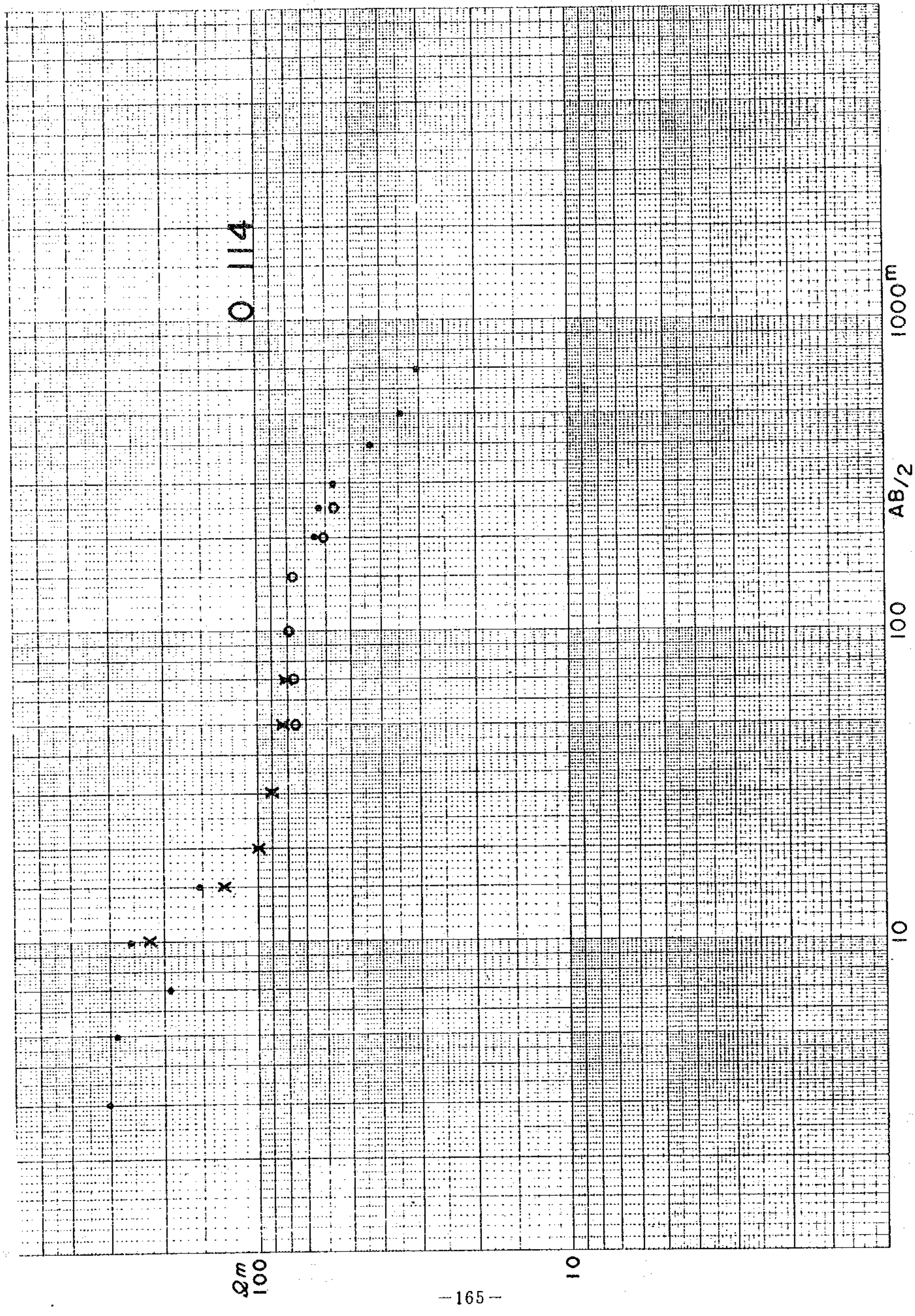
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AB/2
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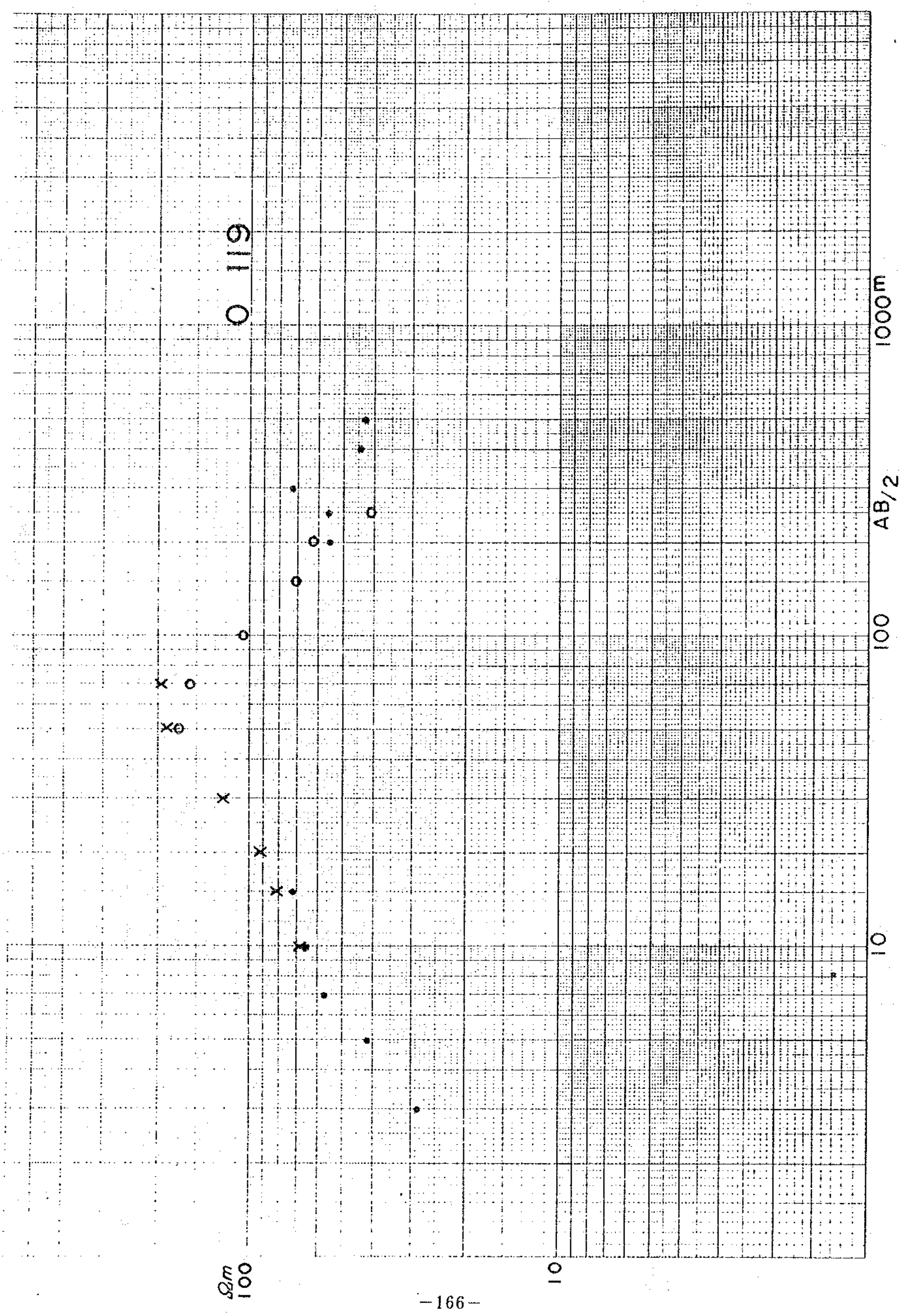
10
Ωm
100
10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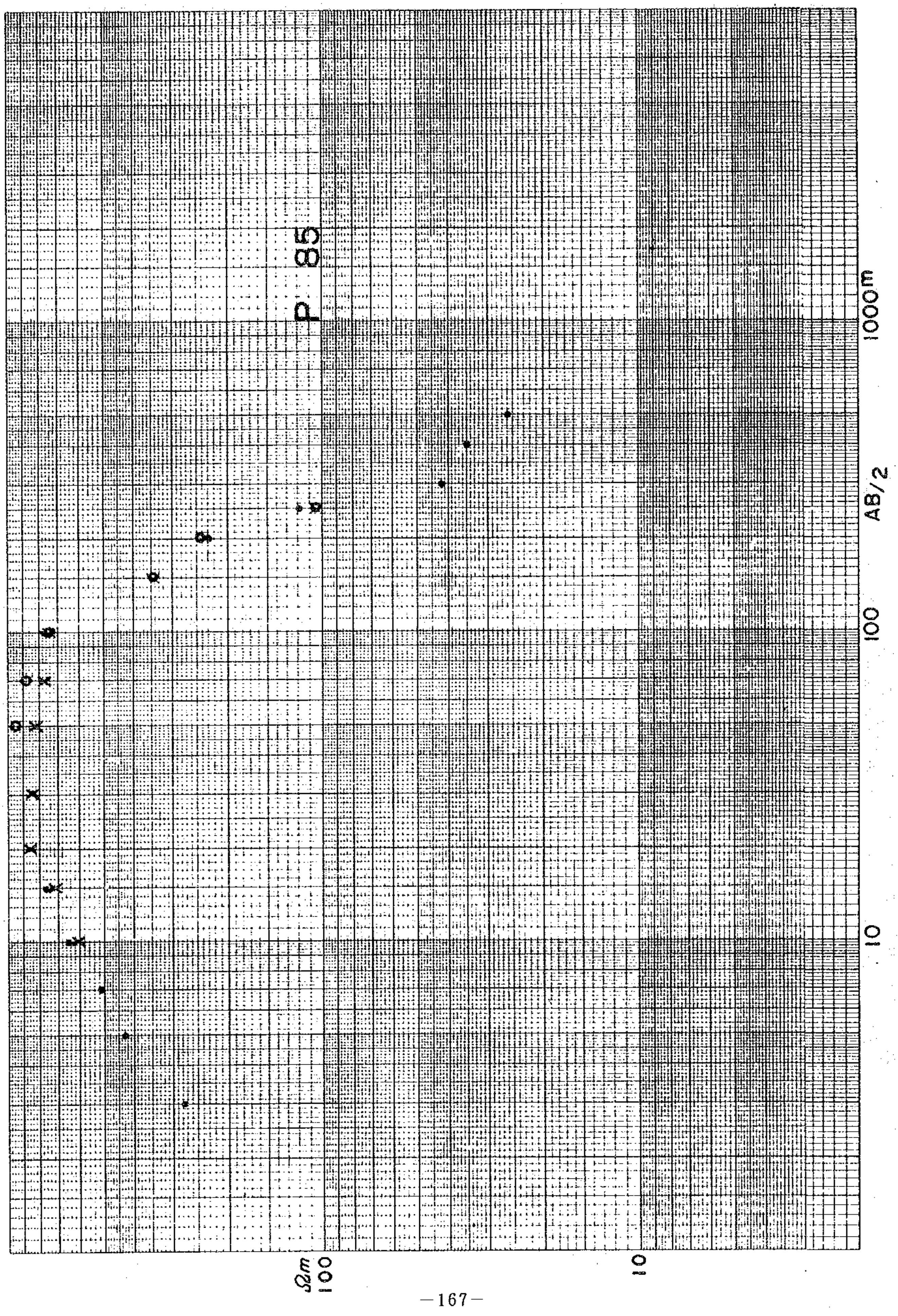
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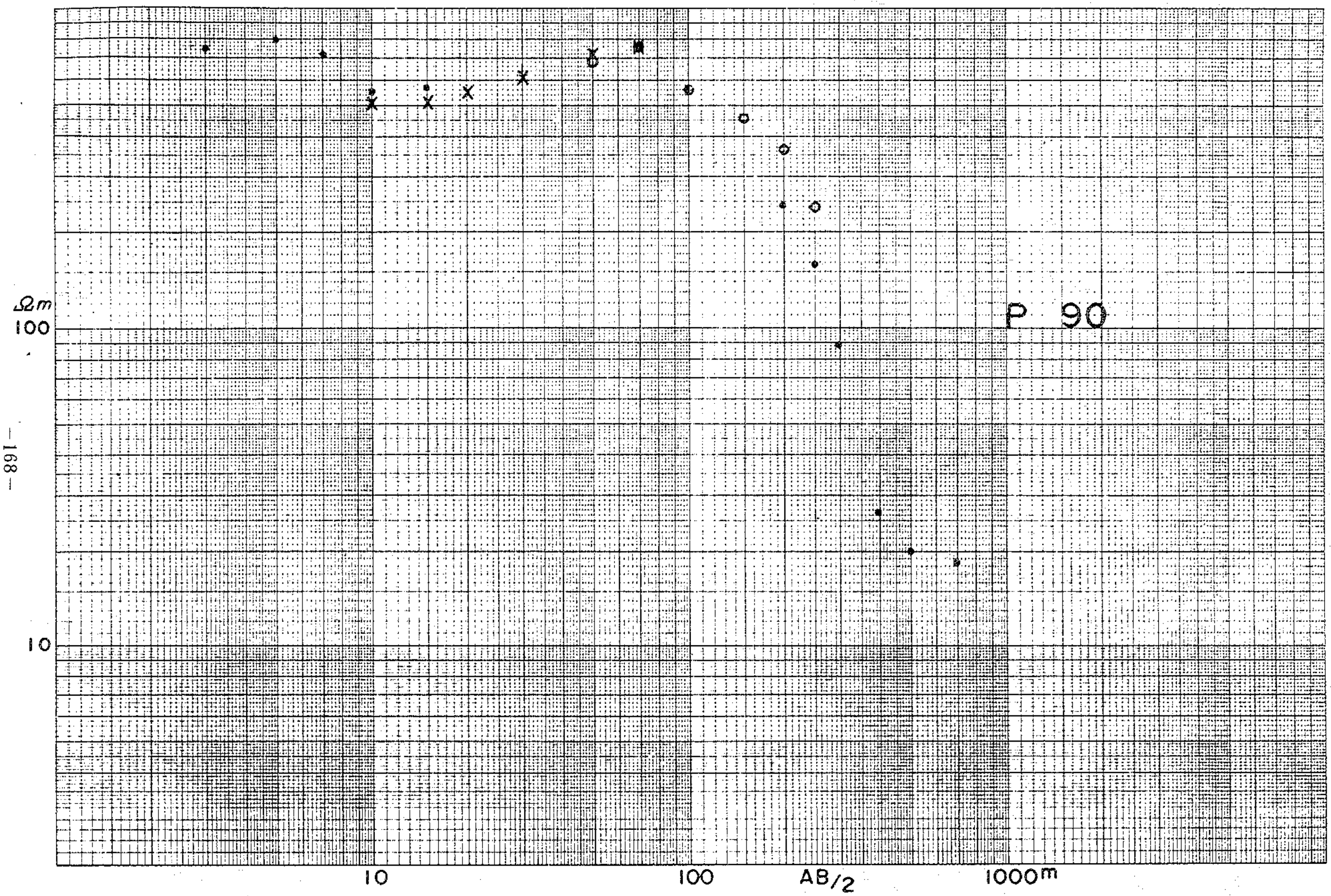
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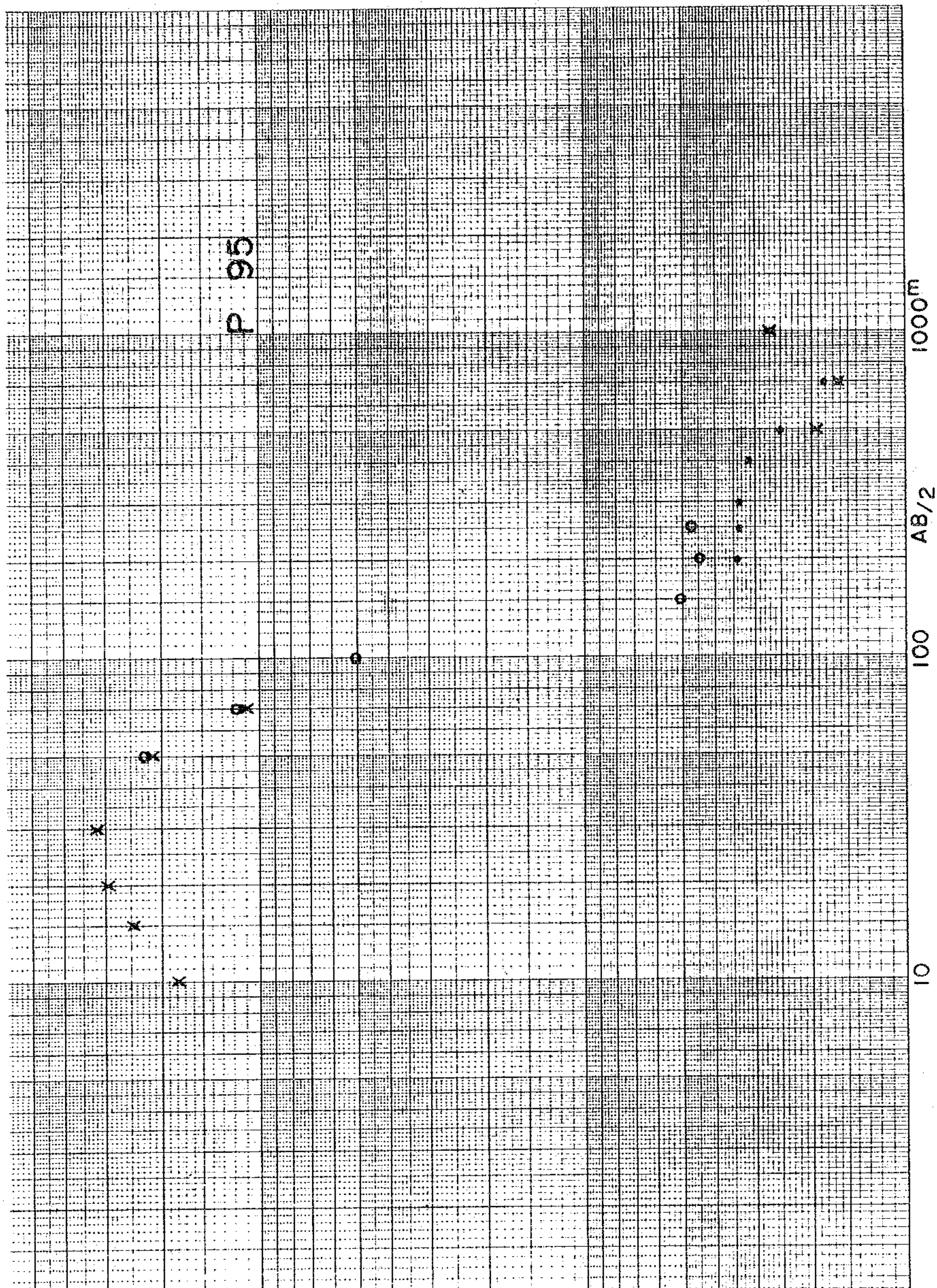
Ωm
100
10
10
100
AB/2
1000m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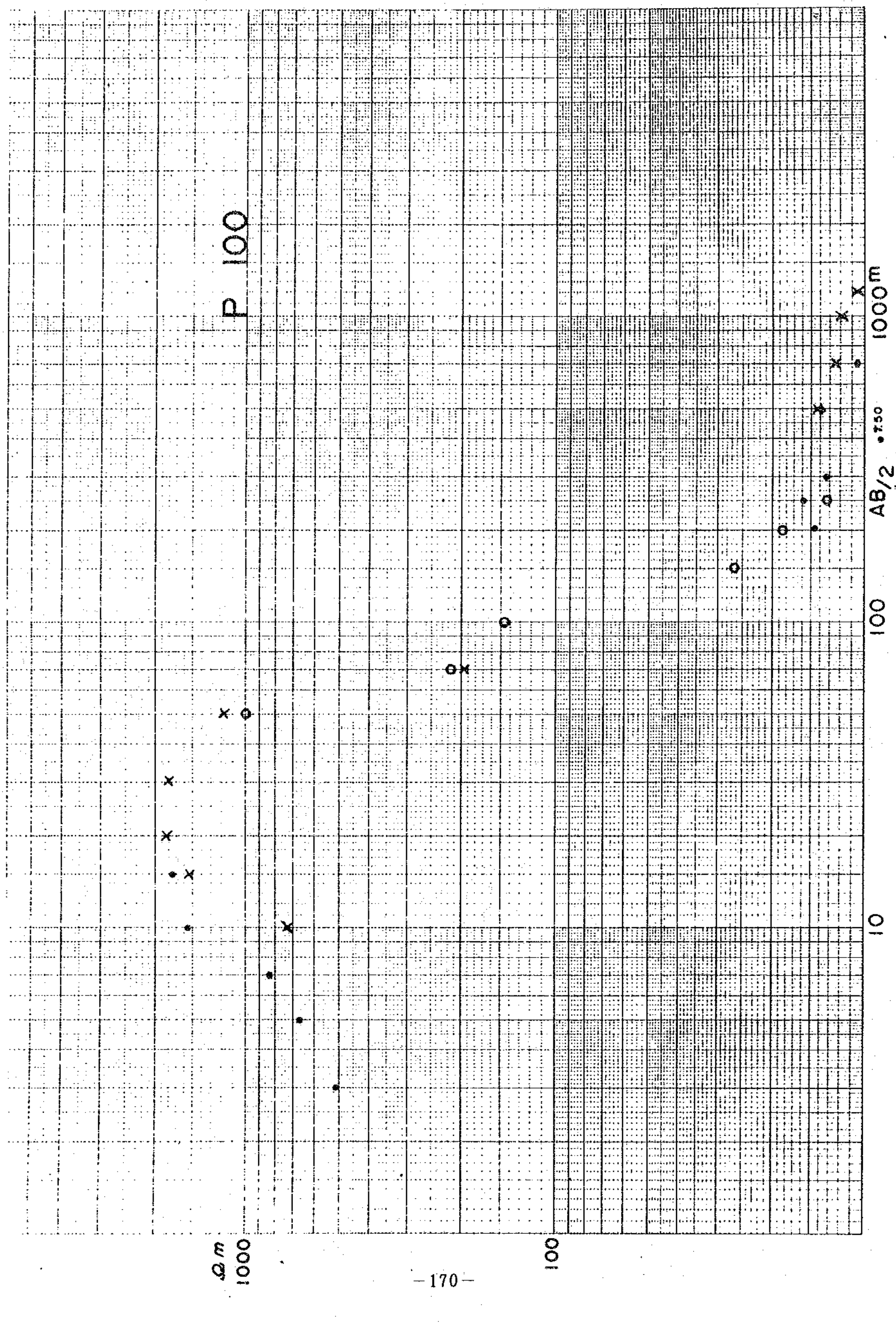
Ωm
1000
100
10
100
1000m
AB/2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Ωm
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100
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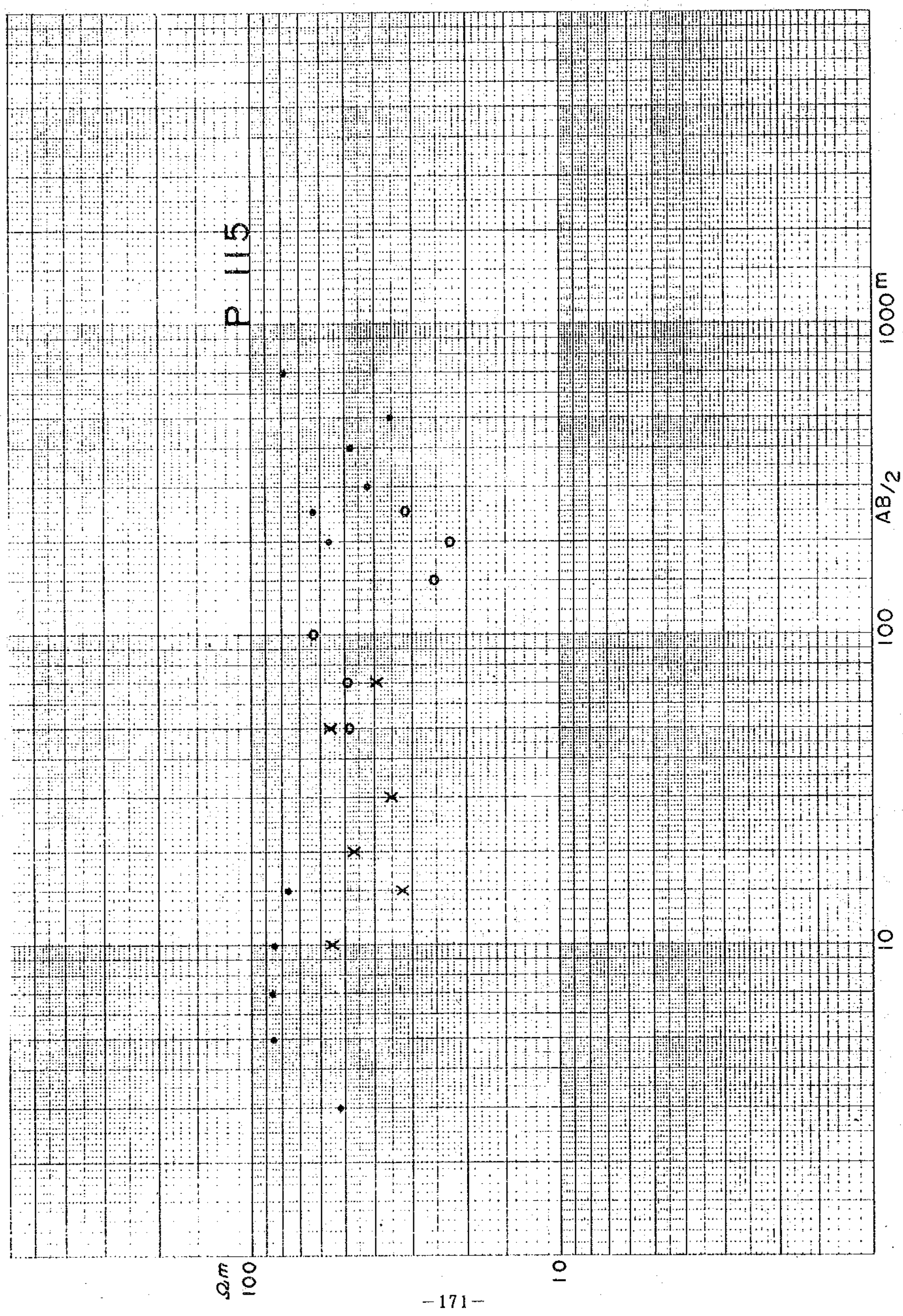
100
1000m
AB/2
750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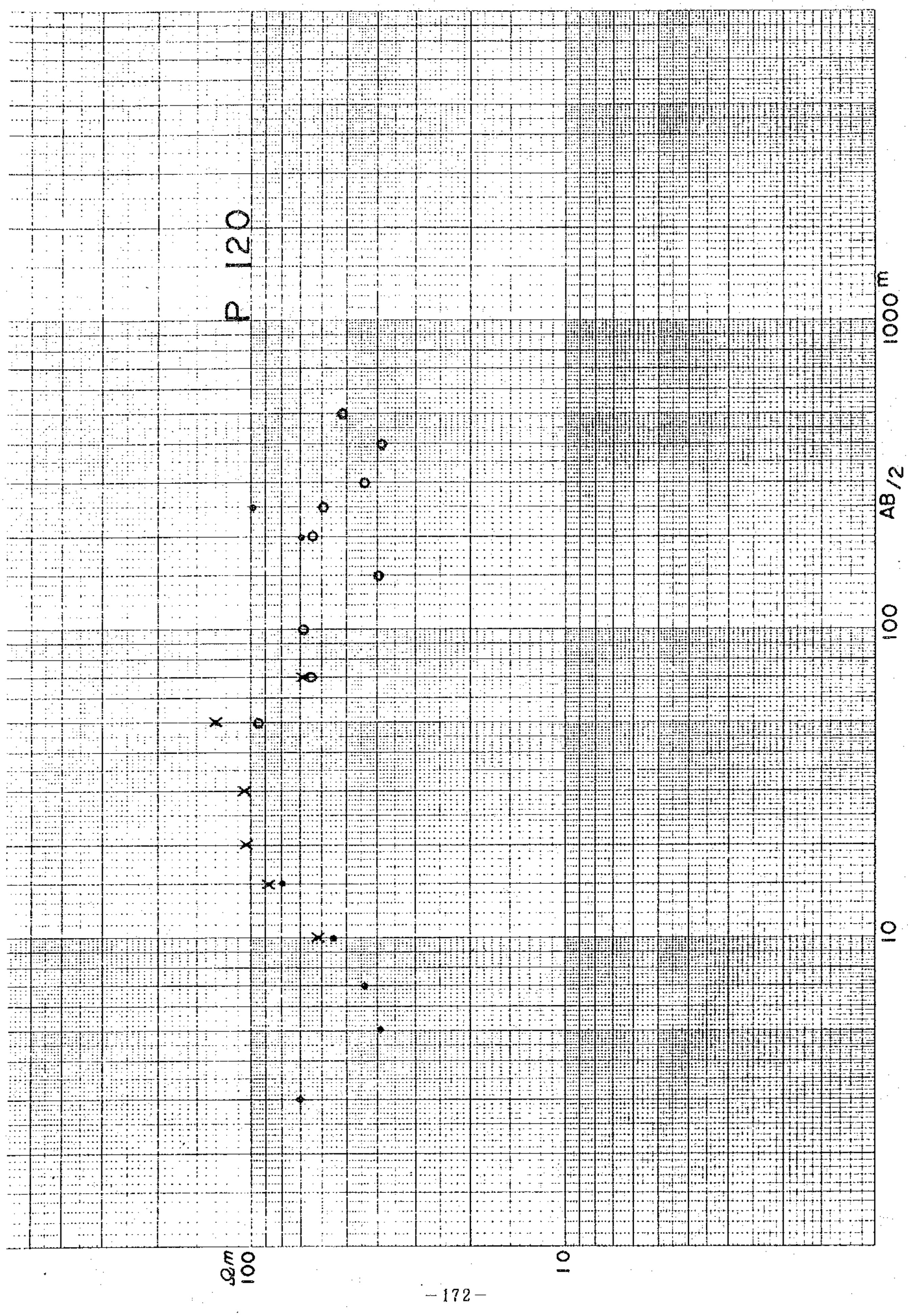
AB/2
100
10
Ωm
100
10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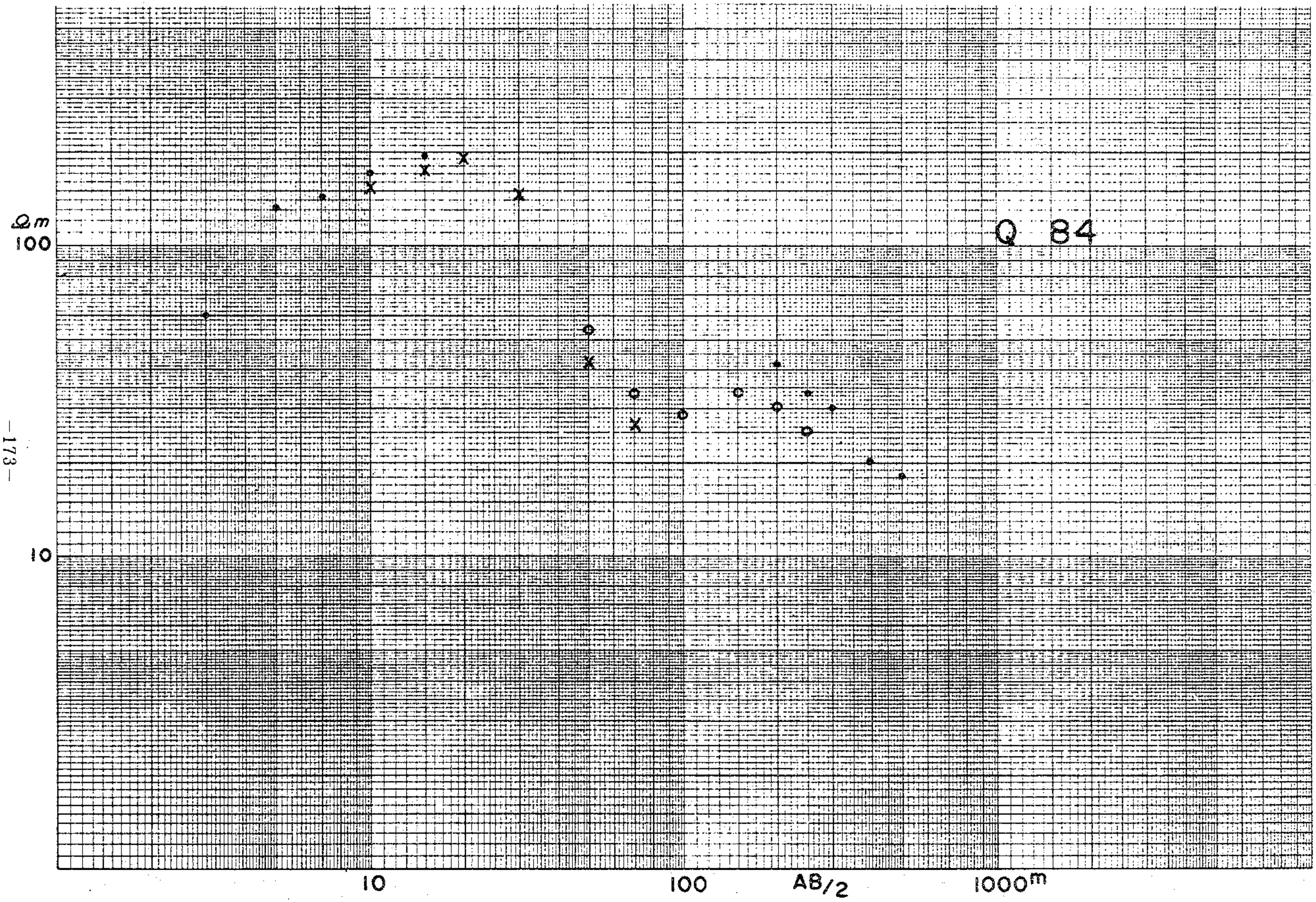
10
10
100
1000 m
AB/2



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Ωm
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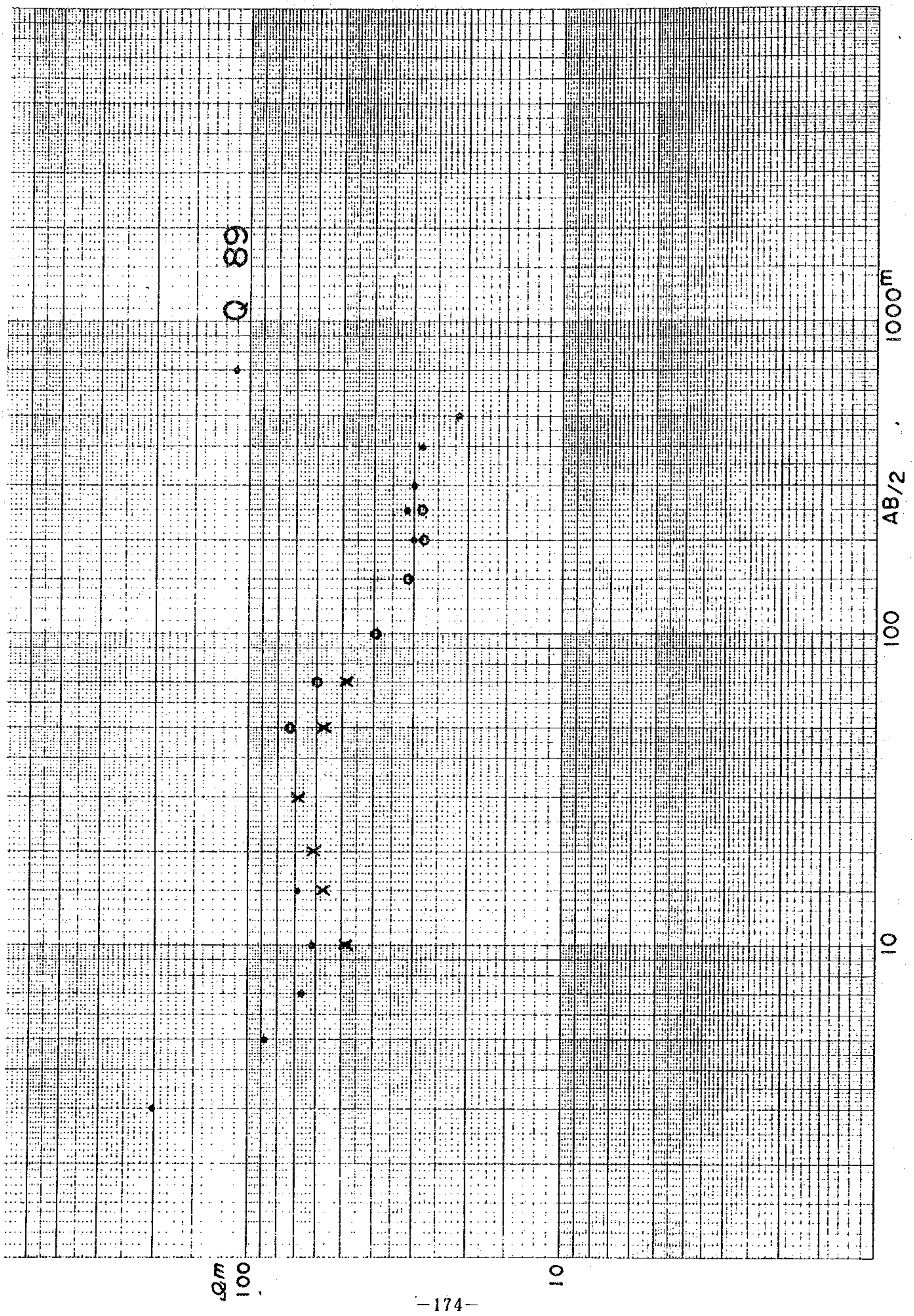
10
10
100
AB/2
1000m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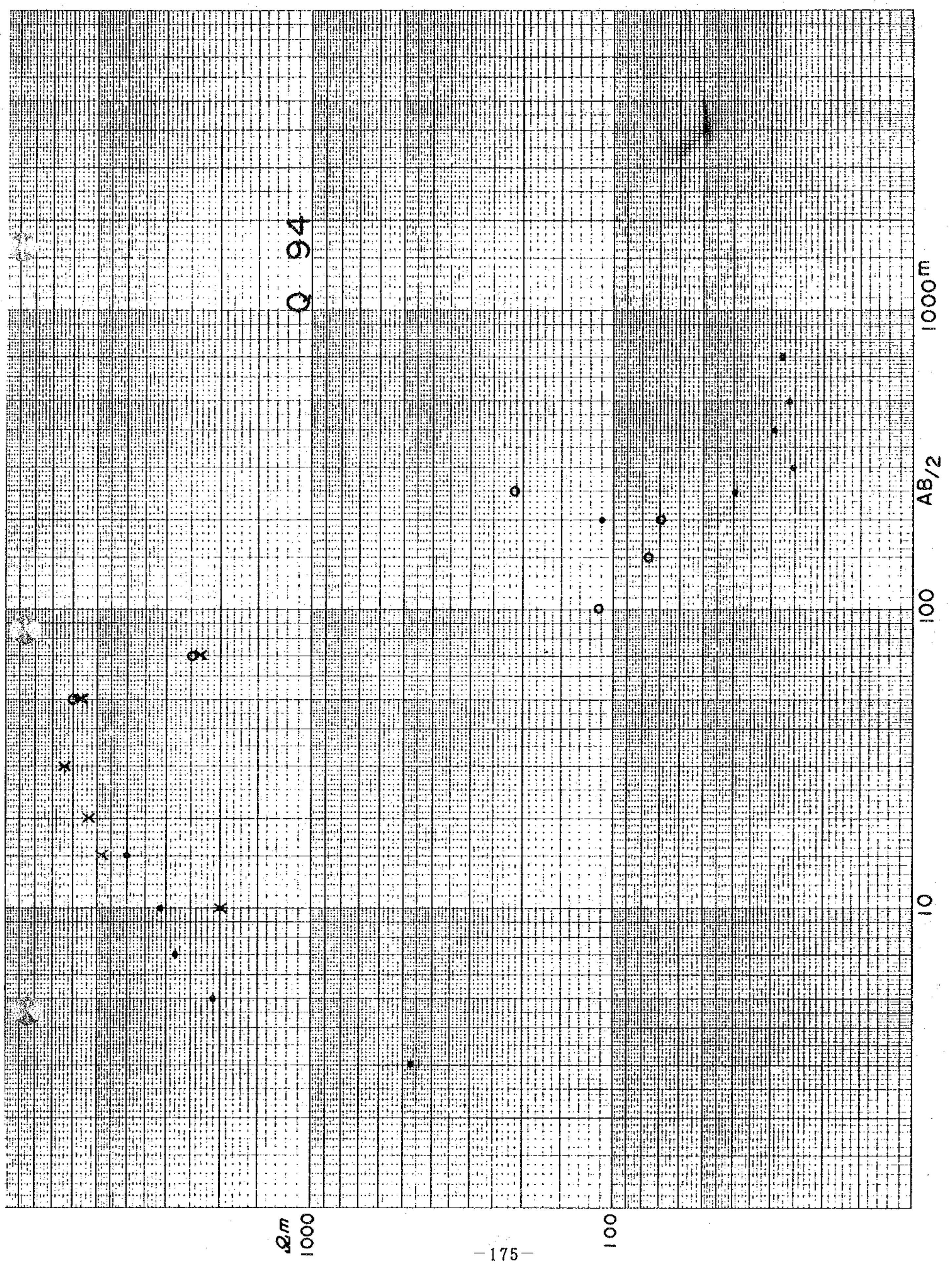
1000m
AB/2
100
10
ρm
100
10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AB/2
Ωm
1000
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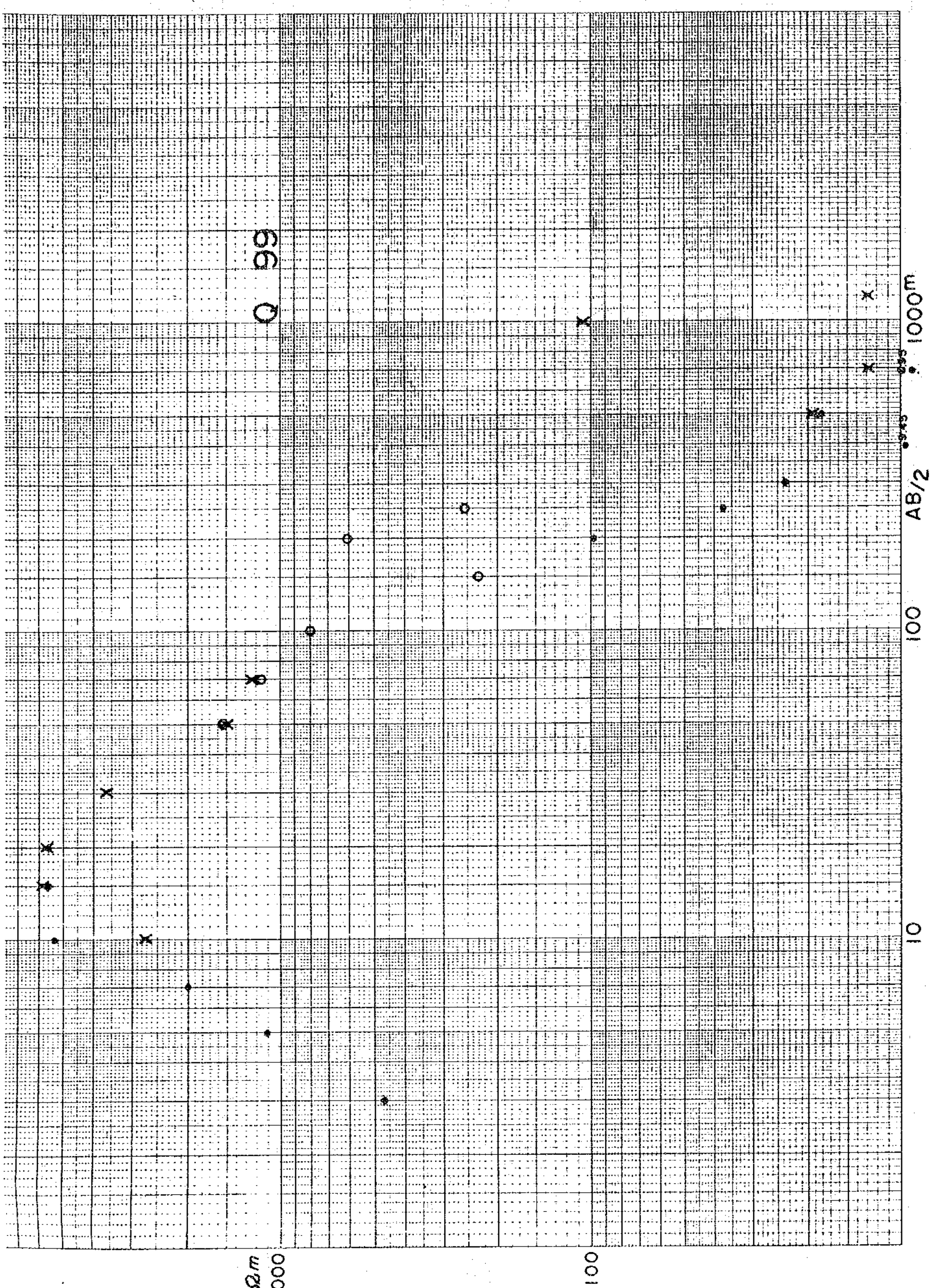
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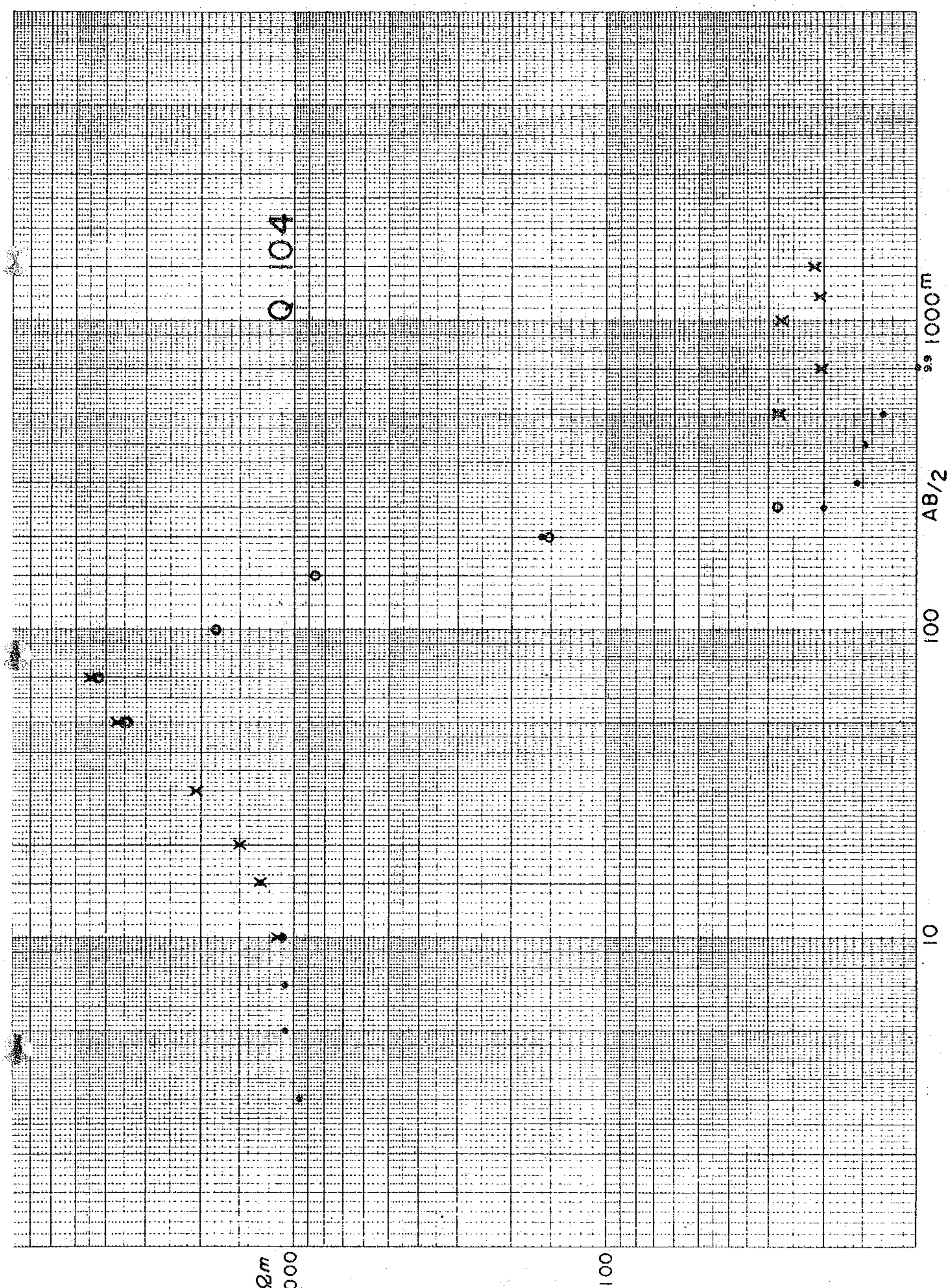
AB/2
Ωm
1000
100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AB/2
1000m
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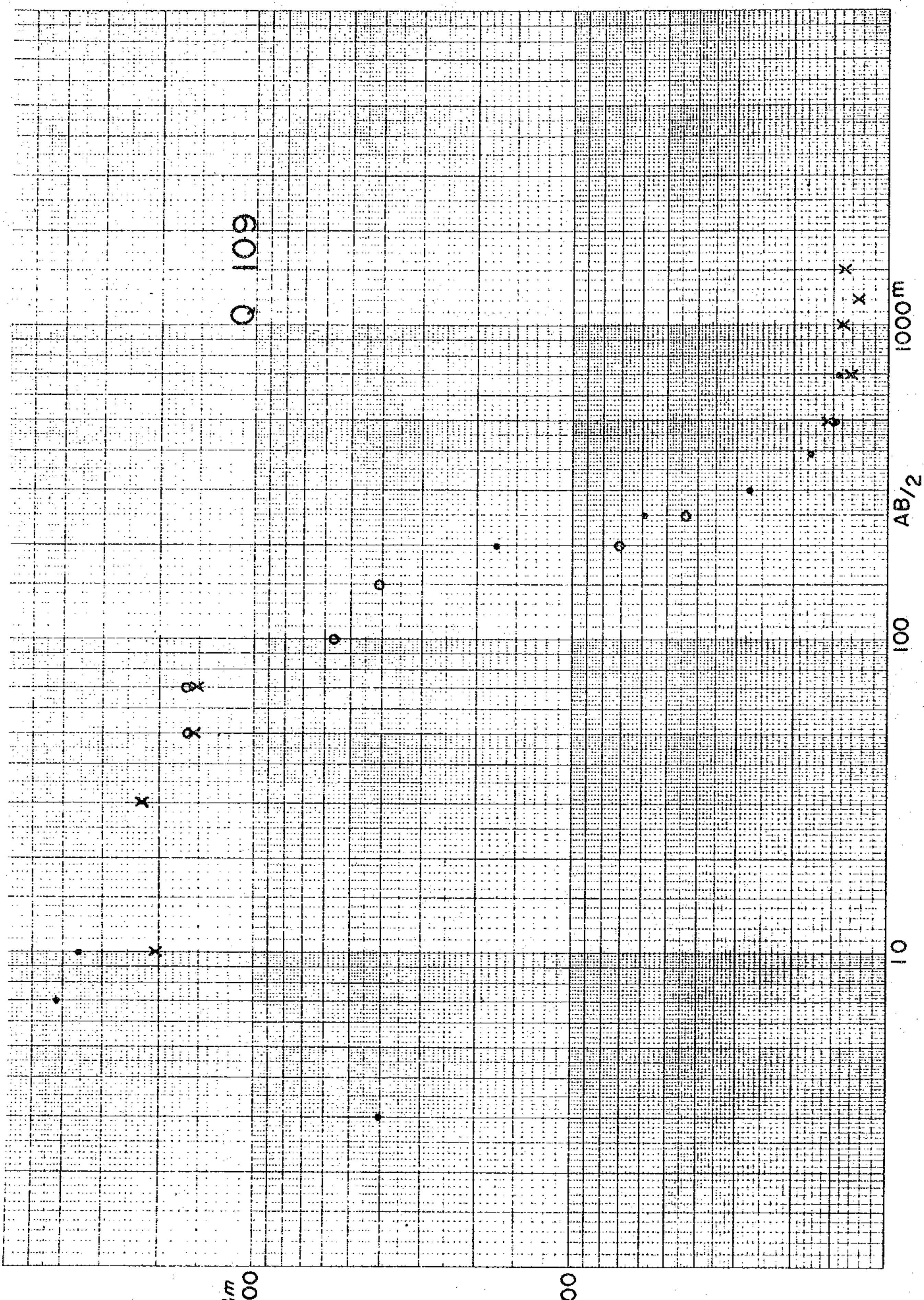
10
Ωm
1000
100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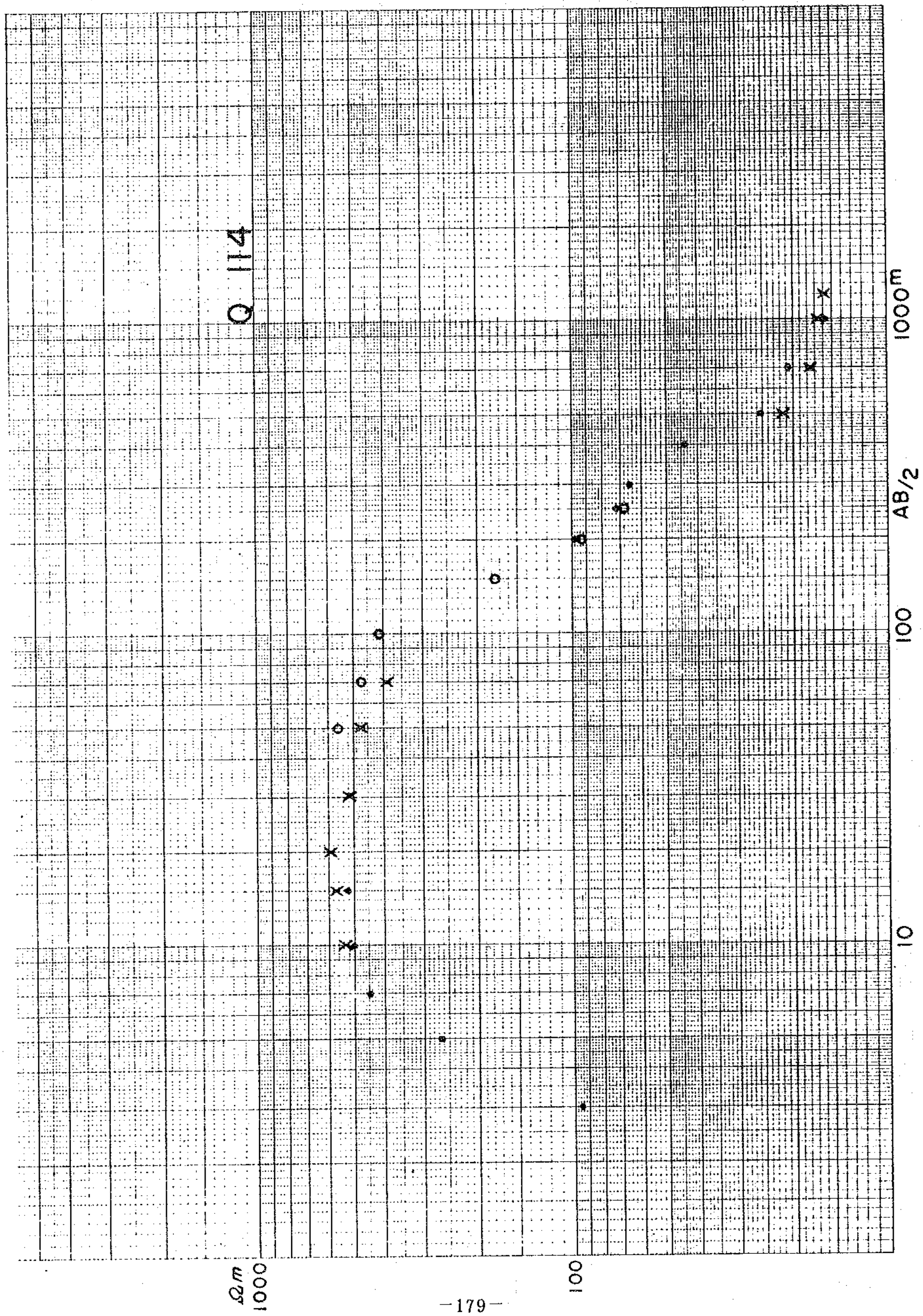
1000m
100
10
AB/2
Ωm
1000
100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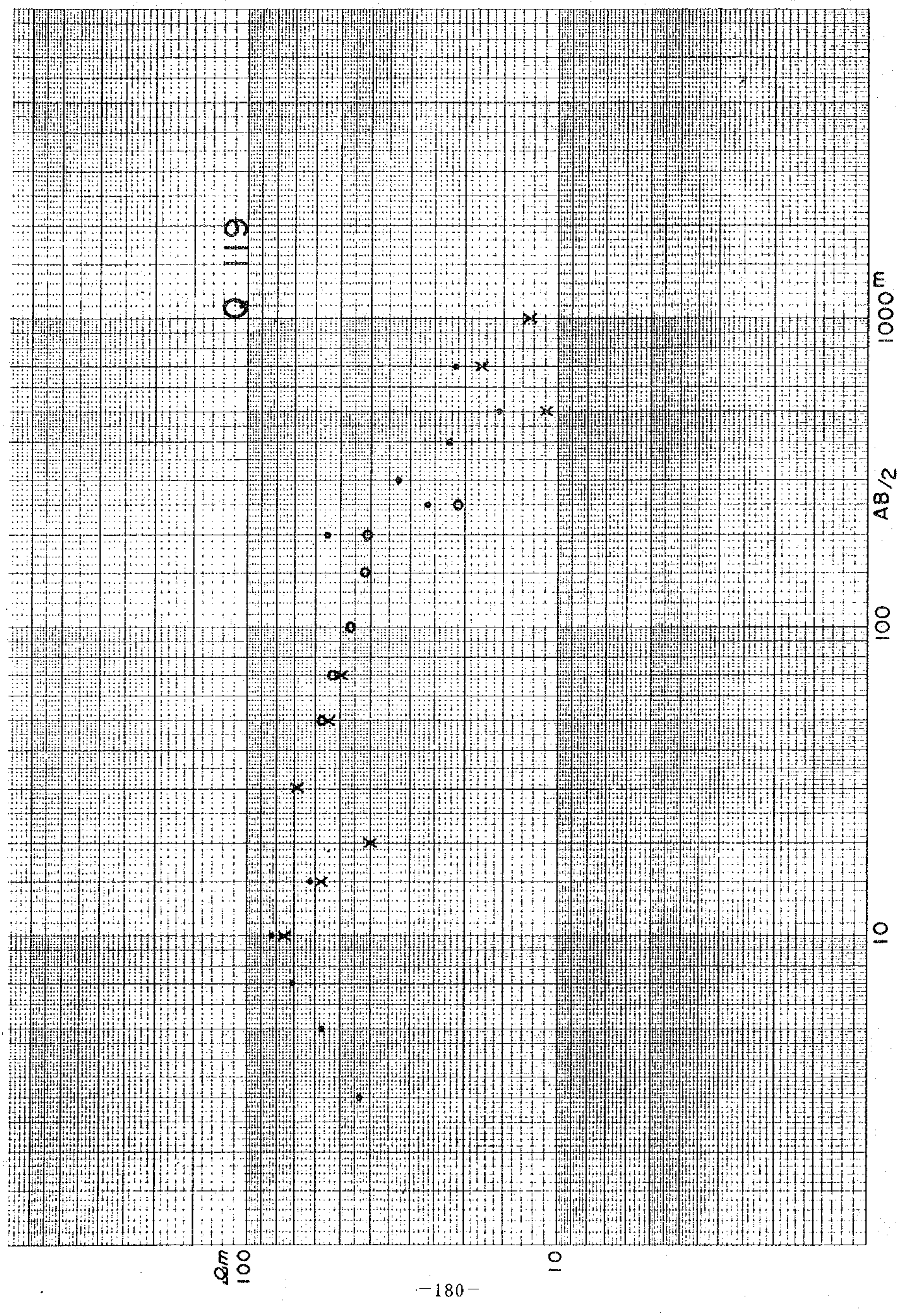
1000m
AB/2
100
10
Ωm 1000
100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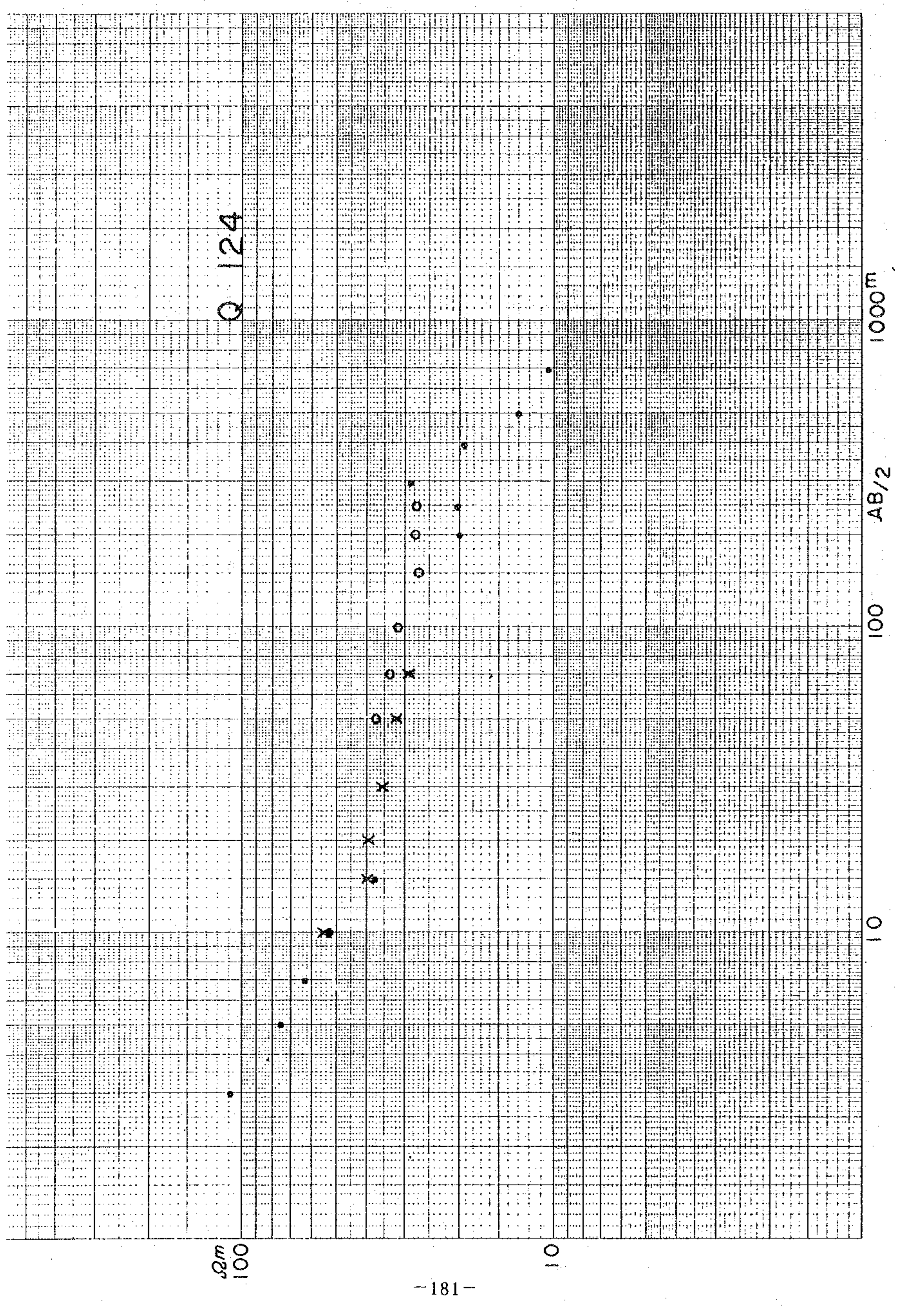
AB/2
10
100
1000m
Ωm
100
10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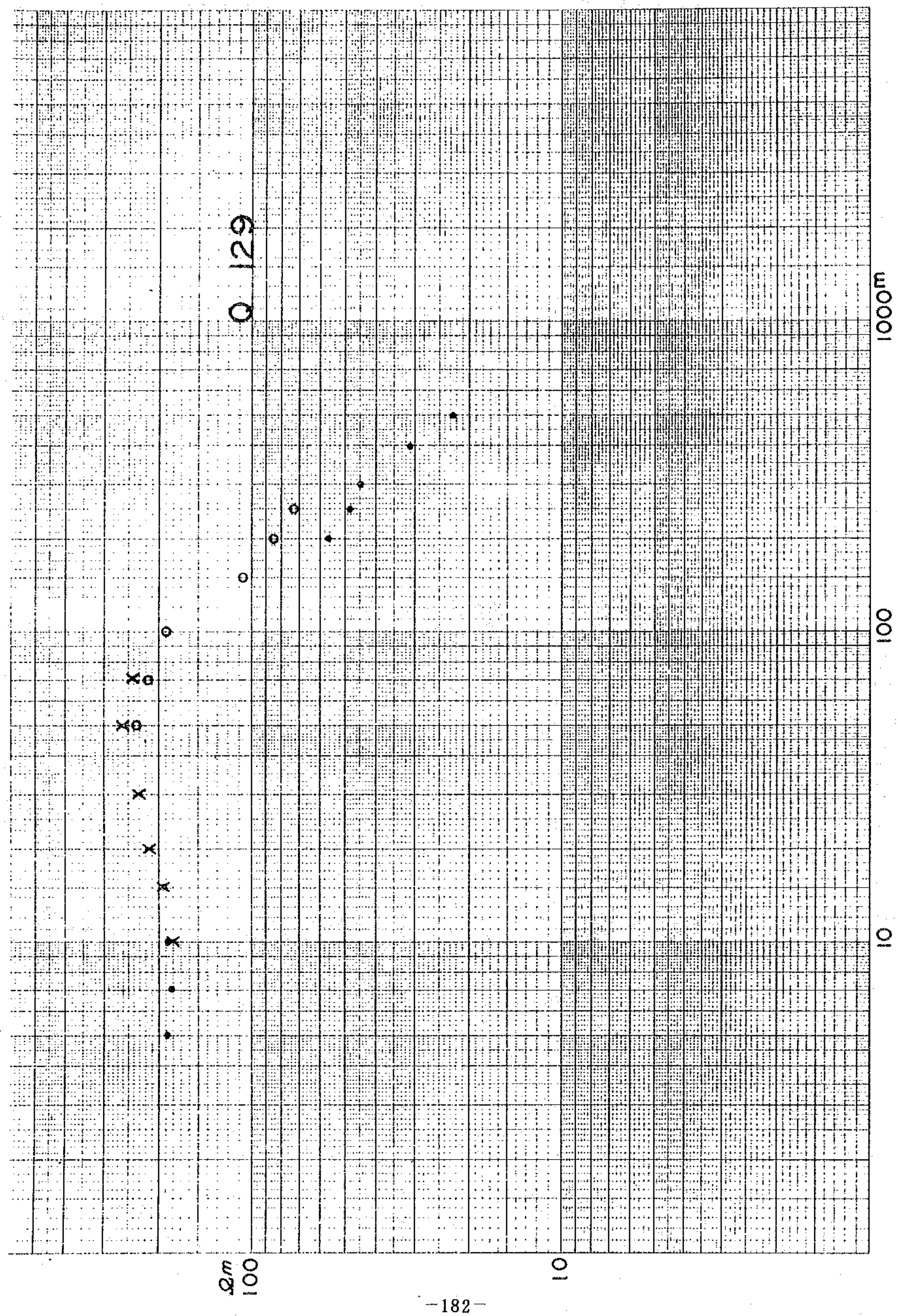
1000m
AB/2
100
10
Ωm
100
10


Q 129
1000m
100
10
Ωm 100
10

V. ROCK ALTERATION SURVEY

CHAPTER 1 INTRODUCTION

The present status of geothermal exploration in Kenya has been reported by Noble and Ojiambo (1975). According to them, geological, geophysical and geochemical surveys were carried out in three of the most promissing area, that is Lake Bogoria, Eburru and Olkaria by the Unite Nations Development Program (UNDP). As the result, Olkaria, about 100 km northeast of Nairobi, was given first priority for geothermal exploration in Kenya. Thus a first geothermal power plant (15 MWe) in Africa will be completed by 1981 and another (15 MWe) unit is planned in 1983 by East African Power and Lighting Company Limited (EAP & L).

On the other hand, a geothermal exploration project was started in 1979 at Eburru, 30 km north of Olkaria, as a joint project between the Governments of Kenya and Japan.

The purpose of the present report is to describe the rock alteration carried out between November, 1980 and February, 1981, as one of geological survey in the Eburru geothermal field.

CHAPTER 2 GEOLOGICAL SETTING

The Rift Valley was formed by two times of major faulting in late Miocene and late Pliocene. The geothermal systems of the Rift Valley are located within Miocene to Recent volcanic rocks covering unconformably the Precambrian basement rocks.

There are many active volcanoes such as Menengai, Ol Doinyo Eburru, Longonot and Ol Doinyo Nyukie (Suswa) in the Rift Valley. The Eburru geothermal field in question is situated on the active volcano of Ol Doinyo Eburru which is classified into a compound volcano. According to the "Catalogue of the active volcanoes and solfatras of the world (1957)", the volcano of Ol Doinyo Eburru consists of an E–W stretching volcanic body, and no eruptions have been recorded since the first explorers reached the interior of East Africa.

The geology of this area has been reported by Thompson and Dodson (1963). Naylor (1971, 1972 unpub.) also reported in detail the geology of Eburru as well as those of Lake Bogoria and Olkaria for geothermal exploration project carried out by the UNDP. Satoh (1981) investigated the geology of the Eburru geothermal field for the present project and geology will be described in detail in II. According to Satoh, outline of the geology is as follows:

The Ol Doinyo Opuru Pumice – Fall Deposits (more than 20 m in thickness) are widely distributed in the Eburru geothermal field overlying the Formations of Welded Tuff and Phonolite & Comendite of Pleistocene in age. It is intruded by numerous dykes of banded obsidian extending N – S direction, and it is covered by the Obsidian Lava Flow Formation in the western area. Some obsidian lava domes and volcanic ash cones are found around Cedar Hill which is composed of obsidian lava dome (1.3 km in width). The Older Badland Basalt Formation consisting of olivine basalt is distributed near Eburru Station. The Younger Pumice-Fall Deposits covered the surface in this field.

CHAPTER 3 OUTLINE OF GEOTHERMAL ACTIVITIES

There are many thermal manifestations such as fumaroles and hot grounds with alteration halo in the Eburru Geothermal Prospect (P1. V – 1). They are found around explosion craters of the active volcano of Ol Doinyo Eburru. They are also found along the faults extending N – S direction in the northern foot area of the volcano. The IR survey conducted by the UNDP shows about 170 thermal patches of ground. It cannot, however, detect any thermal manifestations in the south, west and east areas of the volcano. We cannot also find any hot-springs on the surface because of the lack of water.

The heat discharged area is about 45 km^2, and the natural heat discharge is estimated to be 31,000 Kcal/sec which is equivalent to 130 MWt by the UNDP report.

Natural steam is utilized by the local people to get condensed water and to dry pyrethrum flowers.

CHAPTER 4 SPECIMENS AND METHOD OF STUDY

A field work was carried out for mapping of alteration zone, sampling of altered rocks and check of the ground temperature. About 160 rock samples were collected from the Eburru geothermal field and samples for X-ray analysis are prepared as follows:

The rock sample is crushed into fine powder less than 60 mesh in a stainless mortar and the fine powder is ground in an agate mortar for five minutes. About 70 samples* thus obtained were analyzed by means of an X-ray diffractometer "MINIFLEX" of the Ministry of Energy, Kenya.

Experimental conditions are as follows:

Radiation Cuk ($\lambda = 1.5418$Å), voltage 30KV (fixed) current 10 mA (fixed), time constant 1 sec., full scale 500 or 1000 cps, scanning speed 2°/min., chart speed 20 mm/min.

* One hundred samples were separately examined by an X-ray deffractometer in Japan for detailed identification of alteration product. The result is given in Appendix 1.

CHAPTER 5 ALTERATION PRODUCTS

Although further examination are actually required to determine the mineralogical properties, alteration products confirmed by X-ray powder diffraction method are as follows:

Clay minerals:	Montmorillonite, kaolinite, halloysite, allophane
Silica Minerals:	Quartz, α-cristobalite, β-cristobalite
Carbonate Mineral:	Calcite
Zeolite:	Clinoptilolite or heulandite

The rock alteration in the Eburru geothermal field can be divided into five zones and one distribution area on the basis of mineral association.

Zone I	:	Kaolinite (well-crystallized) – β-cristobalite – quartz
Zone II	:	Kaolinite (well-crystallized) – quartz
Zone III	:	Kaolinite (well-and/or poor-crystallized) – quartz
Zone IV	:	Halloysite and/or allophane
Zone V	:	Montmorillonite

Distribution area of sinter (calcite).

Sulfide and sulfate minerals such as pyrite, alunite and gypsum were not at all recognized so far in this field.

CHAPTER 6 ZONAL DISTRIBUTION OF ALTERATION ZONES

Zonal distribution map of alteration zones is shown in Pl. V – 2.

Zone I is characterized by the presence of well-crystallized kaolinite, β-cristobalite and quartz, and it indicates the highest grade of alteration in this field because of the presence of β-cristobalite.* High temperature minerals such as diaspore, pyrophyllite and dickite could not be, however, detected in this zone. Zone I occurs quite locally in the Eburru Crater area.

Zone II is characterized by the presence of well-crystallized kaolinite and quartz, and it is distinguished from Zone I by the absence of β-cristobalite. Zone II is distributed in the Eburru Crater area surrounding Zone I. Silicified rock and quartz vein are locally found in Zones I and II, and several kaolin deposits are in operation in both zones.

Zone III is characterized by the presence of well-crystallized and/or poor-crystallized kaolinites and quartz. It extends from west to east in the Eburru Crater area surrounding Zone II.

Zone IV is characterized by the formation of halloysite and/or allophane. It is distinguished from Zone III by the disappearance of kaolinite. Zone IV is found in the northern foot of the Eburru Crater area extending N–S direction along the faults whereas Zones II and III extends in W–E direction which is nearly parallel to the alignment of explosion craters in the Eburru Crater area.

* α-cristobalite is experimentally transformed into β-cristobalite by heating between 220°C and 280°C.
α-cristobalite is also transformed into quartz under the condition lower than 100°C in the geothermal field.

Zone V is characterized by the formation of montmorillonite. This zone occurs in the northern area of Zone IV and it seems to disappear at the northeast of Eburru Station in which the thermal patches of ground detected by IR survey also disappear.

Distribution area of sinter (calcite) is found in Zone V near Eburru Station. Sinter mainly occurs filling cavities of porous scoria of the Older Badland Formation.

As shown in Pl. V – 2, these alteration zones give a zonal arrangement from center (Zone I) to margin (Zone V) in the northern area of Eburru Crater. The distribution of alteration zones is, however, restricted to the southern area of Eburru Crater.

CHAPTER 7 DISCUSSION

As mentioned above, the distribution of alteration zones shows a zonal arrangement from Zone I (center) to Zone V (margin). Zones I and II in the Eburru Crater area give intense rock alteration because of the predominant presence of well-crystallized kaolinite. Occurrence of β-cristobalite suggests that Zone I was produced under the high temperature condition between 200°C and 300°C. Although Zones I and II show an acid-leached zone, such superficial leached halo can be caused by not only acidic solution but also vapor. In this case, it is considered that both zones would be produced by vapor rather than acidic solution, because any hot-springs cannot be observed on the surface in this area.

On the other hand, Zone V in the margin area is characterized by the presence of low temperature products such as montmorillonite and α-cristobalite. Zeolite and calcareous sinter (calcite) are also found in this zone. In general, these alteration products are formed by low temperature alkaline water.

As stated already, Zones I, II and III are distributed in the Eburru Crater area, which is nearly located at the center of the active volcano of Ol Doinyo Eburru with E – W stretching volcanic body. On the contrary, Zones IV and V are distributed along or parallel to the faults extending N–S direction in the northern foot of the Eburru Crater area.

Judging from the above facts, although the scientific information is more limited, the geothermal system in this field can be explained as follows:

In the light of the distribution of alteration zones, it is suggested that the center of heat source such as magma reservoir is in the vicinity beneath the Eburru Crater area. This hypothesis is also supported by the distribution of explosion craters of the Ol Doinyo Eburru and the gas analysis data carried out by the UNDP which show low air contamination in this area.

The deep water beneath the Eburru Crater area becomes a brine by dissolved substances under the conductive heat from the magma reservoir. With time, channels of inflowing water are narrowed or diminished by precipitation of alteration products. Such under self-sealing condition, a vapor dominated system containing liquid water and vapor coexisting is formed above the brine. Vapor from brine is superheated above the water table. The superheated vapor and other gases (CO_2, CH_4 and H_2S) rise in the outlet channels with decreasing temperature and pressure. Finally they discharge at the surface from fumaroles. Altered zone is formed by reaction of vapor and/or water derived from condensing steam rich in CO_2 with rock silicates. Thus the leached zones such as Zones I and II were formed in the Eburru Crater area.

On the other hand, the hot brine rising in the Eburru Crater area gradually flows down to the Eburru Station area. It flows from south to north along the water table with decreasing temperature, and steam from the hot brine issues along the faults extending N – S direction. Finally the hot brine would approach nearest to the surface in the Eburru Station area, though any hot-springs cannot be found. Thus Zone V, which is characterized by the presence of calcite and zeolite in association with montmorillonite, was formed in the Eburru Station area. Zone V is characteristic of alteration by hot-water geothermal system.

Although available data are scanty, it is concluded that the Eburru geothermal field has a vapor-dominated geothermal system after White et al. (1971). However, as there are no information on the geology of reservoir in the Eburru geothermal field, additional geological, geophysical and geochemical surveys including drilling are actually required in the future before exploitation.

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Thompson, A.O. and Dodson, R.G. (1963) Geology of the Naivasha area. Geological Survey of Kenya.

White, D.E., Muffler, L.J.P. and Truesdell, A.H. (1971) Vapor-dominated hydrothermal systems compared with hot-water systems. Econ. Geol., Vol. 66 75–97.

IV. SURVEY OF WATER SUPPLY FOR DRILLING

Lost circulation of drilling fluid occurs frequently when a drill hole encounters faults or fissures in a geothermal area. An outburst also occurs when a hole approaches a geothermal reservoir. Therefore, a well may need to be drilled blindly and may need to be cooled by large amount of water being pumped in when there exists an indication of steam blowout.

Necessary amount of water for drilling a 1500 meter well is calculated and possible water source and ways of its transportation are studied.

1. Calculation of Required Amount of Drilling Water for 1500 meter Well

1.1 Water for Drilling

In order to take cuttings out of a well, certain annular velocity of drilling liquid must be maintained. For fresh water as drilling liquid, annular speed must be over 0.9 m/sec (54 m/min) and usually is about 80 m/min. Actually, mud is used for drilling fluid instead of fresh water. If specific gravity and viscosity of drilling mud is well controled, water consumption for drilling can be minimized.

We assumed that when a well is drilled, loss of circulation of drilling mud is deligently prevented and we estimated that an amount of necessary water for supplement of lost returns and for controling specific gravity of drilling mud is as follows:

tri-cone bit drilling	54 tons of water per day
wire line drilling	10.8 tons of water

1.2 Capacity of Water Storage

In order to prepare for blind drilling, sudden temperature rise and/or blowout, a water reservoir must be built at a drilling site. A capacity of the reservoir is estimated as follows:

Supplementary water for drilling	54 tons
Clean out water for cementing	10 tons
Water for blind drilling	20 tons
Water for controling blowout	100 tons
Reserve	200 tons
Total	384 tons

Effective water of the water reservoir is assumed to be 80% and we get:

$$\frac{384 \text{ tons}}{0.8} = 480 \text{ tons} \approx 500 \text{ tons}$$

As stated above, it is needed to build a water reservoir with a capacity of 500 tons at a drilling site.

2. Source of Water Supply

As a source of water supply, we studied the following three:

(i) Use excessive water of neighboring irrigation wells,

(ii) Drill a new water well, and

(iii) Pump water from Naivasha Lake.

When we discussed possibility of water supply with the owner of neighboring irrigation wells, he explained that there is no excessive water from his wells. Therefore, even if we drill a new water well, it may cause some decline of water supply for the existing wells.

In this report, it is assumed that Naivasha Lake is the only possible fresh water supply for drilling a deep exploratory well in Eburru.

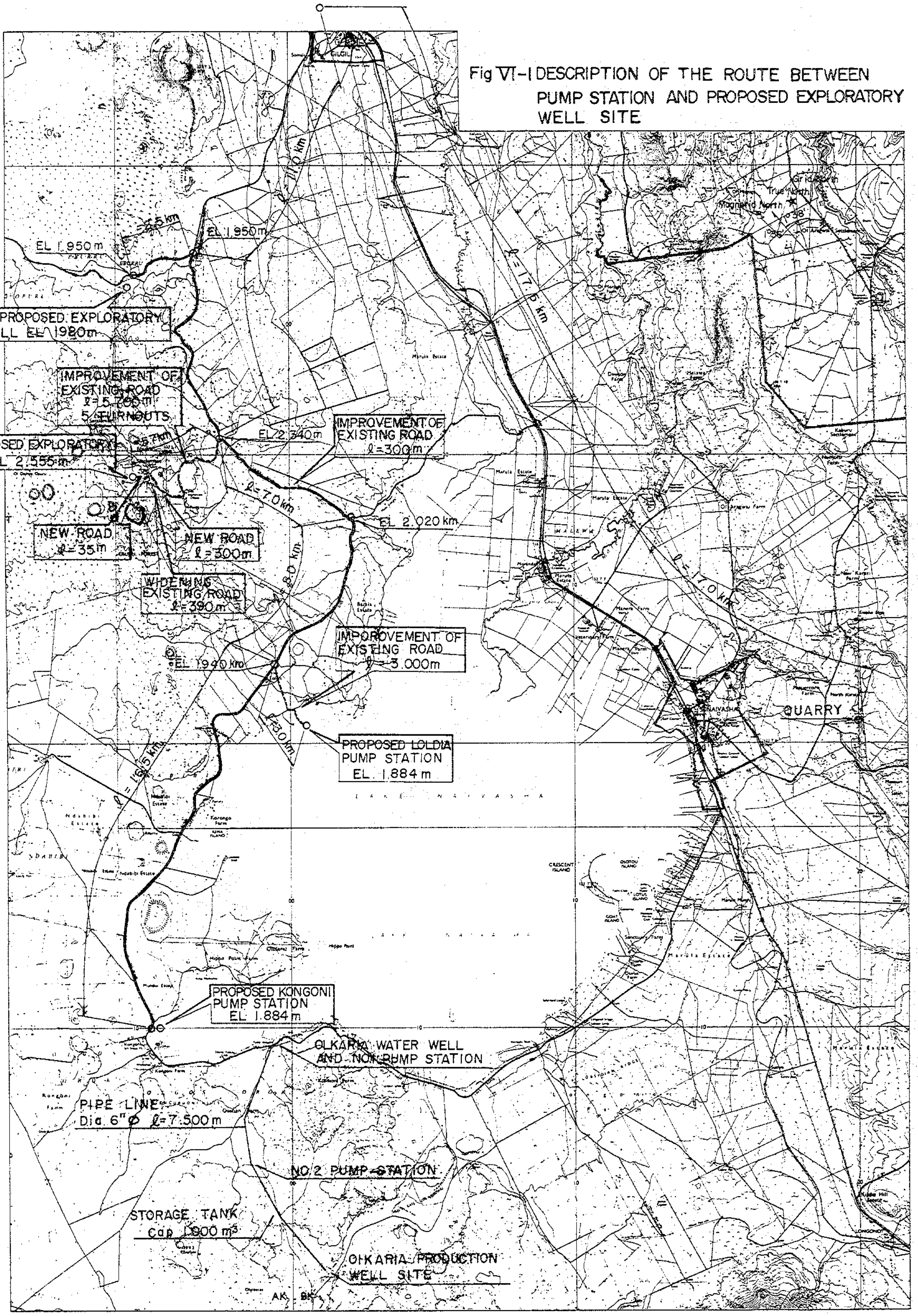
3. Transportation of Water

For transporting water from Naivasha Lake to the drilling site in Eburru, we studied the two methods which are by lorries through Eburru road and by pipe line.

(1) If we consider only drilling 400 meter wells and exploratory 1,500 meter wells, it is more economical to transport water by lorries.

(2) When considering living water of inhabitants in Eburru and exploitation of a geothermal field in Eburru, it is necessary to transport water by pipe line.

Fig VI-1 DESCRIPTION OF THE ROUTE BETWEEN PUMP STATION AND PROPOSED EXPLORATORY WELL SITE



APPENDIX

I X-RAY DIFFRACTION DATA FOR ALTERED ROCKS

Appendix 1

X-ray Diffraction Data for Altered Rocks

No.	Sample No.	Lithology \ Minerals	Silica minerals				Altered minerals								Sulfates & carbonates				Others				Primary minerals						
			α–Cristobalite	β–Cristobalite	α–Quartz		Allophane (amorphous)	Montmorillonite	Montmorillonite/Kaolinite	Kaolinite	Pyrophyllite	Boemite	Clinopilolite		Alunite	Alunogen	Calcite		Magnetite	Hematite	Marcasite	Sinhalite	Feldspar	Hornblende	Aenigmatite	Augite	Acmite	Mica	
1	E–2	clay (white)			◎					◎																			
2	E–3	clay (reddish brown)			△		△	○		△													△						
3	E–4	clay (brownish white)		◎	△					◎																			
4	E–5	clay (yellowish grey)			△			◎		◎													•						
5	E–6	clay (white)			◎					◎																			
6	E–7	altered rock (brownish grey)			◎			△		△													○						
7	E–9	porous altered rock (pinkish brown)			◎			△															○	•					
8	E–11	clay (white)			◎					◎																			
9	E–14	porous altered rock (white)		◎	△					○	?																		
10	E–15	silicified rock (white)		◎	△					◎																			
11	E–16	argillized rock (white)			△					◎																			
12	E–18	altered rock (yellowish brown)		○	◎						?												○						
13	E–20	obsidian (dark green)			○																		◎	△				•	
14	E–21	clay (yellow)			◎					△													△	△					
15	E–22	porous altered obsidian (dark green)			◎			△		•													○	△					
16	E–23	porous obsidian (pale green)			△		•				?												○	△					
17	E–26	porous obsidian (dark green~dark brown)			○																		○	△					
18	E–28	obsidian (greenish grey)			◎																		○	○					
19	E–30	obsidian (yellowish grey)			△		•		•				•										○	•				•	
20	E–31	altered obsidian (yellowish brown)			•		△																△						
21	E–33	porous altered obsidian			○				△														◎	○			△		
22	E–34	pumice					△			•													△						
23	E–36	obsidian (brown)			○				•														○	△				•	
24	E–37	obsidian			△		•																○	○					

X-ray Diffraction Data for Altered Rocks

No.	Sample No.	Minerals / Lithology	Silica minerals				Altered minerals								Sulfates & carbonates				Others				Primary minerals						
			α–Cristobalite	β–Cristobalite	α–Quartz		Allophane (amorphous)	Montmorillonite	Montmorillonite/Kaolinite	Kaolinite	Pyrophyllite	Boemite	Clinoptilolite		Alunite	Alunogen	Calcite		Magnetite	Hematite	Marcasite	Sinhalite	Feldspar	Hornblende	Aenigmatite	Augite	Acmite	Mica	
25	E–38	clay (pale yellowish grey)			•			○															△	◎					
26	E–40	ditto			△			◎															△	△					
27	E–41	clay with brownish stain			△				◎														△	△				•	
28	E–42	clay (reddish brown, partly yellowish grey)			△				○	△													△						
29	E–43	obsidian (pale greenish grey)			○																		○				○		
30	E–48	porous obsidian (dark grey)			△		•												△				○	△					
31	E–50	porous silicified rock (reddish brown)	△		◎					○										•			△						
32	E–52	porous obsidian (dark greenish grey)	•		△		•																○	△					
33	E–54	porous obsidian (pale yellow)	○		○				△													?	◎	○					
34	E–55	porous obsidian (grey)			○																		◎	◎					
35	E–56	obsidian (black)			△		•																△	△					
36	E–57	clay (yellowish brown)			△			◎															○	○					
37	E–60	obsidian (dark green)			◎					•													○	○					
38	E–61	porous altered rock (brownish grey)			△		○		•														△	•					
39	E–63	clay (pale green~grey)			◎			○		◎										•									
40	E–66	porous clay (grey)			◎			△															○	○					
41	E–67	clay (reddish brown)			○					○										△			○						
42	E–68	argillized pumice (yellowish green)			◎				△	•													○	○					
43	E–69	argillized pumice (yellowish grey)			○				○	○													○	○					
44	E–71	weakly argillized pumice (reddish brown)			△		△																•						
45	E–73	argillized pumice (dark reddish brown)					•		○	•										•									
46	E–74	porous altered obsidian (dark yellowish grey)			△			◎															◎	△					
47	E–75	porous obsidian (dark grey)			◎					△													◎	○					
48	E–76	obsidian (reddish brown)			◎															△			◎						

X-ray Diffraction Data for Altered Rocks

No.	Sample No.	Lithology \ Minerals	Silica minerals			Altered minerals							Sulfates & carbonate			Others				Primary minerals					
			α–Cristobalite	β–Cristobalite	α–Quartz	Allophane (amorphous)	Montmorillonite	Montmorillonite/Kaolinite	Kaolinite	Pyrophyllite	Boemite	Clinopilolite	Alunite	Alunogen	Calcite	Magnetite	Hematite	Marcasite	Sinhalite	Feldspar	Hornblende	Aenigmatite	Augite	Acmite	Mica
49	E–77	argillized obsidian (dark reddish brown)			◎				△								△			○					•
50	E–80–2	obsidian (greenish grey)			◎															○				△	
51	E–81	porous basalt (dark brown)			•		◎								○		△						○		
52	E–83	ditto					○										△			◎			△		
53	E–85	obsidian (bluish grey)			◎															◎	○			△	
54	E–89	phonolite (yellowish grey~brown)			◎				•											○	△				•
55	E–91	argillized obsidian (brown)			◎												•			◎					
56	E–93	porous basalt																		◎			○		
57	E–95	altered rock (reddish brown)			○			△									△			◎	△				
58	E–97	argillized obsidian (yellowish brown)					○													◎					
59	E–98	altered obsidian (pale yellow~brown)			◎															○					
60	E–99	porous altered obsidian (reddish brown)			○												•			◎	•				
61	E–100	porous obsidian (dark green)			○			•									•			◎	△	△			
62	E–101	argillized obsidian (reddish brown)			△			△	△								△			○	△				
63	E–104	argillized obsidian (brown)		△	◎	△									△										
64	E–105	weakly argillized obsidian (yellowish~reddish brown)						◎				○													
65	E–106	strongly argillized obsidian (brown)						◎	•																
66	E–108	porous basalt					○													◎			○		
67	E–109	argillized obsidian (bluish white)			○				◎																
68	E–110	clay (grey)			○				◎		○														
69	E–111	clay (white)							◎																
70	E–112	clay (pinkish white)			○				◎																
71	E–113	clay (white)			△				◎																
72	E–115	porous argillized rock (white)			△				◎	?															

X-ray Diffraction Data for Altered Rocks

No.	Sample No.	Lithology \ Minerals	Silica minerals				Altered minerals								Sulfates & carbonates				Others					Primary minerals					
			α–Cristobalite	β–Cristobalite	α–Quartz		Allophane (amorphous)	Montmorillonite	Montmorillonite/Kaolinite	Kaolinite	Pyrophyllite	Boemite	Clinopilolite		Alunite	Alunogen	Calcite		Magnetite	Hematite	Marcasite	Sinhalite		Feldspar	Hornblende	Aenigmatite	Augite	Acmite	Mica
73	E–116	porous argillized rock (white)			◎					◎					◎														
74	E–117	ditto			△		△			◎																			
75	E–118	weakly altered obsidian (black)					•			•																			
76	E–119	strongly altered obsidian (reddish brown)			•					△										•				•					
77	E–121	porous altered obsidian (pale yellowish grey)	◎							•														○	○				
78	E–122	porous altered obsidian (dark brown)					•			•														•					
79	E–123	porous obsidian (dyke)			◎				△											△				◎	•	•			
80	E–124	banded obsidian (dyke)							○															◎					
81	E–125	weakly altered obsidian (dyke)	○		○			○																◎	△				
82	E–126	strongly altered obsidian (yellowish brown)	◎		○			○																○					
83	E–128	porous obsidian (pale green)		△	•		•			•										△				△					
84	E–130	spotted, argillized pumice (yellowish grey~reddish brown)			△			◎		•														△					
85	E–131	banded, altered obsidian (pale green)	◎		•																			△	△				
86	E–132	argillized obsidian (reddish brown)			△				•	○										△				△					
87	E–134	porous altered obsidian (greenish grey)			◎																			○	△			△	
88	E–135	porous altered obsidian (grey)	△		△																			○	△				
89	E–136	porous basalt (reddish brown)							•											△				◎			◎		
90	E–137	porous argillized rock (white)	○		◎					◎																			
91	E–139	ditto			◎					◎																			
92	E–140	porous silicified rock (greenish grey)	△	◎	◎					○																			
93	E–143	clay (pale grey)			○					○					◎														
94	E–146	altered silicified rock (white)		◎	△					○																			
95	E–147	clay (pinkish white)		◎	○					◎																			
96	E–148	altered rock (white)			○					○						△													

X-ray Diffraction Data for Altered Rocks

No.	Sample No.	Lithology \ Minerals	Silica minerals			Altered minerals						Sulfates & carbonates			Others				Primary minerals					
			α–Cristobalite	β–Cristobalite	α–Quartz	Allophane (amorphous)	Montmorillonite	Montmorillonite/Kaolinite	Kaolinite	Pyrophyllite	Boemite	Clinopilolite	Alunite	Alunogen	Calcite	Magnetite	Hematite	Marcasite	Sinhalite	Feldspar	Hornblende	Aenigmatite	Augite	Acmite	Mica
97	E–149	altered silicified rock (white)		◎	△				○																
98	E–150	porous argillized rock (white)		◎	△				○																
99	E–152	porous silicified rock (white)	◎	△	○				◎																
100	E–153	clay (white)							◎																
101	E–33				○				△											◎	○			△	
102	E–42				△				○	△										△					
103	E–55				○															◎	◎				
104	E–73					•			○	•						•									
105	E–98				◎															○					
106	E–106								◎	•															
107	E–112				○					◎															
108	E–128			△	•	•				•							△			△					
109	E–148				○					○			△												
110	E–152		◎	△	○					◎															

Symbols : ◎ abundunt, ○ common, △ a little, • rare, ? uncertain