Geologic Map of the Truth or Consequences 30 x 60 Minute Quadrangle (1:100,000 scale)

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INTRODUCTION

The geologic map of the Truth or Consequences 30 x 60 minute quadrangle has grown out of the Ph.D. dissertations and related work of the authors in south-central New Mexico. Funding and support for this work was provided by New Mexico Bureau of Mines and Mineral Resources. And while the authors have mapped extensive portions of the sheet in either detailed or reconnaissance fashion, large areas of the sheet have been compiled from existing maps (see attached diagram for sources).

This is an in-progress status report. Many aspects of the complex geology found in this area are yet to be worked out. Descriptions of stratigraphy and structure provided in this report are brief. For more details, reference is given to Eggleston (1986), McIntosh (1989), Harrison (1990), and Lozinsky and Hawley (1986).

STRATIGRAPHY

Qc	Quaternary colluvium
Qca	Quaternary alluvium and colluvium, undivided
Qpg	Quaternary piedmont slope deposits

Tb — Tertiary basalts:

Pliocene, approximately 4.2-4.8 Ma (K/Ar dates) in Winston-Las Animas grabens, approximately 2.1 Ma (K/Ar date) in Cutter Sag area, the younger group upon a pediment surface in the Cutter Sag area.

Tsf — Santa Fe Group:

Oligocene and younger basin fill of the Rio Grande drainage west of the Continental Divide: basal beds are intercalated with Oligocene volcanic rocks, are moderately well indurated, more voluminous, younger beds overlie basal beds with angular unconformity and are generally near horizontal in attitude. The Santa Fe Group is dominantly volcaniclastic and heterolithic.

Tg — Gila Conglomerate:

Oligocene and younger basin fill west of the Continental Divide: basal beds [Tirs-sandstone of Inman Ranch] are interbedded with Oligocene volcanics, moderately well indurated, and commonly rotated; overlaid with angular unconformity by subhorizontal younger beds.

Tbw — Bearwallow Mountain Formation:

Trachy-basalt and trachyandesite lavas, both intrusive and extrusive; K/Ar ages range from approximately 20 to 25 Ma (Elston, 1976; Elston et al., 1973; Woodard, 1982; and Stinnett, 1980). Includes andesite of Winston graben: trachyandesite lava flows, breccia deposits, and vent breccias; dated by K/Ar method at 18.3 ± 0.4 Ma (Seager et al., 1984); interbedded with Santa Fe Group in the Winston graben.

Tgc — Tuff of Garcia Camp:

Rhyolite ignimbrite; poorly welded, moderately crystal rich (quartz, sanidine, and biotite); Ar/Ar date of 28.10 (McIntosh, 1989); this unit is found only in Taylor Creek area, where in interfingers with basal portion of the Gila Conglomerate.

Tirs — Sandstone of Inman Ranch:

Tuffaceous sandstone, siltstone, and minor conglomerate deposits occurring in the Taylor Creek area; unconformably overlies Taylor Creek Rhyolite and is unconformably overlain by Gila Conglomerate. Contains vertebrate fossils of upper Oligocene to lower Miocene age (Tedford, 1981); An intercalated, thin ash-flow tuff has been correlated with South Canyon Tuff (27.28 Ma $^{40}Ar/^{39}Ar$ age) by McIntosh (1989).

Tsch — Tuff of Shipman Canyon:

Rhyolite ash-flow tuff found in Monticello area (Maldonado, 1974); overlies rhyolite of Willow Springs and is overlain by Santa Fe Group.

Ttct — Pyroclastic rocks associated with Taylor Creek Rhyolite:

High-silica ash-flow tuffs, air-fall, and surge deposits. [Tuff of Shipman Canyon might be a correlative unit related to rhyolite of Willow Springs.]

Ttc — Taylor Creek Rhyolite:
Tws — Rhyolite of Willow Springs:

High-silica rhyolite flows and domes; crystal-rich with approximately equal amounts of quartz and sanidine, and minor plagioclase and biotite; a mean Ar/Ar age of 28.2 was determined for Taylor Creek Rhyolite by Dalrymple and Duffield (1988), Heyl et al. (1983) report an age for rhyolite of Willow Springs of 27.8 ± 1.0 Ma (fission-track method on zircon); both units contain large areas of vapor-phase alteration and tin mineralization. Taylor Creek Rhyolite is found in northwestern corner of the map; rhyolite of Willow Springs crops out in eastern Sierra Cuchillo Range.

Tlg — Latite of Grapevine Canyon:

Reddish-brown lava flows with sanidine phenocrysts (Maldonado, 1974); found only in the Monticello area.

Thok Rhyolite of HOK Ranch:
Tfm Rhyolite of Franks Mountain:
Twh Dacite of Wildhorse Canyon:

Late Oligocene, rhyolite flow-dome complexes and flows; 10-20 % phenocrysts of quartz and sanidine, with minor biotite; approximately 28.0 Ma. On the Truth or Consequences sheet, dacite of Wildhorse Canyon occurs only as an intrusive dome in secs. 28, 29, & 32, T9S R9W; crystal rich with 15-25% large (2-3 cm) phenocrysts of plagioclase and 1-5% phenocrysts of biotite; believed to be correlative with the quartz latite lava (Tql1 map unit) of Fodor (1976) in the northern Black Range.

Tvp Vicks Peak Tuff:

Rhyolite ash-flow tuff, very crystal poor with 1-3% sanidine and trace amounts of quartz, conspicuously large pumice containing vapor-phase mineralization; a mean Ar/Ar age of 28.56 $\pm$ 0.06 Ma was obtained by McIntosh (1989).

Tdc Tuff of Diamond Creek:
Tlm Tuff of Diamond Mountain:

Complex and poorly understood interval of multiple rhyolite ash-flow tuffs, air-fall tuffs, and volcaniclastic deposits; highly variable phenocryst contents; McIntosh (1989) gives a single Ar/Ar age of 28.7 Ma for tuff of Diamond Creek; regionally extensive in the Black Range; portions of these units are possibly pyroclastic deposits related to the late Oligocene, rhyolite flow-dome complexes (such as rhyolite of Franks Mountain).

Tlj La Jencia Tuff:

Rhyolite ash-flow tuff; crystal poor and typically densely welded with common vitrophyres; Ar/Ar age of 28.9 Ma (McIntosh, 1989).

Tdp Rhyolite of Dolan Peak:

High-silica rhyolite lava and flow-dome complexes; 10-25% phenocrysts of sanidine and quartz, with rare biotite; some areas of this unit contain intense vapor-phase alteration and associated tin mineralization.

Tsp Rhyolite of Sawmill Peak:

Alkalic rhyolite lavas and minor ash-flow tuffs; approximately 10% phenocrysts of conspicuously large (0.7-1.5 cm) sanidine, with minor amounts of quartz and biotite; vent area is located along Sheep Creek Canyon in secs. 35 and 26, T9S R9W.

Tkm Tuff of Kline Mountain:

Rhyolite ash-flow tuff; generally crystal poor with <10% sanidine and quartz; pervasively altered to argillic and advanced argillic assemblages related to intrusion of a body of rhyolite of Franks Mountain; stratigraphic relationship between this unit and tuff of Stiver Canyon is poorly understood.

Tsc Tuff of Silver Canyon

Rhyolite ash-flow tuff; 10-20% phenocrysts of sanidine and quartz, with minor biotite.

Tmj Moccasin John Rhyolite:

Rhyolite flow-dome complexes, dikes, and lavas, with minor interbedded perlitic tuffs and volcaniclastic deposits: very crystal poor with 1-3% quartz, sanidine, plagioclase, and biotite.

Tlmc Tuff of Mineral Creek:
Tmh Tuff of Mud Hole:

Rhyolite ash-flow tuffs; crystal poor and typically poorly welded; tuff of Little Mineral Creek contains 10-50% lithic fragments of Moccasin John Rhyolite and has an Ar/Ar age of 29.10 Ma (McIntosh, 1989); tuff of Mud Hole contains few lithic fragments and has an Ar/Ar age of 29.11 Ma (McIntosh, 1989).

Tpc Basaltic andesite of Poverty Creek:

Multiple, dark, aphanitic lava flows of basaltic andesite through dacite composition with minor intercalated fine-grained volcaniclastic deposits; numerous K/Ar ages and Ar/Ar age constraints indicate an age range of 29.1-29.4 Ma; numerous, widespread flow-dome complexes and dikes; regional stratigraphic unit throughout the western half of map area.

Stratigraphic interval between basaltic andesite of Poverty Creek and Kneeling Nun Tuff:

A volcanic hiatus of roughly 5 Ma is recognized throughout the central portion of the map area, where basaltic andesite of Poverty Creek lies directly upon Kneeling Nun Tuff with little sign of erosion or deposition; along the western margin of the map area, several mappable units occur within this interval: Tmps, Tcb, Tkw, Tcn.

Ti Intrusives in the northern Sierra Cuchillo Range:

Iron Mountain intrusive; white, very fine-grained granite; K/Ar age of 30.1 $\pm$ 1.1 Ma (Chapin et al., 1975).

Tmps Sandstone of Monument Park:

Volcaniclastic sandstone, siltstone, and local pebble-cobble conglomerate deposits; sandstone beds contain of quartz, sanidine, and plagioclase grains; conglomerate beds contain clasts of Kneeling Nun Tuff.

Tkw Tuffs of Koko Well:

Two rhyolite ash-flow tuffs; directly overlie Kneeling Nun Tuff in northwestern corner of map area; the upper tuff is crystal poor with approximately 5% sanidine, <1% plagioclase, and trace quartz and biotite phenocrysts, and is probably correlative to the Rock House Canyon Tuff found in the northern Mogollon-Datil volcanic field; the lower tuff is moderately crystal rich with approximately 6% sanidine, 2-3% plagioclase, 1% biotite, and trace hornblende and pyroxene phenocrysts.

Tcn Cuchillo Negro Complex:

Intrusive-extrusive complex of rhyolite-dacite-trachite-basaltic andesite lavas, ash-flow tuffs, breccias, and intercalated volcaniclastic deposits; much of this complex consists of dark, intermediate lavas and breccia deposits with characteristic green pyroxene phenocrysts; one whole-rock K/Ar age of 34.7 ± 0.8 Ma; this complex crops out exclusively in the area between the Winston and Las Animas grabens; Cuchillo Negro Complex in snterpreted as post-Emory caldera ring-fracture volcanism and most deposits, and thus is generally correlative with the Mimbres Peak Formation.

Tkn Kneeling Nun Tuff:

Rhyolite ash-flow tuff; crystal rich with 20-45% phenocrysts of quartz, sanidine, plagioclase, and biotite; McIntosh (1989) obtained an Ar/Ar age of 34.9 Ma for this unit; Kneeling Nun Tuff is a major stratigraphic unit throughout the western half of the map; source area is the Emory caldera complex, the northern lobe of which is in the southwestern quarter of the map (see Abitz, 1984; 1989).

Ts Stratigraphic interval correlative to the Sugarlump Formation found in the southern Black Range and Mimbres Valley:

Dominantly rhyolite ash-flow tuffs; includes tuff of Rocque Ramos Canyon and tuff of Victoria Tank in Sierra Cuchillo-Animas uplift and Black Range, and the tuff of Luna Park in southern San Mateo Mountains; also includes fine-grained, arkosic to quartzose volcaniclastic rocks such as sandstone of Cliff Canyon in Black Range.

Tuff of Rocque Ramos Canyon is moderately crystal rich with 10-20% combined plagioclase and sanidine, and 1-2% biotite phenocrysts; McIntosh (1989) reports an Ar/Ar age of 34.93 Ma for tuff of Rocque Ramos Canyon and correlates it with the Bell Top 4 tuff in the Goodsight-Cedar Hills area.

Tuff of Victoria Tank is crystal poor with <10% phenocrysts of plagioclase, sanidine, and biotite, and is lithic rich with 20-40% heterolithic clasts of Rocque Ramos Canyon and tuff of Victoria Tank are interpreted as the products of precursor eruptions related to the Kneeling Nun Tuff.

Trp	Rubio Peak Formation: Complex sequence of intermediate volcaniclastic and volcanic rocks; dominantly debris-flow and sandstone deposits with lesser conglomerate beds, lava flows, and ash-flow tuffs; age dates and constraints in the range of 45-37 Ma (Harrison, 1990).
Pme	Exotic blocks of Pennsylvanian limestone (Madera Limestone): Gravity slide blocks, as much as 500 ft (160 m) thick interbedded with debris flow and sandstone deposits of the Rubio Peak Formation in the Black Range (see Harrison, 1989).
Te	Eocene lavas: Hornblende-bearing lavas found in the Sierra Cuchillo and Animas uplift; some are probably intrusive; part of the Rubio Peak Formation.
Tei	Eocene intrusives: Stocks, plugs, lacoliths, and dikes of probable Eocene age; typically hornblende bearing; includes Double S Peak stock (39.2 ± 0.9 Ma) and Sierra Cuchillo lacolith (50.1 ± 2.6 Ma).
Tmz	Monzonite intrusives: Stocks, plugs, sills, and dikes of uncertain or pre-Eocene age; includes Salado Mountains intrusive (61.4 ± 2.4 Ma); typically contain hornblende and/or pyroxene.
TKmz	Monzonite to quartz monzonite intrusives: Intrusives of possible Cretaceous age.
TKmc	McRae Formation: Clastic and volcaniclastic deposits found in Cutter Sag, east of Elephant Butte Lake; dominantly siltstones and shales with minor matrix-supported debris-flow deposits.
K	Cretaceous, undivided:
P	Permian, undivided:
Pa	Permian Abo Formation:
P	Pennsylvanian, undivided:
LP	Lower Paleozoic, undivided:
PC	Precambrian:

STRUCTURE

Geologic structure in the area of the Truth or Consequences sheet is far too complex to discuss in detail in this report. Virtually all of the structures recognized in this area are Late Cretaceous or Cenozoic in age. The following is a brief summary.

Large fault-propagation folds and associated thrust faults of early Laramide age (probably Late Cretaceous) with north-south axes occur in the Caballo and Fra Cristobal Mountains. A large fault-propagation fold of middle Laramide age (probably Paleocene) and with a northwest-trending axis is found in area around the city of Truth or Consequences. Vertical to overturned beds of Paleozoic rocks with northwest strikes also occur in the eastern Sierra Cuchillo Range and are probably an extension of this structure; however, exposures are very limited due to cover by younger formations. Late Laramide (Eocene) structures are widespread throughout the sheet as right-lateral strike-slip faults with dominant north-northeast strikes. The largest of these is the Hot Springs fault which runs along the western margin of the Caballo and Fra Cristobal Mountains and may have as much as 26 km of horizontal displacement (Harrison and Chapin, 1990). Other significant strike-slip structures occur along the western front of the Sierra Cuchillo Range and Animas uplift, and in the Chloride mining district of the Black Range (Harrison, 1989; 1990).

By far, the majority of structures shown on the Truth or Consequences geologic map are normal and oblique-slip faults related to the Rio Grande rift. These are of late Oligocene and Neogene age. Early rift structures are the result of northeast-southwest extension; late rift structures are the result of east-west extension. The entire area and all formations from Precambrian through Santa Fe Group are effected by rift-related structures.

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Legend of map units

Qca Qpg	Quaternary colluvium and pediment gravels; mapped only in northwest corner bedrock map.
Tsf Tg	Santa Fe Group & Gila Conglomerate, also includes Quaternary deposits.
Tb	Tertiary basalts; generally from ~ 2.1-4.8 Ma.
Tbw	Bearwallow Formation; from ~ 18-25 Ma.
Tia	andesite (intermediate) intrusives; age uncertain.
Tir	rhyolite intrusives; age uncertain.
Tvu	Tertiary volcanics undivided.
Tgc Tirs Tshc	Tuff of Garcia Camp; ~ 28.1 Ma; Sandstone of Inman Ranch; Tuff of Shipman Canyon.
Tws Ttc Ttct	Rhyolite of Willow Springs; 27.8 ± 1.0 Ma; Taylor Creek Rhyolite; ~ 28.1 Ma; Tuffs related to Taylor Creek Rhyolite.
Tlg	Latite of Grapevine Canyon.
Thok Tfm Twh	Rhyolite of HOK Ranch; Rhyolite of Franks Mountain; Rhyolite of Wildhorse Canyon.

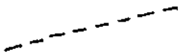
Tvp Tdc Tlm Tlj	Vicks Peak Tuff; ~ 28.6 Ma; includes some moat deposits in the southern San Mateo Mts; Tuff of Diamond Creek; ~ 28.7 Ma; Tuff of Lookout Mountain; La Jencia Tuff; ~ 28.9 Ma.
Tdp	Rhyolite of Dolan Peak.
Tsp	Rhyolite of Sawmill Peak.
Tkm Tsc	Tuff of Kline Mountain; Tuff of Stiver Canyon.
Tmj	Moccasin John Rhyolite.
Tlmc Tmh	Tuff of Little Mineral Creek; ~ 29.1 Ma; Tuff of Mud Hole; ~ 29.1 Ma.
Tpc	Basaltic andesite of Poverty Creek; from 29.1-29.4 Ma.
Ti	Iron Mt. intrusive, microgranite; ~ 30.1 Ma Reilly Peak intrusive.
Tmps Tcb Tkw	Sandstone of Monument Park; Caballo Blanco Tuff; ~ 31.7 Ma; Tuff of Koko Well (Rock House Canyon Tuff; ~ 34.4 Ma.
Tcn	Cuchillo Negro complex; ~ 34.7 Ma.
Tkn	Kneeling Nun Tuff; ~ 34.9 Ma.

Ts	"Sugarlump Tuffs" : Tuff of Rocque Ramos Canyon; ~ 35.0 Ma; Tuff of Victoria Tank; Tuff of Luna Park.
Trp IPme	Rubio Peak Formation; Exotic blocks of Pennsylvanian limestone intercalated with Rubio Peak Fm.
Te	Eocene lavas;
Tei	Eocene intrusives; Double S Peak stock - 39.2 ± .9 Ma; Sierra Cuchillo lacolith - 50.1 ± 2.6 Ma.
Tmz	Monzonite intrusives; Salado Mts. intrusive 61.4 ± 2.4 Ma;
KTmz	Monzonite intrusives of possible Cretaceous age
TKmc	McRae Formation
K	Cretaceous rocks, undivided.
P Pa	Permian rocks, undivided; Permian Abo Formation.
IP	Pennsylvanian rocks, undivdied.
LP	Lower Paleozoic rocks, undivided.
PC	Precambrian rocks.

Legend of Units on Santa Fe Group Map

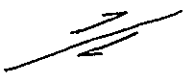
Qvy	young valley-fill alluvium (active)
Qvo	old valley-fill alluvium, terrace deposits
QTpa	ancestrial river facies of the Palomas Fm.
QTpp	piedmont facies of the Palomas Fm.

LEGEND OF MAP SYMBOLS



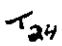
geologic contact, dashed lines except for northwest corner where contacts are thin solid lines

normal fault, tick on down-thrown side



strike-slip fault, arrows indicate sense of motion

thrust fault or high-angle reverse fault, teeth indicate direction of dip



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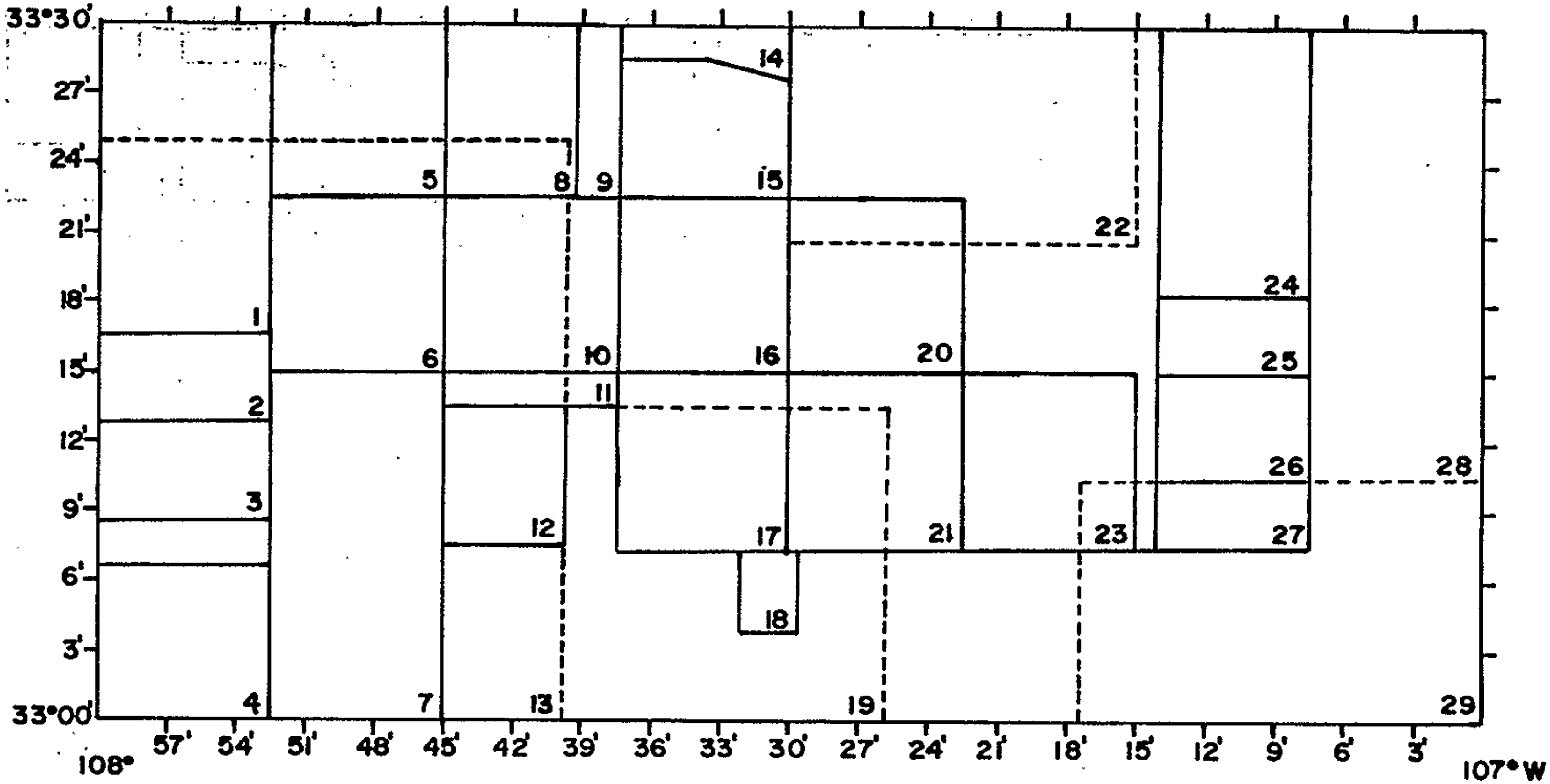
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Source areas for Truth or Consequences 1:100,000-scale, compilation geologic map (Plate 5).

Base map is U.S. Geological Survey, 1979, Truth or Consequences, New Mexico, 30x60 minute series (topographic) N3300-W10700/30x60, 1 sheet. Correlation numbers are located in lower-right-hand corner of each reference area.

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TRUTH OR CONSEQUENCES, NEW MEXICO
Map 1
30x60 MINUTE SERIES (TOPOGRAPHIC)
WINSTON GRABEN
MONTICELLO GRABEN
MOCCASIN JOHN DOME COMPLEX
ENGLE BASIN
LAS ANIMAS GRABEN
PALOMAS BASIN
SCALE 1:100 000
1 CENTIMETER ON THE MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 50 METERS
TRUTH OR CONSEQUENCES, NEW MEXICO
N3300—W10700/30x60
1979
R.W. Harrison