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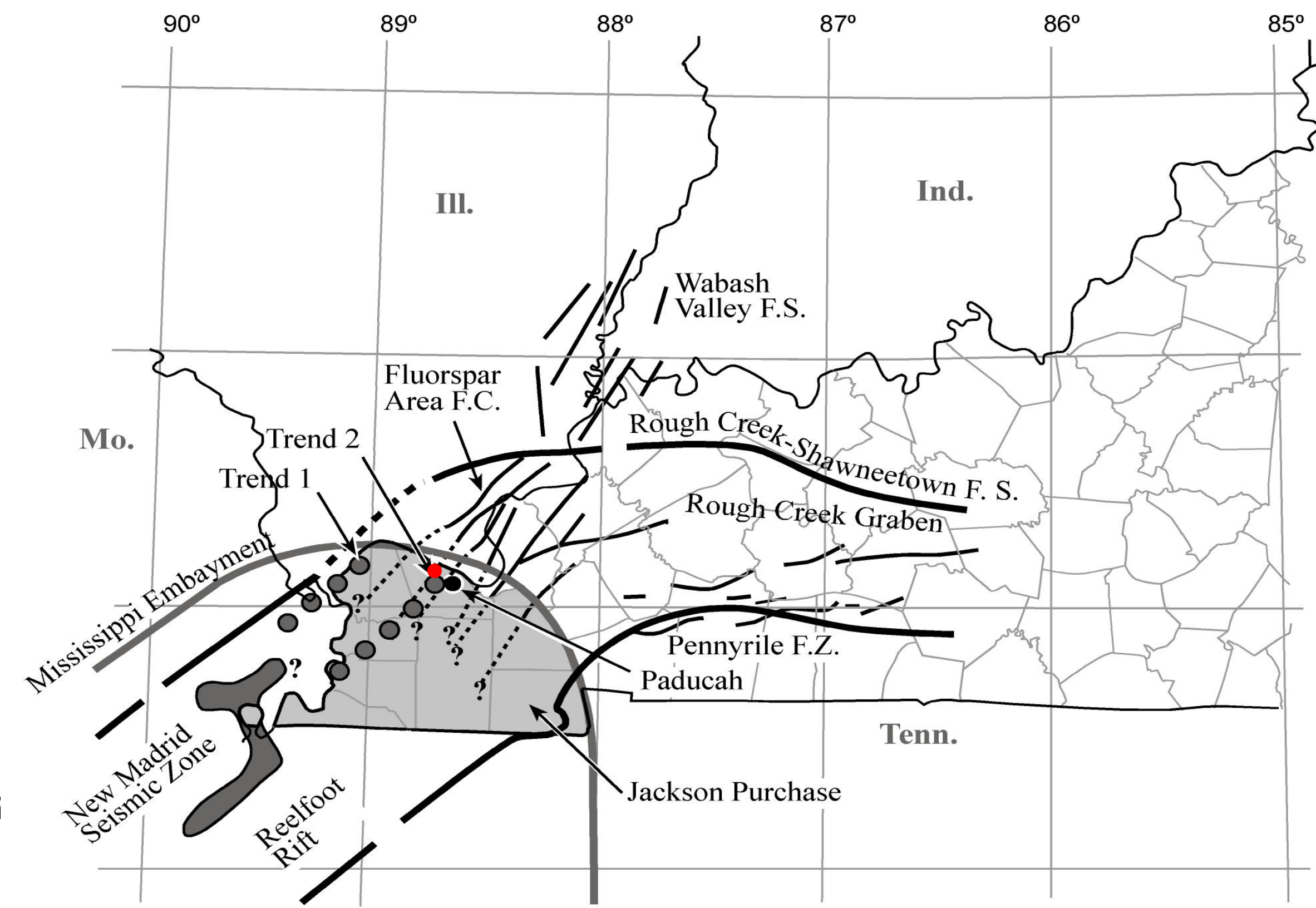
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Regional Geology and Seismicity

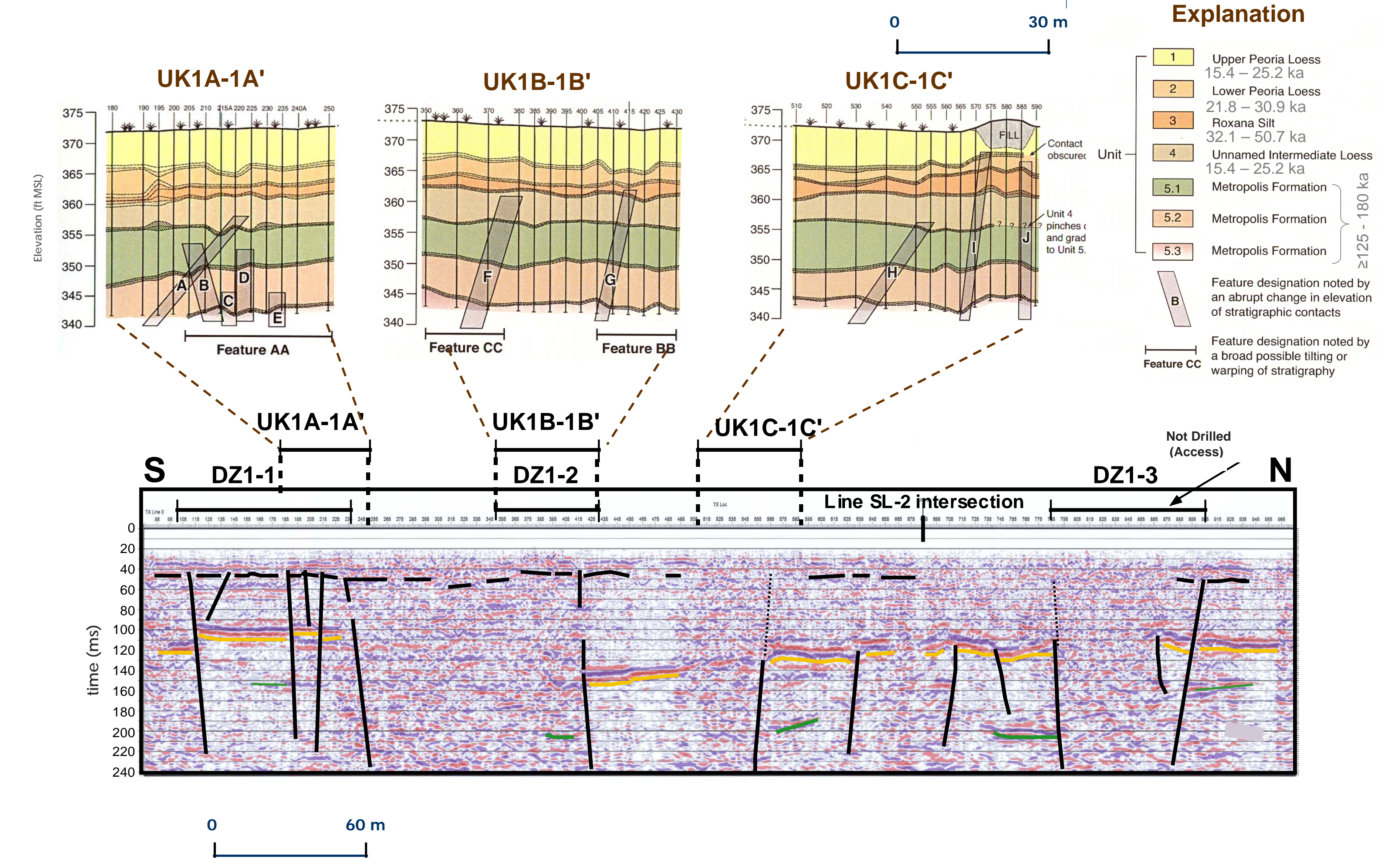


Major structural features in the central Mississippi Valley (modified from Kolata and Nelson, 1997, and Woolery and Street, 2002). The lines of shaded circles represent the locations of Wheeler's (1997) trends 1 and 2 seismicity in relation to the New Madrid seismic zone and the study site (red circle). The Jackson Purchase Region of western Kentucky is also identified in the light shaded area.

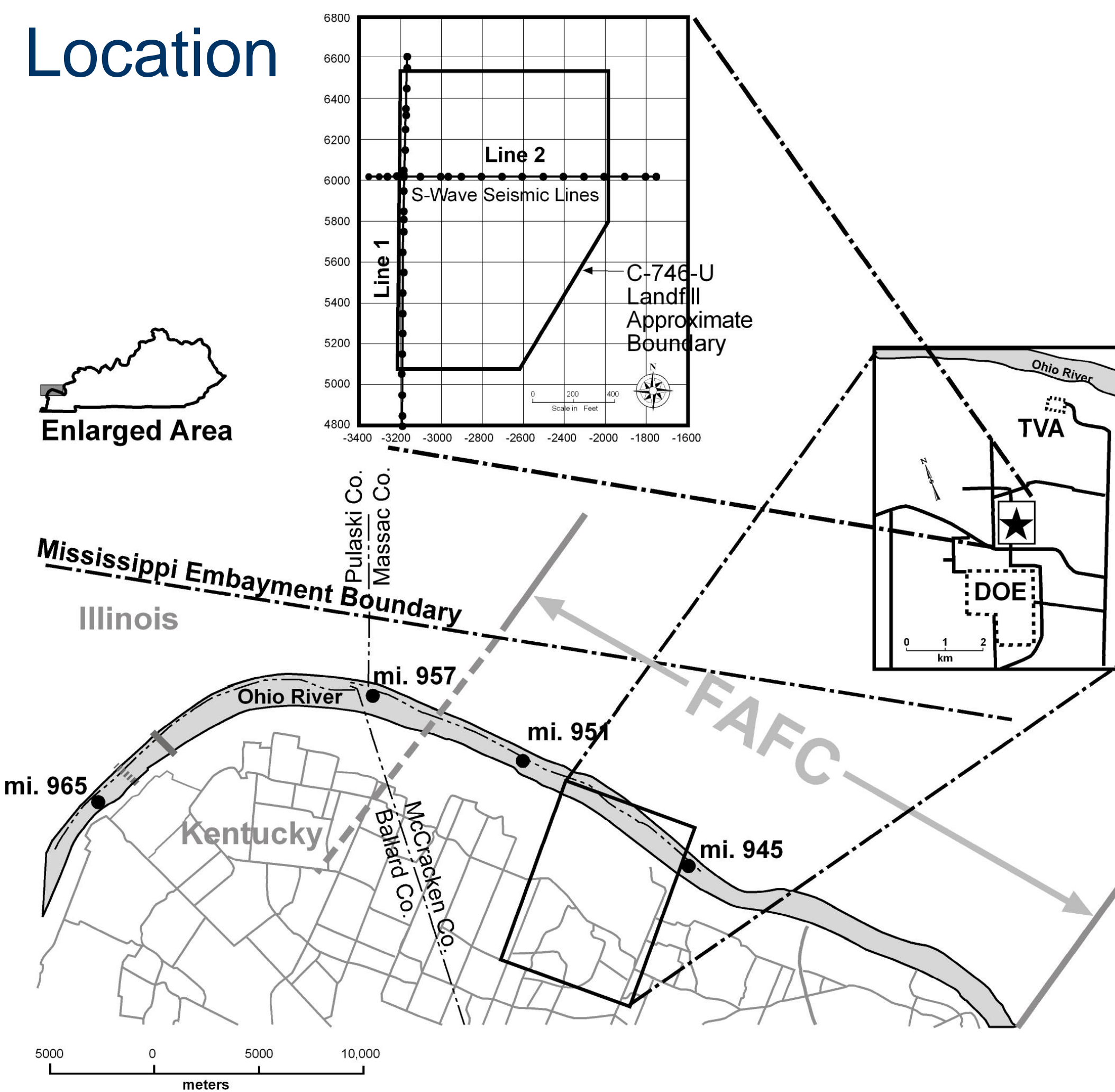
GEOPHYSICAL IMAGE: Three primary deformation zones, DZ1-1, DZ1-2 and DZ1-3, are interpreted along SL-1. The approximately 79-m wide DZ1-1 lies along the southern part of the line and is characterized by a series of steep, north- and south-dipping faults that exhibit both normal and reverse displacement. The northern margin of the zone exhibits an abrupt and nearly total loss of signal coherency. Interpreted displacement on faults within DZ1-1 ranges between 7.6 m at the top of the Mounds Gravel and 0.9 m across reflectors within the Metropolis Formation (unit 5). DZ1-2 is a narrower, 49-m-wide deformation zone defined by a steep north-dipping fault that extends upsection into unit 5. Immediately south of the fault is the northern extent of the previously identified incoherent signal. This segment does not exhibit any identifiable, laterally continuous reflectors, and may be indicative of a broad "rubble" zone bound by the two faults. The existing data are not extensive enough to corroborate this interpretation, however. DZ1-3 is a 36-m-wide anomaly located at the northern end of line SL-1, and is characterized by a sudden loss of signal coherency. The incoherent zone is bound by faults with apparent down-to-the-south vertical displacement (e.g., the top of the Mounds Gravel exhibits ~3 meters of displacement). The data quality above this reflection is insufficient to extend the southern boundary fault any higher into the section; however, the northern fault appears to extend into the earliest resolvable reflectors (i.e., unit 5). South of DZ1-3, the Mounds Gravel reflector has a distinct apparent south dip before being truncated by a fault at station 735. The latter fault, as well as interpreted normal faults at stations 715, 640, and 560 does not appear to extend above the Mounds Gravel, however. DZ1-3 was not included in the follow-up geologic investigation because drill rig inaccessibility.

DRILLING CROSS SECTION: Cross section UK-1A-1A' is oriented along the southern end of SL-1 and intersects a narrow zone of steeply dipping normal faults interpreted as DZ1-1. One broad warp (designated AA) and five possible distinct changes in the elevations of some stratigraphic contacts (designated A to E) are inferred in the cross section. UK-1B-1B' lies along the central part of SL-1, coincident with a broad zone of moderately disturbed reflectors DZ1-2. In section UK-1B-1B', two subtle warps (designated BB and CC) and two anomalous features associated with possible vertical elevation changes (designated F and G) across stratigraphic boundaries are interpreted. Cross section UK-1C-1C' does not cross any primary deformation zone interpreted from the seismic survey, but intersects a single, steep, south-dipping fault (Fig. 6). UK-1C-1C' exhibited no large, broad deformation structure; however, three discrete anomalous features (designated H to J) associated with elevation changes across stratigraphic boundaries are interpreted. Feature I is the only anomaly in which vertical separation across all overlying loess units can be interpreted; however, these displacements are considered suspect, because several of the inferred separations are based on anomalous contacts in the core. In addition, the upward projection across the loess boundaries are questionable, because the cores experienced adverse drilling and sampling conditions due to a moderately thick artificial fill that may have influenced the location of the stratigraphic boundaries. Consequently, the apparent vertical separation potentials across the loess boundaries are considered unlikely.

Line 1



Location



Regional location of the site study in relation to Fluorspar Area Fault Complex (FAFC) and the Paducah Gaseous Diffusion Plant (DOE).

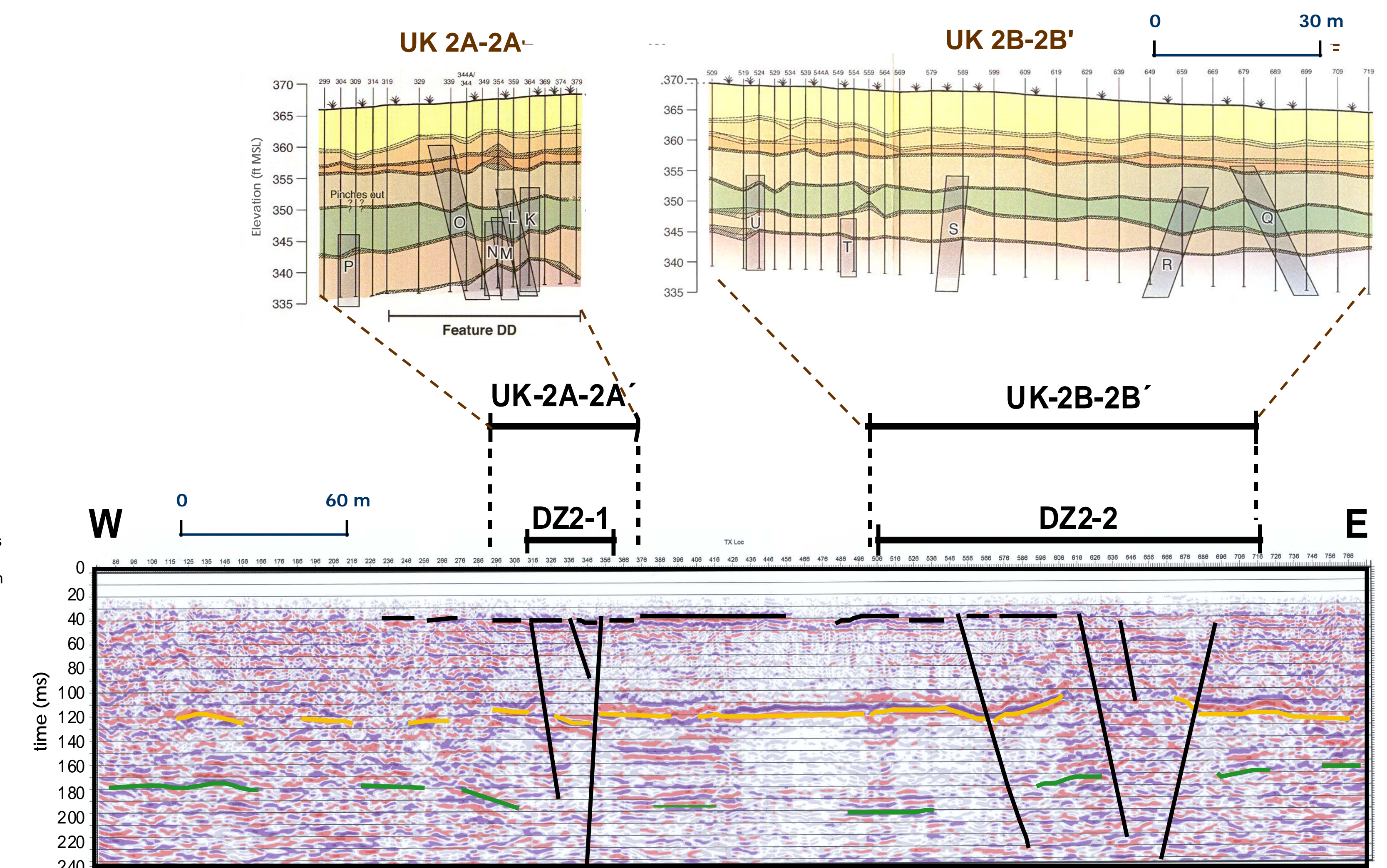
Stratigraphy

SYSTEM	SERIES	FORMATION
QUATERNARY	HOLOCENE & PLEISTOCENE	Alluvium
	PLEISTOCENE	Roxana Silt
	PLEISTOCENE	Metropolis
TERTIARY	PLIOCENE-MIOCENE (?)	Mounds Gravel
	EOCENE	Jackson, Claiborn, and Wilcox Formations
	PALEOCENE	Porters Creek Clay
		Clayton Formation
UPPER CRETACEOUS		McNairy Formation
MISSISSIPPIAN		Rubble Zone
		Limestone Bedrock

GEOPHYSICAL IMAGE: Two primary zones of deformation, DZ2-1 and DZ2-2, were interpreted along SL-2. The 27-m-wide DZ2-1, located in the central part of the profile between stations UK-2-315 and 360 exhibits three relatively high-angle faults that offset the coherent and continuous Mounds Gravel and unit 5 reflectors. The primary fault, located near station UK-2-360, has a southerly apparent dip and branches upsection into a half-flower structure accompanied by two apparent north-dipping faults that offset unit 5 horizons. The 128-m-wide DZ2-2, located in the eastern part of the profile between stations UK-2-509 and 719, is a prominent anomaly with at least four high-angle north- and south-dipping interpreted faults that exhibit both normal and reverse displacement. The top of the Mounds Gravel is displaced approximately 3.0 m, and unit 5 reflections exhibiting 0.6 m of vertical displacements. The southern and northern boundary faults show high-angle north and south apparent dips, respectively. The horizons between these two faults exhibit an upward relative displacement, although the section between the interior fault strands (i.e., between stations 615 and 645) appears downthrown. Overall, the pattern and style of deformation across DZ2-2 is indicative of a positive "flower" structure.

DRILLING CROSS SECTION: Geologic cross-section UK-2A-2A' overlaps a narrow zone of interpreted steeply dipping reverse faults and numerous discontinuities defined as DZ2-1. UK-2A-2A' exhibits an interpreted antiform (feature DD) and numerous distinct elevation changes (features K to P) across intra-Metropolis Formation boundaries. Cross-section UK-2B-2B' lies along the eastern end of seismic reflection line SL-2 coincident with the east and west-dipping faults defined as DZ2-2. Overall, UK-2B-2B' exhibits: (1) relatively flat-lying stratigraphy with no prominent broad structure-like features, and (2) five distinct elevation changes (features Q to U) that are limited primarily to unit 4 and older units, except for feature Q that extends into Roxana Silt.

Line 2



Abstract

Post-Paleozoic sediments overlying a southerly projection of the late Proterozoic-early Cambrian Fluorspar Area fault complex and coincident with an area of diffuse micro-seismicity were evaluated for Quaternary deformation. Nearly 1 km of seismic-reflection data were collected and interpreted for evidence of late Quaternary deformation. Five significant high-angle geophysical anomalies were interpreted to extend within approximately 7 m of the ground surface, near the upper limit of the seismic sampling. Eighty-six, closely spaced, 9.1-m-deep, continuous cores were subsequently collected above these anomalous features. Stratigraphic and chronological analyses were performed on the cores to determine the presence or absence of structure above the geophysical anomalies, and define the near-surface extent and age. Optical stimulated luminescence dates showed the sampled sediment age ranged between nearly 16 ka and greater than 125 ka. Interpretation of the resultant geologic cross sections indicates identified stratigraphic anomalies were generally constrained to postdate a 53.6 to 75.5 ka loess deposit; however, no perceptible displacement was found at the base of younger loess dated between 16.6 and 23.5 ka.