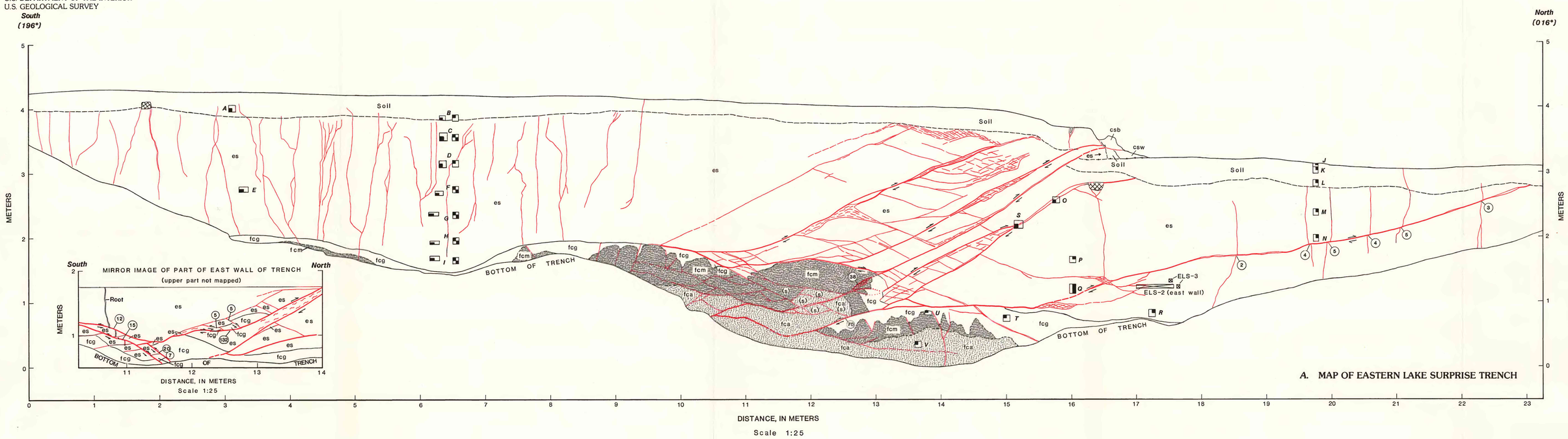
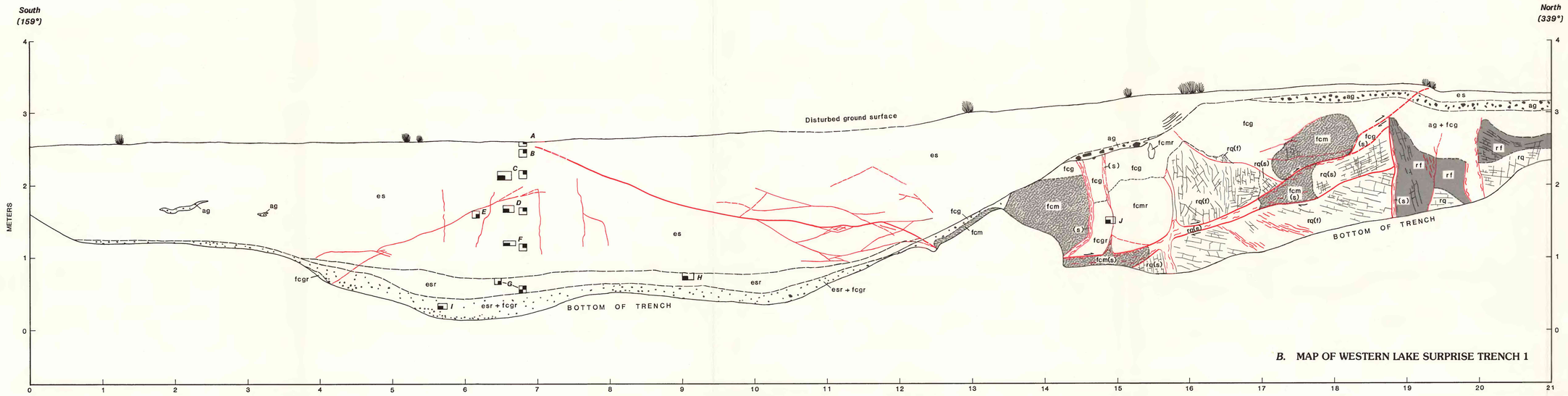
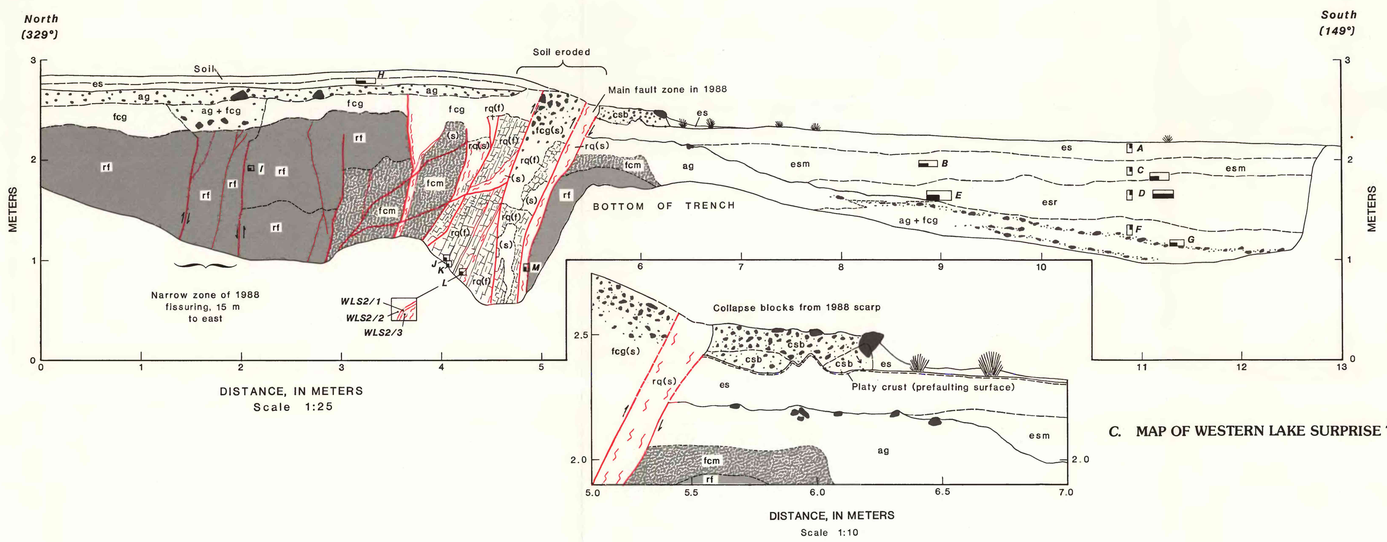


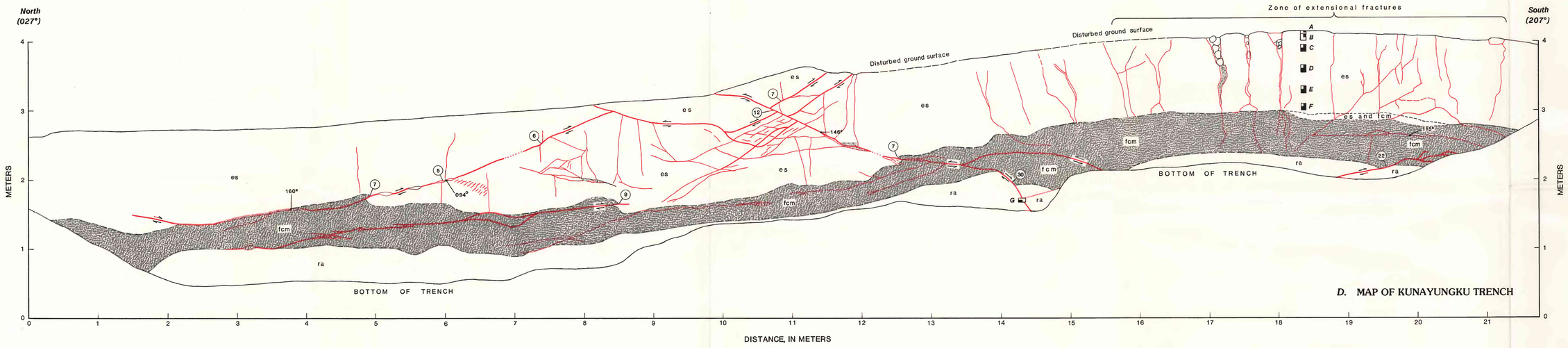
A. MAP OF EASTERN LAKE SURPRISE TRENCH



B. MAP OF WESTERN LAKE SURPRISE TRENCH 1



C. MAP OF WESTERN LAKE SURPRISE TRENCH 2



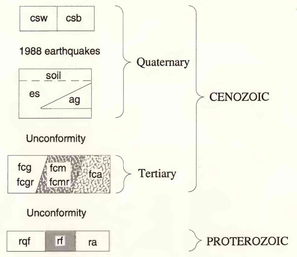
D. MAP OF KUNAYUNGKU TRENCH

MAPS OF TRENCHES ACROSS FAULT SCARPS, 1988 TENNANT CREEK EARTHQUAKES, NORTHERN TERRITORY, AUSTRALIA

By
A.J. Crone, M.N. Machette, and J.R. Bowman

1992

CORRELATION OF MAP UNITS



DESCRIPTION OF UNITS

[Not all units are exposed in any single trench, and significant deviations from the generalized explanation are present in individual trenches. A more complete description of units is in the section on "Description of Units Exposed in the Trenches" in the text]

Surficial deposits (Present to middle? Pleistocene)—Includes eolian sand, locally derived fluvial deposits, and admixtures of these deposits with underlying residual deposits. Absolute age of deposits unknown, although relative stratigraphic position suggests general age relations

Postearthquake deposits (1988–1990)—Includes localized accumulations of colluvium deposited as a result of or after the 1988 Tennant Creek area earthquakes. In western Lake Surprise trench 2, also includes localized accumulation of eolian sand (unit **es**, below) that has been remobilized

csw — **Slope-wash colluvium**—Primarily debris shed from collapse and erosion of fault scarp created during the 1988 earthquakes (recognized only in eastern Lake Surprise trench)

csb — **Slump block (colluvial)**—Coherent block(s) of material slumped from formerly oversteepened scarp. In eastern Lake Surprise trench, colluvium resembles eolian sand (unit **es**) from which it was derived. In western Lake Surprise trench 2, colluvium consists of overturned blocks of soil and coarse angular debris derived from fault scarp

Pre-earthquake deposits—Includes ubiquitous mantle of iron-rich eolian sand and locally derived fluvial deposits

es — **Eolian sand (Holocene to middle? Pleistocene)**—Loose to firmly cemented, well-sorted medium-grain eolian sand. Grains primarily quartz with iron oxide coatings and cement. Typically has soil in upper part. **r** indicates reduced iron as evidenced by light, drab colors; **m** indicates incipient cementation by iron oxide

ag — **Angular gravel (Holocene? to latest? Pleistocene)**—Poorly sorted angular gravel with sandy matrix. Deposits include possible debris flows, colluvial stone lines, and fluvial gravels. Interbedded with medial to upper part of unit **es**

Ferricrete and associated materials (Cenozoic?)—Ferricrete, an iron- (Fe-) rich accumulation over bedrock and beneath eolian sand. Four facies mapped, the uppermost being unit **fcg**. Genesis of ferricrete unknown, but groundwater origin is suspected owing to sandy matrix and development of incipient iron-rich accumulations (protonodules) in overlying eolian sand. **(s)** indicates extensive shearing

fcg — **Ferricrete gravel**—Large granule- (3–4-mm) to small pebble- (4–16-mm) size nodules and concretions of reddish-brown iron and black manganese oxides. Clasts compose about 75 percent of layer, the rest consists of iron-stained, quartz-rich sand

fcgr — **Ferricrete gravel, reduced phase**—Small pebble- (4–16-mm) size nodules and concretions of reddish-brown iron and black manganese oxides. Clasts compose about 75 percent of layer, the rest consists of iron-stained, quartz-rich sand. Reduced iron is shown by whitened surface, whereas interior parts of nodules have typical iron-rich colors

fcm — **Ferricrete**—Loosely to densely cemented agglomeration of gravel-size nodules and concretions (see unit **fcg**)

fcmr — **Ferricrete, reduced phase**—Loosely to densely cemented agglomeration of gravel-size nodules and concretions. Reduced iron is shown by whitened surface, whereas interior parts of nodules have typical iron-rich colors

fca — **Ferricrete, altered**—Loosely cemented to partly disaggregated ferricrete that appears to have been altered. Colors tend to be greenish rather than reddish, indicating possible reduced conditions

Bedrock (Proterozoic)—Includes a variety of bedrock units, most of which are not exposed naturally in the area. Extensive alteration prevents positive identification, although regional mapping and analysis of water-well data was used to make tentative correlations. Symbols in parentheses modify unit name: **(s)**, sheared rock; **(f)**, extensively fractured rock

rq — **Quartzite**—Coarse-grained, with pervasive internal oxidation; largely unfractured and unjointed owing to distance from main faults in trenches. Hematitic and massive in places. Found only in the western Lake Surprise trenches

rf — **Iron-rich bedrock**—Highly altered iron-rich bedrock found only in western Lake Surprise trenches. Composed of quartzite in western Lake Surprise trench 1. In western Lake Surprise trench 2, forms large angular blocks of unknown original lithology that are altered to soft, porous hematite and iron oxides with minor amounts of quartz

ra — **Altered rock**—Claystone, massive but jointed. Contains minor quartz sand and sparse rounded carbonate nodules. Found only in Kunayungku trench

Fault—Primary planes along which movement occurred during 1988 earthquakes. Dashed where significance of displacement is questionable, dotted where concealed or projected. Circled number indicates amount of apparent dip-slip displacement (in centimeters) across extensional fractures or on faults, determined by realigning originally continuous stratigraphic datums. Dot showing value in degrees indicates strike of fault at that location (map *D*).

Other faults and fractures—Other faults are primarily low-angle reverse faults having minor displacement in 1988 or unknown displacement prior to 1988. Vertical to near-vertical features are primarily extensional fractures and cracks. Dashed where poorly located, dotted where projected. Dot showing value in degrees indicates strike of fault at that location (map *D*). Sheared zones are shown by **(s)** and are composed of eolian sand, ferricrete, or sheared rock whose original lithology is uncertain

Collapsed fault plane—Stratigraphic contact formed by collapse of fault plane onto pre-1988 land surface

Contacts

Abrupt—Clearly defined changes in texture or mineralogy, generally across boundaries less than 1 cm wide

Gradual—Well-defined changes in texture or mineralogy, generally across boundaries 1–5 cm wide

Diffuse or transitional—Poorly defined changes in texture or mineralogy, generally across boundaries 5–10 cm wide

Soil — **Soil**—Weakly developed (azonal to immature zonal) soils on eolian sand (unit **es**). Dashed contact depicts base of friable, organic-enriched part of soil profile. Contacts between individual horizons not shown; clay-enriched horizons extend to considerable depth (see section on "Description of Units Exposed in the Trenches"). Horizon boundaries are typically gradual, whereas base of soil profile is typically diffuse

Orientation of rotated blocks—Arrow indicates former top of blocks that have either slumped or collapsed from scarp. Recognized in western Lake Surprise trench 2 and Eastern Lake Surprise trench

Sediment-filled fractures—Open fractures formed by disturbance during 1988 earthquakes that now are filled by sediment. Typically have horizontal bedding, indicating sedimentation under water-filled conditions

Crotovina—Infilled animal burrow (recognized only in eastern Lake Surprise trench)

Prominent gravel-size clasts—Location, size, and generalized shape of prominent cobble- to boulder-size clasts. Clasts commonly control location of upward-propagating fractures and faults, or indicate position of significant erosional or depositional unconformities

J, WLS2/1 — **Sample locality**—Samples were collected for several purposes, and multiple samples were collected from many localities. The size of the box indicates area sampled. Filled quadrant of box corresponds to type of analysis. Field sample numbers given in table 8; capital letters on pl. 2 correspond to reference symbol in table 8

Grain-size analysis—Data given in tables 4-7

Thermoluminescence analysis—Samples extracted from 10-cm-diameter, 50- to 80-cm-deep horizontal bore hole in trench wall. Age estimates are shown in table 9

Electron-spin resonance analysis—Samples extracted from same bore hole in trench wall as thermoluminescence samples or from separate rectangular holes. Preliminary age estimates for some samples are shown in table 9

Uranium isotope analysis—Sample for analysis of uranium isotopes (U-series and U-trend) by D. R. Muhs, U.S. Geological Survey, Denver, Colo., USA

ELS-3 — **Radiocarbon sample locality and number**—Eastern Lake Surprise trench only. Disseminated organic matter (decomposed plant roots) found at similar stratigraphic levels on both sides of trench. Sample ELS-2 (weighing 22 mg) was submitted for radiocarbon analysis by accelerator mass spectrometry technique