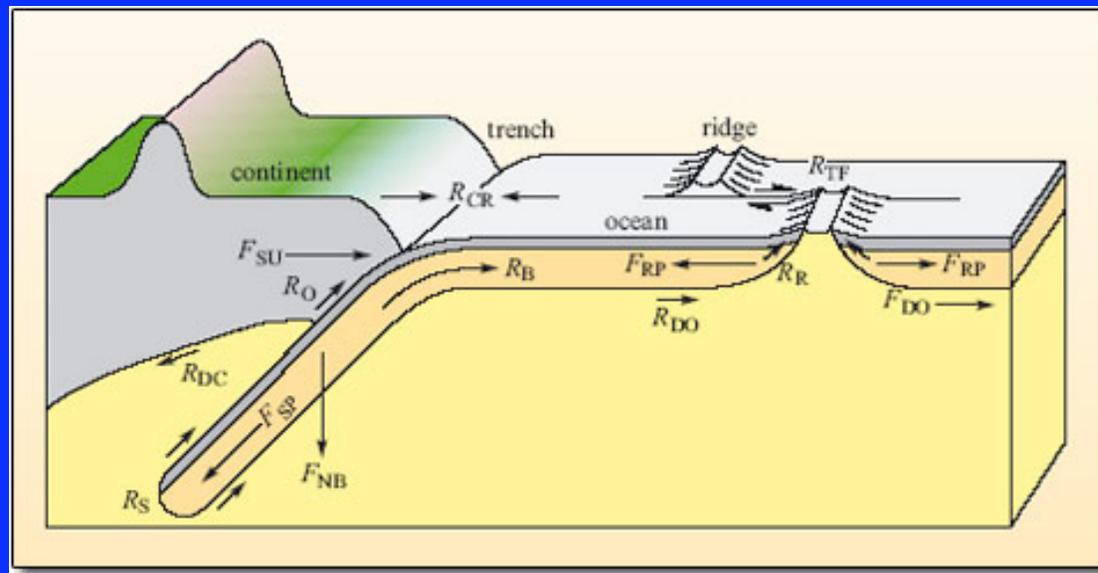
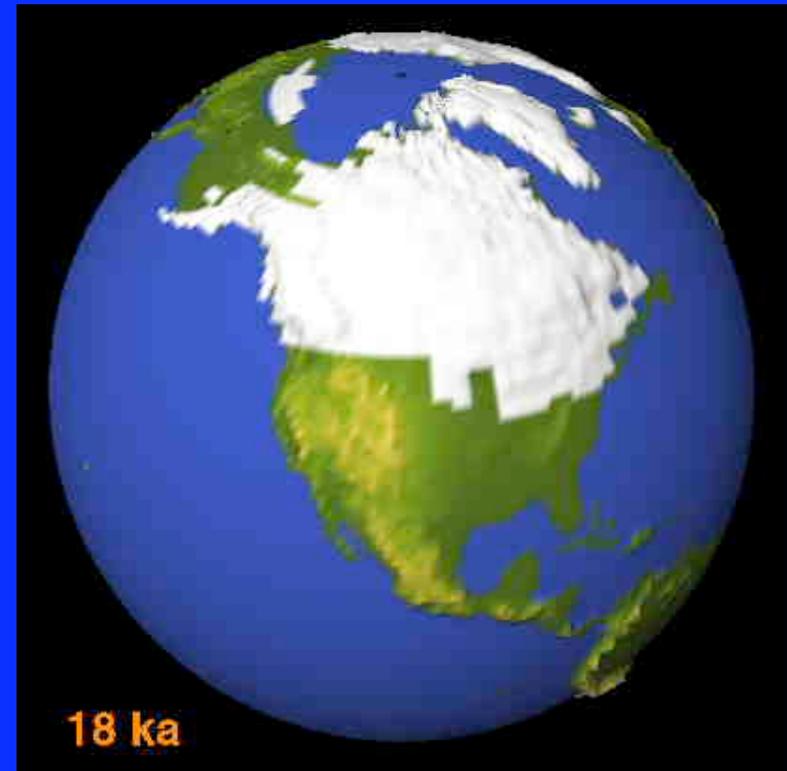
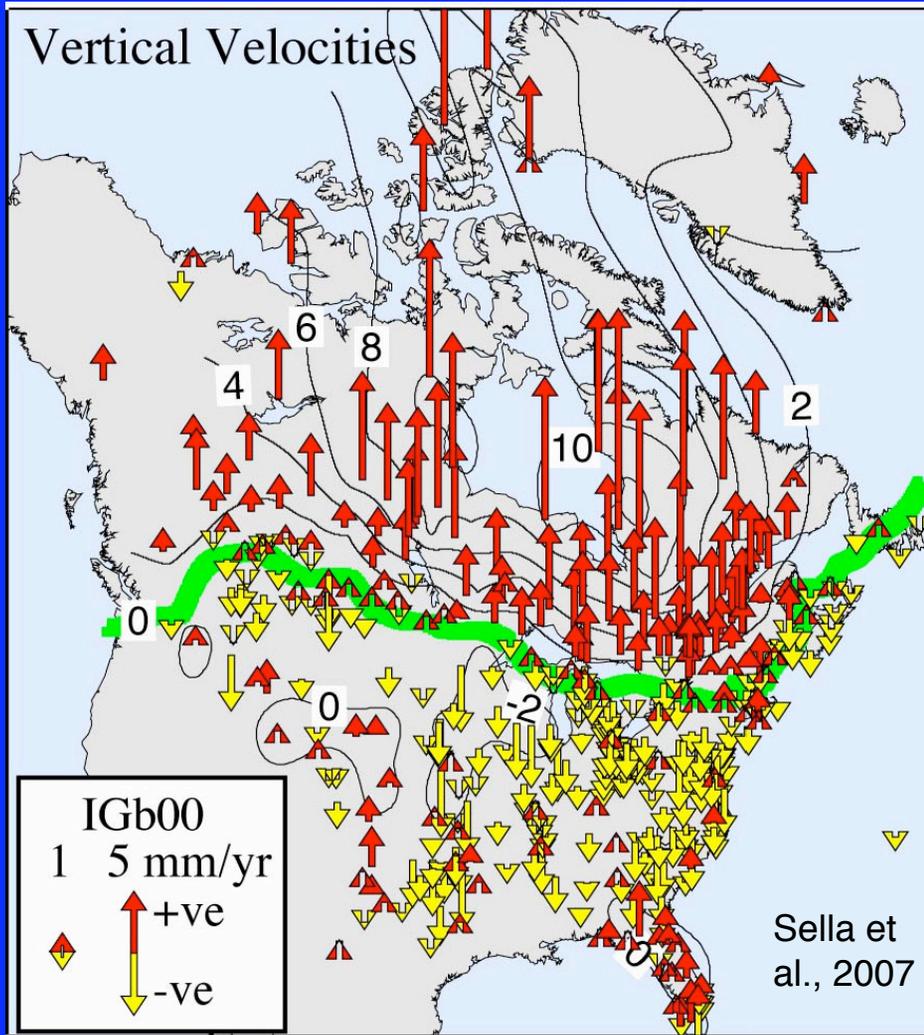
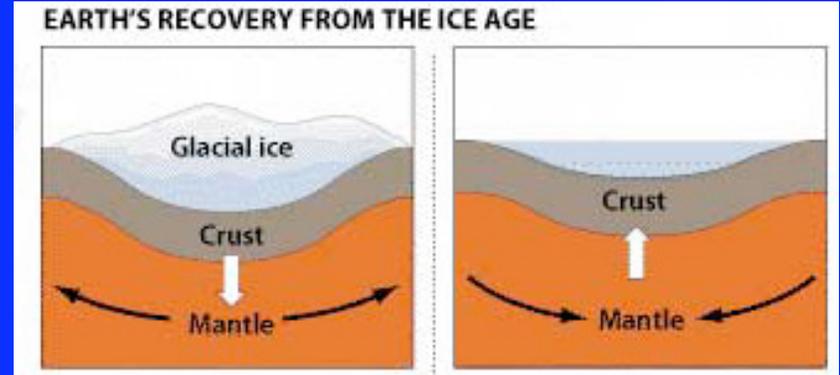


Plate motion driving forces

Another large scale force: GIA - glacial isostatic adjustment



DD11.5 GPS shows nothing unusual at New Madrid

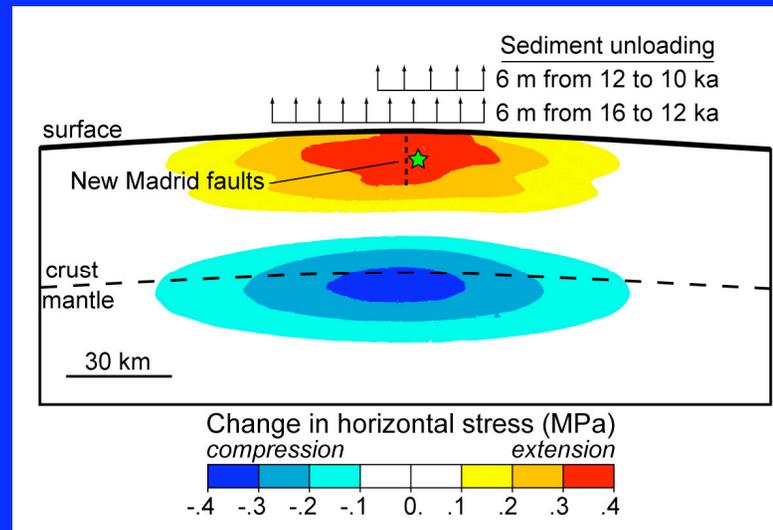
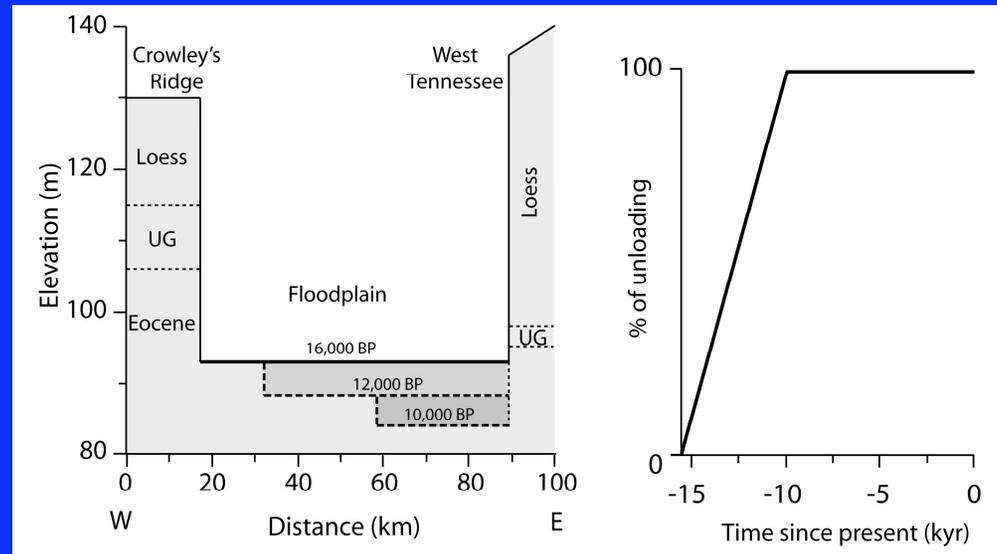
Possible local stress source for seismicity: postglacial erosion in Mississippi Embayment

Flexure caused by unloading
from river incision 16 - 10 ka
reduces normal stresses
sufficiently to unclamp
pre-existing faults

Fits timing of recent
seismicity

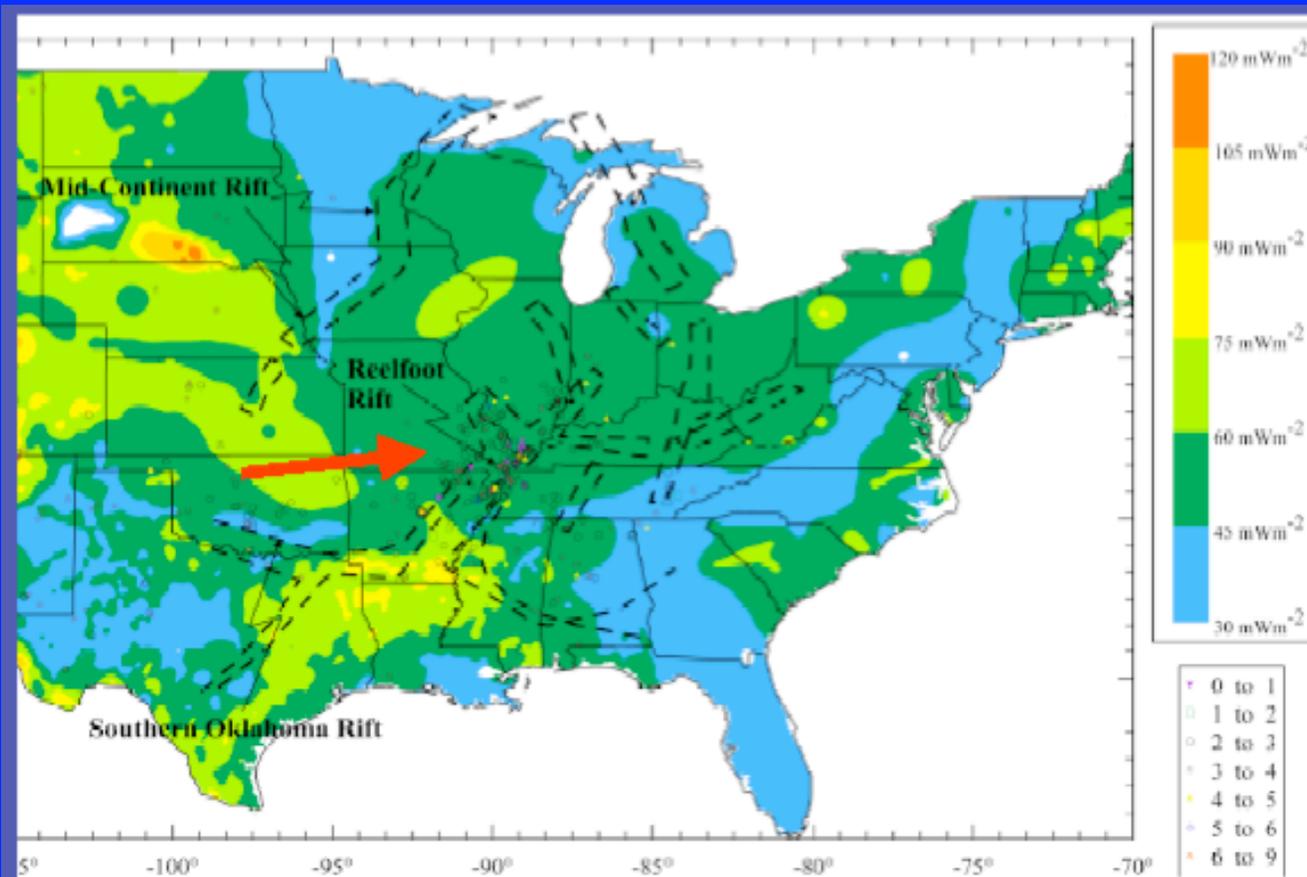
Doesn't require weak zone

Fault segments that
ruptured unlikely
to fail again



Calais,
Freed,
Van
Arsdale
& Stein,
2010

NMSZ no hotter - and thus not thermally weaker - than rest of central US



No obvious strength reason for platewide stresses to concentrate in NMSZ rather than other faults

Option 2: Earthquakes move around, and New Madrid is the presently active area

