BOTANICAL PROSPECTING FOR URANIUM ON LA VENTANA MESA, SANDOVAL COUNTY, NEW MEXICO

By Wm. H. Starrett and Helen L. Cannon

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TEPCO, Denver	2
TEPCO, RPS, Washington, (Including master)	2
	57

CONTENTS

ILLUSTRATIONS

BOTANICAL PROSPECTING FOR URANIUM ON LA VENTANA MESA, SANDOVAL COUNTY, NEW MEXICO

By Wm. H. Starrett and Helen L. Cannon

ABSTRACT

A botanical sampling program has been completed by the U. S. Geological Survey on La Ventana Mesa, Sandoval County, N. Mex. A uranium-bearing coal in the Allison-Gibson members of the Cretaceous Mesaverde formation crops out in erosional remnants of the mesa. The coal is capped by a well-fractured 65-foot sandstone bed through which roots of a pinyon-juniper forest penetrate. Samples of several hundred branches of trees growing on top of the mesa were collected and analyzed for uranium. The assays ranged from 0.1 part per million to 2.3 ppm uranium in the wood ash. Dead branches, which were found to contain more uranium in the ash than live branches, were sampled where possible. The results have been contoured to indicate probable areas of mineralized coal. Parts of the north butte are recommended as favorable for physical exploration.

INTRODUCTION

A botanical sampling program has been completed by the U. S. Geological Survey in advance of exploration in an area of uranium-bearing coal and shale on La Ventana Mesa, Sandoval County, N. Mex. The work was suggested by C. B. Read of the U. S. Geological Survey, and done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. The authors wish to acknowledge the field guidance provided by G. A. Bachman of the Geological Survey. The area has not been explored by drilling.

The purpose of the investigation was to prospect by botanical methods for uranium in an area in which the uranium-bearing coal and shale bed is under cover. The bed known to be mineralized along parts of the outcrop, is overlain by a massive, 65-foot, flat-lying sandstone which caps the mesa. Previous work (Cannon, 1953) indicated that uranium is absorbed from the underlying coal and shale by trees rooted in

the sandstone. Therefore, a program of botanical prospecting was planned to include systematic collection of dead and live tree wood on the sandstone capping. Samples of tree branches were analyzed for uranium content. The results were contoured to show the distribution of uranium content of the plants. Areas of relatively high uranium content in the plants are regarded as favorable for physical exploration.

The area sampled includes the north butte and a part of the south butte of La Ventana Mesa. The mesa lies just east of New Mexico Highway 44, 22 miles by road south of Cuba, and 65 miles by road northwest of Albuquerque in the southern part of T. 19 N., R. 1 W., New Mexico principal meridian (figs. 1 and 2). The two erosional remnants of the mesa are completely isolated from each other and rise about 1,400 feet above the valley floor. The shale and talus-covered slopes can be traversed only on foot except at the northwest corner of the north butte where it is possible to drive a jeep about one-third of the way up the side of the mesa.

La Ventana Mesa, composed of sedimentary beds, lies off the western flank of the granitic Nacimiento Mountains (fig. 1). Rocks exposed on the mesa belong to the Mesaverde formation of Cretaceous age. Uranium-bearing material is found in the upper carbonaceous shale and coal of the Allison-Gibson members (undifferentiated) which form the body of the mesa. Overlying the Allison-Gibson members is 60 to 80 feet of porous jointed La Ventana sandstone, a member of the Mesaverde formation, capping the buttes of the mesa. The area was probably once covered by mildly radioactive tuffs of the Bandelier tuff of Pliocene (?) age. It is believed that uranium was dissolved by descending meteoric water which percolated through the La Ventana sandstone and was precipitated by carbonaceous material in the Allison-Gibson members. The geologic relationships have been described by Darton (1929), Read (1952), and Vine and others (1953) and are generalized in figure 2. Samples of the Bandelier tuff, which is widespread on the Jemez volcanic plateau to the east of the Nacimiento Mountains, contain 0.003 percent uranium (Vine and others, 1953).

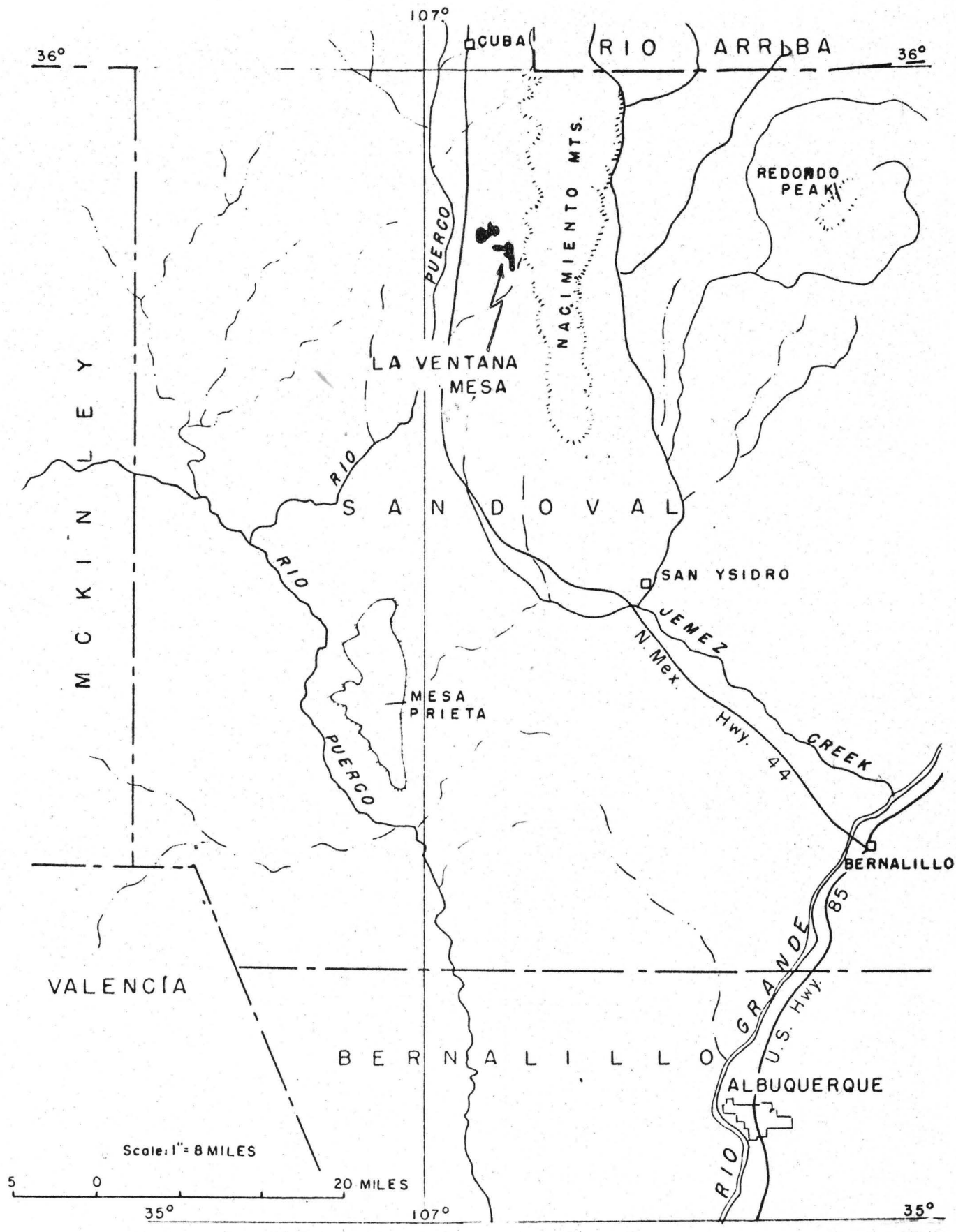

Figure 1. INDEX MAP OF PART OF NEW MEXICO, SHOWING LOCATION OF LA VENTANA MESA, SANDOVAL COUNTY.

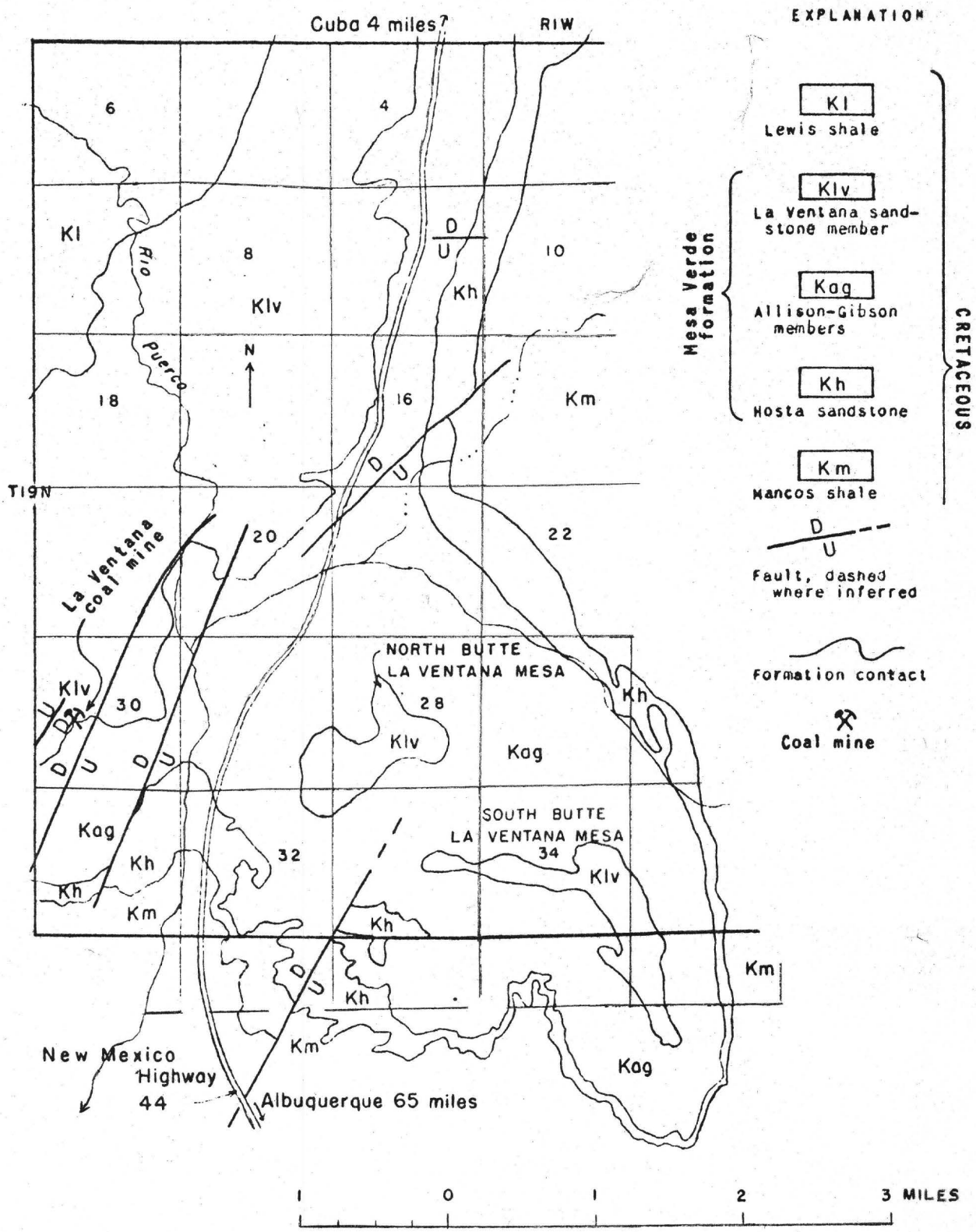

Figure 2. GEOLOGIC MAP OF LA VENTANA AREA, SANDOVAL COUNTY, NEW MEXICO
(After Vine and others, 1953)

METHODS AND EXTENT OF WORK

Livewood and deadwood branch samples of pinyon and juniper were collected and analyzed fluorimetrically for uranium. The buttes of La Ventana Mesa are covered with a thick growth of pinyon and juniper trees, known to be excellent absorbers of uranium. The trees are phreatophytes (Robinson and Turner, in preparation) -- that is to say, they are trees "that habitually obtain their water supply from the zone of saturation, either directly or through the capillary fringe" (Meinzer, 1923, p. 95). The uranium-bearing coal and shale at the base of the sandstone acts as a perched zone of saturation and contains the water supply on which the trees depend. Live juniper roots have been observed in mines at depths of several hundred feet. Whether the tree roots on La Ventana Mesa actually penetrate to the coal or whether there is sufficient upward migration of water and soluble salts in the capillary fringe to support their growth is not known. At least the roots of the trees have worked down through joints and fractures of the sandstone and sufficient uranium is absorbed by the trees to be detectable in the trunk, limbs, and branches (Cannon, 1952 and 1953). For this project, a sample consisted of 6-inch sections of either livewood or deadwood branches collected from four quadrants of the tree. Detailed sampling at 100-200 foot intervals was originally planned on the advice of G. O. Bachman to cover only the western part of the north mesa considered to be most favorable for mineralized ground. Later the project was extended to include wide-spaced and admittedly incomplete coverage of the remainder of the mesa in order to round out the picture. The sampling was halted by adverse weather conditions. In all, 90 livewood (fig. 3) and 103 deadwood (fig. 4) samples were collected to cover a large part of the north butte and 13 deadwood samples were collected on a thin extension of the south butte known to be mineralized (fig. 5). The samples in section 29 and 32 were collected in November 1952, and the remainder in April 1953.

The samples were analyzed by an extraction fluorimetric method in the Denver Trace Elements laboratory by C. Huffman and G. Burrow. The samples were ground, ashed, predigested in nitric acid, and extracted in ethyl acetate and the evaporated residue was analyzed fluorimetrically for uranium.

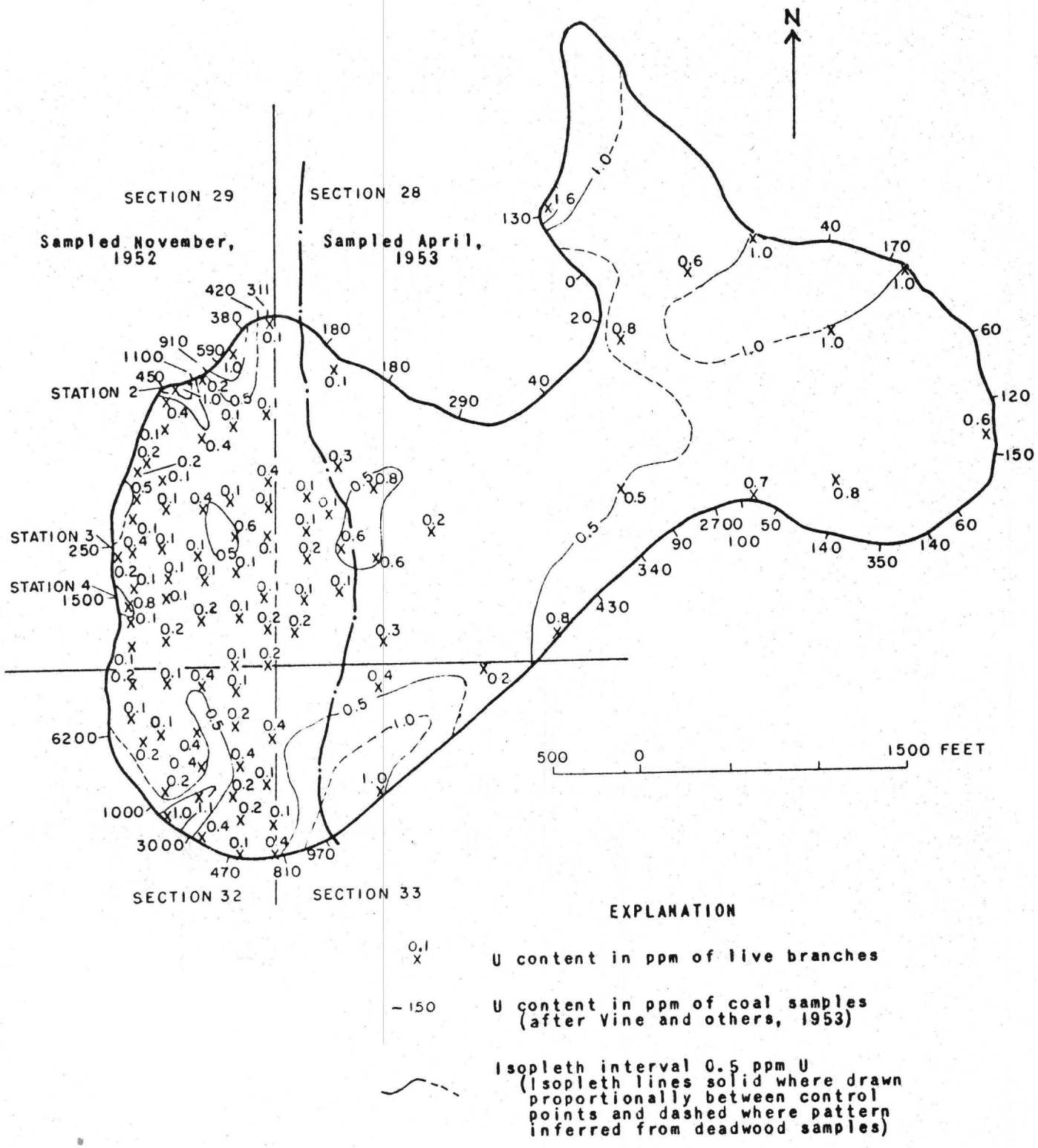

Figure 3. ISOPLETH MAP SHOWING URANIUM CONTENT OF LIVE PINYON AND JUNIPER BRANCHES ON NORTH BUTTE OF LA VENTANA MESA, SANDOVAL COUNTY , NEW MEXICO

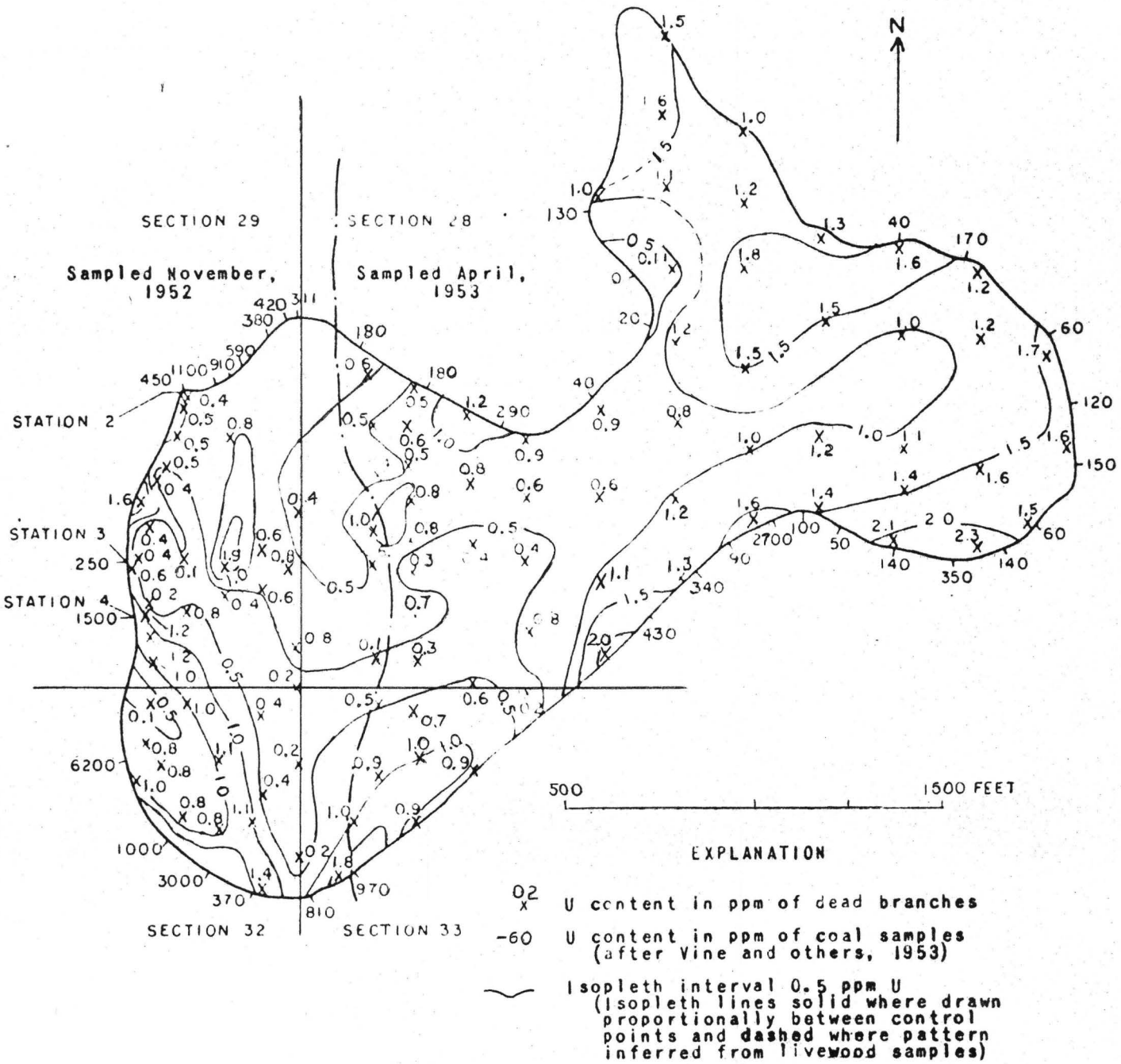

Figure 4. ISOPLETH MAP SHOWING URANIUM CONTENT OF DEAD PINYON AND JUNIPER BRANCHES ON NORTH BUTTE OF LA VENTANA MESA, SANDOVAL COUNTY, NEW MEXICO

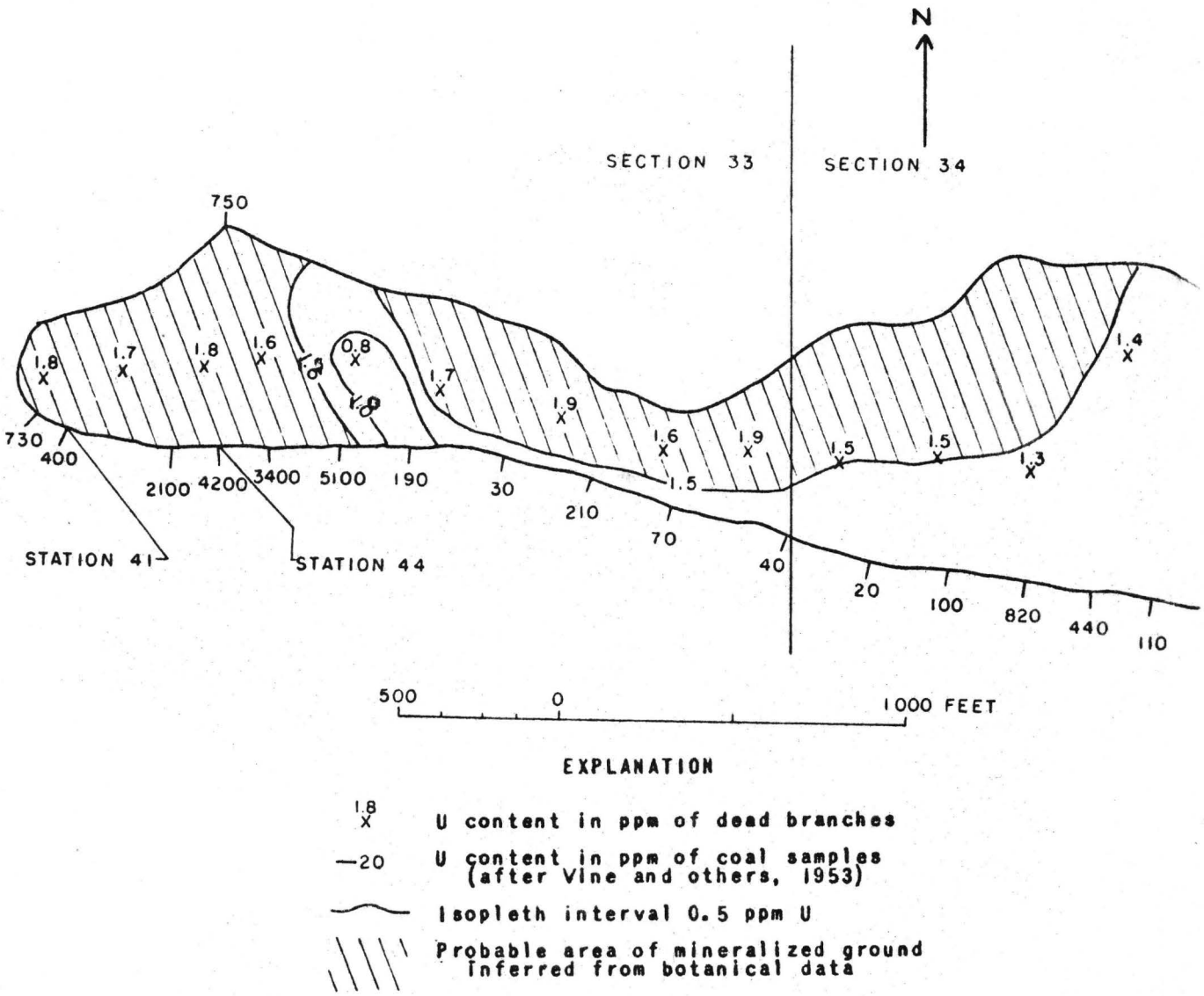

Figure 5. ISOPLETH MAP SHOWING URANIUM CONTENT OF DEAD PINYON AND JUNIPER BRANCHES SAMPLED ON SOUTH BUTTE OF LA VENTANA MESA, SANDOVAL COUNTY, NEW MEXICO

RESULTS

The assays for each tree were plotted on maps of the buttes and the values contoured with an isopleth interval of 0.5 parts per million U (figs. 3, 4, and 5). The isopleths are similar in pattern although several variations in results are apparent. First, both types of wood (deadwood and livewood) were not taken from every tree and therefore the same number of points are not available for contouring on each map. Second, the outstanding difference between maps plotted on deadwood and livewood assays is one of value rather than pattern, as deadwood consistently contains more U in the ash. Assays of livewood samples vary from 0.1 ppm to 1.6 ppm U and deadwood samples from 0.1 ppm to 2.3 ppm U in the ash. The percentage of ash in the deadwood samples averages 4.6 percent compared to 2.5 percent in the livewood samples. Third, the uranium content of samples analyzed at a later date on less favorable parts of the butte averages slightly higher than samples run earlier from the more favorable part of the butte.

Although the causes of the variations mentioned are not entirely understood, it is possible to resolve the differences and to compile maps to show the probable uranium-bearing portions of the butte. It is significant that all fixed control points on one map will permit a similar pattern of contouring on the other map. Therefore, in areas where there are not enough control points for close contouring, dashed contours have been inferred from analyses of the other type of material (figs. 3 and 4). It can also be seen that the contour pattern for 1 ppm U in the ash of livewood coincides closely with that of 1.5 ppm U in the ash of deadwood. Therefore, the outlined areas can be compared in this ratio and the areas on the west side of the butte are considered to be favorable for mineralized material above these cutoffs. The third variation in analyses appears to result from changes in the analytical procedure or contamination of equipment in the laboratory. This conclusion is based on the fact that the content of deadwood could not be expected to exhibit marked seasonal variations. Because of these differences which result in an increase of about 0.5 ppm U, large areas on the east end of the north butte above the cutoffs established are probably not as favorable as indicated and have been left unhatched on figure 6.

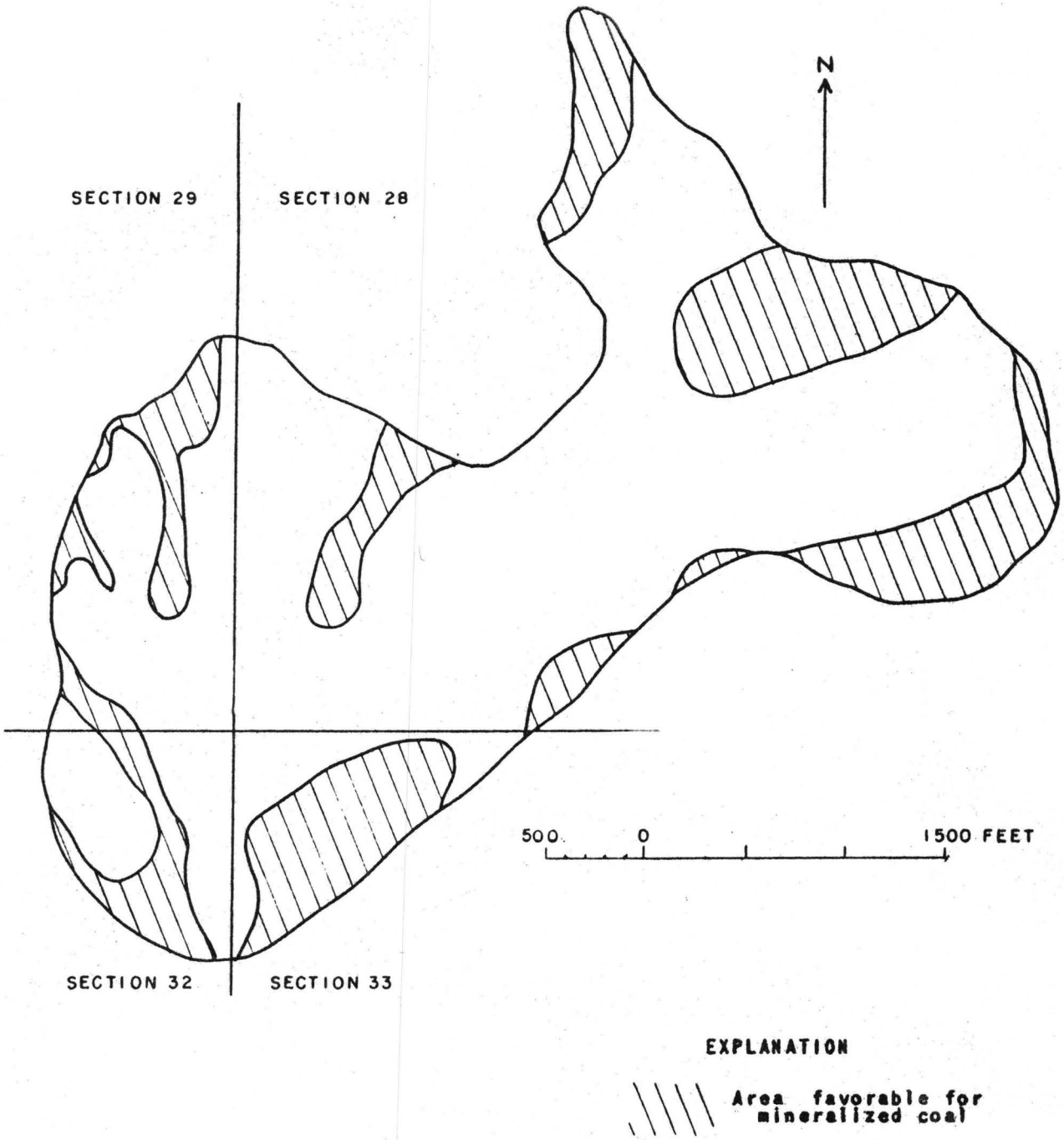

Figure 6. PROBABLE AREAS OF URANIUM-BEARING COAL AS INTERPRETED FROM ANALYSES OF LIVEWOOD AND DEADWOOD SAMPLES, NORTH BUTTE, LA VENTANA MESA, SANDOVAL COUNTY, NEW MEXICO

Areas of relatively high uranium content in the plant samples probably correspond with areas of relatively high uranium content in the coal. The results tie in roughly but not exactly with known areas of uraniferous coal sampled along the outcrop. The coal assays reported by Vine and others (1953, p. 30) are shown on figures 3, 4, and 5. A final compilation of favorable areas has been made in figure 6. The tree assays indicate that the areas of uraniferous coal are probably of relatively small magnitude. Although those in the western part of the north butte were largely indicated from sampling outcrops, the results may provide larger targets for exploration than were previously indicated in the eastern part of the butte.

SUMMARY AND RECOMMENDATIONS

More than 200 livewood and deadwood tree samples were collected over an area of one-half square mile of mesa and analyzed for uranium as a guide to exploration. The assays ranged from 0.1 ppm U in the ash of trees rooted in barren ground to 2.3 ppm U in the ash of trees rooted in mineralized coal. The uranium content of dead branches was found to exceed that of live branches in the majority of trees. The values were contoured and areas presumed to be favorable for drilling outlined on maps of the mesa. Botanical anomalies coincide fairly well with known areas of uraniferous coal sampled along the outcrop.

The assays indicate that the areas of mineralized coal are probably relatively small. Additional information on uraniferous areas of coal is provided on the eastern part of the north butte where the coal in the rim is largely under cover. If physical exploration of La Ventana Mesa is undertaken, it is recommended that all hatched parts on north butte (fig. 6) be tested by drilling.

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