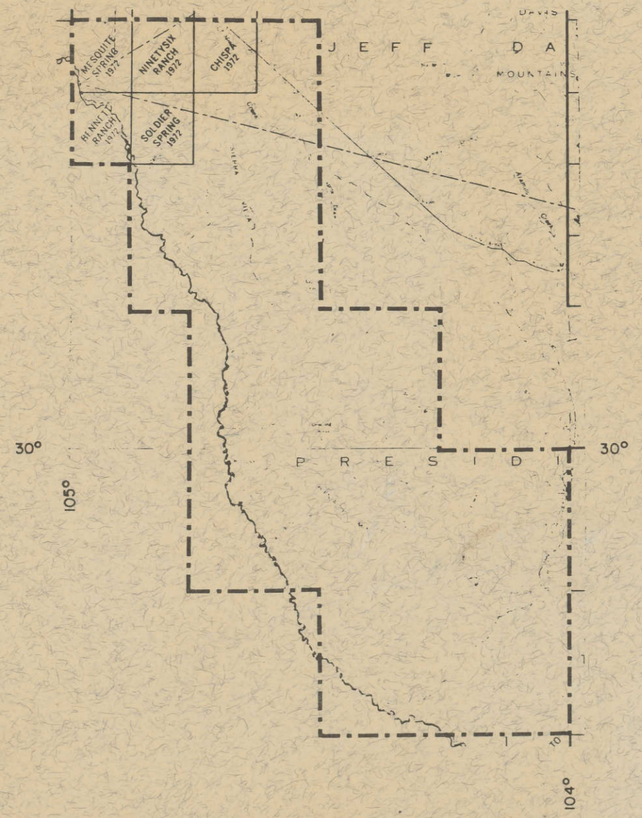
Airborne Gamma-Ray Spectrometer and Magnetometer Survey

Buckshot, Texas

Final Report

Detail Area

Volume II C



prepared by

HIGH LIFE HELICOPTERS, Inc. / QEB, Inc.

Puyallup, Washington Lakewood, Colorado

Prepared for the U. S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

under

Subcontract No. DE-AC13-79GJ01692

DISCLAIMER STATEMENT

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VOLUME IIC

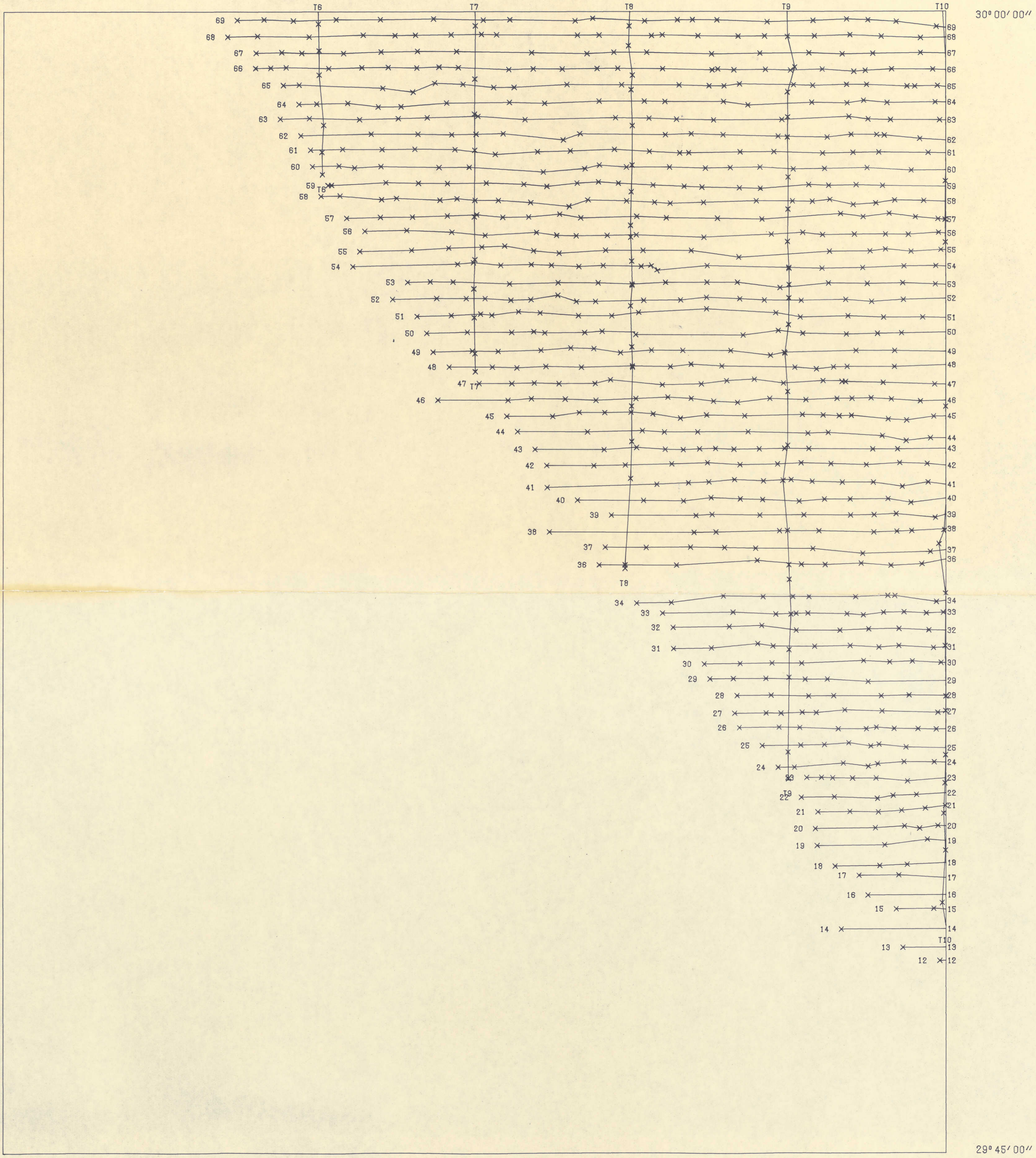
BUCKSHOT DETAIL AREA

APPENDIX A - FLIGHT LINE MAPS

104° 45′ 00″

104° 30′ 00″

30° 00′ 00″



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BUCKSHOT, TX.

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HIGH LIFE - QEB

A1

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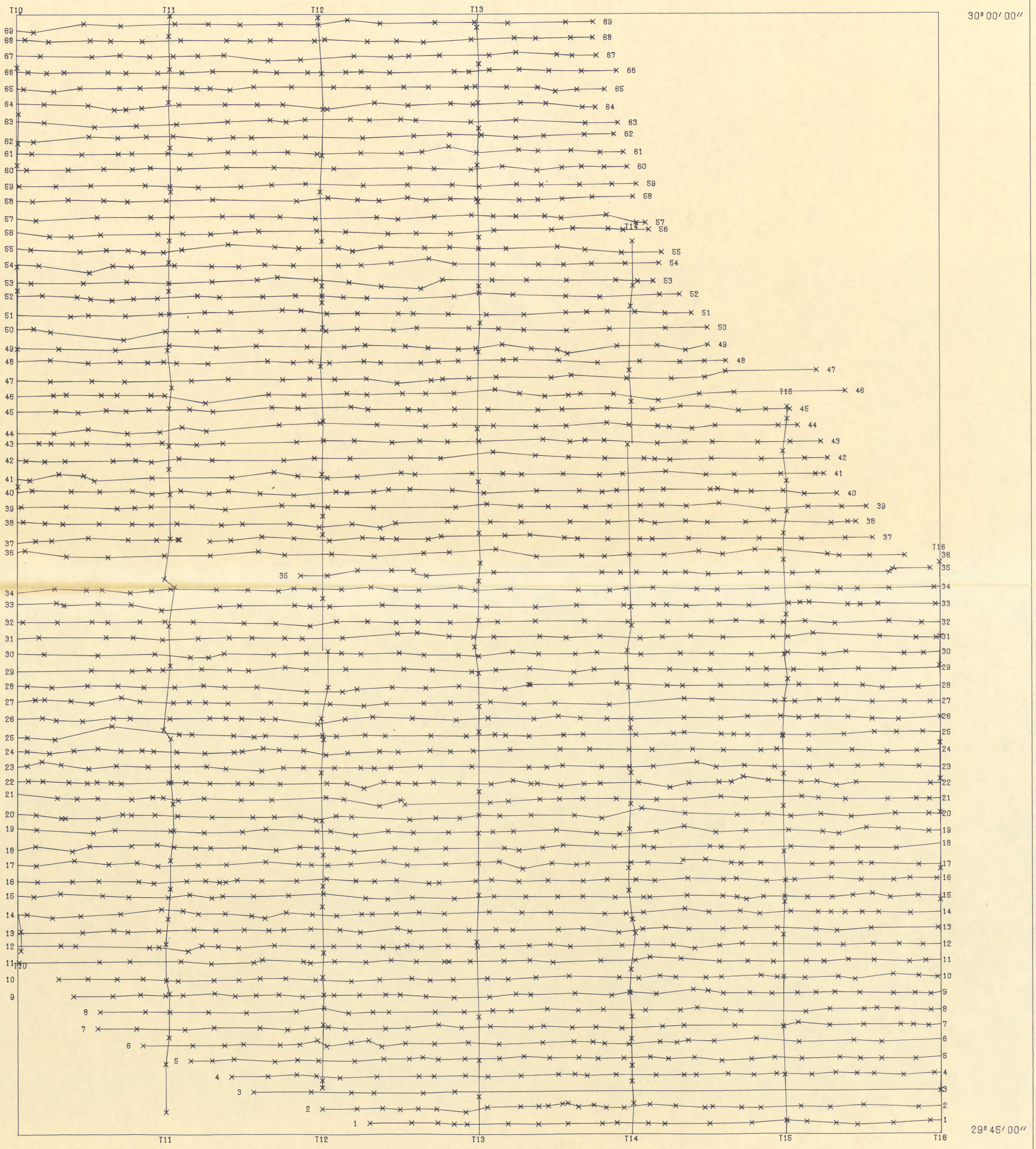

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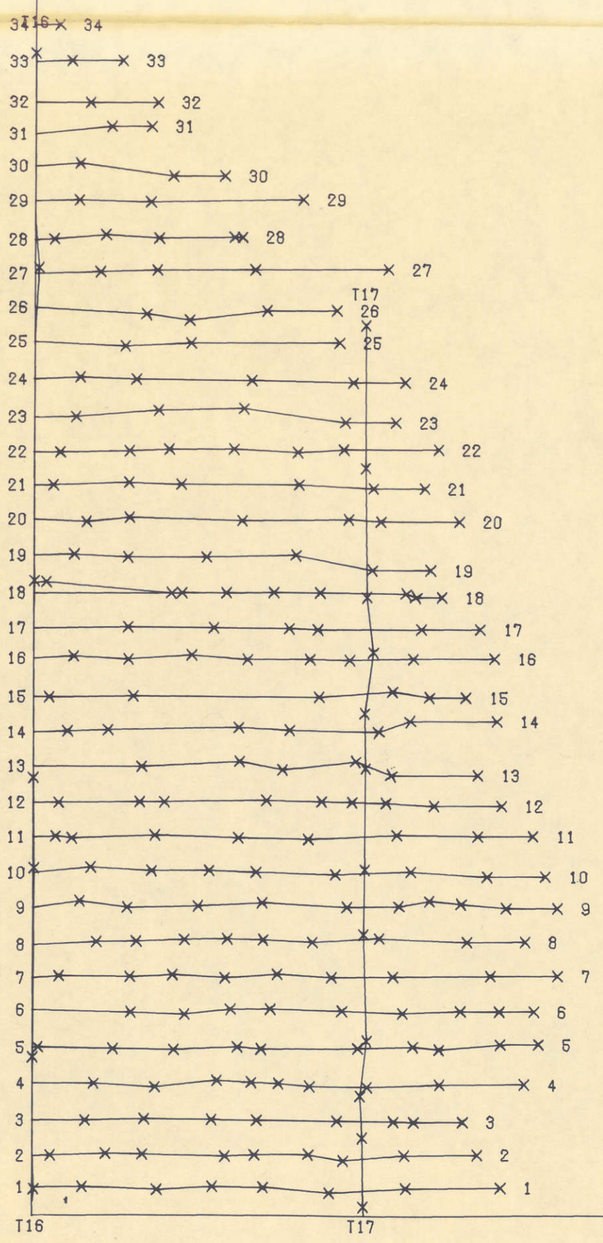

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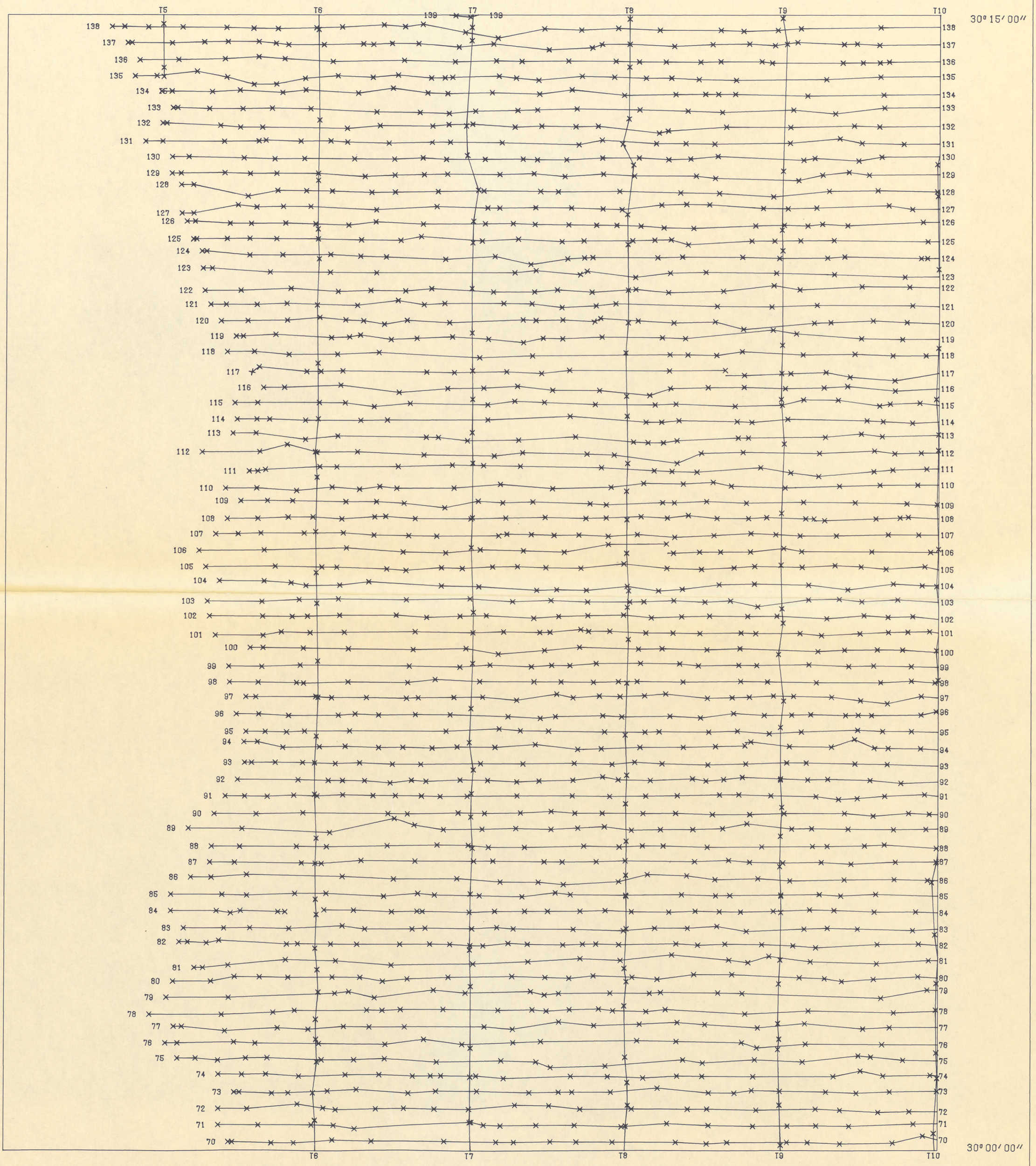

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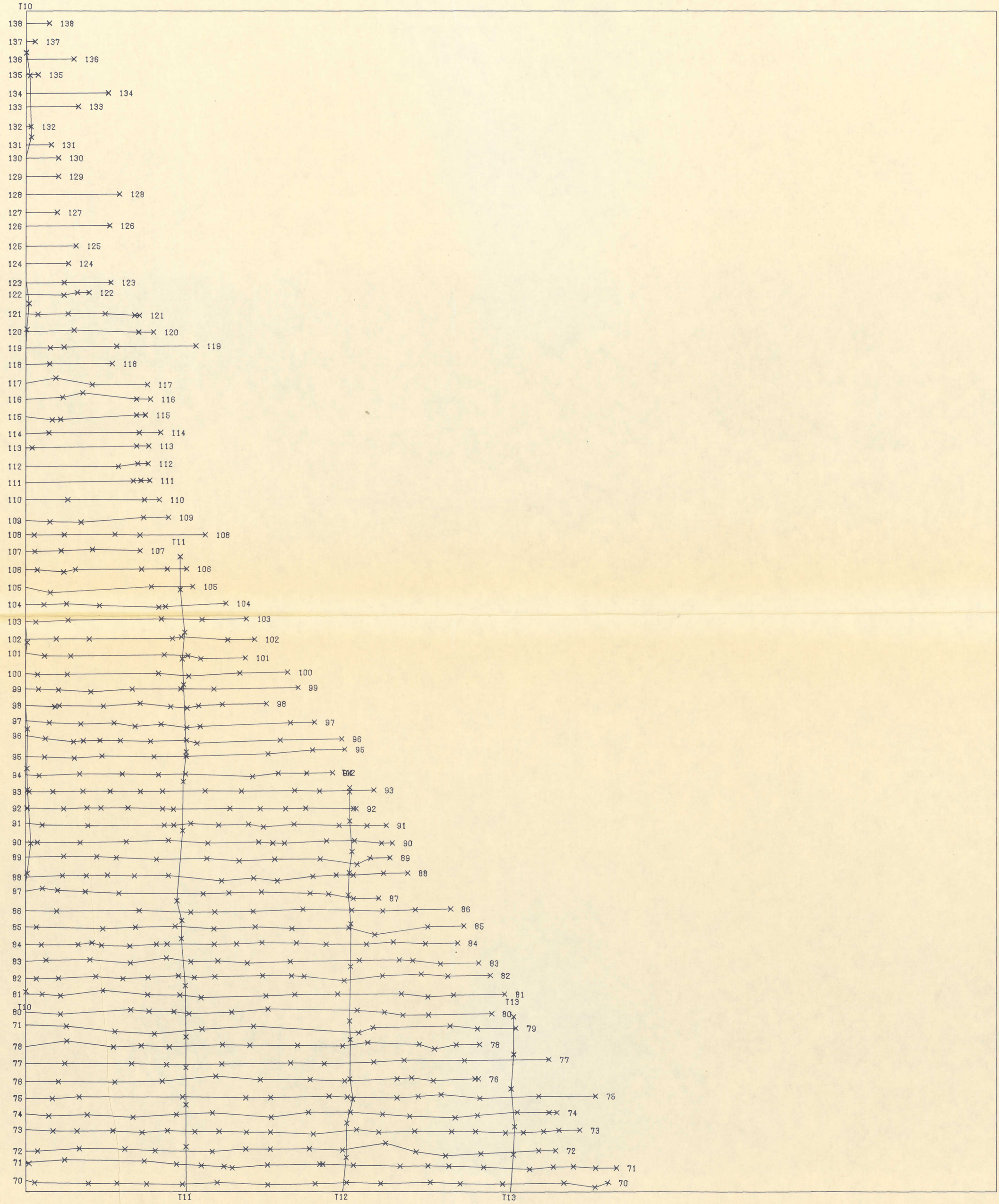

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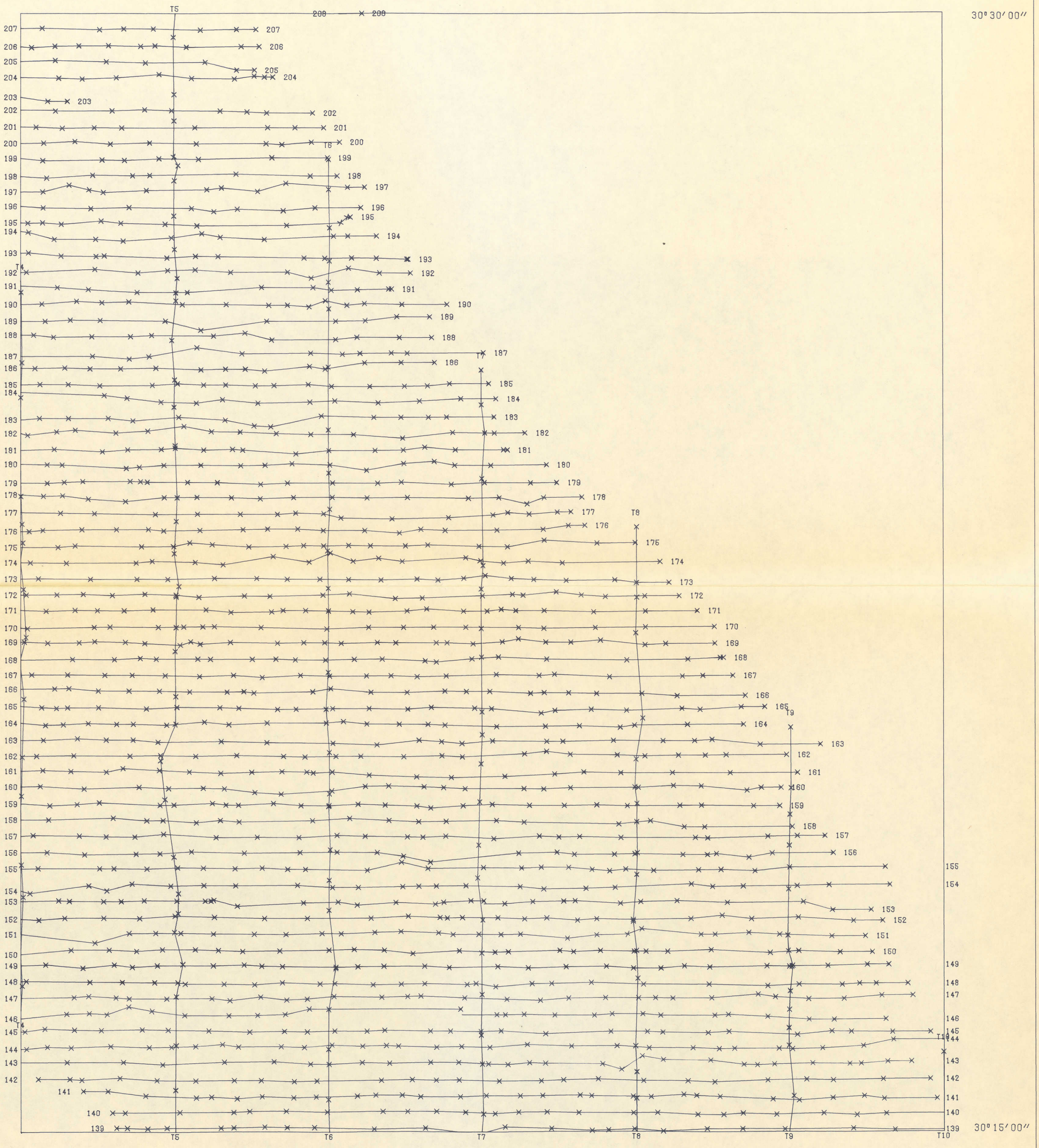

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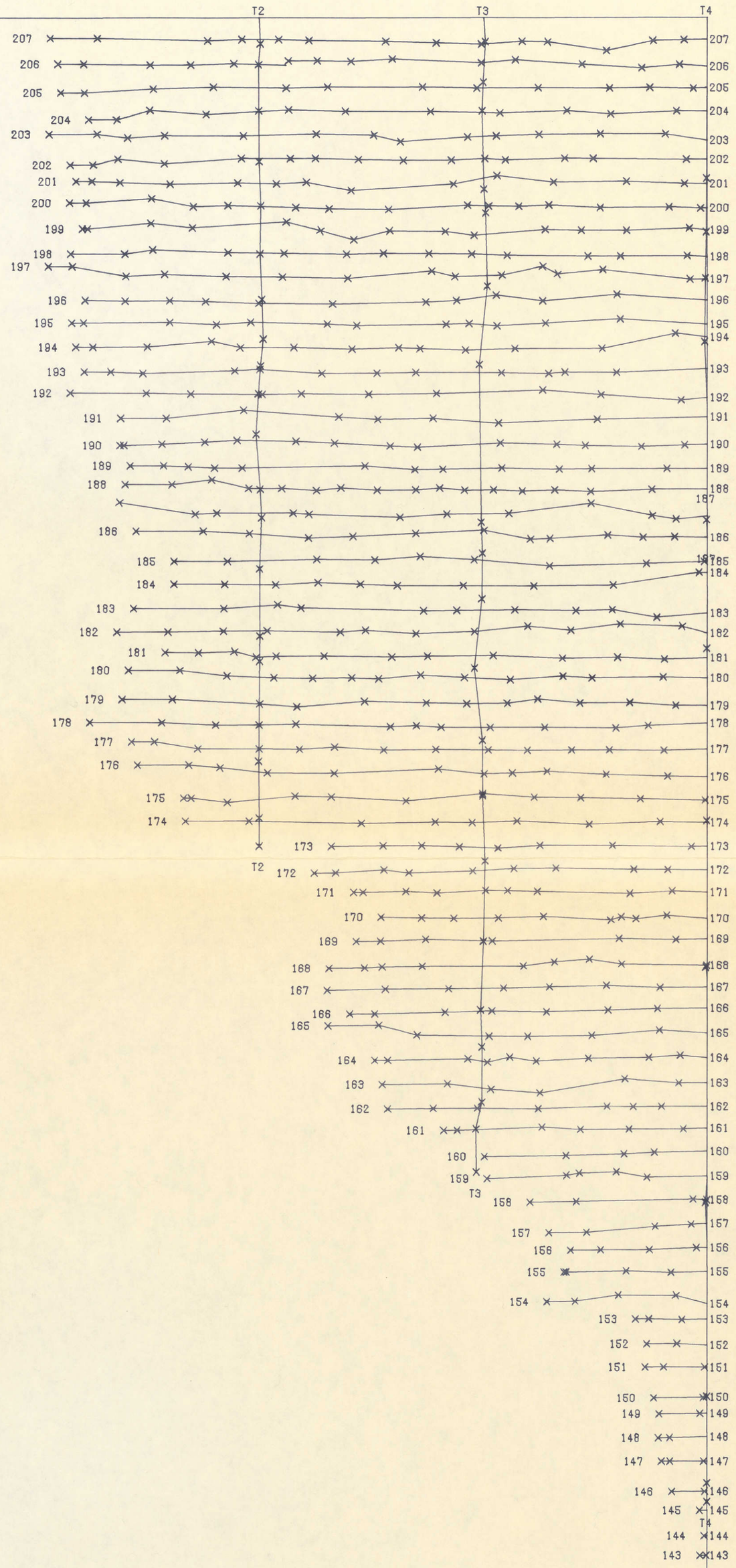

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1/62500.

HIGH LIFE - QEB

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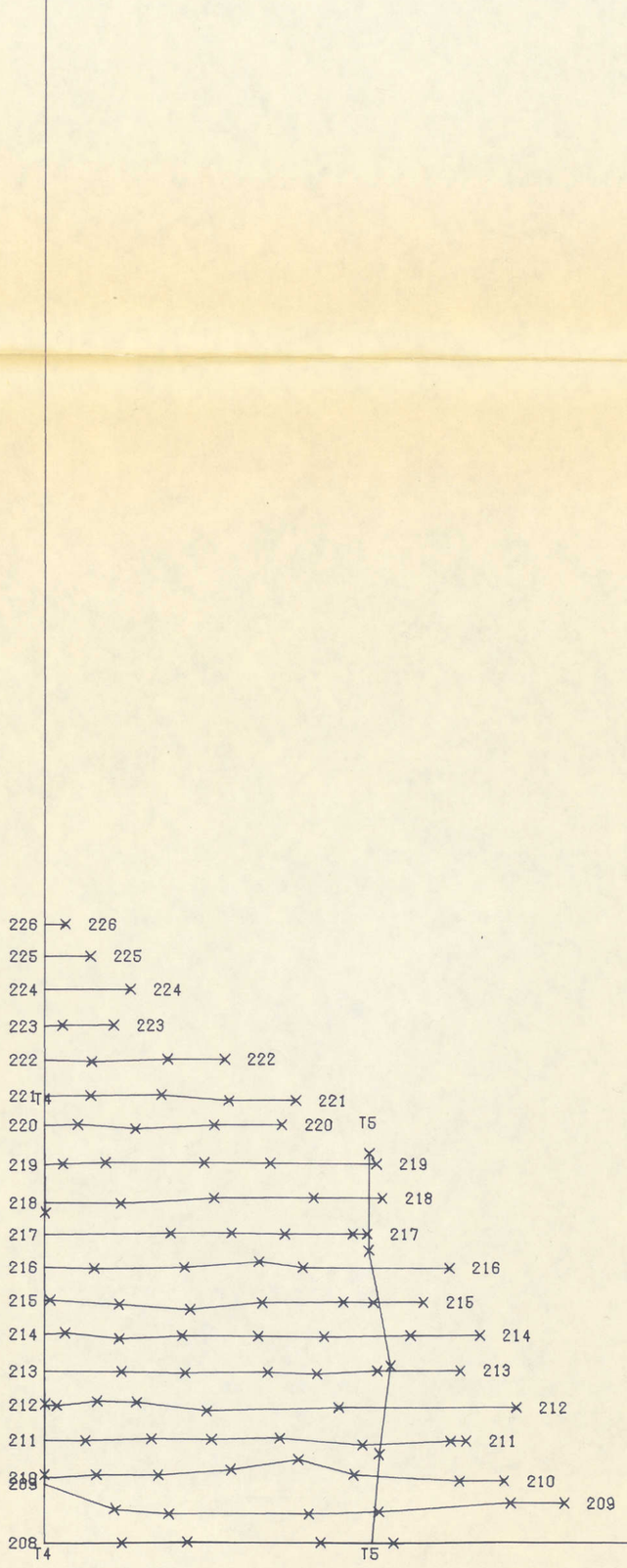
104° 30′ 00″ W

30° 45′ 00″ N

30° 30′ 00″ N



BUCKSHOT, TX.

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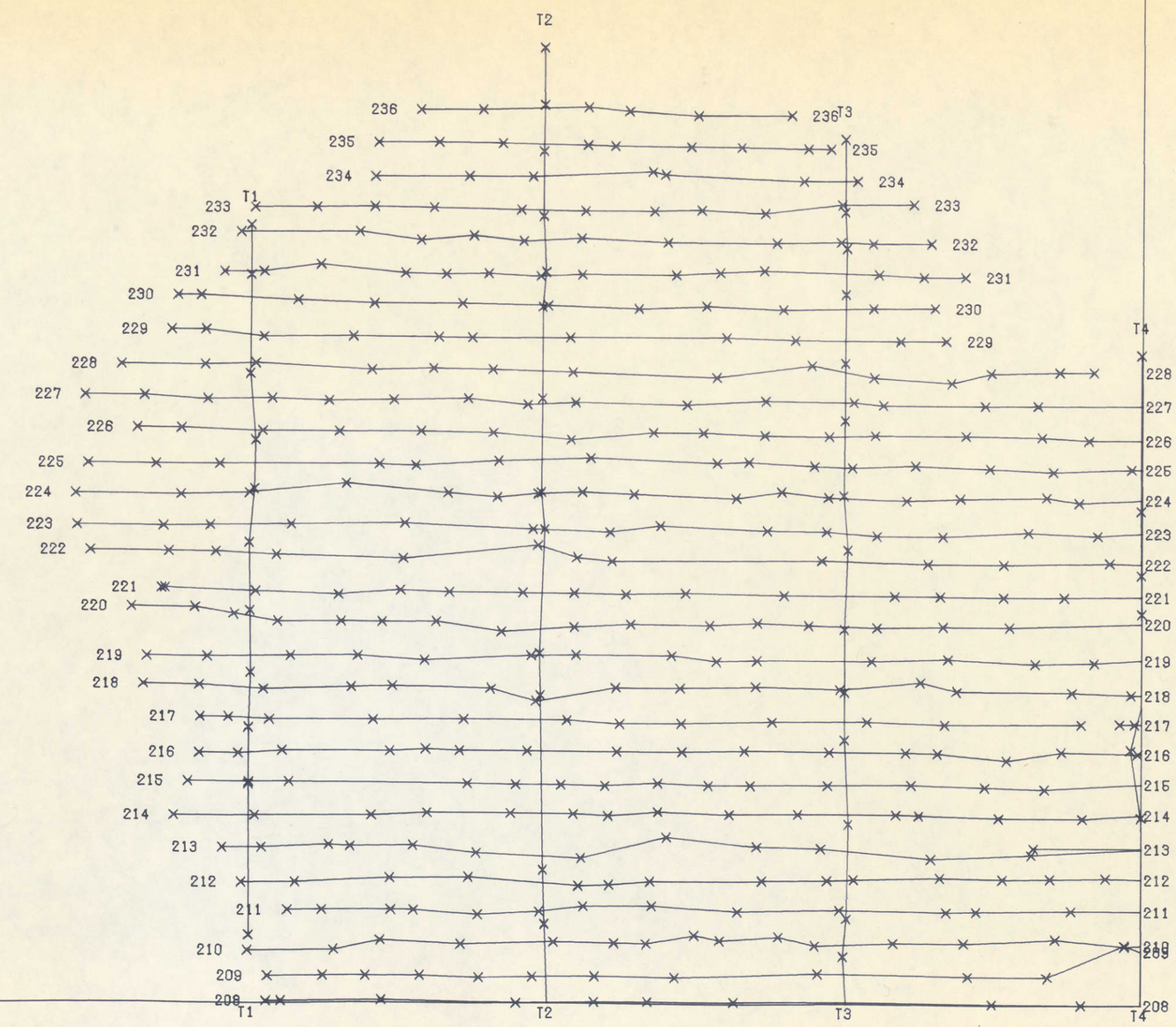

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104° 45′ 00″

MILES 0 1 MILES

BUCKSHOT, TX.

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HIGH LIFE - QEB

104° 30′ 00″

104° 15′ 00″

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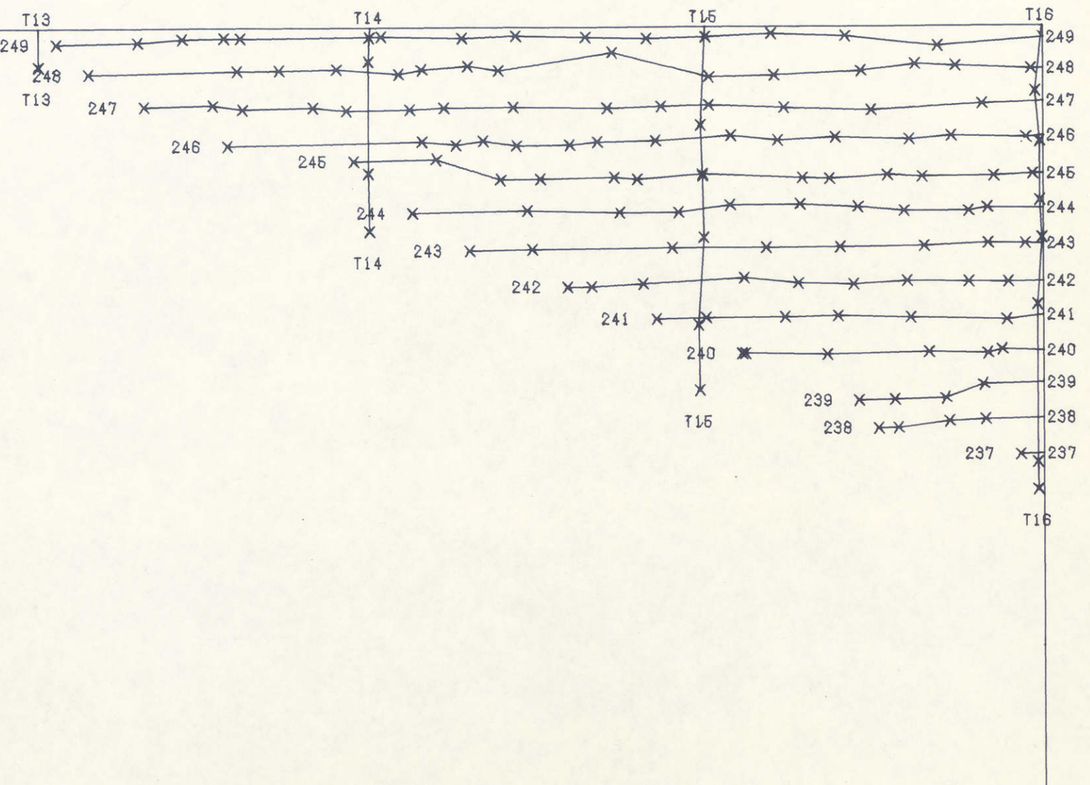
29° 45′ 00″



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104° 30′ 00″

104° 15′ 00″

BUCKSHOT, TX.

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HIGH LIFE - QEB

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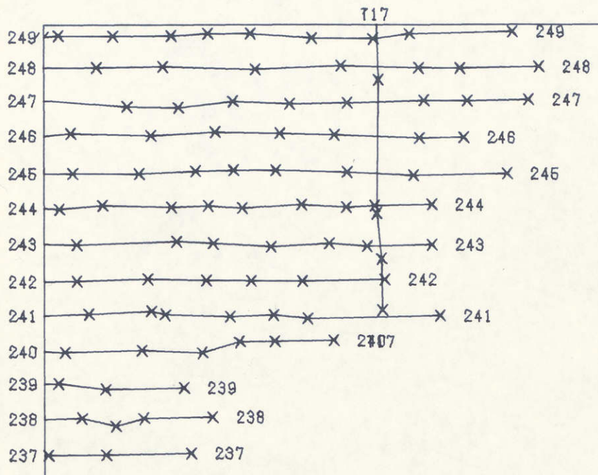
29° 45′ 00″



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104° 00′ 00″

BUCKSHOT, TX.

MILES 0 1 MILES

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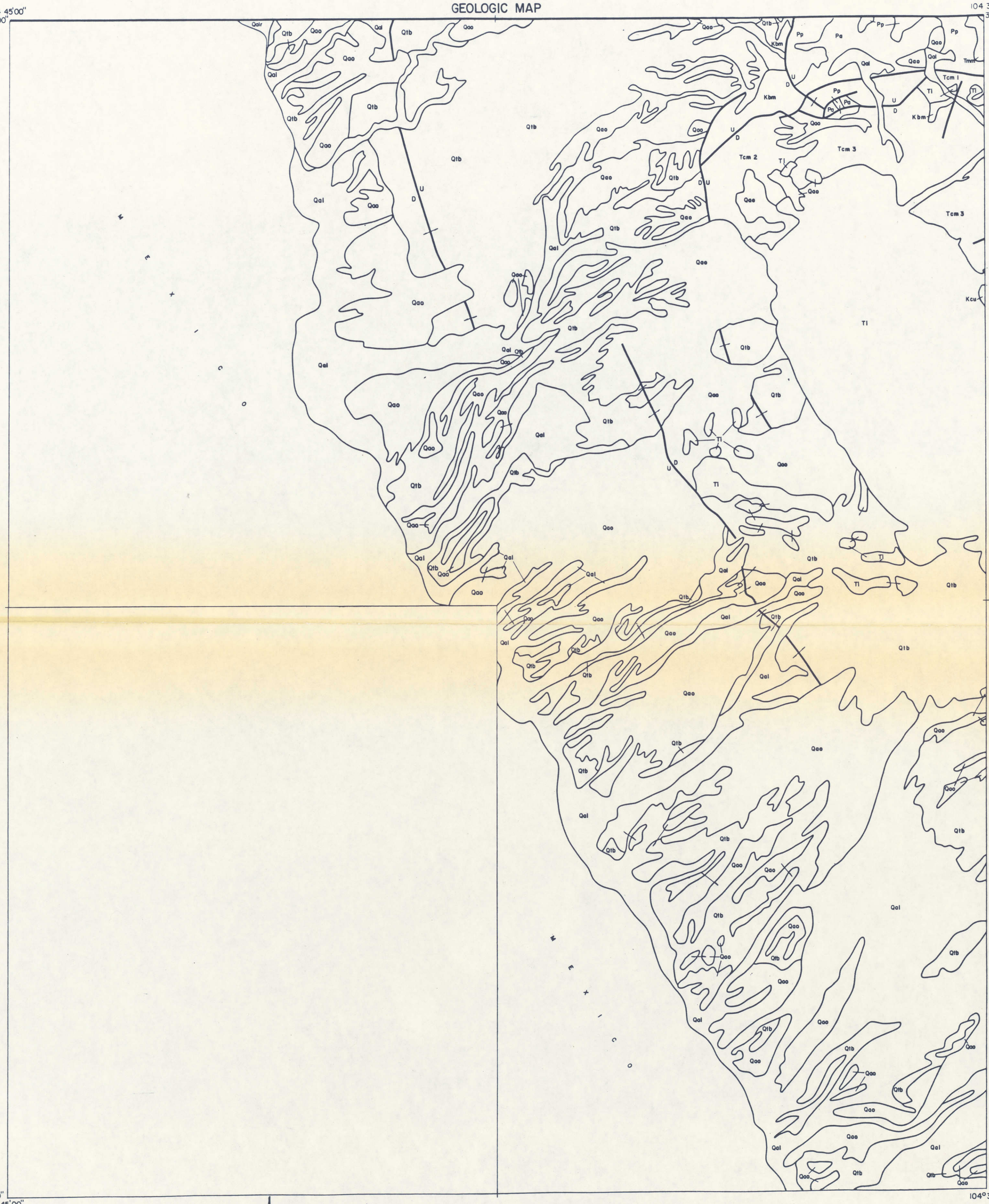
HIGH LIFE - QEB

APPENDIX B - GEOLOGY MAPS

GEOLOGIC MAP

104 45'00"
30 00'00"

104 30'00"
30 00'00"



29°45'00"
104°45'00"

29°45'00"
104°30'00"

4 3 2 1 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

5 4 3 2 1 0 1 5 KILOMETERS

BUCKSHOT
TEXAS

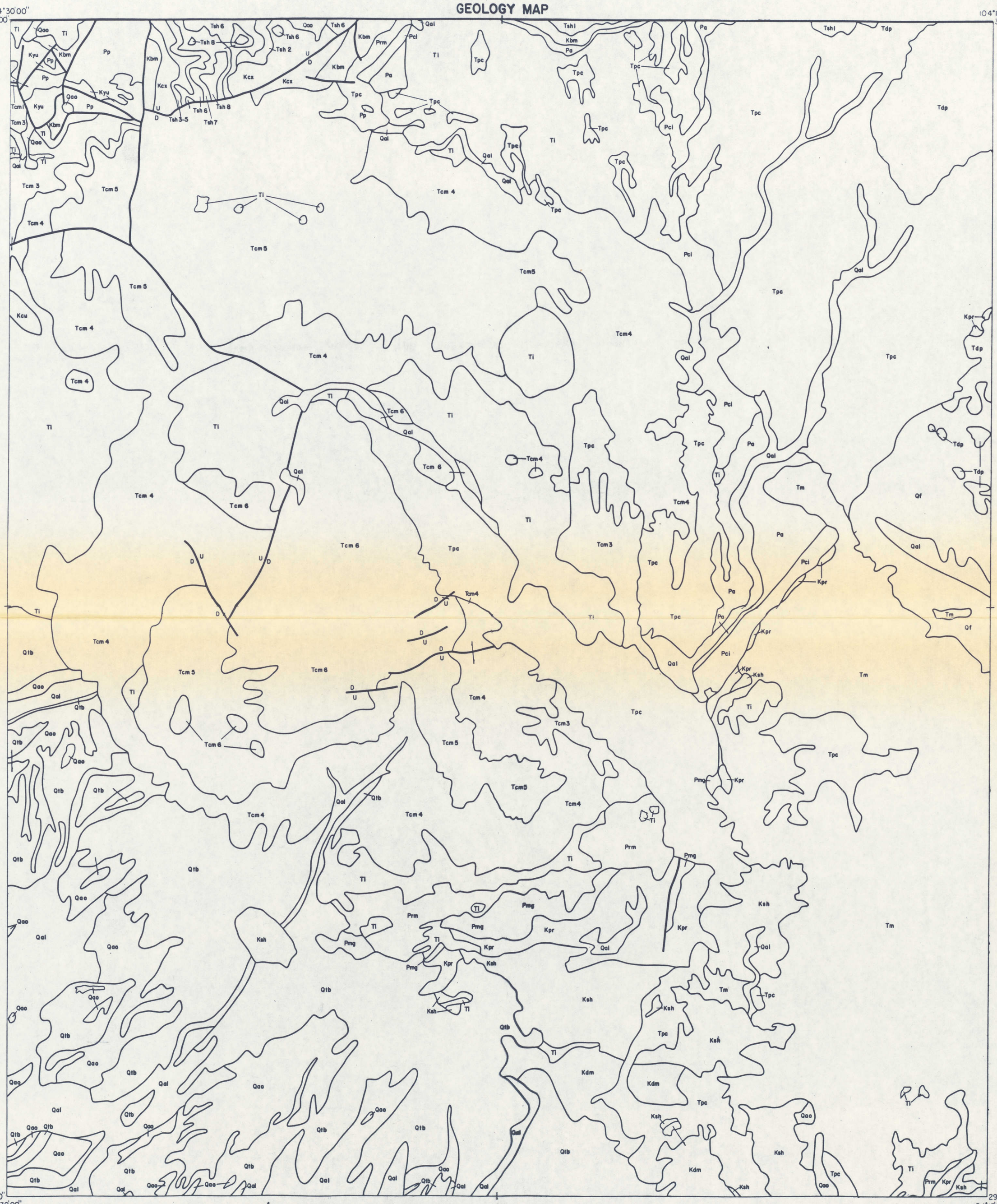
GEOLOGY MAP

104°30'00"
30°00'00"

104°15'00"
30°00'00"

29°45'00"
104°30'00"

29°45'00"
104°15'00"



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1 5 0 1 2 3 4 5 KILOMETERS

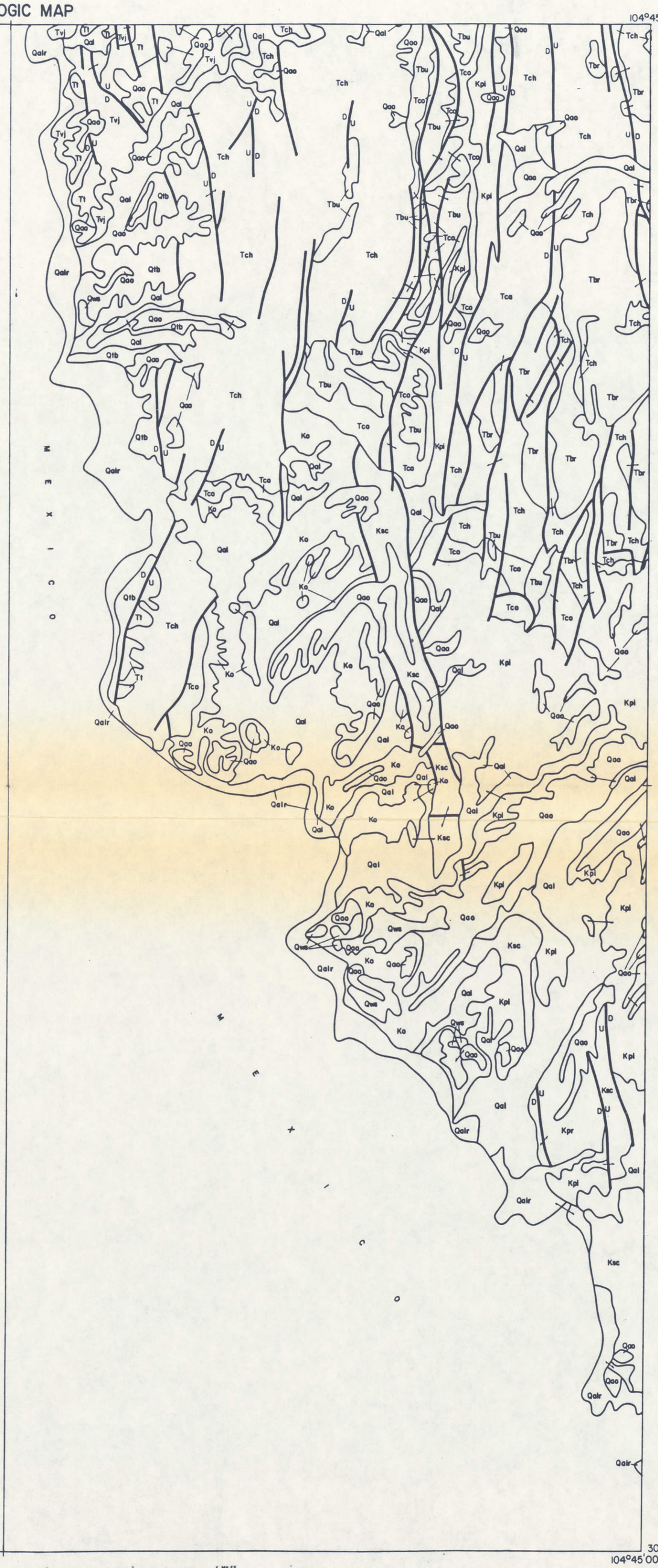
BUCKSHOT
TEXAS

B2

GEOLOGIC MAP

105°00'00"
30°30'00"

104°45'00"
30°30'00"



30°15'00"
105°00'00"

30°15'00"
104°45'00"

N

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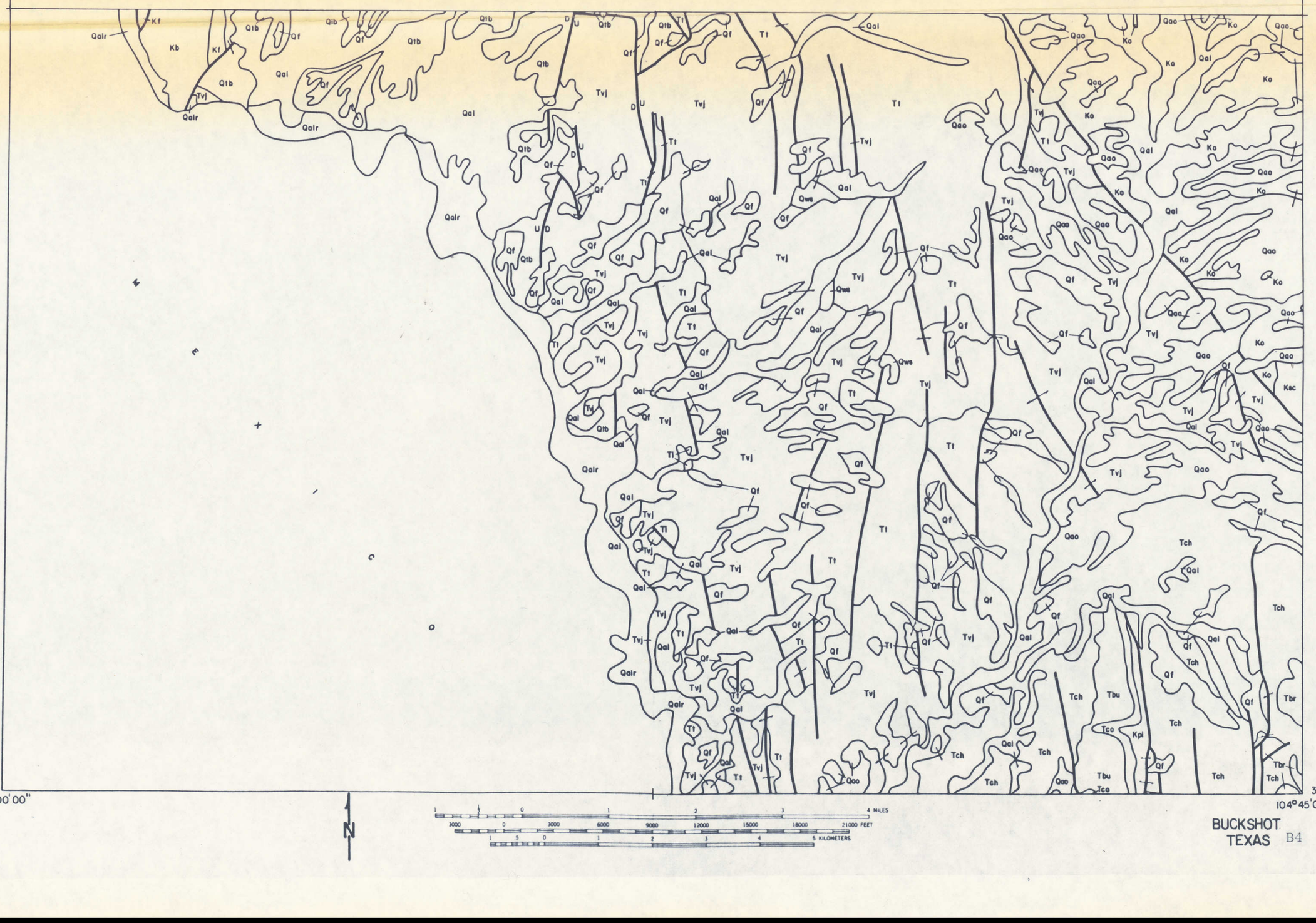
1 5 0 1 2 3 4 5 KILOMETERS

BUCKSHOT
TEXAS B3

GEOLOGIC MAP

105°00'00"
30°45'00"
104°45'00"
30°45'00"



30°30'00"
105°00'00"
30°30'00"
104°45'00"

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3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 5 0 1 2 3 4 5 KILOMETERS

N

BUCKSHOT
TEXAS B4

GEOLOGIC MAP

104°45'00"
30°45'00"

104°30'00"
30°45'00"

30°30'00"
104°45'00"

30°30'00"
104°30'00"

N

1 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 5 0 1 2 3 4 5 KILOMETERS

BUCKSHOT
TEXAS

GEOLOGY MAP

104°45'00"
30°30'00"

104°30'00"
30°30'00"

MEXICO

30°15'00"
104°45'00"

30°15'00"
104°30'00"

N

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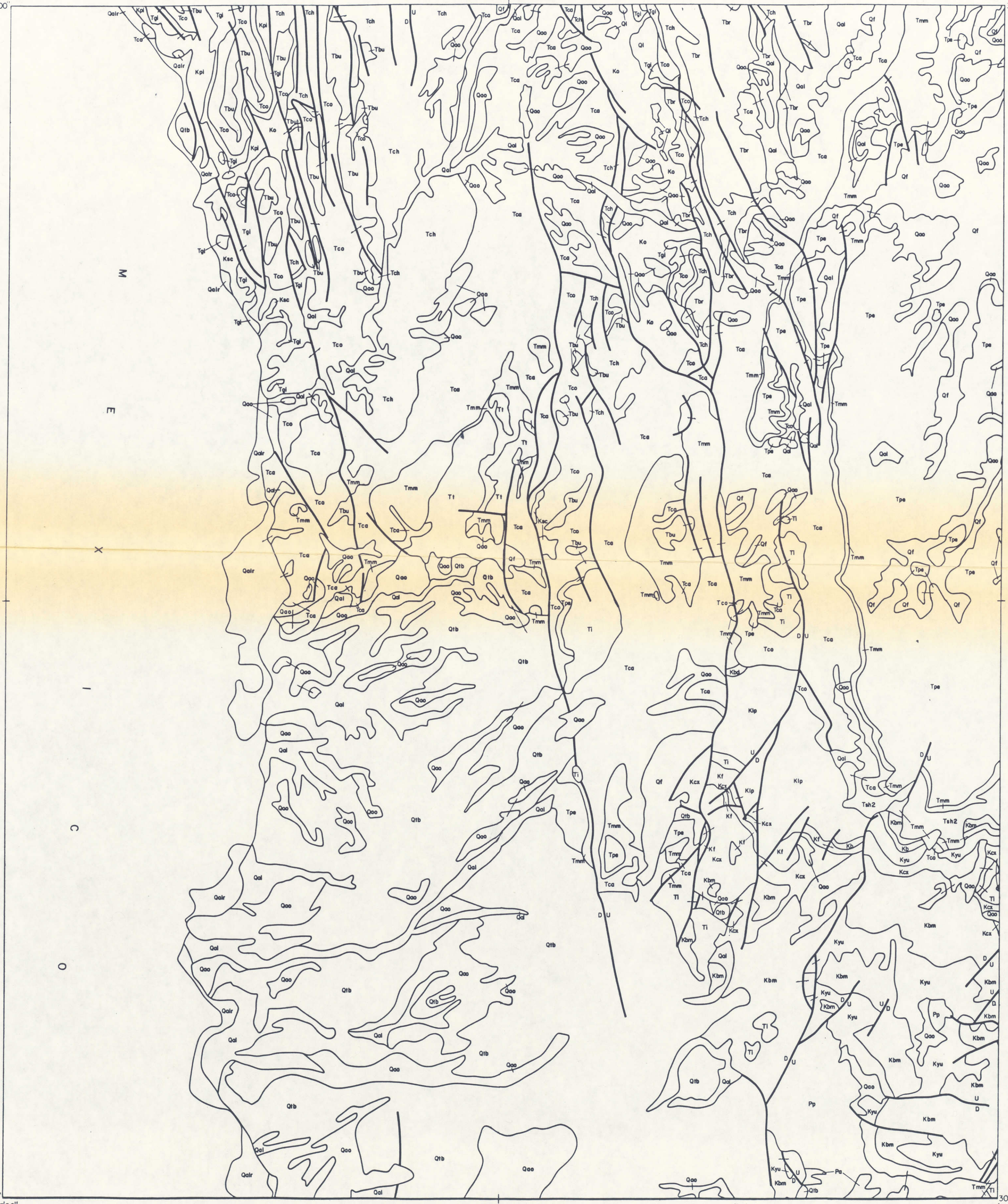
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 5 0 1 2 3 4 5 KILOMETERS

BUCKSHOT
TEXAS

GEOLOGY MAP

104°45'00"
30°15'00"

104°30'00"
30°15'00"



30°00'00"
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30°00'00"
104°30'00"

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3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 5 0 1 2 3 4 5 KILOMETERS

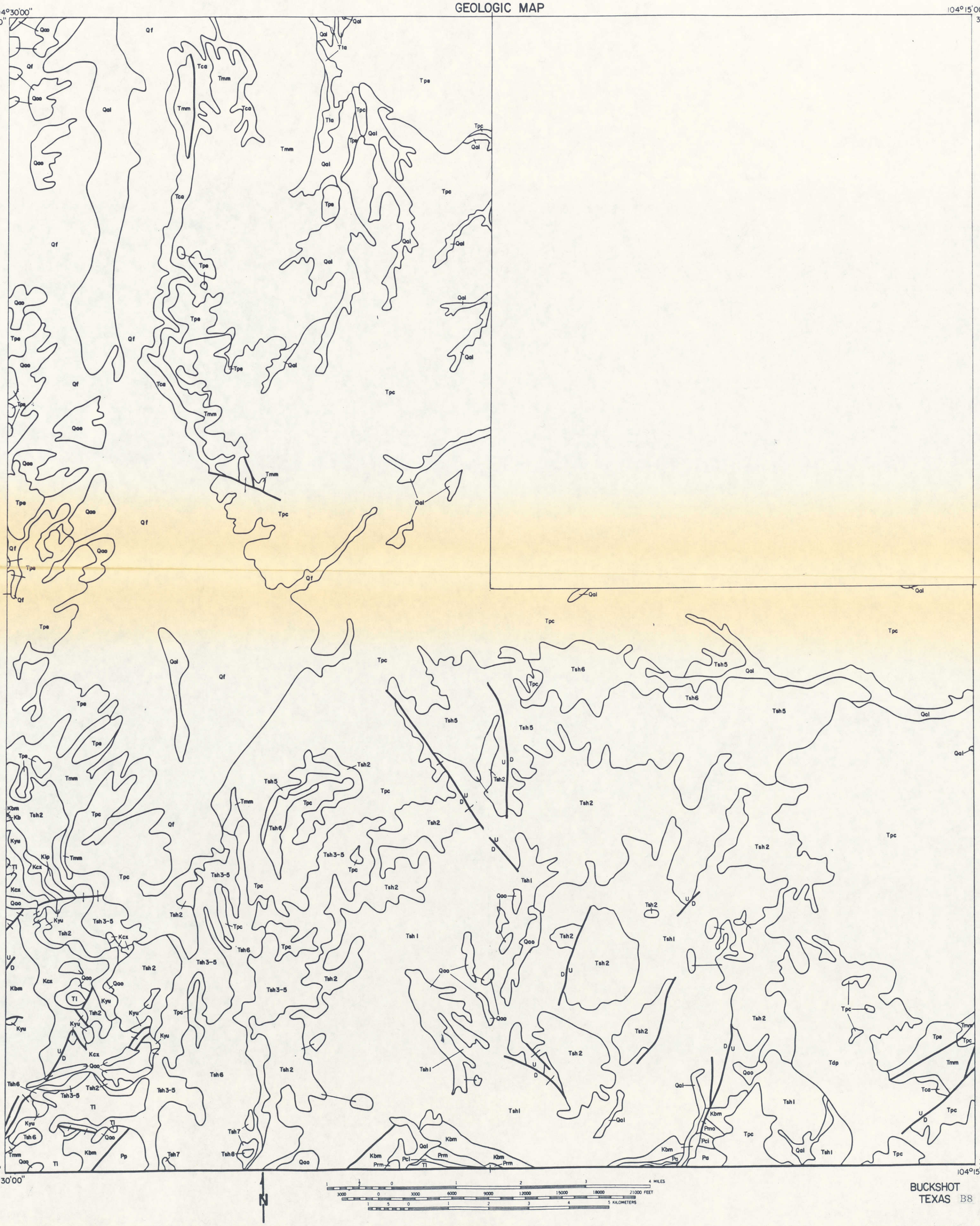
N

BUCKSHOT
TEXAS

GEOLOGIC MAP

104°30'00"
30°15'00"

104°15'00"
30°15'00"



30°00'00"
104°30'00"

30°00'00"
104°15'00"

N

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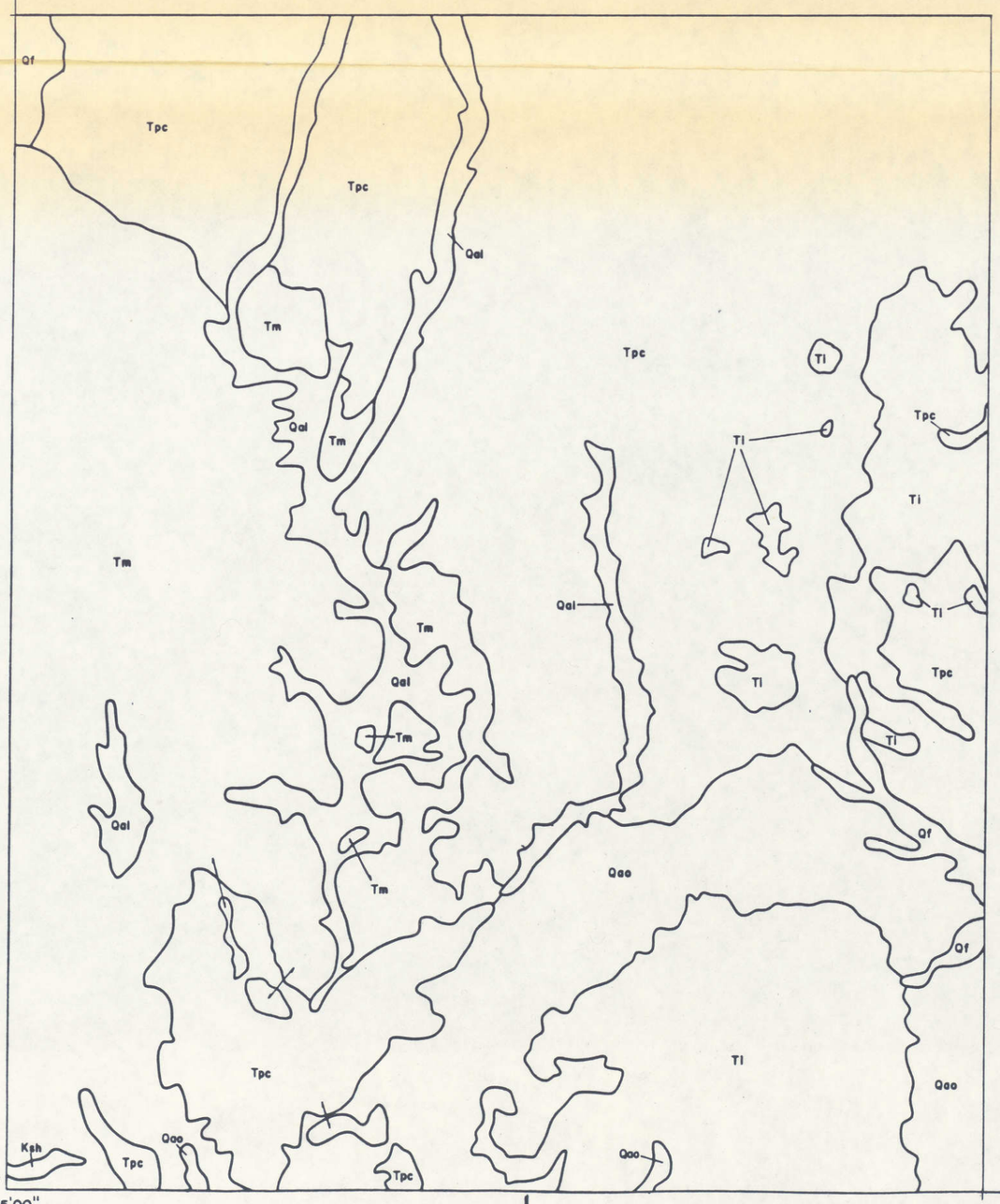
1 5 0 1 2 3 4 5 KILOMETERS

BUCKSHOT
TEXAS B8

GEOLOGIC MAP

104°15'00"
30°00'00"

104°00'00"
30°00'00"



29°45'00"
104°15'00"

29°45'00"
104°00'00"

N

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1 5 0 1 2 3 4 5 KILOMETERS

BUCKSHOT
TEXAS

GEOLOGIC MAP

104°30'00"
29°45'00"

104°15'00"
29°45'00"

29°30'00"
104°30'00"

29°30'00"
104°15'00"

N

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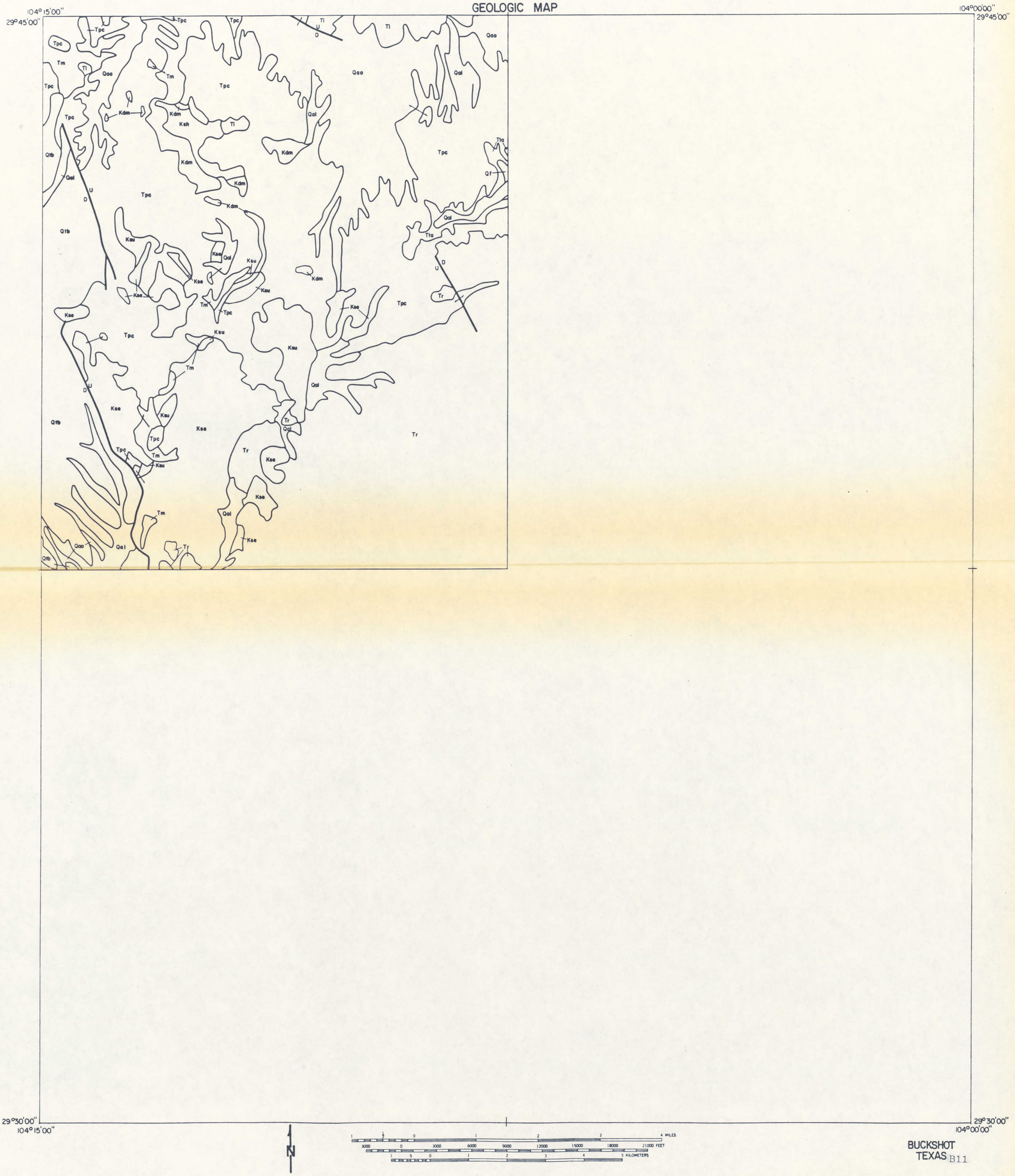
BUCKSHOT
TEXAS B10

GEOLOGIC MAP



BUCKSHOT
TEXAS

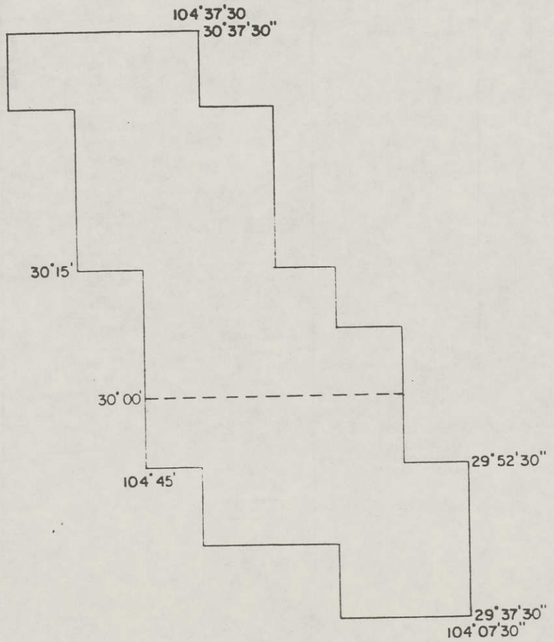
APPENDIX C - EXPLANATION OF GEOLOGIC LEGEND

GEOLOGIC LEGEND

of

BUCKSHOT

TEXAS
Marfa Sheet



THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY

GEOLOGIC ATLAS OF TEXAS

MARFA SHEET

W. H. VON STREERUWITZ MEMORIAL EDITION

VIRGIL E. BARNES, Project Director

1979

EXPLANATION

Recent (Holocene) and Pleistocene

Recent (Holocene)

Pleistocene

QUATERNARY

TERTIARY

Qws

Windblown sand

Qalr | Qal | Qf

Young Quaternary deposits

Qalr, alluvium along Rio Grande; floodplain deposits, silty sand; channel deposits, rounded pebbles, cobbles, and boulders up to 3 feet in size

Qal, alluvium and low terrace deposits along other streams, may include older Quaternary deposits in some areas

Qf, colluvium and fan deposits, includes older Quaternary deposits in some areas

Ql

Landslide deposits

Displaced bouldery masses of rock; on Van Horn-El Paso sheet southwest of Kent areas mapped as Tertiary volcanics are actually landslide deposits composed of volcanic debris

Qao

Old Quaternary deposits

Alluvium, colluvium, and caliche on surfaces dissected by modern drainage; sand, pebbles, cobbles, boulders up to 4 feet in size, composed of chert, quartzite, limestone, and volcanic rocks of vesicular, aphanitic, and porphyritic textures; unconsolidated to partly consolidated by caliche cement

QTb | QTg

Bolson and other similar deposits

Bolson deposits, QTb, clay, silt, sandstone, and conglomerate; finer grained materials in central part, coarsens toward margins where lenses of pebble to boulder conglomerate are common, mostly pale red to light brown; thickness in southern area up to 2,000 feet

Other similar deposits, QTg, consolidated valley fill, in Musgrave Canyon

Ti

Intrusive igneous rocks

Intrusive igneous rocks, stocks, laccoliths, sills, and dikes. Major rock types—basalt, hawaiite, mugearite, trachyte, quartz trachyte, rhyolite, phonolite, latite, trachyandesite, and their coarser grained equivalents

TERTIARY

	Mostly along Rio Grande	Eagle, Van Horn, and Wiley Mountains	Sierra Vieja	Davis Mountains	Southeastern area
	Tt Tarantula Gravel				Tpc Perdiz Conglomerate
	Tpe Petan Basalt	Tpe Petan Basalt	Tpe Petan Basalt	Tpe Petan Basalt	Tpe Petan Basalt
			Tta Tascotal Formation		Tta Tascotal Formation
			Tmm Mitchell Mesa Welded Tuff	Tbm Brooks Mountain Formation	Tmm Mitchell Mesa Welded Tuff
	Tv Volcanic rocks undivided	Tga Undivided part of Garren Group		Tgc Goat Canyon Formation	
				Tme Medley Formation	
Oligocene				Twc / Ter / Twb / Tml / Tbs Wild Cherry, Eppenauer Ranch, Mount Locke, and Barrel Springs Formations; and Wild Cherry-Barrel Springs undivided	
	Tsh8 Tsh7 Tsh6 Tsh3-5 / Tsh5 Tsh2 Tsh1 Shely Group	Garren Group Tp Pantera Trachyte	Tca Capote Mountain Tuff	Tm Merrill Formation	Buck Hill Group
				Tsp Sheep Pasture Formation	Td / Tdp Duff Formation and Duff and Pruett Formations undivided
			Vieja Group	Tfc Frazier Canyon Formation	
			Tbr Bracks Rhyolite	Tac Adobe Canyon Formation	
		Thg Hogeye Tuff	Tch Chambers Tuff	Tg Gomez Tuff	
	Tvj Vieja Group undivided	Tur / Ttr / Tlr Upper rhyolite, Trachyte porphyry, Lower rhyolite	Tbu Buckshot Ignimbrite	Th Huelster Formation	
Eocene			Tco Colmena Tuff		
			Tgi Gill Breccia		

Tarantula Gravel, Perdiz Conglomerate, and volcanic rocks

Correlation of volcanic rocks from area to area in the Marfa sheet is uncertain and the arrangement of blocks in the diagram below, modified from Page Twiss, does not necessarily imply correlation. Because of this, the rocks will be described by areas with little attempt to correlate between areas

ALONG RIO GRANDE

Tarantula Gravel, Tt, composition related to rock types in nearby areas; upper part: fragments of subrounded tuff, trachyte, basalt, and ignimbrite; lower part: subrounded to rounded quartzite and limestone pebbles and cobbles probably derived from basal conglomerate of Colmena Formation; occurs southwest of Van Horn Mountains in northern Rim Rock Country; thickness up to approximately 400 feet

Petan Basalt, Tpe, trachyandesite porphyry, dark greenish gray to brownish gray; thickness up to 510 feet (includes Bell Valley Andesite of the Wiley Mountains area and the Jones Formation of the southern Davis Mountains)

In Quitman Mountains, volcanic rocks undivided, Tv, from top down: basalt float; upper ignimbrite composed of banded tuff and flow breccia; upper tuff, soft, pink, includes tuffaceous clay, white, about 12 feet thick; trachyte porphyry, greenish gray, thickness about 20 feet, K-Ar ages 30.5 to 32.9 ± 0.6 m.y.; "andesite," red to grayish brown, vesicular to amygdaloidal; middle tuff, aphanitic tuff and tuff breccia; middle ignimbrite, composed of a recessive upper unit and a resistant lower unit, thickness 100 feet or more; lower tuff, fine grained, foliated, gray sandy tuff, tuff, and tuff breccia, thickness more than 100 feet; lower ignimbrite, composed of an upper grayish red, lithic welded tuff and a lower dark gray to black, vitric welded tuff; thickness of total sequence 600 feet, probably correlative with Vieja Group

In Pinto Canyon area, Shely Group, Tsh, from top down: Tsh8—Spherulitic rhyolite, excellent flow banding, aegirine-bearing, slightly porphyritic, medium bluish gray to green-speckled yellowish gray, thickness up to 250 feet. Tsh7—Ignimbrite, rhyolitic, very fine grained, hard, partly devitrified, various shades of brown, gray, and pink, thickness up to 75 feet. Tsh6—Ignimbrite, rhyolitic, very fine grained, hard, slightly vesicular, medium grayish red, medium brownish gray in middle, abundant angular xenoliths of light gray, very fine grained trachyte(?), thickness 200 to 250 feet. Tsh5-3—Upper third of unit 5, tuff, thin bedded, conglomeratic, very light gray to white, locally perlite at top up to 100 feet thick; middle third, a wedge of conglomerate, pebbles, cobbles, and boulders of igneous rock in a matrix of tuffaceous sand; lower third, tuff, conglomeratic, calcareous, thin bedded, very pale green to very light gray, thickness not given. Unit 4, breccia. Unit 3, Rhyolite, two flows totaling 70 feet in thickness. Tsh2—Trachyte, consists of numerous separate tongues of breccia and massive lava composed of plagioclase trachyte porphyry and vitrophyre, medium purplish gray to grayish red, thickness up to 400 feet, crops out at north end of Chinati Mountains. Tsh1—trachyte tuff and red siltstone

West of Sierra Vieja, where Bracks Rhyolite absent, Vieja Group, undivided, Tvj

EAGLE, VAN HORN, AND WYLIE MOUNTAINS

Petan Basalt, Tpe (Bell Valley Andesite of Wylie Mountains), described above

Garren Group (undivided part), Tga, in Wiley Mountains area, from top down includes Zopilote Breccia, trachyte lithic flow-breccia, hard, massive, grayish red, thickness approximately 150 feet; Means Trachyte, aphanitic, vesicular, hard, dark gray to black, thickness 530 feet; Fairbury Trachyte, from top down: lapilli tuff and ashy tuff grading downward to agglomerate of 2- to 12-inch fragments of trachytic felsophyre in an ashy matrix, anorthoclase trachyte up to 100 feet thick, porphyritic plagioclase trachyte up to 390 feet thick, and a basal flow breccia member, massive, reddish brown to grayish red, thickness 140 feet, K-Ar age 36.9 ± 0.8 m.y.; Moon Trachyte (eastern equivalent of the Fairbury Trachyte), composed of an upper platy quartz trachyte 350 feet thick, and a lower aphanitic quartz trachyte, moderate red to grayish red, up to 70 feet thick. In Van Horn Mountains area, from top down: "andesite," dark gray; ignimbrite, slightly porphyritic rhyolite, conchoidal fracture, dark yellowish brown, thickness 30 feet; tuff including tuffaceous sandstone and conglomerate, dark yellowish brown to very pale orange; thickness about 200 feet; basalt, slightly porphyritic, hard, grayish black, thickness 20 feet; tuff, fine grained, friable, white, thickness about 50 feet; basalt, aphanitic, black, thickness 42 feet; tuff, friable, pale greenish yellow, weathers very pale orange, thickness 28 feet; trachyte, aphanitic at base, vesicular at top, light brownish gray, weathers to thin plates, moderate brown to brownish black, thickness more than 300 feet; vitric crystal tuff, coarse grained, friable, unbedded, yellowish gray to pinkish gray, thickness up to 140 feet

Pantera Trachyte, Tp, in Eagle Mountains, resistant, pale red or grayish red, with 6 feet of black- to light-gray welded crystal tuff at base, thickness 45 feet; in Van Horn Mountains, light brownish gray to grayish red, thickness about 40 feet; in Wiley Mountains, hard, nonvesicular, reddish brown; thickness 100 to 300 feet; K-Ar ages 32.4 ± 1.7 and 34.2 ± 3.0 m.y. (2 samples)

Hogeye Tuff, Thg, in Eagle Mountains area, southern Indio Mountains, composed of an upper tuff, middle trachyte, and lower tuff; thickness 75, 170 to 250, and 30 feet, respectively; in Van Horn Mountains, composed of an upper sandstone, 7 to 80 feet thick, and a lower vitric tuff with lenses of conglomerate, 180 to 355 feet thick; in Wylie Mountains tuff and tuff breccia with basalt member near base; thickness 195 feet

Eruptive rocks of Eagle Mountains:

- Upper rhyolite, Tur, rhyolite including an upper volcanic breccia, flow breccia, and patches of basal conglomerate; volcanic breccia, fragments of volcanic rock, quartzite, and limestone in aphanitic matrix, white to light gray to very pale orange; rhyolite, aphanitic, compact, brittle, intensely fractured, light gray to medium dark gray to dark greenish gray to pale blue; thickness 1,500 to 2,000 feet at Eagle Bluff, thins northward and westward
- Trachyte porphyry, Ttr, hard, compact, weathers to angular blocks, various shades of grayish red, pale red, pale brown, with very pale orange phenocrysts of alkali feldspar; thickness up to approximately 750 feet
- Lower rhyolite, Tlr, a sequence of tuff, flow breccia, volcanic breccia, extrusive and intrusive rhyolite, with sedimentary rock at the base; thickness more than 1,000 feet

SIERRA VIEJA

Petan Basalt, Tpe, described above

Tascotal Formation, Tta, upper part: sandstone, tuffaceous sandstone, and conglomerate; sandstone medium to coarse grained with lenses, beds, and channel fillings of pebble to cobble conglomerate, mostly limestone, some igneous rocks and chert, about half of interval is tuff and sandy tuff. Lower part: tuff, flaggy, slightly calcareous, light colored; some interbeds of tuffaceous fine-grained sandstone. Thickness 710 feet

Mitchell Mesa Welded Tuff, Tmm, cliff-forming ash flow, generally nonwelded to slightly welded, where more than 30 feet thick pronounced foliation in a broad zone about midway between base and center; in type area porphyritic, phenocrysts of quartz and chatoyant sanidine up to 0.2 inch in size in aphanitic, pink to reddish-gray groundmass; weathers dark reddish gray to black; thickness up to 255 feet, averages about 45 feet (includes Brite Ignimbrite of Rim Rock Country); K-Ar age 31.5 ± 0.7 m.y. (18 determinations)

Capote Mountain Tuff, Tca, fine-grained, vitric, tuffaceous sandstone and siltstone, a few interbeds of conglomerate; on the north very light gray a few pale red beds, on the south lower 2/3 pale red, upper 1/3 very light gray; thickness 600 to 2,100 feet; contains Oligocene vertebrate fossils

Bracks Rhyolite, Tbr, slightly porphyritic with rhombic anorthoclase phenocrysts up to 3 mm in diameter, matrix alkalic feldspar, quartz, and mafic minerals; dark reddish brown to grayish olive; thickness up to 360 feet; K-Ar ages 36.5 ± 1.2 m.y., 36.8 m.y.

Chambers Tuff, Tch, fine grained, crystal-vitric tuff, moderate to well bedded, pale red, grayish pink, grayish green, pale purple, and grayish orange pink; a persistent layer of coarse sandstone in southern area with some conglomerate 130 feet above base; thickness 105 to 750 feet; contains Oligocene vertebrate fossils

Buckshot Ignimbrite, Tbu, rhyolitic, slightly porphyritic, vitric, contains very dark red spheres 2 to 10 mm in diameter; black vitrophyre at base in many places; grayish red, weathers pale to dark reddish brown; many blister cones, 6 feet high and up to 45 feet in diameter, on upper surface; thickness 40 to 75 feet, average 45 feet; range of K-Ar ages 38.6 ± 1.2 m.y., 34.7 ± 2.0 m.y., 35.2 ± 2.3 m.y., 36.3 ± 0.8 m.y. (2 samples)

Colmena Tuff, Tco, fine-grained, thin-bedded tuffaceous sandstone and pebble-to-boulder limestone-and-sandstone conglomerate; some nonmarine limestone, silty claystone, and glassy flow-rock, pale red to white; mostly tuffaceous sandstone and limestone on south, mostly conglomerate on north; includes Jeff Conglomerate which is not separately mapped; thickness up to 450 feet; contains Eocene vertebrate fossils

Gill Breccia, Tgi, flow breccias of three types; medium gray fragments in a grayish-red matrix; variegated mottled fragments in a dark greenish-gray to orange-pink matrix; and brecciated to massive light-olive-green to greenish-gray, fine-grained rock; deposited on irregular surface, restricted to southern 1/3 of area; thickness up to about 360 feet; K-Ar age of volcanic rock from breccia 40.0 ± 2.0 m.y.

DAVIS MOUNTAINS

Petan Basalt, Tpe (Jones Formation of southern Davis Mountains), described above

Brooks Mountain Formation, Tbm, porphyritic trachyte, with colorless to gray alkali feldspar phenocrysts, aphanitic to very fine grained in lower part, fine grained in upper part, weathers grayish brown; forms steep, locally vertical cliffs; in Brooks Mountain area of southern Davis Mountains; maximum thickness 985 feet

Goat Canyon Formation, Tgc, porphyritic-aphanitic trachyte, with white alkali feldspar phenocrysts, hard, gray to greenish gray; weathers platy, grayish white to yellow brown; thickness 515 feet in type section in Goat Canyon, southern Davis Mountains, 8 miles to east thins to 100 feet; K-Ar age 36.8 ± 0.7 m.y.

Medley Formation, Tme, latite porphyry, vesicular, gray; weathers brownish gray to reddish gray; in southern Davis Mountains; thickness uncertain as upper portion covered by talus from Goat Canyon Formation, maximum measureable section 22 feet

Wild Cherry Formation, Twc, from top down: indurated to friable, fine-grained vitric tuff; foliated, porphyritic rhyolite; black, foliated vitrophyre; thickness 355 feet at type locality, thins southward

Eppenauer Ranch Formation, Ter, basalt, aphanitic, hard, massive to vesicular, dark brown to black; thickness probably exceeds 100 feet

Mount Locke Formation, Tml, quartz trachyte and rhyolite porphyry, gray, weathered surface rough, brownish gray to reddish brown; thickness 580 feet at type locality, thins rapidly westward and southwestward

Barrel Springs Formation, Tbs, from top down: indurated to friable, fine-grained vitric tuff; nonfoliated porphyritic rhyolite; pinkish gray to purplish brown, foliated porphyritic rhyolite; black, foliated vitrophyre; thickness about 105 feet at type locality, thickens eastward to 250 feet, thins westward; K-Ar age, 35.6 ± 0.3 m.y. (4 samples)

Wild Cherry and Barrel Springs Formations undivided, Twb, where Mount Locke Formation is absent and the remaining formations become similar in appearance

Merrill Formation, Tm, latite porphyry, hard, reddish brown, weathers with pitted surface, brown to yellowish brown, locally fine- to coarse-grained, vitric-lithic tuff at top; thickness about 130 feet, pinches out rapidly eastward

Sheep Pasture Formation, Tsp, slightly porphyritic rhyolite, indurated to friable, grayish purple to brown; fine-grained vitric tuff locally near top; thickness at type section 510 feet; K-Ar age, 36.2 ± 0.4 m.y. (2 samples)

Frazier Canyon Formation, Tfc, vitric-lithic-crystal tuff and lapilli tuff, locally contains conglomerate and sandstone, poorly bedded; white to light brown, gray, yellow, or green; up to 340 feet thick

Adobe Canyon Formation, Tac, rhyolite and trachyte flows with a basal trachyte porphyry ("Big Brown Porphyry" Member) up to 425 feet thick with anorthoclase phenocrysts up to 8 mm in diameter and clinopyroxene microphenocrysts; rest of formation multiple flow units, massive at base, vesiculated near top; gray, brownish gray, or bluish gray, weathers light brown; up to 1,000 feet thick; K-Ar age 37.1 ± 0.4 m.y. (2 samples)

Gomez Tuff, Tg, peralkaline ash-flow tuff, densely welded to friable, one cooling unit; contains 1.5 mm phenocrysts of anorthoclase and some quartz, and micro-phenocrysts of aegirinaugite and some fayalite; abundant xenoliths of mafic lava, limestone, sandstone, biotite schist, and other rock types; gray, brown, green, and reddish brown to black devitrified glass; thickness up to 1,200 feet, average 300 to 400 feet; K-Ar age, 36.6 ± 0.7 m.y. (6 samples)

Heulster Formation, Th, mostly tuff, thin layers of sandstone and conglomerate, lenses of fresh-water limestone, and trachydoleritic lava; forms landslide terrain of hummocky, grass-covered hills, includes displaced blocks of overlying flow-rock units; thickness up to 490 feet in Madera Canyon. Jeff Conglomerate Member locally at base not separately mapped.

SOUTHEASTERN AREA

Perdiz Conglomerate, Tpc, fanglomerate of highly variable composition shed mostly northeastward from Chinati Mountains in Cuesta del Burro region; thickness up to about 500 feet

Petan Basalt, Tpe, described above

Tascotal Formation, Tta, described above

Mitchell Mesa Welded Tuff, Tmm, described above

Duff Tuff, Td, chiefly rhyolitic ruff with minor breccia and conglomerate; tuff fine grained, well indurated, massive, mostly white, light shades of red and yellow common; conglomerate in lenticular beds up to 40 feet thick, crossbedded, dark brown; thickness up to 1,400 feet; contains Oligocene vertebrate fossils

Duff Tuff and Pruett Formations undivided in Cuesto del Burro area, Tdp, rhyolitic tuff and intercalated tuffaceous clay, silt, sandstone, and conglomerate, moderate to well indurated, white, gray, red, and yellow; thickness up to 1,500 feet

Upper Cretaceous

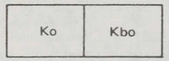
Lower Cretaceous

El Picacho Formation

Claystone, sandstone, and lignite; upper part: claystone, massive, purplish gray, white, pale red, a few yellowish gray sandstone beds; middle part, sandstone, forms prominent ledges, about 175 feet thick; lower part: claystone, alternations of bright purple, gray, pink, white, capped by carbonaceous clay and lignite, thickness about 250 feet; thickness of El Picacho Formation 825 feet

San Carlos Sandstone

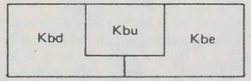
Fossiliferous sandstone and clay containing coal; thickness at least 1,400 feet



Ojinaga Formation and Boquillas Limestone

Ojinaga Formation, Ko, in Quitman Mountains, shale, black, fissile; a few beds of sandstone and limestone, basal 50 feet flaggy; thickness 2,000+ feet. In Eagle Mountains area, shale, brown, fissile, calcareous, in part sandy; shale, black, fissile; and sandstone, calcareous, flaggy; thickness 1,400+ feet. In Van Horn Mountains area, mostly shale, calcareous, grayish orange; lower 150 feet mostly limestone, microgranular, flaggy, fossiliferous, pale yellowish brown and interbeds of calcareous shale; thickness 840+ feet (mapped as Chispa Summit Formation, Kcs, on Van Horn-El Paso sheet to north)

Boquillas Limestone, Kbo, limestone, marl, and shale; upper part: interbedded marl and shale; lower part: limestone, silty to sandy, flaggy, dark grayish orange near base; marine megafossils; confined to a few thin outcrops in the northeastern corner of sheet



Buda Limestone, Buda Limestone and Del Rio Clay undivided, and Buda Limestone and Eagle Mountain Sandstone undivided

Buda Limestone and Del Rio Clay undivided, Kbd, in Pinto Canyon area

Buda Limestone and Eagle Mountain Sandstone undivided, Kbe, in Quitman, Eagle, and Van Horn Mountains areas

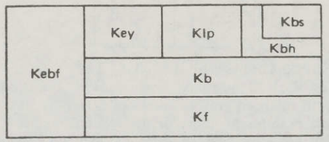
Buda Limestone, Kbu, in Quitman Mountains, upper part: limestone, thin to thick bedded, resistant, a few chert nodules; middle part: interbedded gray limestone, marl, and calcareous shale, recessive, limonite nodules common; lower part: limestone, aphanitic, thin to thick bedded, fossiliferous; thickness of formation 200 to 350 feet. In Eagle Mountains area, very fine grained, nodular, thin bedded, marine megafossils common, light brownish gray; thickness about 225 feet. In Van Horn Mountains, fine grained, medium to thick bedded, medium light gray; thickness about 135 feet. In Wiley Mountains, microgranular, hard, pale yellowish brown, fossiliferous; thickness 40 to 150 feet. In Davis Mountains area, thin to thick bedded, sandstone locally at base; thickness about 140 feet. In Pinto Canyon area, limestone, nodular, resistant, light gray; thickness 5 feet to Tertiary overlap

Del Rio Clay, light gray to light yellow-gray marl interbedded with limestone, argillaceous, nodular, light gray; thickness 87 feet

Eagle Mountain Sandstone, very fine-grained quartz, calcareous, ferruginous, crossbedded in part, thin bedded, yellowish brown; some beds of limestone, fine grained, sandy, and shale, calcareous, olive gray; weathers shades of orange and brown, outcrop littered by angular, platy sandstone fragments; thickness 130 feet

CRETACEOUS

Lower Cretaceous



Espy, Loma Plata, Boracho showing San Martine Member, and Finlay Limestones, and Benevides Formation, and Espy Limestone, Benevides Formation, and Finley Limestone undivided

Espy Limestone, Key; Loma Plata Limestone, Klp; Boracho Limestone, Kbh, showing San Martine Limestone Member, Kbs, locally; Benevides Formation, Kb; Finlay Limestone, Kf; and Espy Limestone, Benevides Formation, and Finlay Limestone undivided, Kebf, in Spar Valley area of Eagle Mountains

Espy Limestone, Key, in Quitman Mountains, upper part: limestone, recessive, thin to thick bedded, fossiliferous, interbedded with limestone, in part nodular, in part flaggy, sandy, and shale, calcareous; lower part: limestone, resistant, thin to thick bedded, with marl and shale interbeds. In Eagle Mountains area, limestone, very fine grained, thin bedded, medium light gray to brownish gray, fossiliferous, interbedded with marl; estimated thickness about 2,200 feet

Loma Plata Limestone, Klp, in Van Horn Mountain area, upper part: fine grained, thick to very thick bedded, medium light gray, fossiliferous; thickness 400 feet; lower part: fine grained, nodular, thin to thick bedded, medium gray, some interbeds of shale, laminated, calcareous, thickness 285 feet. In Pinto Canyon area, upper part: fine to medium grained, cherty, thick bedded, massive, light brownish gray, rudistid-bearing, thickness 380 feet; lower part, upper half cliff-forming limestone, aphanitic, nodular, very light gray, grading down to shale, silty, brownish yellow, interbedded with thin, limestone beds, nodular, thickness 340 feet

Boracho Limestone, Kbh, in Wiley Mountains, upper part (San Martine Limestone Member): microgranular, hard, thick bedded, fossiliferous, pale yellowish brown; lower part (Levinson Limestone Member): marl, mostly covered; thickness of formation 180 to 330 feet. San Martine Limestone Member, Kbs, mapped separately northwest of Boracho Peak

Benevides Formation, Kb, in Quitman Mountains, upper part: shale, gray, fissile, a few thin limestone interbeds, nodular, gray; middle part: limestone, thick bedded, probably a rudistid reef; lower part: shale, dark gray, calcareous, interbedded with sandstone, fine grained, thin bedded, calcareous, and limestone, nodular; thickness of formation probably about 400 feet. In Eagle Mountains area, upper part: sandstone, fine to medium grained, calcareous, pale orange to pinkish gray, ledge-forming; lower part: siltstone and shale. In Van Horn Mountains, upper 25 feet: sandstone, medium grained, calcareous, lower 135 feet: limestone, nodular, thin bedded, sandy, shaly, interbedded with marl, pale orange and yellowish gray. In Pinto Canyon area, upper part: limestone, granular, yellow brown, forms a prominent caprock; lower part: shale, dark gray, thickness 125 to 150 feet

Finlay Limestone, Kf, in Quitman and Eagle Mountains, alternating resistant and recessive units, limestone, fine grained, some beds cherty, thick bedded, fossiliferous, medium gray, weathers pale yellowish brown; shale, silty, calcareous; toward base some siltstone and sandstone; thickness up to 700 feet. In Van Horn Mountains, fine grained, thick bedded and massive in upper part, light gray; toward base, sandy, marly, thin bedded, nodular; thickness 175 feet. In Pinto Canyon area, upper part: aphanitic, in part cherty, thick bedded, white; lower part: marly, sandy toward base; thickness 300 feet. In the Wiley Mountains, microgranular, sandy toward base, fossiliferous, light yellowish brown; thickness 110 to 170 feet. In the Davis Mountains south of Sawtooth Mountain, metasedimentary marble and quartzite, tightly folded, probably Finlay

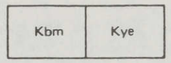
CRETACEOUS

Cox Sandstone

In Quitman Mountains, upper part: interbedded sandstone, fine grained, calcareous, siltstone, shale, limestone, sandy, nodular, fossiliferous, thickness 360 feet; middle part: limestone, thick-bedded, reefy, rudistid-bearing, thickness 250 feet; lower part: interbedded shale, calcareous, sandstone, fine grained, laminated to cross laminated, siltstone, and limestone, sandy, fossiliferous; thickness 1,100 feet. In Eagle Mountains area, mostly sandstone, fine- to medium-grained quartz, some granules and pebbles

Lower Cretaceous

locally, crossbeds, ripple marks, and slump folds common, ranges from white through various shades of gray, orange, and brown; shale and limestone beds mostly covered; thickness about 560 to 1,740 feet, thins northwestward. In Van Horn Mountains, similar to preceding, thickness in excess of 1,000 feet. In Wiley Mountains, northeastern part 130 feet of pebble conglomerate with sandstone matrix and lenses, pebbles well rounded; thickens southwestward to 530 feet of sandstone, fine grained, brownish white to grayish orange. In Pinto Canyon area, upper part: one-third limestone, nodular, medium to thick bedded, very light gray, rest, shale, marl, and sandstone; lower part: mostly sandstone, fine to medium grained, hard, resistant, quartz-cemented, thick bedded, crossbedded, weathers reddish brown, interbedded with sandstone, soft, light colored, and shale, gray, red, and purple; thickness about 450 feet



Bluff Mesa and Yearwood Formations

Bluff Mesa Formation, Kbm, in Quitman Mountains, upper part: limestone, fine grained, massive to thick bedded, dark gray, *Orbitolina*-bearing, at top thin bedded, thickness 600+ feet; middle part: interbedded shale, black-gray, calcareous, limestone, thin bedded, fossiliferous, and sandstone, medium to fine grained, calcareous, massive to thick bedded, thickness 600 feet; lower part: interbedded limestone, fine grained, gray, shale, calcareous, limestone, very sandy, fossiliferous, sandstone, fine grained, calcareous, toward base crossbedded, at base locally conglomeratic, thickness 770 feet. In Eagle Mountains area, limestone, black, nodular, limestone pebble conglomerate, shale, brown, and some sandstone, *Orbitolina* abundant in limestone, thickness up to 1,500 feet. In Van Horn Mountains area, from top down: limestone, fine grained, medium to thick bedded, yellowish gray to medium dark gray, thickness 126 feet; sandstone, fine to medium grained, thin to medium bedded, light olive gray, thickness 390 feet; and interbedded quartzose sandstone, thick bedded, light brownish gray, and limestone, granular, medium gray, thickness 86 feet. In Pinto Canyon area, upper part: limestone, nodular, dark gray, *Orbitolina*-bearing, interbedded with sandstone, crossbedded, light colored, thickness 450 feet; lower part: limestone, thick bedded, very light gray, thickness 200 feet

Yearwood Formation, Kye, south of Kent area Van Horn sheet, limestone and interbedded shale, thin to thick bedded, light gray

CRETACEOUS

Yucca Formation

In Quitman Mountains, upper part: limestone, microgranular, gray, yellow, mudstone, soft, calcareous, nodules of green weathering microgranular calcite common, a few beds of limestone-pebble conglomerate near base, gray-maroon, thickness 400 to 1,100 feet; middle part: sandstone, hard, siliceous to calcareous, conglomeratic, pink, yellowish brown, light brown, mudstone, red, pink, silty, pebbles composed of chert, red, black, gray, quartz of various shades, low-grade metamorphic rock fragments and limestone, thickness 3,660 feet; lower part: limestone, microgranular, yellow, light gray, interbedded with sandstone, fine grained, orange, red, and mudstone, thickness 630+ feet. In Eagle Mountains area, upper part: sandstone, siltstone, shale, and limestone, green weathering calcareous nodules common; lower part: sandstone, conglomeratic sandstone, and conglomerate; sandstone, fine to medium grained, moderate to well-sorted quartz, calcareous; granules and pebbles, rounded to subrounded, chert, pale red, black, quartz, white, pink, and limestone, gray; overall color of formation red-brown; thickness 2,021 feet measured in Indio Mountains, basal part faulted out, 600 to 700 feet near Eagle Spring. In Van Horn Mountains, sandstone, friable, siliceous, grayish red, lenses of chert-pebble conglomerate, thickness about 250 feet. In Pinto Canyon area, upper part from top down: shale, red, purple, sandstone, brown, and one limestone marker bed, fine grained, yellow orange, thickness 50 feet; sandstone, medium grained quartzitic, crossbedded, weathers dark brown, interbedded with sandstone, calcareous, recessive, thickness 100 feet; limestone, granular, gray, red, forms 2 or 3 40-foot cliffs, thickness 200 feet; and limestone and limestone conglomerate, granular, shale, sandstone, calcareous, and limestone, nodular, thickness 200 feet; lower part: conglomerate composed of limestone pebbles and cobbles, light gray and light yellow-gray, scattered chert pebbles, black, white, green, in a matrix of calcite, fine grained, light gray; typically forms a cliff 100 feet high

Guadalupe

Guadalupe & Leonard

Leonard

PERMIAN

Pmg

Mina Grande Formation

Limestone, hard, massive, dolomitic, reefy, surface rough and hackly with brecciated appearance, gray to yellow to yellowish brown; serves as chief lead and silver host rock in Shafter district to the south; thickness up to 200 feet, feathers out both to northwest and southeast

Psr | Prm

Seven Rivers and Ross Mine Formations

Seven Rivers Formation, Psr, in Wiley Mountains area, limestone, fine grained, hard, thick bedded, nonfossiliferous, light colored; thickness 160 feet

Ross Mine Formation, northern Chinati Mountains, sandstone, shale, chert, and limestone; thickness 100 to 600 feet, thins northwestward

Pp

Pinto Canyon Formation

In Pinto Canyon area, from top down: siltstone, dolomitic, cherty, pyritiferous, bituminous, thin to medium bedded, microgranular limestone concretions up to 4 feet long, weathers reddish brown, thickness 93 feet in type section, probably correlates with Ross Mine Formation; limestone, microgranular, bituminous, dark gray, in part fossiliferous, in 3-foot ledges, gray weathering, interbedded with chert, bituminous, pyritiferous, internally laminate, dark gray, in part clayey, thickness 170 feet; submarine-slide blocks of irregularly bedded chert, cherty limestone, microgranular limestone, calcareous sandstone, and cherty sandstone grading laterally within a few feet into regularly bedded chert and limestone, thickness 110 to 170 feet; and chert, dark gray, and limestone, microgranular, medium bedded, interbedded with siltstone, recessive, thickness 95 to 170 feet; thickness of formation about 550 feet

Pvc | Pci

Victorio Peak and Cibolo Formations

Victorio Peak Formation, Pvc, in Van Horn Mountains area, upper part: limestone, dolomitic, fine grained, medium to thick bedded, unfossiliferous, brownish black to medium gray, weathers pale orange, thickness about 180 feet; lower part: probably medium grained dolomite sand cemented by sparry calcite, about 10 percent porosity, medium bedded, grayish orange to yellowish gray, thickness about 80 feet. In Wiley Mountains area, from top down: dolomite, medium grained, porous, massive, pale brownish gray, thickness 1,100 feet; marl, recessive, thickness 15 feet; limestone and dolomite, fine grained, thin to medium bedded, gray to light brownish gray, weathers grayish white to yellowish gray, thickness 470 feet; marly limestone and marl, in part dolomitized, red silty shale, and crossbedded limestone-pebble conglomerate, thickness 520 feet

Cibolo Formation, Pci, in northern Chinati Mountains, from top down: limestone, dolomitic, hard, yellow, thickness 650 feet; limestone, cherty, compact, evenly bedded, in part sandy, dark colored, thickness 470 feet; limestone, somewhat thinner bedded than above, sponge spicules abundant, thickness 85 feet; limestone, in thick ledges, mostly brecciated, grayish white, thickness 133 feet; transition beds of gray marly shale with bioclastic sandstone beds above and pure quartz sandstone beds below, thickness 100 feet; thickness of formation 1,450 feet, thin northwestward to 150 feet

Wolfcamp

PERMIAN

Ph | Pa

Hueco Limestone and Alta Formation

Hueco Limestone, Ph, in Eagle Mountains area, mostly limestone, very fine grained, compact, thin bedded, medium gray to medium dark gray, fetid odor when fractured, irregular patches and nodules of chert in upper half, calcite veins common in lower half, thickness 1,060 feet measured in a section; at base Powwow Conglomerate, not separately mapped, consists of limestone, fine grained, light to dark gray, sandstone, fine to coarse grained, in part quartz, in part bioclastic, light gray, siltstone near base contains calcareous nodules, lowermost part angular fragments of Precambrian rock, poorly sorted, poorly consolidated, thickness 168 feet. In Van Horn Mountains, similar to lower part of Hueco Limestone in Eagle Mountains, thickness 400 feet; Powwow Conglomerate also similar to that in Eagle Mountains, thickness 20 to 250 feet. In Wiley Mountains, mostly limestone, microgranular, in part cherty, hard, pale brown to brownish gray and olive gray, thickness about 1,240 feet; Powwow Conglomerate at base composed of conglomerate, sandstone, siltstone, and shale with some marl and limestone near the top, crossbedding common, dark reddish brown; thickness 20 to 200 feet

Alta Formation, Pa, in Pinto Canyon area, mudstone, thin bedded, dark gray, and sandstone beds every few feet, fine grained, calcareous, in 6- to 12-inch ledges, dark gray, submarine slump features common; thickness 610 to 1,300 feet, thins northwestward. In northern Chinati Mountains, similar to the Alta Formation in Pinto Canyon area, upper part only crops out

PCv

Van Horn Sandstone

In Carrizo Mountains, feldspathic sandstone and arkose, medium to coarse grained, crossbedded, red, brown; pebble and cobble conglomerate in lower part

PCcs / PCci

Carrizo Mountain Group

Meta-igneous rocks, pCci, include amphibolite in the Eagle Mountains and Wiley Mountains areas; and pegmatite in the Mica Mine locality of the Van Horn Mountains area

Metasedimentary rocks, pCcs, include, in the Eagle Mountains area, feldspathic metaquartzite, thickness 3,200 to 3,400 feet; metaquartzite, phyllite, and mica schist, thickness about 600 feet; dark slate, dark phyllite, and black limestone, thickness not given. In the Van Horn Mountains and Carrizo Mountains, metaquartzite and metarkosite, thickness 3,400 feet in the Carrizos, 900 feet in the Van Horns; muscovite schist and metaquartzite with lenses of biotite schist and amphibolite, thickness 400 feet in the Carrizos and 1,500 feet in the Van Horns. In the Wylie Mountain area, meta-arkose, and biotite-muscovite schist; thickness not estimated

PERMIAN

PRECAMBRIAN

INDEX OF GEOLOGIC MAPPING

Numbers in outlined areas refer to items in bibliography in "Index to Aerial Geologic Maps in Texas, 1891-1961," by T. E. Brown (1963), Bureau of Economic Geology, The University of Texas at Austin. For area A, see B. R. Jones and D. F. Reaser (1970) Geology of southern Quitman Mountains, Hudspeth County, Texas, The University of Texas at Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 39; for area B, see J. R. Underwood, Jr. (1963) Geology of Eagle Mountains and vicinity, Hudspeth County, Texas, The University of Texas at Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 26; for area C, see J. E. Anderson, Jr. (1968) Geologic map of central Davis Mountains, Jeff Davis County, Texas, The University of Texas at Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 36; for area D, see P. C. Twiss (MS) Geologic map of northwestern part of Rim Rock Country, Presidio, Jeff Davis, and Hudspeth Counties, Texas, The University of Texas at Austin, Bureau of Economic Geology, Open File Map; for area E, see P. C. Twiss (MS) Geologic map of northeastern part of Rim Rock Country, Jeff Davis and Presidio Counties, Texas, The University of Texas at Austin, Bureau of Economic Geology, Open File Map; for area F, see P. C. Twiss (MS) Geologic map of southwestern part of Rim Rock Country, Presidio County, Texas, The University of Texas at Austin, Bureau of Economic Geology, Open File Map; for area G, see P. C. Twiss (MS) Geologic map of southeastern part of Rim Rock Country, Presidio County, Texas, The University of Texas at Austin, Bureau of Economic Geology, Open File Map; for area H, see C. G. Groat (1972) Presidio bolson, Trans-Pecos Texas, and adjacent Mexico: geology of a desert basin aquifer system, The University of Texas at Austin, Bureau of Economic Geology, Report of Investigations 76; for area I, see E. J. Dickerson (1966) Bolson fill, pediment, and terrace deposits of Hot Springs area, Presidio County, Trans-Pecos Texas, The University of Texas at Austin, Master's thesis.

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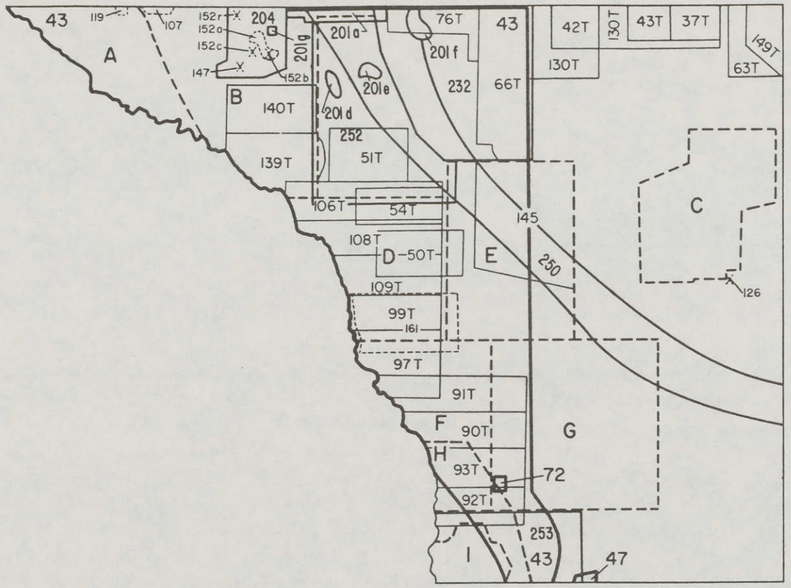


VIRGIL E. BARNES, PROJECT DIRECTOR

Geologic mapping mostly by P. C. Twiss, Kansas State University, Manhattan, Kansas, and sources shown on Index of Geologic Mapping. Geologic mapping gratefully acknowledged from Continental Oil Company, Cities Service Petroleum Company, and Geophoto Services, Inc. Geology in areas not previously mapped, mapped on high altitude aerial photographs by P. C. Twiss. Map scribed by R. L. Dillon. Geologic mapping reviewed by West Texas Geological Society, Geologic Atlas Committee, D. M. Norman (Markay Oil & Gas Company), Chairman, Clifford H. Sherrod, Jr. (consulting geologist), Bruce T. Pearson (independent), and Johnnie B. Brown (Allen K. Trobaugh); by Ronald K. DeFord, John A. Wilson, Stephen E. Clabaugh, Daniel S. Barker, and Fred W. McDowell, Department of Geological Sciences, The University of Texas at Austin; and Page C. Twiss, Department of Geology, Kansas State University, Manhattan.

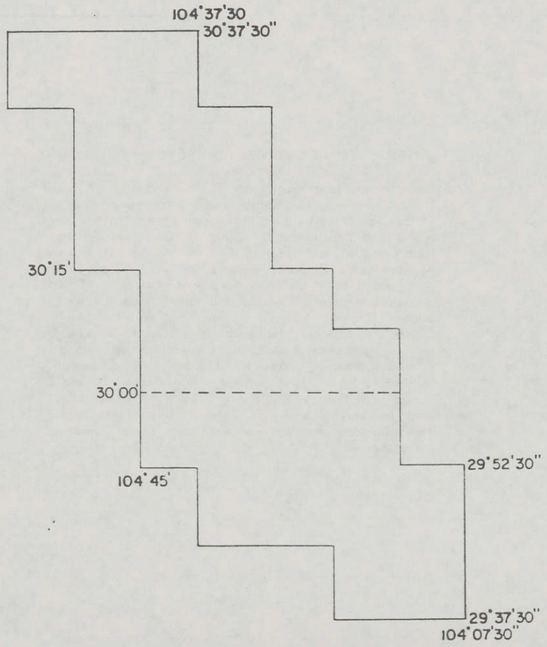
GEOLOGIC LEGEND

of

BUCKSHOT

TEXAS

Emory Peak—Presidio Sheet



GEOLOGIC ATLAS OF TEXAS

EMORY PEAK - PRESIDIO SHEET

JOSHUA WILLIAM BEEDE MEMORIAL EDITION

VIRGIL E. BARNES, Project Director

1979

EXPLANATION

Recent (Holocene) — QUATERNARY

Qws

Windblown sand

Qalr | Qal | Qf

Young Quaternary deposits

Qalr, alluvium along Rio Grande; floodplain deposits, silty sand; channel gravel, rounded pebbles, cobbles, and boulders up to 3 feet in size

Qal, alluvium and low terrace deposits along other streams, may include older Quaternary deposits in some areas

Qf, colluvium and fan deposits, may include older Quaternary deposits in some areas

Recent (Holocene) and Pleistocene — QUATERNARY

Ql

Landslide deposits

Displaced bouldery masses of rock

Pleistocene — QUATERNARY

Qao

Old Quaternary deposits

Alluvium, colluvium, and caliche on surfaces dissected by modern drainage; pebbles, cobbles, boulders up to 4 feet in size, and sand; unconsolidated to partly consolidated by caliche cement; composed of chert, quartzite, limestone, and volcanic rocks of vesicular, aphanitic, and porphyritic textures

Pleistocene — QUATERNARY

QTb | QTg | Tfi / Tde

Bolson and other similar deposits and Fingers and Delaho Formations

Fingers Formation, Tfi, (name not formalized) conglomerate and sandstone, poorly consolidated; in upper part mostly conglomerate, pebbles of tuff dominant; in middle part, mostly coarse quartz-poor arenite, some sandy siltstone, poorly cemented, cement mostly caliche-like, some spar; in lower part, large-pebble conglomerate, coarse sand matrix, pebbles mostly Tule Mountain Trachyandesite, red-brown; pebbles very angular throughout; thickness up to 700 feet

Pleistocene to Miocene — QUATERNARY & TERTIARY

Bolson deposits, QTb, clay, silt, sandstone, and conglomerate; mostly clay, silt, and gypsiferous fine-grained sandstone in central part of Presidio bolson, coarsens toward margins where lenses of pebble to boulder conglomerate are common, mostly pale red to light brown with hue less intense in sandstone beds; thickness up to 2,000 feet

Other similar deposits, QTg, consolidated high-level terrace gravel, pediment gravel, and valley-fill deposits mapped in Big Bend National Park and Black Gap area. In Castolon area Stevens (area G) subdivided QTog of this portion of the Big Bend National Park into three units, Old Quaternary deposits, Qao, Fingers Formation, Tfi, and Delaho Formation, Tde

Miocene — QUATERNARY & TERTIARY

Delaho Formation, Tde, composed of Smoky Creek Member and unnamed lower member. Smoky Creek Member, sandstone and conglomerate, pebbles coarser and with greater size range than in lower member, dominantly Tule Mountain Trachyandesite, in upper part to south, basalt pebbles dominant; sandstone, composed mostly of volcanic rock fragments in both members; festoon crossbedding well developed; thickness up to about 1,100 feet. Lower member, mostly sandy siltstone with lenses of silty sandstone, pebbly sandstone, and conglomerate; distinctive pebbles are riebeckite rhyolite and pink welded tuff with chatoyant sanidine phenocrysts, Tule Mountain Trachyandesite mostly absent; sedimentary structures scarce; thickness about 1,100 feet

Tv

Extrusive igneous rocks

Mapped separately in Black Gap area

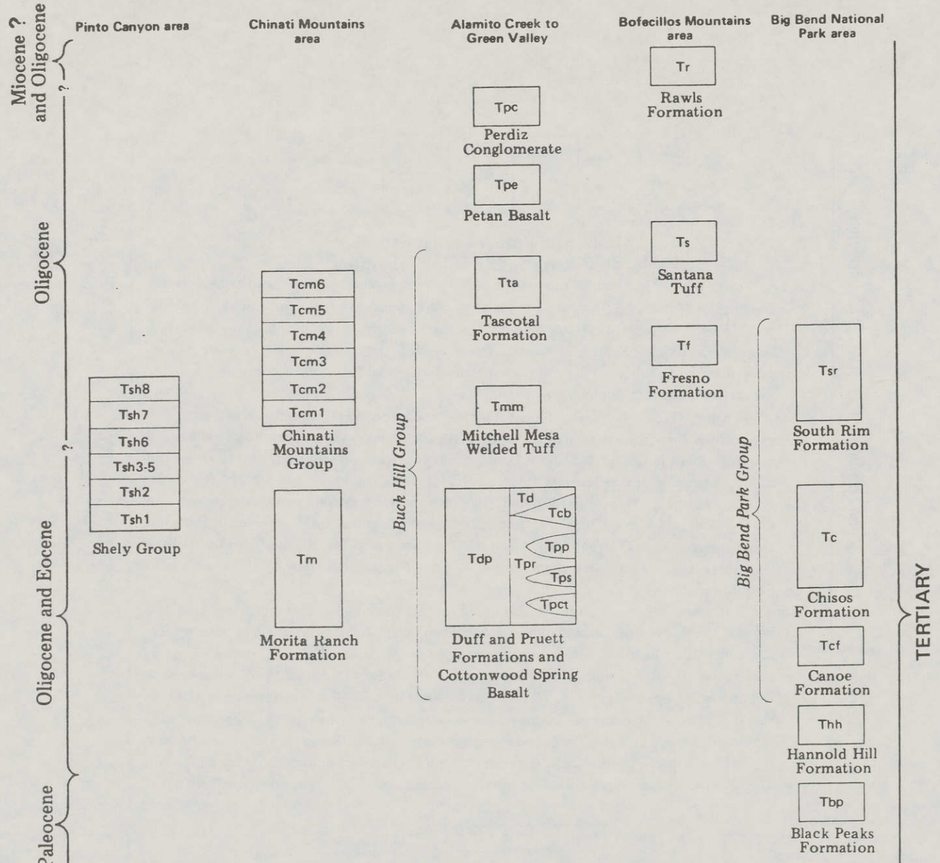
Tivb | Ti

Intrusive igneous rocks

Tivb, vent rock (quartz syenite and pyroclastics) and intrusive breccia associated with Bofecillos vent

Ti, stocks, laccoliths, sills, and dikes. Major rock types, basalt, hawaiite, mugearite, trachyte, quartz trachyte, rhyolite, phonolite, latite, trachyandesite, and their coarser grained equivalents. K-Ar ages: Solitario—Olivine syenite 26.4 ± 0.5 m.y., late soda rhyolite intrusion 34.3 ± 0.8 m.y., rim sill 36.6 ± 0.8 m.y., West Chinati—stock 31.2 ± 0.6 m.y., Yellow Hill area—32.7 ± 1.3, 35.0 ± 2.3, 40.1 ± 1.5 m.y.

TERTIARY



Correlation from area to area in the Emory Peak - Presidio sheet is uncertain and the arrangement of blocks in the preceding diagram does not necessarily imply correlation. Because of this the rocks will be described by areas with little attempt to correlate between areas.

PINTO CANYON AREA

Shely Group, Tsh, from top down: Tsh 8—Spherulitic rhyolite, excellent flow banding, aegirine-bearing, slightly porphyritic, medium bluish gray to green-speckled yellowish gray, thickness up to 250 feet. Tsh 7—Ignimbrite, rhyolitic, very fine grained, hard, partly devitrified, various shades of brown, gray, and pink, thickness up to 75 feet. Tsh 6—Ignimbrite, rhyolitic, very fine grained, hard, slightly vesicular, medium grayish red, medium brownish gray in middle, abundant angular xenoliths of light gray, very fine grained trachyte (?), thickness 200 to 250 feet. Tsh 3-5—Upper third of unit 5, tuff, thin bedded, conglomeratic, very light gray to white, locally perlite at top up to 100 feet thick; middle third, a wedge of conglomerate, pebbles, cobbles, and boulders of igneous rock in a matrix of tuffaceous sand; lower third, tuff, conglomeratic, calcareous, thin bedded, very pale green to very light gray, thickness not given. Unit 4, breccia. Unit 3, rhyolite, two flows totaling 70 feet thick. Tsh 2—Trachyte, consists of numerous separate tongues of breccia and massive lava composed of plagioclase trachyte porphyry and vitrophyre, medium purplish gray to grayish red, thickness up to 400 feet, crops out at north end of Chinati Mountains. Tsh 1—trachyte tuff and red siltstone

CHINATI MOUNTAINS AREA

Chinati Mountains Group, Tcm, trachyte, rhyolite, tuff, and conglomerate subdivided into six units from top down as follows: Tcm 6, upper rhyolite, coarse grained with granitic appearance, green; thickness more than 500 feet. Tcm 5, upper trachyte, olivine-augite trachyandesite, many thick flows, aphanitic to very fine grained, porphyritic, reddish brown to grayish black; thickness 930 feet. Tcm 4, lower rhyolite, many thick flows, fine grained, porphyritic, light brownish black; thickness 500 feet. Tcm 3, middle trachyte, many flows, very fine grained, porphyritic, hard and tough, medium to dark gray, light to dark olive gray, and dark greenish gray; weathers reddish; thickness 1,000 feet. Tcm 2, lower trachyte and tuff, very fine grained, amygdaloidal, porphyritic, dark reddish, interbedded with conglomeratic tuff, fine to coarse grained, greenish; thickness 500 feet. Tcm 1, conglomerate, boulders, cobbles, and pebbles in a matrix of sand, silt, and clay all derived from Comanchean rocks; thickness 100 feet. Thickness of formation about 3,500 feet. K-Ar ages, 31.9 ± 0.7 m.y. (3 determinations); age of West Chinati stock 31.2 ± 0.6 m.y.

Morita Ranch Formation, Tm, from top down four units, not separately mapped, olivine basalt, ash-flow tuff, rhyolite, and basalt porphyry. Olivine basalt, several flows, medium to very fine grained, grayish black, weathered surfaces light brown to dark reddish brown; thickness up to 250 feet. Ash-flow tuff, abundant feldspar and some quartz phenocrysts in an aphanitic matrix, rock fragments scarce to abundant, pale orange through grayish orange pink to reddish purple, weathered surfaces light brown to very dark reddish brown, forms bluff; thickness up to 75 feet. Rhyolite, succession of flows, tuff breccia, and conglomerate; rhyolite, flow banded and spherulitic, moderate red to dark yellowish brown; thickness up to 300 feet. Basalt porphyry, many flows, feldspars up to an inch across, medium gray to black, weathers light to medium gray; thickness up to 200 feet, crops out along Cienega Creek northeast of Presidio

ALAMITO CREEK - GREEN VALLEY AREA

Perdiz Conglomerate, Tpc, fanglomerate of highly variable composition shed mostly eastward from Chinati Mountains, overlies a highly irregular surface cut in Morita Formation and in pre-Cenozoic rock; up to about 500 feet thick

Petan Basalt, Tpe, Trachyandesite porphyry, dark greenish gray to brownish gray, maximum thickness 300 feet

Tascotal Formation, Tta, upper part, sandstone, tuffaceous sandstone, and conglomerate; sandstone medium to coarse grained with lenses, beds, and channel fillings of pebble to cobble conglomerate, mostly limestone, some igneous rocks and chert, about half of interval is tuff and sandy tuff. Lower part, tuff, flaggy, slightly calcareous, light colored; some interbeds of tuffaceous, fine-grained sandstone. Thickness of formation up to 800 feet, crops out in Tascotal Mesa and Buck Hill quadrangles and in Presidio area

Mitchell Mesa Welded Tuff, Tmm, cliff-forming ash flow, generally nonwelded to slightly welded, where more than 30 feet thick pronounced foliation in a broad zone about midway between base and center; in type area porphyritic, phenocrysts of quartz and opalescent sanidine up to 0.2 inch in size in aphanitic, pink to reddish-gray groundmass; weathers dark reddish gray to black; thickness up to 150 feet, also crops out in Bofecillos area and Tascotal Mesa; K-Ar age, 31.5 ± 0.7 m.y. (18 determinations)

Duff Formation, Td, chiefly rhyolitic tuff with minor breccia and conglomerate; tuff fine grained, well indurated, massive, mostly white, light shades of red and yellow common; conglomerate in lenticular beds up to 40 feet thick, crossbedded, dark brown; thickness up to 1,400 feet, crops out in northwestern part of Emory Peak Sheet area; vent area in Paisano Pass area (western part of Fort Stockton sheet)

Eocene ?

Miocene and Oligocene

Oligocene

Buck Hill Group

Cottonwood Springs Basalt, Tcb, up to nine or more flows; upper part vesicular, amygdaloidal, reddish gray to reddish brown; middle part massive, grayish black to dark greenish black; lower part commonly flow breccia; thickness up to 325 feet, crops out north of Green Valley

Pruett Formation, Tpr, with Potato Hill Andesite, Tpp; Sheep Canyon Basalt, Tps; and Crossen Trachyte, Tpct, mapped separately

Pruett Formation, Tpr, mostly volcanic tuff, some tuffaceous sandstone, conglomerate, breccia, and tuffaceous fresh-water limestone which interfingers with named trachyte, basalt, and andesite units described below; grayish white, bluish gray, greenish gray, brownish gray, brown, pink, and red, erodes to low rounded hills; conglomerate at base, mostly well-rounded limestone pebbles and chert of many colors, breccia-conglomerate in upper part mostly composed of igneous rocks cemented by calcareous tuffaceous material, forms resistant ledge up to 40 feet thick; fresh-water limestone, massive, in beds up to 10 feet thick, grayish white to yellowish brown and chocolate brown, fossils are gastropods and algal structures, reaches a thickness of 300 feet in Fort Stockton Sheet to north

Potato Hill Andesite, Tpp, in upper part of Pruett Formation, plagioclase phenocrysts up to an inch in length in part in fine-grained, reddish-brown groundmass, in part in coarse-grained, grayish-brown groundmass, upper half flow breccia, lower half massive, vesicular; thickness about 20 to 40 feet, crops out in Crossen Mesa north of Green Valley

Sheep Canyon Basalt, Tps, in middle part of Pruett Formation, at least four flows with vesicular tops, fine to medium grained, even textured, locally porphyritic, dark greenish black; thickness up to 235 feet, crops out north of Green Valley

Crossen Trachyte, Tpct, in lower part of Pruett Formation, massive, porphyritic, stubby feldspar phenocrysts in fine grained, grayish- to reddish-brown groundmass, hard, brittle; weathers to rusty-brown pitted surface; thickness about 150 feet, crops out in Crossen Mesa north of Green Valley

Duff and Pruett Formations undivided, Tdp, in Tascotal Mesa, Agua Fria Mountain, and Santiago Peak quadrangles

BOFECILLOS MOUNTAINS AREA

Rawls Formation, Tr, in Bofecillos Mountains area, from top down consists of conglomerate, sandstone, and tuff; basalt; bolson fill interbedded with above; trachyte; trachyandesite; latite porphyry; trachybasalt porphyry; nonwelded to thoroughly welded crystal-vitric to lithic-vitric, ash-flow tuff; latite porphyry; basalt; trachyandesite; latite porphyry; trachybasalt porphyry; trachyandesite; tuff; latite porphyry; volcanic mudflow; latite; basalt, tuff, sandstone, and conglomerate; and trachybasalt porphyry. In southeastern part of Presidio area, from top down, porphyritic basalt; conglomerate and tuff; trachyandesite; mafic ash-flow tuff; trachyte; trachyandesite; trachybasalt porphyry; trachyandesite; rhyolite ash-flow tuff; basalt. In north-central and northeastern part of Presidio area, from top down, porphyritic basalt; rhyolite ash-flow tuff; sandstone, conglomerate, and tuff, trachyandesite porphyry; trachyandesite; trachybasalt porphyry; basalt; and tuff, sandstone, and conglomerate. In Tascotal Mesa quadrangle, interfingerings of trachybasalt porphyry, dense basalt, volcanic basalt breccia, and trachyandesite. Maximum thickness of formation about 1,200 feet. K-Ar ages, upper Rawls 23.0 ± 0.4, 22.1 ± 0.4; middle Rawls 26.2 ± 0.5 m.y.

Santana Tuff, Ts, nonwelded to thoroughly welded vitric-crystal tuff, one to at least four flows, high percentage of glassy luster sanidine crystals; where nonwelded, friable, dull, porous, gray, brownish yellow, and white; forms distinct orange cliffs; maximum thickness 550 feet in Santana Mesa area; K-Ar age 26.3 ± 0.5 m.y.

Fresno Formation, Tf, interbedded sedimentary materials and flows; includes ash-fall tuff, eolian tuff, eolian tuffaceous sandstone, ash-flow tuff, volcanic breccia, and near top mud flow units, conglomerate, and conglomeratic sandstone; flows include mafic trachyandesite, latite, latite porphyry, basalt, and sodic rhyolite; in vent area of Bofecillos Mountains, mostly lava flows up to 1,500 feet thick, away from vent 500 to 800 feet thick where not thinned over intrusive domes

TERTIARY

BIG BEND NATIONAL PARK AREA

Oligocene

South Rim Formation, Tsr, from top down, Burro Mesa, Lost Mine, Wasp Spring, and Brown Rhyolite Members not separately mapped. Burro Mesa Member, sodic rhyolite with quartz phenocrysts, highly siliceous, medium grained, gray; thickness 400 to 500 feet; K-Ar age about 30 m.y., also 2 other determinations average 29.4 m.y. Lost Mine Rhyolite Member, mostly reddish rhyolite porphyry, some nonporphyritic, some glassy with complex flow banding. Wasp Spring Flow Breccia Member, dominantly rhyolitic lava with conspicuous flow structure, sporadic inclusions, minor amount of tuff; in general, amount of lava decreases and of flow breccia increases away from mountains; some massive coarse conglomerate, coarse sandstone and tuff; thickness 100 to 350 feet in mountains, thins to less than 30 feet peripherally. Brown Rhyolite Member, sequence of lava flows, dark plagioclase-rich rock with glassy to light colored felsite base, some flows porphyritic, some with flow structure, others with inclusions; thickness up to 800 feet. Crops out in Chisos Mountains area of Big Bend National Park

Oligocene and Eocene

Chisos Formation, Tc, from top down, Tule Mountain, Mule Ear Spring, Bee Mountain, Ash Spring, and Alamo Creek Members not separately mapped. Generally conglomerate, sandstone, mudstone, tuff, and igneous rock with named units described below; conglomerate, beds up to 10 feet for intervals up to 30 feet thick, angular boulders of igneous rock up to 2 feet and rounded boulders of limestone up to 15 inches in size, matrix calcareous tuffaceous sandstone, brownish yellow, gray, grayish green; sandstone in beds up to 5 feet form intervals up to 35 feet thick, poorly sorted volcanic arkose composed of many mineral species, wide variety of colors; mudstone in beds less than a foot forms intervals up to 120 feet thick, wide variety of colors; tuff common throughout lower portion, constitutes most of upper part of formation, well bedded tuff units up to 30 feet thick may be lake deposits, tuff contains wide variety of minerals. Tule Mountain Member, trachyandesite porphyry in several flows, feldspar up to half-inch in size in fine-grained groundmass produces a spotted appearance, gray to brownish gray; weathers brown to reddish brown; maximum thickness 350 feet; K-Ar age, 28.6 ± 1.5 m.y. (2 determinations). Mule Ear Spring Tuff Member, punky ash to very hard, brittle, silicified ash-flow tuff with conchoidal fracture, various shades of pink and red; weathers brown; contains Oligocene vertebrate fossils; thickness 8 to 12 feet in Big Bend National Park, 3 to 40 feet in Bofecillos area; K-Ar age, 31.5 ± 2.0 m.y. (3 determinations). Bee Mountain Basalt Member, fine to medium grained, several flows, scoriaceous and vuggy along flow contacts; 25 to 80 feet thick in high Chisos Mountains, 527 feet thick at Cerro Castellan, up to 250 feet thick in Bofecillos area, feathers out westward; K-Ar age, 22.6 ± 1.0 m.y. (2 determinations) Ash Spring Basalt Member, two or more flows, coarsely porphyritic in eastern area, phenocrysts decrease in size westward, basal 10 feet scoriaceous; thickness up to 200 feet; K-Ar age, 33.6 ± 1.5 m.y. (2 determinations). Alamo Creek Basalt Member, fine grained, hard, dark, lava, base mostly scoriaceous; thickness of measured sections in Big Bend National Park, 20 to 208 feet, 5 to 95 feet in Bofecillos area. K-Ar age, 42.2 ± 2.0 m.y. (2 determinations); also 38.7 and 42.7 m.y. Thickness of Chisos Formation about 3,500 feet

Eocene

Canoe Formation, Tcf, Big Yellow Sandstone Member at base not separately shown, massive, yellow, commonly conglomeratic; thickness 30 to 50 feet. Rest of formation, clay, tuffaceous clay, mudstone, sandstone, conglomeratic sandstone, calcareous tuff or tuffaceous limestone, silicified tuff, and some basalt flows up to 60 feet thick; thickness about 1,200 feet, crops out in northern part of Big Bend National Park

Hannold Hill Formation, Thh, mostly clay, some sandstone and channel conglomerate; clay, contains thin sandstone beds and lignite, some beds contain calcareous concretions, gray and maroon; sandstone, coarse grained, conglomeratic, crossbedded, pebbles of black chert and Comanchean limestone, gray, brownish gray and grayish white; Exhibit Sandstone Member, 320 feet above base, 12 to 15 feet thick, contains vertebrate fossils; thickness of formation up to about 850 feet, crops out in northern part of Big Bend National Park

TERTIARY

Paleocene

Black Peaks Formation, Tbp, sandstone and clay; sandstone at base, conglomeratic, crossbedded, gray to grayish white, some cannonball concretions split into platy layers; clay, mottled gray and deep dark-red; vertebrate fossils common; thicknesses measured range from 284 to 866 feet, crops out in northern part of Big Bend National Park

TERTIARY

Kj

Javelina Formation

Clay and sandstone; clay, bentonitic, mostly structureless, nodular calcareous concretions common, dull gray, olive green, deep dark-red, dirty brown, weathers into rounded topographic forms; sandstone, lenticular bodies, crossbedded, ripple marked, vertebrate fossils and petrified wood common; thicknesses measured range from 244 to 936 feet, crops out in Big Bend National Park and northward

Kag

Aguja Formation

Aguja Formation, Kag, clay, sandstone, and lignite. Upper part continental deposits up to 880 feet thick; sandstone, argillaceous, platy, ripple marked, crossbedded, various shades of yellow and brown; clay in part calcareous, in part contains calcareous nodules, greenish gray to yellowish brown and purple; freshwater limestone scarce; a few lignite beds; vertebrate fossils and petrified wood common. Lower part consists of three units; upper unit transitional downward from continental deposits; middle unit, clay, silty to sandy, medium to dark gray, weathers yellow to yellowish brown, marine fossils common, thickness 175 to 500+ feet; lower unit, sandstone, commonly conglomeratic at base, indurated, forms ridges, yellowish gray to yellowish brown, thickness 5 to 35 feet. Crops out in Bofecillos area, Big Bend National Park, and Agua Fria quadrangle

Upper Cretaceous

CRETACEOUS

Kp	Kau
Kbse	Kbo

Pen and Boquillas Formations, Austin Chalk, and Boquillas Flags

Pen Formation, Kp, equivalent to upper part of Austin Chalk, mostly clay; upper part sandy with some sandstone beds up to 5 feet thick; middle part, yellow, scattered sandy beds; lower 50 feet, calcareous clay with inch-thick chalk beds, light bluish gray; concretions common throughout, mostly calcareous, some clay-ironstone; weathers yellow to yellowish gray, topographically low; marine fossils throughout, *Exogyra ponderosa* common; thickness 219 to 700 feet in Big Bend National Park, 1,000 feet in Terlingua area, 200 feet in Bofecillos area, also crops out in Black Gap area

Boquillas Formation, Kbse, consists of an upper unit, San Vicente Member, Kbs, equivalent to lower part of Austin Chalk, and a lower unit, Ernst Member, equivalent to Boquillas Flags, Kbo. San Vicente Member, not separately mapped, thin to medium bedded, chalky, argillaceous, limestone flags interbedded with gray to yellowish-gray platy marl and soft gray marl; marine megafossils and microfossils abundant; thickness 130 to 400 feet in Big Bend National Park, 274 feet in Black Gap area, crops out widely. Ernst Member, not separately mapped, limestone, siltstone, and clay; limestone, silty ranging to siltstone, flaggy, beds mostly 2 to 5 inches, some up to 18 inches; clay mostly as partings; bluish gray, weathers light yellowish gray to light brownish yellow, blocky from joints; marine megafossils and microfossils common; thickness 277 feet in Black Gap area, 450 feet in Big Bend National Park, 600+ feet in Tascotal Mesa quadrangle, and 1,000 feet in Terlingua area

Upper Cretaceous

Austin Chalk, Kau, chalky lime mudstone with thin marl interbeds, medium bedded, crops out in Terrell County

Boquillas Flags, Kbo, in eastern part of sheet consists of four units: upper unit, shale, silty, medium gray, interbedded with limestone, nodular to laminar, granular, brownish gray; followed downward by shale, silty, medium gray, interbedded with limestone, granular, yellowish gray; shale, silty, dark gray, interbedded with siltstone, laminated, grading upward to silty limestone; and a lower unit of limestone, clastic, in thin mostly cross-laminated beds, interbedded with siltstone, light yellowish gray to grayish orange, and shale, black. Thickness 100 to 450 feet

Kcu

Comanchean limestone undivided

Massive, aphanitic, partly contact metamorphosed to marble and scarn, crops out in Bofecillos area

Kbd

Buda Limestone and Del Rio Clay undivided

Buda Limestone, in Big Bend National Park and eastward divisible into three parts; upper unit, limestone, microgranular, porcelaneous, hard, conchoidal fracture, grayish white, up to 60 feet thick; middle unit, limestone, argillaceous, marly, nodular, weathers to a lumpy surface, grayish white, about 30 feet thick; lower unit, similar to upper unit, about 25 feet thick; thickness of Buda 80 feet in Hood Spring and Santiago Peak quadrangles, and 61 feet in Tascotal Mesa quadrangle

Del Rio Clay, mostly clay, some interbedded, flaggy, siliceous limestone, friable sandstone, and thin beds of ferruginous clay; clay, soft, bluish to greenish gray, weathers yellow to light brown; thickness up to 180 feet in Terlingua district, 185 feet in western part of Black Gap area, feathers out eastward toward Rio Grande, 70 feet thick in Hood Spring, Santiago Peak, and Tascotal Mesa quadrangles

Lower Cretaceous

CRETACEOUS

Ks-t	Kse	
	Ksu	
	Kdm	
	Kdt	

Santa Elena Limestone, Sue Peaks Formation, Del Carmen Limestone, and Telephone Canyon Formation

Santa Elena Limestone, Kse, Sue Peaks Formation, Ksu, Del Carmen Limestone, Kdm, Del Carmen Limestone and Telephone Canyon Formation undivided, Kdt, and Santa Elena Limestone, Sue Peaks Formation, Del Carmen Limestone, and Telephone Canyon Formation undivided, Ks-t, in Terlingua and Christmas-Rosillos Mountain areas, and Tascotal Mesa, Agua Fria, and Santiago Peak quadrangles

Santa Elena Limestone, Kse, fine grained to microgranular, massive, beds up to 10 feet thick, some marl interbeds in upper part, rounded chert nodules and silicified rudistids common in more massive beds, light gray to white; weathers dark gray and shades of brown; rudistids and milliolids abundant; forms cliffs; thickness about 500 feet in Santiago Peak area, 740 feet at mouth of Santa Elena Canyon, 943 feet in Black Gap area

Lower Cretaceous

Sue Peaks Formation, Ksu, Upper part, mostly limestone, nodular, gray, some interbedded yellowish-gray shale, at base 20-foot ledge of limestone, massive, gray. Lower part, mostly shale, marly, some thin interbeds of limestone, marly, nodular, yellowish gray to light brownish gray; thickness 75 feet. Occupies slope between escarpments formed by Santa Elena and Del Carmen Limestones; marine megafossils common; thickness 250 feet in Big Bend National Park, 30 to 70 feet in Santiago Peak and Hood Spring quadrangles

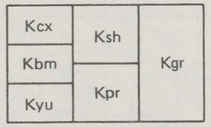
Del Carmen Limestone, Kdm, microgranular to fine grained, massive, chert nodules and masses up to 10 inches in size and beds exceeding 10 feet in length, gray; weathers shades of dark brown, yellowish brown, and pinkish brown; rudistids and milliolids common; forms sheer escarpments; thickness 445 feet in eastern part of Black Gap area, 350 feet in northern Sierra del Carmen, 475 feet at mouth of Santa Elena Canyon, and 300 to 350 feet in Shafter area

Telephone Canyon Formation, not separately shown, limestone, nodular, marly, yellowish gray to brownish gray, yellowish marl partings increase in number downward; marine megafossils common; forms slope at base of Del Carmen Limestone cliffs; thickness about 75 feet in Big Bend National Park

Kmx

Maxon Sandstone

Mostly sandstone, fine grained, calcareous, well cemented to friable, massive to bedded, white to yellow and reddish; limestone, nodular to bedded, hard to soft, white to yellow; thickness 114 feet in area of Santiago Mountains, feathers out eastward and southward short of Big Bend National Park and Black Gap area



Cox Sandstone and Bluff Mesa, Yucca, Shafter, Presidio, and Glen Rose Formations

Cox Sandstone, Kcx, sandstone, shale, limestone, and marl. At north end of Chinati Mountains, upper part, about one-third limestone, hard, nodular, medium to thick bedded, rest mostly shale, gray, red, and purple with interbeds of marl and sandstone, abundant *Exogyra texana*; lower part, sandstone, fine to medium grained, hard, resistant, thick bedded, crossbedded, quartz cemented, weathers reddish brown, interbedded with sandstone, fairly soft, crossbedded, light colored and with shale, gray, red, and purple; a few thin beds of fossiliferous limestone toward base, hard, medium gray, grades downward to Bluff Mesa Formation; thickness about 450 feet

Bluff Mesa Formation, Kbm, limestone, shale, and sandstone. Upper part, consists of about four cycles typically starting at base with limestone, very hard, resistant, medium to thick bedded, in part rudistid bearing, forms top and back slope of cuestas; in foreslopes, alternations of nodular, dark gray, *Orbitolina*-bearing limestone, marl, and dark gray clay shale followed upward by sandstone, medium grained, quartz cemented, resistant, crossbedded, light brown, gradational laterally and vertically into less resistant, calcareous sandstone; lowest cycle, forms caprock sequence, is somewhat different, 40 feet of limestone, followed upward by sandstone, a persistent 10-foot oyster bed, and 50 feet of clay shale; thickness of upper part 450 feet. Lower part, a series of 15- to 20-foot cliff-forming beds of white limestone and locally sandstone, with slope-forming interbeds of shale and nodular limestone; sandstone, medium grained, quartz cemented, thick bedded, crossbedded, dark brown; thickness 200 feet. Formation crops out at north end of Chinati Mountains

CRETACEOUS

Lower Cretaceous

Yucca Formation, Kyu, conglomerate, limestone, shale, marl, and sandstone. Upper part, low cliff-forming units alternating with softer material in slopes; characterized by red color from presence of red limestone, red and purple shale, and brown sandstone and the talus of these rocks; thickness 500 to 550 feet. Lower part conglomerate resting on Permian rocks, well-rounded pebbles and cobbles of light-colored limestone, a scattering of variously colored chert, boulders of Pinto Canyon Formation common near base, grades upward into nodular, fine-grained limestone and marl of overlying member; forms cliffs up to 100 feet high; thickness up to 106 feet. Formation crops out at northern end of Chinati Mountains

Shafter Formation, Ksh, limestone, sandstone, shale, and marl; limestone, nodular to regularly bedded, beds thin to medium, alternating hard and marly units form a series of cuestas; sandstone predominates in basal 50 feet, near middle of formation, fine to medium grained, thin to medium bedded, crossbedded, ripple marked, weathers dark reddish brown; marine fossils include *Exogyra texana* in upper 165 feet, *Orbitolina* in lower 700 feet, and various other marine megafossils, petrified wood in some sandstone beds; thickness of formation 900 feet, crops out in Chinati Peak quadrangle and Presidio area

Presidio Formation, Kpr, conglomerate, limestone, sandstone, and siltstone; a basal well indurated pebble- to boulder-conglomerate, 30 to 80 feet thick, grades upward to slightly indurated pebbly sandstone and siltstone, followed by a succession of alternating impure carbonate rocks, calcareous sandstone, and siltstone; carbonate rocks weather yellowish gray, other rocks are medium to dark gray and weather yellowish and reddish brown; *Orbitolina texana* common in upper half; thickness about 400 feet, crops out in Chinati Peak quadrangle and Presidio area

Glen Rose Formation, Kgr, alternating resistant limestone ledges and soft marls which weather to form a characteristic stairstep topography; in the Solitario Uplift, because of narrow outcrop width, a basal conglomerate resting on Paleozoic rocks and local patches of limestone and marl of the Glen Rose beneath a much younger felsite sill are included with the sill that encircles the rim; the remaining 900 feet or so above the felsite sill is characteristic of the Glen Rose to the east; also includes basal Cretaceous conglomerate in Horseshoe Mesa - Pine Mountain area; thickness 335 to 500 feet in Big Bend National Park and northward, rests on Paleozoic rocks, 733 feet measured in Black Gap area, base not exposed

CRETACEOUS

Pmg

Mina Grande Formation

Limestone, hard, massive, dolomitic, reefy, surface rough and hackly with brecciated appearance, gray to yellow to yellowish brown; serves as chief lead and silver host rock in Shafter district; thickness up to 400 feet in Shafter district, 25 feet in Upper Cibolo Basin, missing in many places because of pre-Cretaceous erosion

Guadalupe

Prm

Ross Mine Formation

Shale, sandstone, and limestone. In Shafter area, in upper part alternating shale and sandstone, some lenses of limestone, massive, aphanitic, black, weathers orange; followed downward by thin interbeds of sandstone and chert; interbedded sandstone and dark gray limestone containing silicified fossils; massive limestone, aphanitic, fossiliferous, light to medium gray; and in lower part alternations of sandstone and shale; sandstone, medium-grained quartz, indurated, thinly bedded; shale, silty, laminated, fissile, black; thickness of formation 727 feet in measured section. In Morita Basin sandstone predominates, some conglomerate, thickness about 160 feet; In Upper Cibolo Basin, mostly shale, sandy, muscovitic, thinly bedded, yellowish brown; limestone forms prominent ledges 100 and 115 feet above base; thickness 150 feet

PERMIAN

Middle and Upper Pennsylvanian

Leonard and Guadalupe

Pp

Pinto Canyon Formation

From top down: Siltstone, bituminous, pyritic, cherty, dolomitic, contains limestone concretions up to 4 feet in size, microgranular, 1-inch chert nodules, dark gray, weathers reddish brown, 93 feet thick in measured section. Limestone, microgranular, bituminous, massive, dark gray, weathers gray, interbedded with chert, laminated, pyritic, bituminous, limestone, microgranular, and chert, argillaceous; thickness 170 feet. Chert, cherty limestone, microgranular limestone, calcareous sandstone, and cherty sandstone in irregular beds, formed as submarine slide blocks; thickness 110 to 170 feet. At base chert, medium bedded, dark gray and limestone, microgranular, interbedded with siltstone, thickness 95 to 170 feet

Leonard

Pci

Cibolo Formation

In type section from top down; limestone, dolomitic, upper part massive, lower part thinly bedded, porous, vuggy, vugs lined by calcite, yellow; limestone and shale, some chert; limestone, shale, and sandstone, sponge spicules abundant, chert layers common, shale, sandy, laminated, muscovitic, sandstone beds commonly marked by Liesegang banding; limestone, massive, either a breccia or conglomerate with rounded clasts or boulders up to 6 feet in size; shale, marly, contains sandy lenses which are friable, gray, weather green and rusty brown, fossiliferous; thickness of formation about 1,450 feet, 494 feet measured at confluence of Cibolo and Sierra Alta Creeks. In Upper Cibolo Basin, mostly shale, laminated, brown, interspersed with sandstone lenses, coarse grained, ferruginous, in upper 90 feet some thin limestone beds; thickness 162 feet in a measured section

Wolfcamp

Pa

Alta Formation

Upper part sandstone, quartz, medium to coarse grained, irregularly crossbedded, friable. Lower part, shale, sandy, silty, slightly muscovitic, laminated, fissile to compact with semiconchoidal fracture, alternates with thin sandstone beds, yellowish to greenish brown. Thickness in type section 5,415 feet, in measured section west side of Ojo Bonito 2,610 feet, in Upper Cibolo Basin upper 350 feet exposed

PERMIAN

IPci

Cieneguita Formation

Alternating beds of quartz pebble conglomerate, ferruginous sandstone, sandy shale, and brecciated masses of reef limestone; sandstone, fine grained, muscovitic, irregularly bedded, reds and browns; limestone in part locally derived limestone-pebble conglomerate, in part contains pebbles of vein quartz; some black shale has been metamorphosed to hornfels; thickness more than 2,000 feet, crops out in northern part of Chinati Mountains area

PENNSYLVANIAN

Lower Pennsylvanian

IPh

Haymond Formation

Shale and sandstone, dark gray, poorly exposed beds a few inches thick; crops out in southern part of Cochran Mountains

IPd

Dimple Limestone

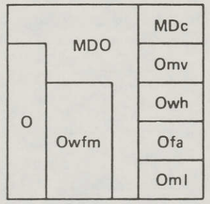
Limestone with black chert pebbles interbedded with green shale; crops out on eastern flank of Cochran Mountains

IPt

Tesnus Formation

Sandstone and shale; sandstone, fine grained, in part quartzitic, thin bedded, greenish brown, weathers rusty brown to olive gray; shale, hard, fissile, chloritic, green, red, brown, black; some arkose, chert, and basal conglomerate; thickness several thousand feet, crops out in Solitario Uplift, base of Santiago and Cochran Mountains, and at intervals eastward to headwaters of San Francisco Creek

PENNSYLVANIAN



Mississippian, Devonian, and Ordovician rocks

Units, in part mapped separately, include Caballos Novaculite, MDc, Maravillas Formation, Omv, Woods Hollow Shale, Owh, and Marathon Limestone, Oml. Units combined include in north-central part, Fort Peña Formation and Alsate Shale, Ofa, and various combinations of Caballos Novaculite, Maravillas Formation, Woods Hollow Shale, Fort Peña Formation, Alsate Shale, and Marathon Limestone, MDO; in Solitario Uplift, Caballos Novaculite and Maravillas Formation, MDO, and Woods Hollow Shale, Fort Peña Formation, and upper part of Marathon Limestone, Owfm; and in Pine Mountain area, Ordovician undivided, O.

Caballos Novaculite, MDc, includes five members: (1) Upper chert member, gray to green, dull lustered, translucent, some siliceous shale, thickness 85 to 150 feet; (2) Upper novaculite member, from top down, novaculite, white, massive, shattered, 35 feet thick; chert, thin bedded, brown and gray banded, also some black, white, and pale green bands, 117 feet thick; chert, irregularly bedded, beds 1 to 12 inches, light brown, 40 feet thick; chert, light brownish gray, somewhat banded, beds 1 to 18 inches, 70 feet thick; and at base novaculite, beds 1 to 4 feet, 83 feet thick; thickness of member 200 to 345 feet; (3) Middle chert member, covered, ant hills show fragments of green to greenish gray, fissile shale, thickness 34 to 90 feet; (4) Lower novaculite member, light gray, porcelaneous, shattered, weathers white, forms low ridge, thickness 17 to 57 feet; (5) Lower chert member, mostly covered, light gray, moderate to dark red, brownish yellow, in part translucent, beds 1 to 4 feet, thickness 24 to 33 feet. Thickness of formation 411 to 619 feet

MISSISSIPPIAN & DEVONIAN

Upper Ordovician

Middle Ordovician

Lower Ordovician

Upper Cambrian

ORDOVICIAN

CAMBRIAN

Maravillas Formation, Omv, limestone and chert; limestone, fine to medium grained, medium dark gray to grayish black, interbedded with chert, nodular to bedded, black, most abundant near middle and in upper part; thickness about 300 feet

Woods Hollow Shale, Owh, grayish green to greenish black, thinly laminated, splintery; minor interbeds of limestone, aphanitic, brownish gray; thickness about 100 feet

Fort Peña Formation, mostly limestone, fine grained, brownish gray, weathers yellowish brown; some sandstone, medium grained, medium dark gray, calcareous; some shale, light brown; thickness about 150 feet

Alsate Shale, some interbedded sandstone, calcareous, pale brown and limestone, laminated, medium gray; weathers moderate yellowish brown; thickness about 200 feet

Marathon Limestone, Oml, flaggy, dark gray to grayish black, interbedded with some shale, chert, sandstone, and edgewise conglomerate; sandstone, fine to medium grained, moderate brown, weathers dark brown and rough; shale, splintery, moderate olive brown to light brown; thickness about 800 feet, lower part included with Dagger Flat Sandstone in Solitario Uplift

These rocks crop out in the Solitario Uplift, at the base of Santiago and Cochran Mountains, and eastward at intervals to Tinaja Mountains

€O	€d

Lower part of Marathon Limestone and Dagger Flat Sandstone

In Solitario Uplift, Dagger Flat Sandstone and lower part of Marathon Limestone undivided, €O

Dagger Flat Sandstone, €d, medium grained, brownish yellow to yellowish brown, weathers light brown; some interbedded limestone, medium grained, sandy, moderate brown, exposed thickness about 300 feet, crops out in Three Mile Hill area

VIRGIL E. BARNES, PROJECT DIRECTOR

Geologic mapping mostly from sources shown on Index of Geologic Mapping. Geologic mapping gratefully acknowledged from Geophoto Services, Inc.; Cities Service Petroleum Company; and Mobil Oil Company. Areas mapped geologically on high-altitude aerial photographs, not covered by previous mapping, are listed as follows: area N, Joseph Cepeda and area O, F. W. Daugherty, both of West Texas State University, Canyon, Texas; and areas P, Q, R, and S, J. B. Brown of Allen K. Trobaugh, Midland, Texas. Map scribed by R. L. Dillon. Geological mapping reviewed by West Texas Geological Society, Geologic Atlas Committee, D. M. Norman of Markay Oil and Gas Company, chairman; Clifford H. Sherrod, Jr., consulting geologist; Bruce T. Pearson, independent; and J. B. Brown of Allen K. Trobaugh; by Ronald K. DeFord, John A. Wilson, Stephen E. Clabaugh, Daniel S. Barker, and Fred W. McDowell, all of the Department of Geological Sciences, The University of Texas at Austin; and by Page C. Twiss, Department of Geology, Kansas State University, Manhattan.

Upper Ordovician

Middle Ordovician

Lower Ordovician

Upper Cambrian

ORDOVICIAN

CAMBRIAN

Maravillas Formation, Omv, limestone and chert; limestone, fine to medium grained, medium dark gray to grayish black, interbedded with chert, nodular to bedded, black, most abundant near middle and in upper part; thickness about 300 feet

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Alsate Shale, some interbedded sandstone, calcareous, pale brown and limestone, laminated, medium gray; weathers moderate yellowish brown; thickness about 200 feet

Marathon Limestone, Oml, flaggy, dark gray to grayish black, interbedded with some shale, chert, sandstone, and edgewise conglomerate; sandstone, fine to medium grained, moderate brown, weathers dark brown and rough; shale, splintery, moderate olive brown to light brown; thickness about 800 feet, lower part included with Dagger Flat Sandstone in Solitario Uplift

These rocks crop out in the Solitario Uplift, at the base of Santiago and Cochran Mountains, and eastward at intervals to Tinaja Mountains

€O	€d

Lower part of Marathon Limestone and Dagger Flat Sandstone

In Solitario Uplift, Dagger Flat Sandstone and lower part of Marathon Limestone undivided, €O

Dagger Flat Sandstone, €d, medium grained, brownish yellow to yellowish brown, weathers light brown; some interbedded limestone, medium grained, sandy, moderate brown, exposed thickness about 300 feet, crops out in Three Mile Hill area

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INDEX OF GEOLOGIC MAPPING

Numbers in outlined areas refer to items in bibliography in "Index to Aerial Geologic Maps in Texas, 1891-1961," by T. E. Brown (1963), University of Texas, Austin, Bureau of Economic Geology.

Area A, see J. A. Sharps (1964), Geologic map of the Dryden Crossing quadrangle, Terrell County, Texas, U. S. Geological Survey, Miscellaneous Geological Investigations, Map I-386.

Area B, see V. L. Freeman (1964), Geologic map of the Indian Wells quadrangle, Terrell and Brewster Counties, Texas, U. S. Geological Survey, Miscellaneous Geological Investigations, Map I-395.

Area C, see B. E. St. John (1966), Geology of Black Gap area, Brewster County, Texas, University of Texas, Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 30.

Area D, see J. F. Houser (1967), Structural Geology of Threemile Hill area, Brewster County, Texas, The University of Texas at Austin, Master's thesis.

Area E, see R. A. Maxwell, J. T. Lonsdale, R. T. Hazzard, and J. A. Wilson (1967), Geology of Big Bend National Park, Brewster County, Texas, The University of Texas at Austin Publication 6711, 320 p.

Area F, see G. M. Stafford (MS map), Geologic map of Nine Point Mesa quadrangle, Brewster County, Texas.

Area G, see J. B. Stevens (1969), Geology of the Castolon area, Big Bend National Park, Brewster County, Texas, The University of Texas at Austin, Ph.D. dissertation.

Area H, see C. L. Seward, R. B. Haynie, and S. S. Goldich (MS), Geology of Jordan Gap quadrangle, Presidio and Brewster Counties, Texas.

Area I, see J. F. McKnight (1969), Geologic map of Bofecillos Mountains area, Trans-Pecos Texas, The University of Texas at Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 37.

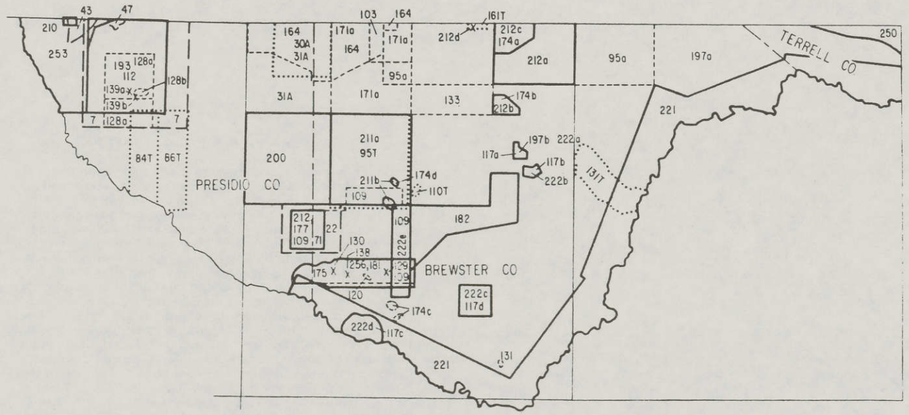
Area J, see J. W. Dietrich (1965), Geologic map of Presidio area, Presidio County, Texas, University of Texas, Austin, Bureau of Economic Geology, Geologic Quadrangle Map No. 28.

Area K, see C. G. Groat (1972), Geologic and geomorphic map of Presidio and Redford bolsons, Presidio County, Texas, and Chihuahua, Mexico, The University of Texas at Austin, Bureau of Economic Geology, Report of Investigations 76.

Area L, see R. P. McCulloch (MS), Geology of Yellow Hill quadrangle, Brewster County, Texas, The University of Texas at Austin, Master's thesis.

Area M, see Joseph Cepeda (1977), Geology and geochemistry of the igneous rocks of the Chinati Mountains, Presidio County, Texas, The University of Texas at Austin, Ph.D. dissertation.

Area T, see E. J. Dickerson (1966), Bolson fill, pediment, and terrace deposits of Hot Springs area, Presidio County, Trans-Pecos Texas, University of Texas, Austin, Master's thesis.



APPENDIX D - FLIGHT LINE/GEOLOGY MAPS

GEOLOGIC MAP

104 45'00"
30 00'00"

T6 T8 T9 T10

104 30'00"
30 00'00"

29°45'00"
104°45'00"

29°45'00"
104°30'00"

N

4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21,000 FEET
5 KILOMETERS

BUCKSHOT
TEXAS D1

GEOLOGY MAP

104°30'00" 104°15'00" 30°00'00" 29°45'00"

T11 T12 T13 T14 T15 T16

R10 R11 R12 R13 R14 R15 R16

Ti Qao Qal Qtb Qaa Tsh 6 Tsh 8 Tsh 2 Tsh 3-5 Tsh 7 Kbm Kcx Kyu Kcu Pp Tcm1 Tcm3 Tcm 3 Tcm 4 Tcm 5 Tcm 6 Tpc Tshl Tdp Pa Pci Pmg Prm Ksh Kpr Kdm Tm Qf U D

SCALE 1:125,000

1 0 1 2 3 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 5 0 1 2 3 4 5 KILOMETERS

N

BUCKSHOT
TEXAS

D2

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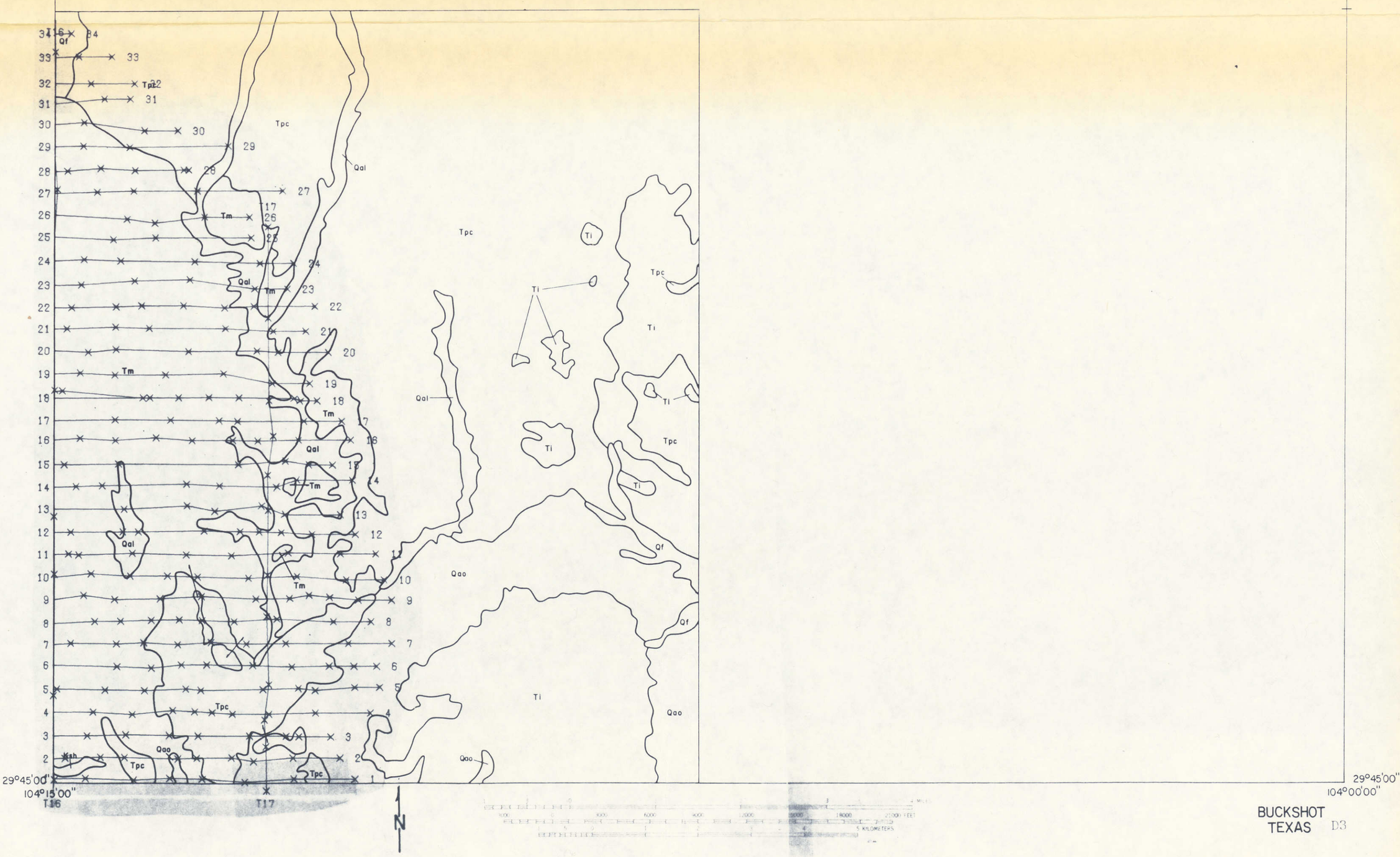
30°00'00"

104°00'00"
30°00'00"



29°45'00"
104°15'00"

29°45'00"
104°00'00"

BUCKSHOT
TEXAS D3

GEOLOGY MAP

104°45'00"
30°15'00"
104°30'00"
30°00'00"

T5 T6 T7 T8 T9 T10

N

BUCKSHOT
TEXAS

D1

GEOLOGIC MAP

104°30'00"
30°15'00"
104°15'00"
30°15'00"
30°00'00"
104°30'00"
104°15'00"
30°00'00"

T10
T11
T12
T13

BUCKSHOT
TEXAS

D5

GEOLOGY MAP

30°30'00"

30°15'00"

104°45'00"

104°30'00"

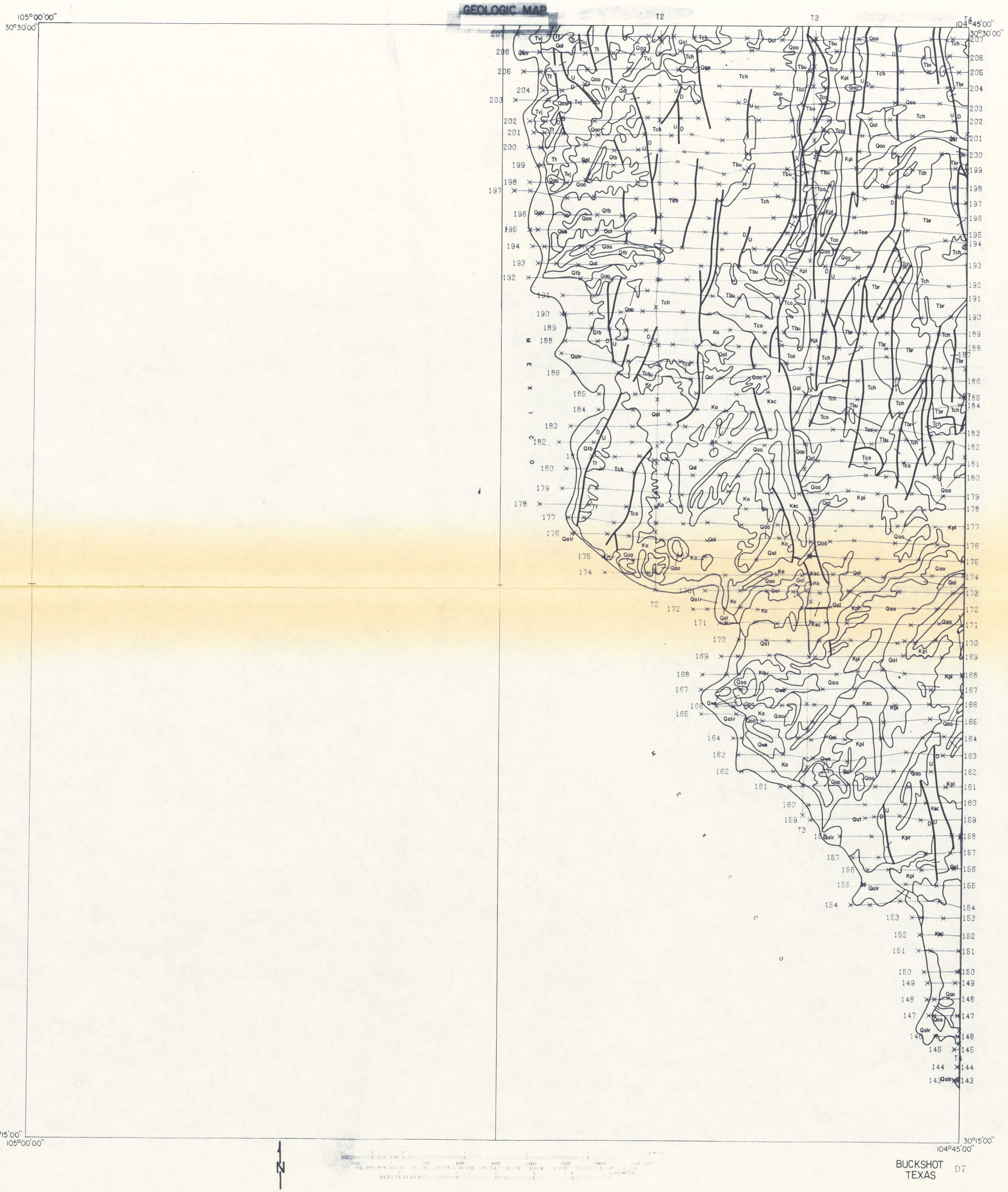
T5 T6 T7 T8

MEXICO

BUCKSHOT
TEXAS

D6

GEOLOGIC MAP



BUCKSHOT
TEXAS
D7

GEOLOGIC MAP

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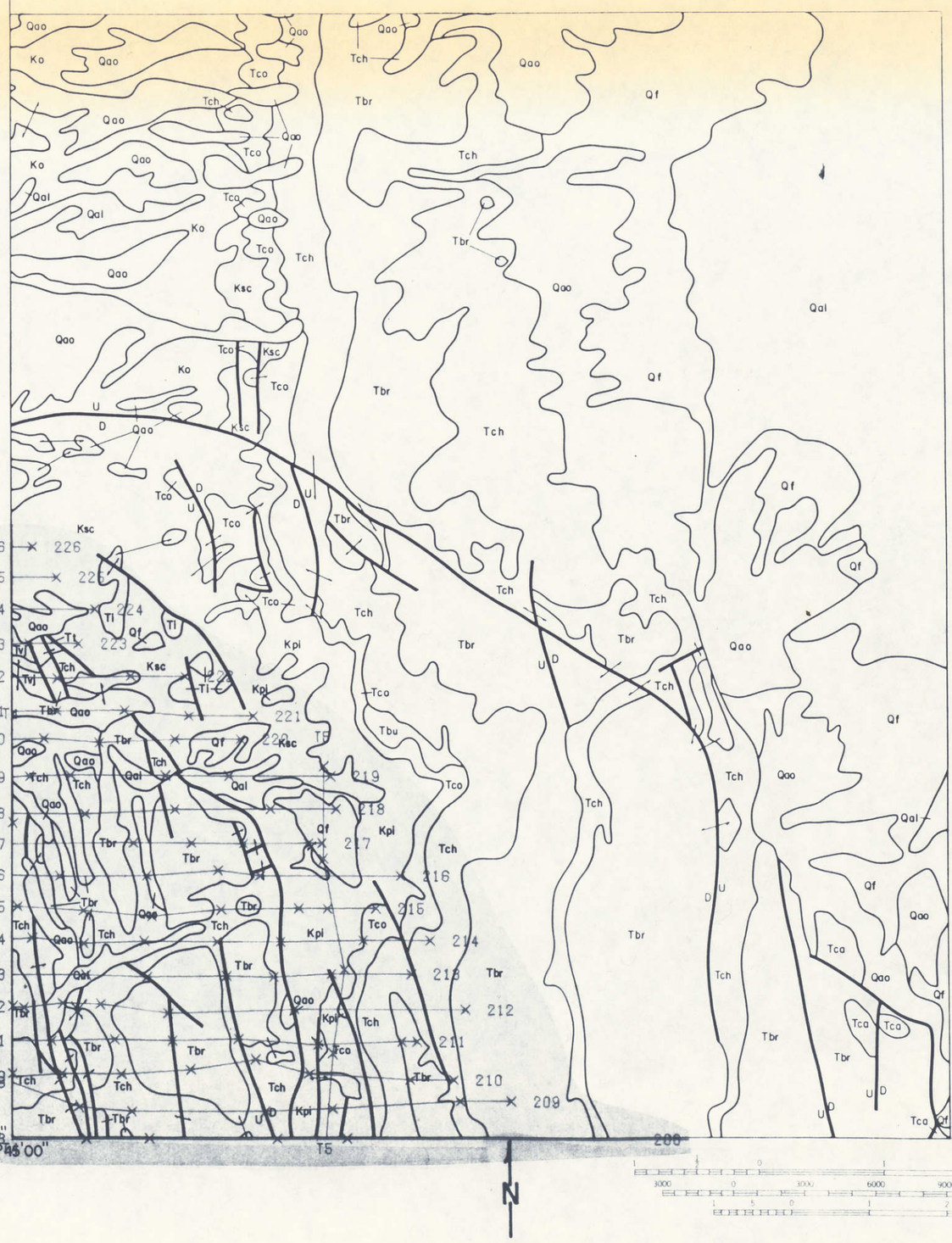
104°30'00"
30°45'00"



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104°45'00"

30°30'00"
104°30'00"

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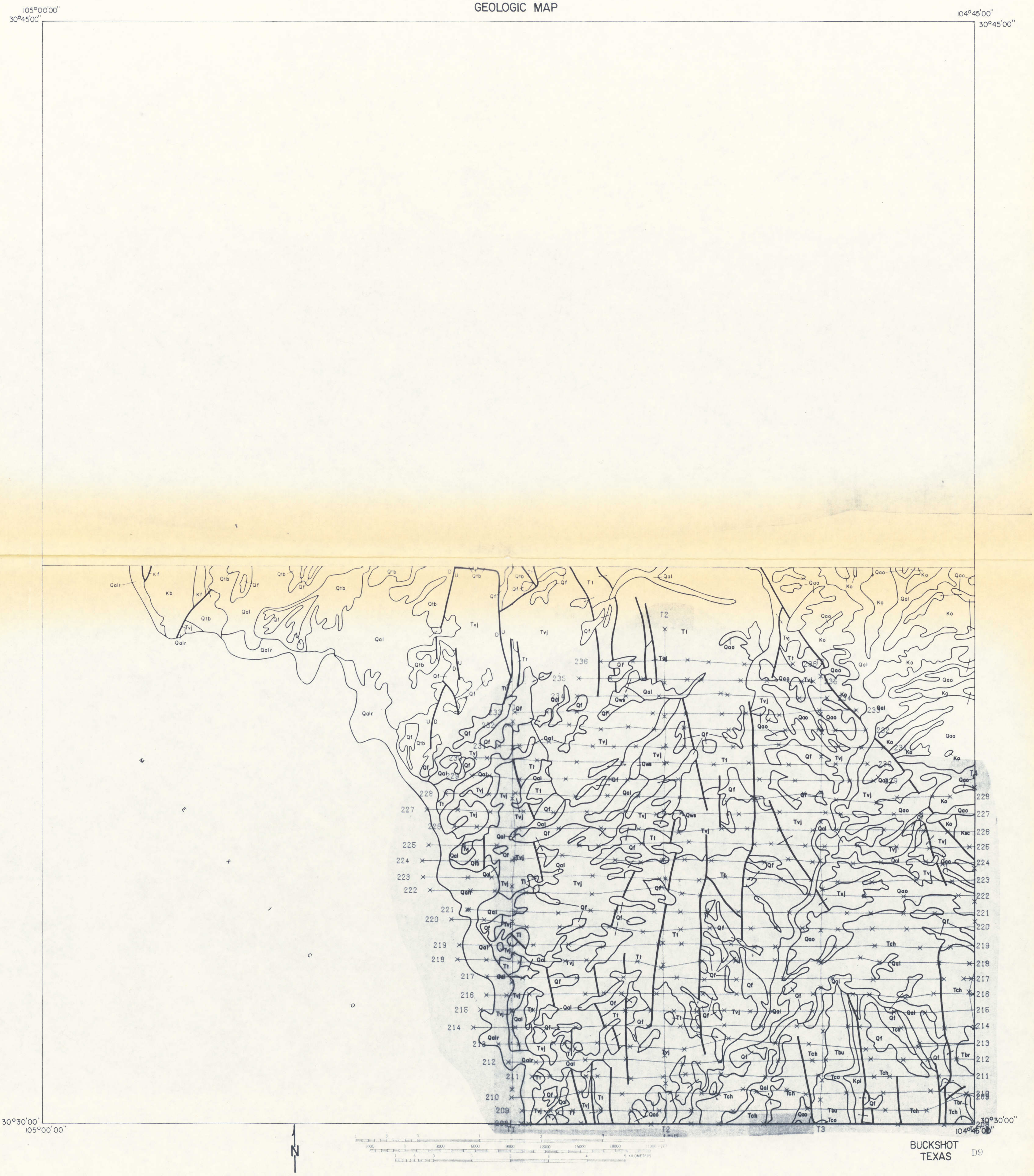
1 0 1 2 3 4 5 KILOMETERS

N

BUCKSHOT
TEXAS D8

GEOLOGIC MAP



BUCKSHOT
TEXAS

GEOLOGIC MAP

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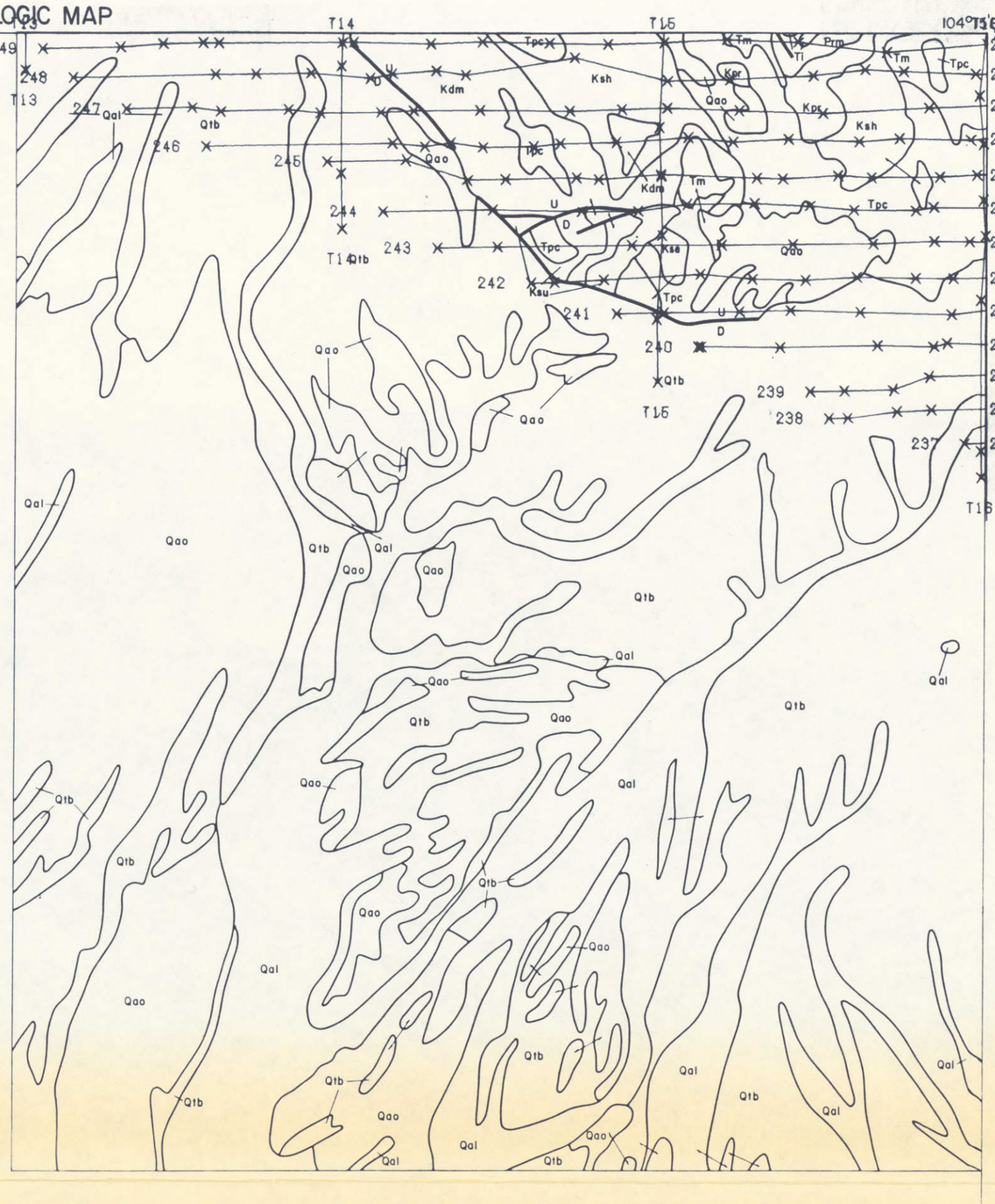
29°45'00"



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29°30'00"
104°30'00"

29°30'00"
104°15'00"

BUCKSHOT D10
TEXAS

GEOLOGIC MAP

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29°45'00"
T17
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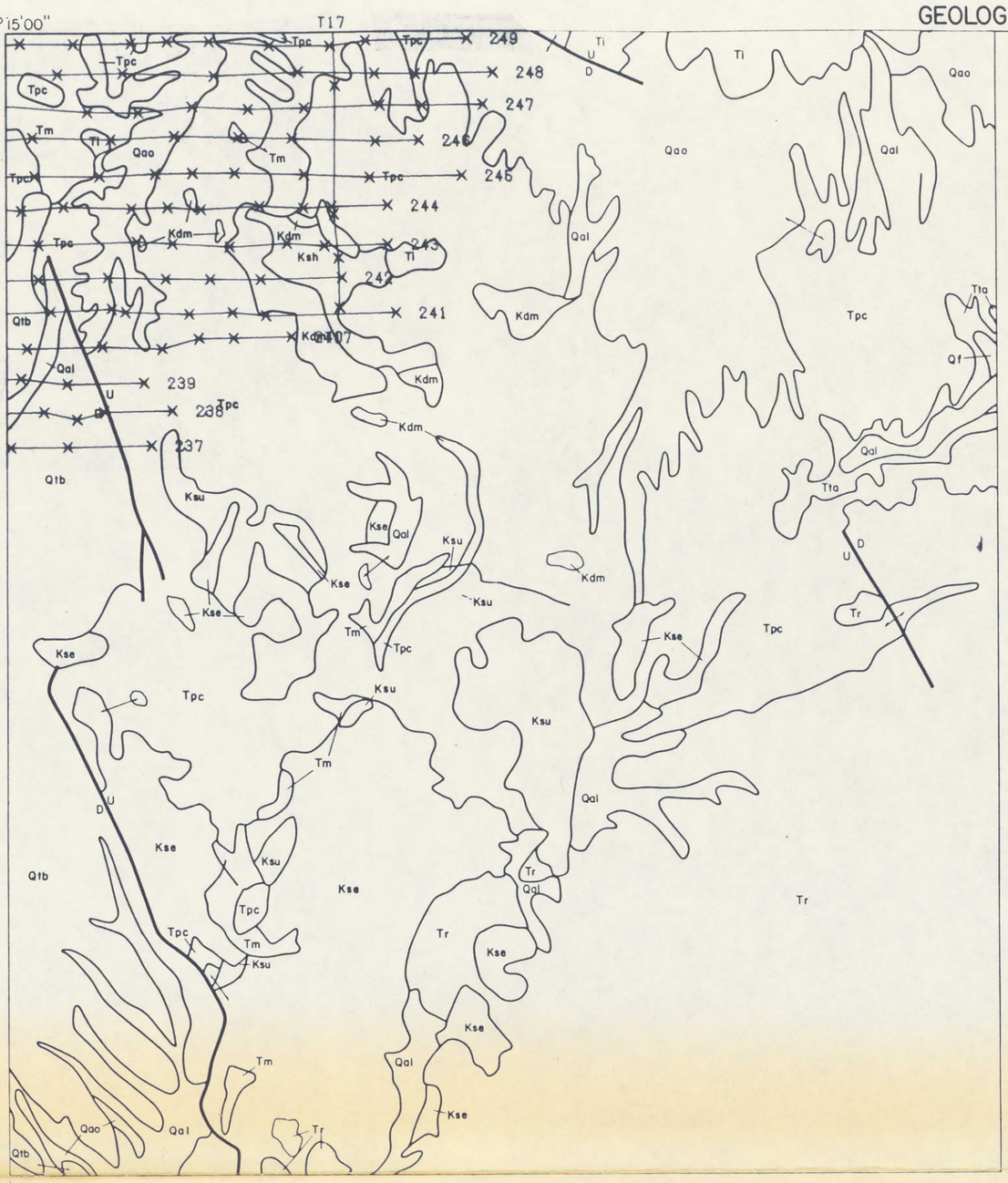
29°45'00"



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104°15'00"

29°30'00"
104°00'00"

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1 0 0 1 2 3 4 5 KILOMETERS

BUCKSHOT D11
TEXAS

APPENDIX E - GEOCHEMICAL FACTOR ANALYSIS MAPS

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104° 30′ 00″

30° 00′ 00″

30° 00′ 00″

29° 45′ 00″

29° 45′ 00″

104° 45′ 00″

104° 30′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 — 1 MILES

QC-A	HIGH K-40,ETH,AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB

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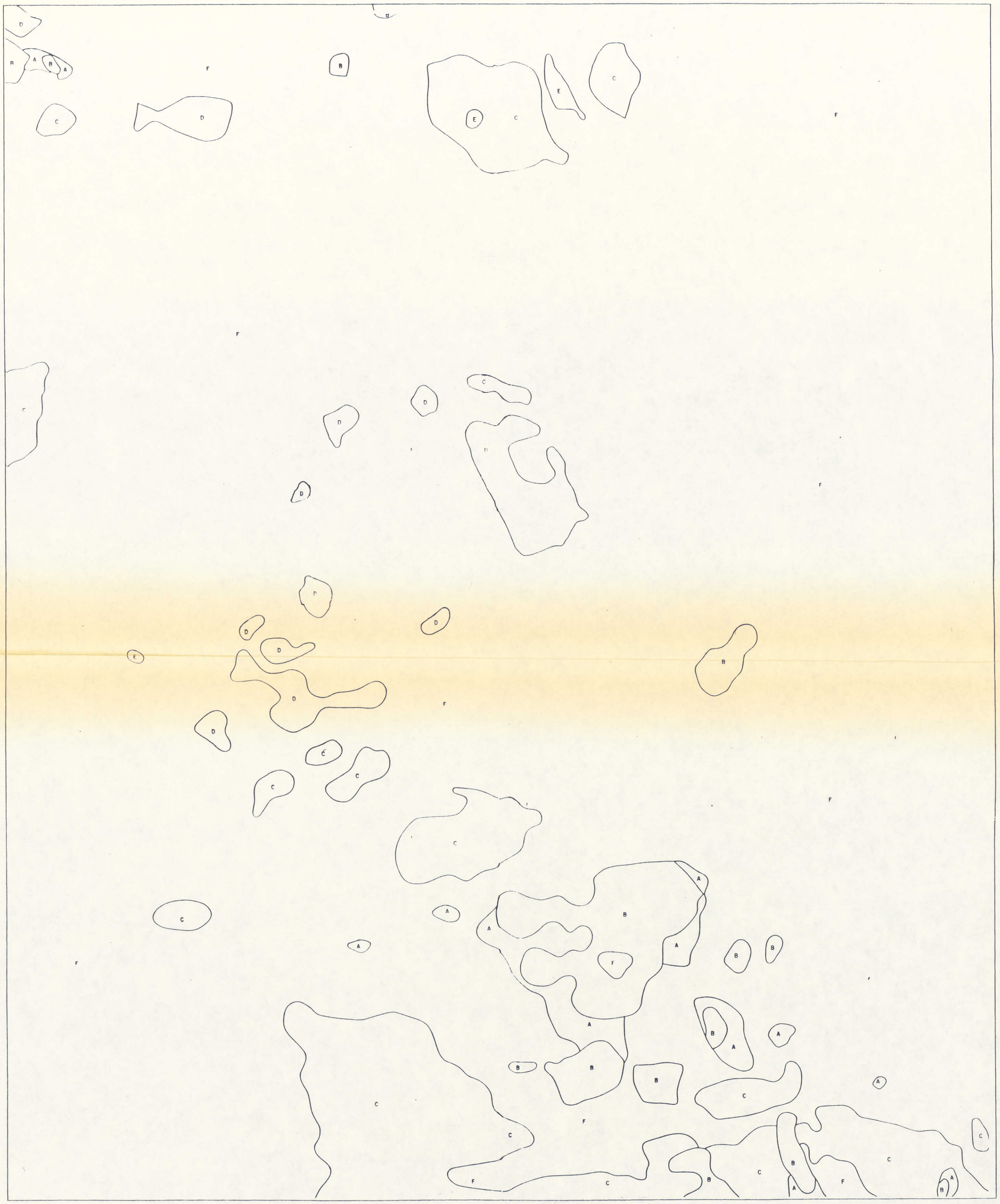
104° 15′ 00″

30° 00′ 00″

30° 00′ 00″



29° 45′ 00″

29° 45′ 00″

104° 30′ 00″

104° 15′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 — 1 MILES

QC-A	HIGH K-40,ETH,AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB

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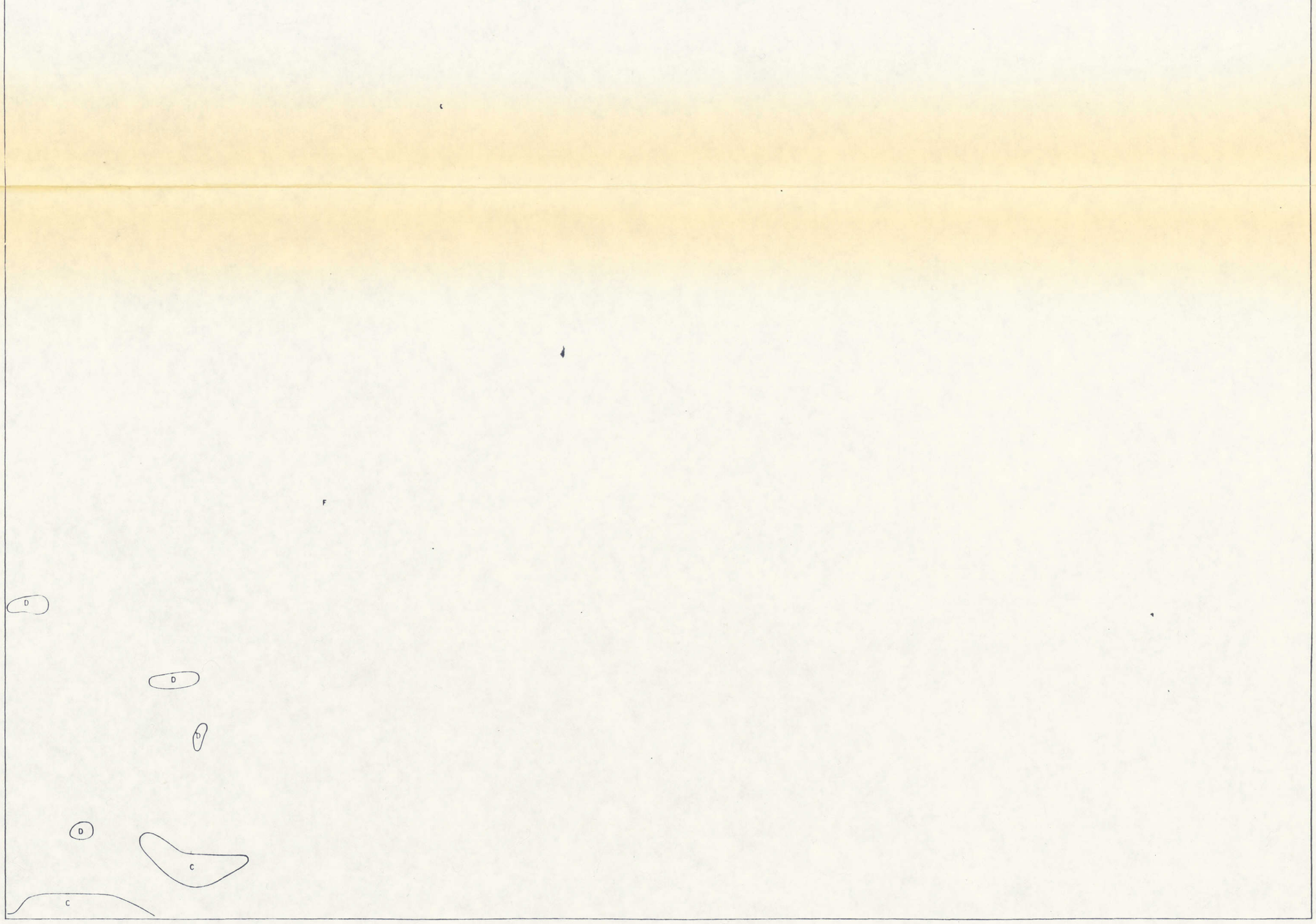
104° 00′ 00″

30° 00′ 00″

30° 00′ 00″



29° 45′ 00″

29° 45′ 00″

104° 15′ 00″

104° 00′ 00″

MILES 0 1 MILES

BUCKSHOT, TX.

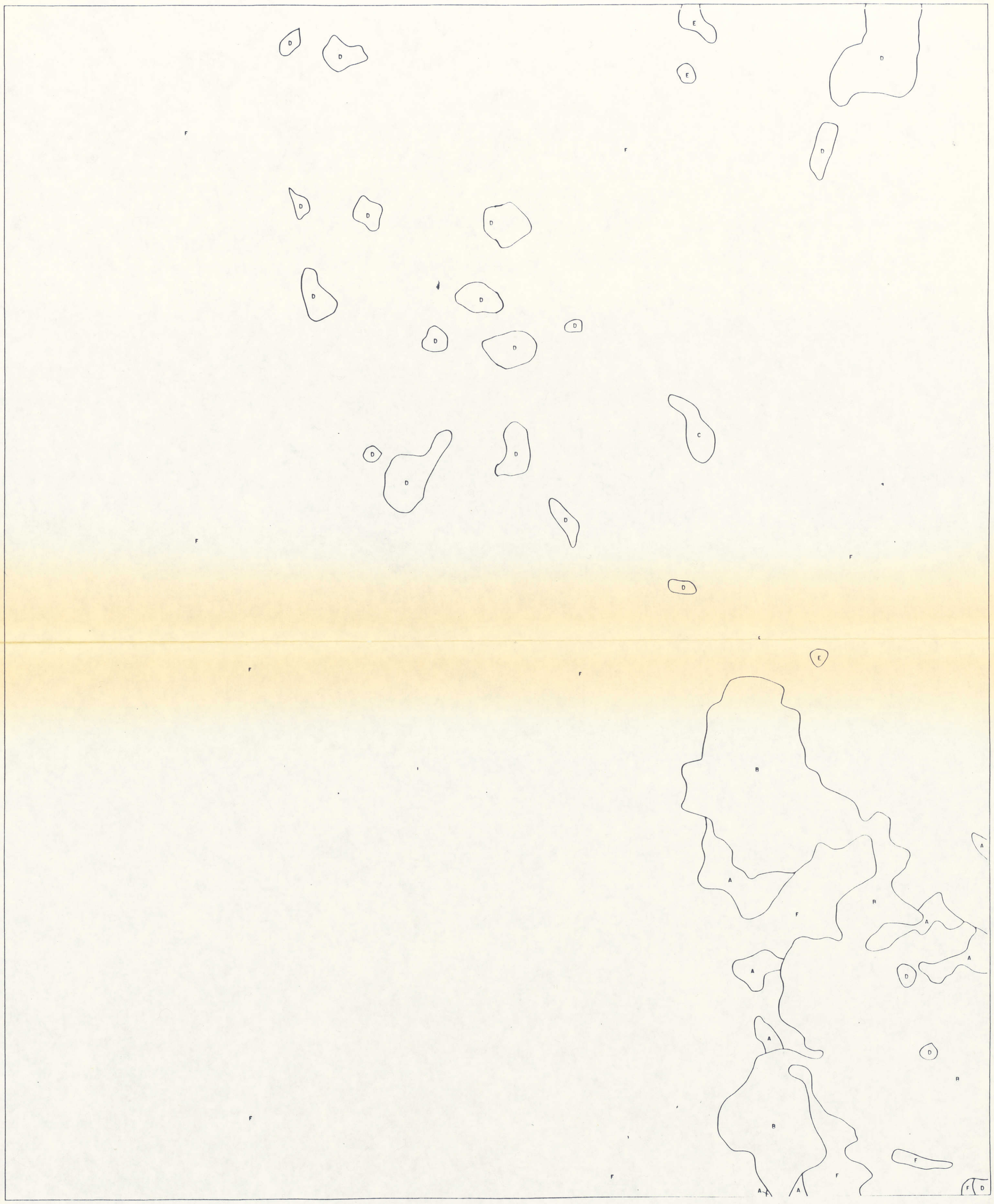
1/62500.

OC-A HIGH K-40,ETH,AND TOTAL COUNT
OC-B HIGH EU/ETH & HIGH EU/K RATIOS
OC-C HIGH MAGNETOMETER ACTIVITY
OC-D HIGH ETH/K RATIO
OC-E HIGH EU - K
OC-F NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB

104°45′00″ 104°30′00″

30°15′00″ 30°15′00″



30°00′00″ 30°00′00″

104°45′00″ 104°30′00″

BUCKSHOT, TX.

1/62500.

MILES 0 1 MILES

OC-A	HIGH K-40,ETH,AND TOTAL COUNT
OC-B	HIGH EU/ETH & EU/K RATIOS
OC-C	HIGH MAGNETOMETER ACTIVITY
OC-D	HIGH ETH/K RATIO
OC-E	HIGH EU - K
OC-F	NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB

104° 30′ 00″

104° 15′ 00″

30° 15′ 00″

30° 15′ 00″

30° 00′ 00″

30° 00′ 00″

104° 30′ 00″

104° 15′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 — 1 MILES

QC-A	HIGH K-40,ETH,AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

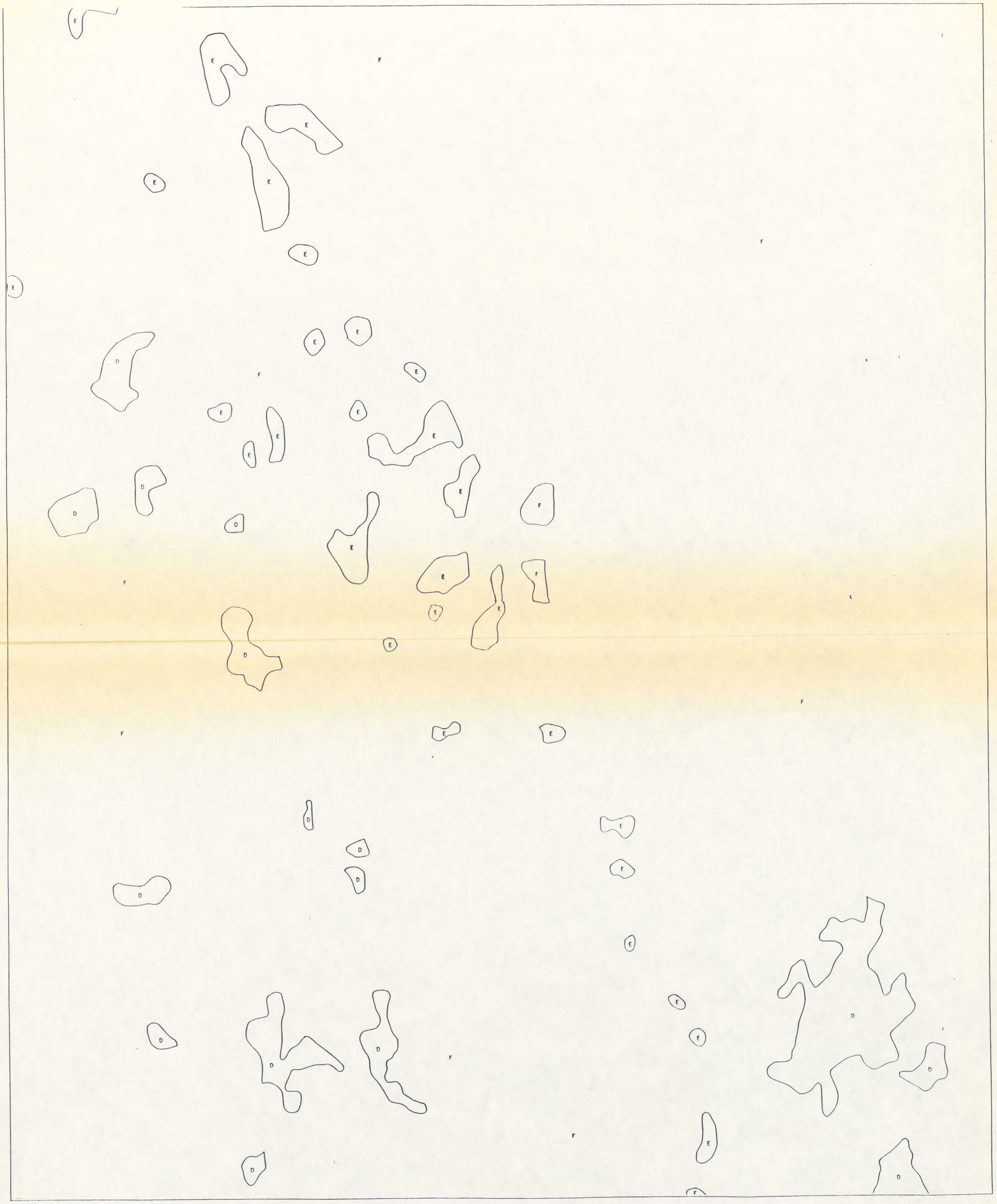
HIGH LIFE - QEB

104° 45′ 00″

104° 30′ 00″

30° 30′ 00″

30° 30′ 00″



30° 15′ 00″

30° 15′ 00″

104° 45′ 00″

104° 30′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 — 1 MILES

QC-A	HIGH K-40, ETH, AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

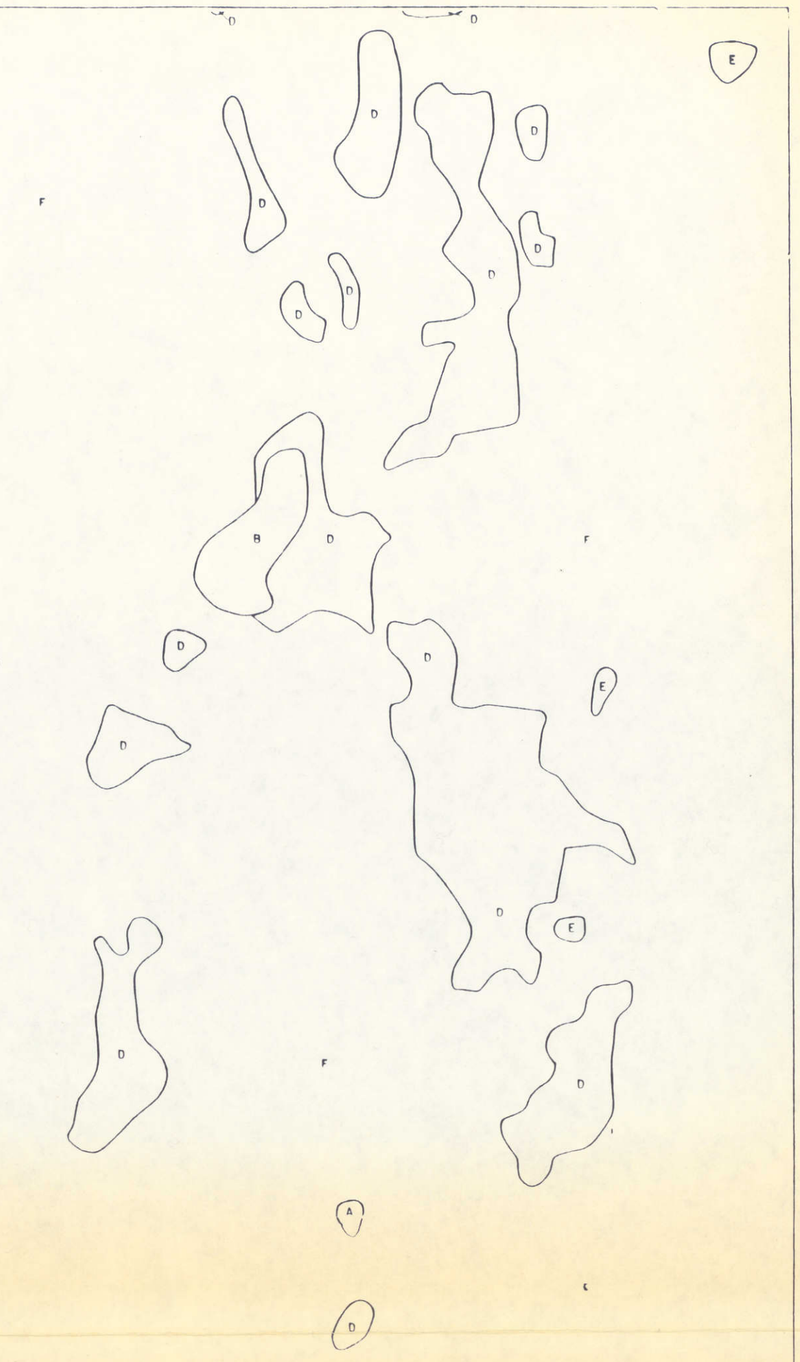
HIGH LIFE - QEB

105° 00′ 00″

104° 45′ 00″

30° 30′ 00″

30° 15′ 00″



105° 00′ 00″

104° 45′ 00″

MILES 0 1 MILES

BUCKSHOT, TX.

1/62500.

OC-A HIGH K-40,ETH,AND TOTAL COUNT
OC-B HIGH EU/EH & HIGH EU/K RATIOS
OC-C HIGH MAGNETOMETERS ACTIVITY
OC-D HIGH ETH/K RATIO
OC-E HIGH EU - K
OC-F NON-ANOMOLUS BACKGROUND

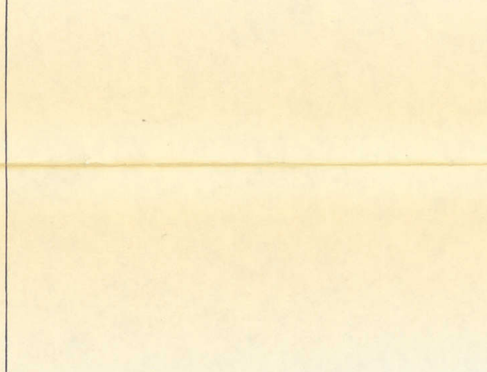
HIGH LIFE - QEB

104° 45′ 00″

104° 30′ 00″

30° 45′ 00″

30° 45′ 00″



30° 30′ 00″

30° 30′ 00″

104° 45′ 00″

104° 30′ 00″

MILES 0 1 MILES

BUCKSHOT, TX.

1/62500.

QC-A	HIGH K-40,ETH,AND TOTLA COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

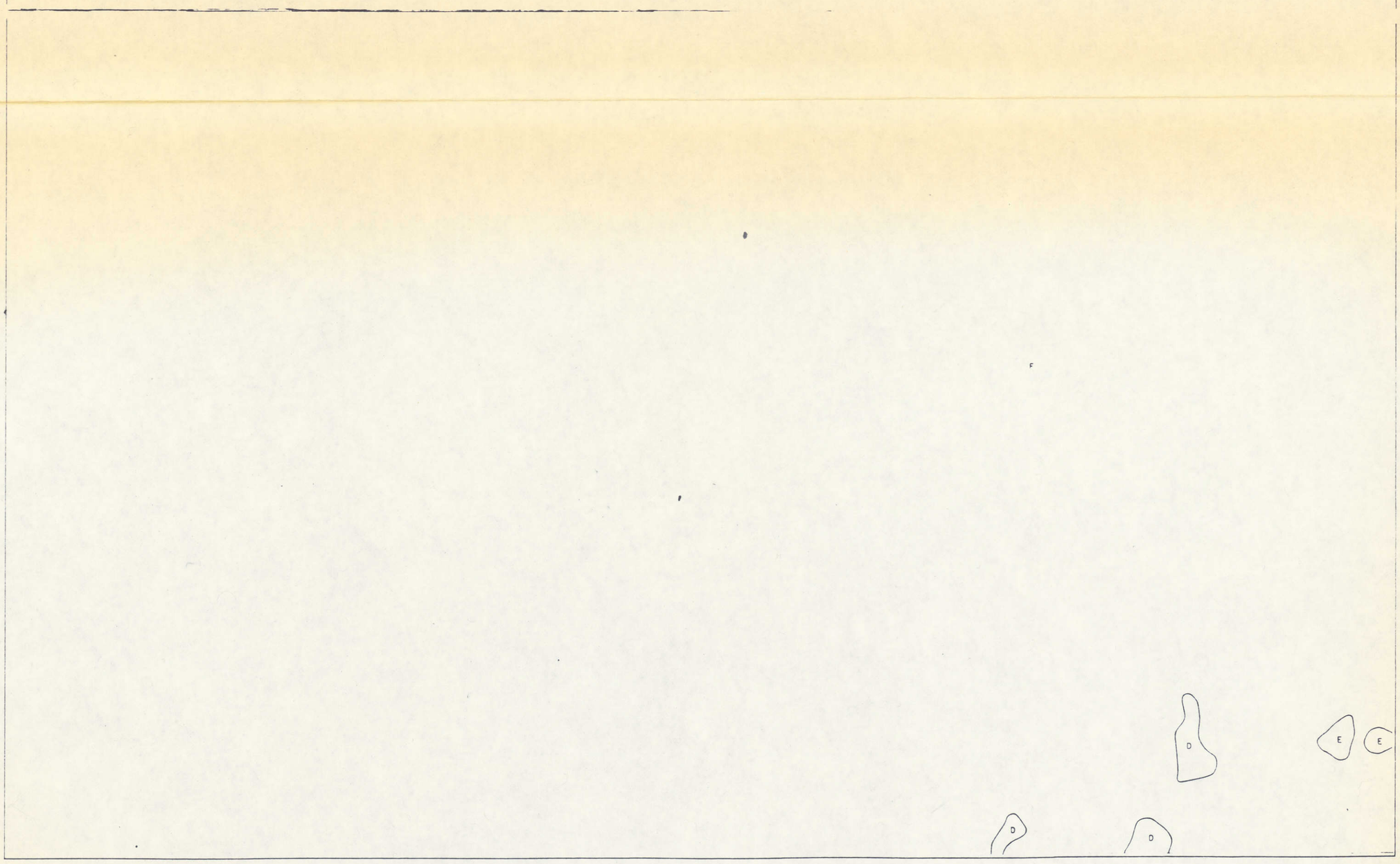
HIGH LIFE - QEB

105° 00′ 00″

104° 45′ 00″

30° 45′ 00″

30° 45′ 00″



30° 30′ 00″

30° 30′ 00″

105° 00′ 00″

104° 45′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 1 MILES

GC-A HIGH K-40,ETH.AND TOTAL COUNT
GC-B HIGH EU/ETH & HIGH EU/K RATIOS
GC-C HIGH MAGNETOMETER ACTIVITY
GC-D HIGH ETH/K RATIO
GC-E HIGH EU - K
GC-F NON-ANOMOLUS BACKGROUND

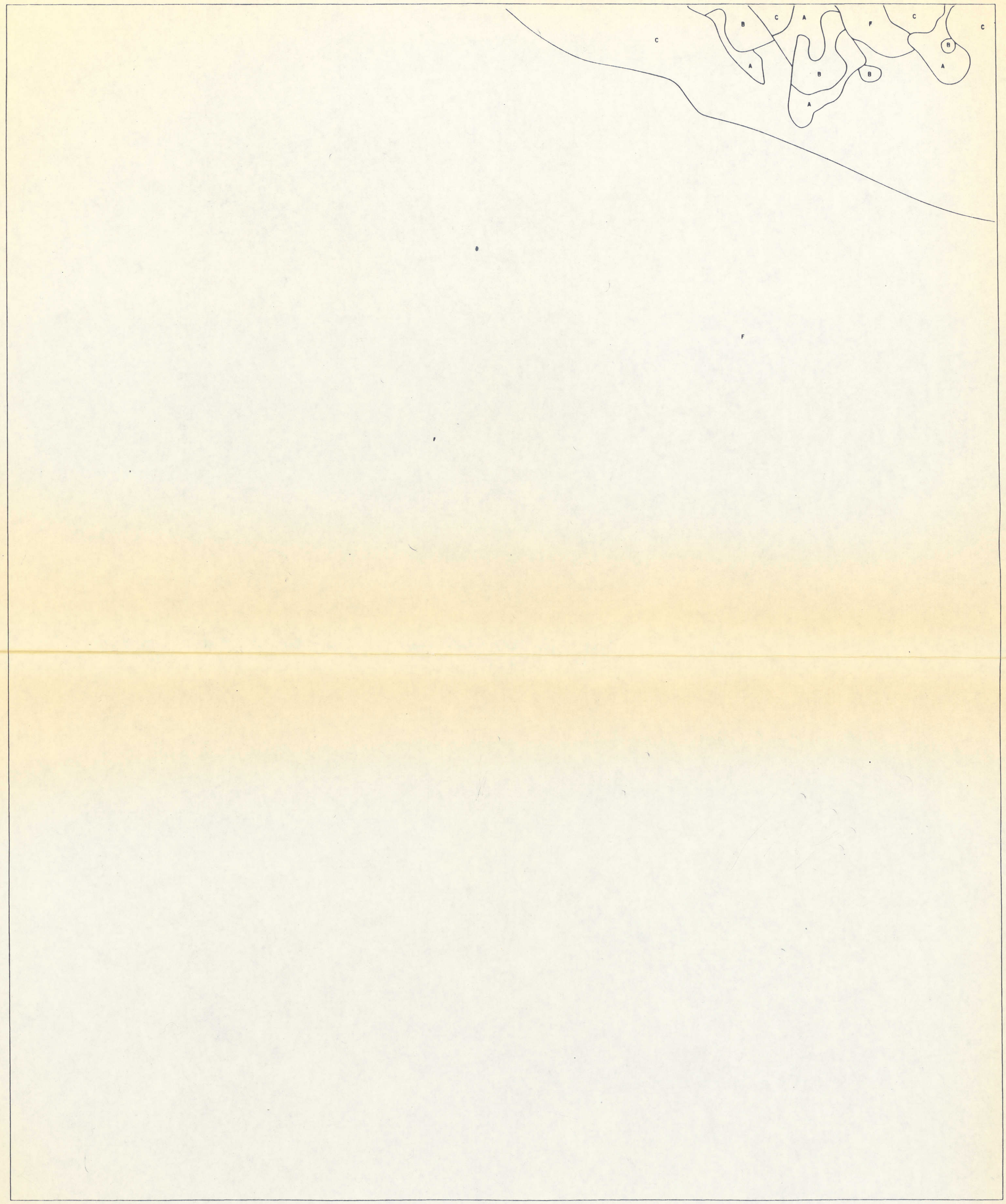
HIGH LIFE - QEB

104° 30′ 00″

104° 15′ 00″

29° 45′ 00″

29° 45′ 00″



29° 30′ 00″

29° 30′ 00″

104° 30′ 00″

104° 15′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 — 1 MILES

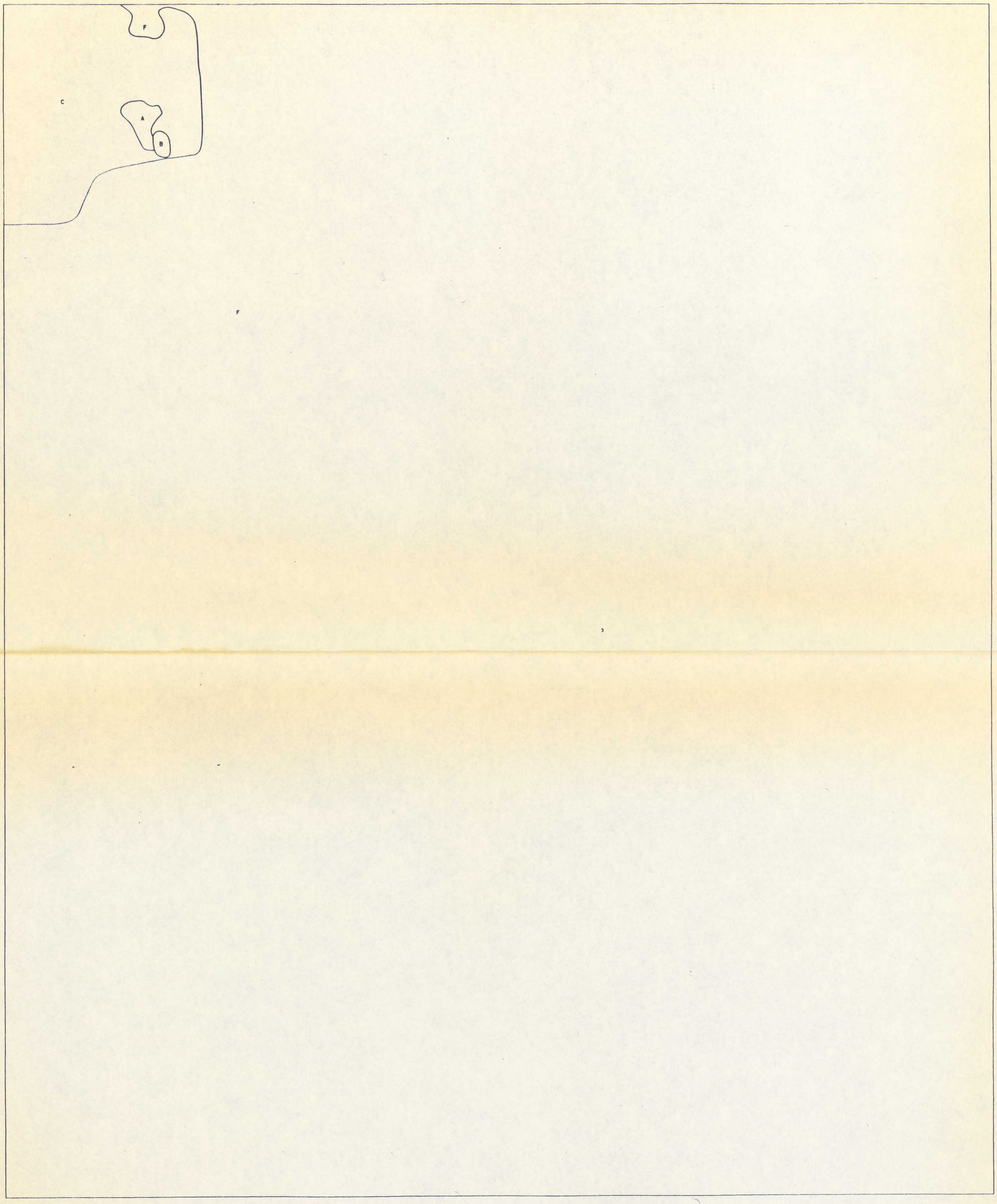
QC-A	HIGH K-40,ETH,AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH ETH/K RATIO
QC-E	HIGH EU-K
QC-F	NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB

104° 15′ 00″

104° 00′ 00″

29° 45′ 00″



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104° 15′ 00″

104° 00′ 00″

BUCKSHOT, TX.

1/62500.

MILES 0 1 MILES

QC-A	HIGH K-40,ETH,AND TOTAL COUNT
QC-B	HIGH EU/ETH & HIGH EU/K RATIOS
QC-C	HIGH MAGNETOMETER ACTIVITY
QC-D	HIGH EU/K RATIO
QC-E	HIGH EU - K
QC-F	NON-ANOMOLUS BACKGROUND

HIGH LIFE - QEB