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UNITED STATES ATOMIC ENERGY COMMISSION

DRILLING AT DRIPPING SPRINGS, EMERY COUNTY, UTAH

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UNITED STATES ATOMIC ENERGY COMMISSION

GRAND JUNCTION OPERATIONS OFFICE

EXPLORATION DIVISION

DRILLING AT DRIPPING SPRINGS

EMERY COUNTY, UTAH

CONTRACT NO. AT(05-1)-223

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ABSTRACT

The diamond drilling project in the Dripping Springs area of the San Rafael Swell was carried out as part of Contract No. AT(05-1)-223 during the period from April 13, 1953, to August 8, 1953. Two rigs drilled 14,472.9 feet in 212 holes.

The three favorable areas in the Shinarump conglomerate upon which the drilling program was recommended were drilled as planned. In addition to this, twenty wildcat holes, based on lithologic and structural trends, were drilled at various locations throughout the area. Geologic conditions favorable and not favorable to the occurrence of uranium deposits are discussed.

INTRODUCTION

The Dripping Springs area is on the southern flank of the San Rafael Swell in unsurveyed T. 25 S., R. 10 E., Emery County, Utah. It is about ten air miles southwest of Temple Mountain and approximately fifteen air miles south of Green Vein Mesa (fig. 1). The area is accessible by road a distance of about thirteen miles from Temple Mountain.

The nearest railroad and bus terminal is at Green River, Utah, 47 miles northeast of Temple Mountain on Utah Highway 24. General supplies and provisions can be obtained there.

At the time of this study only two parties had claims in the area.

HISTORY AND PRODUCTION

History of Operations

The Dripping Springs area was first investigated during the fall of 1952 in the progress of a general San Rafael Swell reconnaissance program. Anomalous radioactivity was found in the area and supplementary investigation was deemed advisable. As the result of this supplementary work, reports were submitted by R. L. Akright (1) and D. N. Hinckley (2) which recommended the area to be diamond drilled. At that time the Dripping Springs area was inaccessible to vehicles without four-wheel drive. Valid mining claims, filed during 1951 and 1952, could be reached only on horseback or on foot. There were no shipments of ore prior to the construction of the AEC access road.

AEC interest in the area has stimulated private industry to complete several thousand feet of rim stripping and eight wagon drill holes.

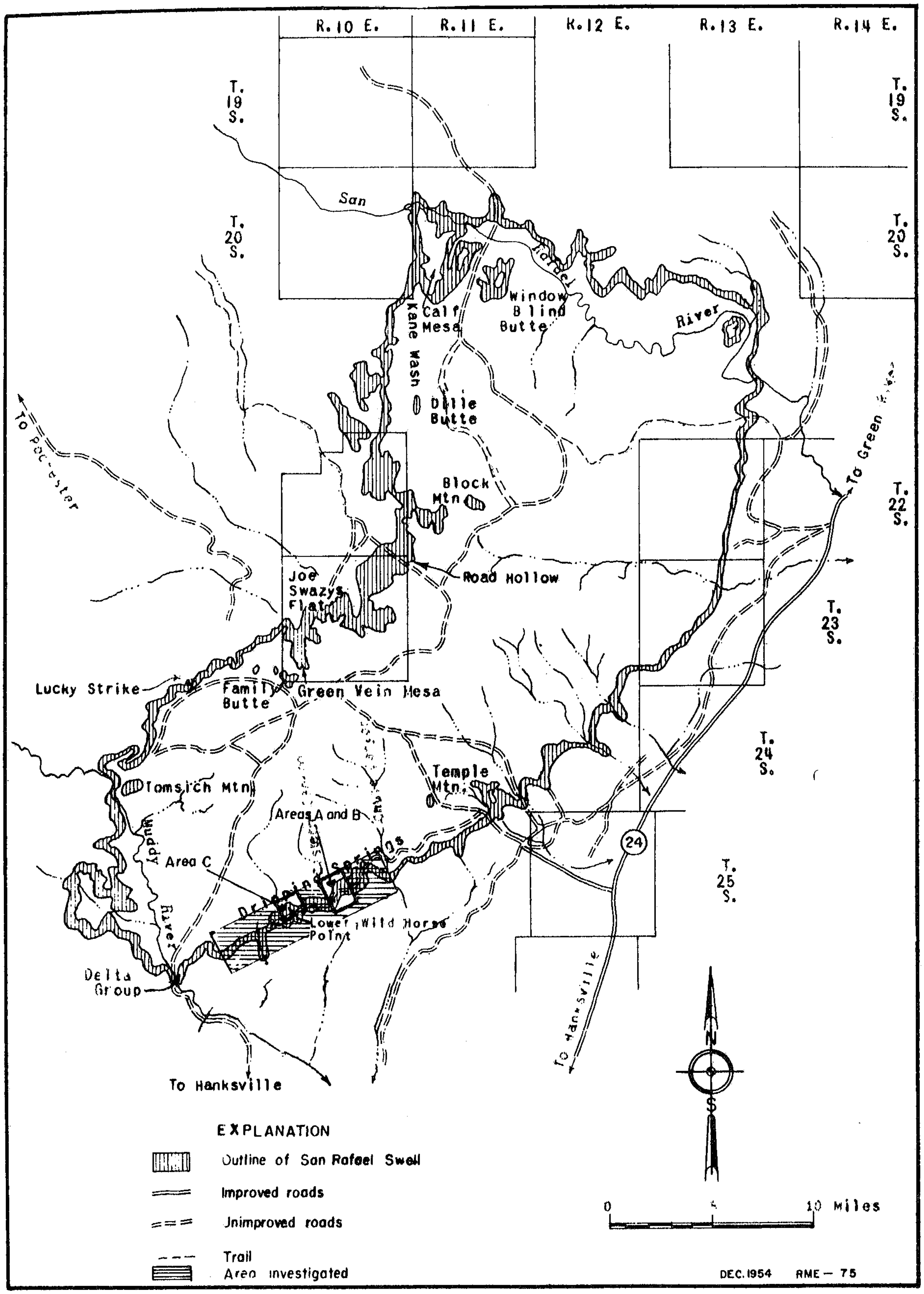

Figure I — Location of Dripping Springs area, Emery County, Utah

GEOLOGY

The San Rafael Swell is an elliptical upwarp of sedimentary rocks about 70 miles long and 30 miles wide with the long axis trending to the northeast. It is surrounded by a rim of inward-facing, almost vertical cliffs (referred to as the "reef") which have been breached by stream erosion. The south central portion and the periphery is a maze of nearly impassable canyons dotted with large buttes, mesas, and cuestas.

The "Swell" is an elongated asymmetrical dome with the beds along the eastern flank dipping much more steeply than those along the western flank. The Dripping Springs area is inside the reef on the southeastern flank.

The topography in this area is governed by the rock structure. Massive sandstones and conglomerates form steep ledges and smooth benches, while the softer shales weather into slopes. Drainage is southward, cutting through the resistant rock of the reef in narrow walled canyons and through the shales in wider valleys with gentler side slopes (3).

Stratigraphy

The oldest rocks exposed in the Dripping Springs area is the Moenkopi formation of lower Triassic age. Above the Moenkopi is the ore-bearing Shinarump conglomerate, the Chinle formation, the Wingate sandstone (upper Triassic), the Kayenta formation and the Navajo sandstone of Jurassic age (Table 1).

The Shinarump conglomerate in the San Rafael Swell area has been renamed the Mossback sandstone of the Chinle formation by George Williams of the USGS in a memorandum dated October 28, 1954. However, the term Shinarump conglomerate is used throughout this report, as this field work was done prior to the reclassification.

The lithology of the fluviatile Shinarump conglomerate of the Dripping Springs area is similar to that in the Green Vein (4) and Temple Mountain (5) areas, except that considerably more mudstone is present in the lower portions. Upper portions of the Shinarump are characterized by thick sections of sandstone which range widely in grain size, sorting and cementation. This upper sandstone often contains large amounts of soft asphaltic material. Discontinuous lenses of medium- to fine-grained conglomerate of well-cemented chert and limestone pebbles are often interbedded with this sandstone. The lower portions of the Shinarump contain conglomerates composed largely of mudstone pebbles and angular mudstone fragments with flakes and thin layers of carbon. Mudstones are abundant in the lower portions and lenses up to 18 feet thick are common. Asphaltic material is not found in the lower portions, but the proportion of carbonized trash and tree remains increases with depth. Red colored, highly micaceous, evenly bedded mudstones, typical of many portions of the Moenkopi, were found as high as 20 feet above the Shinarump-Moenkopi contact.

The pre-Shinarump erosion surface of the upper Moenkopi is usually characterized by altered mudstones occurring in a mottled zone of red, brown, and purple coloring. This zone may be overlain by a blocky, green mudstone (usually occupying a topographic high in the pre-Shinarump erosion surface), but is more often overlain by sandstone or conglomerate or occasional mudstones of the Shinarump. Large numbers of various sized limy nodules, as well as chert nodules and jasperoid aggregates, are found locally along this contact zone.

TABLE 1. - Generalized section of the Dripping Springs area.

	Thickness, Feet	
Wingate sandstone	300 ±	Massive, buff to tan, cross-bedded sandstone; weathers dark tan to red; forms cliffs
Chinle formation	265 ±	Buff through light red to lavender, alternating sandstone and shale (3), forms slope
Shinarump conglomerate	80 ±	Interbedded lenses of conglomerate, conglomeratic sandstones, sandstones, shales, and mudstones with carbonaceous material and poorly silicified trees; uranium-bearing unit; forms low cliffs and benches
Moenkopi formation	684 ±	Predominantly interbedded sandstones and shales; red to buff in color (3); micaceous, ripple marked, persistent sandstone units; forms slopes broken by low cliffs

Structure

Geologic structure in the Dripping Springs area is relatively uniform. The formations dip 4 to 8 degrees southeast, with the dip increasing as the edge of the upwarp is approached. The area contains few faults, most of which have small displacement. One large fault with a displacement of over 100 feet occurs in the southern part of the area. The trend and displacement of the faults appear to be typical of the pattern produced by domal upwarp. Fracturing is common. Large warps or flexures were not observed.

Mineralogy

From samples taken in the Dripping Springs area the following uranium minerals were identified: autunite, metatorbernite, zippeite, and cyanotrichite. These samples were associated with varying amounts of tree carbon, malachite, azurite, gypsum, and small jasper aggregates.

EXPLORATION TECHNIQUE

Before a drilling program was launched in the Dripping Springs area, considerable geological work had been completed. Three areas were described as "favorable" to occurrence of uranium ore because of the good correlation found to exist between high radioactivity along the rim and lows in the pre-Shinarump topography. The results of drilling these favorable areas are described in detail under Areas A, B, and C.

Diamond drilling in the Dripping Springs area commenced April 13, 1953, and terminated August 7, 1953. A total of 14,472.9 feet was drilled to complete 212 holes to an average depth of 68.3 feet. Of this number, ten holes penetrated rock of ore grade and 42 were mineralized.

Uranium mineralization in the Dripping Springs area, as in other deposits in the Shinarump, occurs near the base of the Shinarump. This fairly uniform position permitted considerable drilling to be done with a plug-bit in the non-favorable zones of the upper Shinarump.

The project was provided with a jeep-mounted Scherbatskoy gamma-logging unit which made radiometric information immediately available and served as a check on core sampling. All core samples which indicated radioactivity were sent into the laboratory for analysis.

GEOLOGY OF THE DRILLING AREAS

Drilling Area A

Drilling Area A is located on the main Shinarump bench between Chute and Cistern Canyons near a small drainage called the Cistern Canyon Annex (fig. 1). It is bounded on the north by a low Shinarump cliff caused by the erosion of the softer underlying Moenkopi, and on the south by the steep slopes of the overlying Chinle formation and the Wingate sandstone cliffs. The formations of this area dip to the southeast at a 6-degree angle with a gradually increasing dip in this direction as the "reef" is approached. The over-all dimensions of the drilling area measure about 2,700 feet square.

The location of drill holes in Area A was somewhat determined by the topography. Adjustments up to 100 feet had to be made in a proposed 240-foot triangular grid which resulted in an irregular

Gamma logs from the Scherbatskoy gamma-logging unit provided means for construction of isorad maps. Two types of isorad maps were made: 1. The area under the curve type. This method consists of measuring by planimeter the area under the curve on the Scherbatskoy log for the interval under consideration, and using these figures in drawing the isorad contours (6). 2. The maximum amplitude type. This method consists of a linear measurement of the line showing radioactivity on the gamma log at the point of its greatest deflection (or maximum amplitude). The figures thus obtained are used in drawing the isorad contours. The results of the two types of isorad maps were so similar that only the simpler maximum amplitude type is used in this report (fig. 2).

The steep radiometric gradient displayed by the isorad map indicates the deposits have sharp boundaries and very small radioactive haloes. As the chemical and radiometric assays were nearly identical, the isorad map in this area gives an accurate interpretation of the relative amounts of uranium present. Good correlation was found between the isorad map and the subsurface pre-Shinarump contour map. The areas of highest radioactivity are elongate along the channel lows.

An isopach map was constructed on the thickness of the lowest sandstone and conglomerate sediments of the Shinarump (fig. 3). A general trend appears which exhibits some relationship to the pre-Shinarump topography. A maximum thickness of about 19 feet occurs in the center of the channel, gradually diminishes to 4 feet on the eastern edge and pinches out on the western edge. Mineralization occurred along the flanks of and in the thickest sections as depicted by this isopach map (fig. 3).

An estimate was made of the relative amounts of tree type carbon found in the lower 20 feet of the Shinarump. Three general classifications, "abundant, some, and sparse" were made in estimating the amount of carbon present. On the basis of this estimate, an isocarbon map was compiled (fig. 2). This map indicates that where mineralization occurs, "some" or "abundant" carbon was always found; but not all such areas contained mineralization. Mineralization never occurred in the "sparse" carbon area.

Mineralization in Area A

Uranium mineralization in this area is found in sandstone or muddy sandstone located in channels or pre-Shinarump topographic depressions. Close examination of the channels along the rim after the contact was cleaned off with a bulldozer showed them to be filled with a fine-grained, tightly cemented sandstone which by megascopic examination appeared relatively impermeable. Uranium mineralization along the outcrop of these channels appears to be limited to surface coatings and is associated with azurite, malachite, and gypsum.

grid pattern. Immediately behind the most favorable mineralized spots on the rim, two rows of holes were drilled on a 60-foot triangular pattern in an attempt to pick up the mineralized channels which appeared on the rim. Seventy-one grid and 12 offset holes were drilled in this area, averaging 63.6 feet deep. Eighteen holes penetrated mineralized rock, but only one of these holes penetrated rock of ore grade. Ten holes were drilled in this general area for structural and lithological information, but no mineralization was encountered.

The upper part of the Shinarump in this area has been largely removed by erosion. The few remnants appear to be typical of the upper-Shinarump sandstones which are exposed elsewhere in the general area. Lower units of the Shinarump are composed largely of conglomerates containing angular mudstone fragments and flattened mudstone pebbles, along with sandstones which contain considerable interstitial mudstone and mudstone splits. A thick lens of medium-gray mudstone which rests on the Moenkopi formation is found along the west border of the area. Clean sandstone sections increase in the lower parts of the Shinarump as the eastern margin of the area is approached.

Topographic lows in the pre-Shinarump erosion surface usually contain sandstones or muddy sandstones which rest on altered Moenkopi mudstones. Topographic highs in the pre-Shinarump erosion surface are generally composed of blocky, hard, green-colored mudstones which usually overlie the mottled green and red mudstones (fig. 4). Good correlation was found to exist between drill-hole information and rim data.

No faults were observed close to Area A. Fracturing was common, but no prominent joint patterns were ascertained.

Previous mapping (2) along the north rim of this area revealed a pre-Shinarump topographic low on the top of the Moenkopi formation. A more detailed structural contour map, depicting the base of the lowest sandstone or conglomerate of the Shinarump, was drawn by using plane table and stadia board methods. This was done after the contact had been exposed by a bulldozer, which permitted a much more detailed inspection than was previously possible. For structural control, an even marker bed in the Moenkopi formation was selected as the basis for dip correction, which was determined to be 5 degrees 40 minutes in a southeast direction. In the southern portions of the area, dip correction of 6 degrees 20 minutes was necessary because of the increase in dip. Information gained from this work along the rim revealed the presence of three closely-spaced channels or scours in the pre-Shinarump erosion surface.

Drill hole data behind the rim identified these three paleostream scours or channels and showed that they join to form a basin-like depression or trunk channel whose long axis trends southeast through the area. Uranium mineralization is entirely limited to the lower portions of this channel (fig. 3).

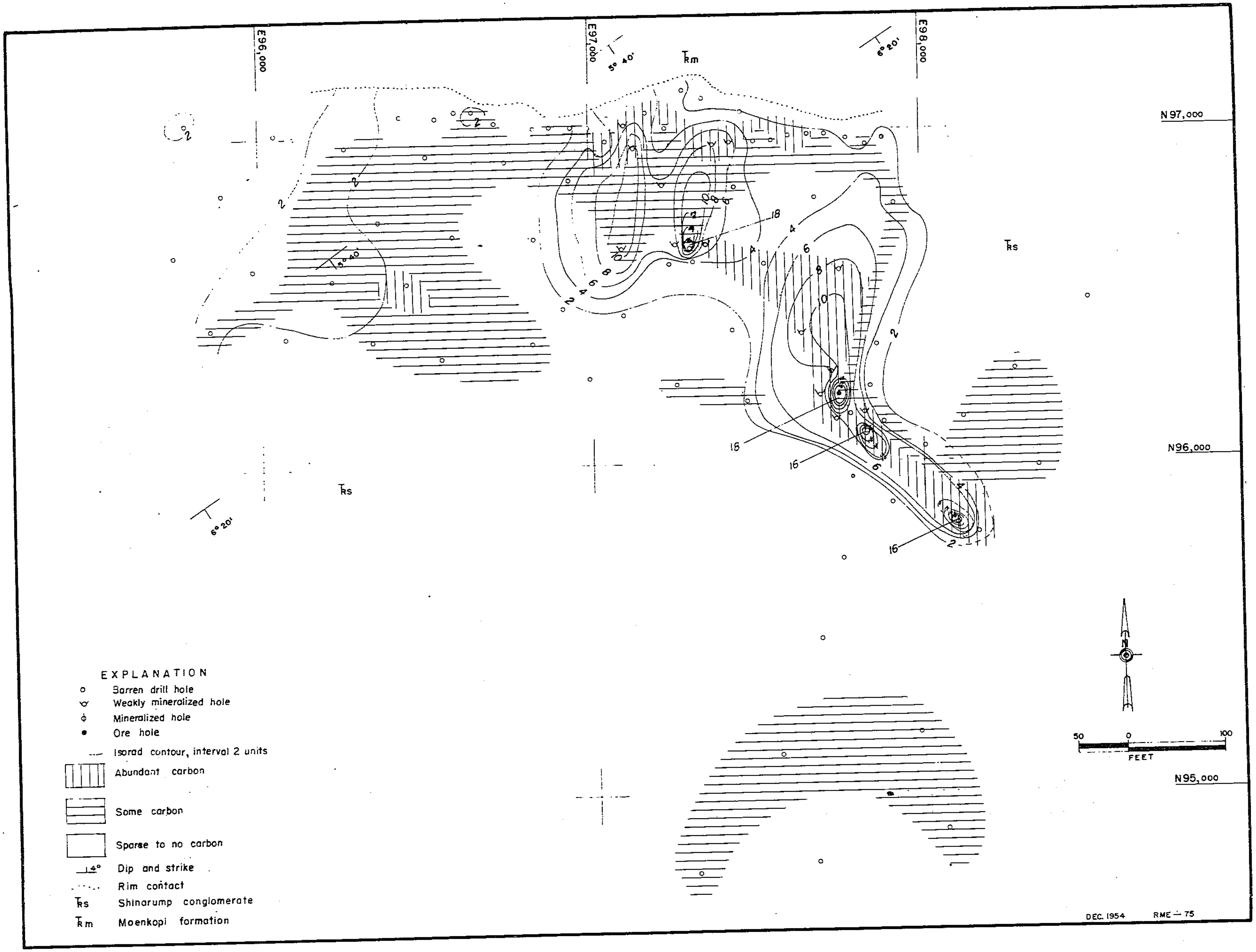

Figure 2- Isorad and isocarbon, area A, Dripping Springs, Emery County, Utah

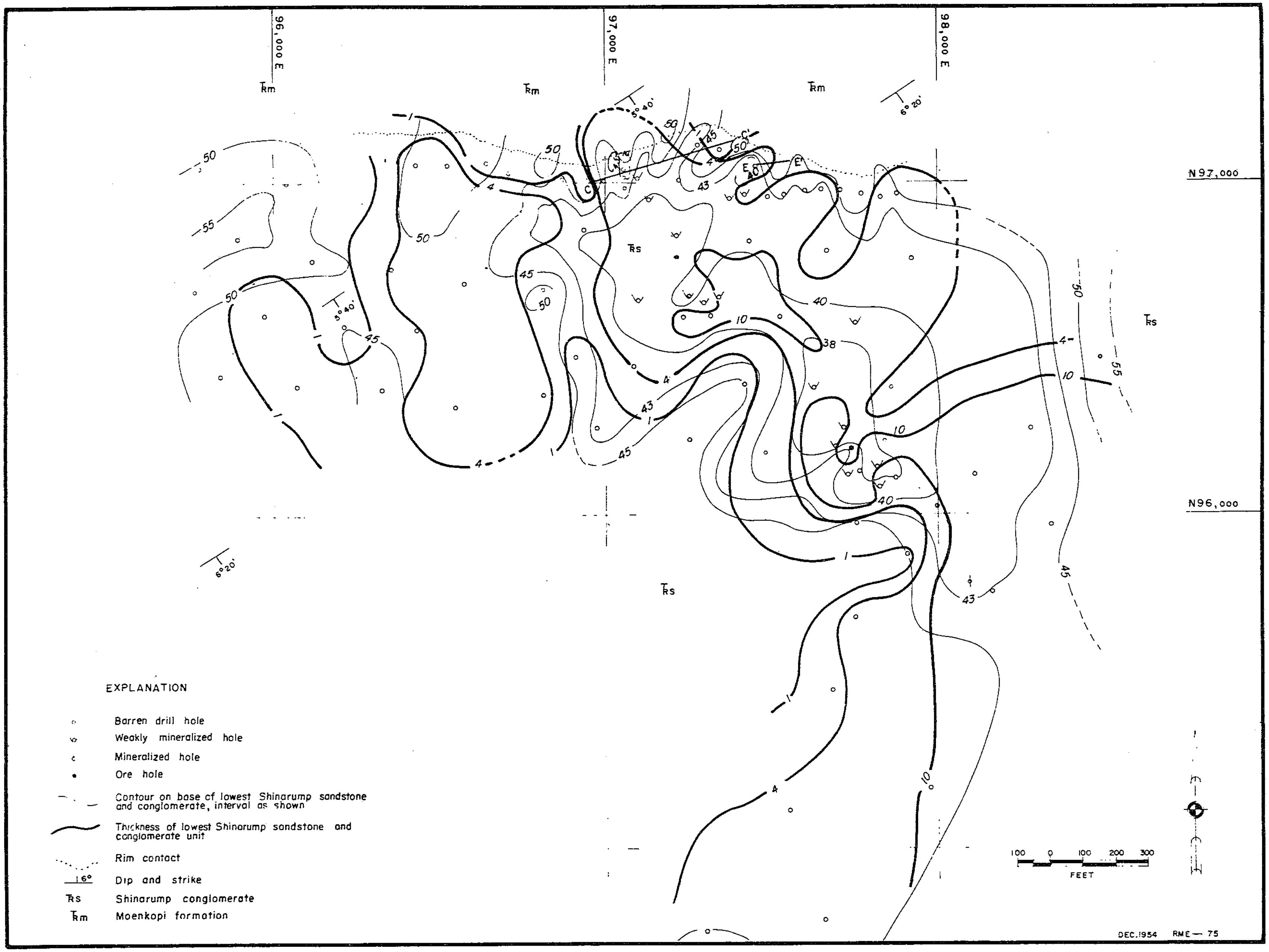

Figure 3 - Structure contour on base of lowest Shinarump sandstone and conglomerate and isopach, area A, Dripping Springs, Emery County, Utah

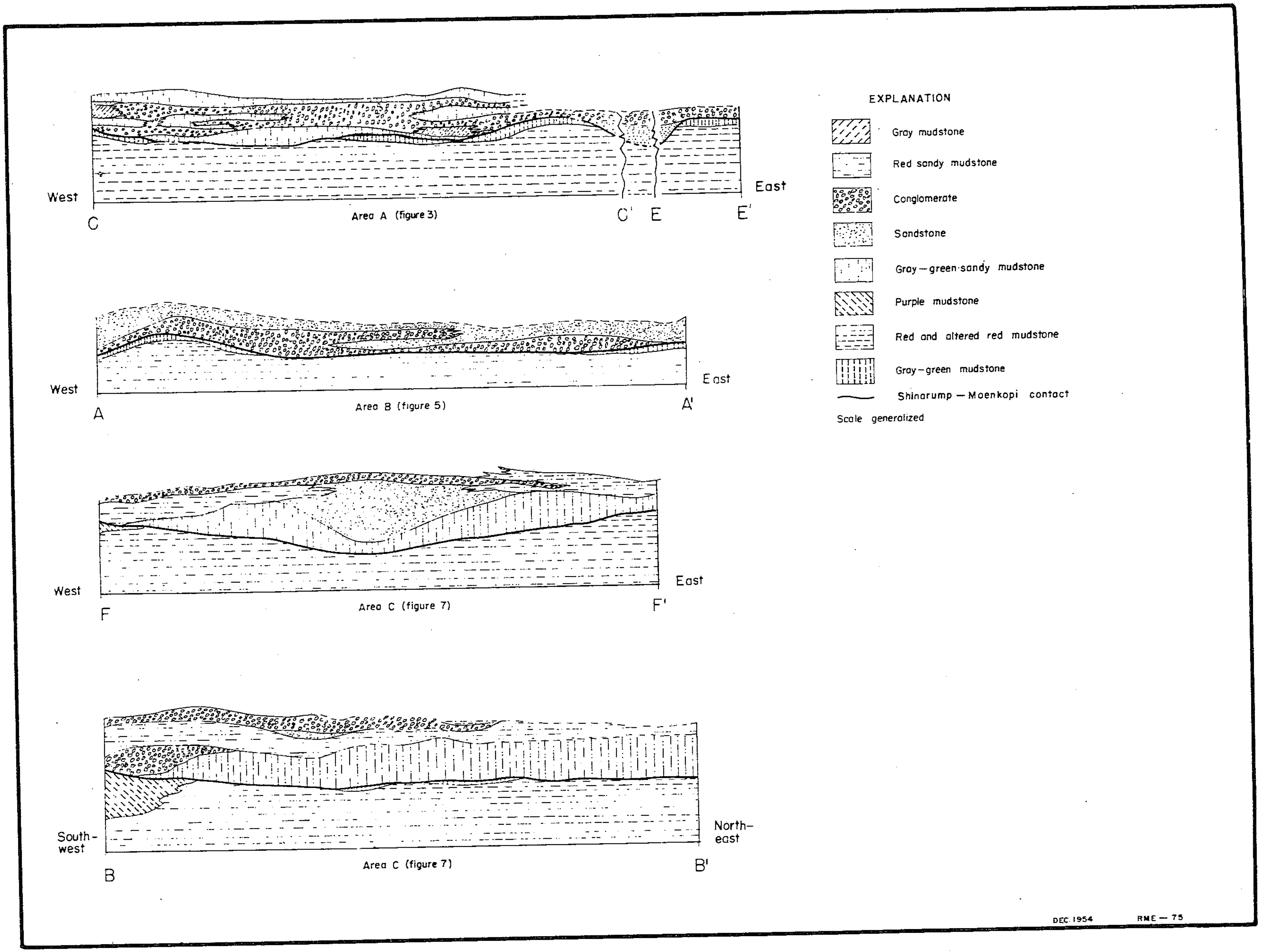

Figure 4 - Cross sections of areas A, B, and C, Dripping Springs
Emery County, Utah

Mineralization in holes behind the rim occurs in a more permeable sandstone, and is always found in and along the flanks of the thickest sections of sandstone and conglomerate. All known mineralization in this area occurs where "some" or "abundant" carbon is found.

Drilling Area B

Drilling Area B (fig. 1) is located on a small butte about 1,500 feet northeast of Drilling Area A. The butte is elongate to the southeast, parallel to the regional dip, measures about 3,000 by 1,000 feet. Drilling was confined to a rectangular area about 1,000 by 800 feet near the center of the butte. The butte is separated from the main Shinarump bench to the east and south by two washes which join at the down-dip end of the butte. Because of its exposed position, it was possible to obtain good elevation control along the outcrop.

Drilling in this area began with an initial row of close-spaced holes along the west rim, immediately behind the mineralized outcrop. Subsequent holes were placed to the east in an effort to pick up the trend of the most prominent channel. The drill holes in this area averaged 42.2 feet in depth and were bottomed in the mottled purple mudstones in the top of the Moenkopi formation. A total of 34 holes were drilled, of which only one penetrated rock having mineralization.

The upper portions of the Shinarump conglomerate have been entirely removed by erosion in this area. The lowest Shinarump sediment consists of a loosely-cemented conglomerate which is composed largely of chert pebbles and of mudstone and limestone fragments, and is sometimes interbedded with a greenish-gray sandy mudstone. This conglomerate contains small amounts of limonite and is usually poorly cemented with $CaCO_3$. In a few drill holes gypsum and malachite appeared in the conglomerate near the contact. Carbonized trash and silicified trees were noted along the rim, but few fragments were observed in the drill core. Asphalt is very sparse and only a few specks were seen. Mineralization in this area was found in the sandy conglomerate just above the Shinarump-Moenkopi contact. A fine-grained, well sorted sandstone overlies the basal conglomerate and interfingers with it in several locations (fig. 4).

In the western part of this area a topographic low in the pre-Shinarump erosion surface with a corresponding radioactive high had been located by previous work (2). Subsequently, accessible portions of the Shinarump-Moenkopi contact were stripped with a bulldozer and detailed mapping was done. A structural contour map was made on the basal Shinarump conglomerate or sandstone, using a marker bed in the Moenkopi as a uniform control bed (fig. 5). A dip correction of 6 degrees 12 minutes in a S. 35° E. direction was used to rotate the formation to its approximate position when deposited.

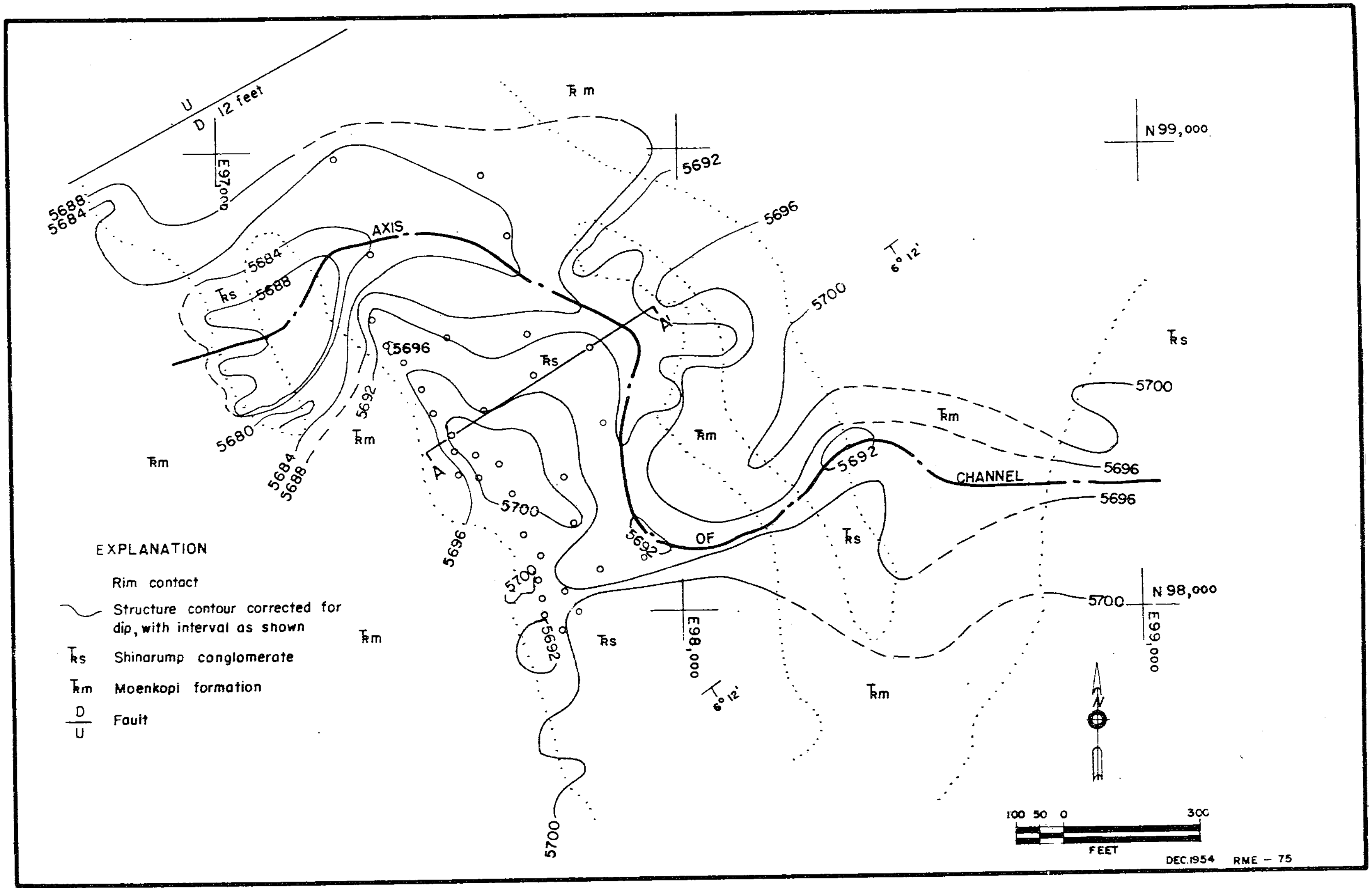

Figure 5 – Structure contour on base of lowest Shinarump sandstone and conglomerate, area B, Dripping Springs, Emery County, Utah

Elevations were taken at approximately 30-foot intervals along the contact of the lowest Shinarump sandstone or conglomerate with the mottled, purple Moenkopi mudstone. The dip-corrected map confirmed earlier work by showing a channel in the northwest portion of the drilling area as well as several small scours along the west rim. The initial row of holes, which were radioactively barren, disclosed a pre-Shinarump topographic high behind the mineralized rim with the small Shinarump channels rapidly pinching out. Subsequent drilling results outlined a shallow channel which dropped 16 feet in elevation from the southeast corner of the area to the northwest corner, in a distance of 1,000 feet. The course of this channel was not defined until later stages of drilling showed it coming from the southeast, making a sharp meander to the north, paralleling the rims through the drilling area, making a broad meander to the west, and appearing on the rim in the far northwest corner of the drilling area (fig. 4). The channel widens in the northern portion of the drilling area, but the exact northern limit was not determined due to inaccessible drilling ground. Mineralization is limited to the lower parts of this channel.

An isorad map was constructed for Area B, but is not included with this report. Mineralization was sparse in this area, but isorad values exhibited close alignment with contours showing pre-Shinarump topography. The areas of highest radioactivity were observed within the topographic lows.

Mineralization in Area B

Uranium mineralization along the western outcrop of Area B (fig. 1) occurs in several small topographic lows in the pre-Shinarump erosion surface. It is in a medium-grained, cross-bedded sandstone, and is closely associated with tree carbon. Drilling proved only one of these channels is continuous through the drilling area. Mineralization in this channel is in a sandy conglomerate, but no tree carbon was observed.

Drilling Area C

Drilling Area C is on the main Shinarump bench just west of Cistern Canyon (fig. 1). A large number of the holes were drilled on a projection of the bench called Lower Wild Horse Point. The remainder of the holes were drilled southeast of this promontory on the main bench. The main bench and the promontory are bounded on the north by a Shinarump cliff somewhat higher than in Area A, and on the south by the steep slopes of the overlying Chinle formation. The drilling area trends southeast, paralleling the east rim of Lower Wild Horse Point, and measures 7,000 by 2,000 feet.

The location of drill holes in Area C was entirely determined by topography. The roughness of the terrain prohibited any systematic pattern for locating the holes. A total of 58 holes and 17 offset holes were drilled in the favorable area and in its extension down dip. The average depth was 76.7 feet. Thirty-three of these holes penetrated mineralized rock, but only 9 of them indicated ore. Seven wildcat holes, based on sedimentary and structural criteria, were drilled in this general area; one hole encountered a mineralized tree of ore grade.

Erosion has removed most of the upper Shinarump on Lower Wild Horse Point and along the northern part of the main bench. Holes drilled in the southern portions of the area show thick sandstone sections in the upper Shinarump, with less than the usual amounts of conglomerate. The lower Shinarump in the vicinity of Lower Wild Horse Point contains thick lenses of red or green sandy-mudstone separated by occasional discontinuous conglomerate layers. This green mudstone lens is thinly bedded and rests in a topographic low of the pre-Shinarump erosion surface. In localized areas this mudstone lense approaches a muddy sandstone in texture. Cross-bedding and carbon trash are commonly found throughout the lens, but the carbon is more abundant in the lower portions. Thin stringers of discontinuous, tightly cemented, sandstone layers locally underlie this lens. Mineralization is sometimes found in these sandstone stringers, but is generally limited to the lower, highly carbonaceous material within the mudstone lens.

A red, sandy-mudstone lens rests directly over the ore-bearing lens, and is very similar in texture, but is lacking in carbon trash.

Portions of both the green and red mudstone lenses lie directly over a purple mudstone lens which parallels the drilling area on the west. The exact relationship of this purple mudstone lens to the pre-Shinarump topography is not known, but it appears to overlie the altered mudstones of the pre-Shinarump erosion surface.

The pre-Shinarump erosion surface, in this area, is composed of mottled red, purple, and brown altered mudstones. Considerable amounts of jasperoid aggregate in small pockets and in layers several inches to over a foot thick are found in this altered zone. Good correlation existed between drill-hole data and rim information. One small fault and numerous fractures occur in the middle Shinarump sandstones in the main drilling area, but they have no apparent relationship to ore.

A structural contour map was drawn on the bottom of the green, ore-bearing sandy-mudstone by using the same methods as in Areas A and B (fig. 7). A dip correction of 6½ degrees in a southeast direction was used to rotate the formation in Area C to its approximate position when deposited. This contour map revealed a channel trending to the northwest with two minor depressions within it. Mineralization in this area was limited to the lower portions of the channel.

An isorad map was constructed for Area C using the maximum amplitude method (fig. 6). Good correlation existed between the isorad map and the structural contour map, revealing radioactivity concentrated in the topographic lows.

An isopach map was constructed on the thickness of the ore-bearing sandy-mudstone and overlain on the structure contour map (fig. 7).

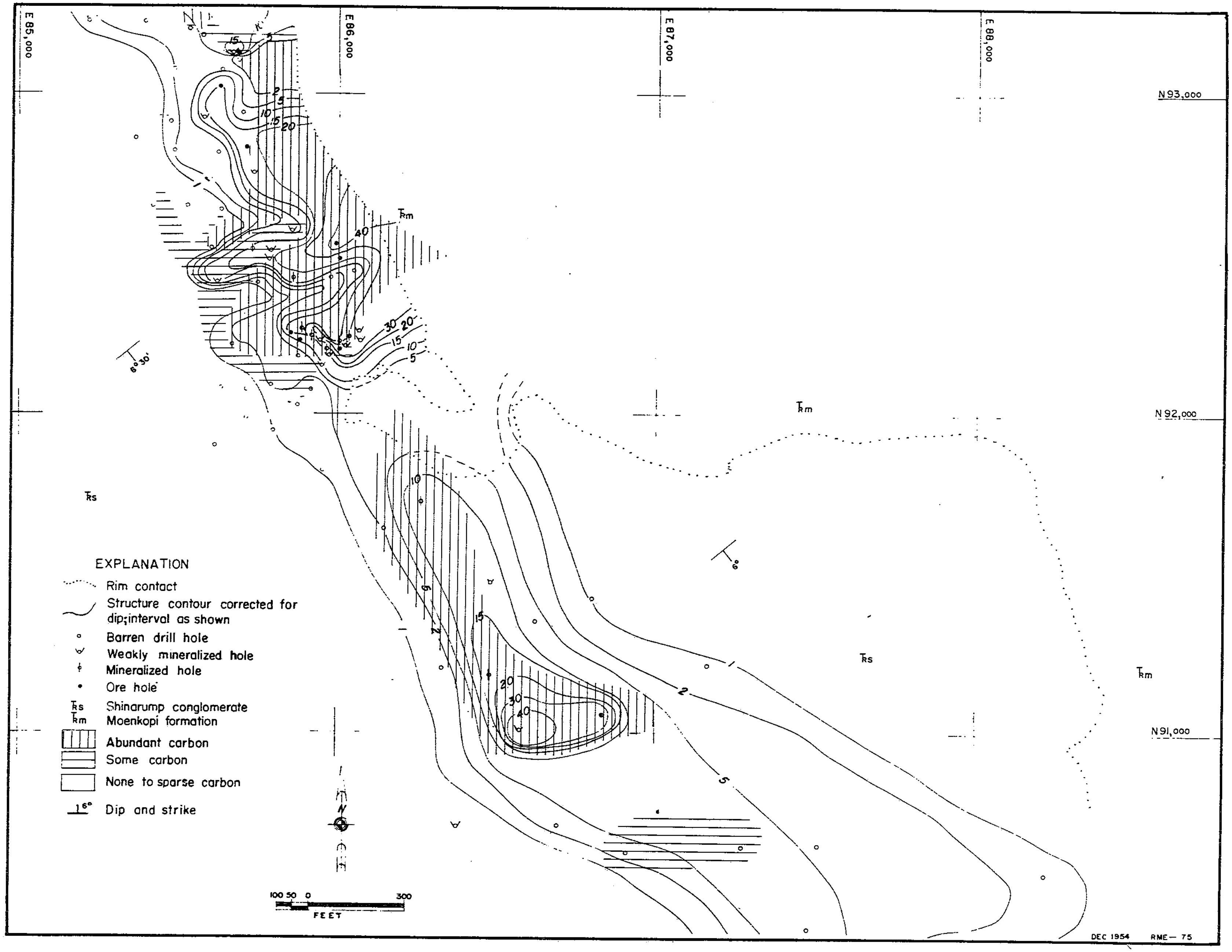

Figure 6 — Isorad and isocarbon, area C, Dripping Springs, Emery County, Utah

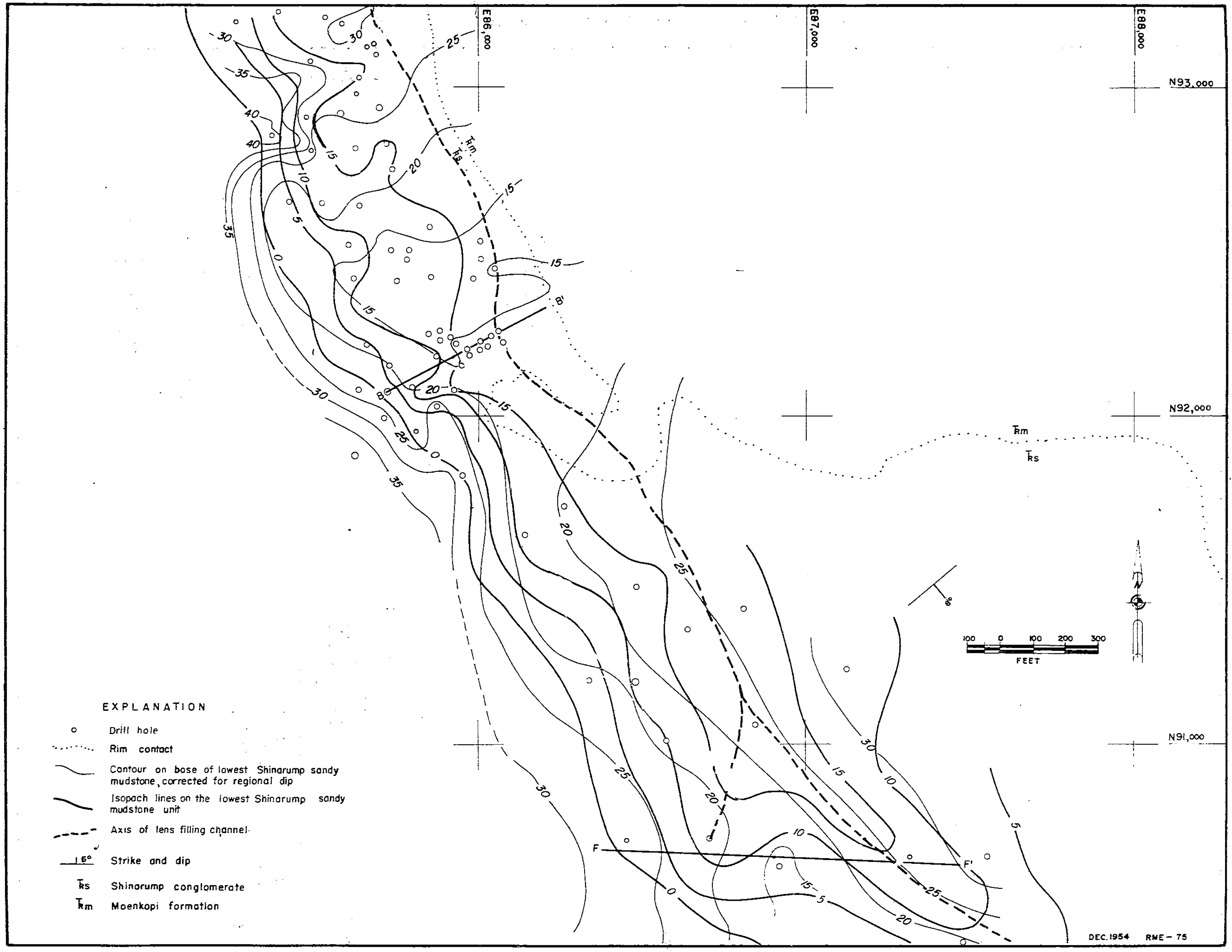

Figure 7 — Corrected structure contours and isopach lines on the lowest Shinarump sandy mudstone unit, area C, Dripping Springs, Emery County, Utah

The isopach shows an elongation of the mudstone lens along the channel, with a thinning of the lens toward the western margin of the channel and general thickening toward the center. It did not conform in detail to the bottom of the channel. Where mineralization occurred in this mudstone lens the thickness of the lens was always greater than 10 feet and generally exceeded 15 feet.

Another isopach map was constructed on a purple mudstone lens which underlies the green, ore-bearing mudstone lens on the west. This revealed that the purple mudstone thinned where the ore-bearing lens thickened. Isopach maps were also constructed on the red, sandy, mudstone lens which overlies the green, ore-bearing lens, and on the sporadically occurring conglomerate. No relationship could be established between these isopach maps and any other mappable criteria, and they are not included in the report.

An isocarbon map (fig. 6) was constructed on the same basis as in Area A. Carbon trash was abundant in the ore-bearing mudstone and directly associated with mineralization resulting in good correlation between the isorad and isocarbon maps. A similar relationship exists between the isocarbon and the structure contour map, in that the areas of greatest carbon content occur within the topographic lows (fig. 6).

Mineralization in Area C

Mineralization in Area C occurs along the bottom of a sandy-mudstone lens which is located in a pre-Shinarump topographic low. Mineralization seldom exceeds one foot in thickness and occurs most abundantly in carbon trash in the lower portions of the lens, but was occasionally found in sandstone stringers underlying the lens. Mineralization appears most abundantly in the thicker portions of the lens and in the lower portions of the channel. Minerals associated with the uranium are azurite, malachite and gypsum.

Wildcat Drilling in the Dripping Springs Area

Twenty wildcat holes were drilled in the Dripping Springs area. Ten of these were located at random on a wide-spaced interval (400 feet apart) near Area A. Information gained from those holes was tied in with the grid holes of the area and assisted in giving a more complete geologic picture. No ore was located in any of these wildcat holes.

Seven wildcat holes were drilled near Area C. Five of these holes were located from lithologic and inferred structural criteria. One hole of this group penetrated mineralized rock of ore grade, but since the ore occurred in a tree about 17 feet above the Shinarump-Moenkopi contact it was not offset. Two holes were placed astride a fault which traversed the extreme southeast portion of the area; but no mineralization was encountered.

Three holes were drilled on the Little Erma claim in Chute Canyon (fig. 8). These holes were drilled within a Shinarump channel of large proportions which contained some uranium mineralization in association with carbonaceous material and copper and cobalt minerals. This channel had been previously mapped and the pre-Shinarump topography contoured. Information from the three drill holes in this area extended the known limits of the channel, but no uranium ore was found.

SUMMARY

Information gained from geologic study of Shinarump outcrops and drill core in the Dripping Springs area revealed that uranium mineralization was limited to minor amounts located either in small bodies or thin layers. The geologic conditions favoring the occurrence of ore are:

1. Topographic lows in the pre-Shinarump topography (Shinarump channels).

2. An abundance of carbonaceous material.

3. Thick sections within the Shinarump conglomerate of the lithologic unit which carries the mineralization.

Comparative evaluation of these and other criteria indicate that conditions unfavorable to the occurrence of ore are:

1. Shallow topographic lows in the pre-Shinarump topography.

2. A well-cemented, fine-grained sandstone present in the channel.

3. A high percentage of mudstone (more than 60 percent) present in the ore unit.

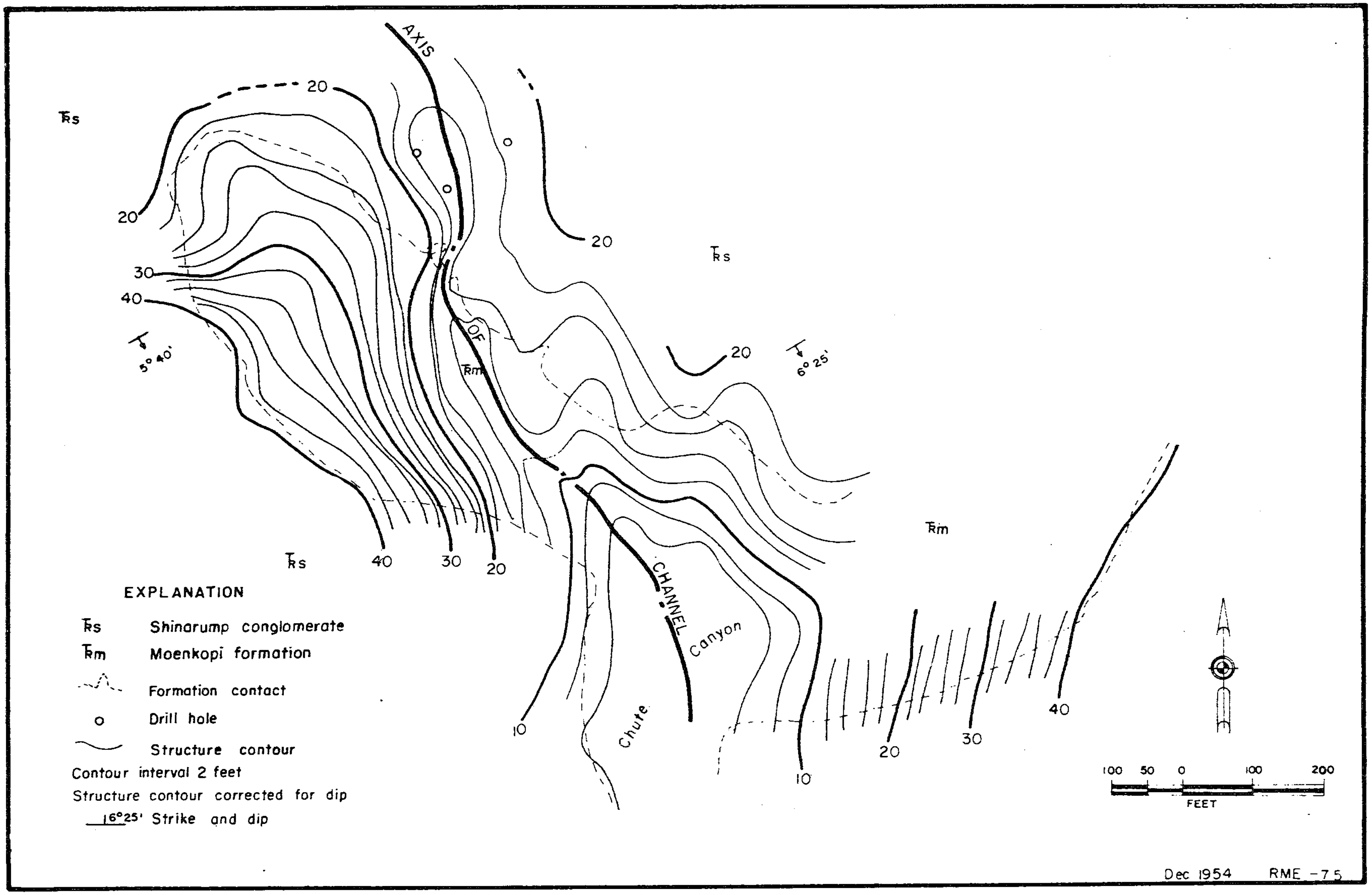

Figure 8— Structure contour on base of the Shinarump conglomerate, Chute Canyon, Dripping Springs, Emery County, Utah

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Drilling at Dripping Springs, Emery County, Utah