GRAPHITE IN LLANO COUNTY, TEXAS

MINERAL RESOURCE SURVEY
Circular No. 57

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THE UNIVERSITY OF TEXAS
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The information in this circula r was partly obtained from work carried on by a unit of the WPA Statewide Mineral Resources Survey Project, sponsored by The University of Texas, Bureau of Economic Geology. The purpose of this survey is to assemble information concerning the mineral resources of Texas and make it available to the public. It is hoped that this information will be a contribution to the industrialization of the State. This report is based on work done by W. P. #18509.

GRAPHITE IN LLANO COUNTY , TEXAS*/

By Carl Chelf, Supervisor

The origin and occurrence of graphite in the Central Mineral region of Texas have been described by Barnes 1/, Comstock 2/, Dub 3/, Paige 4/, Baker 5/, and possibly others. The following excerpt from Barnes 1/ explains the most logical origin of the pre-Cambrian graphite when compared with field conditions:

> "Graphite is very common in the Packsaddle schist of Llano and Burnet counties. This schist series was originally a sedimentary series composed mostly of argillaceous, calcareous, arenaceous, and carbonaceous sediment mixtures. This series before metamorphism took place probably was very similar to the Pennsylvanian rocks of north-central Texas. The carbonaceous material changed into graphite during the metamorphism to which these pre-Cambrian rocks were subjected. The graphite content of these rocks varies in amount, as did the carbonaceous material in the original sediments. Many of the graphite schists of this area contain insufficient, graphite to be of commercial value which others contain abundant graphite."

Sidney Paige 4/ wrote the following concerning the origin:

> "As the series of pre-Cambrian rocks described above were in part originally shales, sandstones, and limestones, they are now represented by schists of varying composition. Moreover, certain constituents have become, through metamorphism, of possible economic importance. Such is the change of carbonaceous matter originally in the shales to graphite".

*/ Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration Official Project No. 265-1-65-214.

1/ Barnes, V. E., Additional notes on graphite in Texas: Univ. Texas, Bur.Econ.Geol., Min. Res. Cir. No. 15, 9 pp., July, 1940.

2/ Comstock, T. B., Report on the geology and mineral resources of the Central Mineral region of Texas...: Texas Geol. Surv., 2d Ann.Rpt. (1890), pp. 553-664, 1891.

3/ Dub, G. D., and Moses, F. G., Mining and preparing domestic graphite for crucible use: U.S.Bur.Mines, Bull. 112, 80 pp., 1920.

Baker[5] has written the following pertaining to the origin: "It (graphite) is not uncommonly a constituent of schists derived from sedimentary rocks. Under these conditions (in schists) it is believed to have been formed from organic material of the original rock."

Regional metamorphism and locally igneous intrusion appear to be the most likely cause or causes for the formation of graphite in this area. There is no evidence that graphite has been formed from carbon dioxide derived from near-by or adjacent limestone during metamorphism as has been suggested by some writers. Schist beds in direct contact with marble appear to have contaminated the limestone by depositing well formed graphite crystals in some instances; however, if the schist is non-graphitic, the limestone carries no graphite. When intrusions of pegmatite or aplite cut graphitic schists of this area, the contact zones usually carry better developed crystals of graphite in the schist as well as in the intrusion, but intrusions cutting non-graphitic schists or limestones carry no graphite. This clearly indicates a non-magmatic origin. It also indicates that the limestone is not the parent material from which the graphite originated.

The schist bands carrying graphite vary in width from a fraction of a foot to 150 feet and can be traced for a variable distance, often intermittently, for several miles. The graphite occurs in a variety of schists, usually of highly siliceous composition. The flakes or crystals are well distributed and of unequal size. Crystals are elongated parallel to the schistosity. Crystal size of the average material from ten sites is definitely medium or small. Large crystals (+30 mesh) are rare and occur only in quartz sills or dikes, in pegmatite dikes, augen structures or intrusive stringers of varying composition. Hand specimens generally show such recognizable minerals as quartz, graphite, muscovite, feldspar, and a host of minor constituents such as pyrite, actinolite, and probably vesuvianite. Ores contain a varying quantity of graphite from a trace to 20 per cent, but no locality is known to carry consistently high-grade material in all parts.

Production.--Graphite production in the Central Mineral region has been intermittent, and, in general, the overall results have been unsatisfactory. The only production of any consequence has come from the Southwestern Graphite Company mill located 9 miles west of Burnet, Burnet County. The history of production of this plant is much the same as that of other plants in the United States--emergencies such as the present war make production possible and worthwhile.

World War I marked the last great expansion of the industry, but most of the plants closed at the cessation of hostilities due to the restoration of facilities for importing foreign grades chiefly from Ceylon, Chosen, and Madagascar.

4/ Paige, Sidney, Mineral resources of the Llano-Burnet region, Texas, with an account of the pre-Cambrian geology: U.S. Geol. Surv. Bull 450, 103 pp., 1911.

5/ Baker, C. L., Construction materials, mineral, stone, and clay products, etc., in The Geology of Texas, Vol. II: Univ. Texas Bull. 3401, p. 259, 1934 [1935].

6/ For a more thorough explanation of the above reasons, see Geological Survey of Alabama Bull. 49 by Clemmer, Smith, Clemmons, and Stacy, published in 1941.

The generally accepted reasons for the plight of domestic production are as follows 6/:

1. The actual size of the industry and domestic needs are not so large as is generally believed. Many plants could produce certain grades immediately but the question of market would trip them. If quantity alone was the only requirement, one or two plants could produce the entire domestic market demand.

2. Domestic flake has never been readily accepted by consumers.

3. Price difference between foreign and domestic grades, the advantage going to foreign, cheap labor producers.

4. Consumers are reluctant to depart from manufacturing procedures developed in the use of foreign grades.

The outlook for domestic production is not altogether dark in view of the recent trends in the use of different grades available. The following information from Tyler and Harness 7/ shows recent trends in requirements.

Commercial description	Customary sources	Consumption trend
A. Natural crystalline:		
1. Lump and chip 90% C.	Ceylon, 100% (Minor deposits at Dillon, Mont.)	Diminishing
2. Flake 85% C.	Madagascar, 90% Canada, 5% Other, 5%	Fairly large, stationary
3. Dust 75% C.	Ceylon, 60% Madagascar, 30% Other, 10%	Insignificant
B. Natural amorphous: 90% C.	Mexico, 50% Chosen, 30% Canada, 10% Ceylon United States	Large, increasing
C. Manufactured:		
1. Electrodes, etc. 95% C.	United States, 100%	Large, Increasing
2. Powder 95% C.	United States and Canada, 100%	Fairly large, stationary

6/ For a more thorough explanation of the above reasons, see Geological Survey of Alabama Bull. 49, by Clemmer, Smith, Clemmons, and Stacy, published in 1941.

Llano County Sites

Fitzsimmons ranch.-- Graphitic schist bands on the Fitzsimmons ranch have been described by Sidney Paige [8] and William Young Westervelt [9]. This locality is about 1 7/8 mi. due south of Lone Grove post office, about 1500 feet west of Little Llano River, and 800 feet north of the Southern Pacific Railroad and new State highway No. 29. The shaft and workings described by Paige can be easily reached via the new highway.

No testing was carried on at this site by the present writer other than the preparation of a sketch map and collection of typical samples from various exposures.

Graphite occurs in rather siliceous graphitic schists, and the bands are by no means continuously exposed because of surficial material, but a sufficient number of outcrops are visible to trace them without difficulty. Aplo-granite and pegmatite intrusions have disrupted and cut the beds at various points, changing the dip and directional trend, but normally the bands can be traced northwest from the old diggings near the highway for more than one-half mile.

The following excerpt describing the workings near the highway is taken from Paige. [10]

> "The deposit has been prospected by a shaft with underground workings and by a number of surface cuts, four or more in a distance of 500 feet. Two to the southeast of the shaft (about 150 and 300 feet from it, respectively) only show granite debris. One to the north of it about 150 feet is badly filled. A 70-foot cut about 25 feet north of the shaft gives an excellent exposure.
>
> "At the west end of the cut, a mixture of schist and pegmatite with calcite veinlets is exposed for 22 feet. There is a little graphite in the schist. Limestone is exposed in the extreme west end. Next to this 22 feet of lean material, an irregular mass is exposed, about 3 feet across and extending from the bottom to the top of the cut. It contains considerable graphite, mixed with quartz, feldspar, and calcite and represents a rich graphite-bearing layer intruded and broken by pegmatite with subsequent filling of fractures by calcite.

[7] Tyler, P. M., and Harness, C. L., Marketing graphite: U. S. Bur. Mines, Inf. Circ. No. 7177, p. 8, 1941.

[8] Paige, Sidney, Description of the Llano and Burnet quadrangles: U. S. Geol. Surv. Geol. Atlas, Llano-Burnet fol. (No. 183), p. 13, 1912.

[9] Westervelt, W. Y., in Paige, Sidney, Mineral resources of the Llano-Burnet region, Texas, with an account of the pre-Cambrian geology: U. S. Geol. Surv. Bull. 450, pp. 79-82, 1911.

[10] Paige, Sidney, Mineral resources of the Llano-Burnet region, Texas, etc.: U. S. Geol. Surv. Bull. 450, p. 78, 1911.

"At first glance the impression might be formed that the pegmatite had introduced the graphite. A careful examination of the graphite bunches in the pegmatite shows, however, that they represent broken fragments of schist. A specimen was polished and etched with hydrochloric acid, which by dissolving out the calcite contained between the laminae of the schist fragments showed clearly the schistose nature of the graphite.

"Following this mass is 6½ feet of fine-grained mica schist, carrying a small content of graphite, after which is exposed 6 feet of material similar to the 3-foot irregular mass described above. Seven feet of schist, practically barren of graphite, is followed by 25 feet of material similar to the irregular mass of graphite, feldspar, and quartz, but containing more of the latter material as the end of the cut is approached. Decayed granite appears in the east end of the cut.

"An average sample taken over the length of the cut described above showed a carbon content of 11.45 per cent."

The flake size of a typical sample from the workings is shown by Westervelt's test [11] in which he found that from 1 to 4 per cent by weight of the graphite remained on a 60-mesh screen.

Quartz is the principal mineral of this ore, with minor amounts of mica, pyrite and calcium carbonate. Graphite is present principally as visible flat crystals, but some of the graphite also occurs as pea-size or larger lumps made of masses of tiny graphite crystals. Ore on the dumps and near trenches is iron-oxide stained from the decomposition of pyrite. The ore is deeply weathered and in part is very friable. This is an important factor in grinding regardless of the grade which is sought. Mineral rights are owned by the Downman Estate and the Fitzsimmons Land and Cattle Company.

The nearness of electrical power, water from Llano River, railroad and highway makes this a desirably situated site for the establishment of a graphite industry. However, the site should be thoroughly tested and mapped before serious development is contemplated.

G. W. Templeton Estate (Lillie Templeton).-- Two distinct bands were investigated on the G. W. Templeton Estate located about 1 mile north of Lone Grove post office on Little Llano River. A mill has been erected on the west band as shown by the accompanying sketch map.

Several test trenches and pits were made on this property in order to determine if sufficient quantity was present for commercial production, class of material, accessory minerals, and state of weathering. Trenches with test numbers are shown on the sketch map. Results obtained from the trenches are as follows:

No. 1.-- Length, 68 feet; depth, 14 feet. Considerable time was spent in digging this long trench at right angle to the direction of schistosity of the graphitic schist. The trench was extended sufficiently in both directions to pass out of the graphite-bearing schist into micaceous schists and weathered aplitic intrusions.

The character of schist was essentially the same from surface to the final depth. Small amounts of unaltered pyrite were found from the surface to the greatest depth reached and feldspar was somewhat kaolinized. Flake size of the bulk of the material is small and is tightly heid in the tough siliceous matrix. Megascopic examination of specimens from this trench show flake graphite with quartz, feldspar, kaolinite, vesuvianite, actinolite(?), and pyrite present.

No. 2.-- Length, 37 feet; depth, 5 to 6 feet. Graphitic schist carrying an appreciable quantity of ore began in a thin bed on the west end of the trench, gradually thickened to the east as an uneven bed lying on lean siliceous and micaceous schist. A maximum of about 6 feet of ore could be taken at this point.

No. 3.-- Length, 65 feet; depth, 4 feet. Graphitic schist dipped rapidly away from the center of the trench to the east and west. A great deal of stripping would have to be done at this point in order to uncover an appreciable quantity of useful ore.

No. 4.-- This trench is a few feet from the east wall of the mill. A fold of graphitic schist dips rapidly to the east. The ore is hard and siliceous but carries an appreciable quantity of flake graphite.

No. 5.-- Material is essentially like that of test No. 4. Entire trench is within graphitic schist.

No. 6.-- Graphite-bearing schist in this test is very thin. The pinched out bed is very thin and carries a lump type graphite made up of groups of tiny graphite crystals.

No. 7.--Ore in this trench is very rich in both flake and lump variety.

No. 8.-- Very lean graphitic and micaceous schist throughout.

No. 9.-- Hard relatively unaltered material. This band extends farther northwest for about one-half mile, but the schist becomes lean. This site has sufficient graphite for a mill operation if relatively unweathered material can be used and if a large flake size is not necessary. The finished product would require at least a 7-mile haul to the railroad.

The graphitic schist exposure east of the described occurrence is an elongated hill rising approximately 50 feet above the surrounding area and lying approximately 200 yards east of the Latsen mill site. Alternate beds of schist, graphitic schist, and "marble" dip eastward at approximately 45 to 60 degrees and plunge to the southeast. Several indistinct and narrow lit-par-lit sills are included. An old shaft marked "A" on the following sketch map was found on the northwest end of the hill. It had been dug along the contact of the schist and dolomite as shown in the detail on the sketch map. Five test holes and trenches were made on this site. With the exception of No. 1, all were in the graphitic schist. No. 2 cut "marble" and schist.

11/ Westevelt, W. Y., op. cit., p. 81.

The graphitic schist at this site is similar to that of the first band described on the Lillie Templeton farm but is more schistose, particle alignment being more noticeable. From the standpoint of mining, this site would offer a great deal of ore, most of which is somewhat better weathered than the band to the west. This hill is only a few hundred feet from the west band; consequently, it could be mined for use in the present mill.

Logan Templeton.-- The Logan Templeton site is located about one-fourth mile from Lone Grove on the south side of the Lone-Grove-Llano road. The indefinitely defined graphitic schist bands are cut by the road as shown by the accompanying sketch map and are on the downthrown side of a fault involving the pre-Cambrian schist series and Hickory sandstone. The sandstone, as well as the overlying limestone of Upper Cambrian age, forms a prominent hill, while the schists weather low and are poorly exposed. The schist bands are somewhat distorted and fractured by intrusions as well as by faulting. The bands trend slightly west of north from the line of test trenches and can be traced north of the road about 100 feet where they disappear under recent stream deposits. The total length of the bands as revealed by trenching is about 600 feet. Small pegmatite sills and aplo-granite were found in most tests.

The ore of the narrower band shown in the sketch map is extremely rich and appears to carry more graphite than any other site described with the exception of the Fitzsimmons ranch. The ore of the larger band appears to carry about 8 to 10 per cent graphite but shows little weathering. Ore from test No. 7 is extremely rich and probably carries 15 to 20 per cent graphite.

Louis Templeton.--The exposure of graphitic schist at the Louis Templeton site is located about 2½ miles west of Lone Grove on the Lone Grove-Babyhead road. The graphitic schist band as well as other outcrops in the area are shown on the accompanying sketch map. The total length of outcrop is about 125 feet, and the maximum width of the band is 25 feet. Two test trenches were made at this site. It was found that the graphite is not extensive, the trenches bottoming in weathered aplo-granite a few feet below the surface.

The bulk of material from the test trenches is medium grained and fairly well weathered. Some of the ore contains flake and flattened lumps, the lumps being essentially the same as that described from the Logan Templeton site.

The surrounding beds include dolomite, that appears to be rather siliceous, and calcium carbonate marble. Several old prospect holes are shown on the sketch map. Part of an extensive marble band is shown to the north of the schist outcrop.

Robinson State Park.-- A prominent graphite band is located approximately 2 miles west of Llano adjacent to the Robinson State Park. As shown by the accompanying sketch map, the band lies to the west of the park and is cut by State highway No. 29. The trend is nearly north-south. The beds are best exposed near the excavation shown on the sketch map as Darnell pit. At this point graphite was mined for test runs, and a few tons of ore are piled near by. No attempt was made to trace the band across Llano River northward, and it can only be traced with difficulty south of the road.

At first glance the ore appears to be very rich in both flake and cryptocrystalline graphite, but closer examination shows an appreciable quantity of mica, some green mineral, probably actinolite, feldspar, and pyrite. The bulk of graphite present in the ore is medium flake. The east end of test trench No. 1 yields fractured graphitic schist that has healed with fluorescent chalcedony. Test trench No. 3 cuts through altered carbonate beds that contain an abundance of vesuvianite.

The schist band dips on an average of 45 degrees; consequently, in open pit mining, the overburden would increase rapidly. The ore is weathered and could be easily crushed and milled. Water is abundant in near-by Llano River, and the railroad is only 2 miles away.

A second band of graphitic schist on the Robinson ranch is located about one-fourth mile south of the Robinson State Park and State highway No. 29. The band has been trenched, and large test pit about 2 feet in depth has been made near the south end of the visible outcrop.

The surface ore is weathered but deeper ore was found to be siliceous and comparatively hard. A green silicate mineral, probably actinolite, is present in the schist, and it appears to be harder or more unaltered than a similar mineral described from the ore at the State Park.

The character of the ore is very different from one portion of the band to another. As the band is traced northward the ore becomes more siliceous and carries little or no graphite. The maximum width of this band is 45 feet but varies in places to as little as 20 feet.

Jess Long.-- The Jess Long graphitic schist band is located at the present west line of the Llano city limits south of State highway No. 29, as shown on the accompanying sketch map. Two test trenches were cut through the band at right angles to the schistosity of the rock.

The schist carries very little graphite and is very siliceous. Siliceous dolomite and banded calcium carbonate marble are present at this site as shown on the map. There is evidence of a limited amount of dimension stone quarrying in the banded marble west of the Jess Long house.

About 200 yards south and east of the Jess Long site there is a prominent rounded hill on the B. Lange property. The west half of this hill is composed of cryptocrystalline type graphite. The graphite in this ore is extremely fine and well disseminated throughout the schist. This band is possibly a northwest extension or continuance of the graphitic schist band south of Llano occupied at present by the Texas Graphite Company mill.

Texas Graphite Company site (Scott land).-- The large and extensive graphitic schist band occupied by the Texas Graphite Company mill, 1 mile south of Llano on State highway No. 16, has been somewhat described by Sidney Paige on the Llano-Burnet folio and U. S. Geological Survey Bulletin 450. The mill is located immediately east of the highway. Erected in 1940, it operated for only a few days, and during this time the ore was mined underground even though the deposit had no appreciable

overburden. Later an open pit was made west of the mill, and good exposures can be seen at this point.

In investigating this site, three trenches were cut at right angles to the long axis or schistosity of the deposit. These are shown on the accompanying sketch map. The longest of the cuts is approximately 140 feet and cuts graphitic schists of varying richness for almost the entire distance. Graphitic schists on the south extremity of the cut terminate against siliceous dolomite, while in the north portion the schists become increasingly lean and finally are composed almost entirely of quartz and mica. At least 100 feet of the band is minable at this point.

The second cut is located immediately west of the mill. This short trench cuts graphitic schist and siliceous dolomite. The dolomite appears to be a lens with no visible connections to adjacent dolomite.

The third cut is located at the southeast end of the exposed schist. This trench cuts alternate beds of graphitic schist and dolomite. The dolomite ranges in color from dull gray to pearly white and carries free calcite as well as silicate minerals. The graphitic schist beds are plainly constricted at this extreme exposure. Attempts to follow this particular band were rather unsuccessful due to the intervening intrusion of the Oatman Creek granite.

Small sills and dikes have cut the band in places, but there are no serious interruptions in the exposure from the highway to the southeast extremity of the outcrop. Aplite intrusions are generally lit-par-lit. The main schist band strikes approximately northwest-southeast and dips from 45 to 90 degrees. Beds exposed in the mill cut are near vertical, making open pit mining a relatively simple matter. The dip is variable, but it averages about 20 degrees to the southeast. The same band is exposed on the Sixmile road northwest of this site and probably on the Lange farm west of Llano. Intermittent exposures and the lack of aerial photographs made tracing difficult.

The typical ore is a fine-grained, irregularly splitting black or grayish-black schist, usually accented with numerous ashy colored and probably somewhat altered prismatic crystals of some undetermined silicate, oriented in no particular manner. These crystals are apparently orthorhombic, the axis being about 1 mm. Cruciform patterns of darker colored material are evident on broken cross sections of some specimens. The fresh ore is composed largely of cryptocrystalline quartz and graphite. Typical samples contain roughly 10 to 17 per cent graphite. Since the particle size of quartz and graphite is so fine grained, a fine grind is necessary in milling to free the graphite from the gangue. Refined samples of this graphite (85 to 90 per cent carbon) are extremely black and present a very fine sparkling crystalline texture. In trade practice the refined product would be considered "amorphous."

Elmon Stewart ranch.--Graphitic schists are exposed in a road metal pit 0.01 mile east of State highway No. 16 on the south side of the Sharp Mountain road about 1.5 miles south of Llano. Two bands are exposed by the excavation made in weathered diorite. The band exposed in the west and south sides of the pit strikes about N. 15° W. The strike of the schist band exposed on the east side of the pit is

about N. 25° W. Both bands apparently pitch to the southeast. The schists at this locality have been intruded by small sills and dikes. Like other graphitic schists in this area, it is extremely fine grained, and the weathered schist readily parts into thin straight laminae. This site is of no value as a graphite source.

Gray Fowler land.--A graphitic schist band, variable in thickness but averaging about 60 feet, is exposed on the Sharp Mountain road 1.3 miles east of State highway No. 16 on the Gray Fowler land. This band is probably a continuation of the Texas Graphite Company's deposit. One test trench was dug across the band south of the point where it is cut by the Sharp Mountain road.

The ore is very fine grained, and the beds dip almost vertically. Quartz and quartz-feldspar augen are abundant. Although aplo-granite and pegmatite have intruded and disturbed the band a large tonnage of minable ore is present in this deposit. This band has been reported to extend southeast on the Dan Stribling ranch.

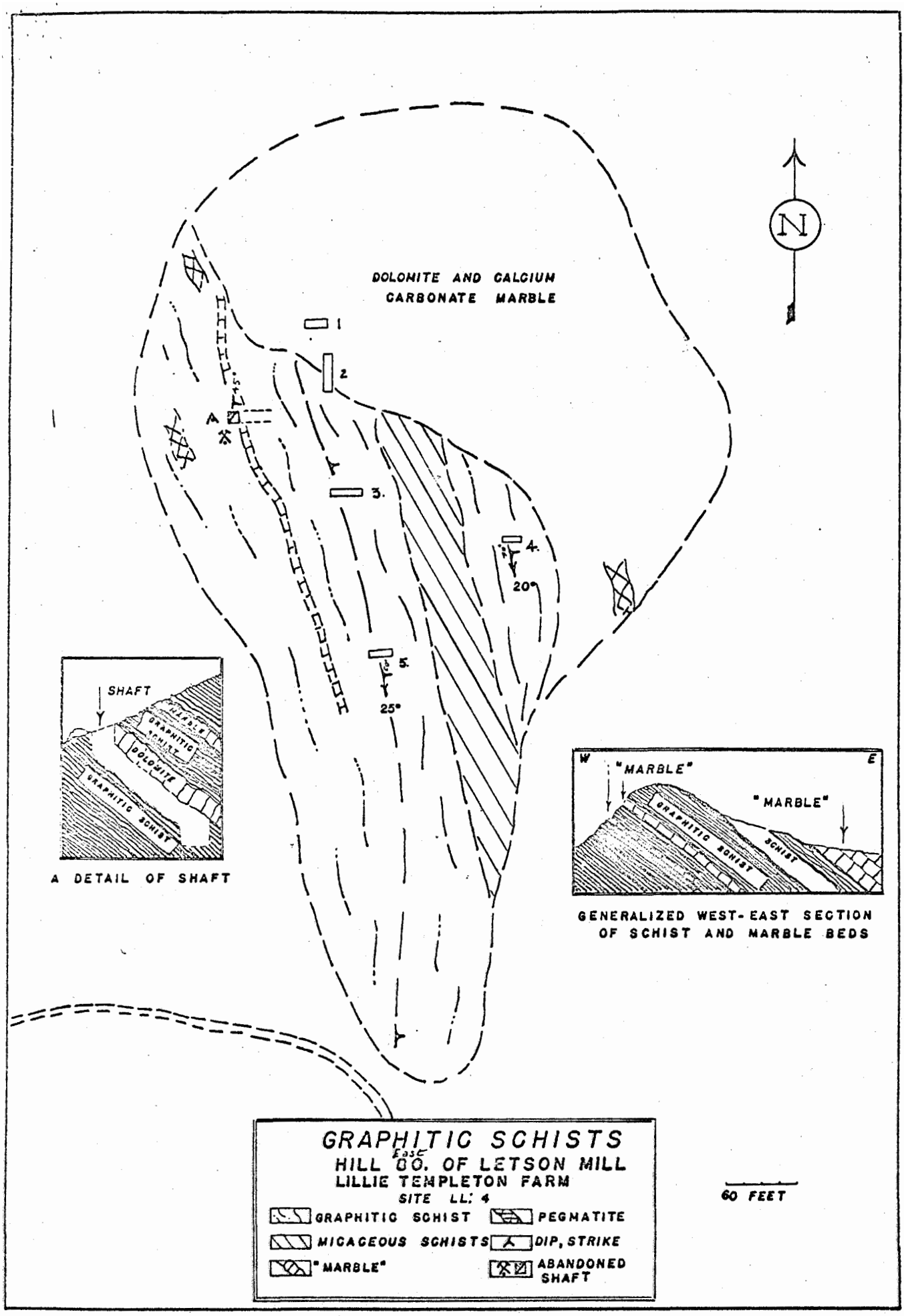
Sharp Mountain (Ben Thomas mineral rights).--Rather prominent graphitic schist bands occur along the west flank of Sharp Mountain on the Will Stribling tract (Ben Thomas mineral rights). Thicknesses of beds can rarely be measured, and the intermittent nature of outcrops makes it difficult to follow individual beds. Several shafts and cuts have been made through the schist and carbonate series. Two vertical shafts are cut on the south end of the mountain, a horizontal drift on the west face, and a deep vertical shaft on the northwest side at the contact of the aplo-granite and schist. The west drift cuts about a hundred feet of eastward dipping strata made up of very impure dolomite, graphitic schists, and shear material. A hasty examination shows one large overthrust in the tunnel and quantities of red and white clay rock flour near the back wall or contact of the aplo-granite of Sharp Mountain with the schist and carbonate series. The Sharp Mountain graphitic schists are found to the south of the mountain in and near the Texas Mines magnesite mine. The schist and carbonate pre-Cambrian series disappears south of Texas Mines under a thin Hickory sandstone overlap.

Dixie Graphite Company (old Heath gold mine).--The Heath mine is located about 5 miles northeast of Llano, just north of the Llano-Lone Grove road. The mill on this site was erected to recover gold from near-by residual deposits, but it was not successful.

During part of 1918 the mill was converted for graphite production. During the three months of operation one shipment was made. The material produced was largely medium and small flake, but the product contained sulfides to the extent that operators are said to have been unable to remain in the drying room continuously.

Ore was mined underground about 1200 feet northwest of the mill. The ore is similar to the Logan Templeton material at Lone Grove and appears to be rather rich, but outcrops are few, the band is very narrow, and it is cut by intrusions.

NOTE: Unfortunately the maps originally accompanying this circular are now out of print and no longer available.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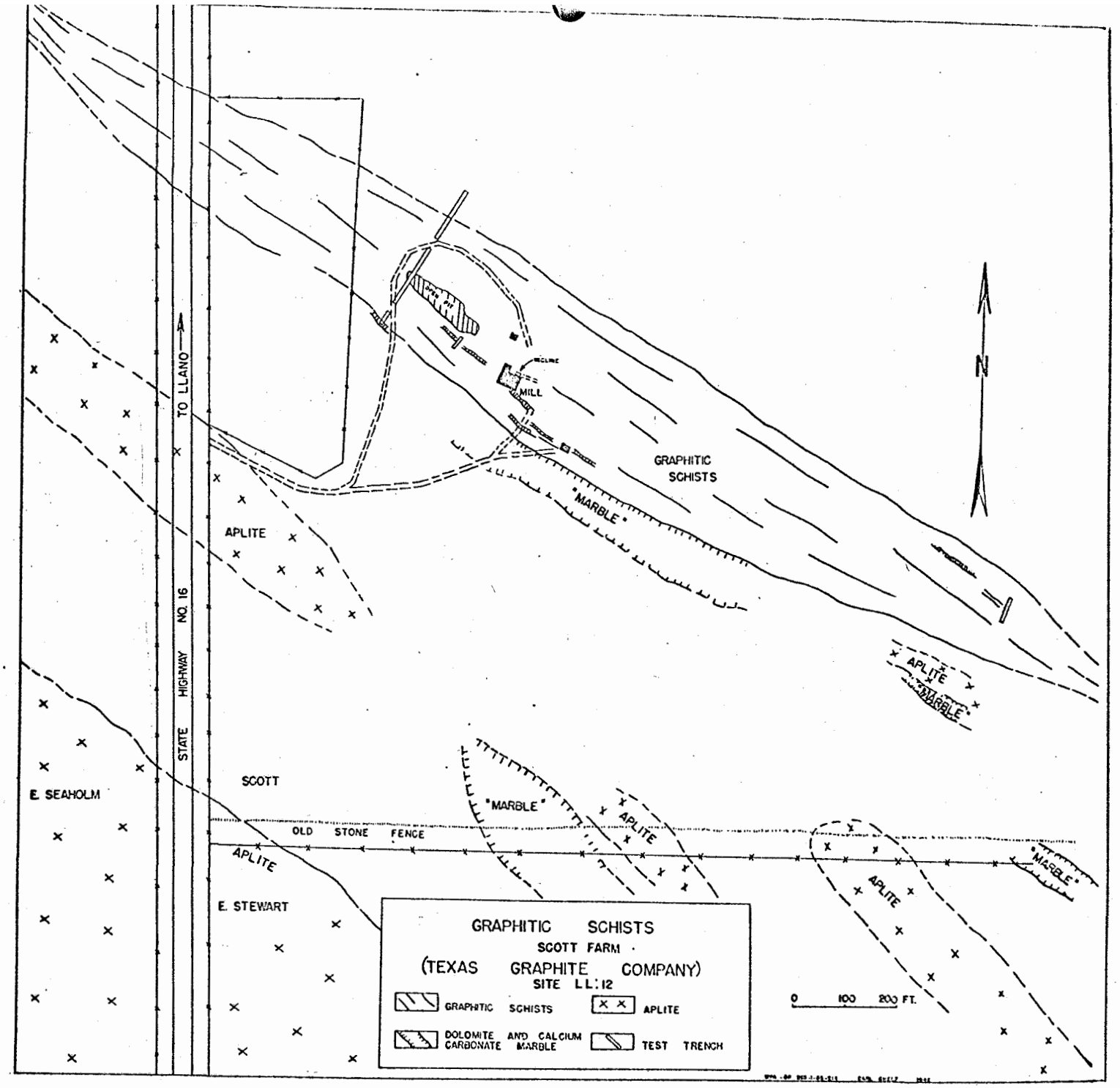
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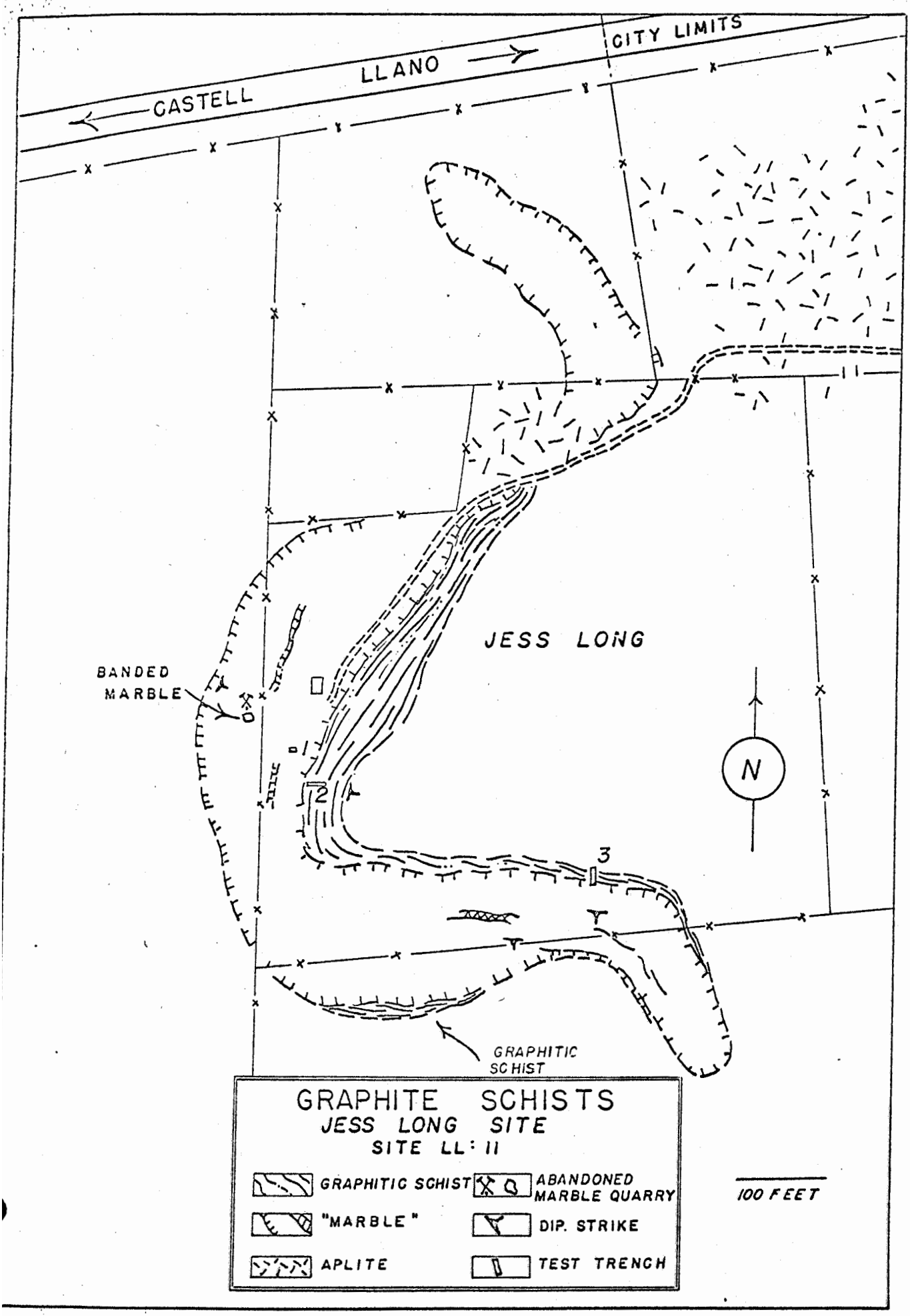
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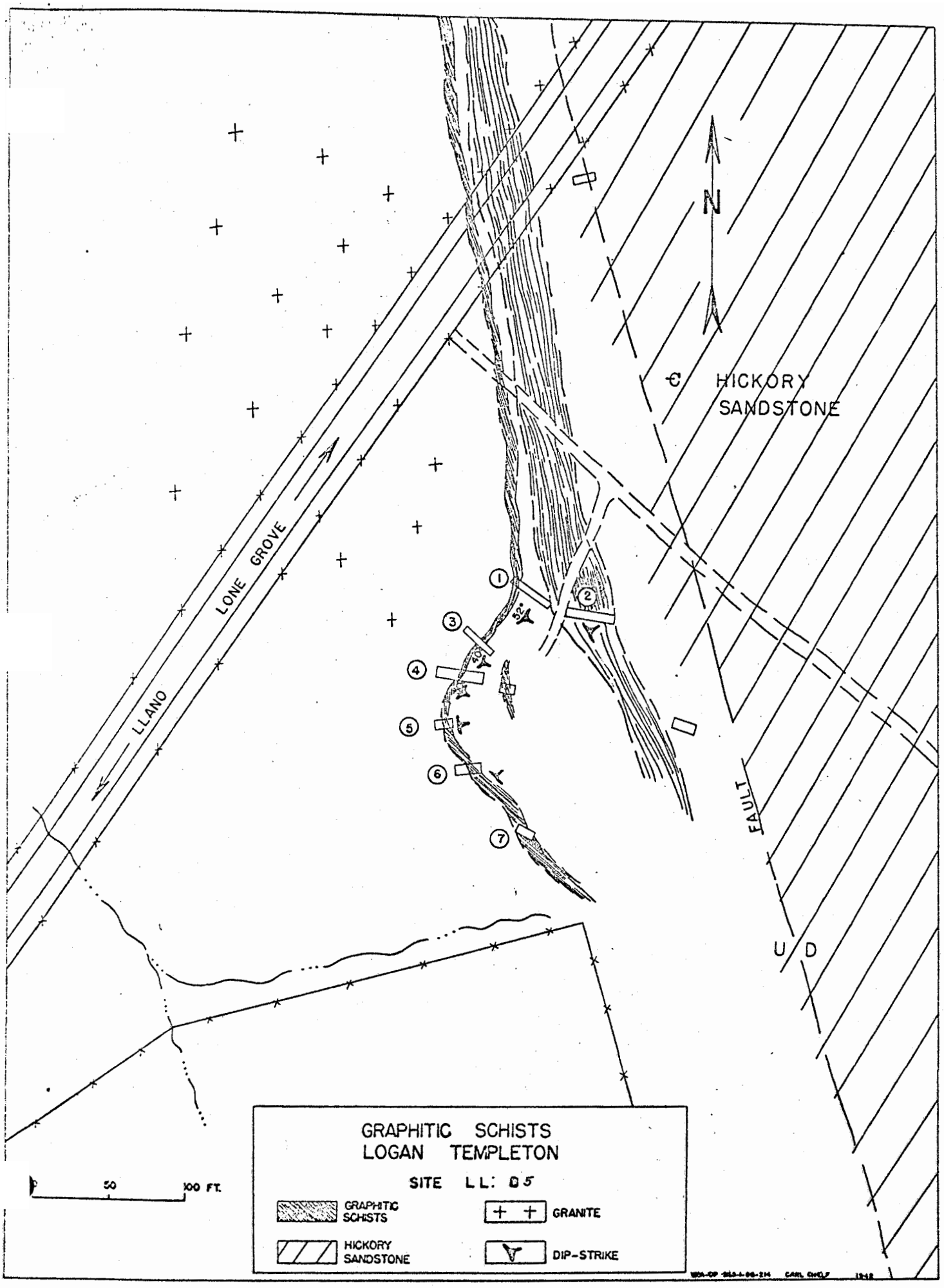
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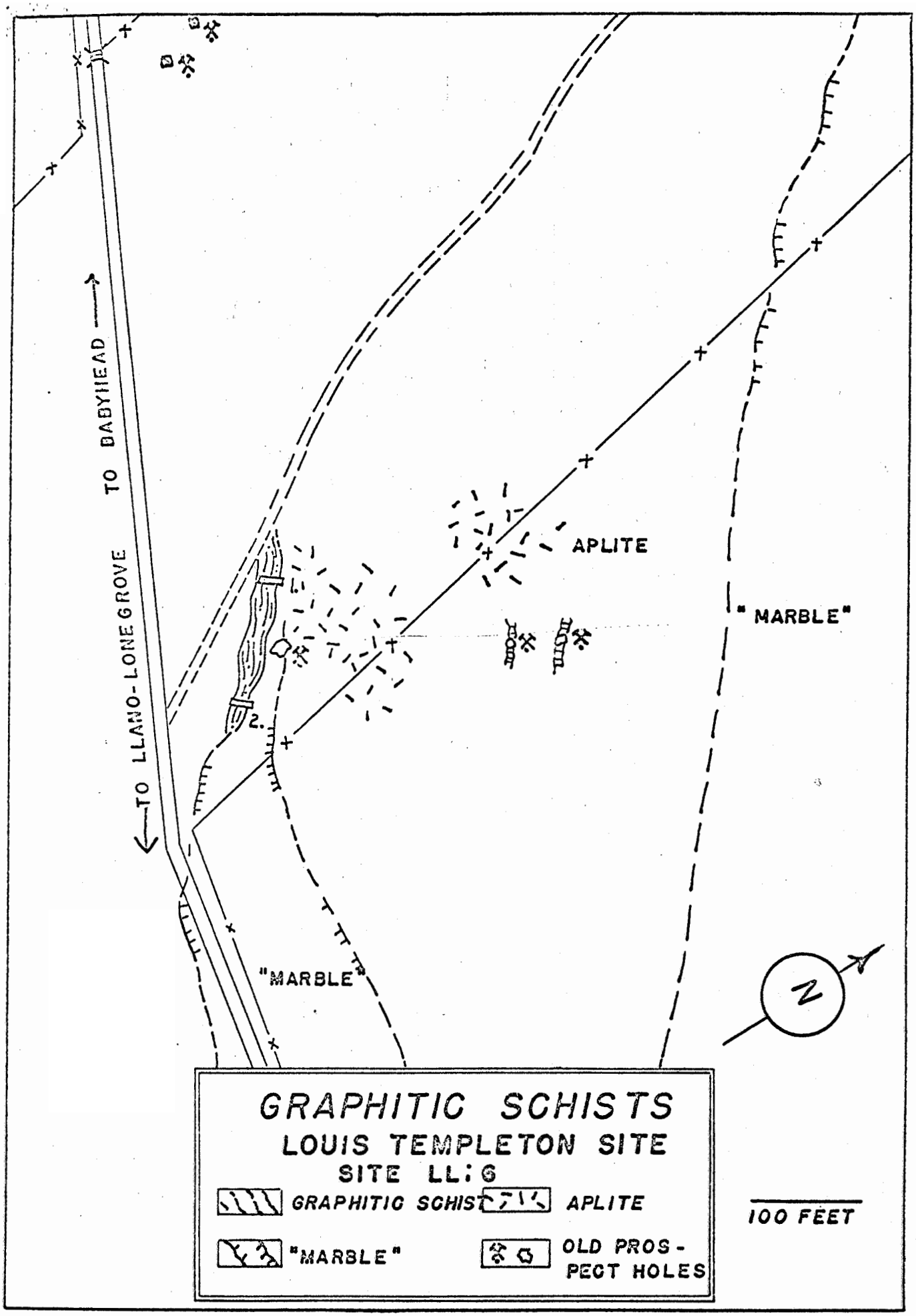
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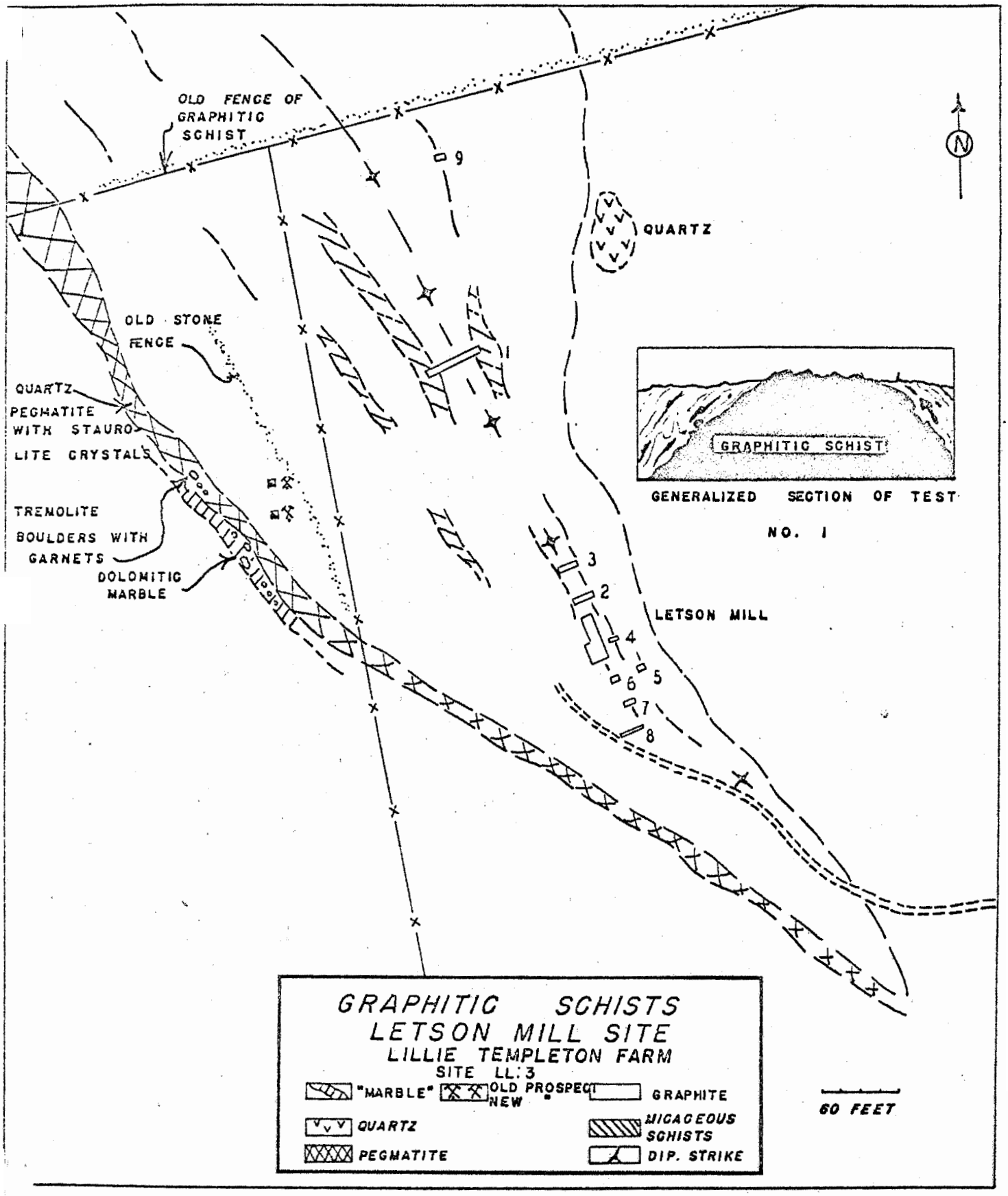
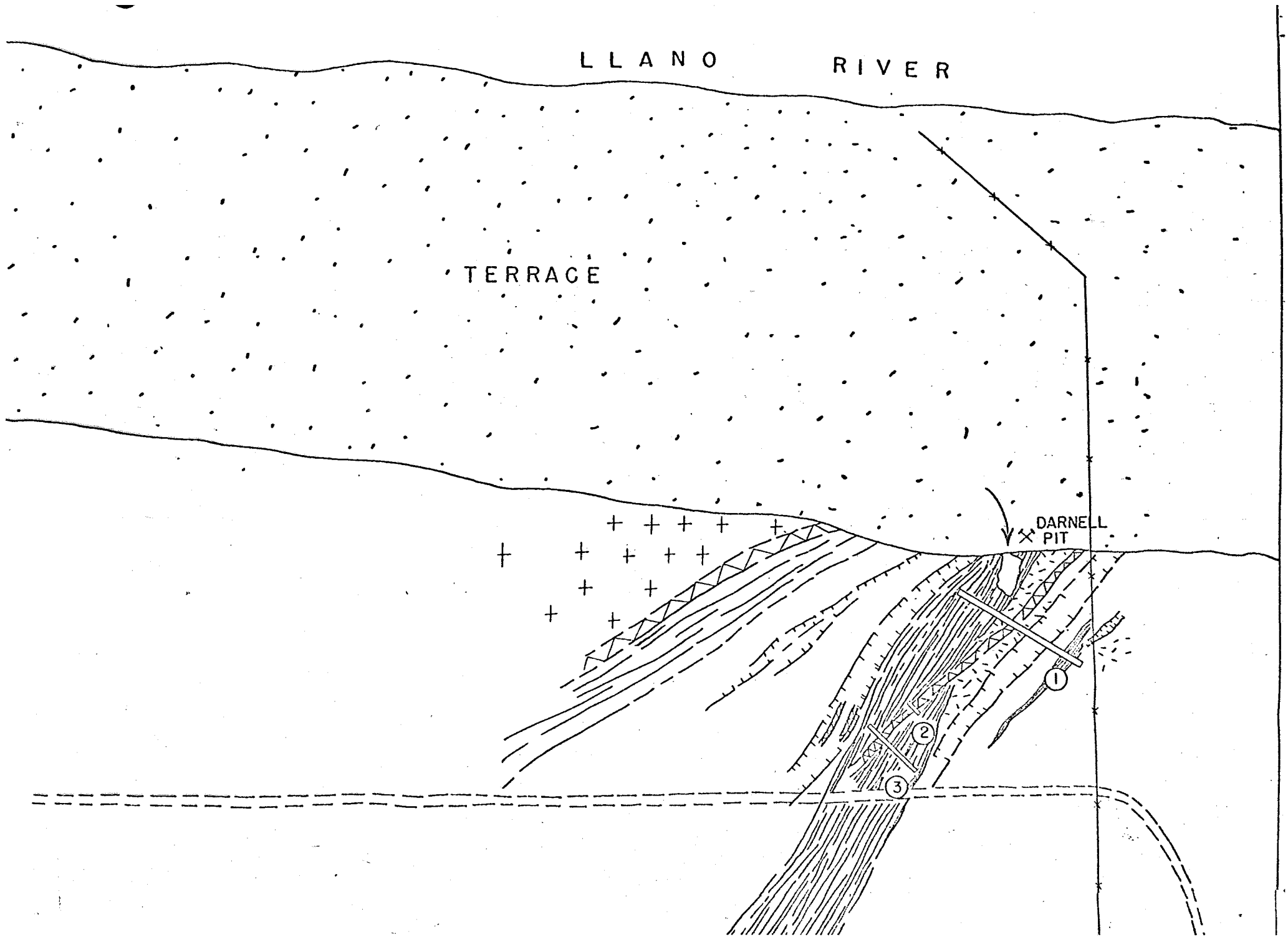
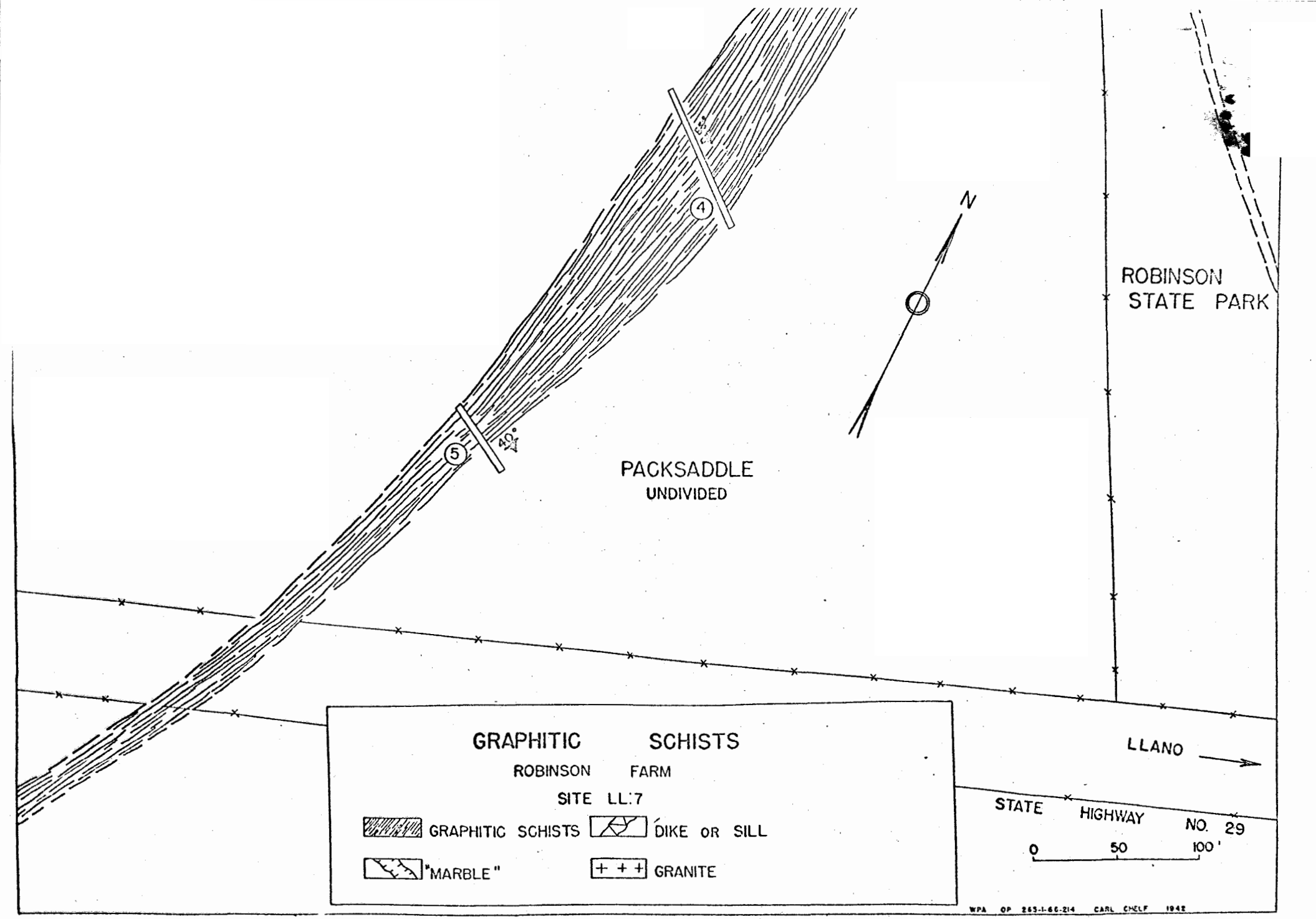
OLD PROSPECT HOLES
100 FEET


OLD FENCE OF GRAPHITIC SCHIST
9
QUARTZ
OLD STONE FENCE
QUARTZ PEGMATITE WITH STAURO LITE CRYSTALS
TREMOLITE BOULDERS WITH GARNETS
DOLOMITIC MARBLE
GRAPHITIC SCHIST
GENERALIZED SECTION OF TEST NO. 1
3
2
LETSON MILL
4
5
6
7
8
GRAPHITIC SCHISTS
LETSON MILL SITE
LILLIE TEMPLETON FARM
SITE LL:3
"MARBLE"
OLD PROSPECT
NEW
GRAPHITE
QUARTZ
MICACEOUS SCHISTS
PEGMATITE
DIP. STRIKE
60 FEET


LLANO RIVER
TERRACE
DARNELL PIT
1
2
3


ROBINSON
STATE PARK
N
PACKSADDLE
UNDIVIDED
4
5
40°
LLANO
STATE HIGHWAY NO. 29
0 50 100'
GRAPHITIC SCHISTS
ROBINSON FARM
SITE LL:7
GRAPHITIC SCHISTS
DIKE OR SILL
"MARBLE"
GRANITE
WPA OP 265-1-66-214 CARL CHELF 1942

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