UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOCHEMICAL PROSPECTING FOR ZINC, LEAD, COPPER, AND SILVER, LANCASTER VALLEY, SOUTHEASTERN PENNSYLVANIA

By

Jacob Freedman 1911-

(Reproducibles are with author at Franklin and Marshall College, Lancaster, Penna.)

1968

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ILLUSTRATIONS

Geochemical prospecting for zinc, lead, copper, and silver, Lancaster Valley, southeastern Pennsylvania

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Introduction

Zinc, lead and copper anomalous patterns occur in the soils, rocks, and stream sediments in the vicinity of two old mines and a prospect in the Lancaster Valley, southeastern Pennsylvania. The latter has the maturely dissected rolling terrane of the Piedmont Province, is underlain dominantly by carbonates disrupted by imbricate thrusting and folded into Alpine-like nappes. The poorly exposed rocks in the heavily farmed area are early Paleozoic in age, with local Triassic sedimentary rocks and intrusive diabasic dikes.

Bamford zinc mine

The Bamford area is underlain by Cambrian undifferentiated Chickies-Antietam-Harpers formation, Vintage Dolomite, Kinzers shale and limestone and Ledger Dolomite. These have been thrust northward, folded into a major anticline plunging east and numerous minor folds asymmetric to the north, and further disrupted by high angle faults.

Sphalerite, the dominant mineral, and galena have been oxidized in the shallow zone to smithsonite, hemimorphite, cerussite, anglesite, and aurichalcite (?). These minerals occur in two known and possible other fill-breccias in steeply dipping beds 12 and 14-18 feet thick, averaging 12 percent sphalerite, and in a number of prospects. Anomalous values of soils, rocks and stream sediments range to 30,000 ppm zinc, and 1,000 ppm each of lead and copper. The geochemical dispersion pattern is similar to that of plunging folds suggesting stratigraphic control of ore deposition and extends for 35,000 linear feet with anomalous values at or above 300 ppm Zn, and 13,000 linear feet, at or above 500 ppm Zn. With a threshold of 50 ppm for lead, 219 (22.60 percent) values of 969 samples were equal to or higher than threshold. With a threshold of 50 ppm for copper, 29 (6.67 percent) values of 435 samples are equal to or greater than threshold.

A sample of sphalerite contained 420 ppm Ag equivalent to 12.264 oz. of Ag per ton. Past production has been stated as 357 tons of metallic zinc, but it is possible that as much as 5,000 tons of zinc was produced from over 60,000 tons of ore from depths down to 110 feet.

Pequea Silver Mine

The Pequea area is underlain by asymmetrical, gently doubly plunging folds of the Cambrian Antietam quartzite and schist, the Vintage dolomite, and the Ordovician (?) Conestoga Formation. The basal black carbonaceous phyllite of the Conestoga Formation either disconformably overlies or is a deeper sea facies of the Vintage Formation. The yield by flowage of the former acted as a barrier to solutions in fractures of the latter, which responded to deformation in a brittle manner. Quartz veins with dominantly galena, some chalcopyrite and sphalerite filled fractures and bedding planes. The minerals were oxidized near the surface to cerussite, anglesite, calamine, aurichalcite (?) and vauquelinite (?).

The geochemical distribution pattern in the Pequea area is characterized by isolated anomalous areas. An area in the vicinity of the Pequea silver mine about 7,000' by 5,000' is the largest of the few anomalies that seem to have areal extent. Values range up to 1,700 ppm Pb and 860 ppm Zn in this dominantly lead area. Although thresholds based on frequency curves were chosen at 80 ppm Pb and 150 ppm Zn, contours on geochemical maps nearest these values are 100 ppm Pb and 200 ppm Zn.

Previous studies have indicated as much as 250 ounces of Ag per ton. Two samples of pure galena from the Pequea silver mine gave values of 7,000 ppm Ag (168 oz./ton), and 20,000 ppm (600 oz./ton). Mining in the past proceeded only to a depth of about 75 feet , Past production and reserves can only be estimated.

The Gap Prospect

The Gap mineral prospect is one mile N. 10° E. of the junction of U. S. Route 30 and State Route 41 at Gap. A small, abandoned quarry in Vintage dolomite lies about 100 feet west of an unnamed stream flowing north to Pequea Creek. Satterthwaite and Wright (1958) noted the presence of sulfides. The rock is a white, fine-grained, crystalline dolomite with numerous very thin phyllitic layers composed of muscovite, biotite and locally chlorite. It weathers to a distinctive light or dark ivory hue. Sphalerite, galena, chalcopyrite and pyrite occur as scattered euhedral to subhedral grains to 0.1 to 0.2 mm. in diameter and veinlets to 5 mm. thick along the phyllitic cleavage planes. In both thin and polished sections, crystals have grown across the sheared, oriented micaceous minerals. This would imply that the metallic minerals were emplaced after the deformation that formed the cleavage.

The geologic map is by Curran and Gucwa (1967) and is based on distinctive lithologic units. It contrasts with the geologic maps of Jonas and Stose (1926) and Satterthwaite and Wright (1958). The geochemical map shows concentrations of zinc in parts per million. The values range from 42 to 4,230 ppm; two other anomalous values are 3,915 and 1,250 ppm. If the threshold for zinc is taken at 150 ppm, 28 or 18.7 percent of the 150 samples are anomalous. The average of all samples is 180 ppm; of all below threshold, 84.8 ppm; and of all anomalous values, 592.6 ppm.

Stratigraphy of the Gap Area

Triassic		Diabase dike	
CAMBRIAN	Ck	Kinzers Formation:	interbedded limestones and dolomite with local shale layers
	Cv	Vintage Formation:	Interbedded limestones and dolomite
		Vintage Formation:	light blue, fine-grained dolomite with some phyllitic layers
	Cvs	Vintage Formation:	sparkling white to dull, fine-grain[ed] dolomite with phyllitic layers and impregnated with sulfides
	Cvc	Vintage Formation:	quartz-biotite schist with local mineralization
	Ca	Antietam Formation:	Quartz-biotite schist

1 1/2 0 1 miles

Explanation

Xwc

Wissahickon schist

Oc

Conestoga limestone

€v

Vintage dolomite

€a

Antietam schist and quartzite, including Harpers shale

Triassic diabase

Ages are omitted because of uncertainties. The above sequence is listed as it appears in the field.

References Cited

Curran, Steven, and Gucwa, John, 1967, Geology of the Gap area Lancaster County, Pennsylvania, 51p., unpublished senior thesis, Franklin and Marshall College.

Jonas, A. I., and Stose, G. W., 1926, Geology and mineral resources of the New Holland quadrangle, Pennsylvania: Pennsylvania Geol. Survey, 4th Ser., Topog. and Geol. Atlas, no. 178, 40p.

Satterthwaite, W. B., and Wright, R. E., 1958, Geologic report of the Gap area as covered by air photo AHG-4D-171, 35p., unpublished senior thesis, Franklin and Marshall College.

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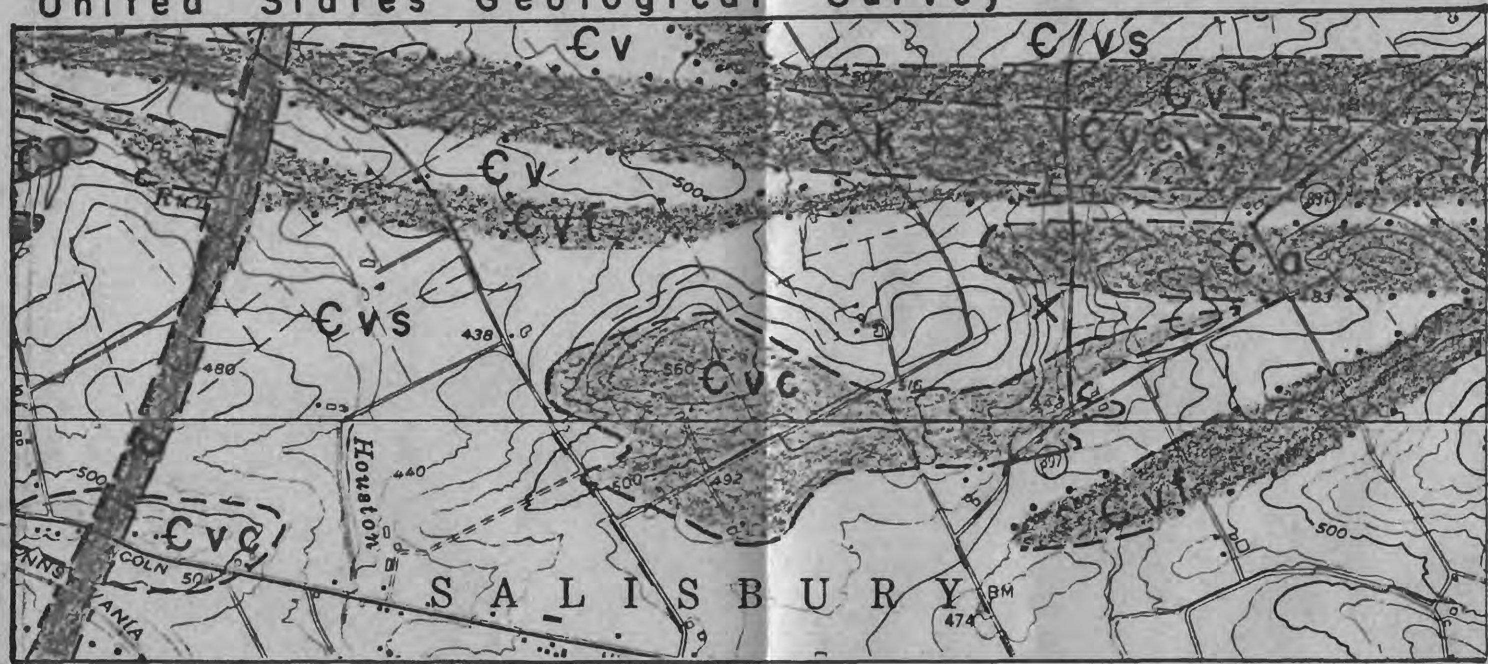

Geology by
S. Curran and J. Gucwa

1 1/2 0 1 miles

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Fig. 3a Geologic Map of the Gap Area, southeastern Penna.

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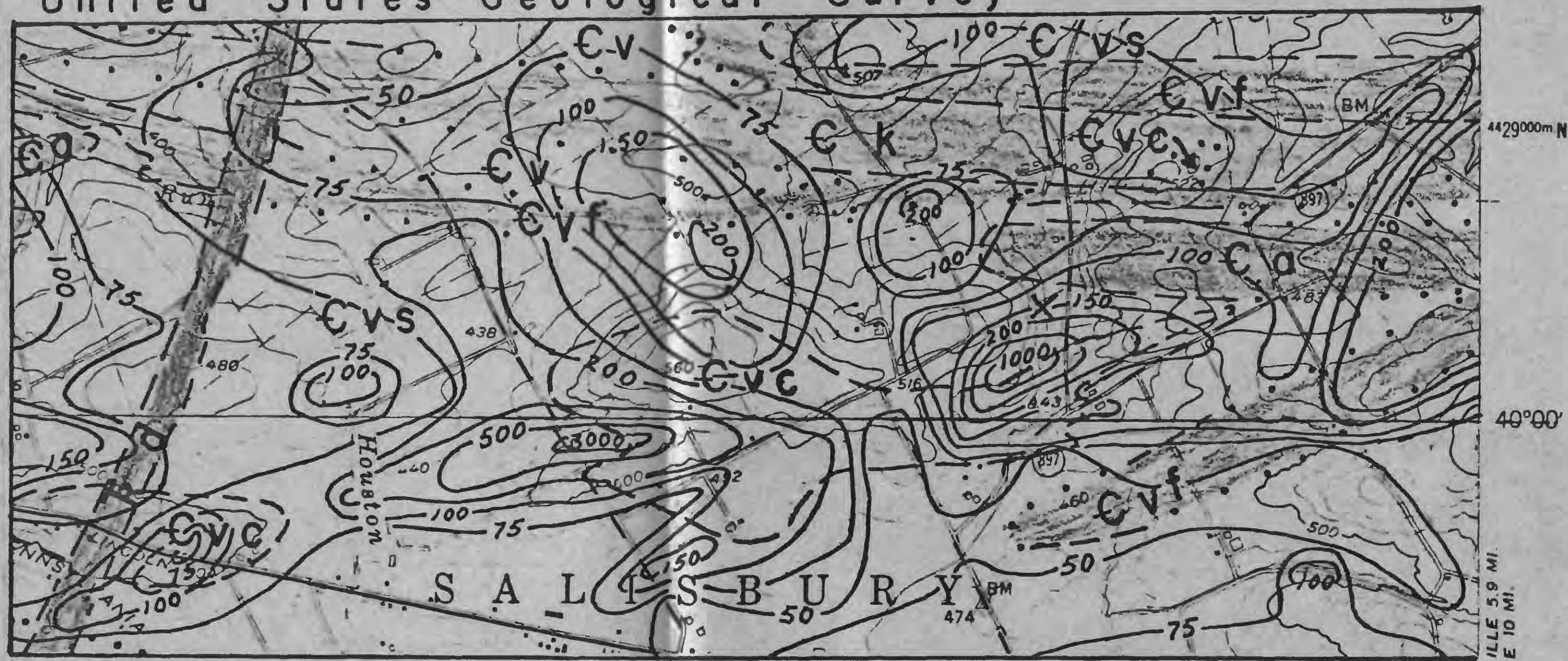

Geology by
S. Curran and J. Gucwa

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Fig. 3b. Geochemical Map for Zinc in the Gap Area
Contoured in PPM

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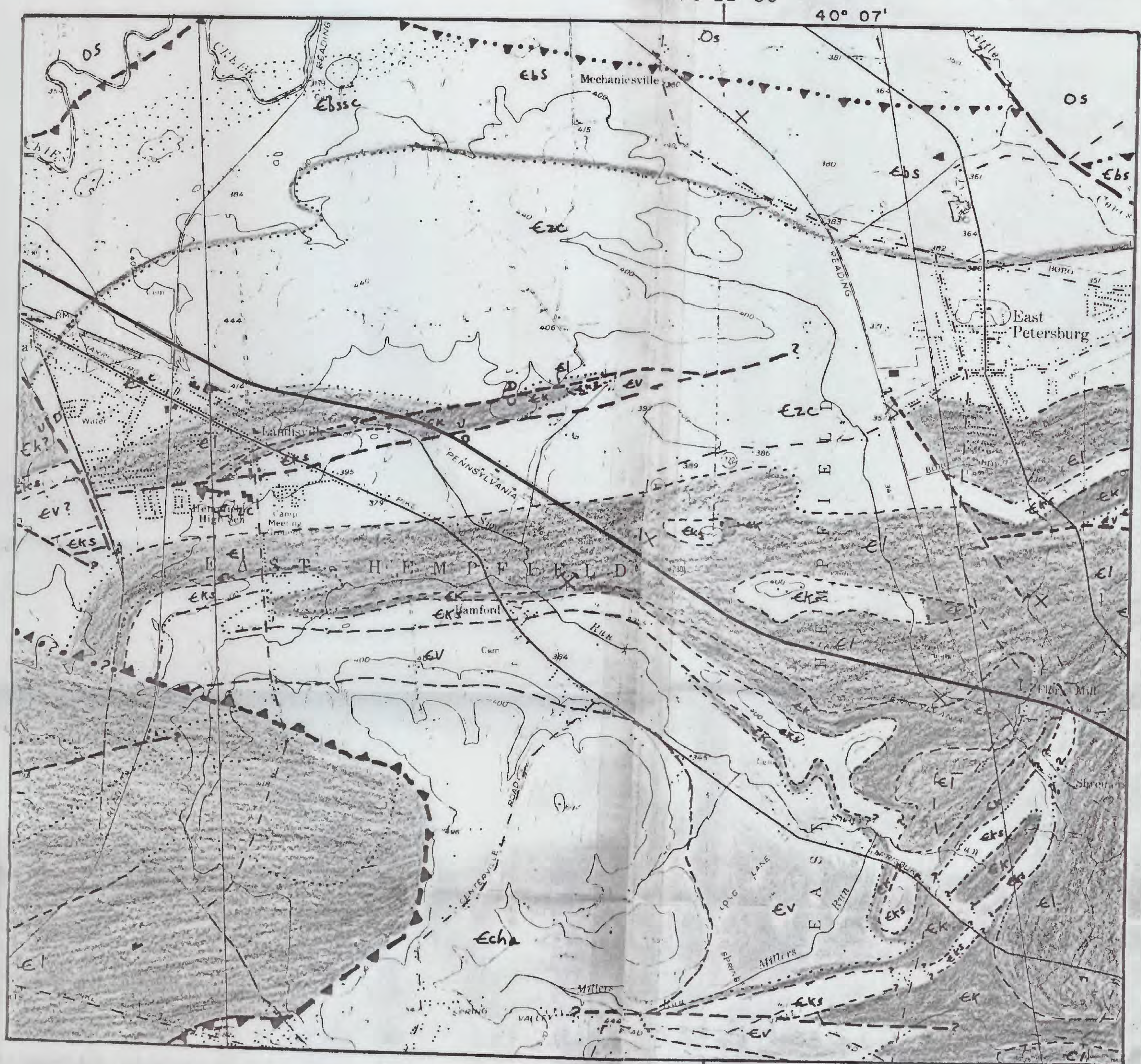

Scale 1:24,000

Fig. 1a Geologic Map of the Bamford Area, Pa.

Geology by H. Meisler & A.E. Becher

68-106

U.S. Geological Survey
OPEN FILE MAP 68-106
This map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

EXPLANATION

Os

STONEHENGE FORMATION

Gray limestone contains shaly laminae and fossiliferous calcavenite beds.

Ocs

CONESTOGA FORMATION

Gray, finely to coarsely crystalline limestone; schistose in part; limestone conglomerate near base

Conococheague Group

Єr

RICHLAND FORMATION

Gray, interbedded limestone and dolomite, contains beds of fine conglomerate and calcavenite.

Єm

MILLBACH FORMATION

White, pinkish-gray, and gray limestone, contains scattered laminae and interbeds of dolomite

Єbssc | Єsc | Єbs

BUFFALO SPRINGS and SNITZ CREEK FORMATIONS

Єsc - Snitz Creek - Gray, argillaceous, silty, and sandy dolomite.

Єbs - Buffalo Springs - White, pinkish-gray, and gray interbedded limestone and dolomite; scattered beds of sandstone.

Єbssc - Combined Buffalo Springs and Snitz Creek Formations where Snitz Creek lithology does not occur above the Buffalo Springs; stippled where argillaceous, silty and sandy dolomite lens occurs within the combined unit.

Єzc

ZOOKS CORNER FORMATION

Gray, very finely crystalline dolomite; commonly silty and sandy; contains some limestone; commonly cross-laminated and ripple-marked.

Єl

LEDGER FORMATION

Light-gray, coarsely crystalline, sparkling dolomite

Єks | Єk

KINZERS FORMATION

Єks - Gray, rusty weathering shale

Єk - Limestone commonly containing reticulated silty and argillaceous laminae; some dark-gray earthy dolomite.

Єv

VINTAGE FORMATION

Gray, very finely to coarsely crystalline dolomite

Єcha

CHICKIES, HARPERS, and ANTIETAM FORMATIONS

Quartzite, phyllite, slate and schist

CAMBRIAN

— — — ......

Contact

Dashed where inferred; dotted where concealed

— — U/D —

Inferred fault

U, upthrown side;

D, downthrown side

—▲—▲..▲..

Thrust fault

Sawteeth on upper plate

Dashed where inferred; dotted where concealed

Fig. 1a1

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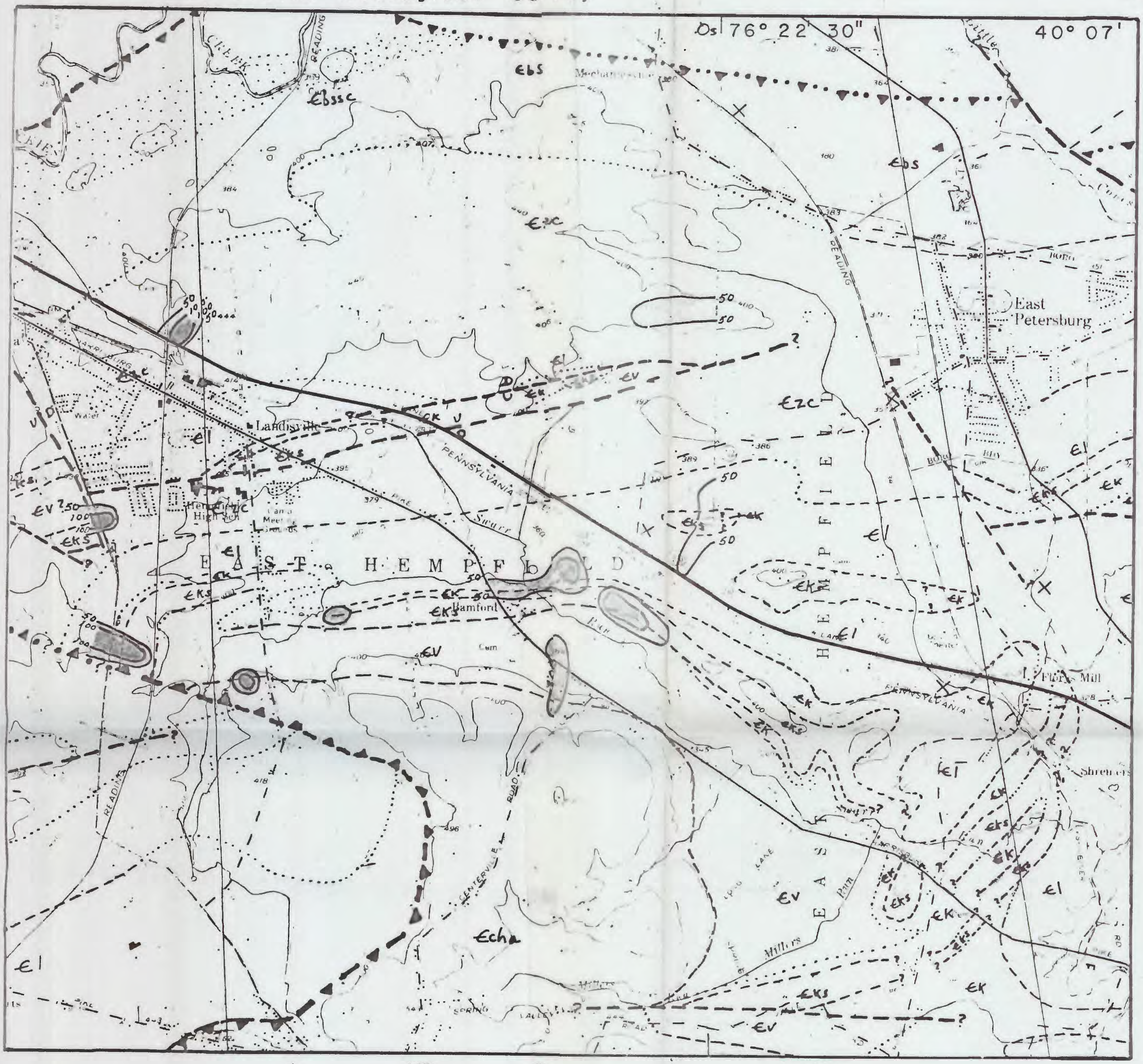

1 1/2 0 1 mile

SCALE 1 : 24,000

Fig. 1b Geochemical Map Showing Concentrations of Copper in the Bamford Area, Pa. in PPM

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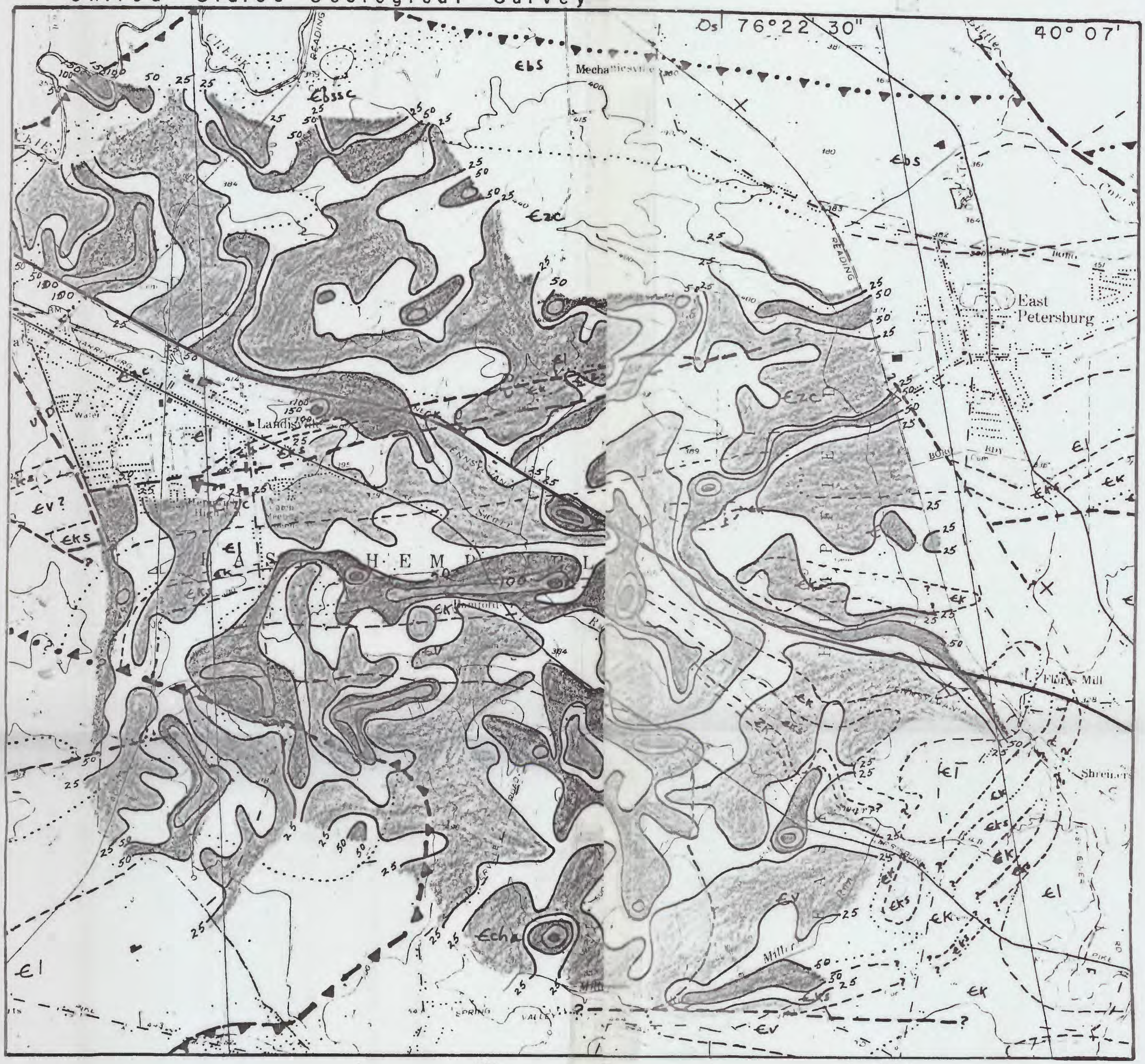

1/2 0 1 mile

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Fig. 1c. Geochemical Map Showing Concentration of Lead in the Bamford Area, Pa. in PPM

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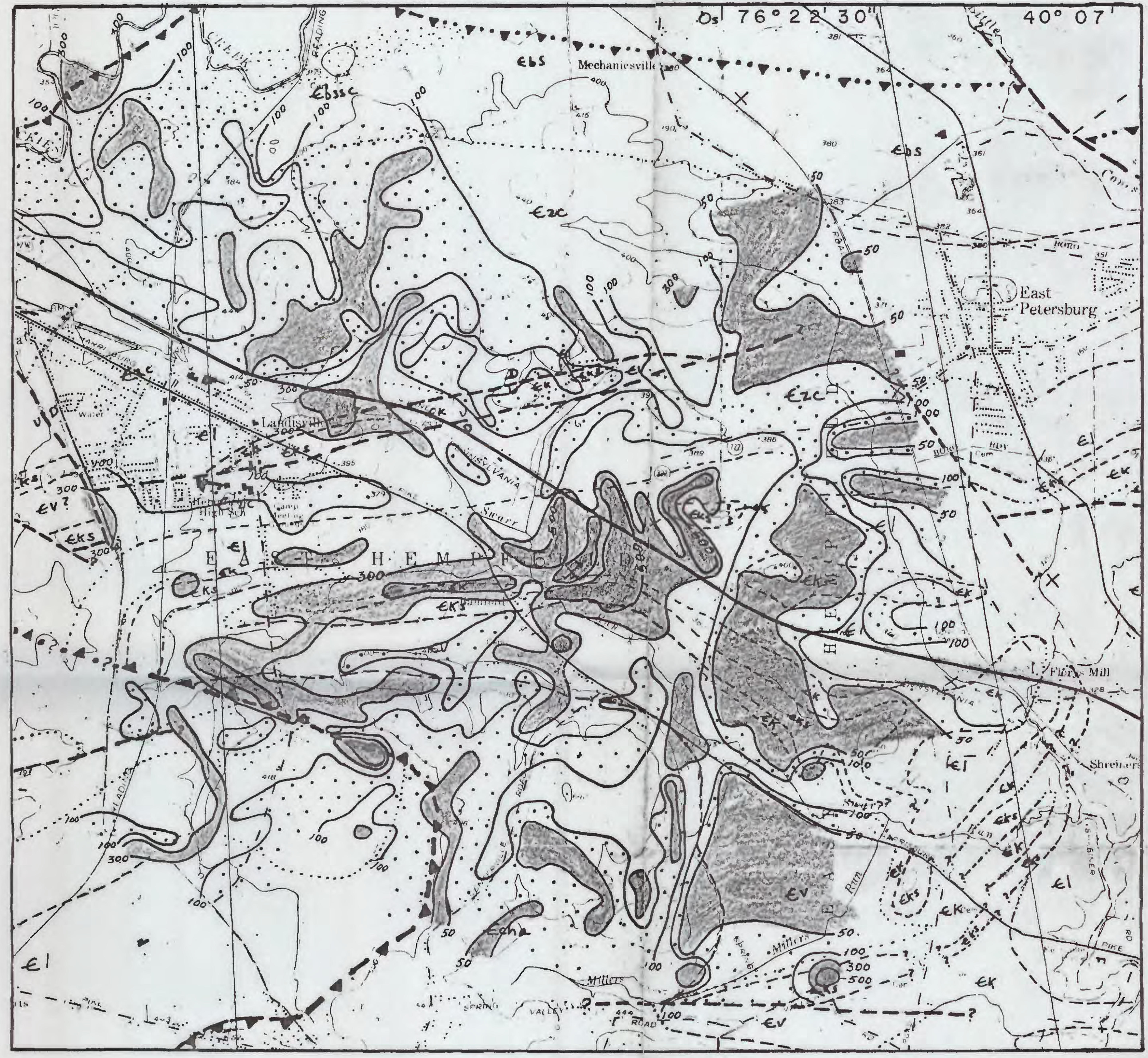

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Fig. 1d. Geochemical Map Showing Concentration of Zinc in the Bamford Area, Pa. in PPM

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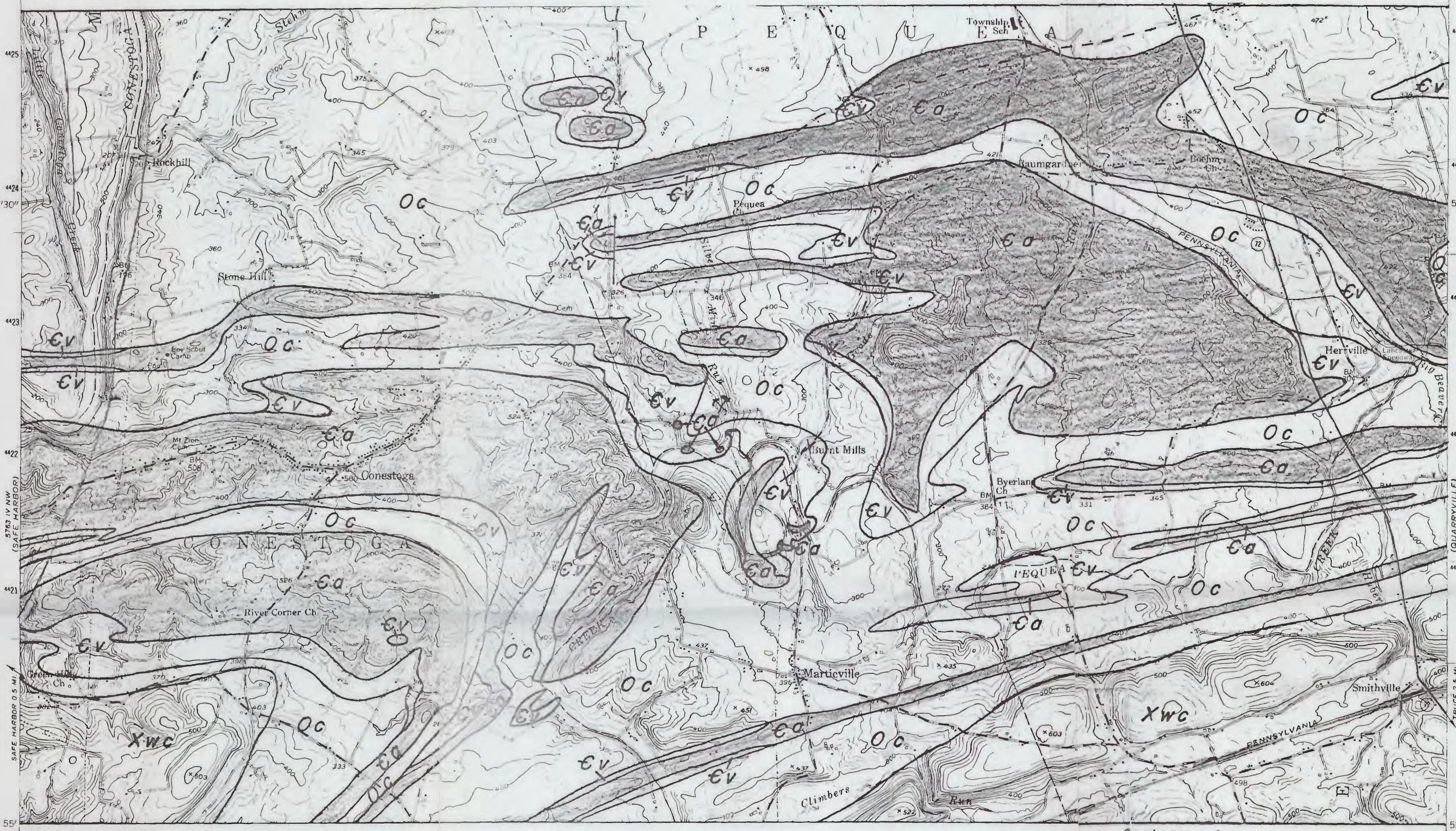

Geology by
Ernst Cloos & P. W. Guild

1 1/2 0 1 mile
SCALE 1:24,000

Fig. 2a. Geologic Map of the "Thrust Belt" in vicinity of Pequea Silver Mine, southeastern Pennsylvania

U.S. Geological Survey
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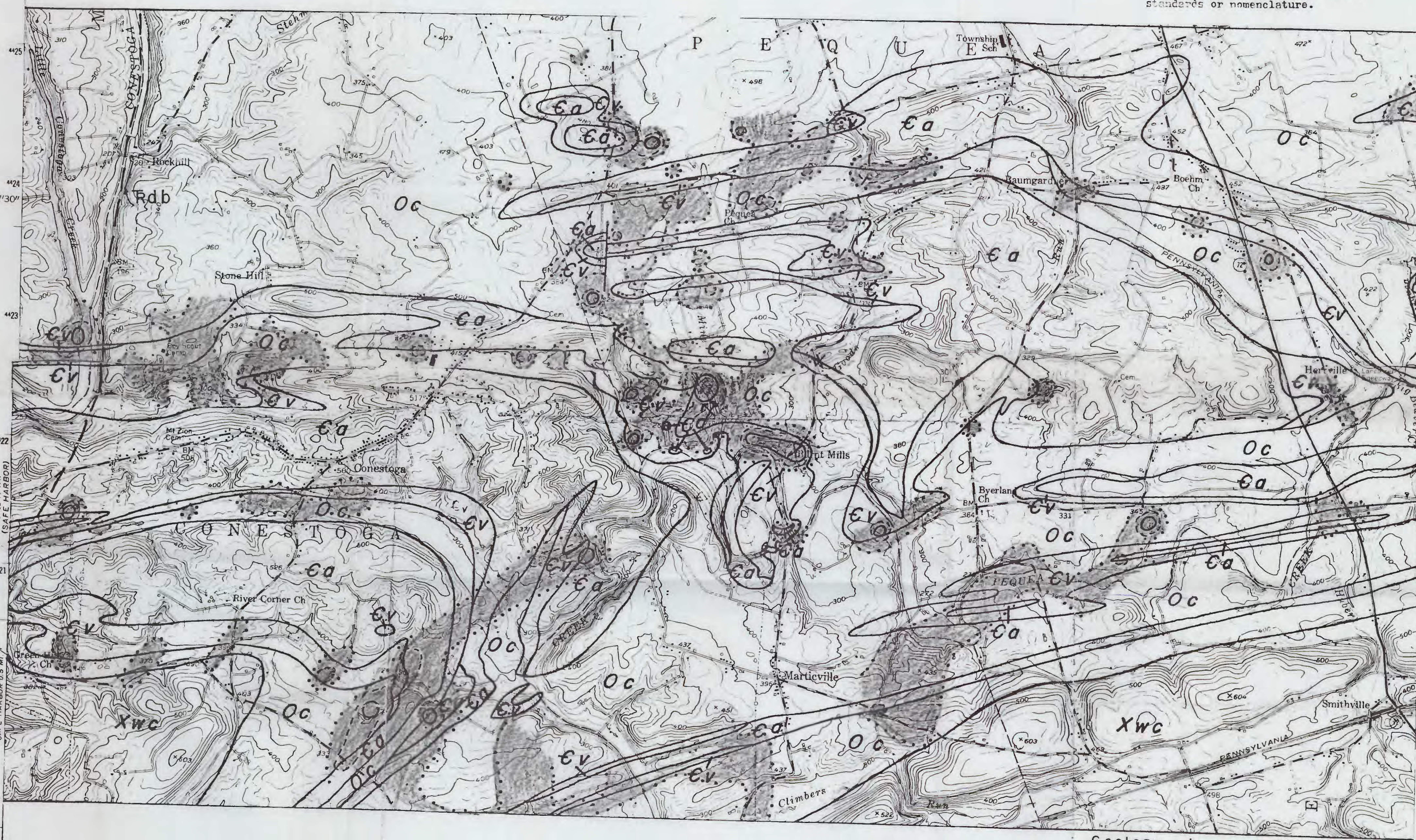

Geology by
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1 1/2 0 1 mile
SCALE 1:24,000

Fig. 2b. Geochemical Map Showing Concentration of Zinc in the "Thrust Belt"

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OPEN FILE MAP 68-106
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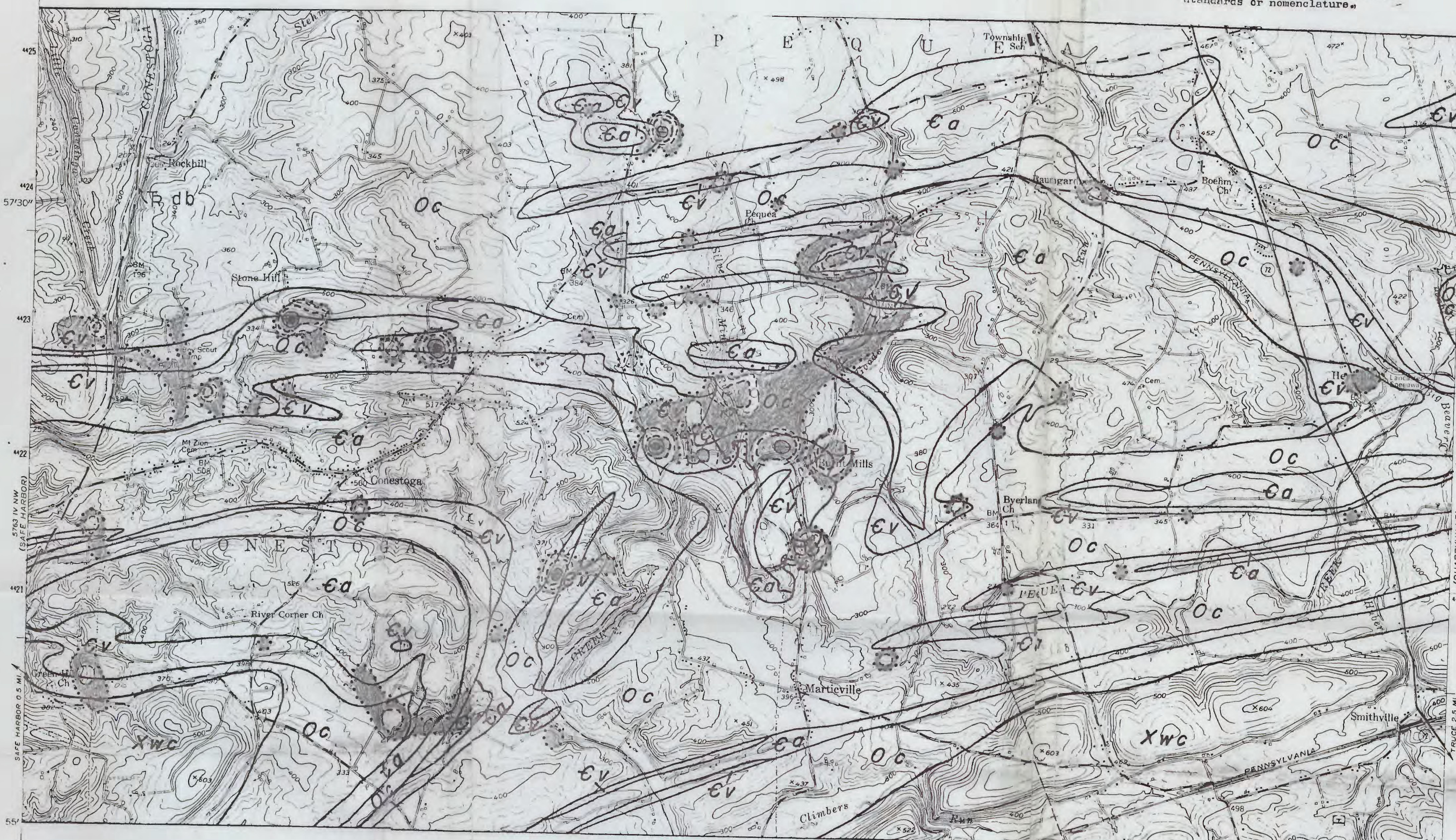

Geology by
Ernst Cloos & P. W. Guild

1/2 0 1 mile
SCALE 1:24,000

Fig. 2c. Geochemical Map Showing Concentration of Lead in the "Thrust Belt"