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E7-10089
CR-149572

"COMPREHENSIVE STUDY OF LEON-QUERETARO AREA".

Investigation number SR-9631/7.

Principal investigator — Ing. Héctor Alonso Espinosa.

Co-investigators. — Ing. Humberto Ramos Moreno.

Ing. Jorge H. Olivares Martell.

Comisión de Estudios del Territorio Nacional (CETENAL).

Sponsoring Organization. — Comisión Nacional del Espacio Exterior (CONEE).

Type of Report. — First Trimestral Report.

December 17, 1976.

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INTRODUCTION

In this first stage of research on the use of the data obtained through Landsat satellites for the inventory of natural resources, the first experiences on geology and edaphology have been obtained.

GENERAL INFORMATION ON THE AREA UNDER STUDY

The area under study is located between parallels 20° 00' N and 22° 00' and between the Meridians 100° 15' W and 102° 00' W. However, in this first stage only the area of one image, of central coordinates 21° 45' N and 100° 29' W, has been studied. The image was taken by the satellite on March 28, 1976, and bears the identification number E 2431-16231. It is covered by 21 CETENAL charts each of which embraces some 1 000 km^2.

The climate of the lower parts of the area is hot to warm semiarid with mean annual temperature between 18 and 22°C and mean annual precipitation of 400-500 mm. In its mountainous parts, the climate is temperate semiarid with mean annual temperatures of 16-18°C and mean annual precipitation of 500-600 mm.

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Geologically, the area covered by the image is made up for the greater part of Tertiary volcanic rocks, mainly rhyolites with some basalt ranges. The flat areas are covered by Quaternary alluvia excepting small areas of Quaternary basaltic lavas in the eastern part. In the north sector of the image there are two bands of sedimentary rocks. The eastern one, in long and narrow folds, is made up of limestones and shales as well as calcareous shales interbedded with layers of calcareous sandstones. In the one on the western side of the image, these same rocks form broad ranges, remnants of overthrusts with a complex carstic topography. The schists in the southwest corner of the image are predominantly meta-volcanics. The green schists in the southwest corner of the image are predominantly meta-volcanics in greeh schist facies. (The above is verbal information given by Ing. Alejandro Bello Barradas and the Carta Geológica de la República Mexicana).

METHODS

The geological and edaphological interpretation was carried out with the use of the I^2S Mini-Addcol Color Viewer at an approximate scale of 1:500 000. Various trials with bands and filters were run until it was decided, in the geological studies, to utilize bands, 4, 5 and 7 (4 without filter, 5 with green filter and 7 with red filter) and, in the edaphological studies, bands 4, 5 and 7 sith blue, green and

red filters respectively, though contacts were also checked on the various bands without filters. Band 6 was not used due to mal functioning of the apparatus. Contacts were traced with black ink on transparent acetate film. The use of a hand lens (4 dioptries) was found help ful for both types of study.

The geological studies sought to obtain:

1. The drainage of the area as revealed by the image.

2. The delimitation of the principle lakes of the area.

3. The principal and secondary alignments (fractures, faults, etc.) found in the area.

4. The lithology of the area, classified in broad units.

The edaphological studies pursued the delineation of broad units of soil groups in the area.

A selection and compilation of geological studies based on images as well as other geological studies of the area was carried out and this available information was evaluated.

The edaphological investigation was based on the above mentioned general information on the area (climates, lithology, etc.).

In both geological and edaphological studies the traditional criteria of photointerpretation were applied, these being, analysis of the drainage pattern, the geomorphology and geology (for edaphology), texture and tone of the image, changes in slope (when determinable)

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and distribution of vegetation (for edaphology). Basic principles of electromagnetic theory and the response of the different bands of various bodies and features of the earth's surface were likewise taken into account.

Owing to end of the year and end of presidential term administrative adjustments, field verification of the interpretations of the image could not be carried out. Fortunately, however, the area embraced by the image has been covered both for geology and edaphology by CETENAL'S 1:50 000 scale charts. These were elaborated on the basis of aerial photographic interpretations and detailed field verification of the same. Both the geological and edaphological interpretation of the satellite image were therefore checked against these mapas.

Results (Geology).

1. Drainage and lakes.

These were interpreted in bands 7 (green filter) and 5 (red filter) at their maximum intensity (8.5). The drainage pattern was traced and lakes were located. Rivers and streams observable in red tones displayed dry tracts since the image was taken in the dry season.

2. Structural alignments. Due to the smallness of the scale of the image, an overal view is obtained which permits the identification of fundamental tectonic features (straight or curved aligments

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of major extension). These features were traced and will facilitate mineral exploration.

3. Lithology.

It was possible to trace contacts between the following rock types.

a) Acid extrusive igneous rocks. Those of acid nature display particular types of landforms, a drainage pattern of dendritic type and particulare tones which permit their separation from other rock types. This group was given the key "Igea" and, in this first intent, were not separated from rocks of intermediate nature.

b) Basalts. These are easily identifiable through their darker tone and their associated landforms.

c) Sedimentary rocks. These were identified with little trouble and include the following: limestones, limestones with shales, shales with interbedded sandstones, sedimentary breccia and conglomerates. Soils, designated with key "Q". When erosional or structural openings were found to occur in the igneous units which permitted the outcro-

pping of sedimentary rocks, these were not separated from the igneous rocks when their dimension on the chart being traced amounted to only several square millimeters. Such outcroppings, however, are delimited in CETENAL'S 1:50 000 scale maps.

d) Metamorphic rocks, Metamorphic rock units were localized with the help of supplementary information.

Results (Edaphology).

In the analysis of the false color composite it was found that in the flat areas towards the southern part of the image there are dark reddish patches between lighter yellowish areas. In the CETENAL maps the darker patches correspond to deep soils while the lighter areas are soils with a petrocalcic layer which outcrops in eroded parts.

Other flat areas with aridic climate of very light yellow color and lacking vegetation were interpreted as Xerosols. But very dark cultivated zones and very low reflectance in band 4 were interpreted as Vertisols. Both interpretations checked with the information in CETENAL'S edaphology maps.

Small white areas in the northeastern part of the image observed in the false color composite and with very high reflectance in all bands,

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especially band 4 are saline soils of the Zolonchak group. This appears to be a very good indicator of saline soils although it is well to bear in mind that some of these soils sustain a halophile vegetation which would lower the reflectance.

CONCLUSIONS.

In the present stage of the investigation we are able to confirm the fact pointed out by other workers that satellite images represent a very useful tool in the elaboration of regional maps of geological or edaphological nature. Major structural features, drainage patterns and lithological units as well as soil associations may be distinguited and represented in maps drawn up at a low cost.

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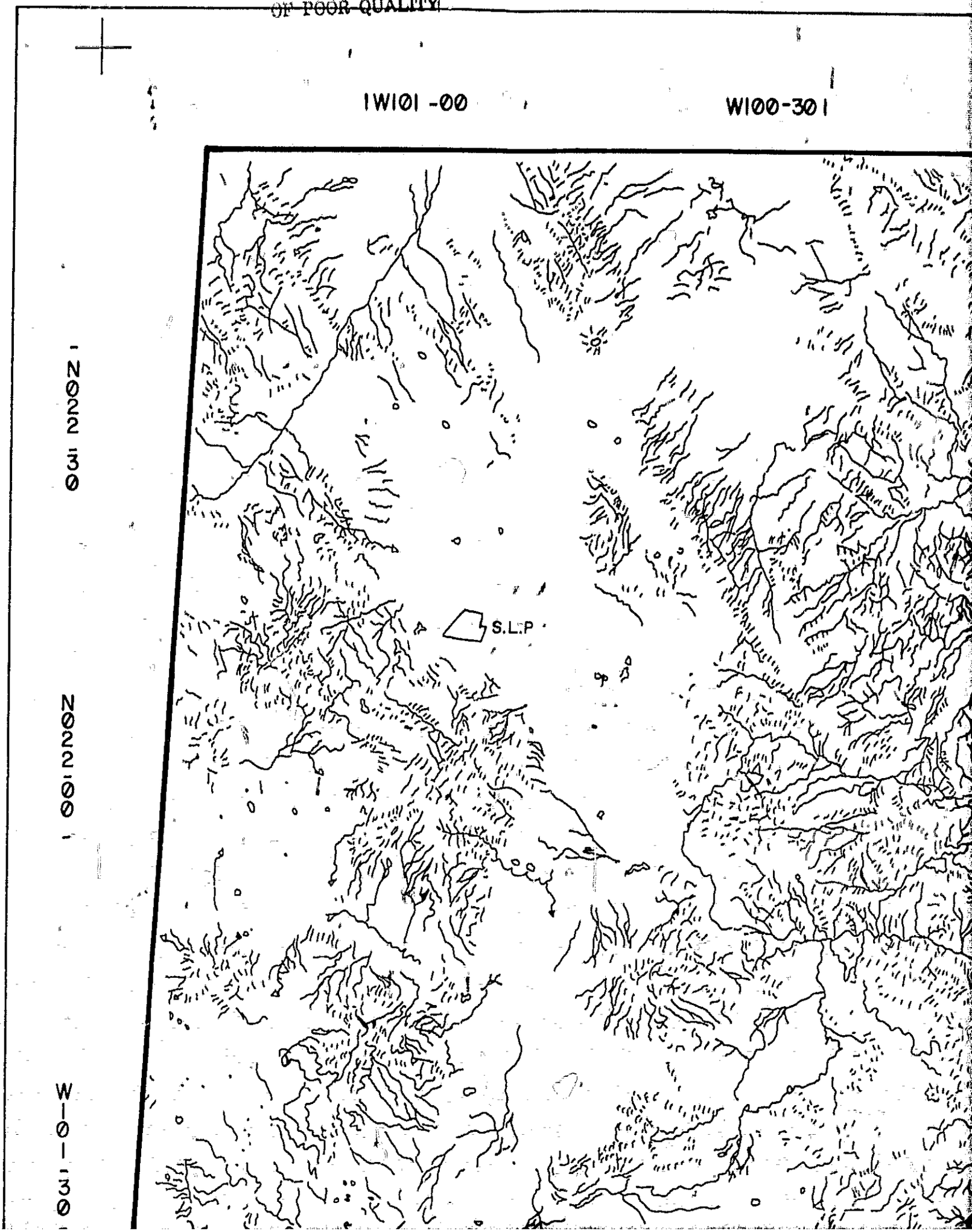

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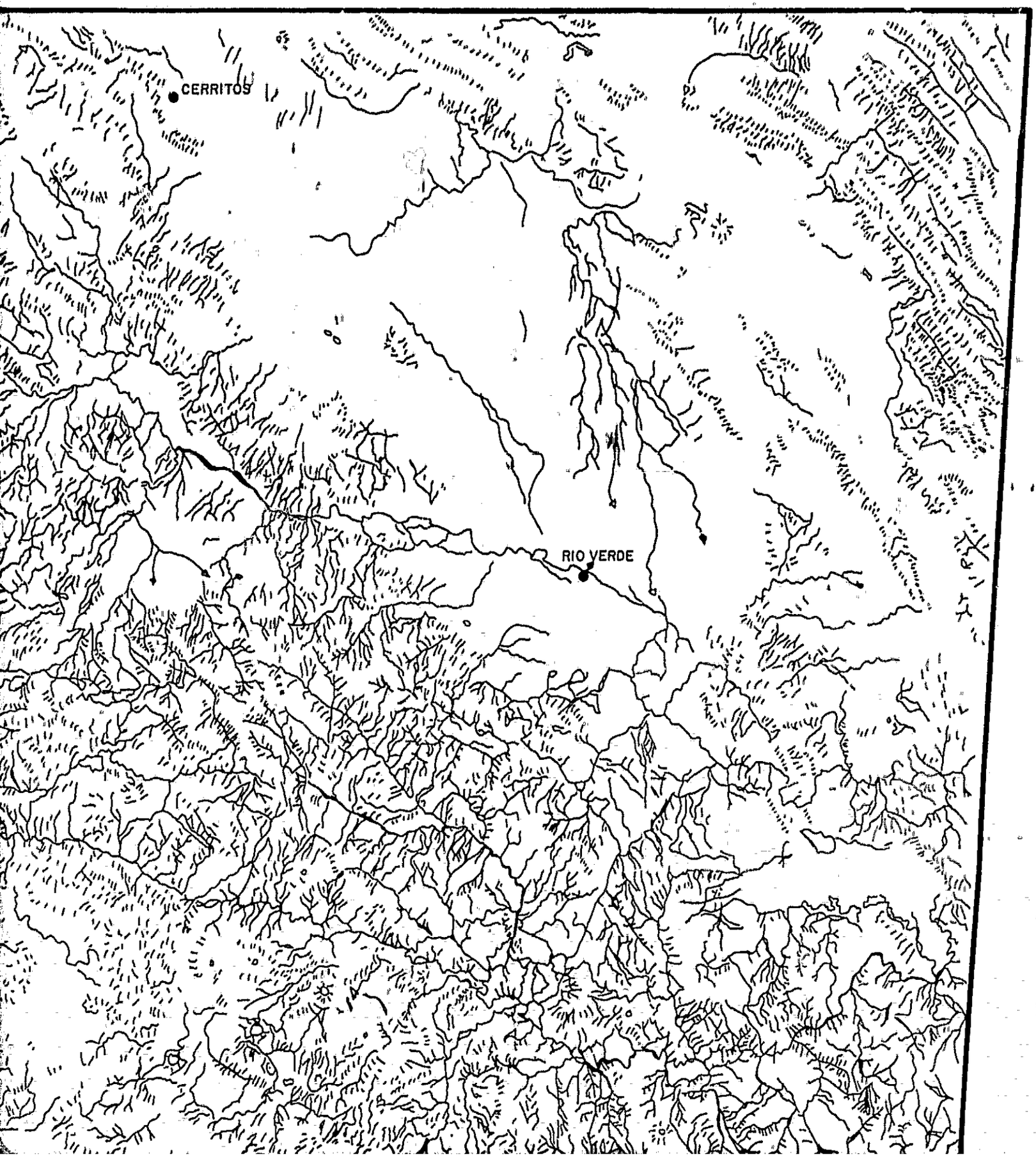

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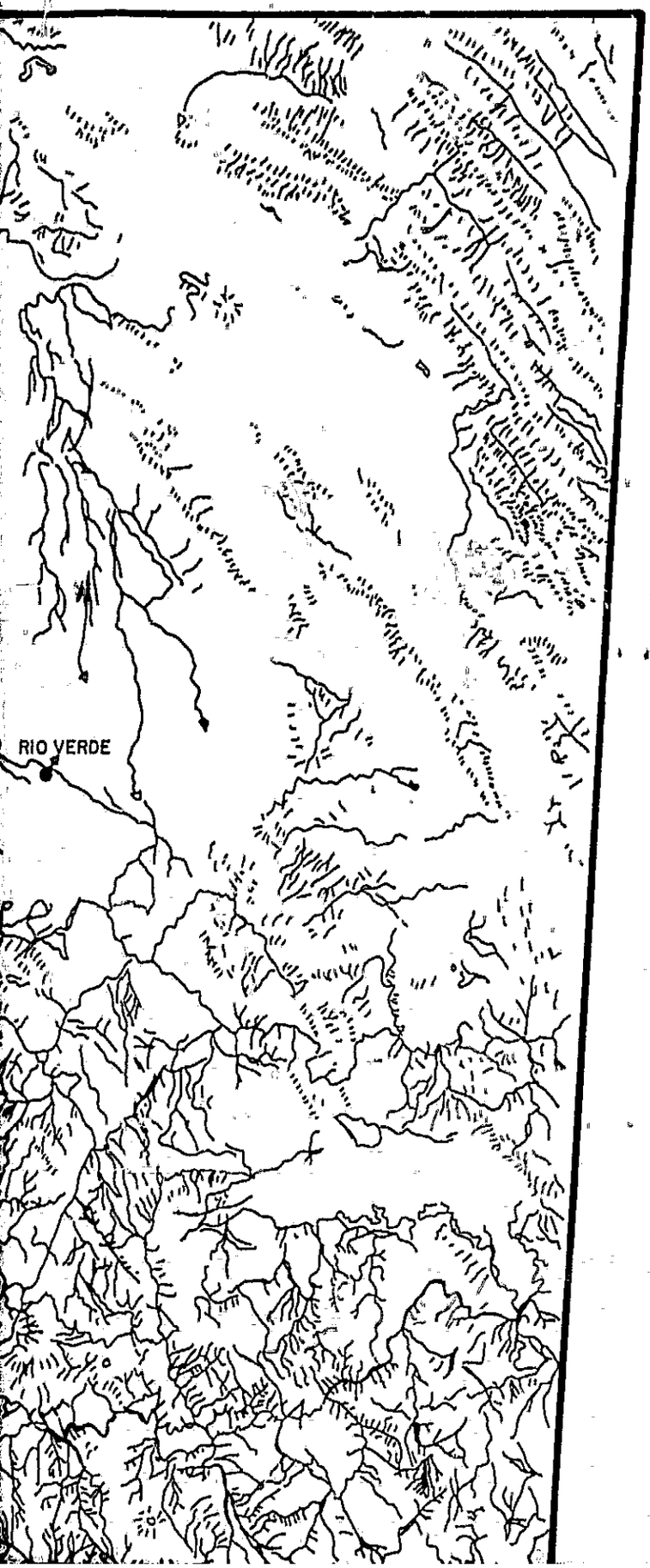

LEGEND

- Water bodies.
- Rivers.
- Creeks.
- Cultural features.

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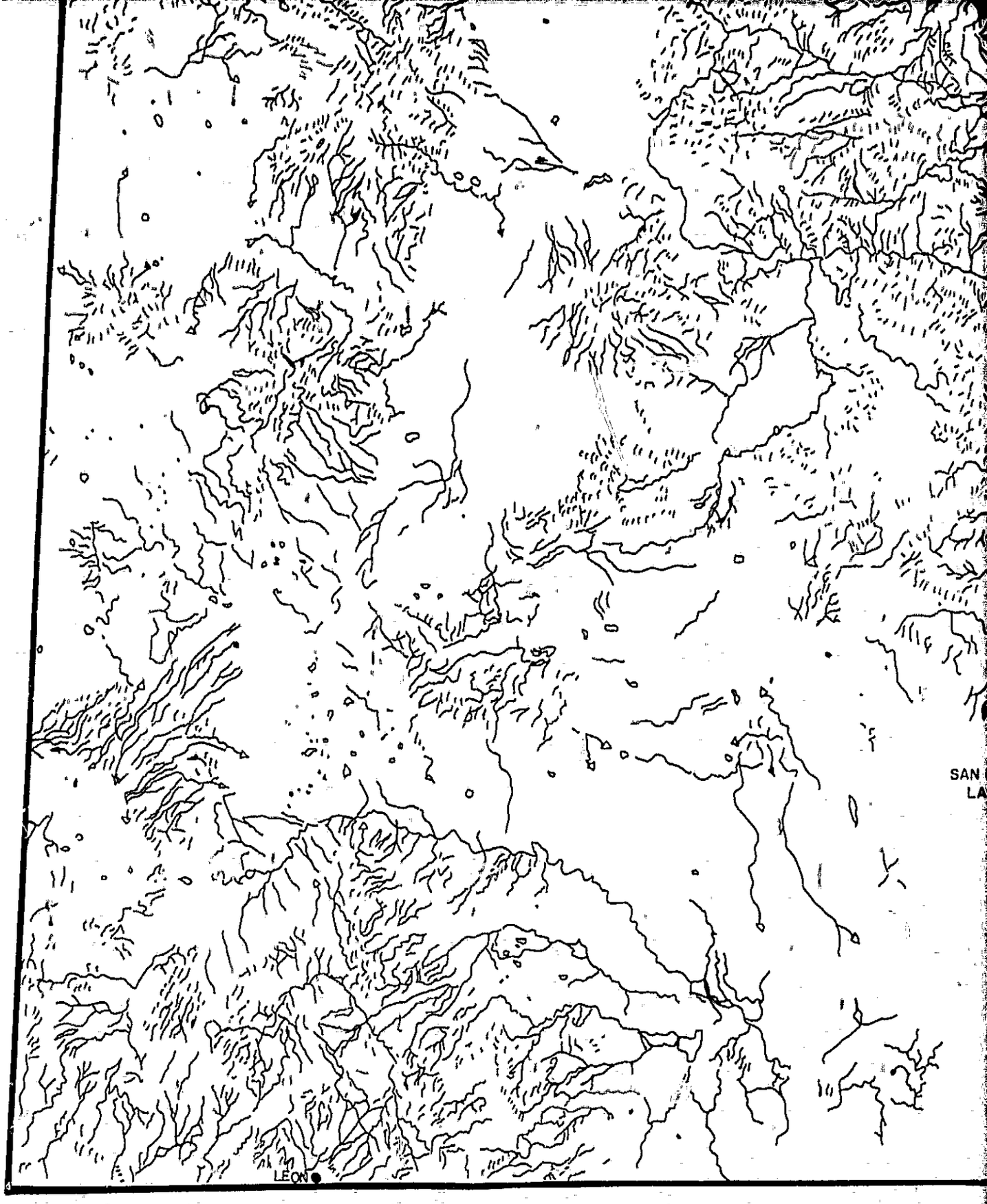

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DRAINAGE MO

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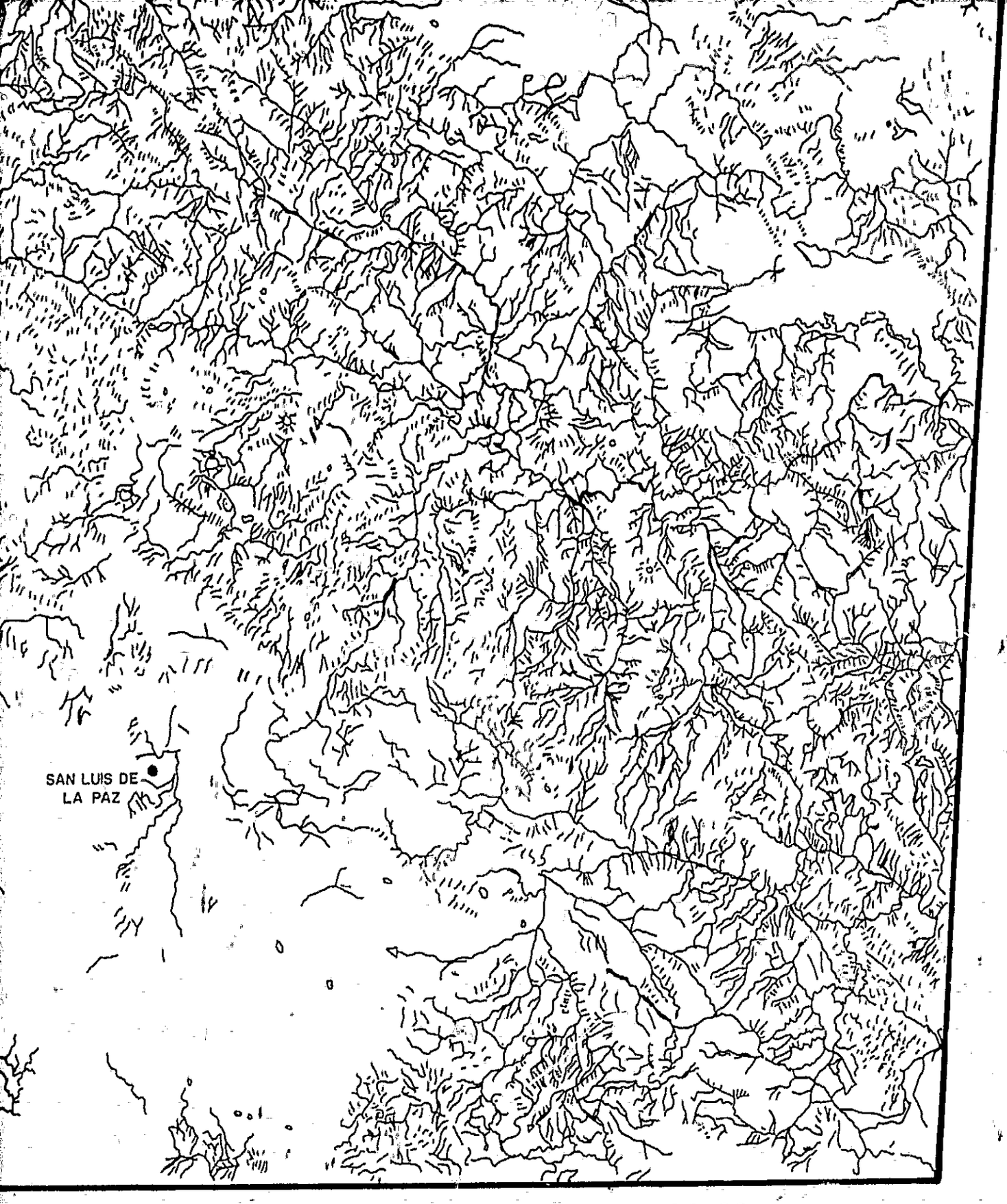

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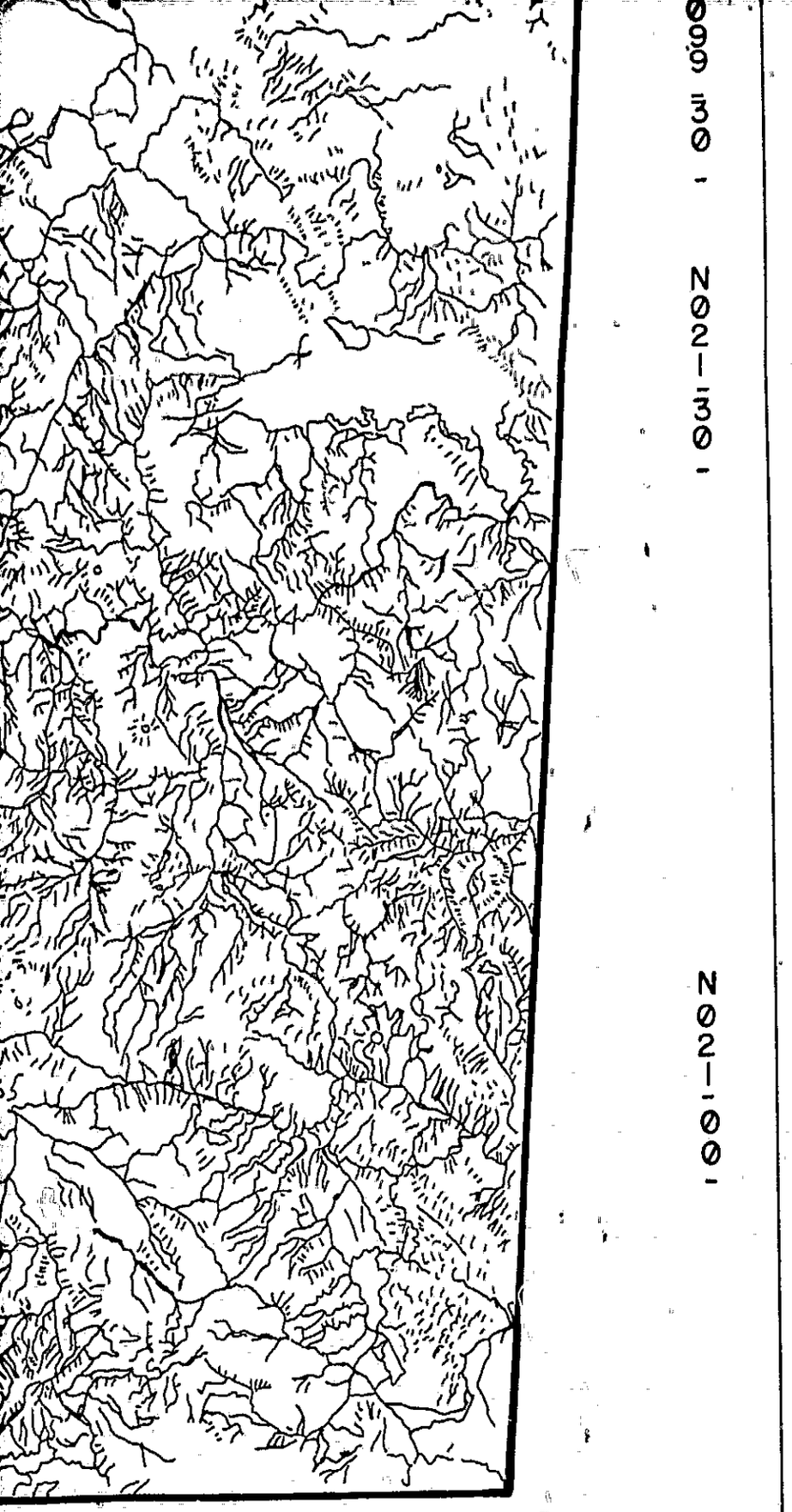

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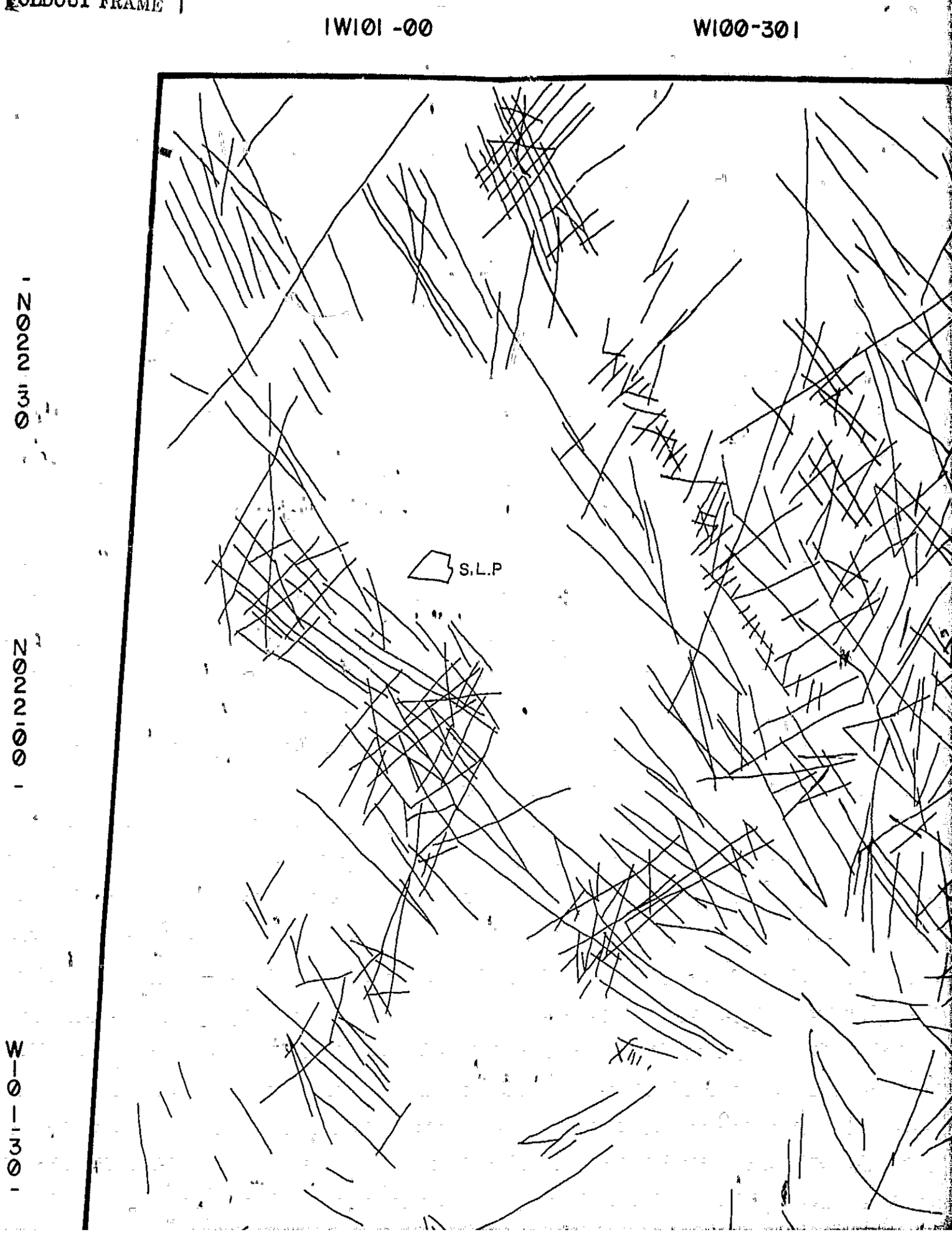

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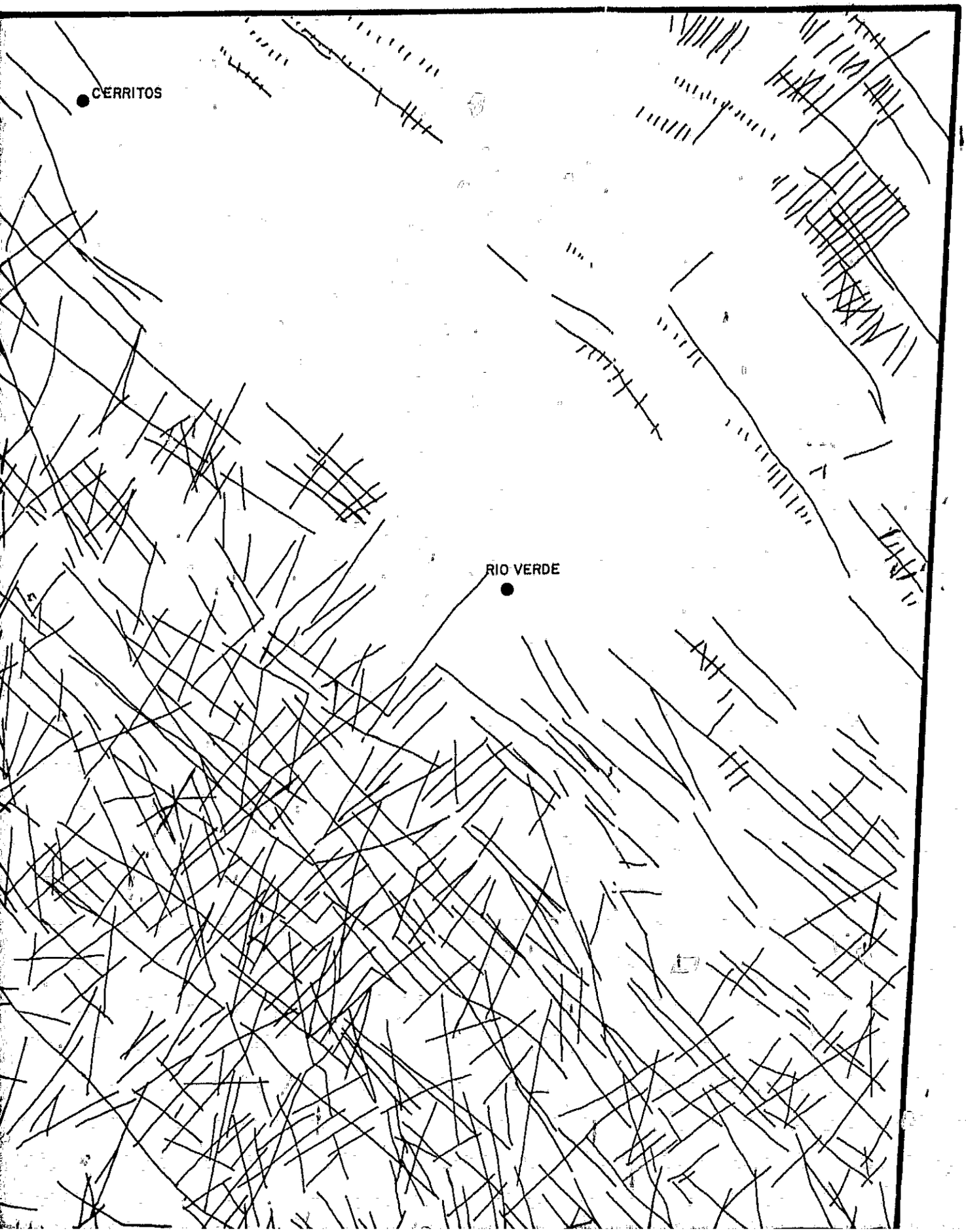

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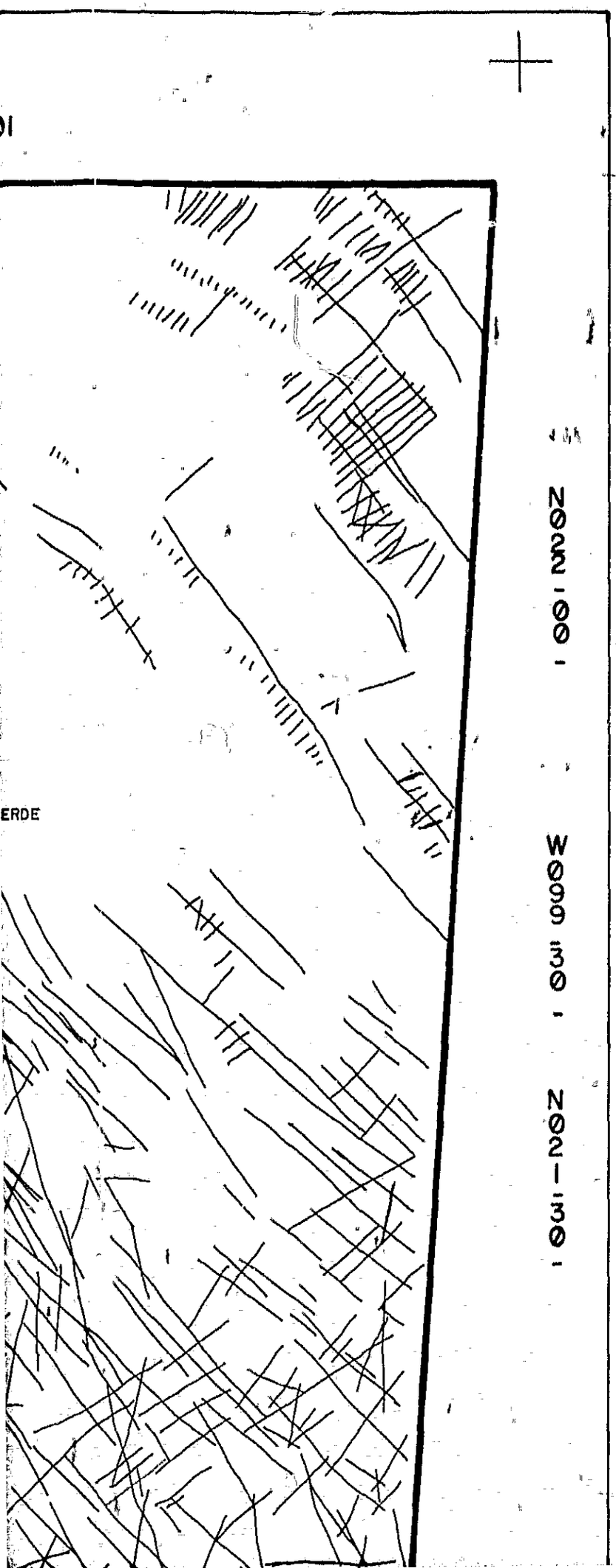
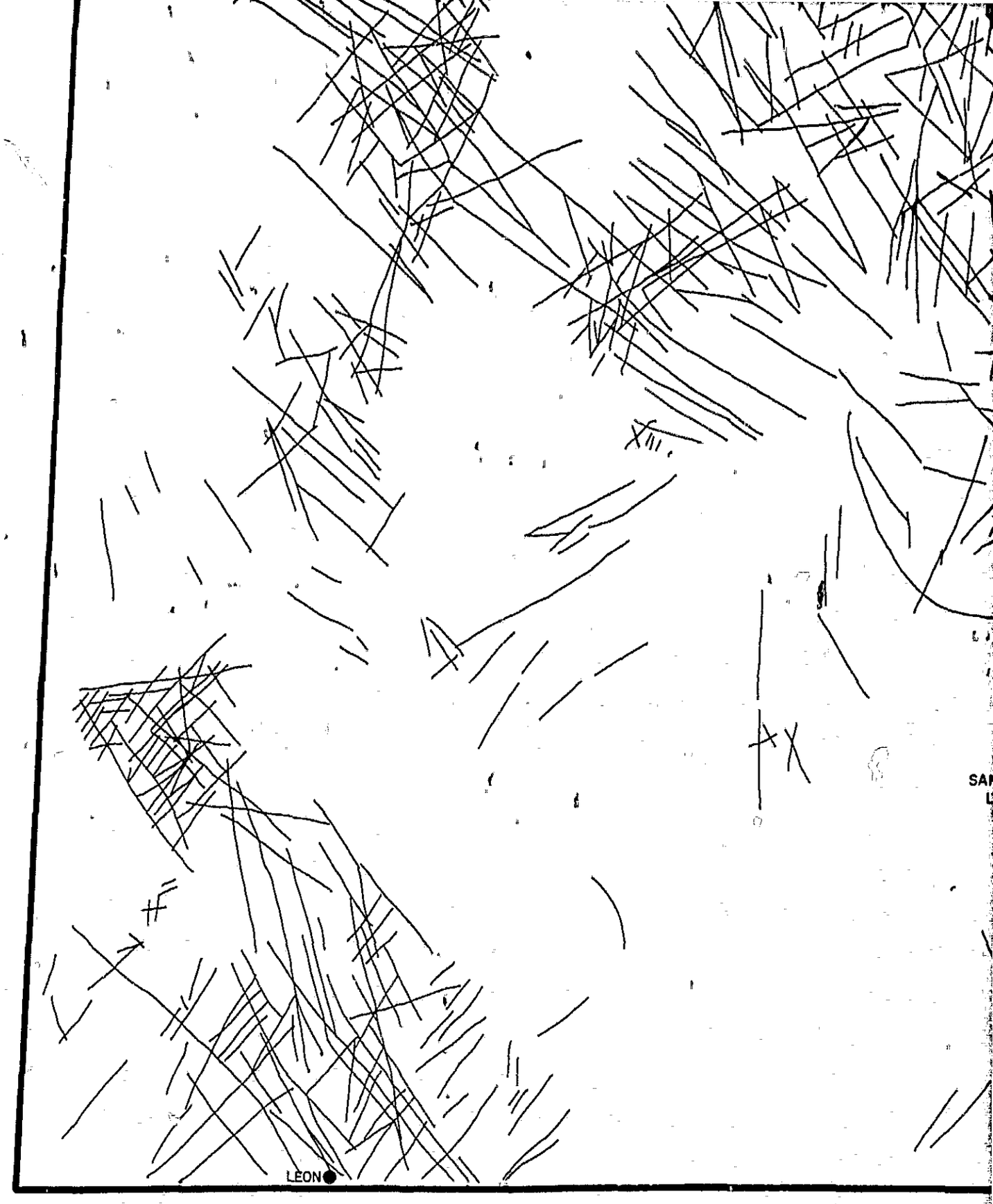


LEGEND

- Dominant Tectonic Features.
- Secondary Tectonic Features.
- Tectonic Complex.
- Lineament Intersections. (faults, fractures, etc.)
- Cultural Features.



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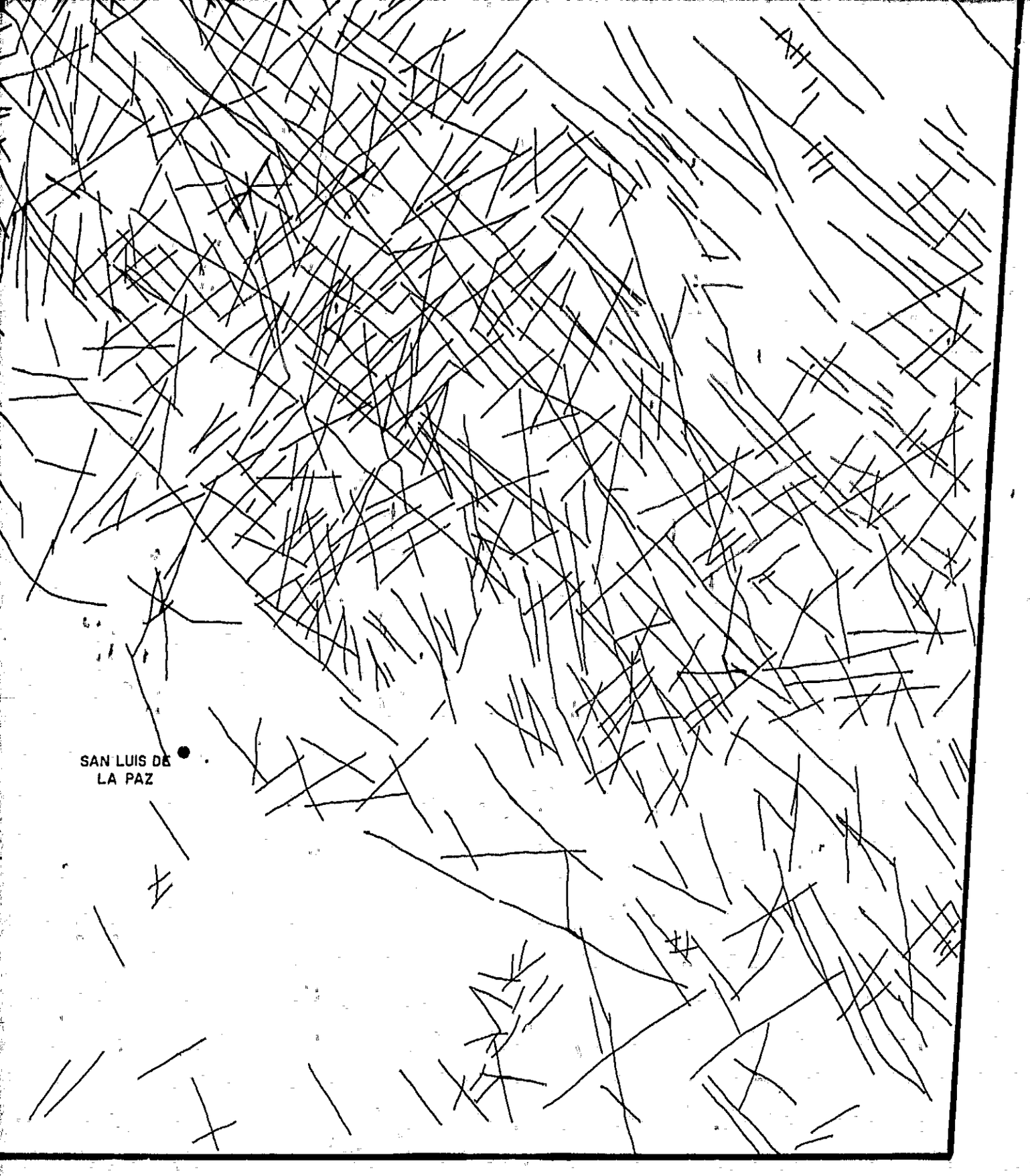

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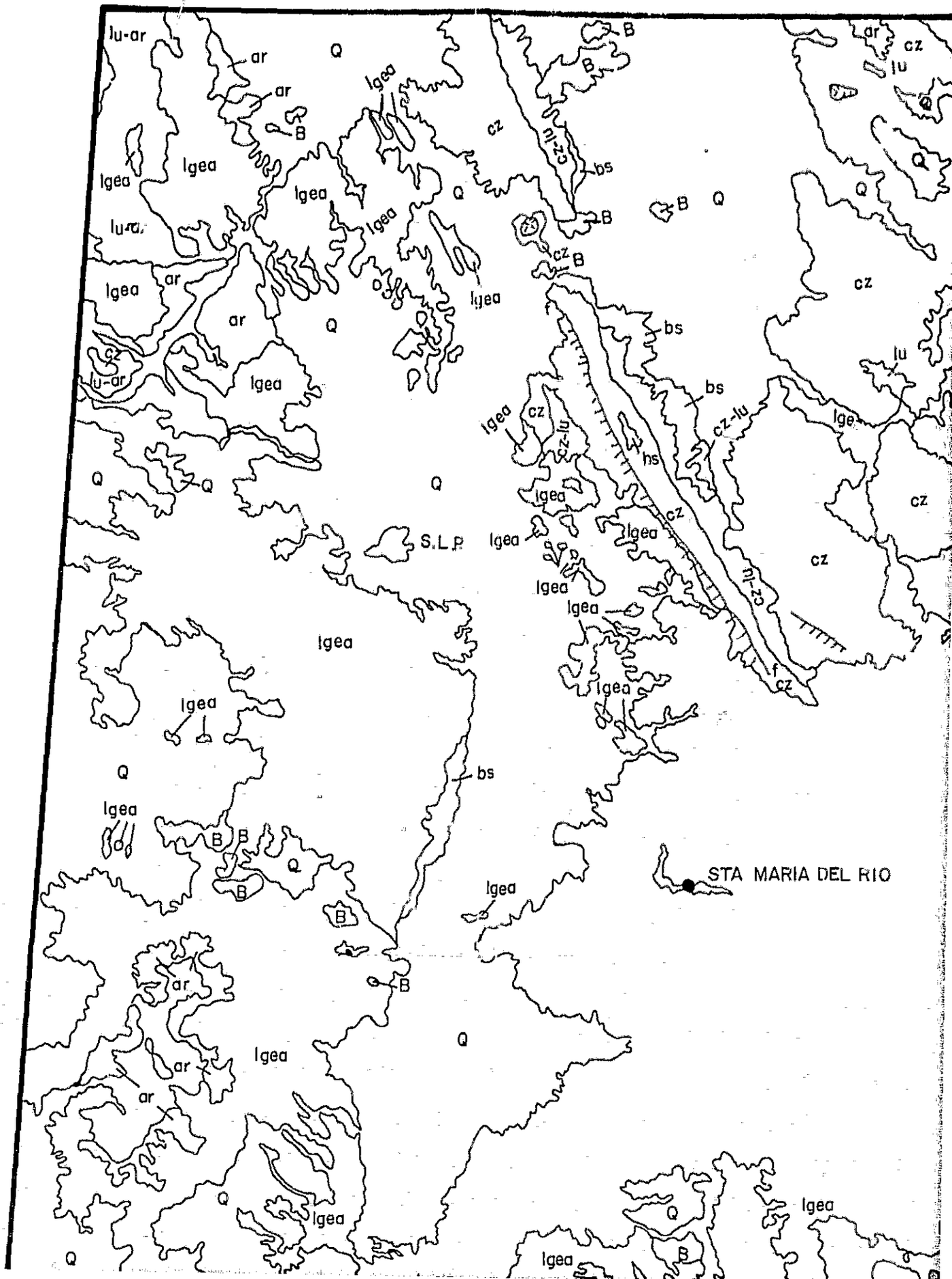

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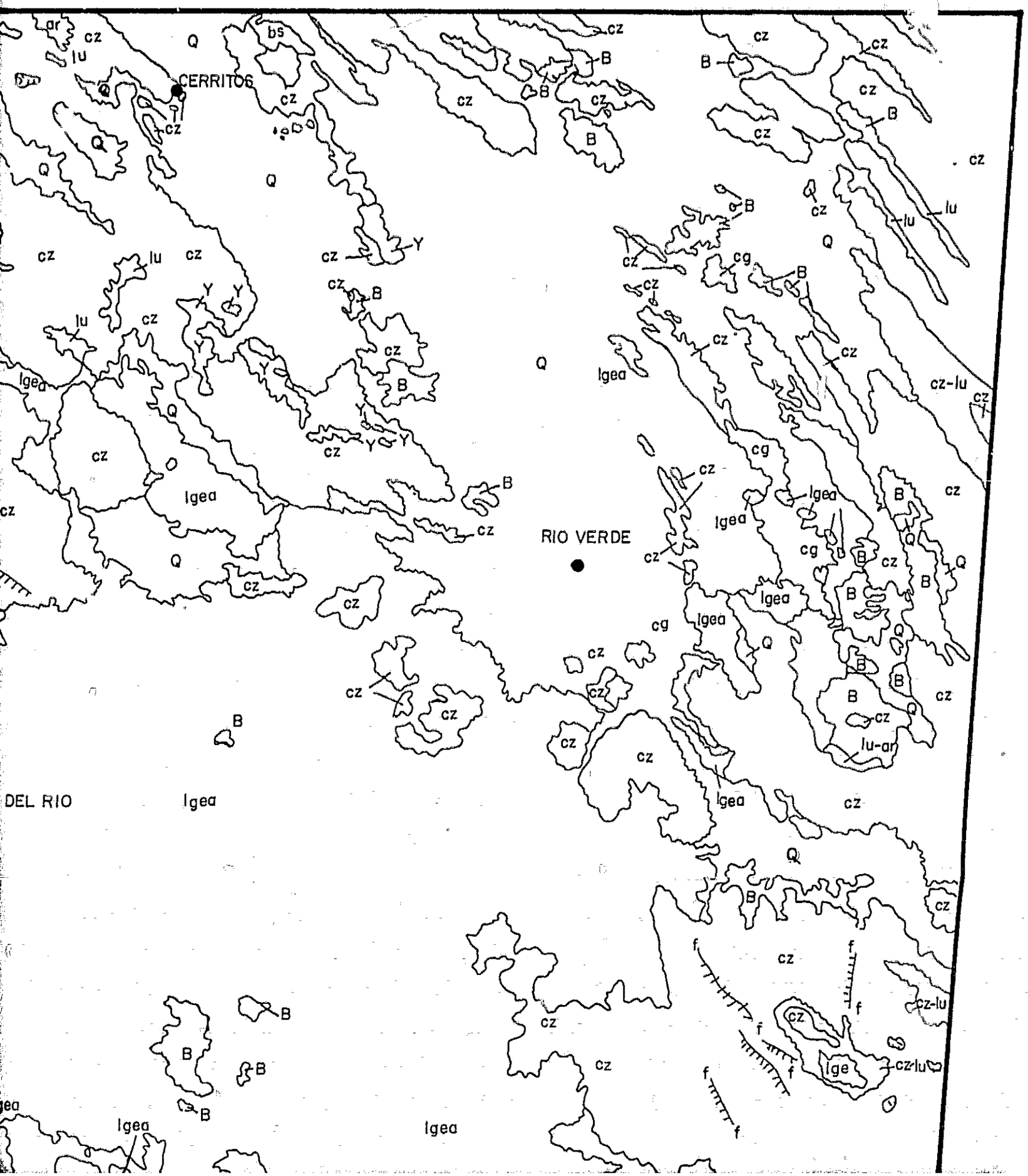
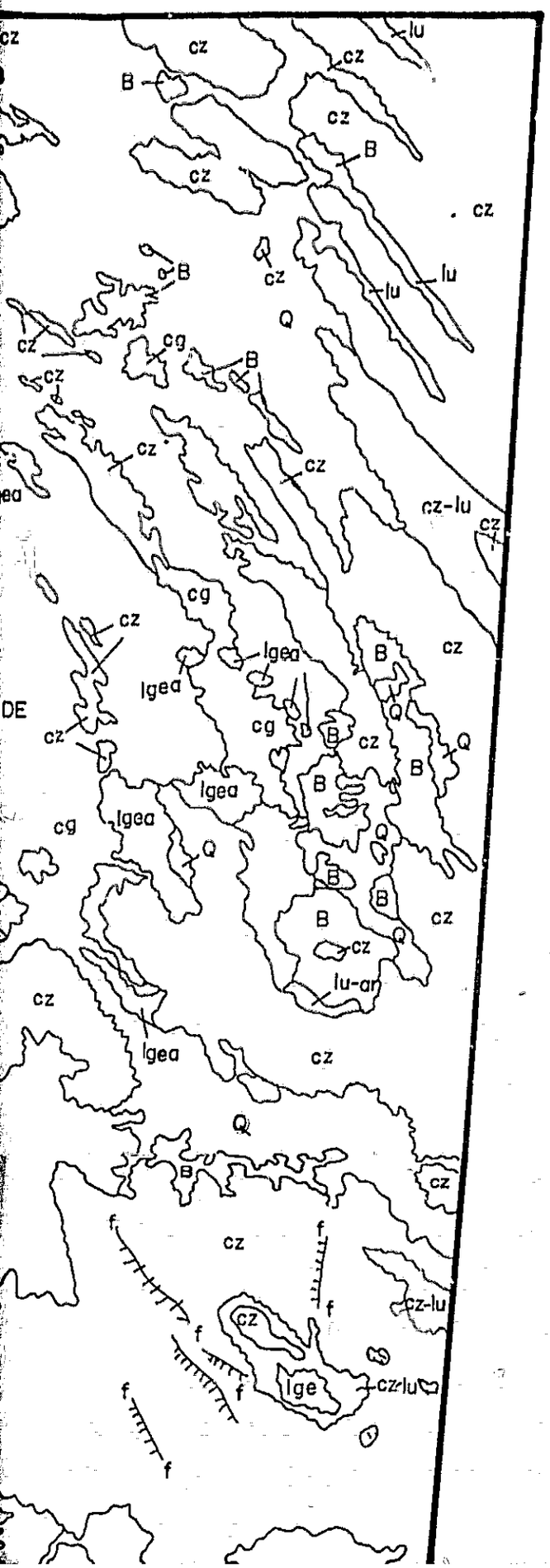




LEGEND

IGNEOUS ROCKS

lge	Extrusive.
lgea	Acid Extrusive.
B	Basalt.

SEDIMENTARY ROCKS

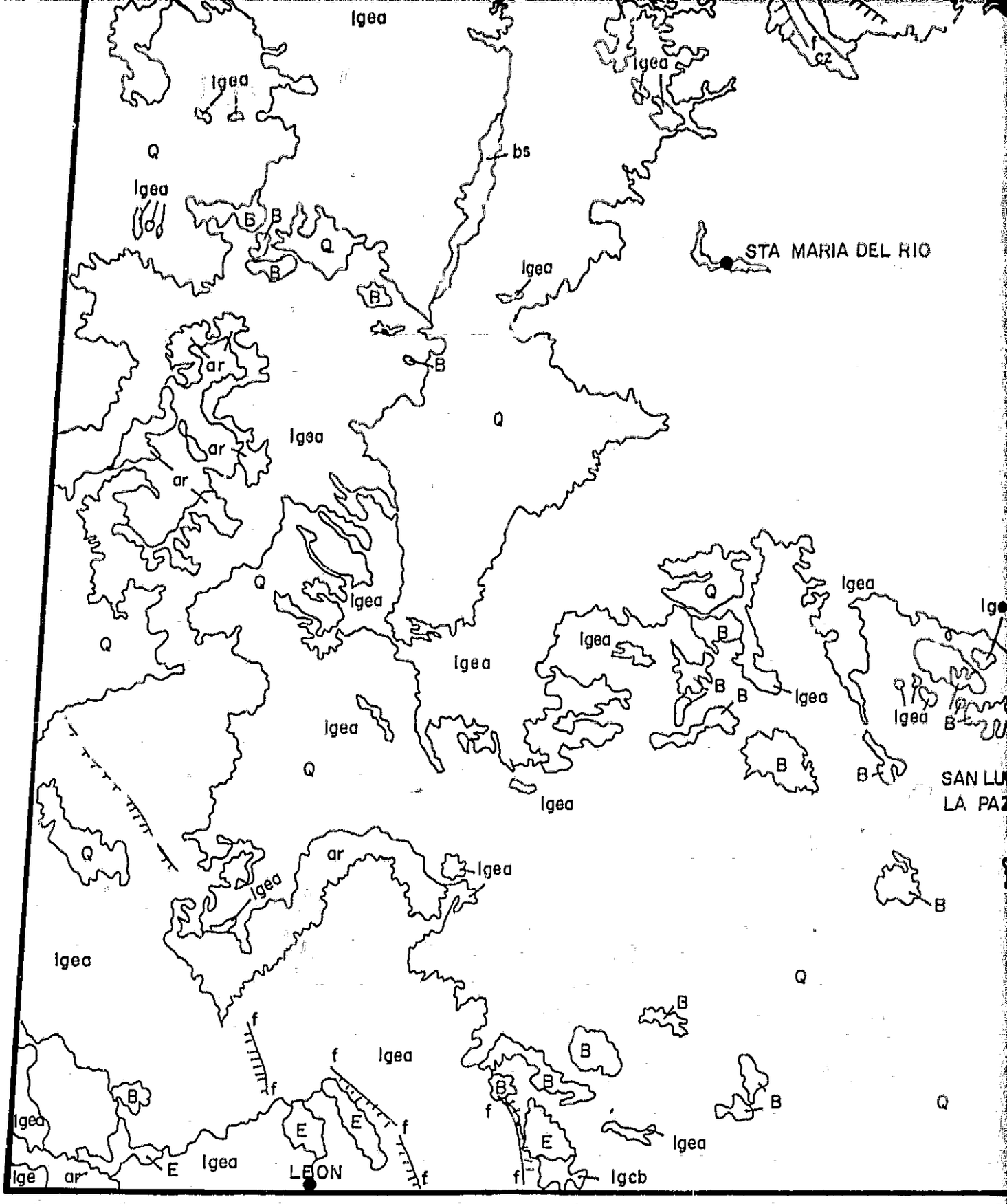
cz	Limestone.
cz-lu	Limestone and Shale.
lu	Shale and Marl.
lu-ar	Shale and Sandstone.
ar	Sandstone.
Y	Gypsum.
bs	Breccia.
cg	Conglomerate.

SOILS

Q	Alluvium, Residual, Materials, Lake Deposits, River Gravel, Sands and Silt.

METAMORPHIC ROCKS

E	Schist.
f——f	Normal Fault.
——	Geological Contact.
——	Fracture.



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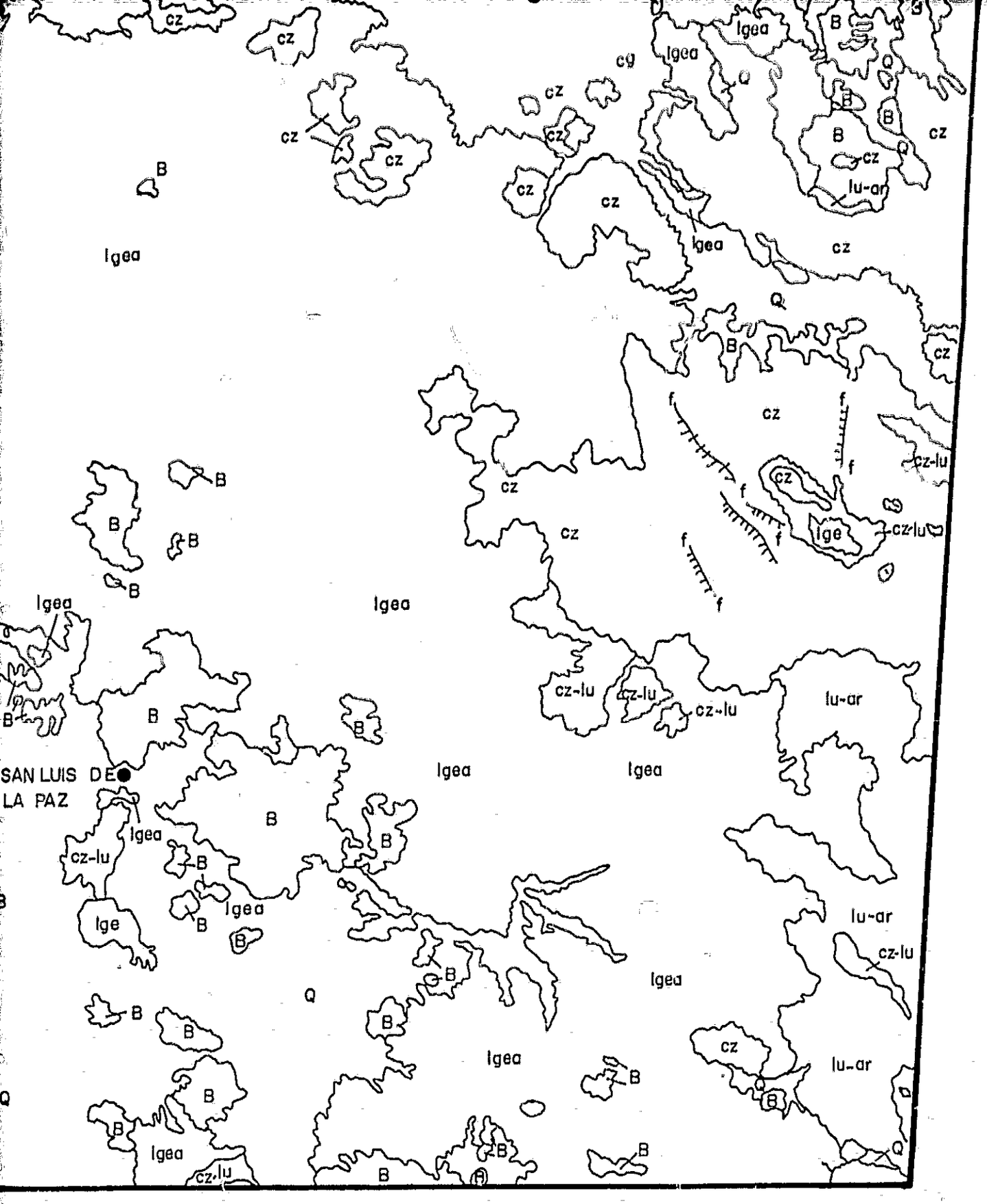

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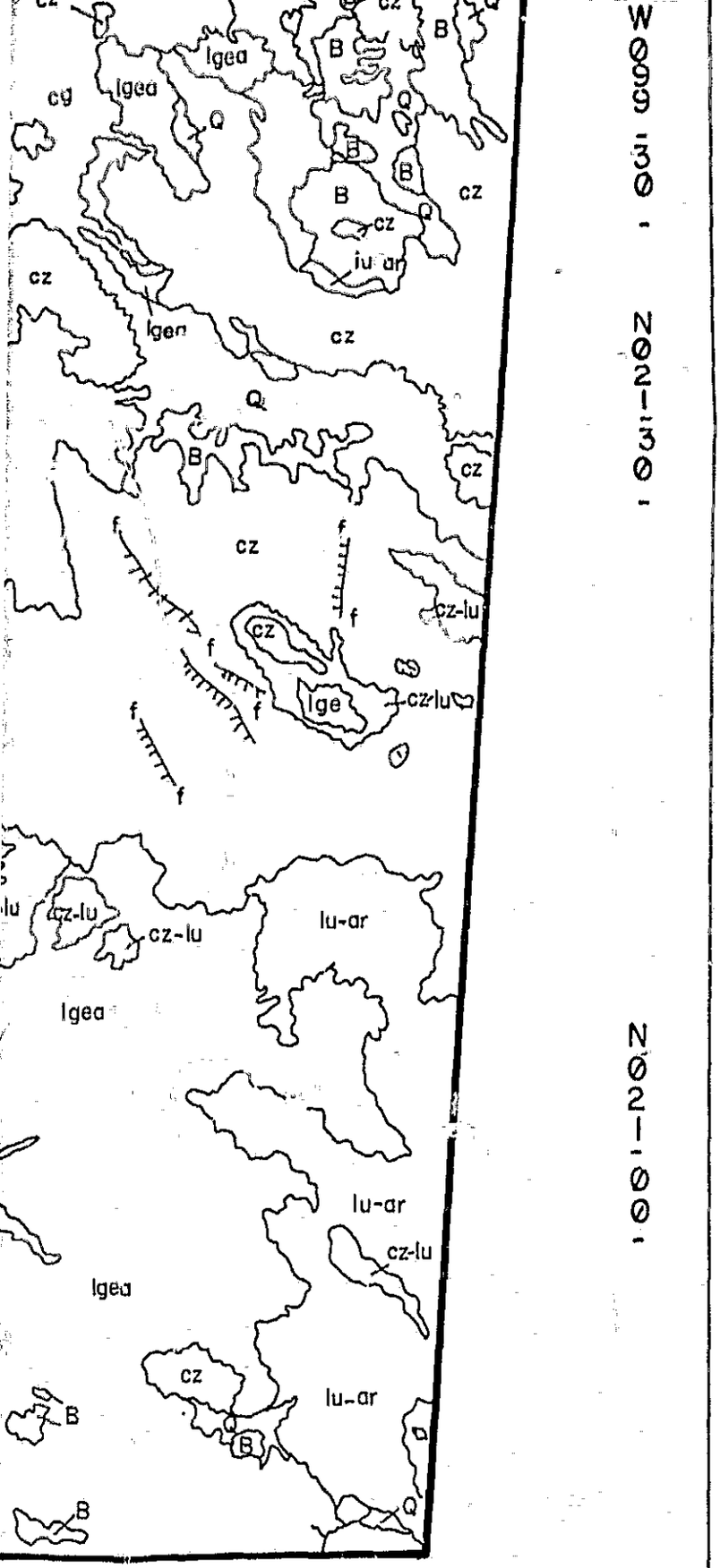

Y Gypsum.

bs Breccia.

cg Conglomerate.

SOILS.

Q Alluvium, Residual, Materials, Lake Deposits, River Gravel, Sands and Silt.

METAMORPHIC ROCKS

E Schist.

f——f Normal Fault.

—— Geological Contact.

/ Fracture.

• ⊔ Cultural Features.

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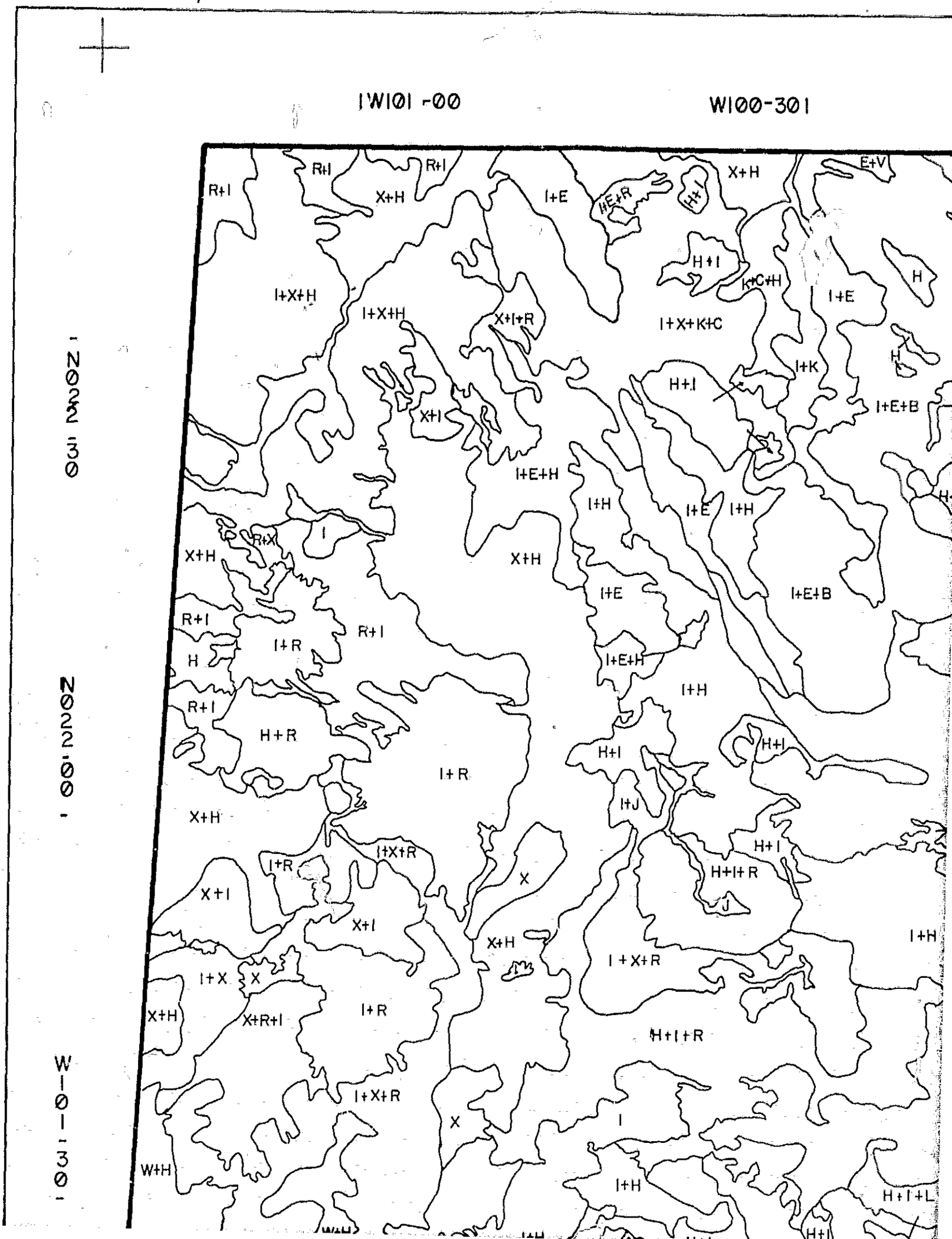

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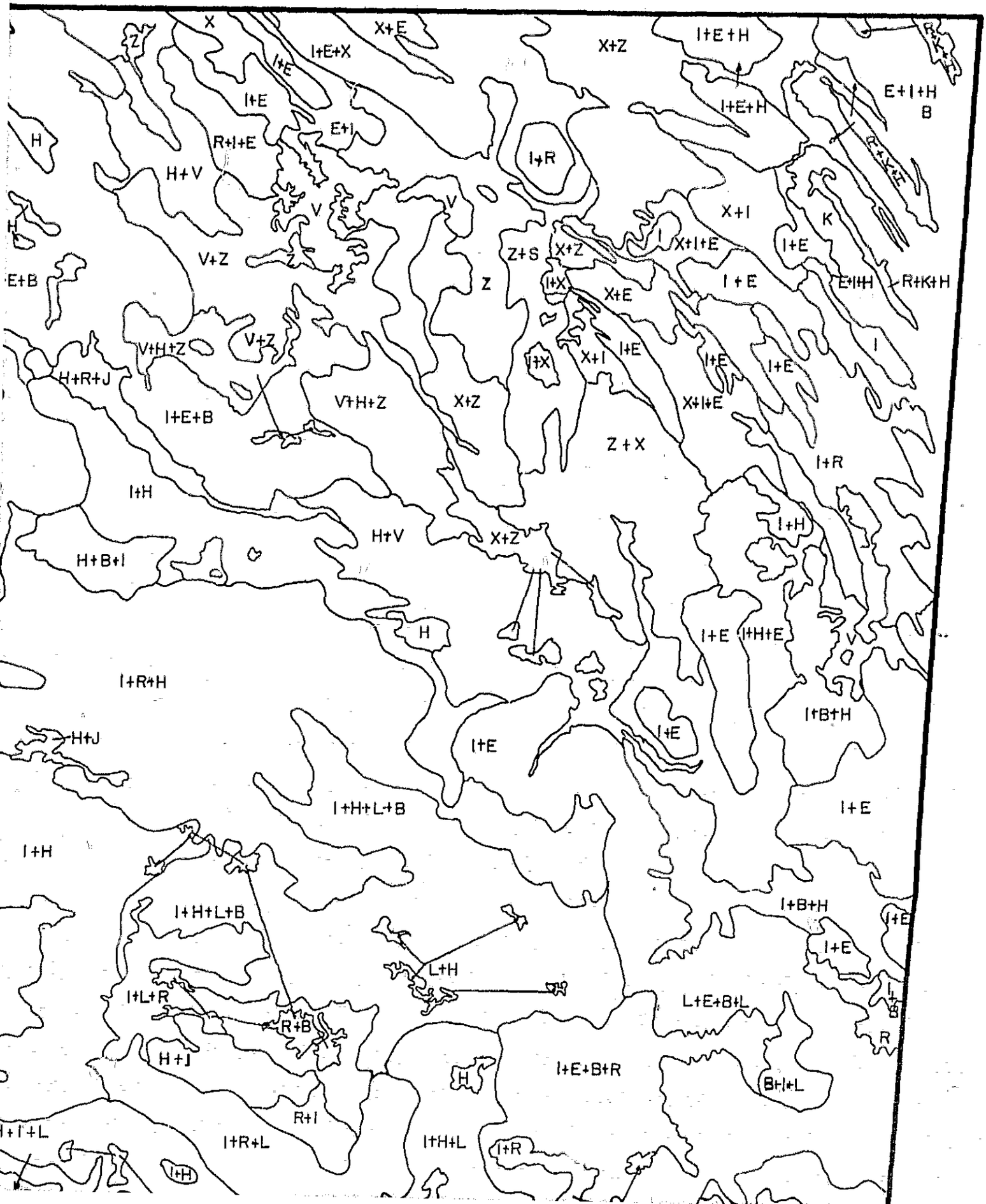

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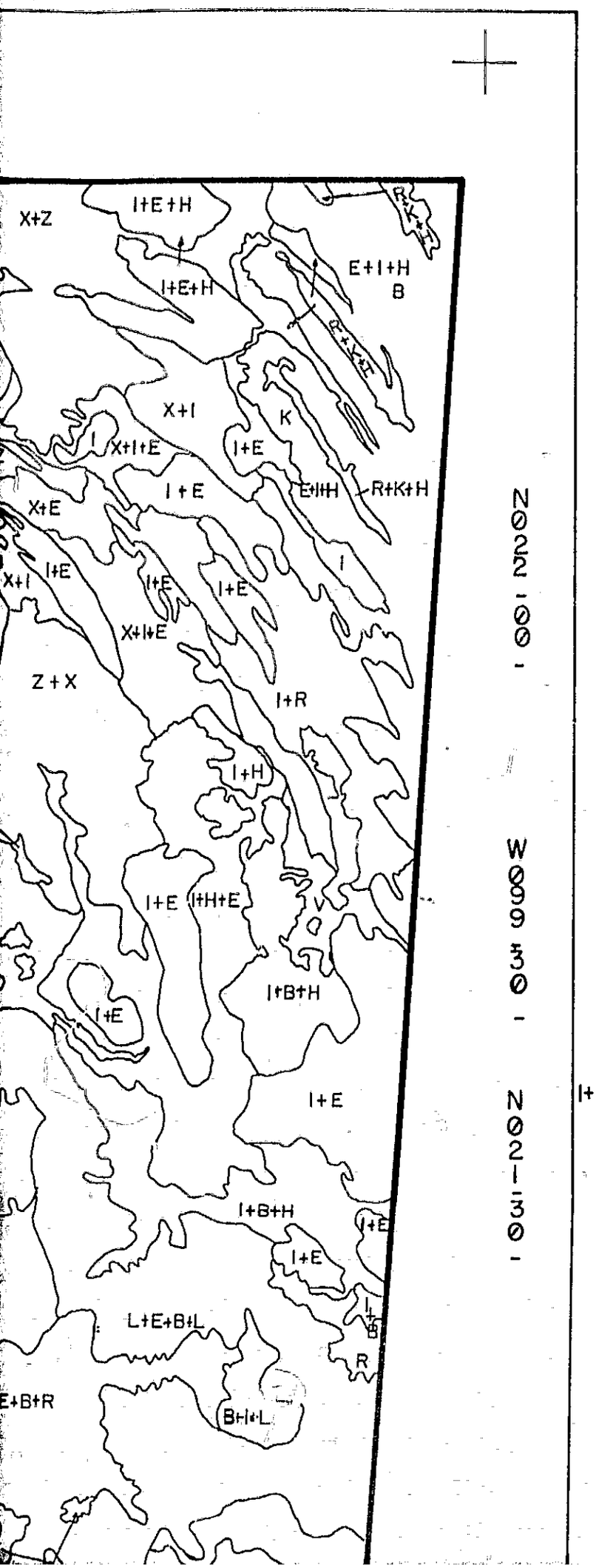
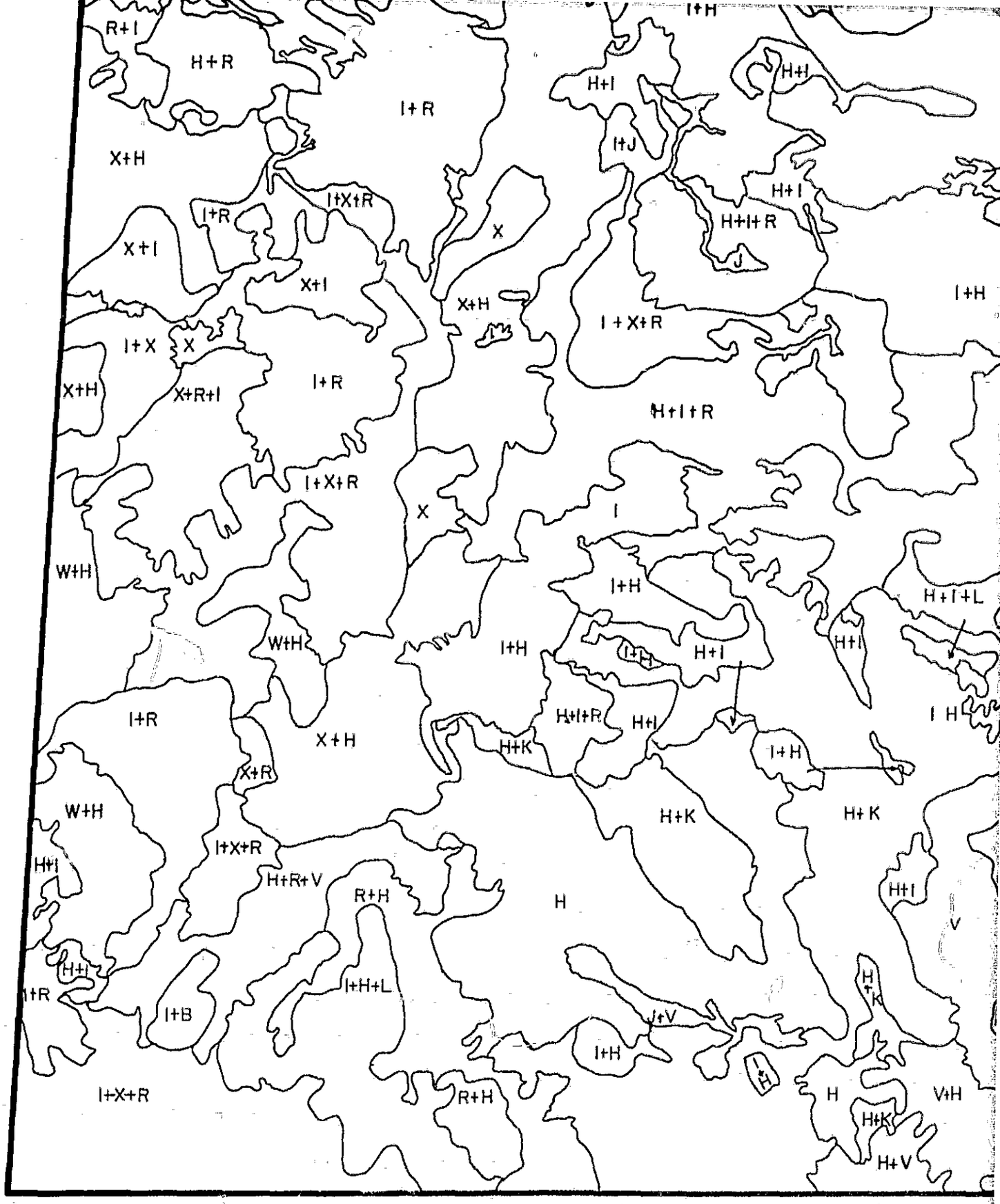


LEGEND

V	Vertisol.
I	Litosol.
J	Fluvisol.
Z	Solonchak.
W	Planosol.
Y	Yemosol
S	Solonetz.
R	Regosol.
C	Chemozem.
K	Castoñozem.
X	Xerosol.
E	Rendzina
B	Cambisol.
H	Phaeozem.

I+R+B Dominant soil + Secondary soil + Tertiary soil.



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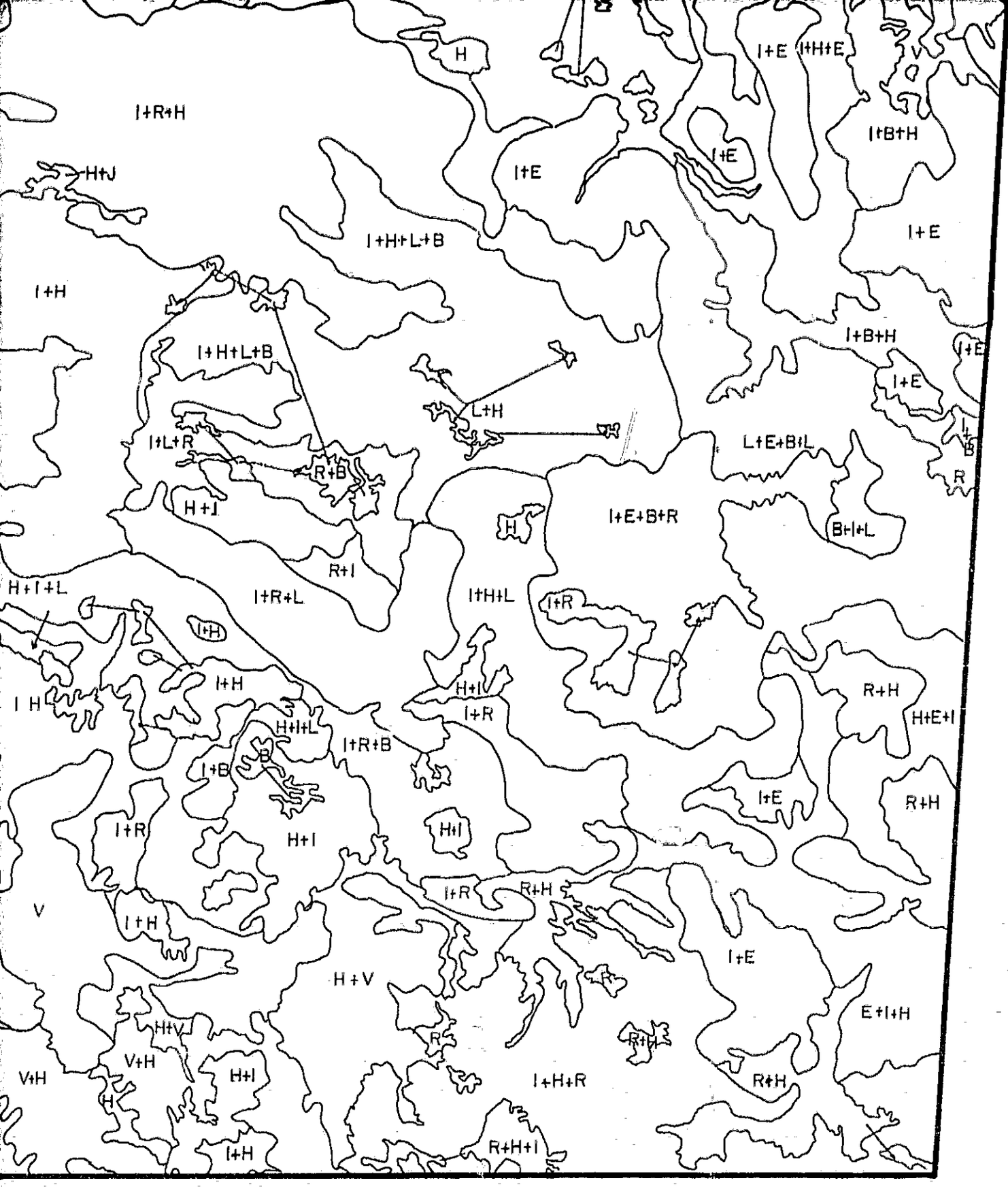

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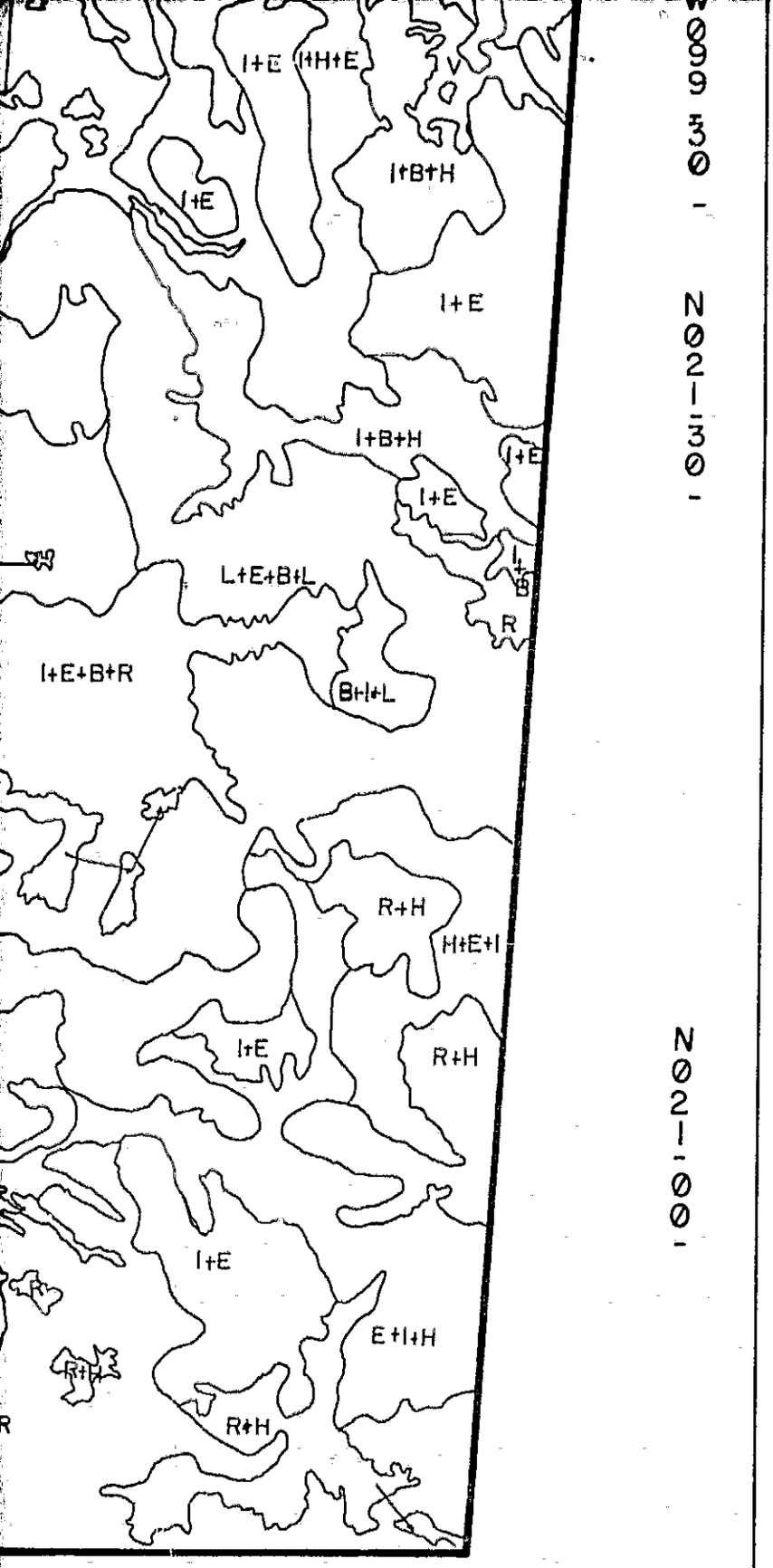

X	Xerosol.
E	Rendzina
B	Cambisol.
H	Phaeozem.

I+R+B Dominant soil + Secondary soil + Tertiary soil.

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