UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Delineation of an anomalous lead-zinc area in the Philip Smith Mountains A-2 quadrangle, Alaska

PROPERTY OF DGGS LIBRARY

By

D. E. Detra

U.S. Geological Survey

Open-File Report 77-223

1977

This report is preliminary and has not been edited or reviewed for confirmity with U.S. Geological Survey standards and nomenclature.

Interpretation of spectrographic (Grimes and Marranzino, 1968) and wet-chemical (Ward and others, 1969) analyses of crushed-rock samples, minus- and plus-80-mesh stream-sediment samples, and the nonmagnetic fraction of heavy-mineral concentrates delineates an anomalous lead-zinc area in the southeast sector of the Philip Smith Mountains A-2 quadrangle, Alaska. Although the results from these sample media support the existence of a lead-zinc area, the extent of the anomalous area cannot be determined without further investigation.

Two mineralized areas, A and B on figure 1, contain small outcrops of lead and zinc veins that are intersected by two streams, S1 and S2. Stream S1 intersects area A, is approximately 2.0 m wide, and averages 0.2 m deep. Stream S2 intersects area B and is less than 1 m in width and less than 0.1 m in depth. The water in both streams is rapid-flowing and has a pH of less than 4.5. The area is generally characterized as arctic, with limited tundra-type ground cover overlying permafrost in the drainage basins. The relief on either side of the valley, where the mineralization occurs, is approximately 500 m. The consistently anomalous metals in the mineralized veins are zinc, lead, and silver. The upper values obtained for these metals from rock samples taken in the area are zinc, 34 percent; lead, greater than 2 percent; silver, 150 ppm (table 1 and fig. 2). The anomalous metals occur in a chert cap on a limestone bed that is overlain by yellow-weathering phyllitic silt shales and sandstones which, in turn, are overlain by the black slates of the typical Hunt Fork Shale (fig. 3).

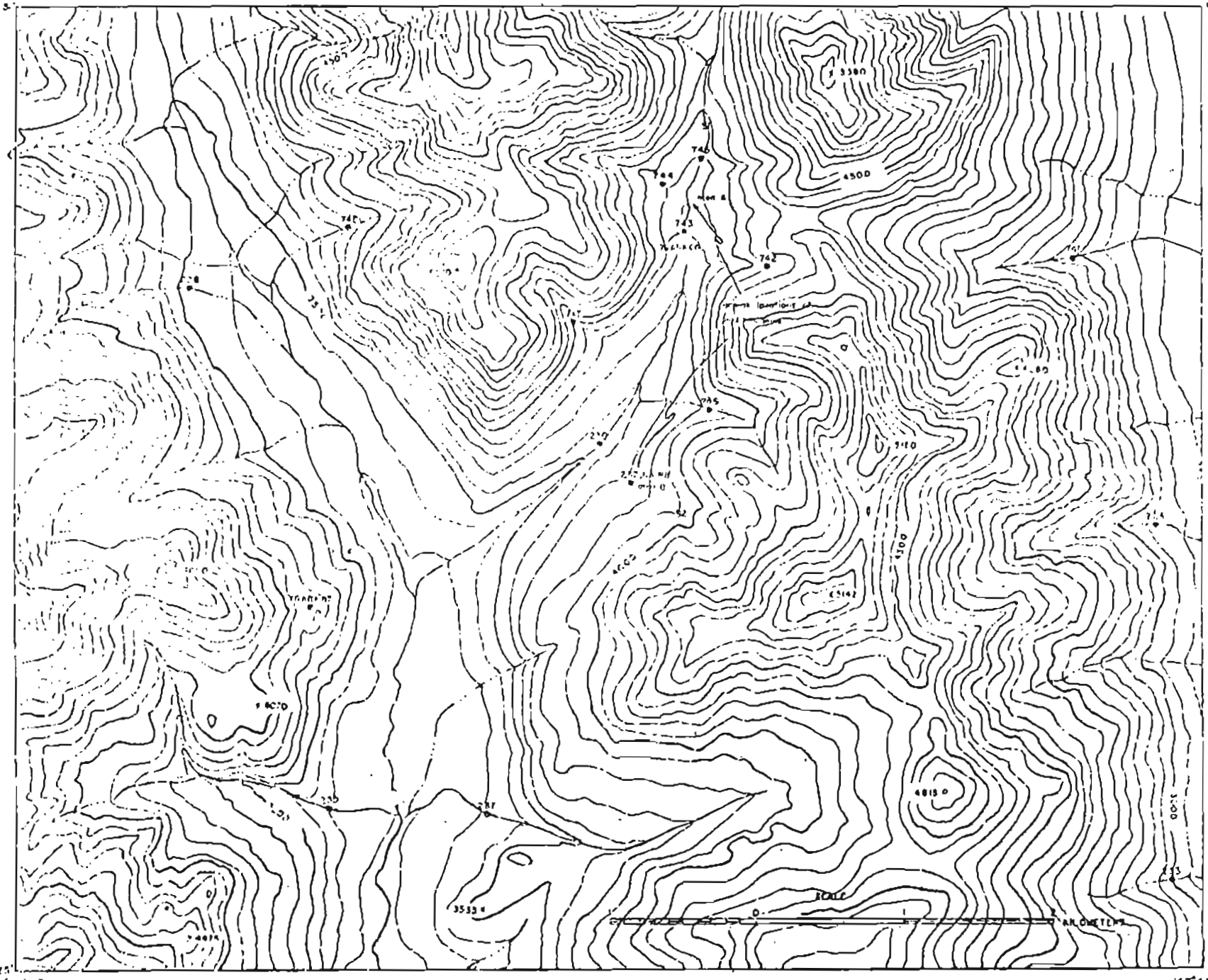
147°55'40"
68°03'30"
4500
4600
4700
4800
4900
5000
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000
6100
6200
6300
6400
6500
6600
6700
6800
6900
7000
7100
7200
7300
7400
7500
7600
7700
7800
7900
8000
8100
8200
8300
8400

TABLE 1.--*Rock samples*

[Results reported in parts per million (ppm). G = greater than value shown; N = not detected at limit of detection; L = detected, but below limit of detection]

Field No.	Tag No.	Spec. Ag	Spec. Ba	Spec. Cd	Spec. Cu	Spec. Pb	Spec. Sb	Spec. Zn	Wet Chem. Zn
232RA	CB1419	150	200	N(20)	700	G(20,000)	N(100)	G(20,000)	250,000
232RB	CB1420	30	300	N(20)	150	15,000	N(100)	G(20,000)	75,000
76ARR46	CCA514	70	N(20)	N(20)	1,000	3,000	700	G(20,000)	340,000
76ARR47	CCA516	30	G(5,000)	70	1,000	20,000	300	10,000	5,000
Lower Detection Limits		.5	20	20	20	10	100	200	5

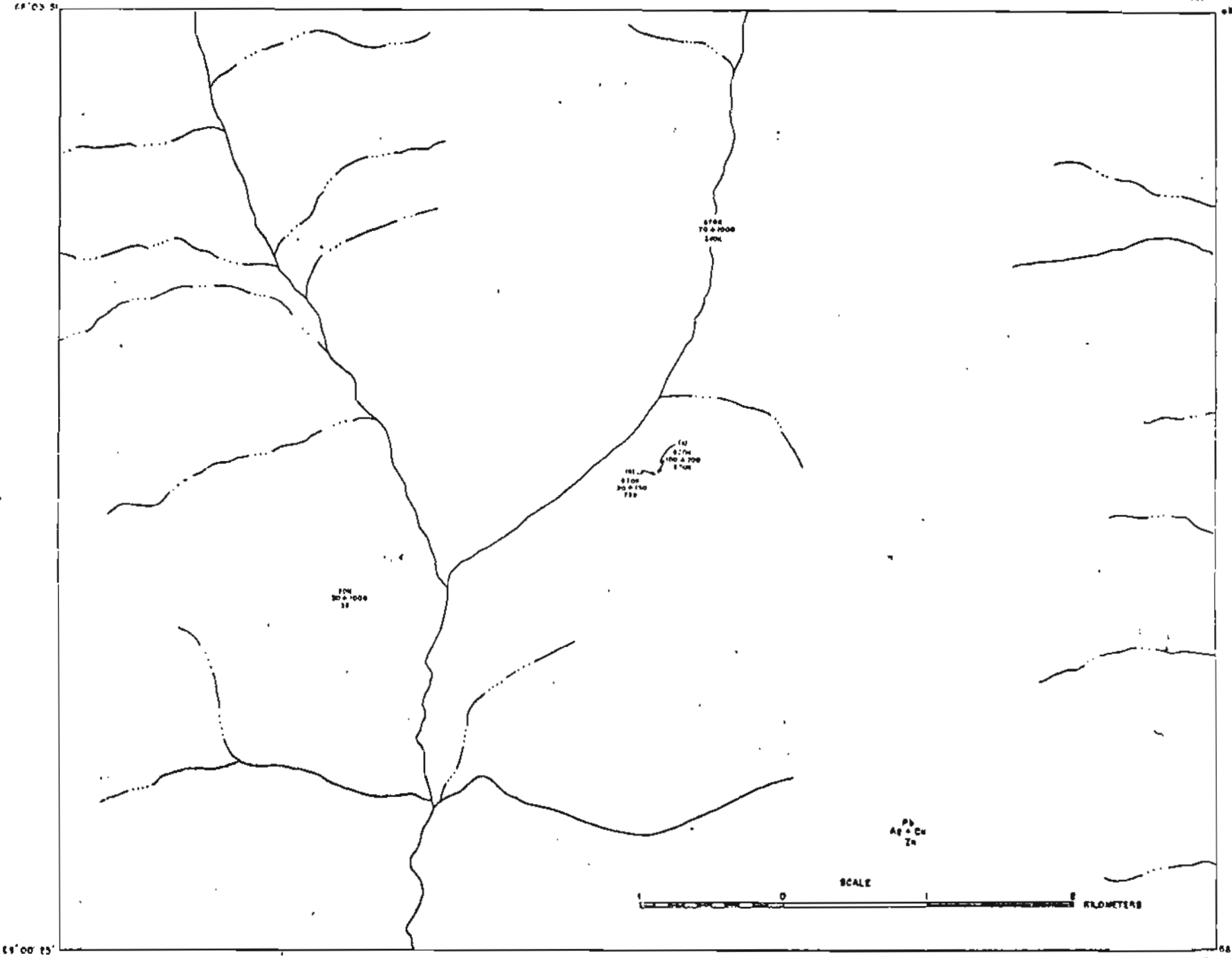

FIGURE 2.--Lead (Pb), copper (Cu), silver (Ag), and zinc (Zn) in rocks. Pb, Cu, and Ag determinations by emission spectrography; Zn determinations by atomic absorption.

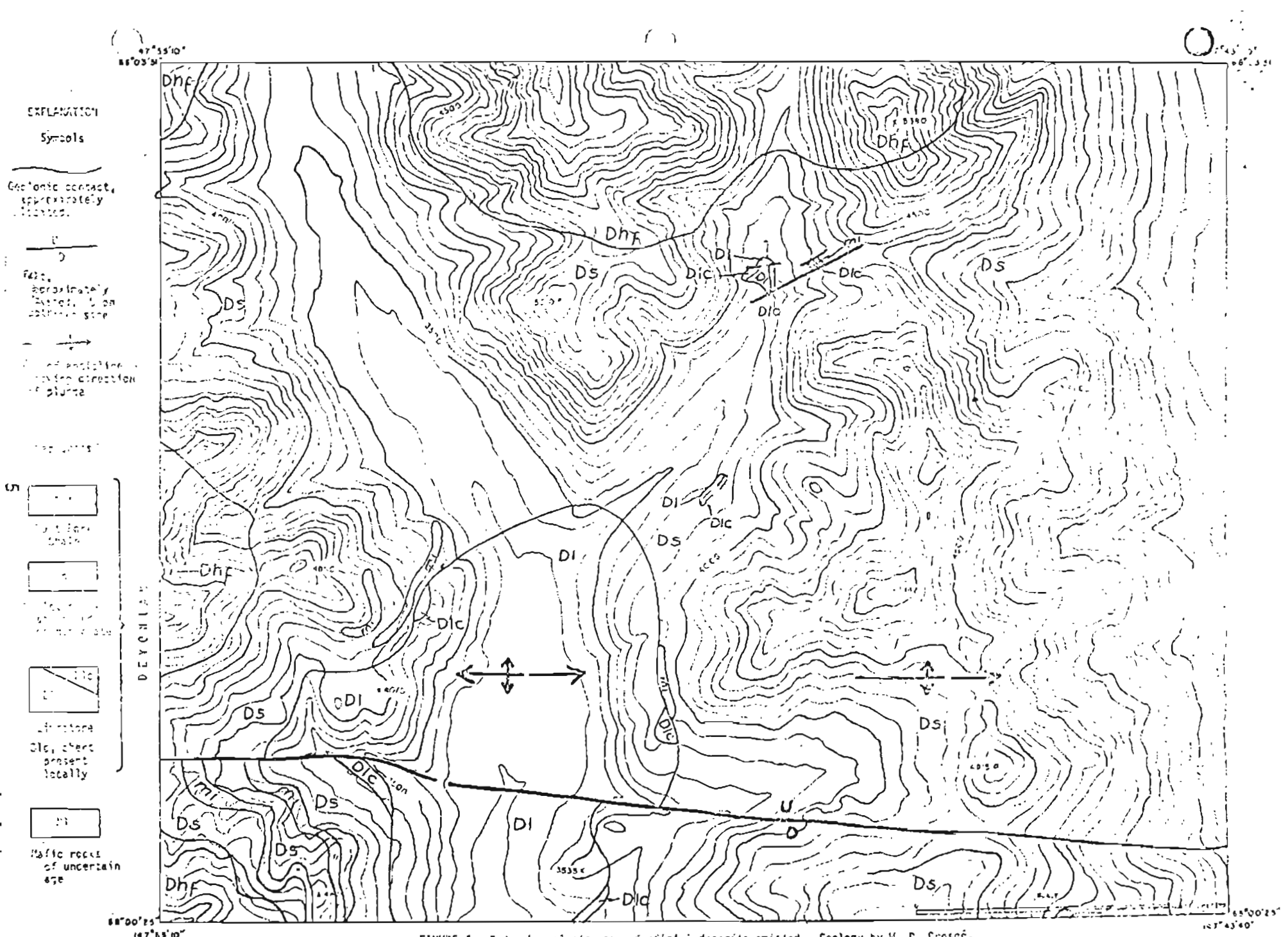

FIGURE 8.--Bedrock geologic map. Surficial deposits omitted. Geology by W. D. Crosset, J. T. Gutro, Jr., and H. N. Reiser, 1976.

A stream-sediment sample (232) taken in one of the mineralized areas (B) yields anomalous values for lead and zinc, but these values do not persist in a sample (230) taken downstream from the prospect area. This change in values suggests that the minus-80-mesh dispersion train of anomalous lead and zinc particulate material is limited to a short distance from the exposure. The absence of highly anomalous lead and zinc values in the minus-80-mesh stream sediments and nonmagnetic fraction of heavy-mineral concentrates can be explained by a combination of pH of hydrolysis (of the metals) and stream-transport mechanics.

Much of the minus-80-mesh, lead-zinc particulate material is possibly being transported downstream in solution, because the stream waters are producing an acidic environment (pH $\leq$ 4.5) and the values for pH of hydrolysis of lead and zinc are 6.0 and 7.0, respectively. Exposures of the mineralized veins are limited, less than 3 m in length and not much wider than the stream. The production of lead-zinc particulate material is relatively small, and this material is rapidly diluted with that of the surrounding country rock. The lead-zinc particulate material that is not going into solution and being transported as cations is being rapidly transported downstream in suspension or within the bed load. This rapid transport of minus-80-mesh lead-zinc particulate material is caused by high stream gradient which produces rapid stream flow.

To support this explanation, analyses of both minus- and plus-80-mesh stream sediments were carried out by an extractable heavy-metal method (Ward and others, 1963). This method analyzes only the loosely bound metal ions. The results show that anomalous zinc values for the plus-80-mesh stream sediments were obtained at sample localities 743 and 230, where minus-80-mesh showed no anomalous values (fig. 4). This evidence suggests that lead-zinc particulate matter is present in the coarse fraction of the stream sediment and not in the fine fraction.

The rock samples taken from the mineralized veins contain galena, sphalerite, and chalcopyrite. Galena reacts with sulfuric acid produced by the oxidation of sulfide minerals to form an insoluble lead sulfate, resulting in anomalous lead values in some of the heavy-mineral concentrates (table 2, fig. 5) (743 and 230). The same does not hold for zinc and copper, because sulfates produced by the reaction between sphalerite and chalcophyrite and sulfuric acid are very soluble. These sulfates remain in solution, and residual values for copper and zinc in the stream sediments and heavy-mineral concentrates are low.

In conclusion, geochemical analyses of sediments, heavy-mineral concentrates, and rock samples positively delineate an anomalous lead-zinc area within the Philip Smith Mountains A-2 quadrangle, which shows promise for additional exploration.

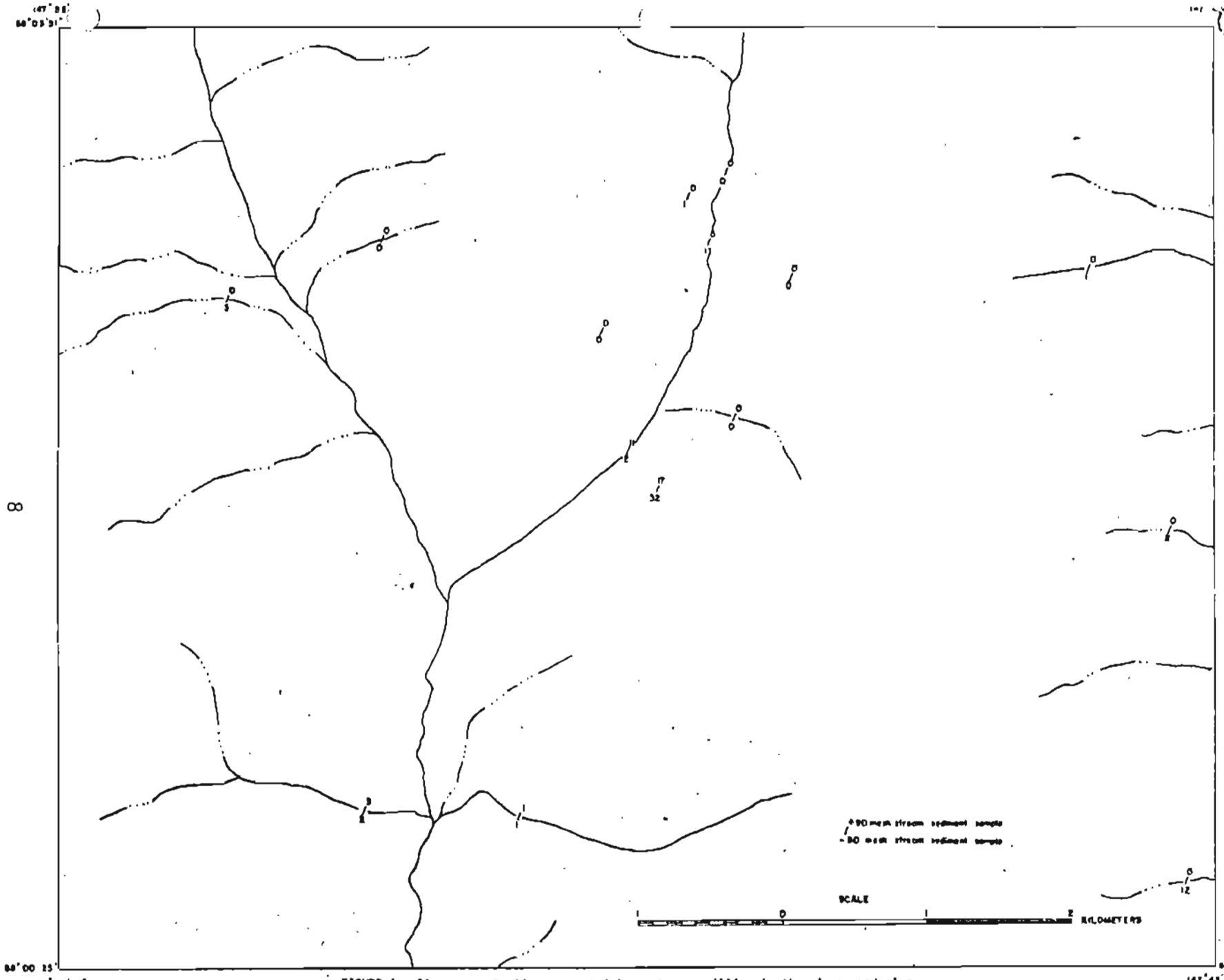

FIGURE 4.--Zinc concentrations reported in parts per million in the minus- and plus-80-mesh fractions of stream sediment. Determination by extractable heavy-metal method.

TABLE 2.--*Stream-sediment and heavy-mineral concentrates*

[Geometric mean includes all stream sediments taken during the 1976 field season in the Philip Smith Mountains A-2 quadrangle, Alaska. Results reported in ppm (parts per million). N = not detected at limit of detection; L = detected, but below limit of detection; INS = insufficient amount of sample; N/A = data not available]

Sample No.	Wet Chem. Zn	Spec. Zn	Spec. Pb	Spec. As	Heavy-Mineral Concentrates				
					Spec. Zn	Spec. Ag	Spec. Pb	Spec. As	Spec. Cu
741	130	200	50	N(200)	N(500)	N/A	N/A	N(500)	N/A
742	140	200	50	N(200)	N(500)	N/A	70	N(500)	100
743	130	L(200)	50	N(200)	N(500)	3	1,500	1,000	300
744	130	L(200)	50	N(200)	N(500)	1	70	N(500)	100
745	130	L(200)	50	N(200)	N(500)	N(1)	70	N(500)	70
746	130	200	50	N(200)	N(500)	1	100	N(500)	100
747	140	200	50	N(200)	N(500)	1	70	N(500)	70
748	150	200	50	N(200)	N(500)	N(1)	70	N(500)	70
225	130	200	30	N(200)	N(500)	N(1)	150	N(500)	500
228	120	300	50	N(200)	N(500)	1	500	N(500)	500
230	150	200	50	N(200)	700	2	300	N(500)	300
232	360	500	70	N(200)	INS	INS	INS	INS	INS
233	170	200	50	N(200)	N(500)	N(1)	300	N(500)	300
237	150	200	30	N(200)	N(500)	N(1)	200	N(500)	500
239	160	200	70	N(200)	N(500)	1	70	N(500)	200
Lower Detection Limits	.5	200	10	200	500	1	20	500	10

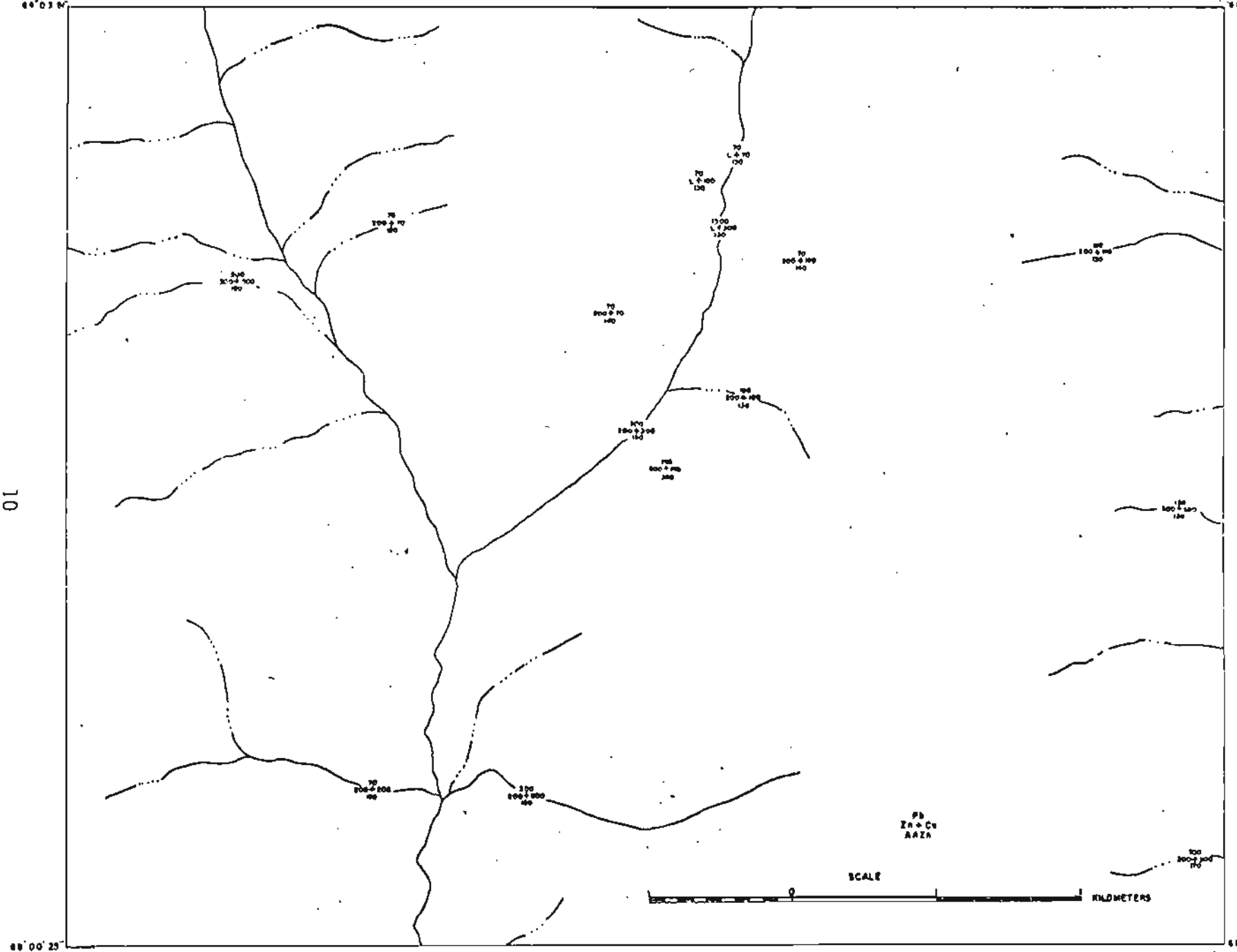

FIGURE 8.--Lead (Pb), copper (Cu), and zinc (Zn) in parts per million. Pb and Cu from the nonmagnetic fraction of the heavy mineral concentrate. Zn from the minus-80-mesh stream sediment. Pb, Cu, and Zn determinations by emission spectrography. AA Zn determinations by atomic absorption.

References

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geol. Survey Circ. 591, 6 p.

Ward, F. N., Lakin, H. W., Canney, F. C., and others, 1963, Analytical methods used in geochemical exploration by the U.S. Geological Survey: U.S. Geol. Survey Bull. 1152, 100 p.

Ward, F. N., Nakagawa, H. M., Harms, T. F., and Van Sickle, G. H., 1969, Atomic-absorption methods of analysis useful in geochemical exploration: U.S. Geol. Survey Bull. 1289, 45 p.