Introduction

The Sabinoso district is located in eastern San Miguel County approximately 35 mi east of Las Vegas, New Mexico (fig. 1). Uranium mineralization was discovered in the area by prospectors in 1952 (Wanek, 1962). Aerial and ground reconnaissance surveys by the federal government (U.S. Atomic Energy Commission [AEC], 1966) and prospecting by private mining companies located additional radioactive occurrences within 5-6 mi of Sabinoso (fig. 2, table 1). In 1956, two separate trial shipments of low-grade ore from the Bish No. 2 and Windy No. 9 mines were sent to Grants, New Mexico (table 2). After these low-grade shipments were made, only minor exploration occurred in the district because of 1) the small, low-grade nature of the deposits, 2) inaccessibility of the deposits, and 3) high production costs. Recently, part of the Sabinoso district was designated a Wilderness Study Area (WSA) by the U.S. Bureau of Land Management (BLM). To aid in appraisal of the WSA and as part of a statewide study of uranium occurrences, the New Mexico Bureau of Mines and Mineral Resources reevaluated the uranium potential of the Sabinoso area.

Regional geologic maps by Wanek (1962) and by Griggs and Hendrickson (1951) include the Sabinoso area, and numerous authors have described the various uranium occurrences (Reid and others, 1980; Finch, 1972; U.S. Atomic Energy Commission, 1970; Baltz, 1955a, 1955b). Reid and others (1980) discussed the uranium potential of the area and concluded that the depositional environment and sandstone lithology are not favorable for large-tonnage, high-grade, sandstone-type uranium deposits. Field investigations by the authors support this conclusion, but additional discoveries of low-grade, small to medium deposits are possible.

Geology

The oldest rocks exposed in the Sabinoso area (fig. 2) are in the Chinle Formation (Triassic) which consists of three members (Wanek, 1962): lower member (170 ft thick), middle sandstone member (300 ft thick), and upper member (180 ft thick). The majority of the uranium deposits and occurrences are in the middle sandstone member, although a few prospects occur in the upper portion of the lower member.

The lower member of the Chinle Formation consists of interbedded, grayish-red and greenish-gray shales and claystones, siltstones and sandstones with minor interbeds of thin, light-brown sandstones and gray, limestone-pebble conglomerates. Shales and siltstones are dominant. The sandstones are less than 5 ft thick, calcite cemented, fine grained, poor to medium sorted, and consist of sub-angular quartz (50-80%), feldspar (20-50%), and chert grains (up to 5%). Mica, gypsum (or anhydrite), and clay clasts are common.

The middle sandstone member consists of reddish-brown to maroon sandstones and gray limestone-pebble conglomerates separated by grayish-red and greenish-gray shales and siltstones. The sandstones are dominant, fine to medium grained, poor to medium sorted, crossbedded to massive, and calcite cemented. The individual beds are up to 30 ft thick and locally may contain thin lenses or stringers of mudstone, limestone-pebble conglomerate, or carbonate shale. The sandstones consist of quartz (50-80%), feldspar (10-20%), chert (up to 5%), clay clasts (10-20%), mica (0-2%), rock fragments (0-3%) and detrital calcite (trace). Distinct channel deposits grade laterally into siltstones and shales representing overbank deposits. Plant material and fossil wood such as roots, stems, and logs are common. The middle sandstone member is similar in character and stratigraphic position to the Cuervo Sandstone Member of Kelley (1972) which is exposed south of the Sabinoso area.

The upper member consists of thick beds of limestone and siltstone.
of reddish-brown siltstones and fine-grained sandstones separated by grayish-red and greenish-gray shales. Massive light-gray sandstones are common. The sandstones are fine to medium grained and less than 10 ft thick.

The Chinle Formation was probably deposited under arid conditions in a complex, fluvial system with adjacent floodplain and lacustrine (playa lakes?) deposits.

The Chinle Formation is overlain by the Entrada Sandstone (Jurassic) and Morrison Formation (fig. 2). The Entrada Sandstone is 50-60 ft thick and consists of thick, cliff-forming, orange, eolian sandstones (Wanek, 1962). The sandstones are crossbedded, fine grained, well sorted, and consist of subrounded-to-rounded frosted quartz grains.

The Morrison Formation overlies the Entrada Sandstone and consists of three members: red shale (lower), sandstone (middle), and green shale (upper). The Morrison Formation is approximately 350 ft thick and was deposited in stream channels, flood plains, and lacustrine environments (Wanek, 1962).

Only two uranium occurrences are reported from the Morrison Formation in the Sabinoso area: the Mars claim and minor uranium mineralization associated with carbonaceous logs in a 30-40-ft-thick sandstone in sec. 19, T. 16 N., R. 23 E. (U.S. Bureau of Mines files, 1956).

The Jurassic rocks are overlain by the Mesa Rica Sandstone (Cretaceous) which caps the Canadian escarpment and the mesas in the Sabinoso area (fig. 2). The Mesa Rica Sandstone consists of calcareous, medium-grained, buff to orange, marine sandstones that were deposited as off-shore bars and beach sands along the margin of an advancing shallow sea (Wanek, 1962).

Flows of basaltic lavas that overlie the Triassic rocks along the Canadian and Mora Rivers originated from the Mayson cone vents west of Sabinoso (fig. 2). These flows are approximately 60 ft thick and probably represent the latest period of Quaternary volcanism in northeast New Mexico (Wanek, 1962).

Uranium mineralization

Uranium mineralization is found scattered throughout the middle sandstone member and the upper portion of the lower member of the Chinle Formation in eastern New Mexico (Finch, 1972). One of the areas containing numerous uranium occurrences is in the Sabinoso district, where the authors examined ten occurrences (fig. 2). At least four additional occurrences are reported in the district (table 2).

The Windy No. 9 mine, located 3 mi east of the Canadian River along Cañon Largo, is typical of the deposits of the Sabinoso district and it is one of the two mines that produced ore. A shipment of 19 tons, averaging 0.05% \( \text{U}_3\text{O}_8 \) and 0.33% \( \text{V}_2\text{O}_5 \), was produced by the San Carlos Uranium Company in the third quarter of 1956 (table 1). The 81-ft adit is still accessible and a plan map of the mine is shown in fig. 3. Mineralized lenses up to 1 ft thick, consisting of gray, calcareous clay and limestone-pebble conglomerate are interbedded with a gray, medium-grained, medium-sorted arenite. The arenite is truncated laterally by maroon to red sandstones and siltstones. Unmineralized gray conglomeratic sandstones overlie and underlie the mineralized arenite. Selected samples from the adit assayed between 0.031 and 0.406% \( \text{U}_3\text{O}_8 \) (table 3). The highest assay values were from a sample from the back of the adit (fig. 3). Drilling would be required to delineate any additional ore.

![FIGURE 2—GEOLOGIC MAP OF SABINOSO AREA, SAN MIGUEL COUNTY, NEW MEXICO. Geology by V. T. McLemore and D. Menzie; modified from Wanek (1962). Base map from Sabinoso and Arroyo Alamocito 7½-min topographic quadrangles.](image-url)
TABLE 2—Uranium production (including “no-pay” ore) from Sabino district, San Miguel County (from U.S. Atomic Energy Commission, government contracts only for years 1948–1970); fig. 2.

<table>
<thead>
<tr>
<th>Map Name</th>
<th>Name</th>
<th>Tons Ore</th>
<th>Lbs UO₂</th>
<th>% UO₂</th>
<th>Lbs V₂O₅</th>
<th>% V₂O₅</th>
<th>Shipper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Windy No. 9</td>
<td>19</td>
<td>19</td>
<td>0.05</td>
<td>147</td>
<td>0.38</td>
<td>San Carlos Uranium Co.</td>
</tr>
<tr>
<td>2</td>
<td>Bish No. 2</td>
<td>30</td>
<td>62</td>
<td>0.10</td>
<td>27</td>
<td>0.04</td>
<td>Swain, Brooks, and Holcomb</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>49</td>
<td>81</td>
<td>0.08</td>
<td>174</td>
<td>0.18</td>
<td></td>
</tr>
</tbody>
</table>

The Mickie V claims and AEC Anomaly No. 3 also occur in Canion Largo (table 1) but were inaccessible during field investigation, owing to high waters in the Canadian River. Uranium mineralization is reported to occur in gray, limestone-pebble conglomerates of the lower and middle sandstone members. An assay on a sample from the Mickie V claims contained 0.118% UO₂, 4.55% V₂O₅, and 0.12% Cu (U.S. Atomic Energy Commission, 1970, p. 151).

Three minor uranium occurrences are found along the Canadian River, near Sabino: Sabino Uranium Company, Cip Lujan, and northwest side of the mesa, is 15 ft long and exposes two horizontal, thin zones of mineralization. The mineralization is associated with limonitic alteration and organic debris in limy shales interbedded with brown siltstone (fig. 5). Selected samples assayed 0.015 and 0.089% UO₂, 0.40 and 8.80% V, less than 0.2% Mo, and 0.74 oz Ag/ton (table 3). Sample 2804 from the Hunt Oil Company adit contained the highest uranium and vanadium content of all 14 samples collected in the Sabino district.

The Bish No. 2 mine (fig. 2), on the southeast side of the mesa, consists of several small bench cuts and a 75-ft long adit which is currently flooded (fig. 6). Uranium mineralization occurs in the middle sandstone member at the adit level and minor mineralization in the lower member is exposed in the bench cuts. Mineralized lenses of gray, calcareous shale and gray limestone-pebble conglomerates are interbedded with a 10-ft thick conglomerate at the base of the middle sandstone member. Swain, Brooks, and Holcomb shipped 30 tons of ore averaging 0.10% UO₂ and 0.04% V₂O₅ in the fourth quarter of 1956 from this mine (table 2). Selected samples from near the portal (fig. 5) and from the dump of the Bish No. 2 mine assayed 0.005 and 0.071% UO₂ (table 3).

Possibly a low-grade, small tonnage deposit may exist underneath the Bish No. 2–Hunt Oil Company mesa (fig. 2). The widespread occurrence of low-grade mineralization along both sides of the mesa is a favorable condition; however, a closer examination of the geology in order to determine any deposit trends and close-spaced drilling along the mesa would be needed to discover any additional deposits.

Four occurrences are located east of Sabino on the Lujan Ranch (fig. 7): El Villa, Locality 43, Lujan Ranch, and Lujan Ranch drill holes. Additional occurrences are reported along Mesita Colorado in secs. 23 and 24, T. 17 N., R. 24 E. and secs. 18 and 19, T. 17 N., R. 24 E. (Perhac, 1953; Perhac and others, 1953; Wolfe and Perhac, 1953). These occurrences are within a gray conglomerate up to 10 ft thick which lies between red to maroon sandstones and siltstones (fig. 8). The conglomerate may be up to 200 ft in width and is truncated laterally by unmineralized red to maroon sandstones. Five selected samples from the Lujan Ranch area (fig. 7) assayed from 0.001 to 0.054% UO₂ (table 3). Up to 0.51% Cu and 0.41% V are present in sample 2814 (table 3). A total of 30 holes were drilled at Mesita Colorado by prospectors on 500 ft or 1,000 ft centers; some of these drill holes are plotted in fig. 7. No ore-grade material was encountered during drilling (U.S. Atomic Energy Commission files, late 1950's).

The T claims are located in secs. 10 and 11, T. 16 N., R. 23 E., south of the Bish No. 2 mine (table 1). No visible workings were seen by the authors on August 20, 1982, although trenches and a pit had been reported to occur (U.S. Atomic Energy Commission files, late 1950's). Uranium mineralization was re-
TABLE 3—CHEMICAL ANALYSES OF SELECTED SAMPLES FROM SABINOSO DISTRICT; fig. 2, also fig. 3 (Windy No. 9), fig. 4 (Hunt Oil), and fig. 7 (Locality No. 43 and Lujan Ranch); sample number and chemical analyses provided by Lynn Brandvold and associates, New Mexico Bureau of Mines and Mineral Resources, chemical laboratory.

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Name</th>
<th>% U$_3$O$_8$</th>
<th>% Cu</th>
<th>% V</th>
<th>% Mo</th>
<th>Ag oz/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Windy No. 9</td>
<td>0.037</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>Windy No. 9</td>
<td>0.031</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>Windy No. 9</td>
<td>0.406</td>
<td>&lt;0.01</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sabinoso Uranium Co.</td>
<td>0.021</td>
<td>&lt;0.01</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cip Lujan</td>
<td>0.020</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-1</td>
<td>Hunt Oil</td>
<td>0.015</td>
<td>0.64</td>
<td>0.40</td>
<td>&lt;0.15</td>
<td>0.74</td>
</tr>
<tr>
<td>5-2</td>
<td>Hunt Oil</td>
<td>0.090</td>
<td>&lt;0.01</td>
<td>8.80</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bish No. 2</td>
<td>0.009</td>
<td></td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bish No. 2—dump</td>
<td>0.071</td>
<td></td>
<td>&lt;0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-6</td>
<td>Locality No. 43</td>
<td>0.006</td>
<td>0.18</td>
<td>&lt;0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-7</td>
<td>Lujan Ranch</td>
<td>0.033</td>
<td></td>
<td>&lt;0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Lujan Ranch</td>
<td>0.033</td>
<td>0.51</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-5</td>
<td>El Villa</td>
<td>0.001</td>
<td>0.08</td>
<td>&lt;0.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 8—PHOTOGRAPH SHOWING 3-FT-THICK MINERALIZED CONGLOMERATE LENS ON LUJAN RANCH

No. 25 found no visible workings except for an ore dump. A grab sample from the dump assayed 0.04% U$_3$O$_8$ and 1.0% V$_2$O$_5$. The host rock is a gray, fine-grained arenite. A local rancher, J. S. Upton, reported that radioactive outcrops similar to the T claims occur in sec. 36, T. 17 N., R. 23 E.

Conclusion

The majority of the uranium occurrences and deposits in the Sabinoso area are in the middle sandstone member of the Chinle Formation (Triassic). The mineralization is associated with 1) carbonaceous organic material, 2) calcareous clay lenses or interbeds, and 3) limestone-pebble conglomerates or interbeds. Although the exposed mineralization is low grade (table 3), at least three areas are favorable for low- to medium-grade small- to medium-tonnage deposits: Windy No. 9, Bish No. 1—Hunt Oil Company, and Lujan Ranch areas. Ore-grade mineralization in these areas is spotty but proven; although economic ore bodies have never been discovered, large areas have not been adequately examined.

High-grade uranium deposits (greater than 0.10% U$_3$O$_8$) probably do not occur in the Sabinoso area because of 1) thinness of the sandstones, 2) low permeability and porosity, and 3) lack of abundant organic material. The inaccessibility of the deposits, the high development and production costs, and the small low-grade nature of the deposits will hinder exploration or development of these Sabinoso deposits in the future. However, Triassic Rocks crop out in large areas of northeast New Mexico. Thus similar undiscovered, low-grade uranium deposits (less than 0.10% U$_3$O$_8$) may exist in that large region.

ACKNOWLEDGMENTS—The authors are grateful to Robert Weber and Frank Kottlowski who reviewed this manuscript.

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MINING REGISTRATIONS

(AUG. 6, 1982 THROUGH SEPT. 8, 1982)

State Mine Inspector

2340 Menaul N.E.

Albuquerque, NM 87107

Date and Location

Operators and owners

8-6-82 metal

Operator—Ortiz, Mountain States Constructor's Station B, Box 28, Albuquerque, NM 87107; Gen. Mgr.: Steve Besott, same address, phone: 345-4401; Person in charge: Gayle Hampton, Box 825, Moriarity, NM, phone 242-1064; Other official: Fidel Sanchez, Property owner—Goldfields Operating Co.

8-5-82 Operator—Tails Pond, West Arc Welding & Machine Works, 212 S. Bullard, Silver City, NM 88061; Gen. Mgr.: Ray F. Leon, Jr., same address, phone: 538-287; Person in charge: Gene Gallusini, same address and phone; Gen. Supt.: Thomas D. McArthur, same address and phone; Property owner—Kennecott Minerals Company.

8-26-82 Operator—Center shaft, Summit Minerals, Inc., Box W, Duncan, AZ 85534; Gen. Mgr.: Fred Dollarhide, same address, phone: 359-2834; Person in charge: D. E. Hanson, phone: 359-2834; Property owner—Summit Minerals, Inc.

8-1-82 Operator—Summit mine, Summit Minerals, Inc., Box W, Duncan, AZ 85534; Gen. Mgr.: Fred Dollarhide, Duncan, phone: 359-2239; Person in charge: D. E. Hanson, phone: 359-2835; Property owner—Summit Minerals, Inc.


9-8-82 Operator—Woodlaw, Carl Davis, Rt. 8, Box 290, Silver City, NM 88061; Gen. Mgr.: Carl E. Davis, same address, phone: 538-2769; Other official: P. L. Hunter, Box 1162, Silver City, NM 88062; Property owner—B. H. Tiller, 11000 Dyer, El Paso, TX 79924

(SABINO DISTRICT)

(continued from p. 38)


