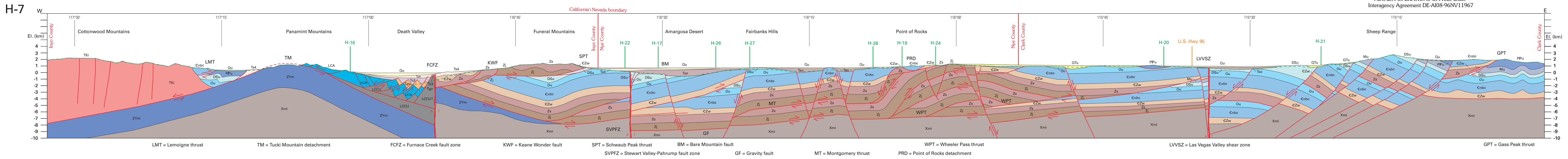
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

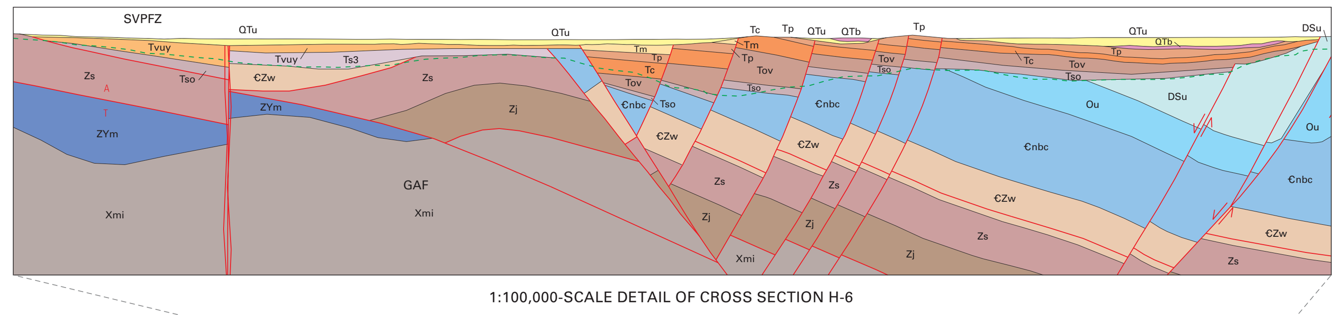
Prepared in cooperation with
OFFICE OF ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT,
U.S. DEPARTMENT OF ENERGY
NATIONAL NUCLEAR SECURITY ADMINISTRATION
NEVADA OPERATIONS OFFICE, under
Interagency Agreement DE-AI08-96NV11967

MISCELLANEOUS FIELD STUDIES MAP MF–2370
SHEET 3 OF 3
Version 1.0
Pamphlet accompanies map

H-7

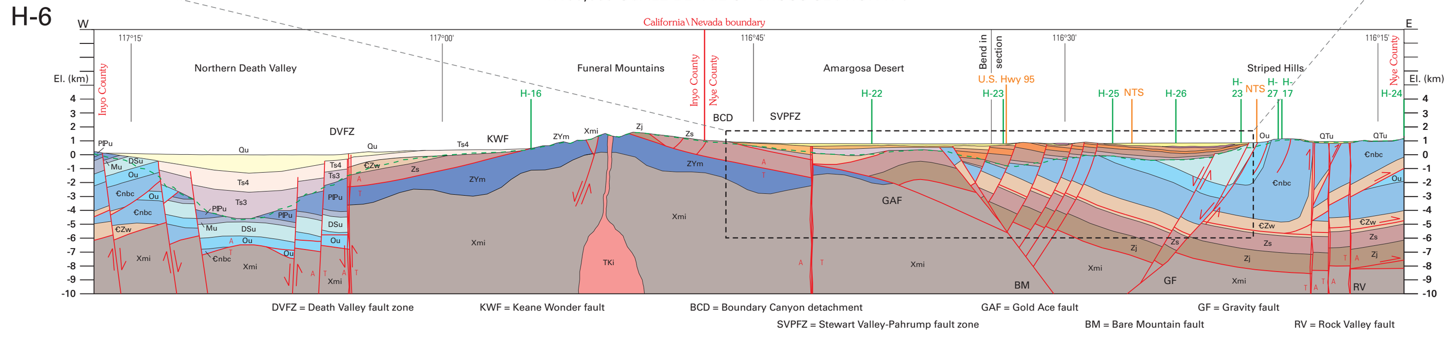


LMT = Lemoigne thrust; TM = Tucki Mountain detachment; FCFZ = Furnace Creek fault zone; KWF = Keane Wonder fault; SPT = Schwaub Peak thrust; SVPFZ = Stewart Valley-Pahrump fault zone; BM = Bare Mountain fault; GF = Gravity fault; MT = Montgomery thrust; WPT = Wheeler Pass thrust; PRD = Point of Rocks detachment; LVVSZ = Las Vegas Valley shear zone; GPT = Gass Peak thrust



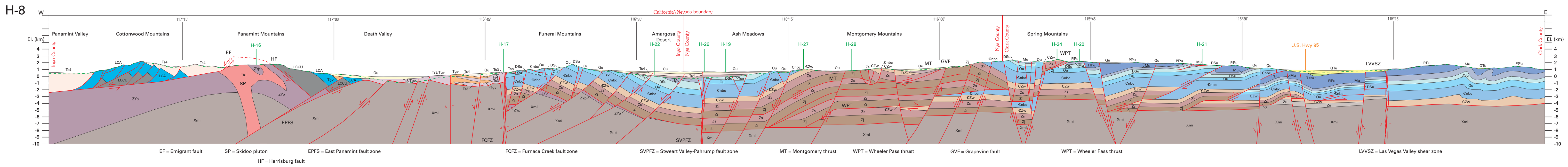
1:100,000-SCALE DETAIL OF CROSS SECTION H-6

H-6



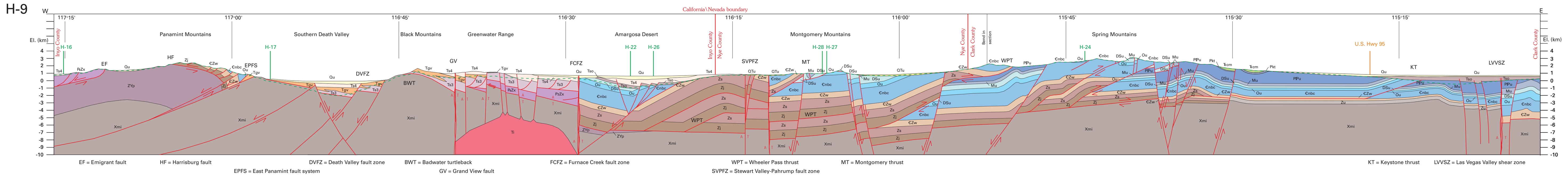
DVFZ = Death Valley fault zone; KWF = Keane Wonder fault; BCD = Boundary Canyon detachment; SVPFZ = Stewart Valley-Pahrump fault zone; GAF = Gold Ace fault; BM = Bare Mountain fault; GF = Gravity fault; RV = Rock Valley fault

H-8

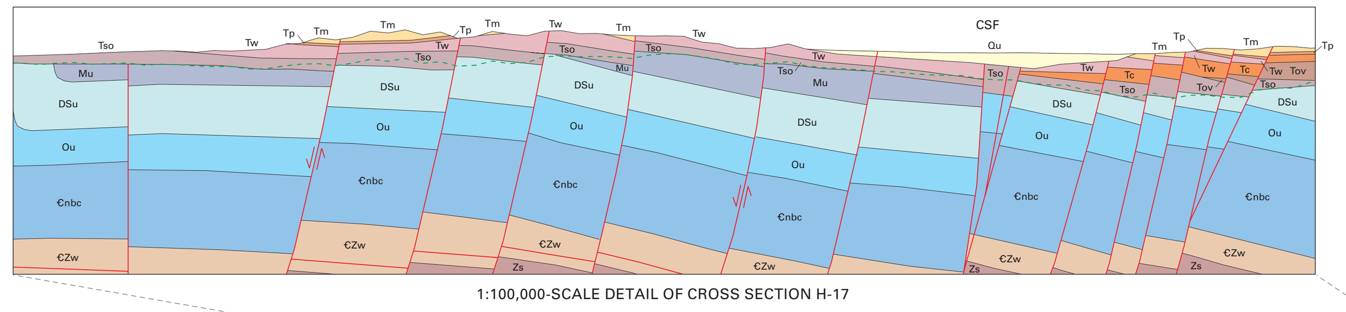


EF = Emigrant fault; SP = Skidoo pluton; HF = Harrisburg fault; EPFS = East Panamint fault zone; FCFZ = Furnace Creek fault zone; SVPFZ = Stewart Valley-Pahrump fault zone; MT = Montgomery thrust; WPT = Wheeler Pass thrust; GVF = Grapevine fault; LVVSZ = Las Vegas Valley shear zone

H-9

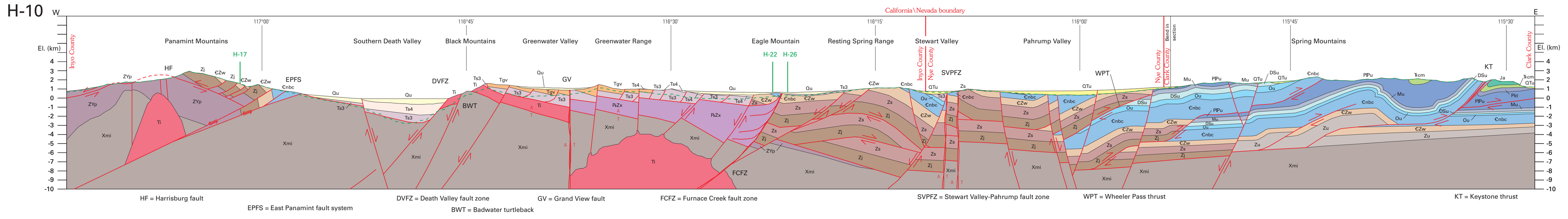


EF = Emigrant fault; HF = Harrisburg fault; EPFS = East Panamint fault system; DVFZ = Death Valley fault zone; BWT = Badwater turtleback; GV = Grand View fault; FCFZ = Furnace Creek fault zone; SVPFZ = Stewart Valley-Pahrump fault zone; WPT = Wheeler Pass thrust; MT = Montgomery thrust; KT = Keystone thrust; LVVSZ = Las Vegas Valley shear zone



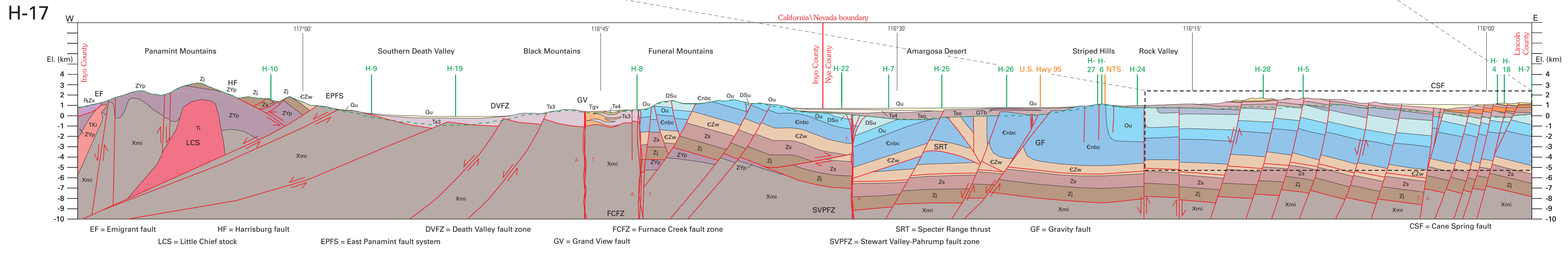
1:100,000-SCALE DETAIL OF CROSS SECTION H-17

H-10



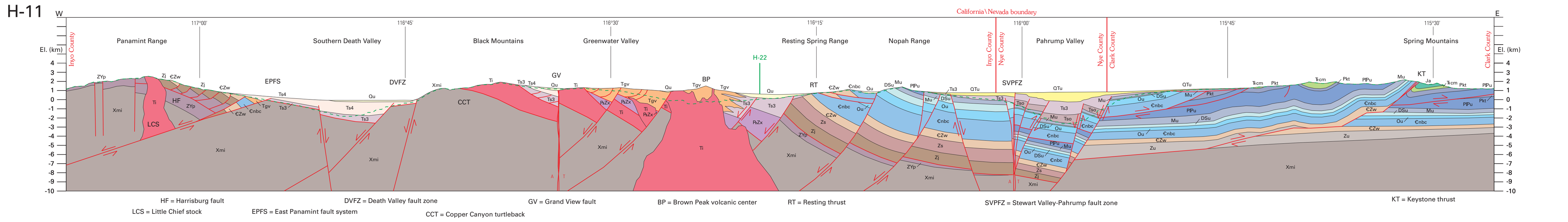
HF = Harrisburg fault; EPFS = East Panamint fault system; DVFZ = Death Valley fault zone; BWT = Badwater turtleback; GV = Grand View fault; FCFZ = Furnace Creek fault zone; SVPFZ = Stewart Valley-Pahrump fault zone; WPT = Wheeler Pass thrust; KT = Keystone thrust

H-17



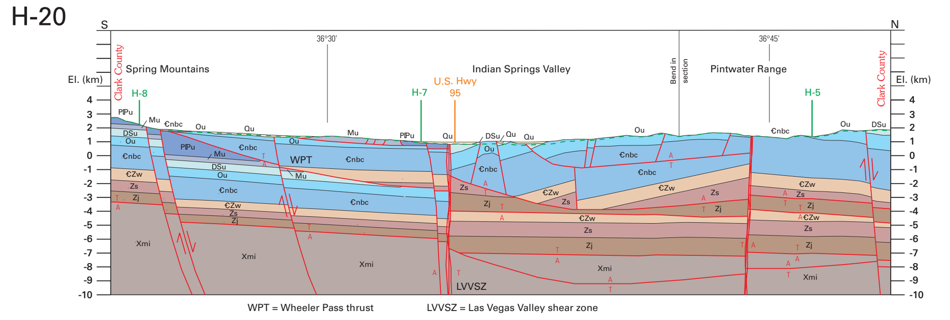
EF = Emigrant fault; LCS = Little Chief stock; HF = Harrisburg fault; EPFS = East Panamint fault system; DVFZ = Death Valley fault zone; GV = Grand View fault; FCFZ = Furnace Creek fault zone; SPRT = Specter Range thrust; SVPFZ = Stewart Valley-Pahrump fault zone; GF = Gravity fault; CSF = Cane Spring fault

H-11



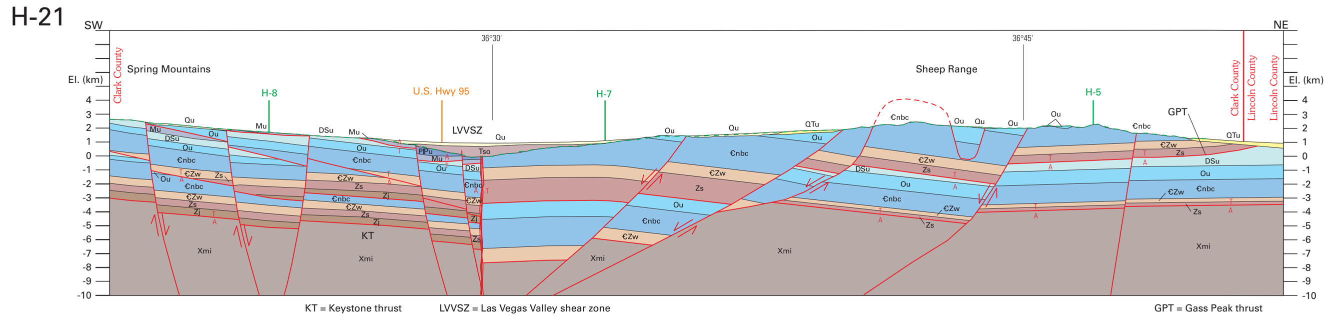
HF = Harrisburg fault; LCS = Little Chief stock; EPFS = East Panamint fault system; DVFZ = Death Valley fault zone; CCT = Copper Canyon turtleback; GV = Grand View fault; BP = Brown Peak volcanic center; RT = Resting thrust; SVPFZ = Stewart Valley-Pahrump fault zone; KT = Keystone thrust

H-20



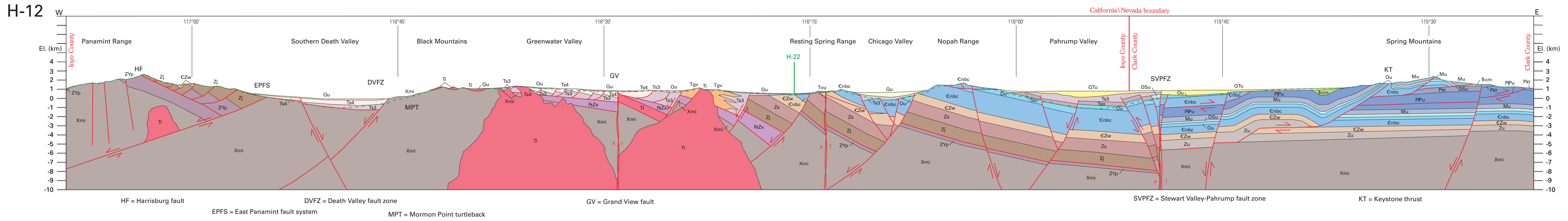
WPT = Wheeler Pass thrust; LVVSZ = Las Vegas Valley shear zone

H-21

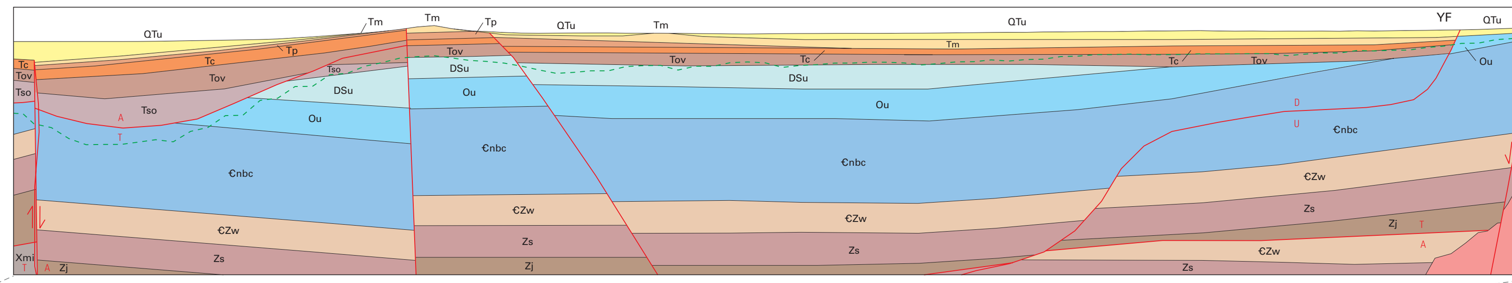


KT = Keystone thrust; LVVSZ = Las Vegas Valley shear zone; GPT = Gass Peak thrust

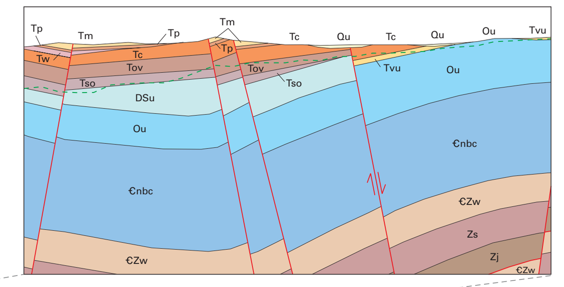
H-12



HF = Harrisburg fault; EPFS = East Panamint fault system; DVFZ = Death Valley fault zone; MPT = Mormon Point turtleback; GV = Grand View fault; SVPFZ = Stewart Valley-Pahrump fault zone; KT = Keystone thrust

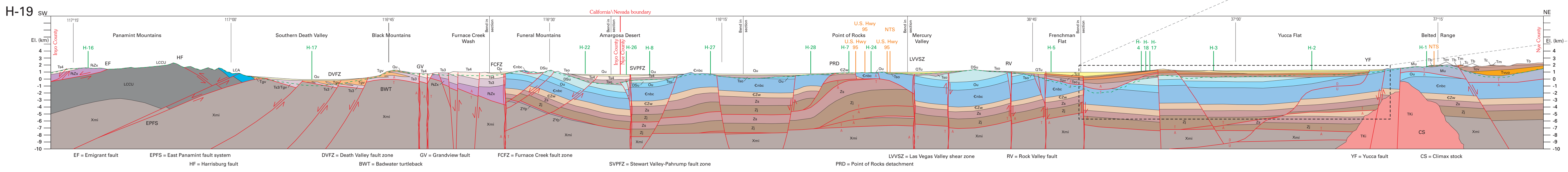


1:100,000-SCALE DETAIL OF CROSS SECTION H-19



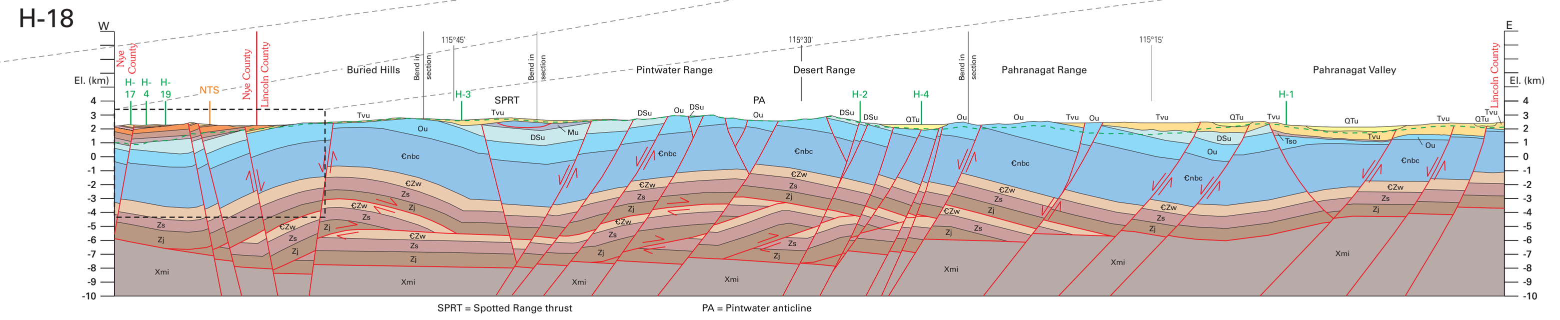
1:100,000-SCALE DETAIL OF CROSS SECTION H-18

H-19



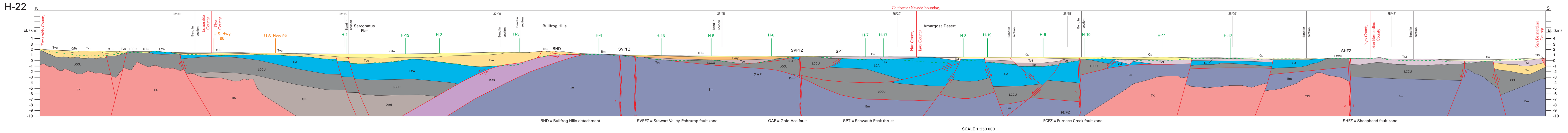
EF = Emigrant fault; EPFS = East Panamint fault system; HF = Harrisburg fault; DVFZ = Death Valley fault zone; BWT = Badwater turtleback; GV = Grandview fault; FCFZ = Furnace Creek fault zone; SVPFZ = Stewart Valley-Pahrump fault zone; LVVSZ = Las Vegas Valley shear zone; PRD = Point of Rocks detachment; RV = Rock Valley fault; YF = Yucca fault; CS = Climax stock

H-18



SPRT = Spotted Range thrust; PA = Pintwater anticline

H-22



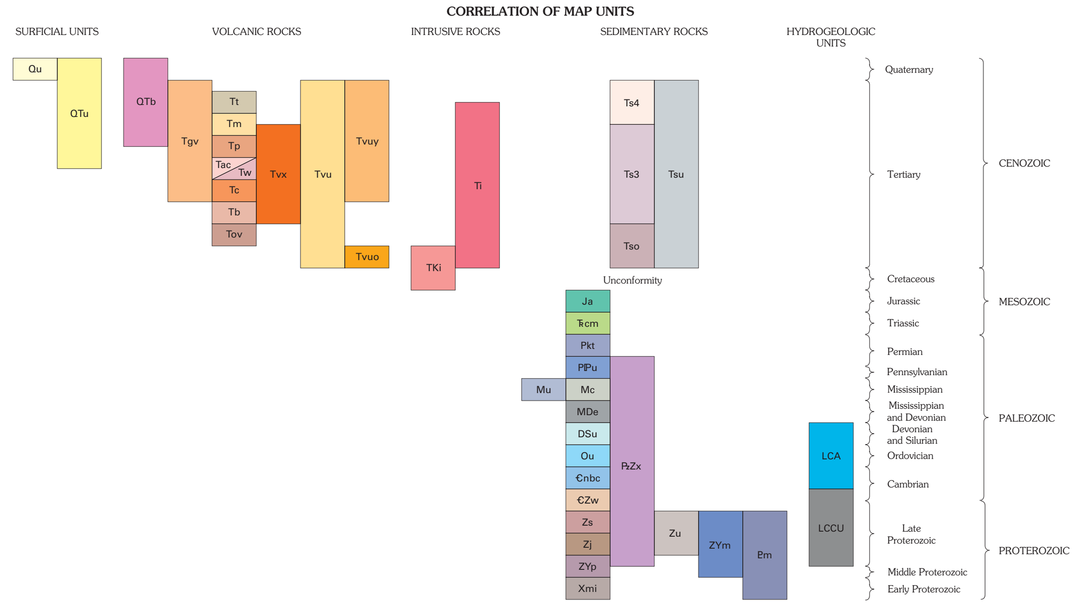
BHD = Bullfrog Hills detachment; SVPFZ = Stewart Valley-Pahrump fault zone; GAF = Gold Ace fault; SPT = Schwaub Peak thrust; FCFZ = Furnace Creek fault zone; SHFZ = Sheephead fault zone

SCALE 1:250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 KILOMETERS

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qu — **Undifferentiated Quaternary deposits**

QTu — **Undifferentiated Quaternary and Tertiary deposits (Holocene to Pliocene, but may locally include Miocene and Oligocene deposits)**

BEDROCK UNITS

VOLCANIC ROCKS

QTb — **Basaltic lava flows, undivided (Pleistocene to Miocene)**

Volcanic rocks of the Death Valley vicinity

Tgv — **Volcanic rocks (Pliocene and Miocene)**—Volcanic rocks associated with the central Death Valley volcanic field and other volcanic rocks of the Death Valley area. Includes the 6.0- to 5.4-Ma Greenwater Volcanics (Pliocene) of the Death Valley area and the 12- to 9-Ma dacitic rocks in Death Valley and the Grapevine Mountains

Volcanic rocks of the Nevada Test Site and vicinity

Tt — **Stonewall Flat Tuff (Miocene), Thirsty Canyon Group (Miocene), and younger volcanic rocks, undivided**—Includes Fortymile Canyon assemblage and rocks that fill moat of the Timber Mountain caldera

Tm — **Timber Mountain Group (Miocene)**

Tvx — **Intracaldera and caldera margin megabreccia, undivided (Miocene)**

Tp — **Paintbrush Group (Miocene)**

Tac — **Calico Hills Formation (Miocene)**

Tw — **Wahmonie and Salyer Formations, undivided (Miocene)**

Tc — **Crater Flat Group (Miocene)**

Tb — **Belted Range Group (Miocene)**

Tov — **Older ash-flow tuffs and lava sequences (Miocene)**—Includes Lithic Ridge Tuff, Tunnel Formation, Tub Spring Tuff, tuff of Yucca Flat, and other volcanic units older than the Belted Range Group

Tvu — **Volcanic rocks, undivided (Pliocene to Oligocene)**—Includes all volcanic rocks associated with the southwestern Nevada volcanic field and also older volcanic rocks not associated with southwestern Nevada volcanic field, including Kane Wash Tuff, Hiko Tuff, and Fraction Tuff (Miocene) and Shingle Pass Tuff and Monotony Tuff (Oligocene). Where subsurface information is available, unit is subdivided into younger and older units

Tvuy — **Younger volcanic rocks, undivided (Pliocene to Miocene)**—Includes Crater Flat Group and younger rocks; use is restricted to sections H-6, H-16, and H-22 where these sections cross northwestern part of Amargosa Desert

Tvuo — **Older volcanic rocks, undivided (Miocene to Oligocene)**—Use is restricted to north end of section H-19; unit is used for Miocene and Oligocene volcanic rocks not associated with southwestern Nevada volcanic field, including Kane Wash Tuff, Hiko Tuff, and Fraction Tuff (Miocene) and Shingle Pass Tuff and Monotony Tuff (Oligocene)

INTRUSIVE AND METAMORPHIC ROCKS (MIOCENE TO CRETACEOUS)

Ti — **Intrusive rocks (Miocene and Oligocene)**—Intrusive rocks of Tertiary age. Includes granitic and mafic intrusive rocks in the Black Mountains (for example, Willow Spring Diorite and granite at Smith Mountain) and Panamint Mountains, hypabyssal intrusive rocks in the Greenwater Range (for example, Brown Peak intrusive center), and intrusive rocks at the Nevada Test Site [associated with the Timber Mountain Group, Calico Hills Formation and Wahmonie Formation (Miocene)]. Locally includes minor associated extrusive rocks

TKi — **Intrusive rocks (Oligocene to Cretaceous)**—Intrusions and dikes of Cretaceous age or those intrusions whose age is poorly constrained. Includes plutons in the Panamint Range and plutons north of Yucca Flat at the Nevada Test Site

CONTINENTAL SEDIMENTARY ROCKS (PLIOCENE TO OLIGOCENE)

Ts4 — **Unit 4 (Pleistocene? to Miocene)**—Late synextensional to post-extensional sedimentary rocks, predominantly post 6 Ma. Includes the Funeral Formation (Pleistocene? and Pliocene) of the Furnace Creek basin

Ts3 — **Unit 3 (predominantly Miocene)**—Miocene synextensional and (or) synvolcanic sedimentary rocks, predominantly between 14 and 10 Ma. Includes the Artist Drive (Pliocene to Oligocene?) and Furnace Creek Formations (Pliocene? and Miocene) within the Furnace Creek basin

Tso — **Older Tertiary sedimentary rocks, undivided (Miocene to Eocene)**

Tsu — **Tertiary sedimentary rocks, undivided (Pleistocene? to Eocene)**

SEDIMENTARY AND METASEDIMENTARY ROCKS (MESOZOIC TO PROTEROZOIC)

Ja — **Aztec Sandstone (Lower Jurassic)**—Exposed in the eastern and southern Spring Mountains

Ꞧcm — **Chinle Formation (Upper Triassic) and Moenkopi Formation (Middle? and Lower Triassic), undivided**—Exposed in the eastern Spring Mountains

Pkt — **Kaibab and Toroweap Formations, undivided (Lower Permian)**—Includes Permian redbeds that underlie the Toroweap Formation. Exposed in the Spring Mountains

PzZx — **Tectonically disrupted Paleozoic and Late Proterozoic sedimentary rocks, undivided**—Pahrump Group (Late Proterozoic) and younger sedimentary rocks that are tectonically thinned and (or) pervasively brecciated in the upper plates of extensional detachment faults. Use is restricted to the Death Valley area

PIPu — **Permian and Pennsylvanian rocks, undivided**—Predominantly carbonate rocks. Includes the Keeler Canyon Formation (Lower Permian to Middle Pennsylvanian), exposed in the Last Chance Range and Cottonwood Mountains; the Bird Spring Formation (Lower Permian to Pennsylvanian), exposed in the Spring Mountains, Las Vegas Range, Sheep Range, and Nopah Range; and the Tippipah Limestone (Lower Permian and Pennsylvanian), exposed at the Nevada Test Site

Mu — **Mississippian rocks, undivided**—Mostly carbonate rocks. Includes the Monte Cristo Limestone (Upper and Lower Mississippian), exposed in the Montgomery Mountains, Spring Mountains, and nearby ranges; the Joana Limestone (Lower Mississippian), exposed in the Pahranagat Range; various Mississippian carbonate units in the Spotted Range; and carbonate rocks of the Perdido Formation and Tin Mountain Limestone (Lower Mississippian) in the Cottonwood Mountains and Last Chance Range. In Keystone thrust plate (eastern Spring Mountains), includes the Sultan Limestone (Lower Mississippian to Middle Devonian)

Mc — **Chainman Shale (Mississippian)**—Exposed in the Pahranagat Range, and the eastern Nevada Test Site (Syncline Ridge, CP Hills, and Calico Hills). Includes the Scotty Wash Quartzite

MDe — **Eleana Formation (Mississippian and Upper Devonian)**—Exposed in the Nevada Test Site area. Shown on cross sections within footwall duplex of Belted Range thrust

DSu — **Devonian and Silurian rocks, undivided (Devonian and Silurian)**—Includes the Simonson Dolomite (Middle and Lower Devonian), Sevy Dolomite (Lower Devonian), and Laketown Dolomite (Silurian)

Ou — **Ordovician rocks, undivided**—Includes the Ely Springs Dolomite (Upper Ordovician), Eureka Quartzite (Upper and Middle Ordovician), and Pogonip Group (Middle and Lower Ordovician)

Ꞓnbc — **Nopah (Upper Cambrian), Bonanza King (Upper and Middle Cambrian), and Carrara (Middle and Lower Cambrian) Formations, undivided**

ꞒZw — **Zabriskie Quartzite (Lower Cambrian) and Wood Canyon Formation (Lower Cambrian to Late Proterozoic), undivided**

Zs — **Stirling Quartzite (Late Proterozoic)**

Zj — **Johnnie Formation (Late Proterozoic)**

Zu — **Stirling Quartzite and Johnnie Formation, undivided (Late Proterozoic)**—Use is restricted to the vicinity of the Spring Mountains in footwall of Keystone thrust and to thrust duplexes that are inferred at depth

ZYm — **Stirling Quartzite and Johnnie Formation (Late Proterozoic) and Pahrump Group (Middle to Late Proterozoic), undivided**—Use is restricted to those areas where these rocks are metamorphosed to medium grades; includes minor younger igneous rocks. Occurs at Bare Mountain, the Funeral Mountains, and the Bullfrog Hills

Ꝑm — **Metamorphic and igneous rocks, undifferentiated (Late Proterozoic to Early? Proterozoic)**—Includes all Proterozoic rocks; use is restricted to section H-22

ZYp — **Noonday Dolomite (Late Proterozoic) and Pahrump Group (Middle and Late Proterozoic), undivided**

Xmi — **Metamorphic and igneous rocks, undifferentiated (Early? Proterozoic)**

HYDROGEOLOGIC UNITS (PALEOZOIC TO PROTEROZOIC)

[Use is restricted to those sections or parts of sections where abundant Quaternary cover (for example, section H-22 and northeastern end of section H-29) or lack of detailed map data (for example, sections H-44 and H-45) prevent more detailed stratigraphic subdivision]

LCA — **Lower carbonate-rock aquifer (Devonian to Cambrian)**—Includes Paleozoic carbonate rocks of Devonian to Cambrian age, as used by Laczniak and others (1996)

LCCU — **Lower clastic confining unit (Late Proterozoic to Lower Cambrian)**—Predominantly clastic rocks; equivalent to the quartzite confining unit of Laczniak and others (1996)

EXPLANATION OF SYMBOLS USED ON CROSS SECTIONS

[These sections use no direct subsurface data, such as borehole data, below about 2 km; all contacts and faults below this depth are interpreted. Confidence in the geologic interpretation naturally decreases with depth; however, for legibility, all contacts and faults are shown as solid lines]

Contact between lithologic or hydrogeologic units

D / U — **Normal fault or thrust fault**—Opposed barbs indicate direction of relative vertical movement. D and U indicate relative down and up motion, respectively, for normal faults that are subparallel to the line of section. Dashed where projected above land surface

A / T — **Strike-slip fault**—A and T indicate direction of relative movement away from and toward observer, respectively

Profile representing the inferred base of the Cenozoic section, based upon inversion of regional gravity data—After Blakely and others (1999)

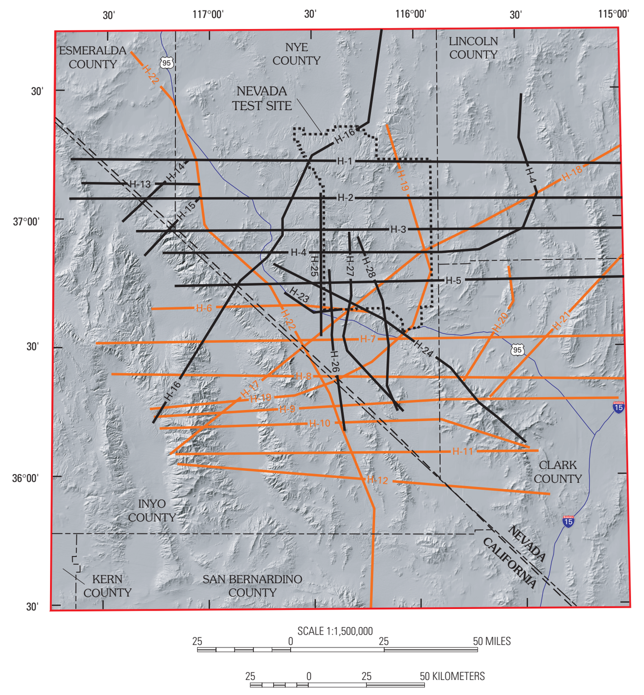
H-22 — **Tie point with intersecting cross section**—Some intersects not apparent to viewer at scale (1:750,000) of accompanying index maps. All coordinates of individual cross section tie points are reported in metadata that supports the associated digital files

NTS — **Tie point with boundary of Nevada Test Site**

U.S. Hwy 95 — **Tie point with U.S. Highway 95**

Nye County / Clark County — **Tie point with county boundary**

Bend in section — **Bend in cross section**—All bends in cross section are shown. Some subtle bends are not discernible to viewer at scale (1:750,000) of accompanying index maps. Location of all vertices (section bends) are reported in metadata that supports the associated digital files



EXPLANATION

Lines of section featured on sheet 3

Lines of section featured on sheet 2

State boundary

Von Schmidt line (historical line)

County boundary

Nevada Test Site boundary

Interstate highway

State highway

Area depicted on the five index maps (figs. 3–7)

INDEX TO CROSS-SECTION LINES FEATURED ON SHEET 3

INTERPRETIVE GEOLOGIC CROSS SECTIONS FOR THE DEATH VALLEY REGIONAL FLOW SYSTEM AND SURROUNDING AREAS, NEVADA AND CALIFORNIA

By
Donald S. Sweetkind[1], Robert P. Dickerson[2], Richard J. Blakely[3], and Paul D. Denning[1]
2001

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