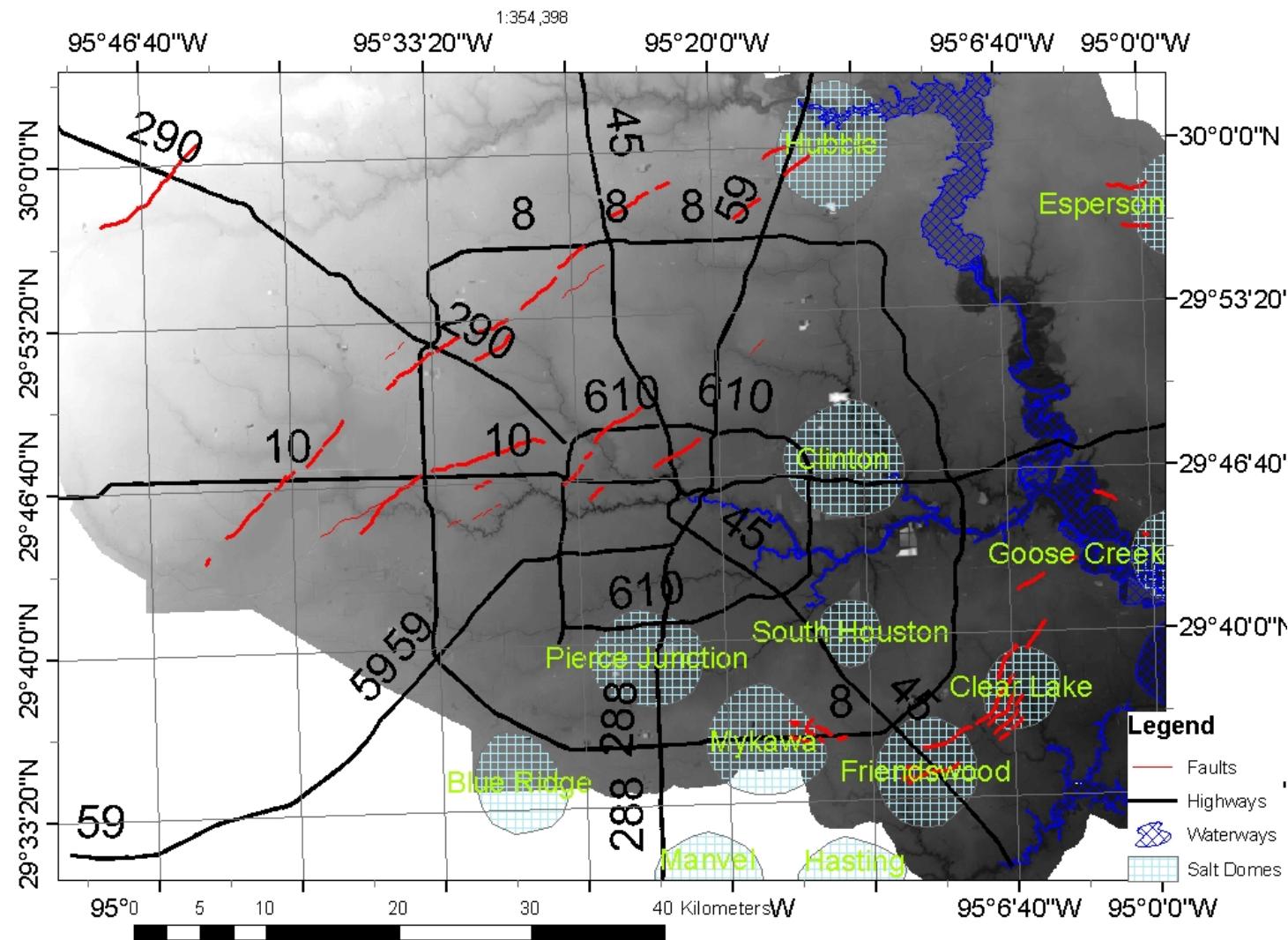


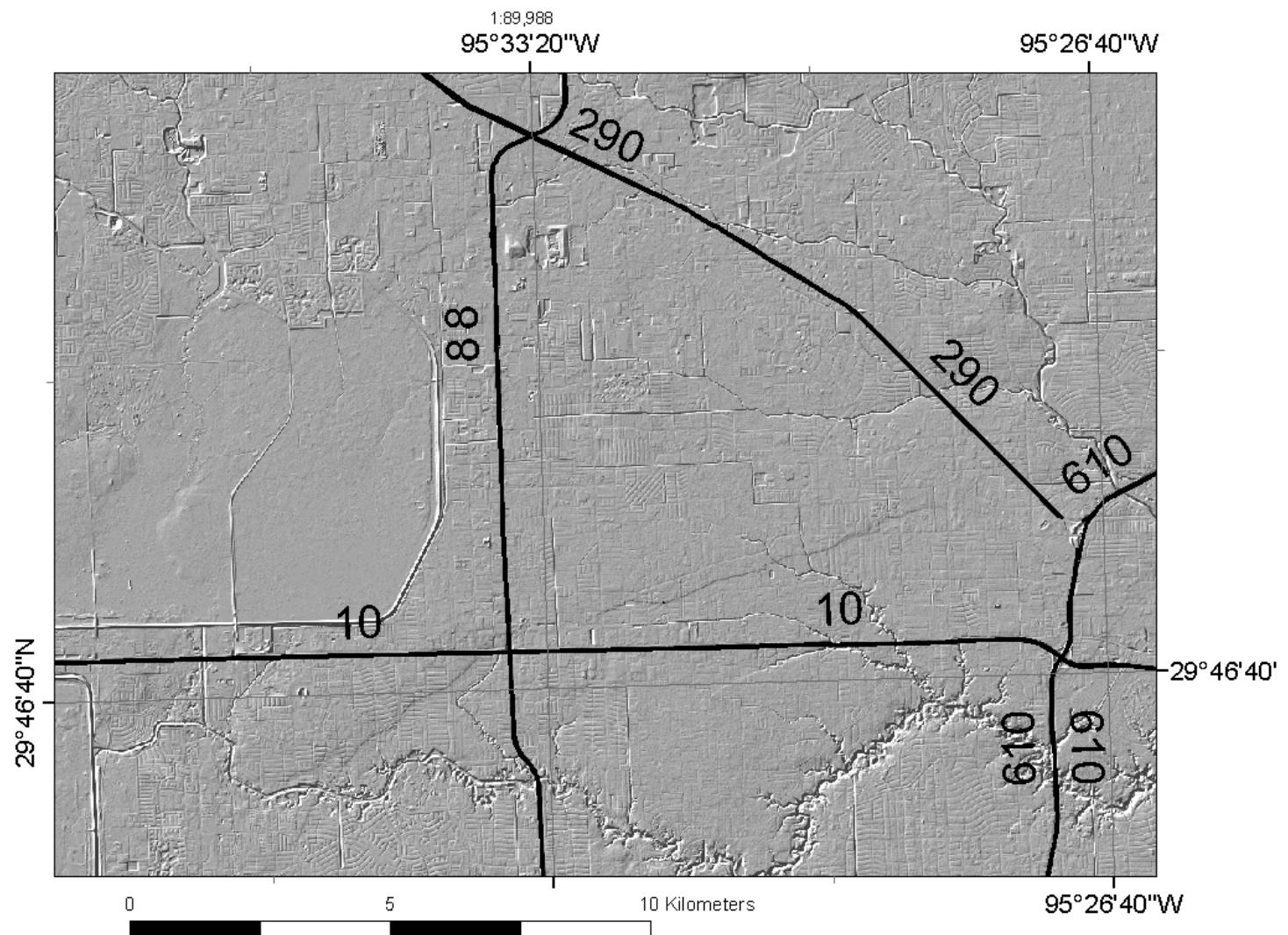
**Mapping Active
Faults
in the Houston
Area
using LIDAR Data**

- Richard Engelkemeir,
University of Houston
- Dr. Shuhab Khan,
University of Houston
- Dr. Carl Norman,
University of Houston





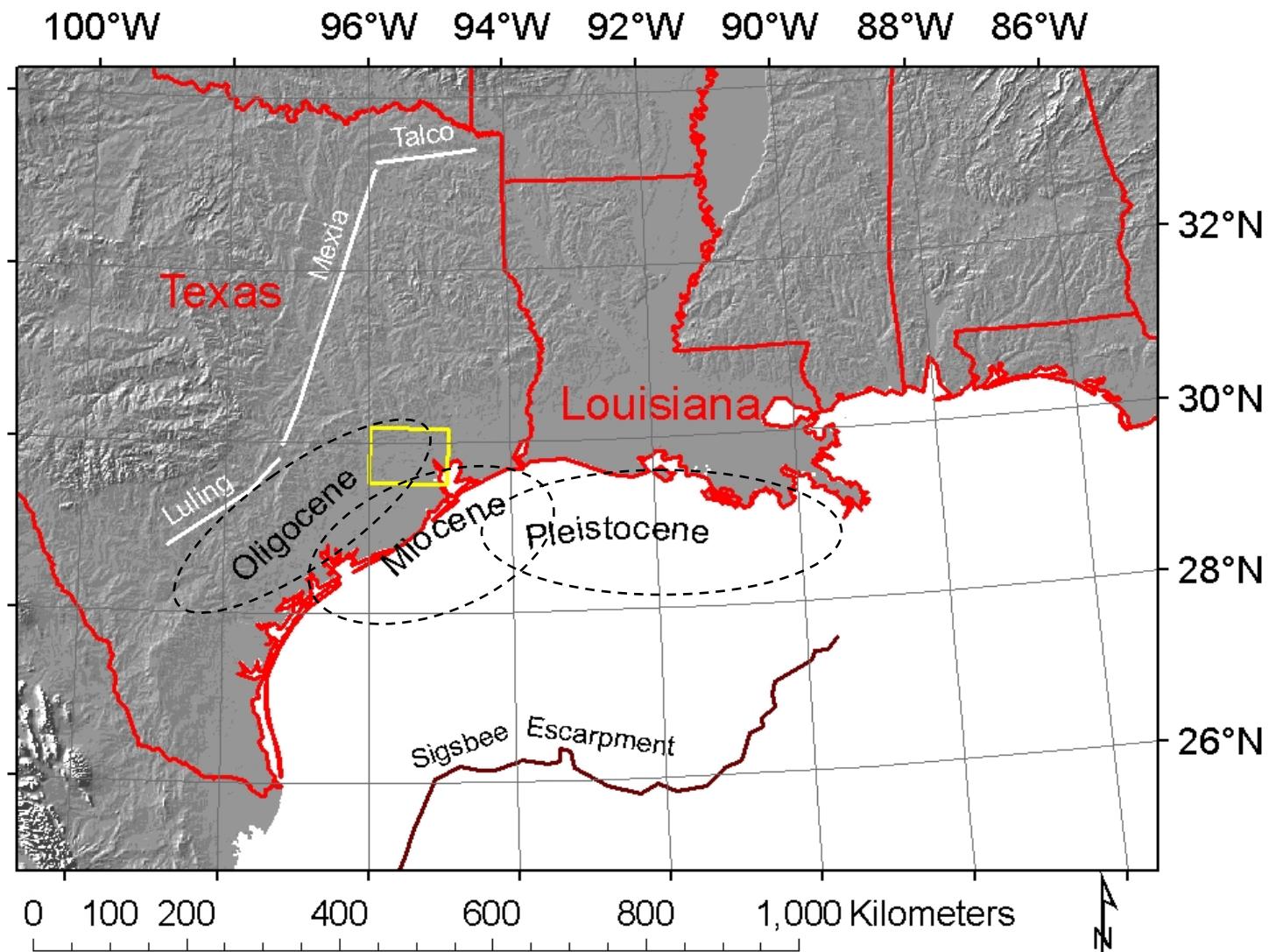
LIDAR DEM of Harris County. LIDAR mapped faults, salt dome locations.



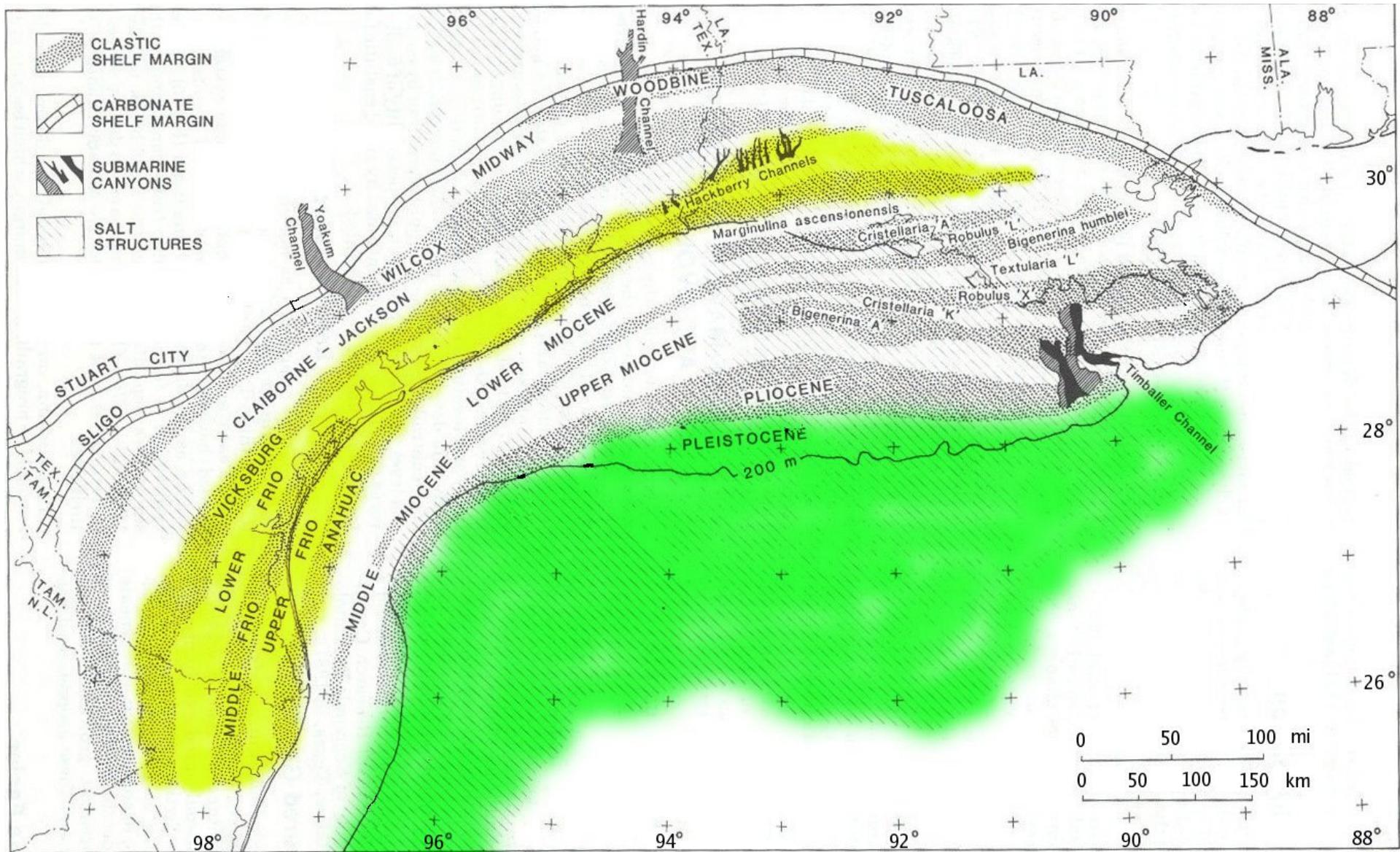
Hillshade of LIDAR DEM for northwestern Harris County, shown without faults.

Geologic Overview

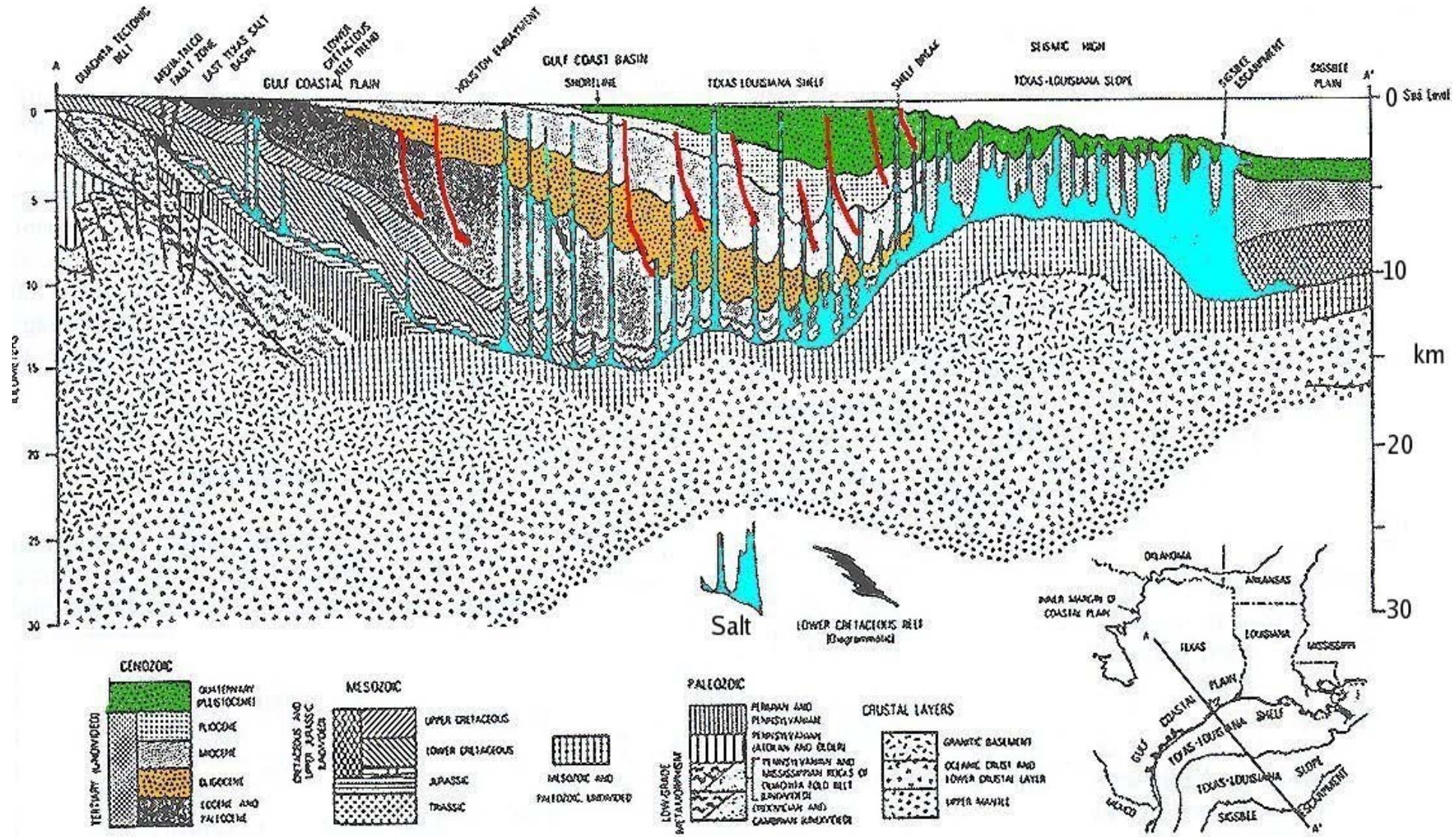
- Salt deposited during extension prior to sea floor spreading
- Deposition prograding into basin
- Faulting initiating along shelf margin
- Depositional and salt role in faulting



Regional map, showing the Northwestern Gulf of Mexico. The labels indicate the primary depocenters, showing the prograding into the basin along with the eastward migration of depocenters. The salt basin limits are shown. The salt basin extends from the Luling-Mexia-Talco faults to the Sigsbee escarpment.

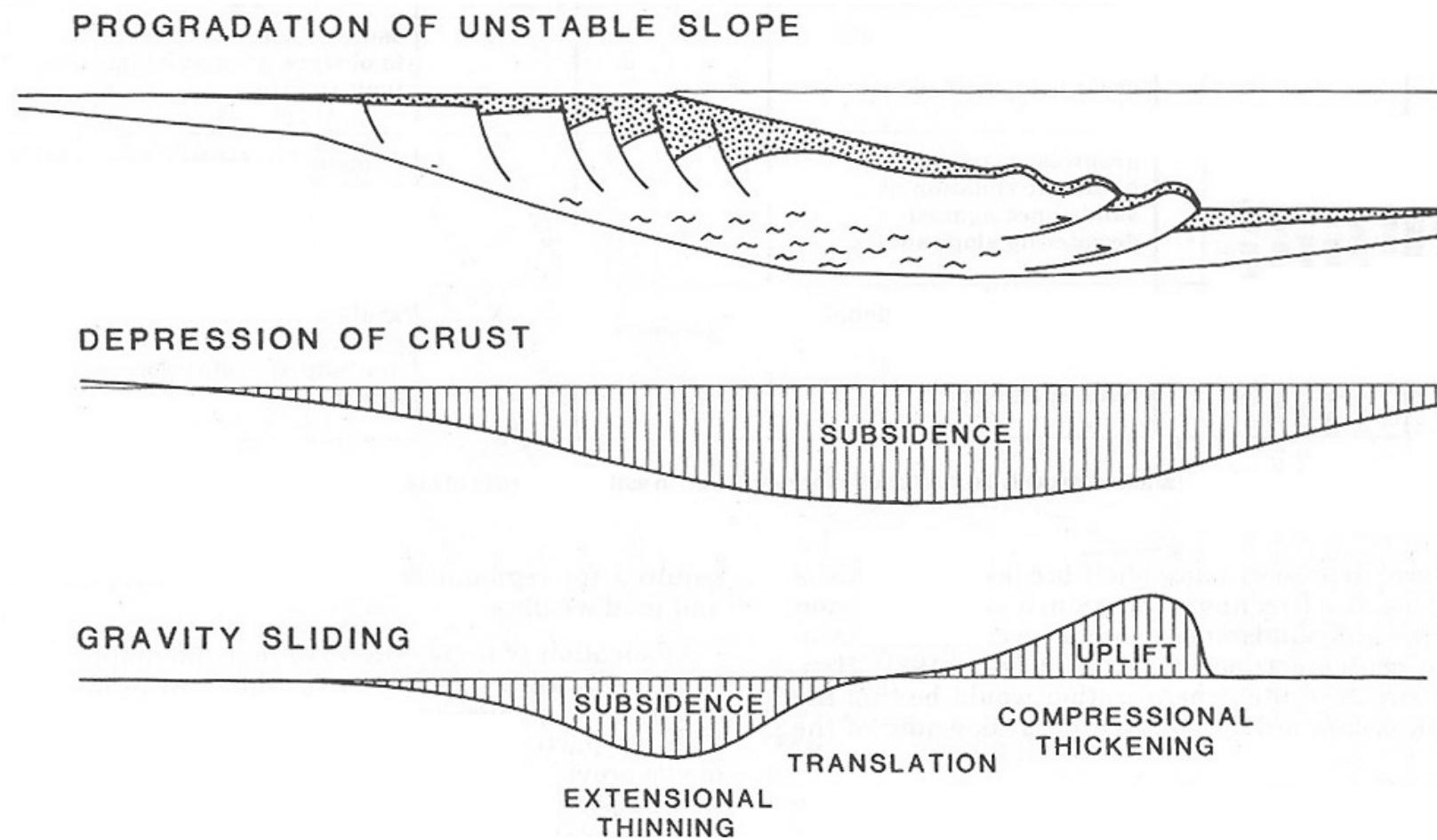


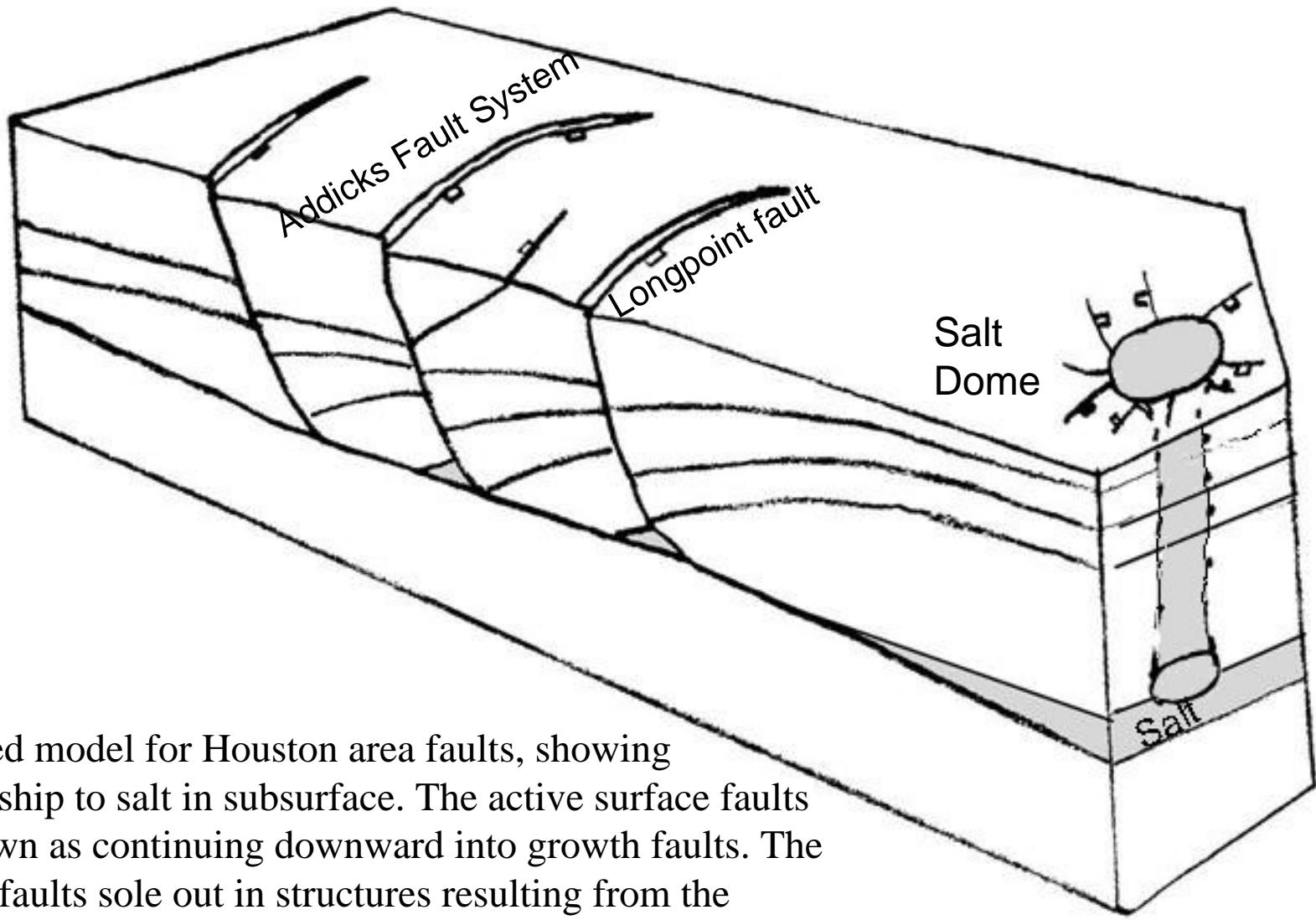
Cenozoic shelf margins (adapted from Winker, 1982). Note progradation of shelf margins throughout Cenozoic. Most active growth faulting occurs at shelf margin. Significant subsidence due to loading of sediments. Late Cretaceous – Woodbine, Tuscaloosa; Paleocene – Midway, Lower Wilcox; Eocene – Upper Wilcox, Claiborne, Jackson; Oligocene- Vicksburg, Frio, Anahuac (yellow) – Houston on shelf margin; Miocene; Plio-Pleistocene (green). Paleogene predominantly in South Texas; Neogene in East Texas and Louisiana.



Deposition and salt migration (from Lowrie et al., 1996). Salt deposited during period of extension which preceded sea-floor spreading in Middle Jurassic. The weight of the sediments has displaced the salt. Note that bulk of salt now to the South. Also note growth faults. The faults typically dip into the basin. We see the general basinward progression of deposition. Tectonic subsidence amplified by sediment loading. Is Basement high the northern half of the split mantle plume noted in Bird et al., 2005?

General Dynamical Model

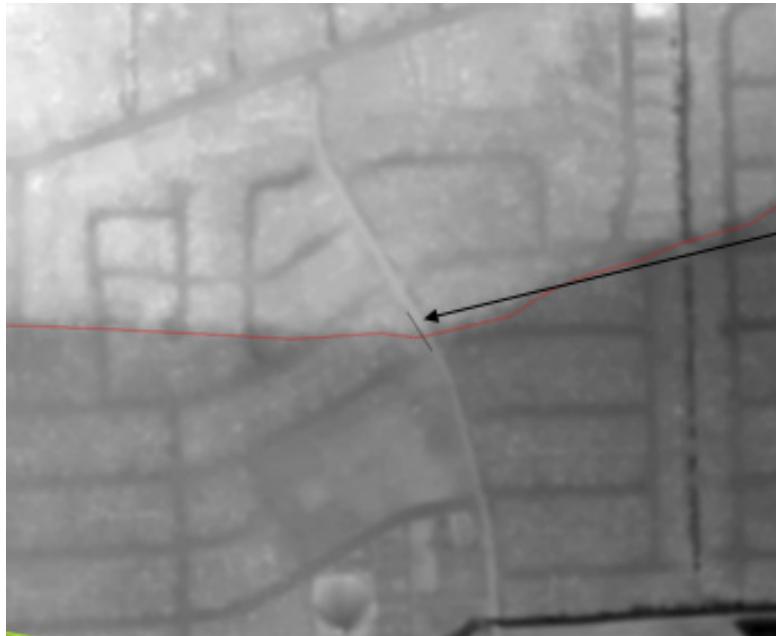




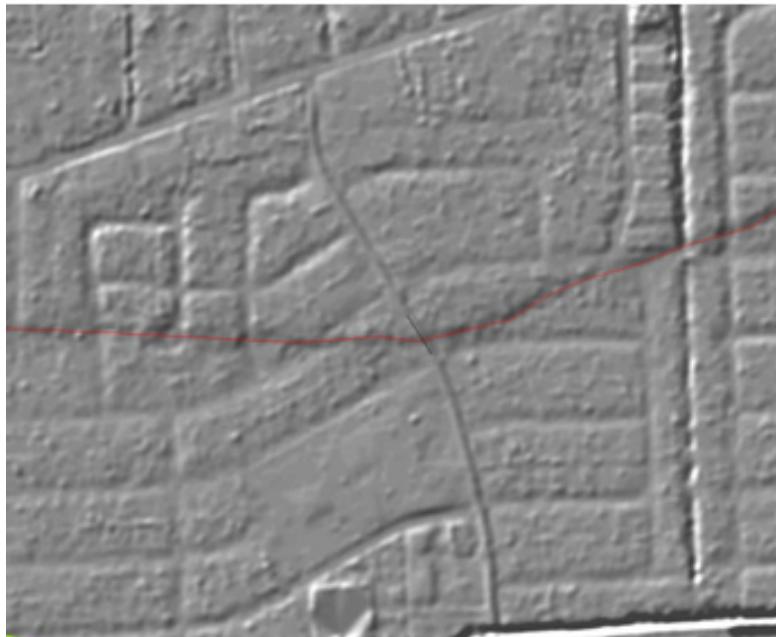
Proposed model for Houston area faults, showing relationship to salt in subsurface. The active surface faults are shown as continuing downward into growth faults. The growth faults sole out in structures resulting from the withdrawal of salt. Some of the salt rises in salt domes downdip of the faults.

LIDAR Fault Interpretation

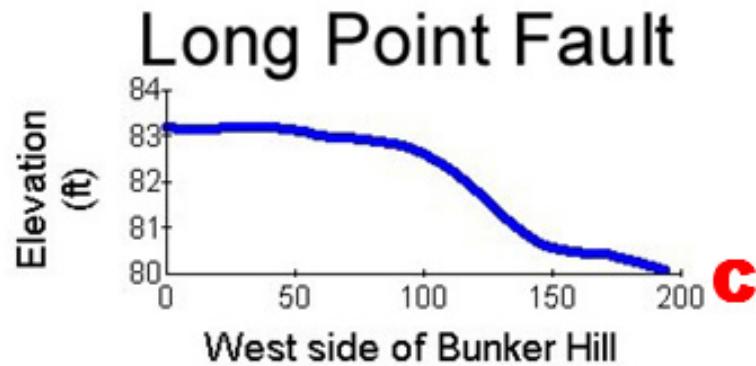
- Fault Mapping
 - Hillshading shows elevation contrast
- DEM refinement
 - Raw Data (30 M points/quarter quadrangle)
 - Use coarse DEM for weighted grid interpolation
 - Ground cover may provide additional controls
- Field Confirmation



A



B



Long Point Fault at Bunker Hill. (a) LIDAR; (b) LIDAR hillshade; (c) profile along Bunker Hill; arrow shows location on DEM; (d) photo looking up-dip along profile in c. Note tilted sidewalk slabs along scarp face.

LIDAR:

15 foot grid cells

Slope map. Slope is maximum spatial rate of change of surface
Aspect maps show the direction of slope.

Better spatial resolution will result in enhanced slopes since less averaging.

E-W streets (from south) : IH 10, Westview, Longpoint

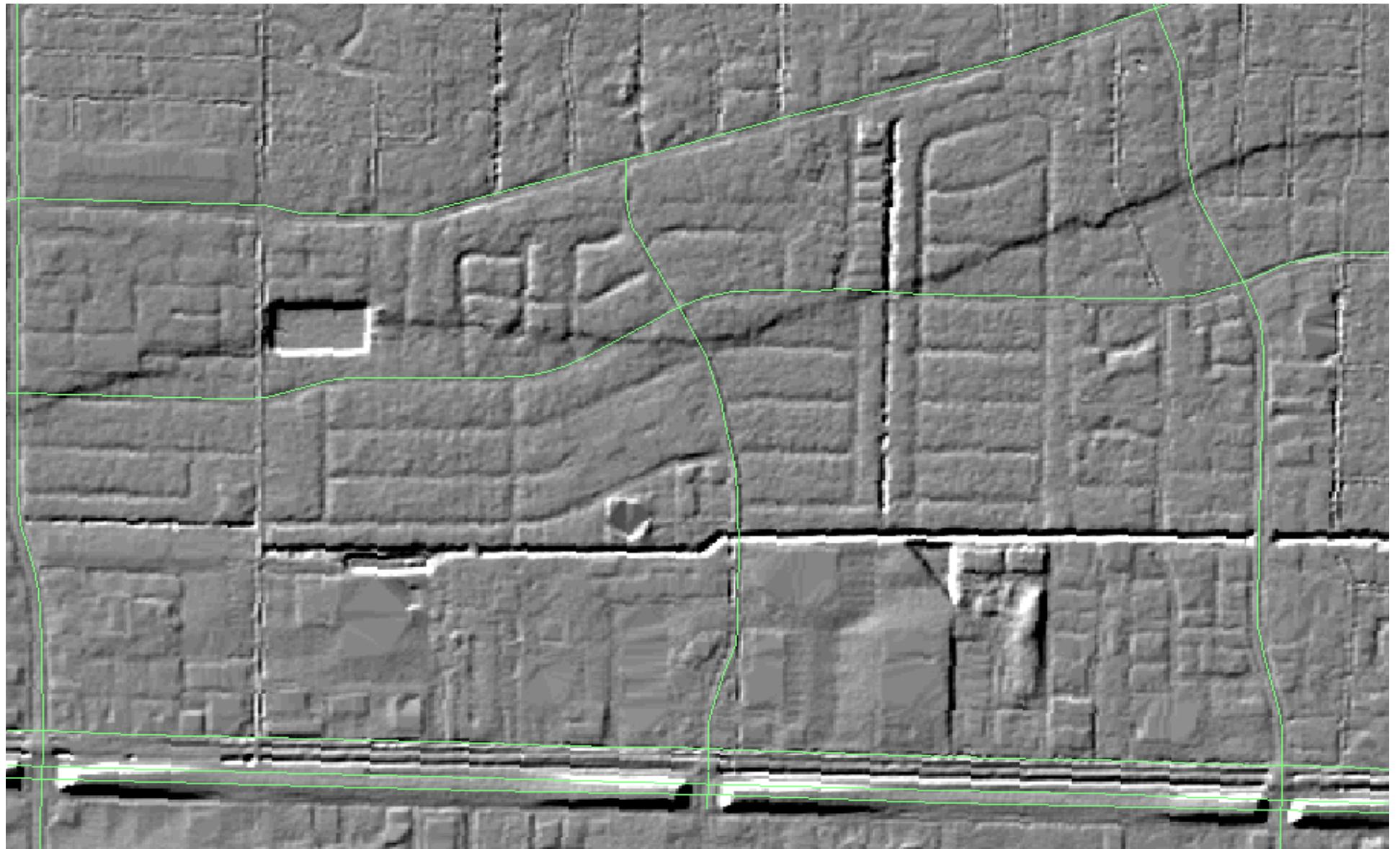
NS streets (from W): Gessner, Bunker Hill, Blalock.

Orthophoto:

1 foot grid cells.

Have zoomed in and can ‘see’ trees (January 2002 orthophoto)

LIDAR shows Longpoint Fault



Fault not Visible on Orthophoto

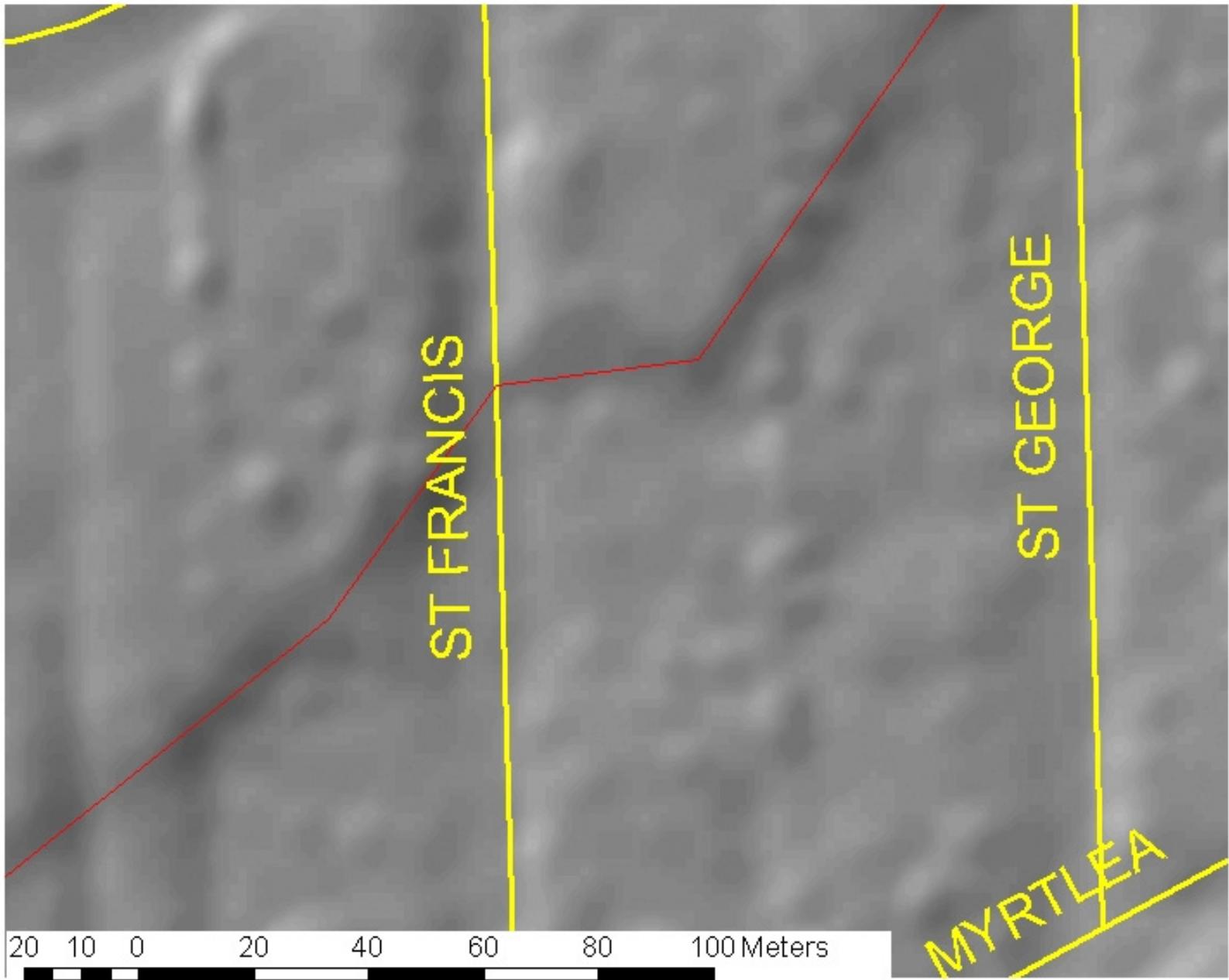


This house on Morehead has had several foundation repair jobs over the years.



Witte. West side of pit (behind fence). Looking South





St Francis kink. Hillshade image showing Long Point fault where it crosses St. Francis Street. East-west segment of trace on east side of St. Francis runs along property line between 2 houses. The kink in the trace thus appears to be man-made. With ongoing fault movement the house on the south side of the scarp is at risk.

Looking E. Ramp on property line explains kink

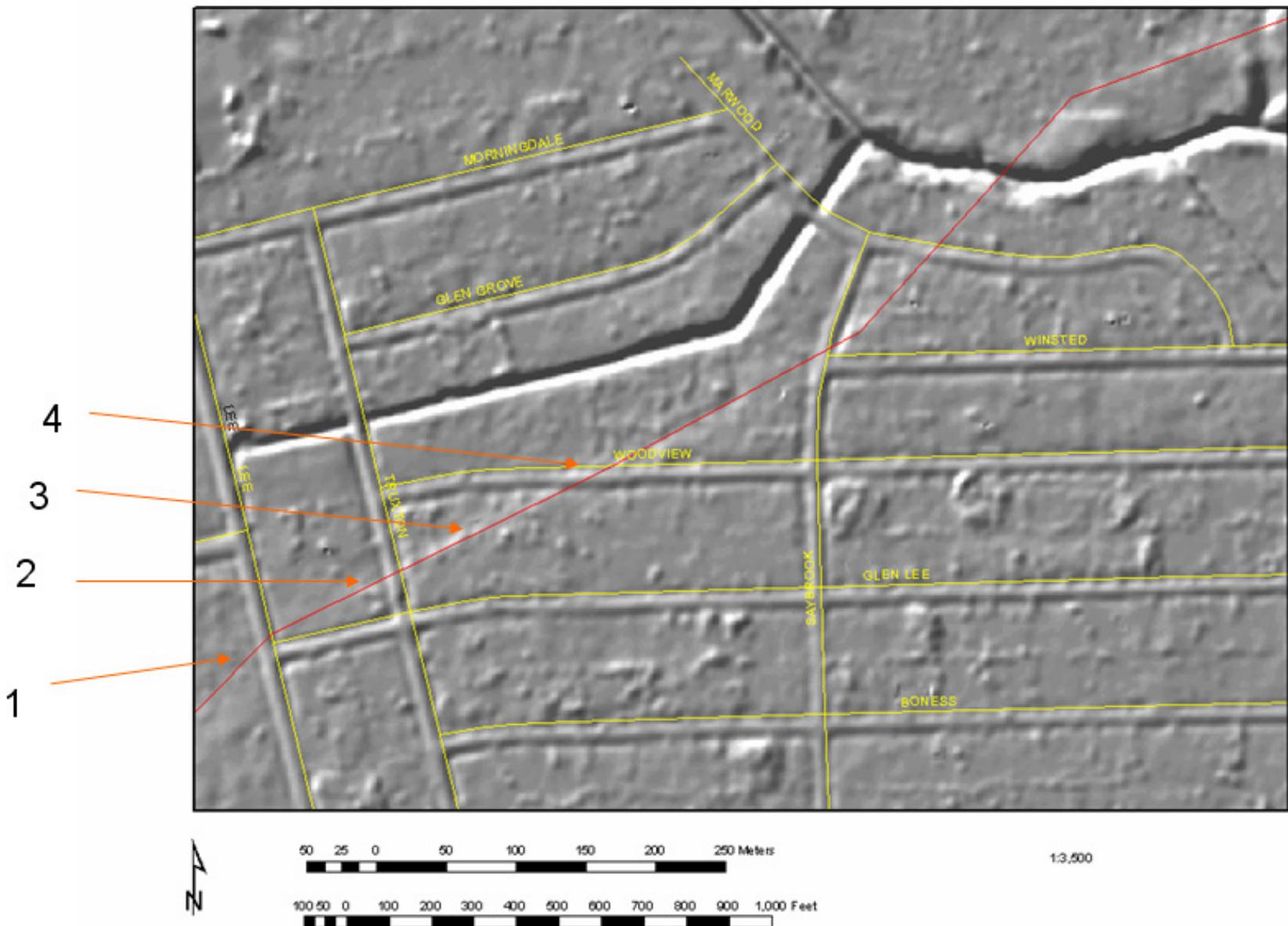




Long Point fault splits. LIDAR hillshade image of Long Point fault where it crosses Long Point. Here the scarp splits into several branches.

1) Looking N along Huge Oaks towards primary scarp.





Lee Road fault. This fault is an antithetic fault (up-to-the-coast) southeast of Bush Intercontinental Airport. It is presently active, and residents report ongoing foundation problems. There may be an active segment of the master fault running through the airport.

Looking E across scarp on Truxton





Gathering GPR data with my thesis advisor, Dr. Shuhab Khan. We used high frequency GPR (400 MHz) but were unable to find clear evidence for faulting in the subsurface. My wife and/or son accompanied me on most of my field visits.

Future Research

- InSAR
 - Attempt to measure fault displacements.
 - See whether salt domes are actively rising
- GPR, seismic
 - Try and image faults in near-surface
 - Test potential fault picks