Evaluation of basalt samples (17,859' - 17,888') from the Husky Oil NPRA Tunalik No. 1 well, Western Alaska.

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Shell Development Company
A Division of Shell Oil Company

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Houston, TX 77025

December 30, 1991

Mr. D. M. Worrall
Chief Geologist
Shell Western E&P Inc.
P. O. Box 4252
Houston, TX 77001-4252

Dear Mr. Worrall:

REFERENCE: SHELL OIL COMPANY/SHELL WESTERN E&P INC. RESEARCH AGREEMENT

At your request members of our staff examined basalt samples from the Tunalik #1 well, western Alaska, for stratigraphic control. The primary goals were to determine whether the basalts were intrusive or extrusive and if K/Ar age dating was viable. Textural relations indicate that the basalts were quenched and therefore cooled at or near the earth's surface. K/Ar dating will not yield reliable results due to the absence of K-bearing minerals and the high degree of alteration in the basalts. The age of the basalt is therefore best constrained by its stratigraphic position.

Thin section photomicrographs along with a more detailed discussion are forwarded to R. R. Smith.

Very truly yours,

Dean N. Malouta
Manager Geology Research

TRT:rml

Enclosure

cc: Shell Western E&P Inc.
R. R. Smith (w/o enclosure)

EVALUATION OF BASALT SAMPLES FROM THE HUSKY OIL NPRA TUNALIK NO. 1 WELL, WESTERN ALASKA

T. R. Taylor
Reservoir Geology Section

L. T. Bryndzia
Basin Analysis Section

L. Garmezy
Structure and Tectonics Section

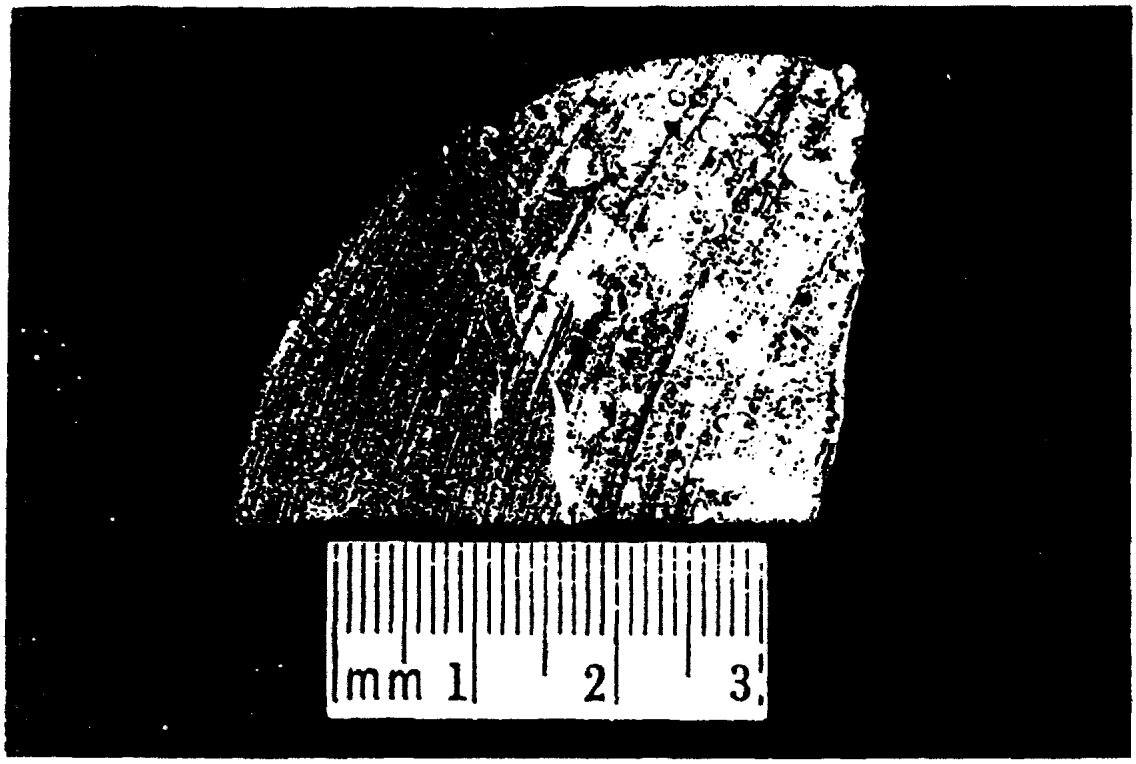
Purpose: At the request of SWEPI Alaska Division Exploration six core samples of basalt from the Husky NPRA Tunalik #1 well were examined in hand sample and thin section. The samples were taken from depths of 17,859' to 17,888' and are underlain and overlain by sedimentary rocks of Permian age. These igneous rocks are of interest for their potential use in regional stratigraphic calibration and prediction. Three questions were addressed in this study: 1) Are these basalts extrusive, having cooled at or near the earth's surface or are they intrusive having crystallized at depth? 2) If the basalts are extrusive, did they crystallize on the seafloor or on land? 3) Can the basalts be dated using K/Ar techniques and are previously determined K/Ar data reliable?

Sample Description: All the samples examined are relatively fine-grained, amygdaloidal basalt. The original mineralogy consisted of acicular plagioclase, olivine, pyroxene, an opaque phase (magnetite? ilmenite?), and glass. The samples exhibit varying degrees of alteration. The alteration products are chlorite, calcite and quartz. Pyroxene phenocrysts are commonly altered to chlorite, often from the core outward. Fresh pyroxene is relatively rare. Irregular patches of chlorite and radial fibrous chlorite that lines amygdules most likely formed by hydration of glass. In rare occurrences, glass remains in a relatively unaltered state. Amygdules are filled with calcite, chlorite or in some cases quartz. Calcite-filled veins are also present.

K/Ar Dating: Due to the high degree of alteration and the absence of K-bearing minerals such as amphiboles, plagioclase represents the only phase from which a K/Ar date could be derived. Four K\Ar ages were previously determined from plagioclases by the University of Alaska. The ages are Tertiary (50.3 m.y., 50.4 m.y.), Jurassic (186 m.y.), and Devonian (385 m.y.). None of the ages can be considered as a reliable crystallization age for the basalt. The two youngest ages, although overlapping within the errors of the technique, are from altered plagioclases with K_2O values of 2.095%, far in excess of that in pristine diabasic plagioclase. Typical values are less than 0.3%. Therefore, most of the argon that is measured is from potassium added to the system during alteration. The unreliability of the data is also reflected in the radiogenic yields of the samples. Good K/Ar data has radiogenic yields of over 90%. The lower values reported in these analyses (51 - 67%) suggest that a great deal of the argon is coming from extraneous sources.

Synthesis: The textural relationships seen in thin section, most notably the abundance of acicular plagioclase and the presence of glass, are indicative of very rapid cooling (quenching). It is likely that the basalts were either extruded at the surface or emplaced at a very shallow level. Given the size of

the samples, it is difficult to determine whether extrusion was on the seafloor or on land. Previously determined K/Ar ages are unreliable and due to the altered nature of the basalts no further age dating is recommended. The age of the basalt is best constrained by its stratigraphic position.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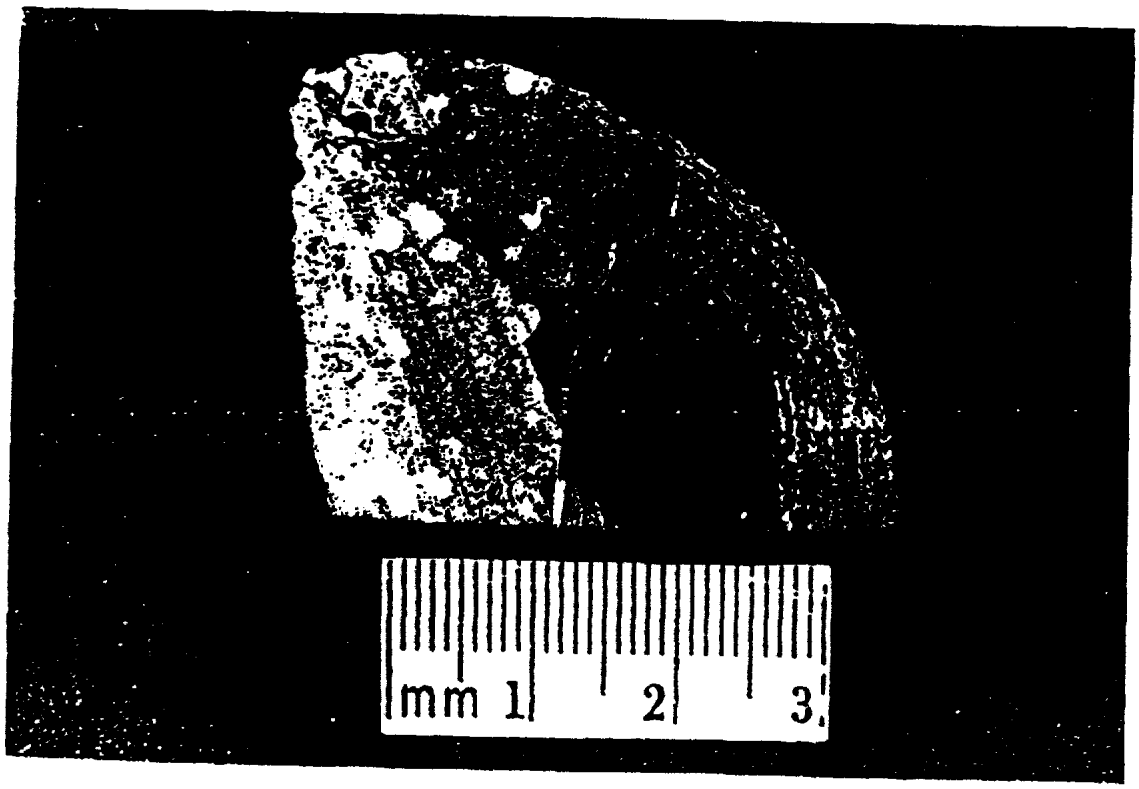
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USGS/NPR-A
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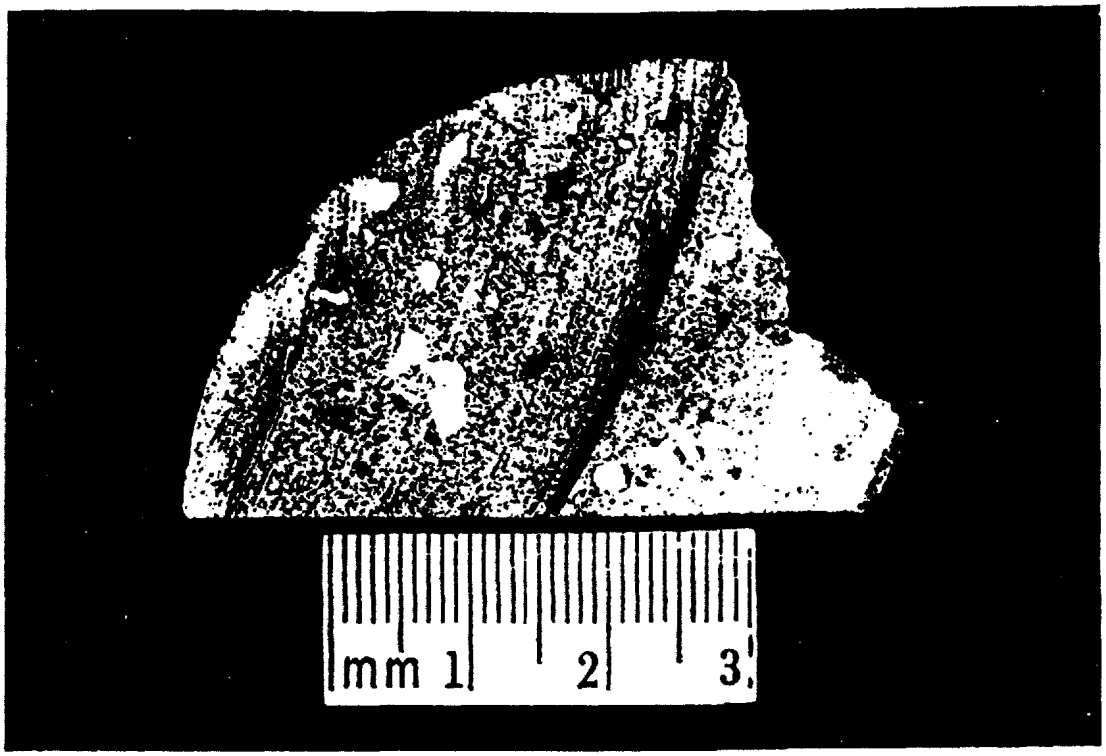
FLAT SIDE

USGS/NPR-A
HUSKY, TUNALIK NO. 1
17859.5±, 1.9X
ROUGH SIDE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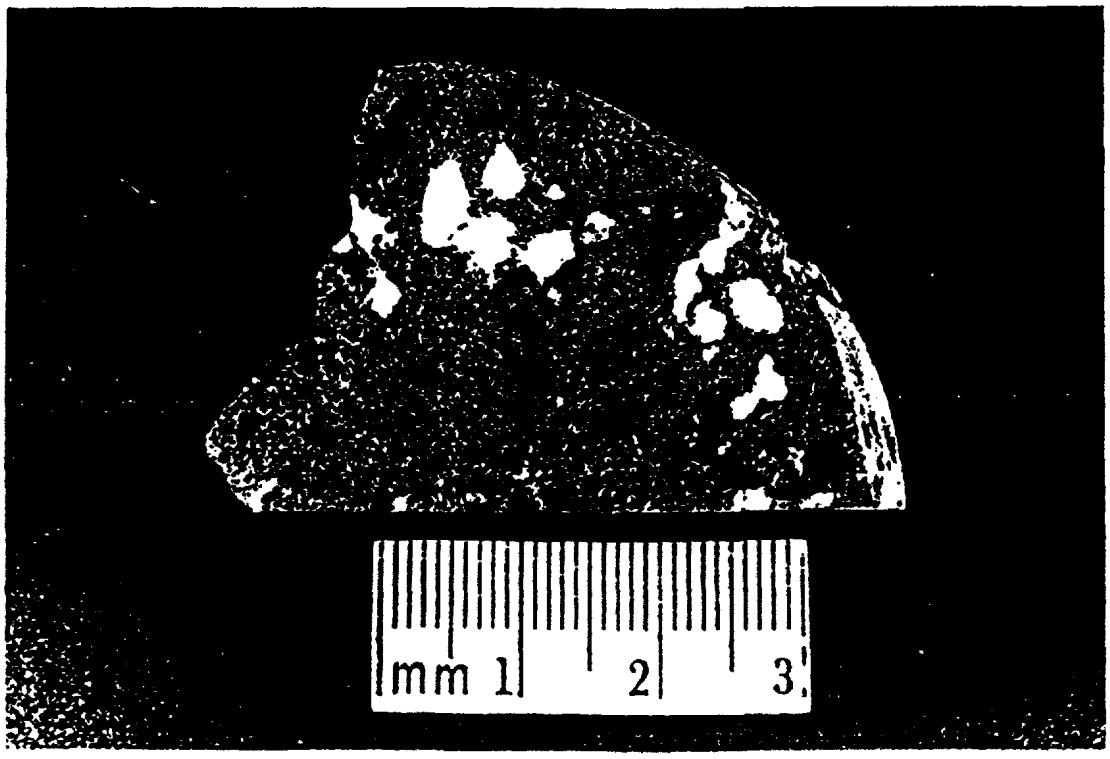
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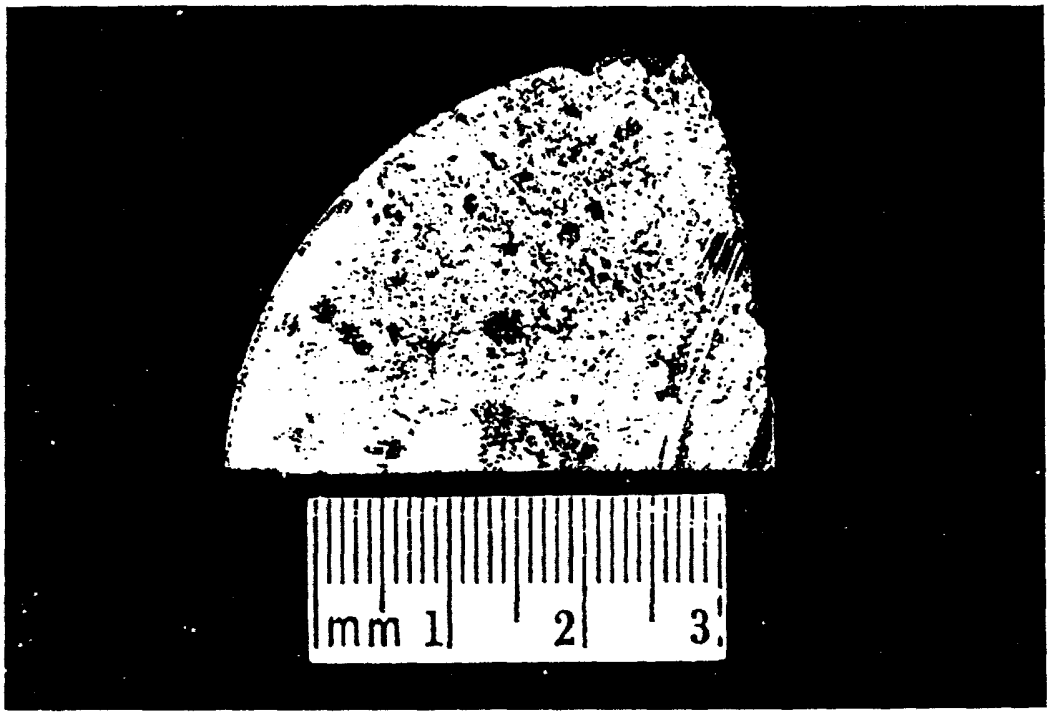
17866', 1.9X
ROUGH SIDE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mm 1
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USGS/NPR-A
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ROUGH SIDE

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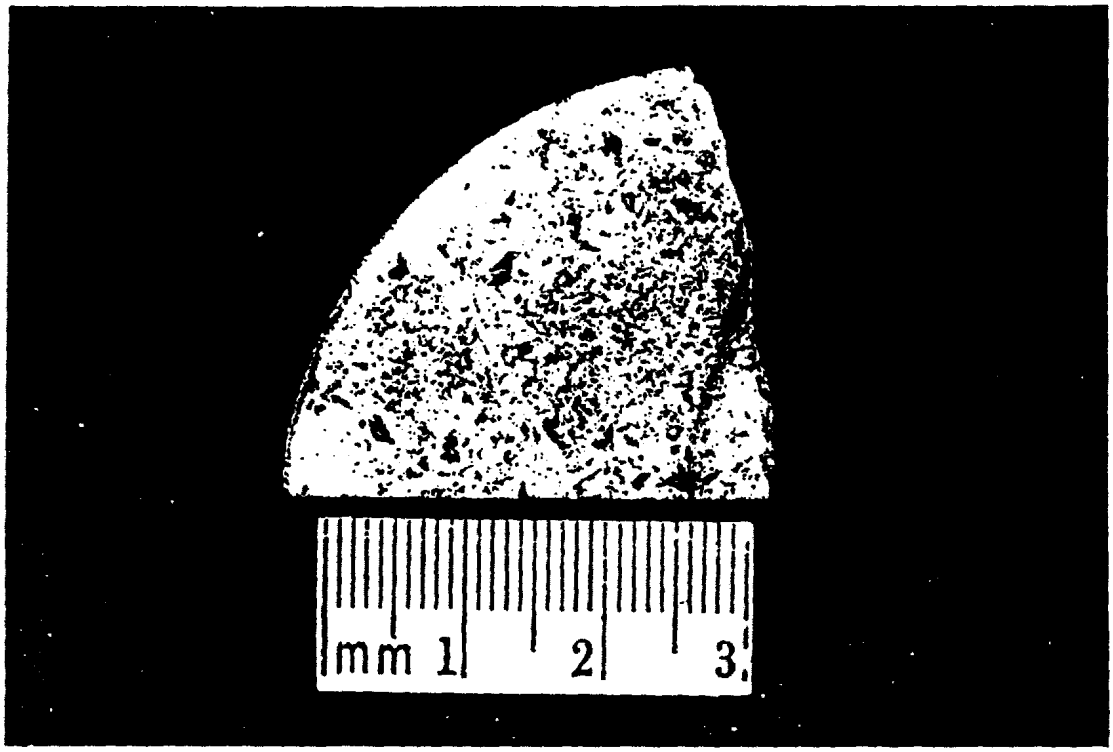
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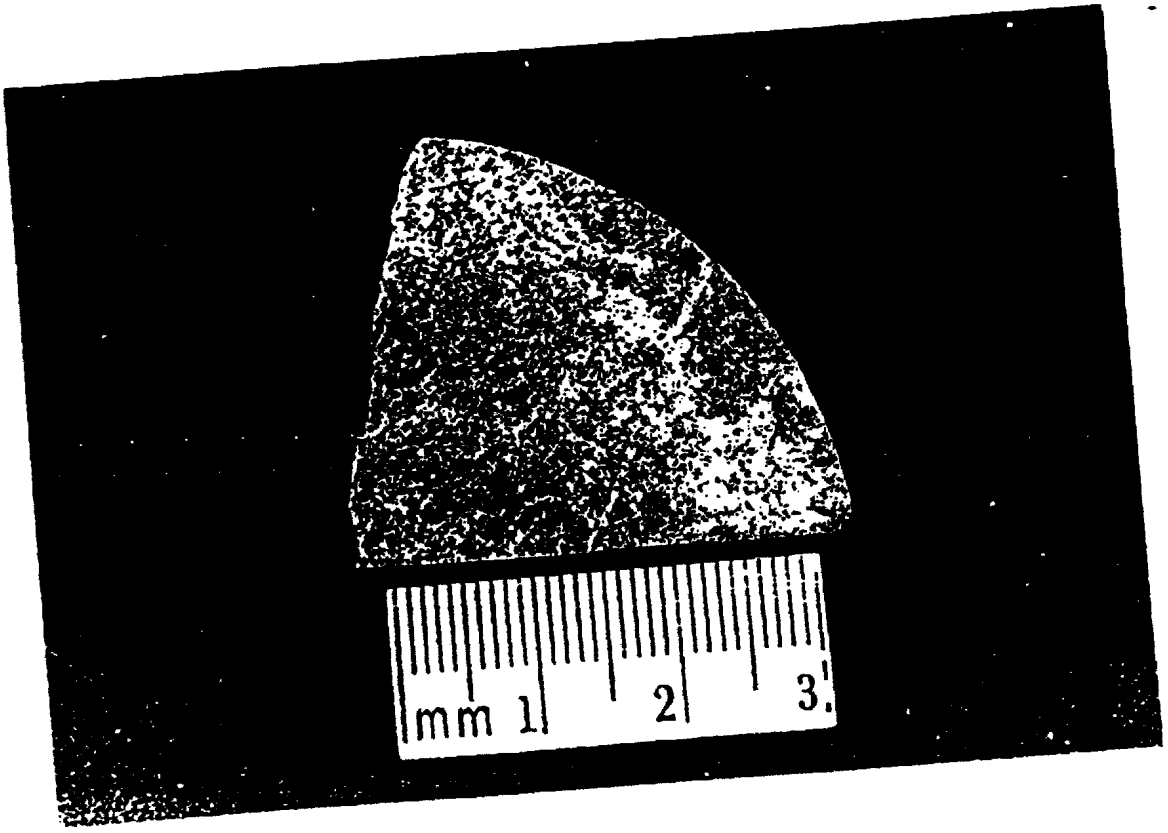
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USGS/NPR-A
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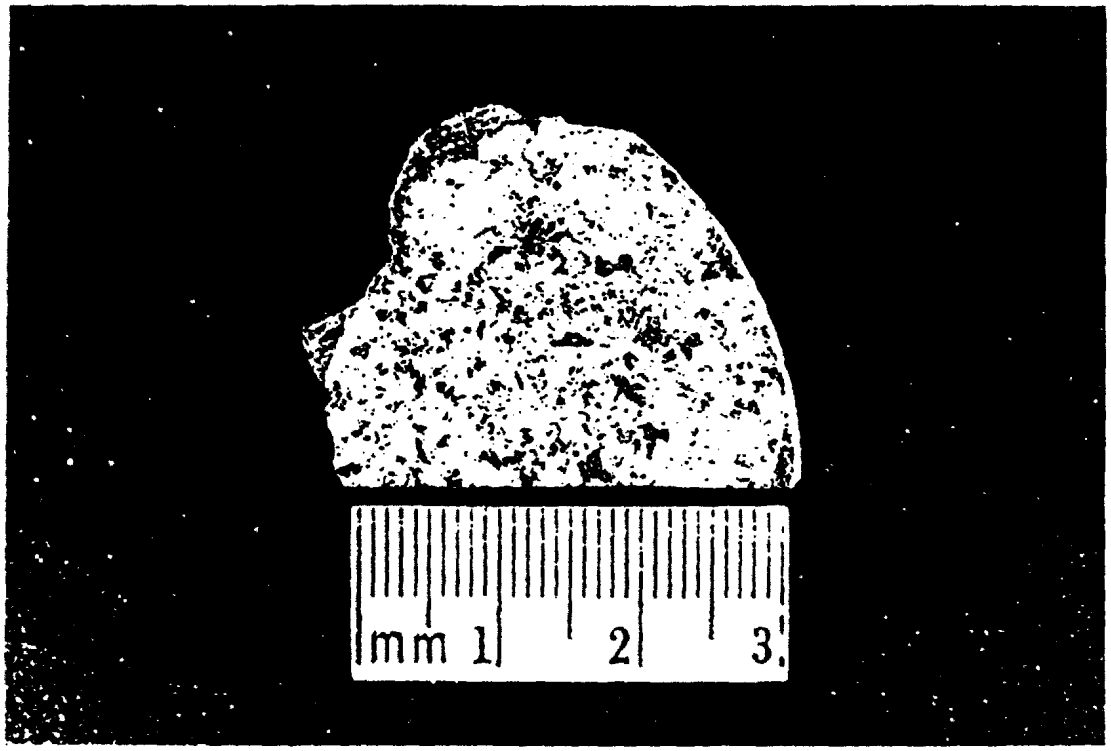
17876', 1.9X
ROUGH SIDE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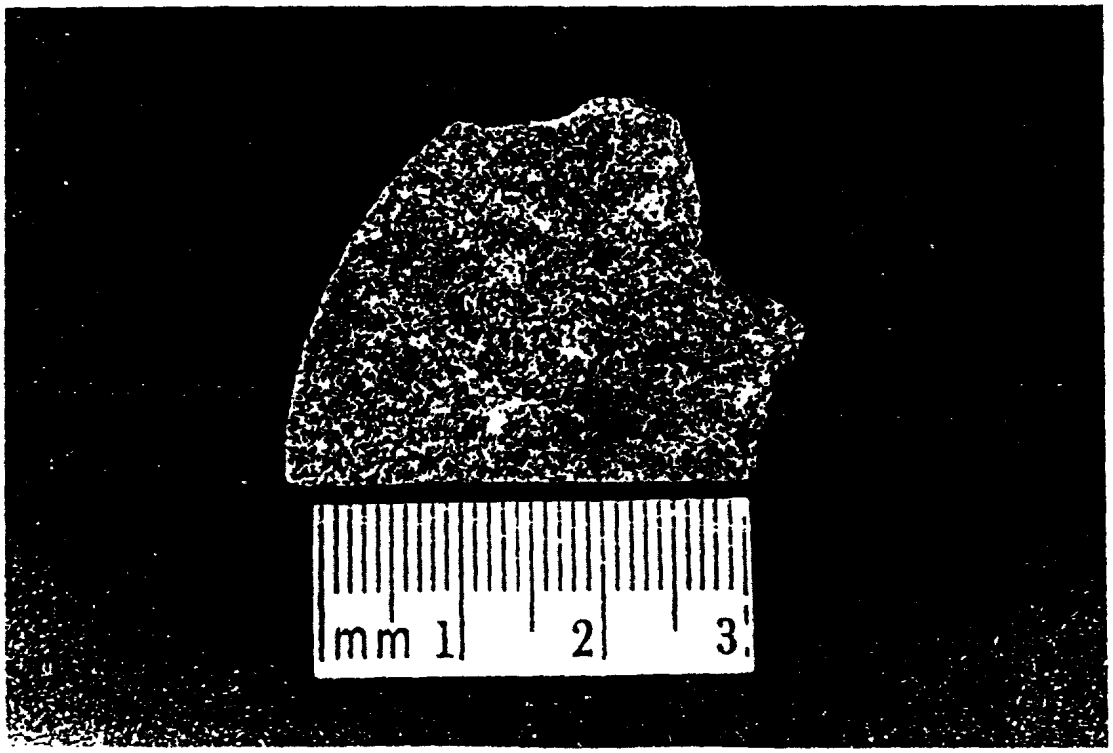
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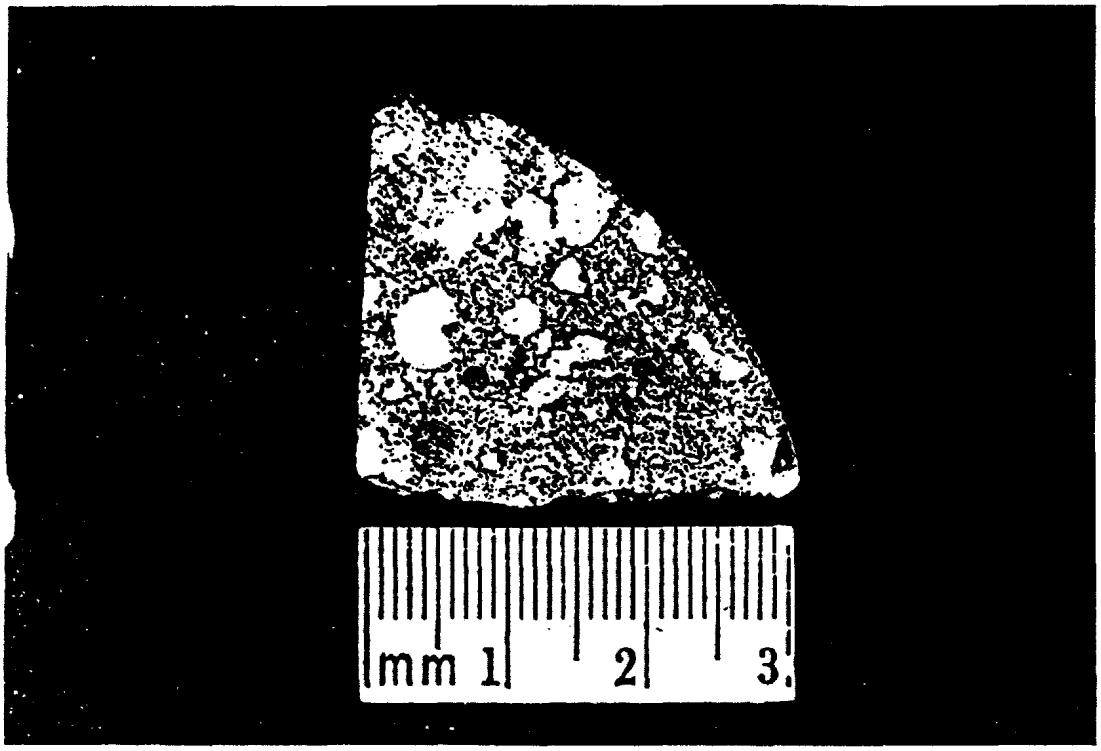
ROUGH SIDE

7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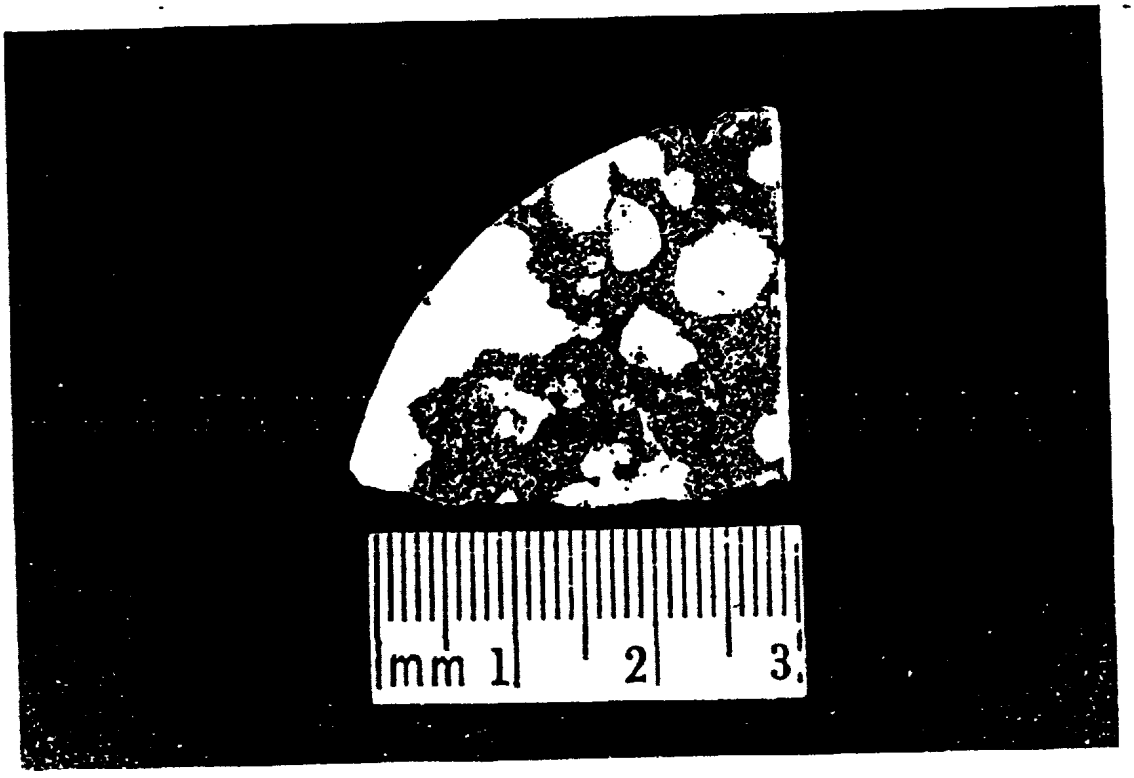
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USGS/NPR-A
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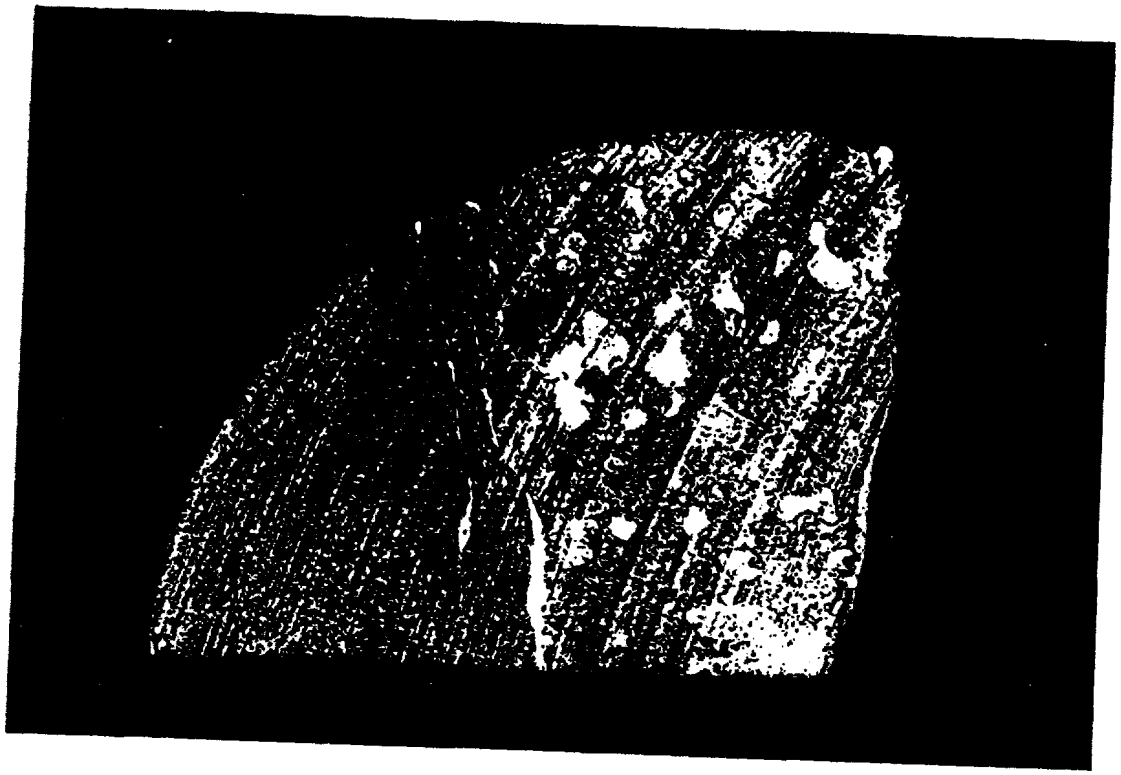
17888', 1.9X
ROUGH SIDE



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FLAT SIDE

USGS/NPR-A
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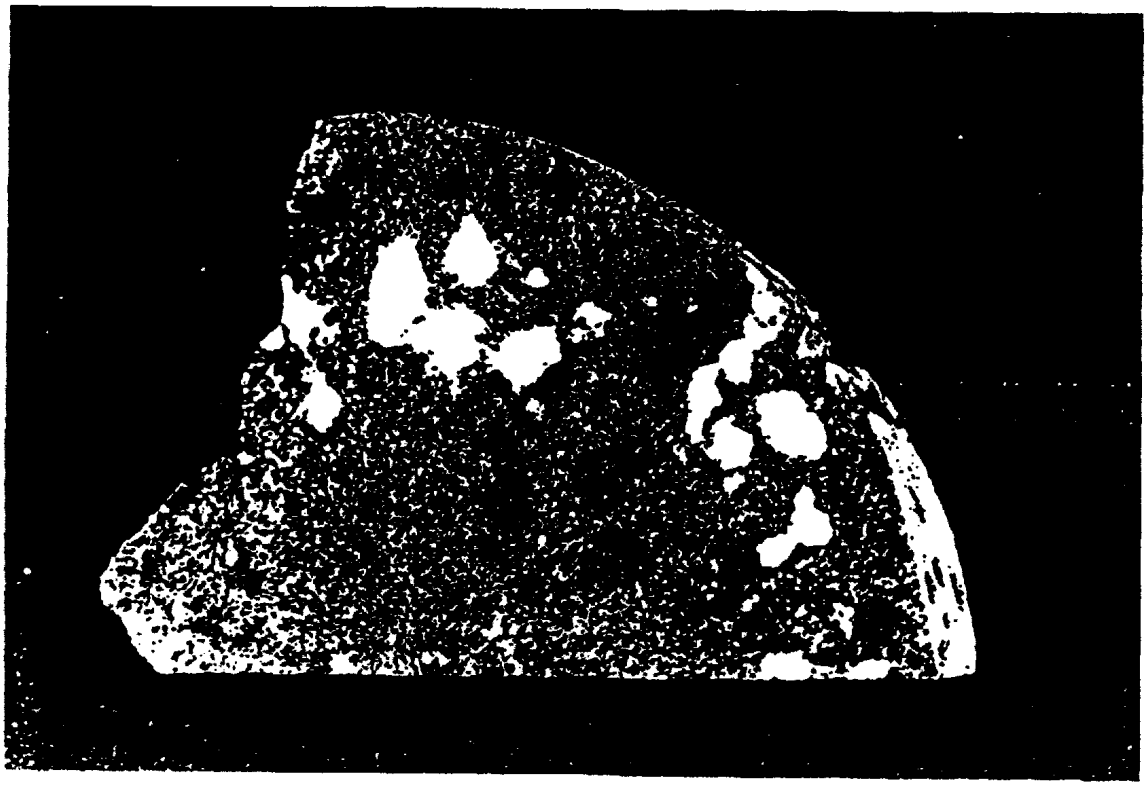
17859.5±', 2.3X
ROUGH SIDE



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FLAT SIDE

14

USGS/NPR-A
HUSKY, TUNALIK NO. 1
17866', 2.3X
ROUGH SIDE

15

USGS/NPR-A
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USGS/NPR-A
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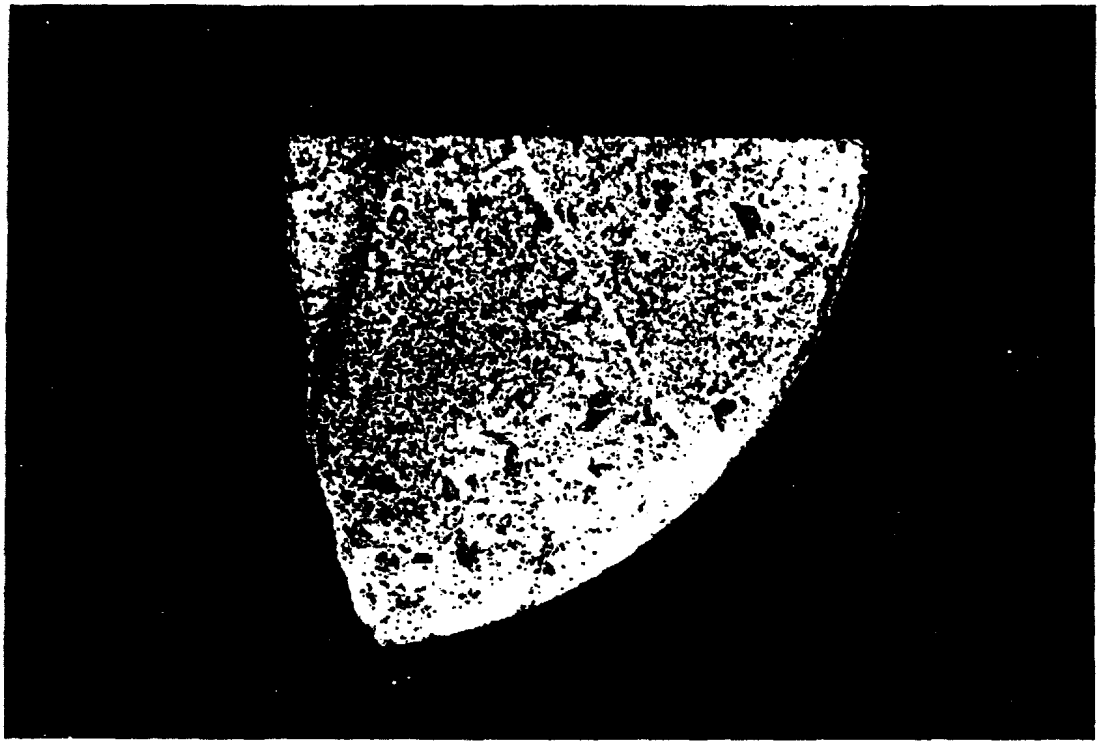
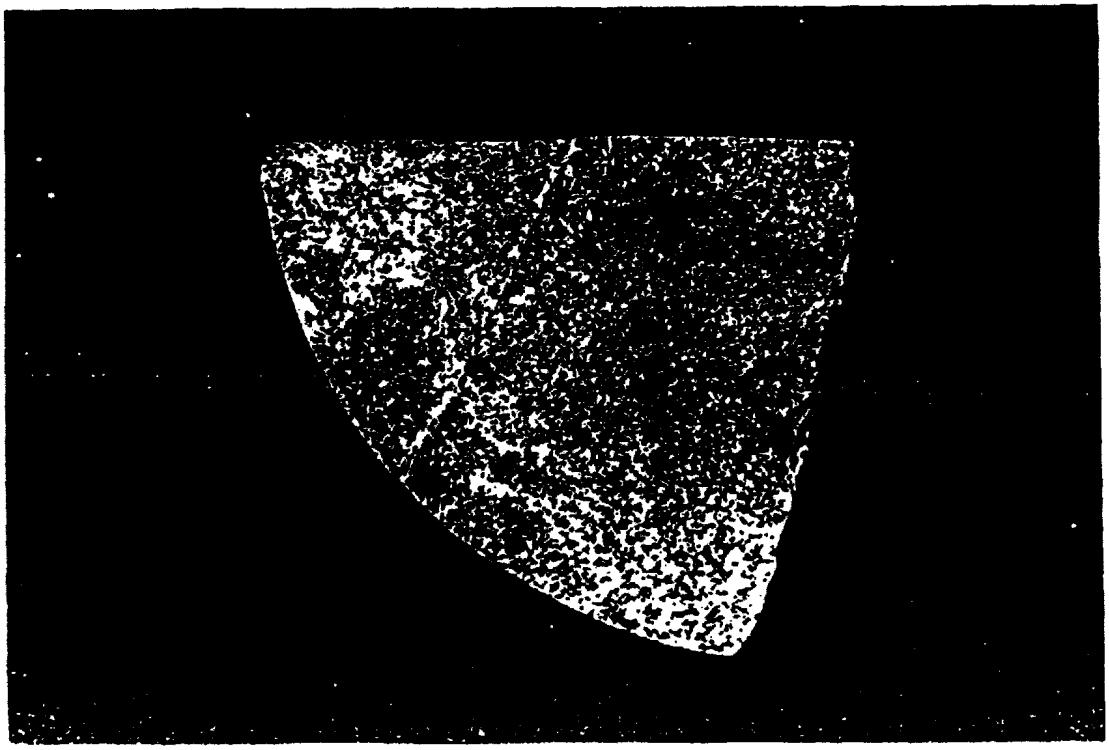
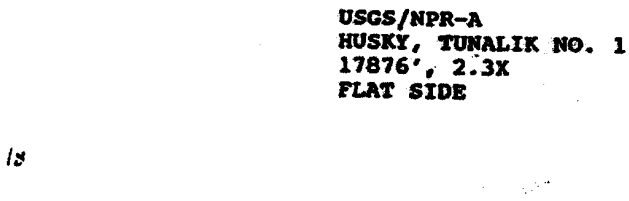
ROUGH SIDE



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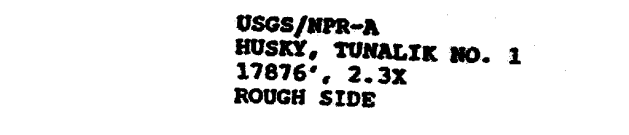
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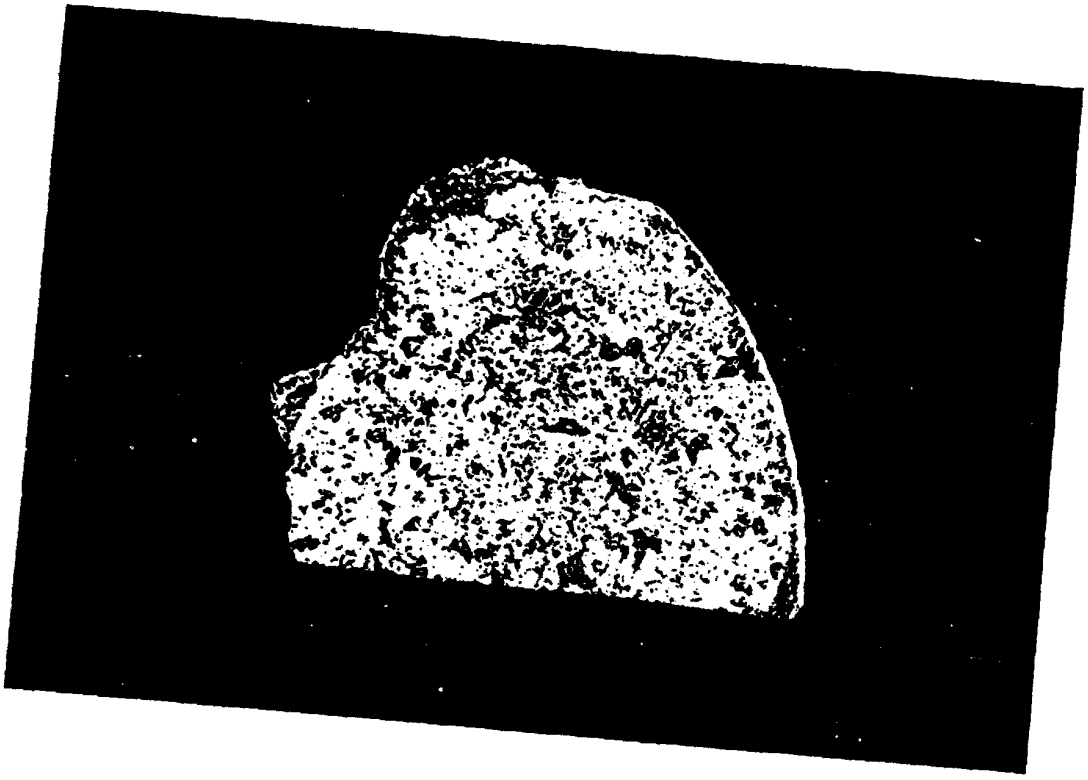

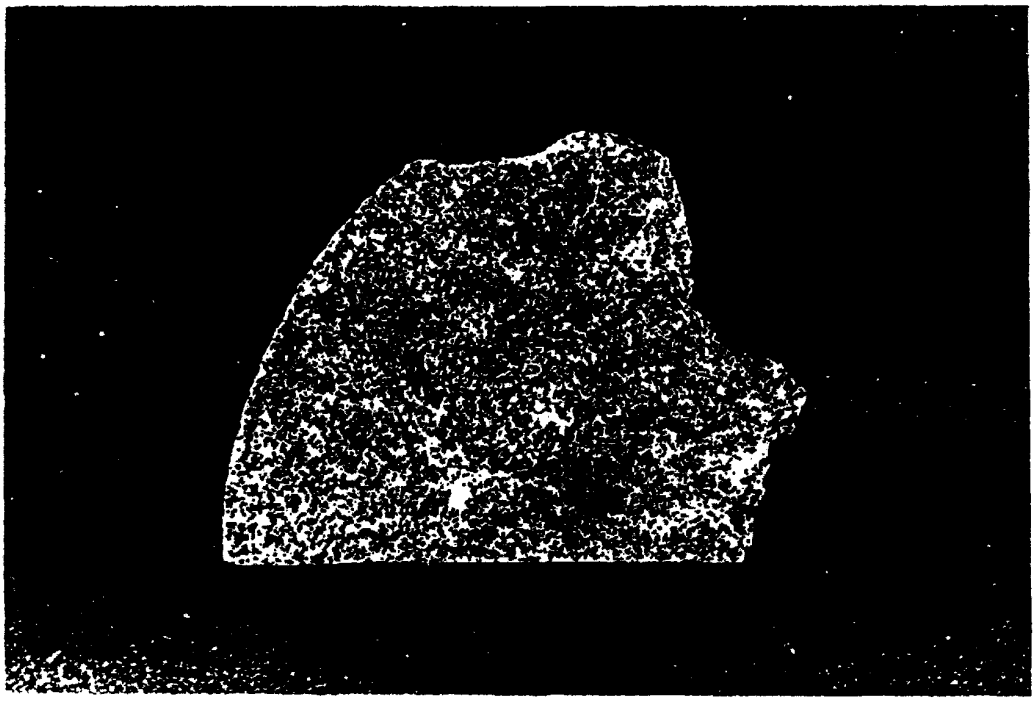

USGS/NPR-A
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USGS/NPR-A
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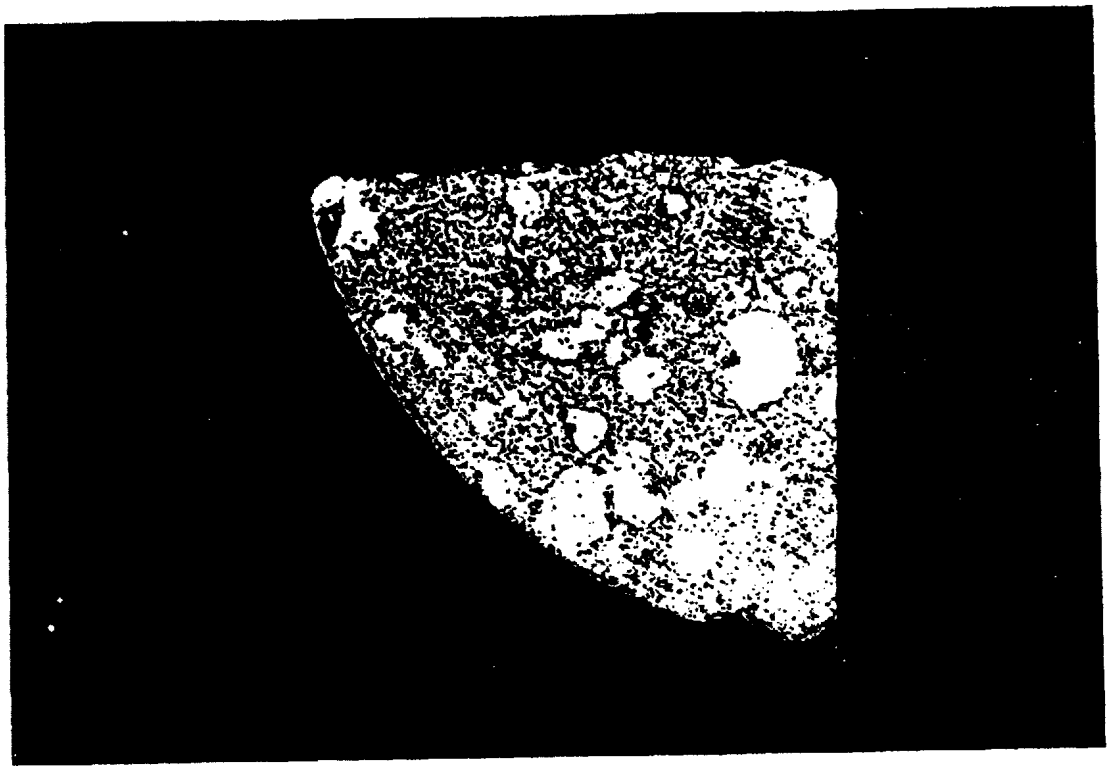
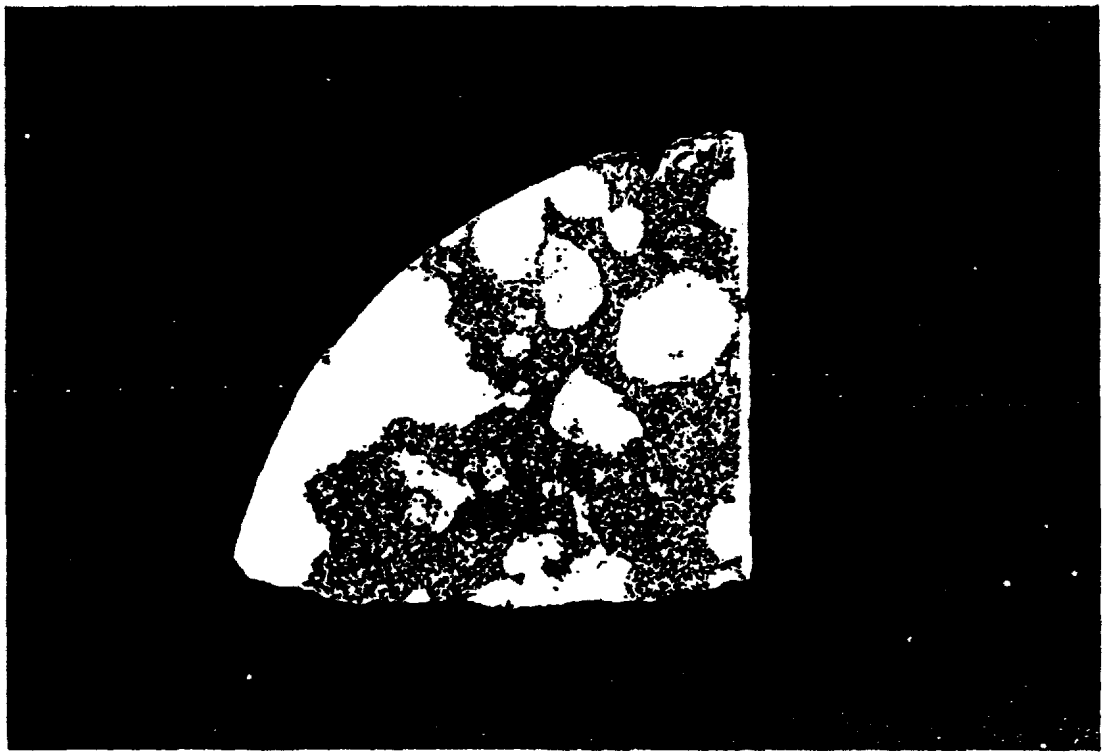
17881', 2.3X
ROUGH SIDE





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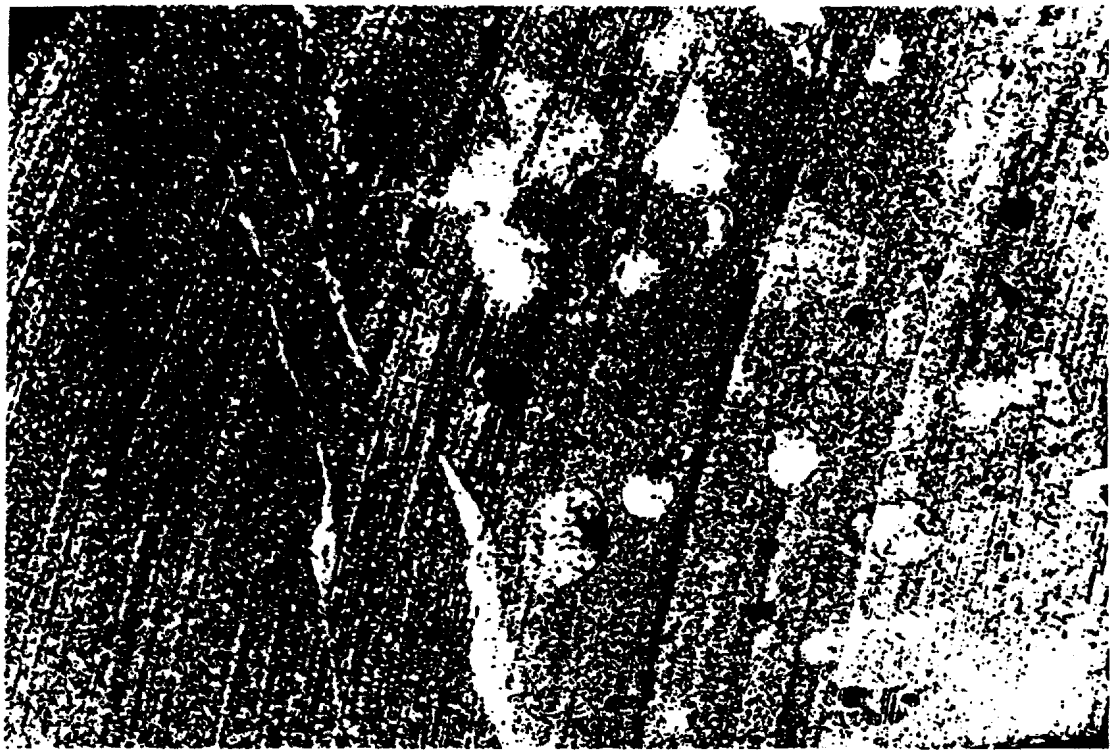
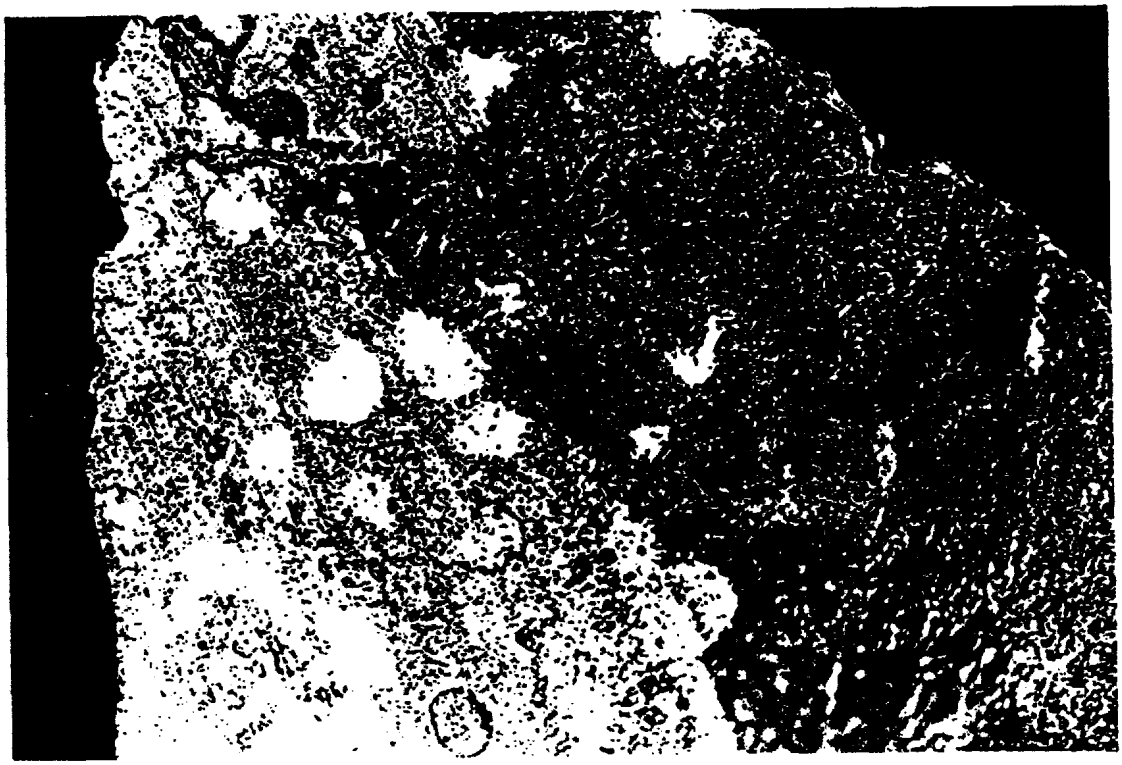
ROUGH SIDE





USGS/NPR-A
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FLAT SIDE

USGS/NPR-A
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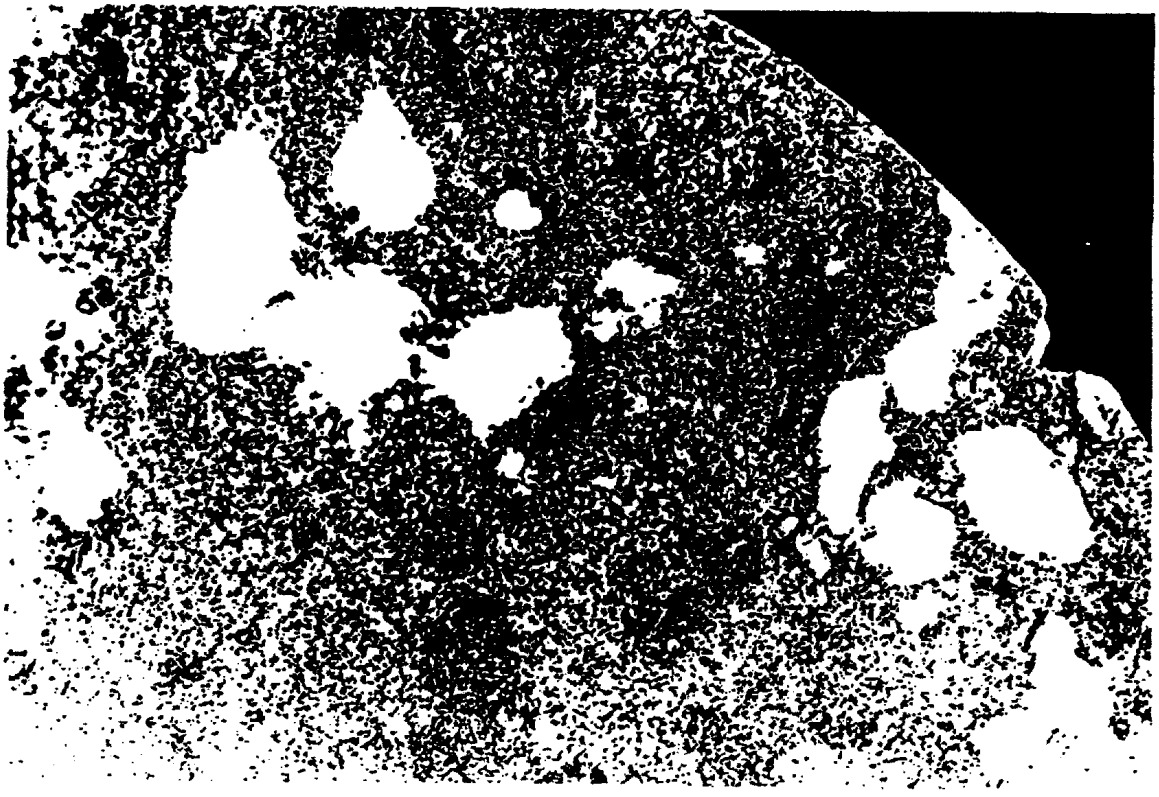
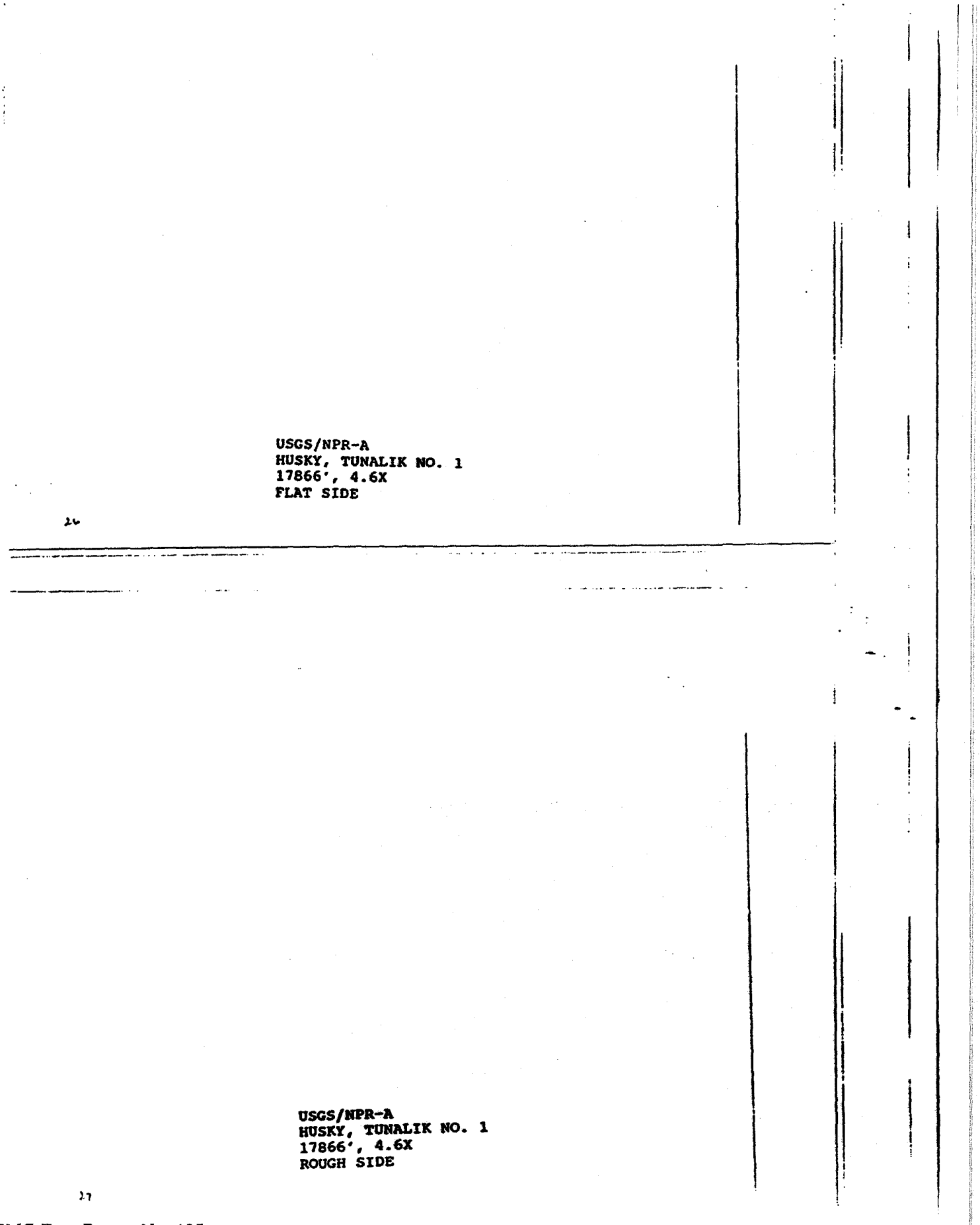
17859.5±', 4.6X
ROUGH SIDE





USGS/NPR-A
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USGS/NPR-A
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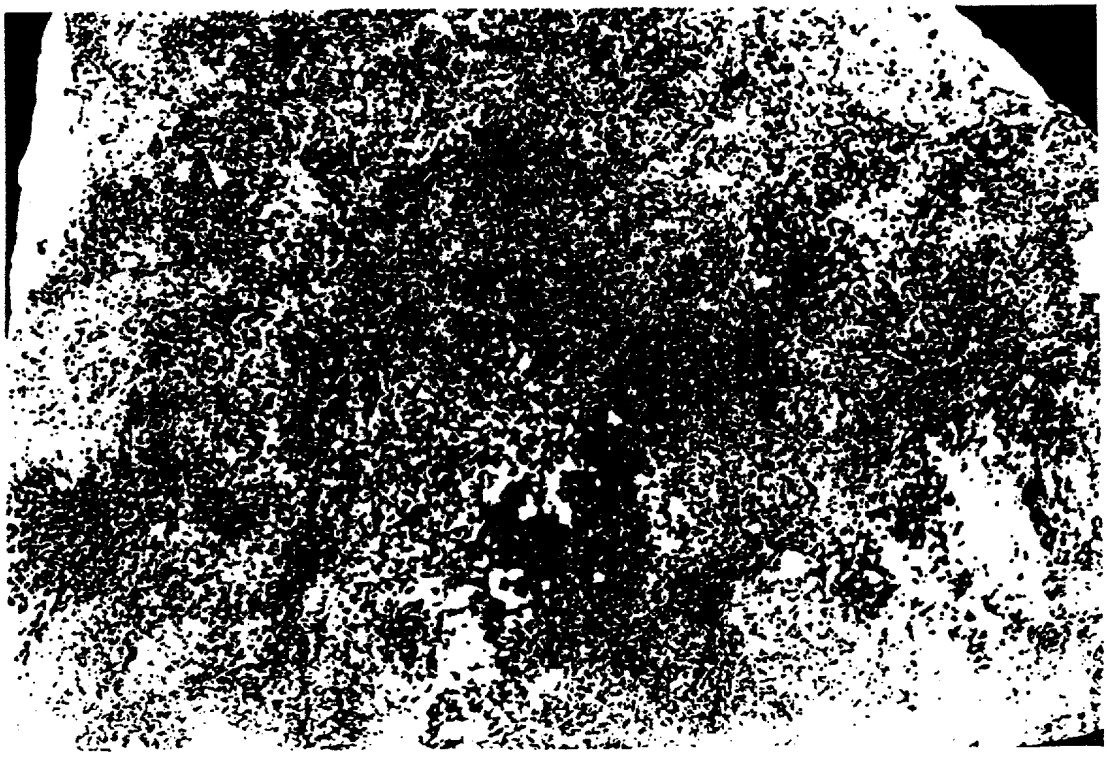

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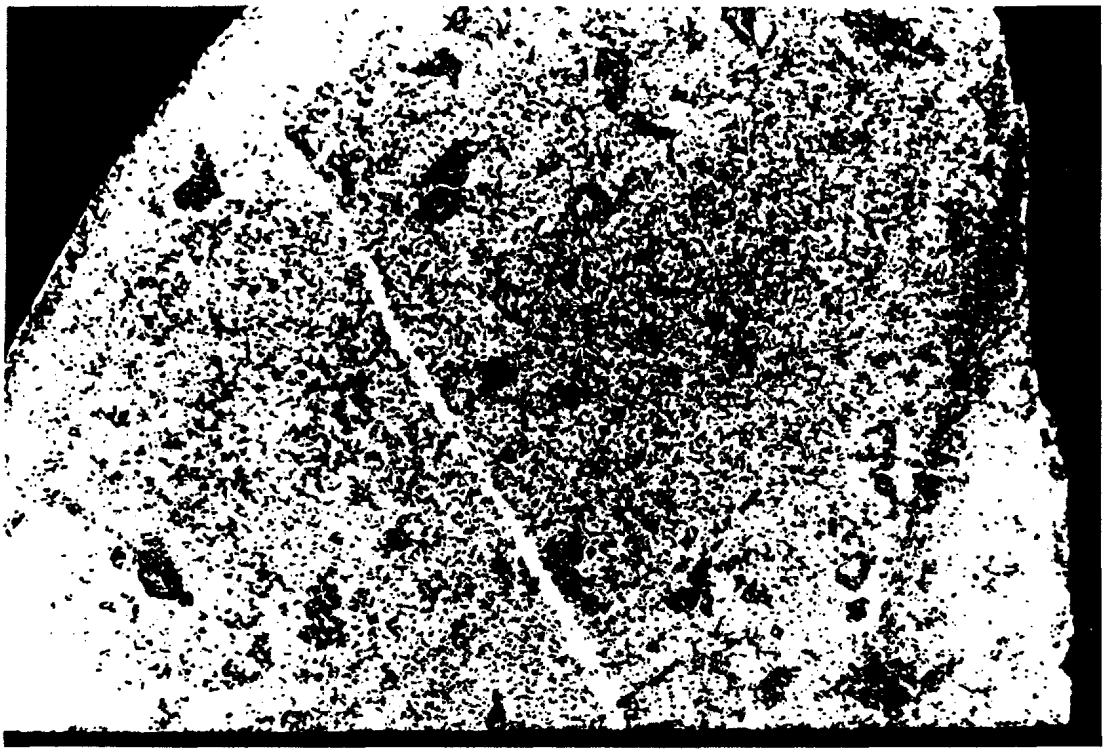

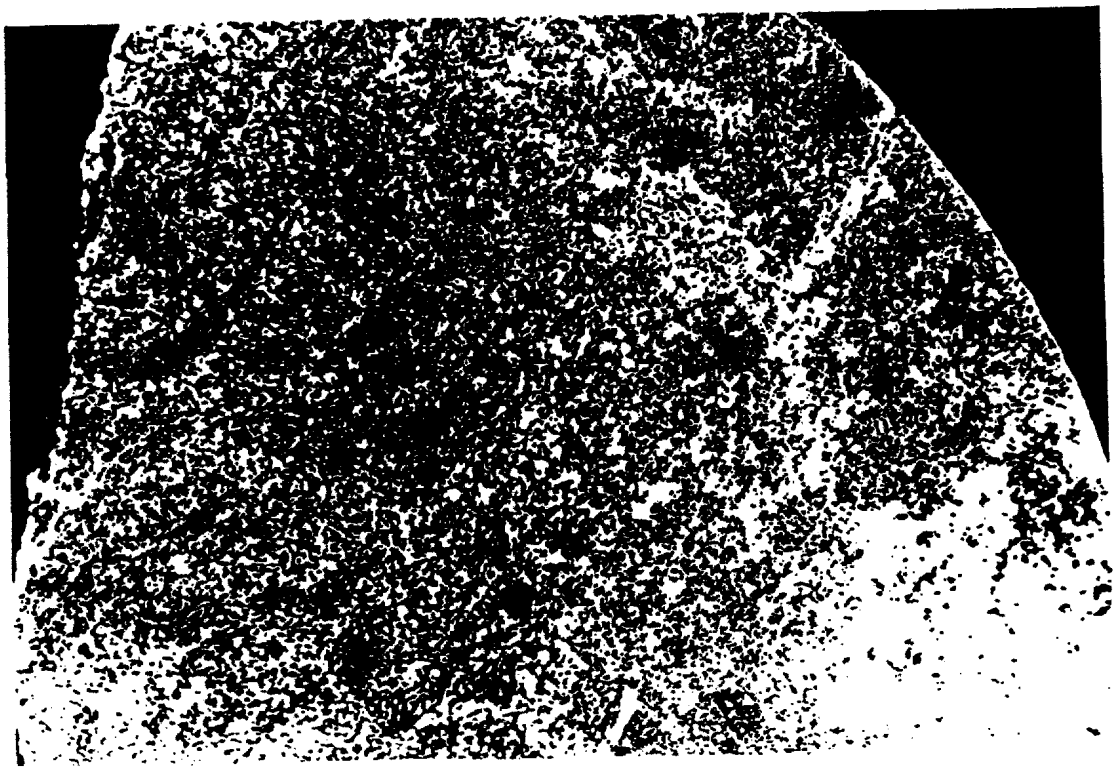

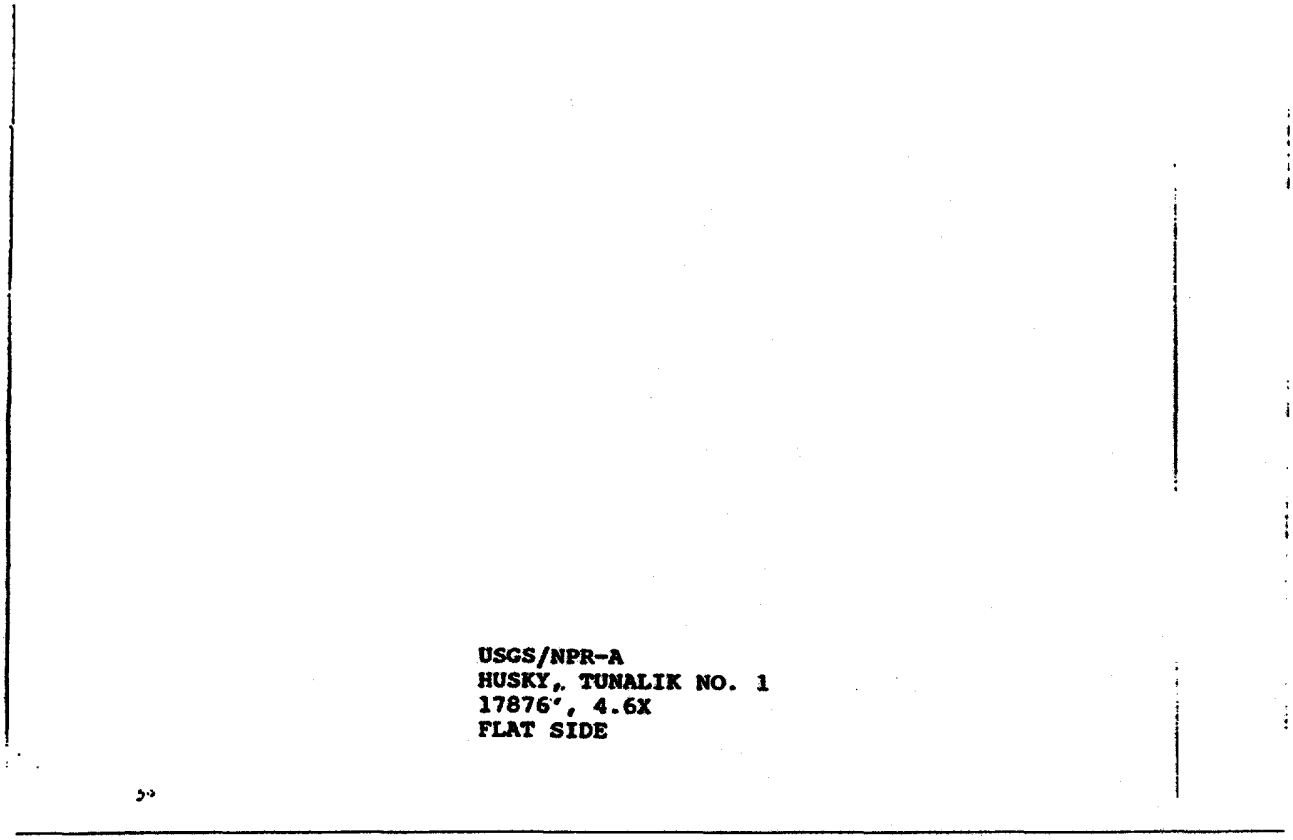

USGS/NPR-A
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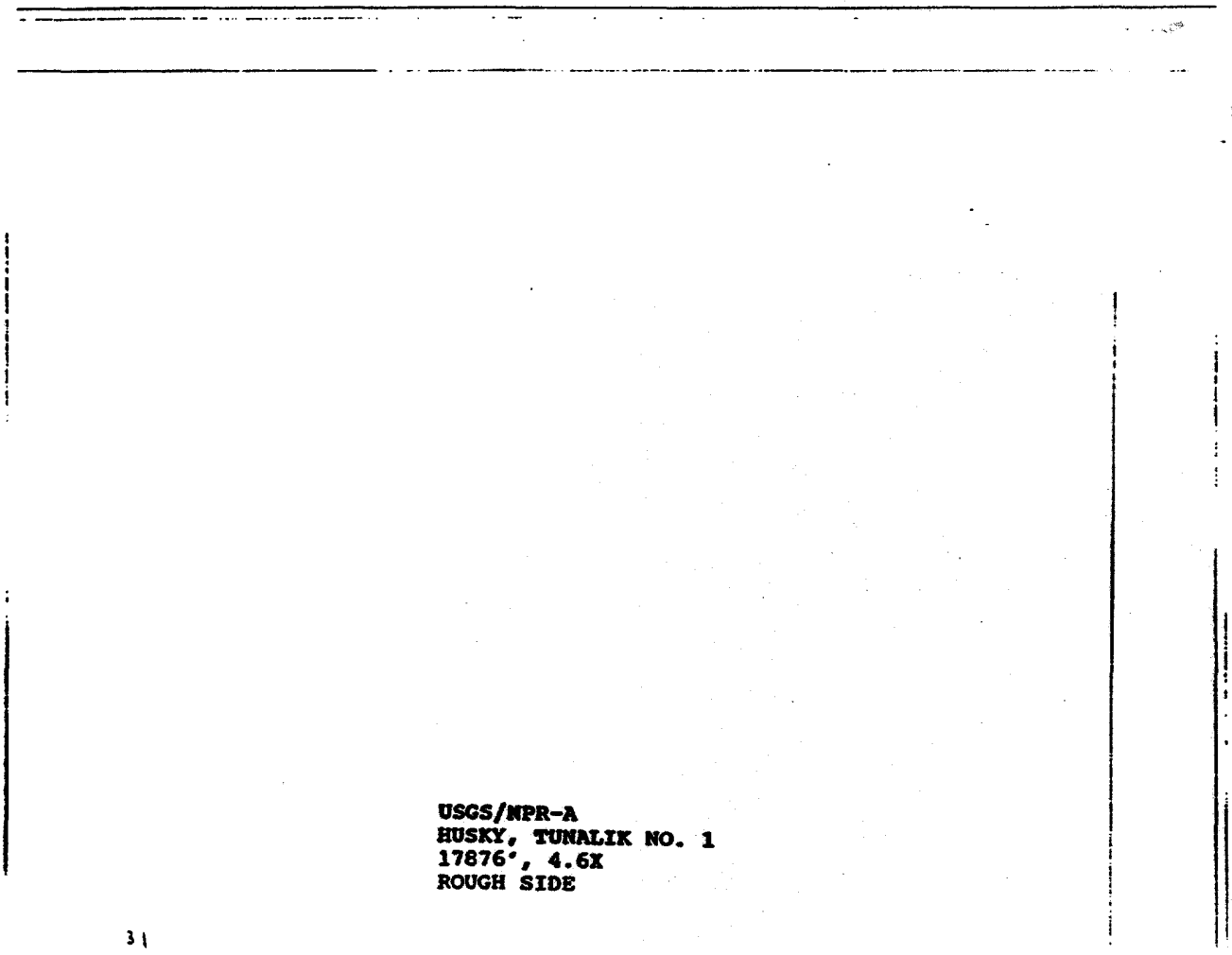

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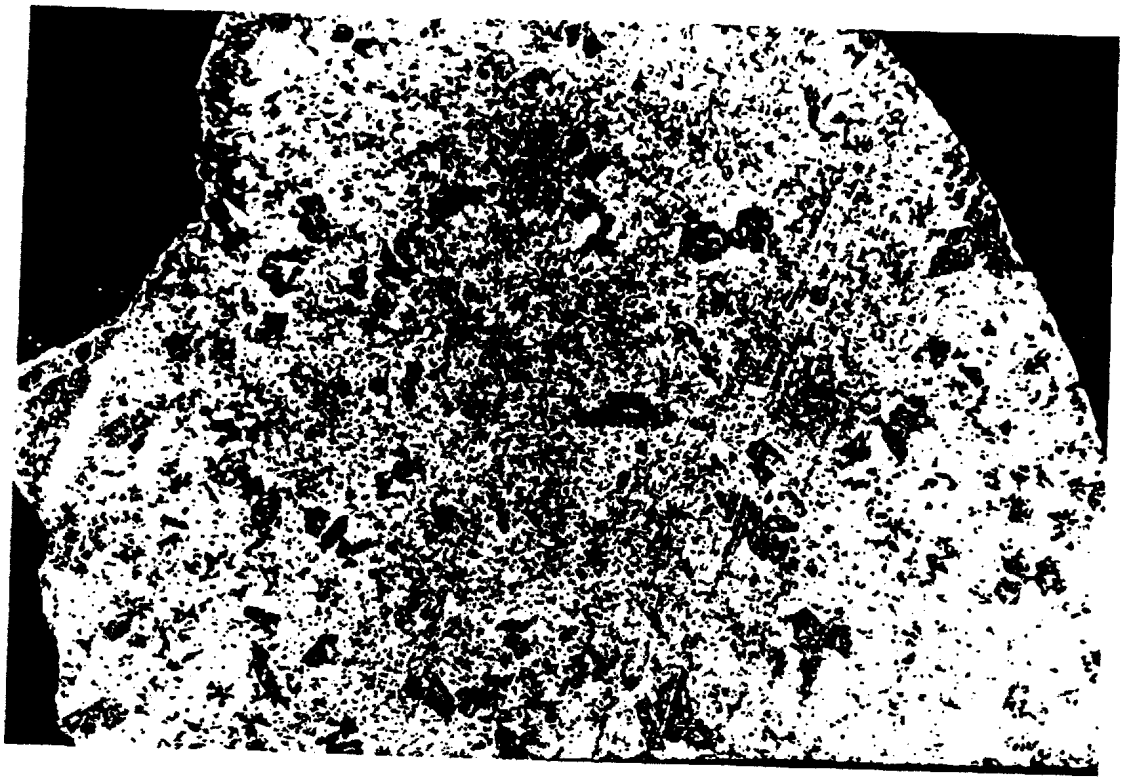

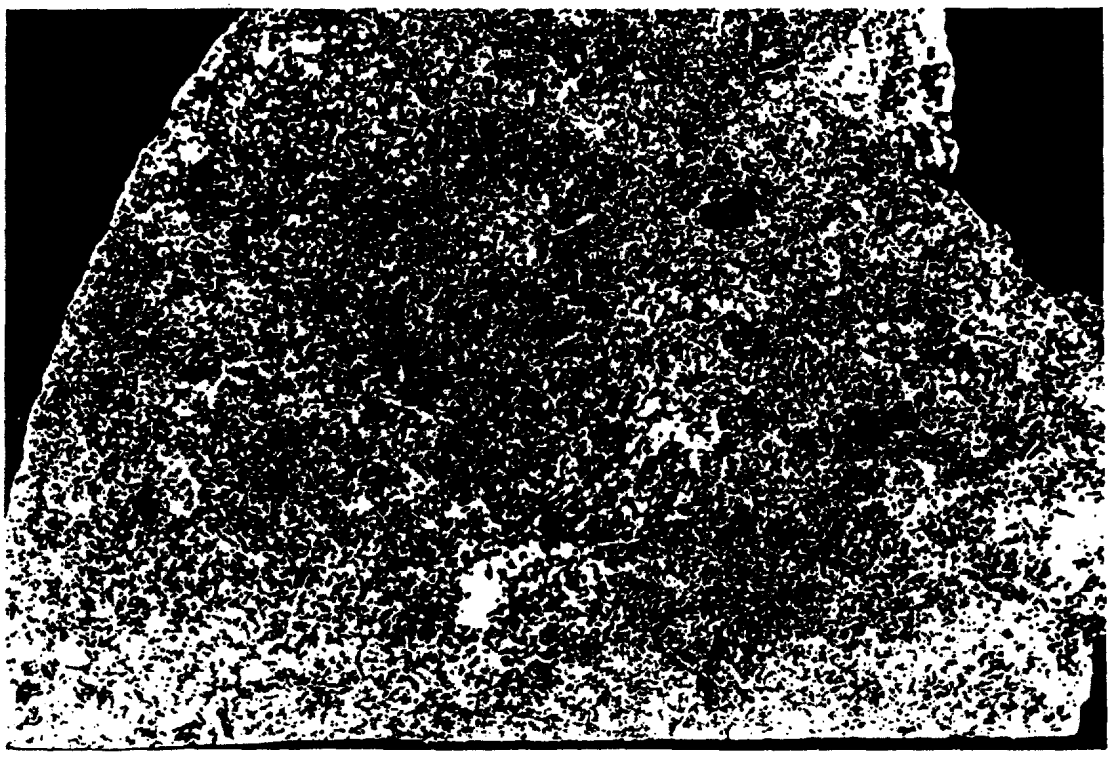

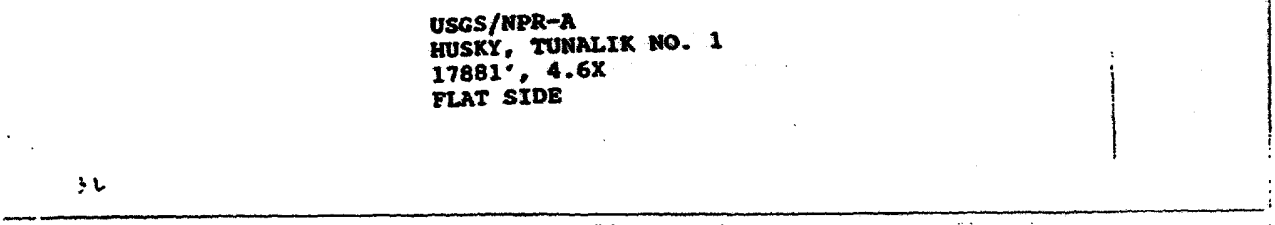

USGS/NPR-A
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USGS/NPR-A
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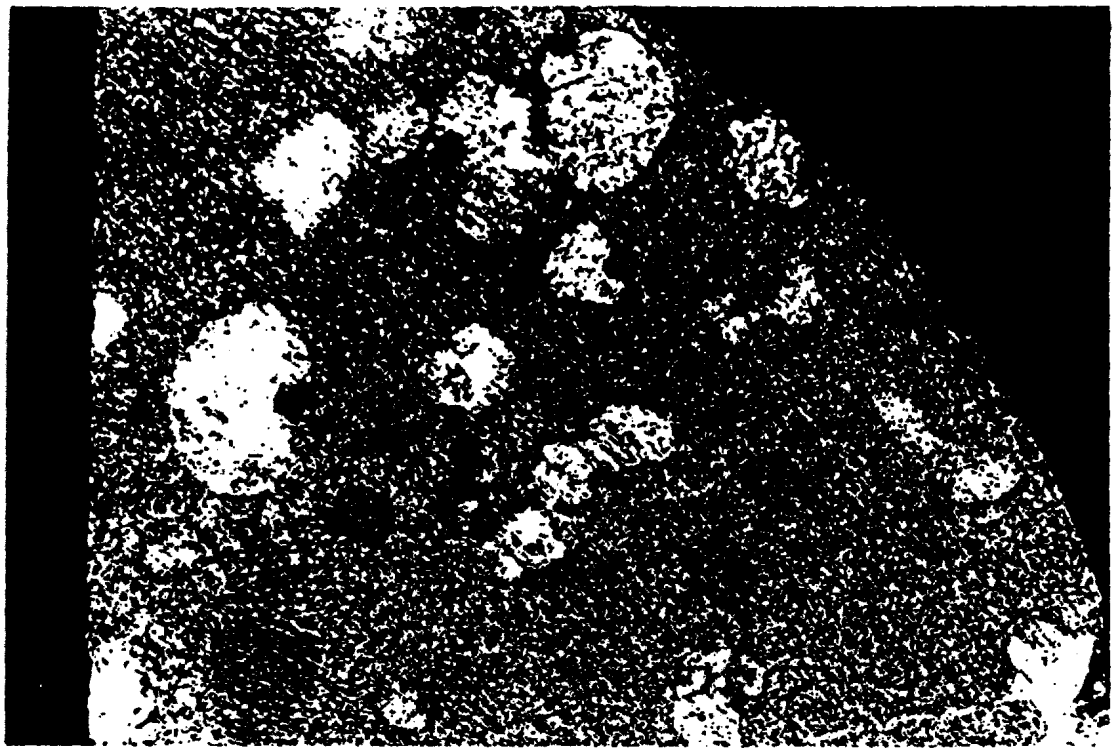

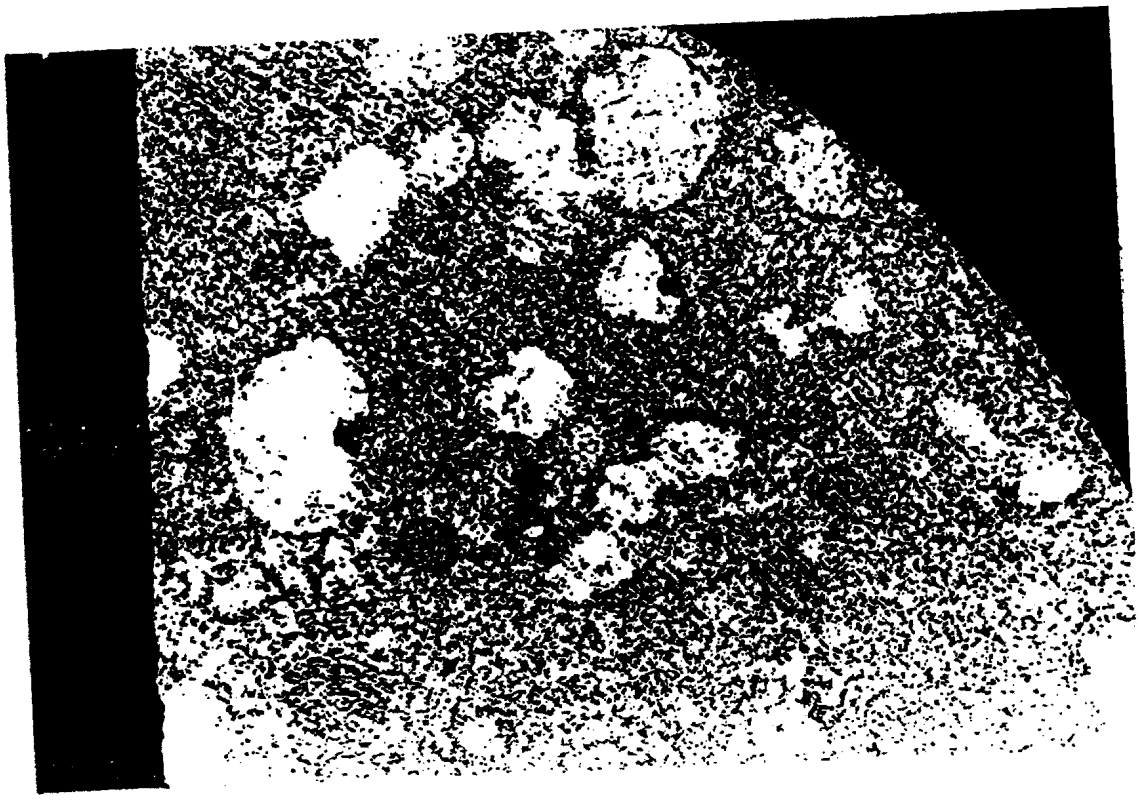

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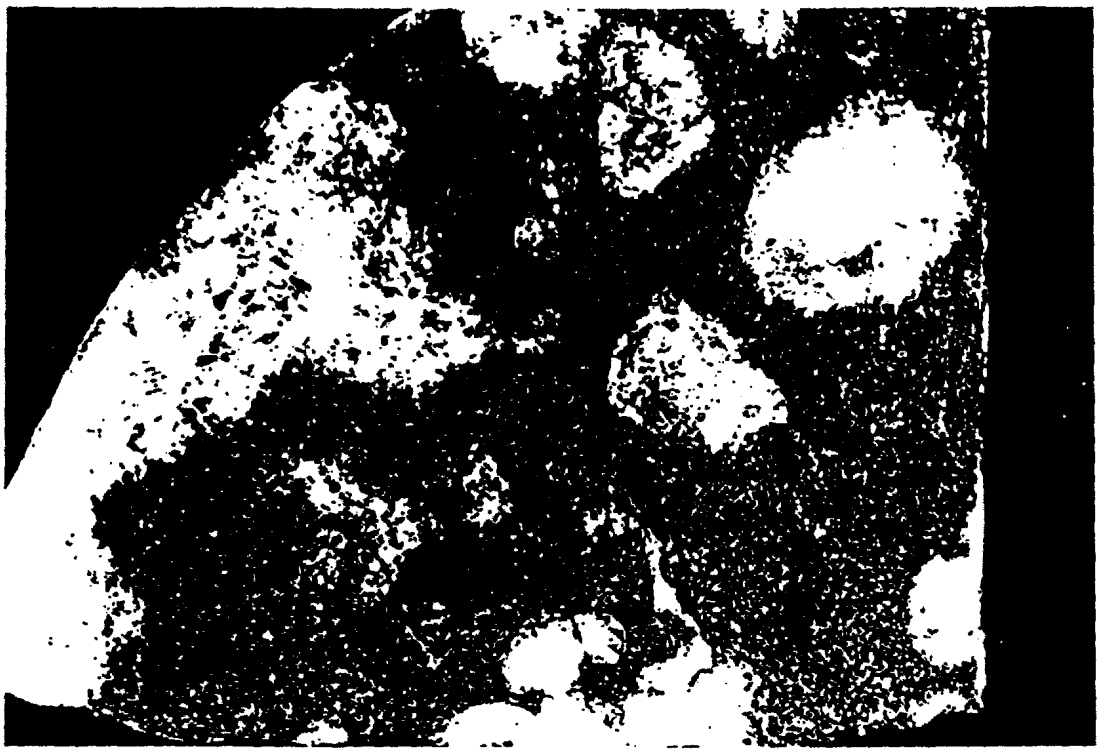

USGS/NPR-A
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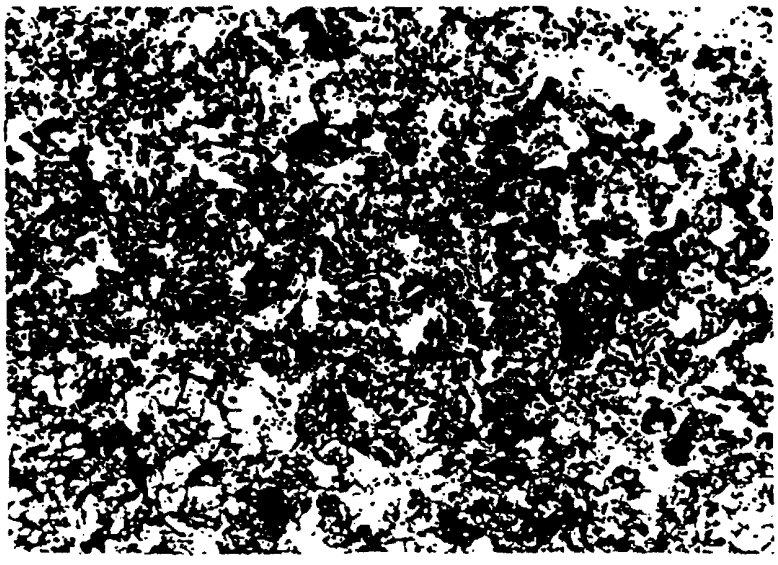
ROUGH SIDE

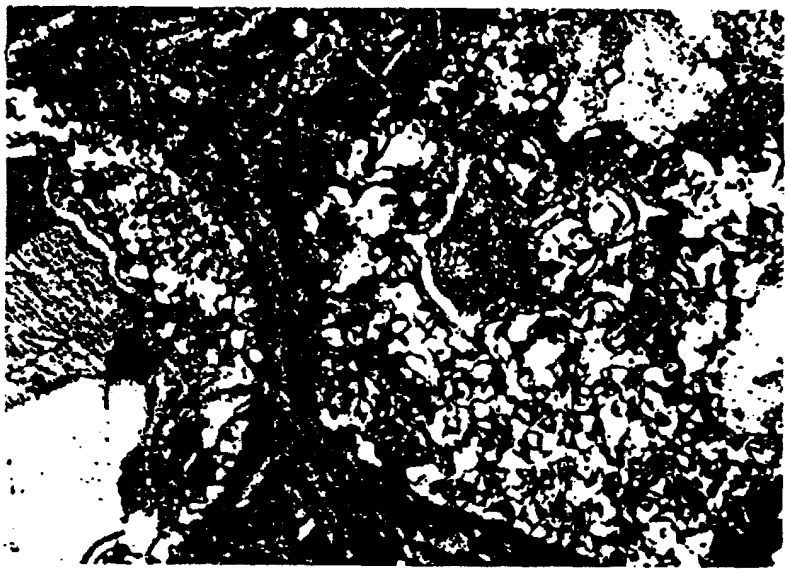


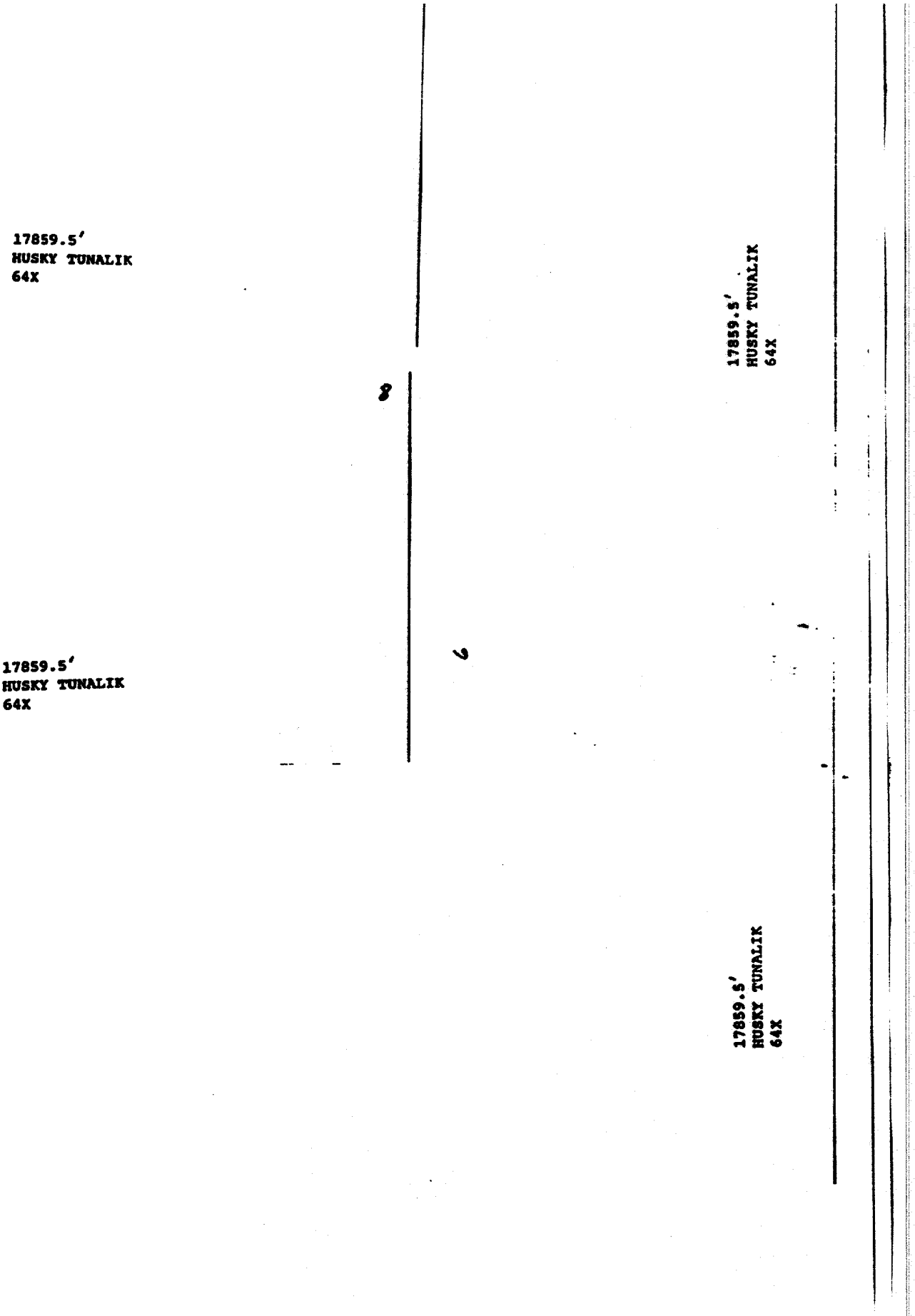
17859.5'
HUSKY TUNALIK
64X

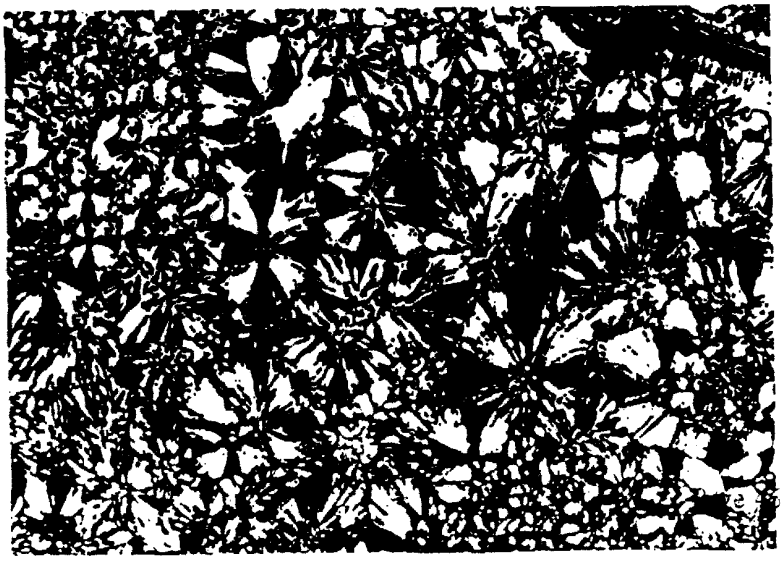
17859.5'
HUSKY TUNALIK
64X

17859.5'
HUSKY TUNALIK
64X

17859.5'
HUSKY TUNALIK
64X




17859.5'
HUSKY TUNALIK
64X
17859.5'
HUSKY TUNALIK
64X
17859.5'
HUSKY TUNALIK
64X
17859.5'
HUSKY TUNALIK
64X



10

17859.5'
HUSKY TUNALIK
40.X

14

17859.5'
HUSKY TUNALIK
64X

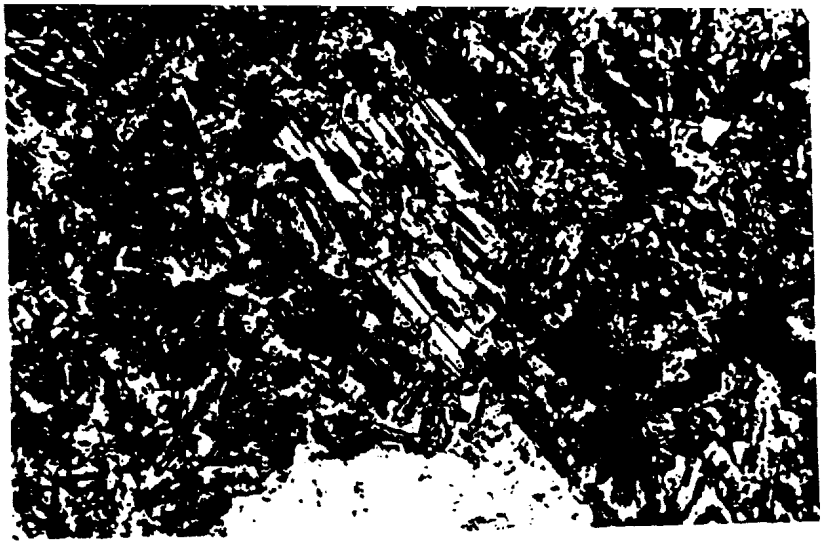
11

17859.5'
HUSKY TUNALIK
40X

17

17859.5'
HUSKY TUNALIK
40X

17866'
HUSKY TUNALIK
64X

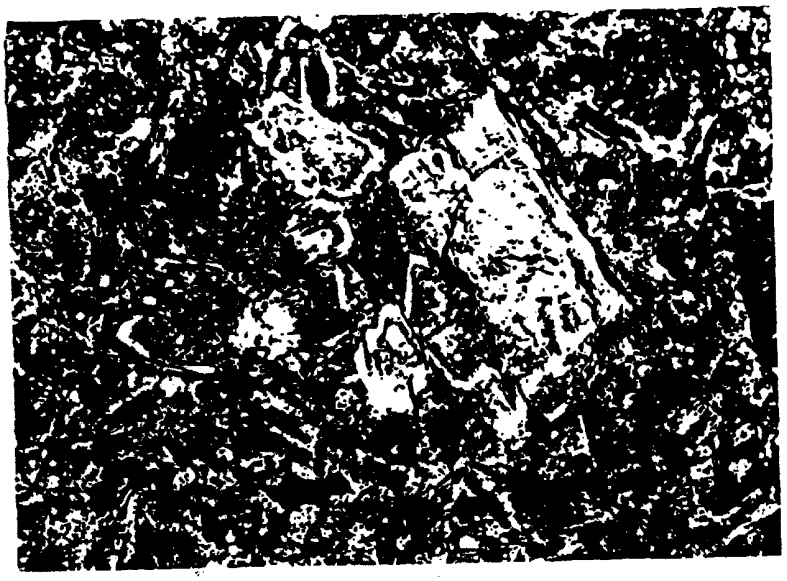


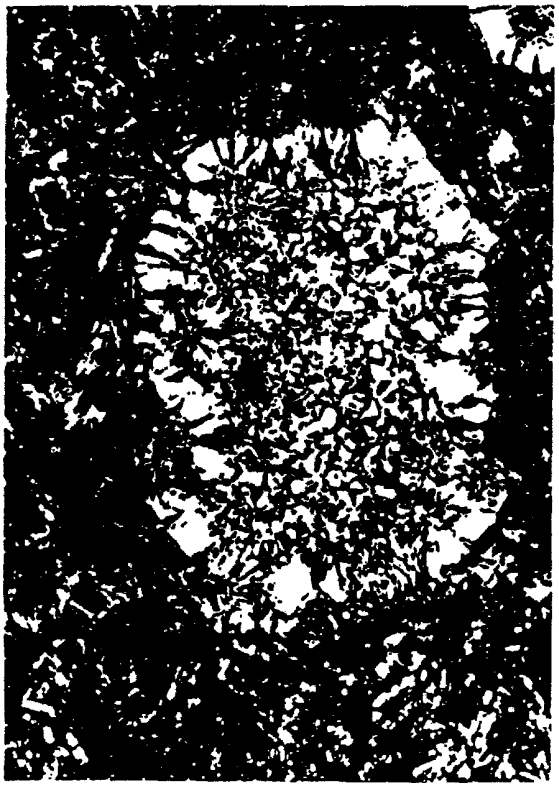
17866'
HUSKY TUNALIK
64X

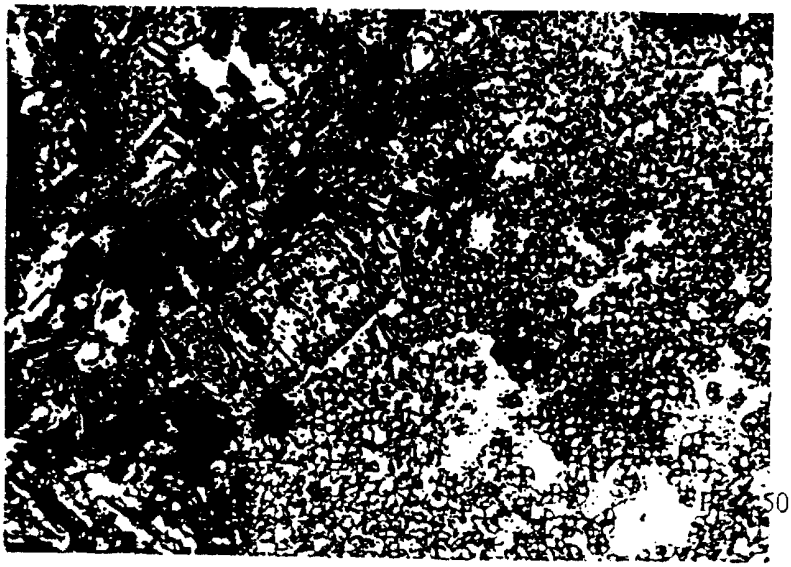
17866'
HUSKY TUNALIK
64X

17859.5'
HUSKY TUNALIK
40.X

17866'
HUSKY TUNALIK
100X







17866'
HUSKY TUNALIK
64X

17866'
HUSKY TUNALIK
40X

23

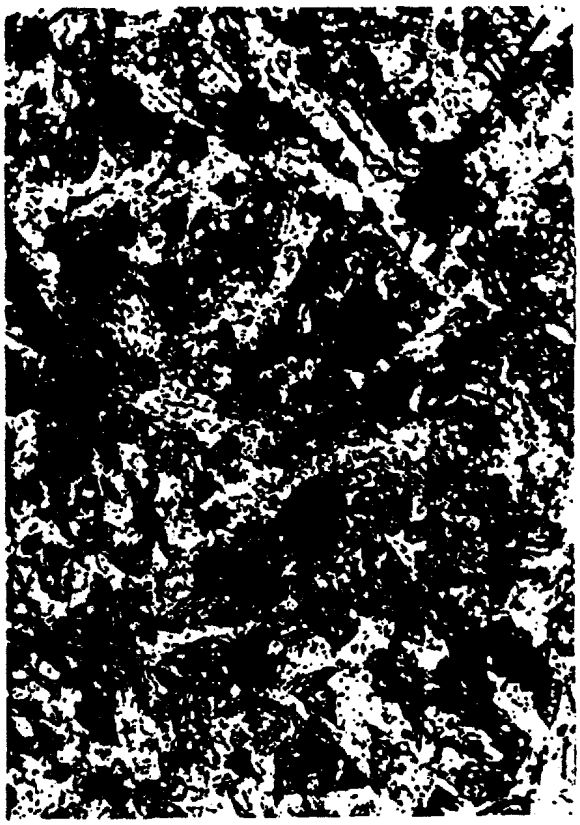
21

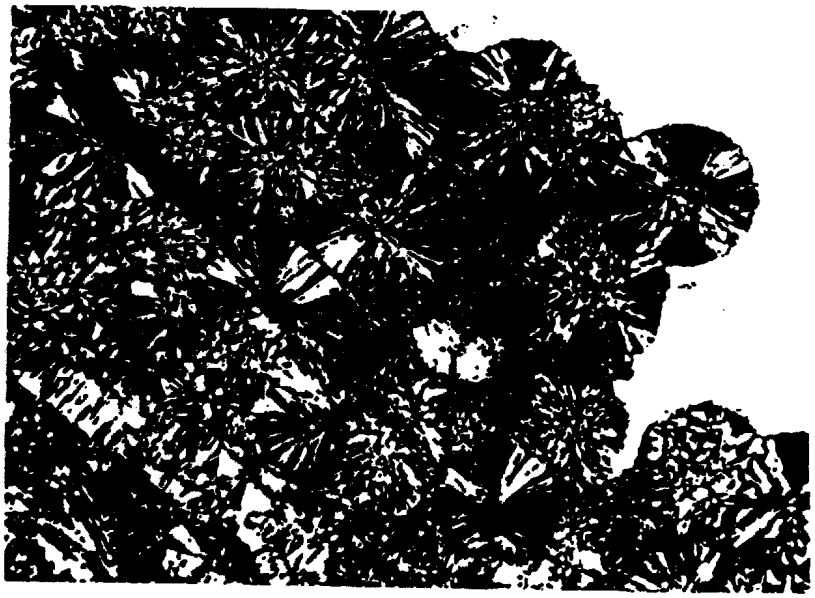
17866'
HUSKY TUNALIK
64X

24

17866'
HUSKY TUNALIK
40X

17866'
HUSKY TUNALIK
64X





25

17868.5'

17[illegible]5'
HU[illegible]TUNALIK
64X

17866'
HUSKY TUNALIK
100X

28

17868.5'

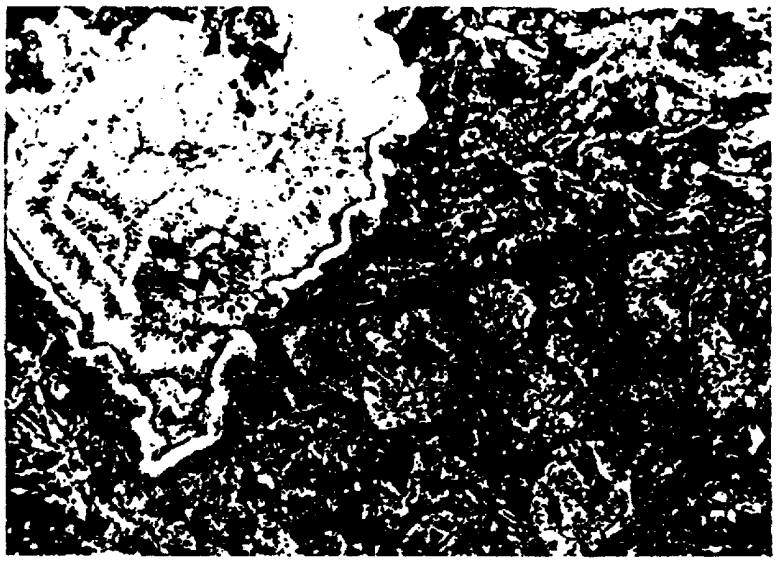
[illegible]868.5'
[illegible]SKY TUNALIK
[illegible] 64X

17866'
HUSKY TUNALIK
100X

17868.5'
HUSKY TUNALIK
64X

26

32



17868.5′
HUSKY TUNALIK
40X

17868.5′
HUSKY TUNALIK
64X

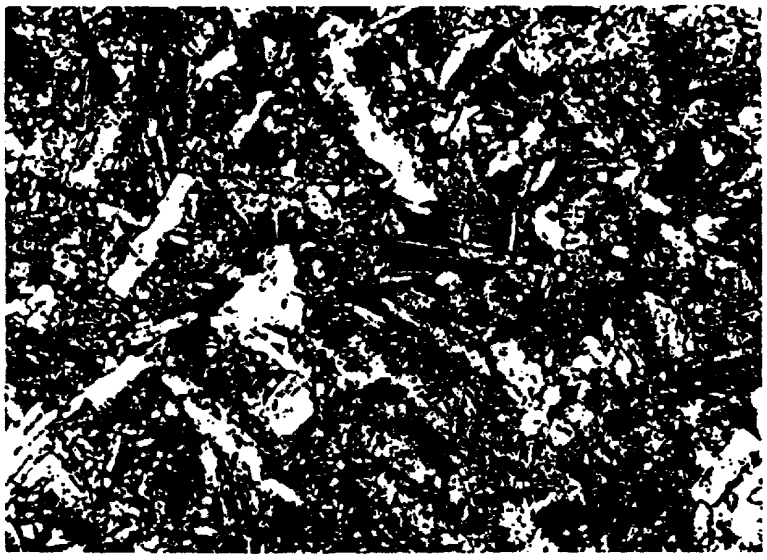
34

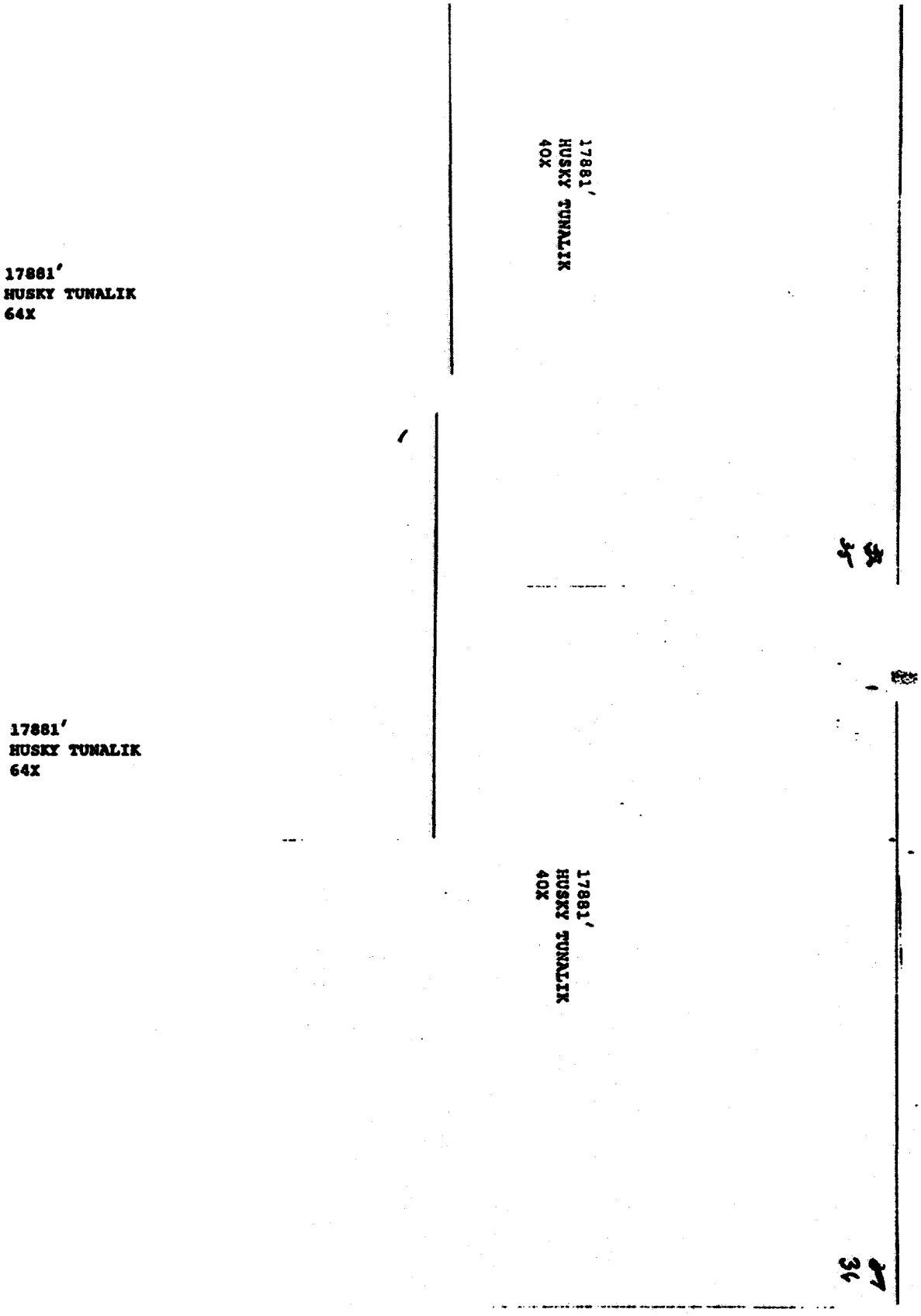
27

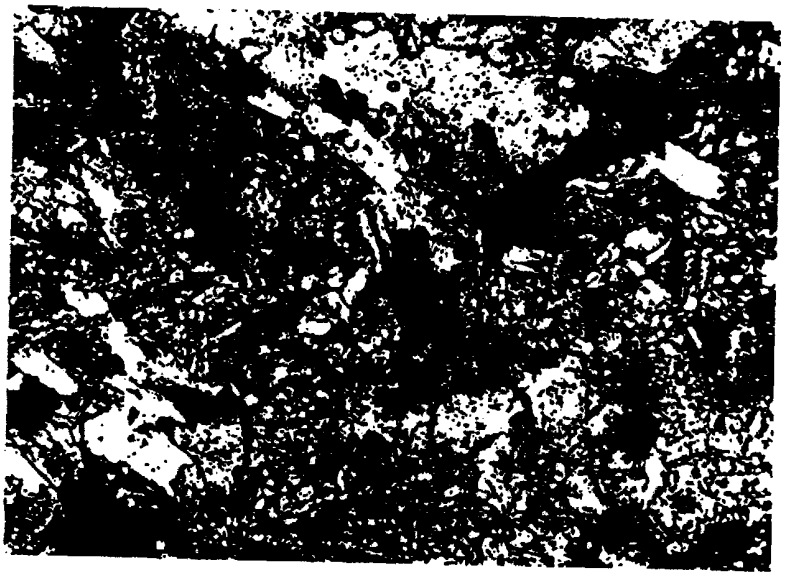
17868.5′
HUSKY TUNALIK
40X

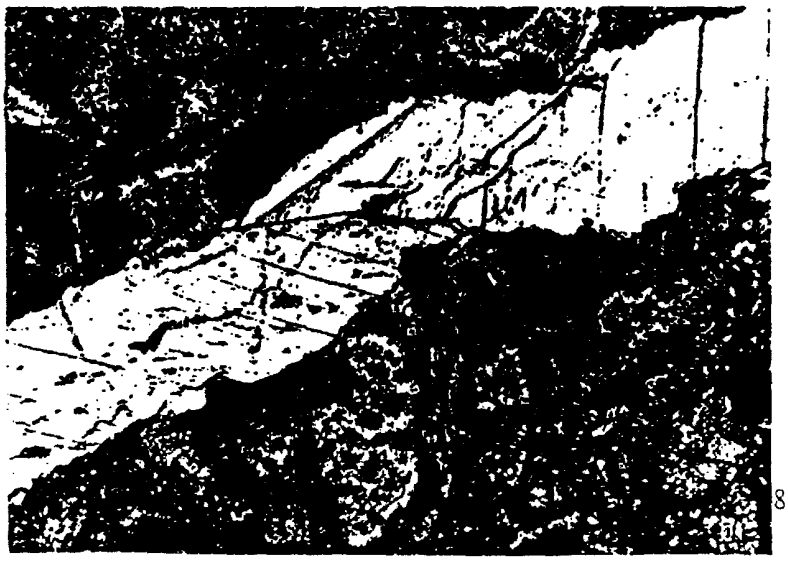
17868.5′
HUSKY TUNALIK
64X

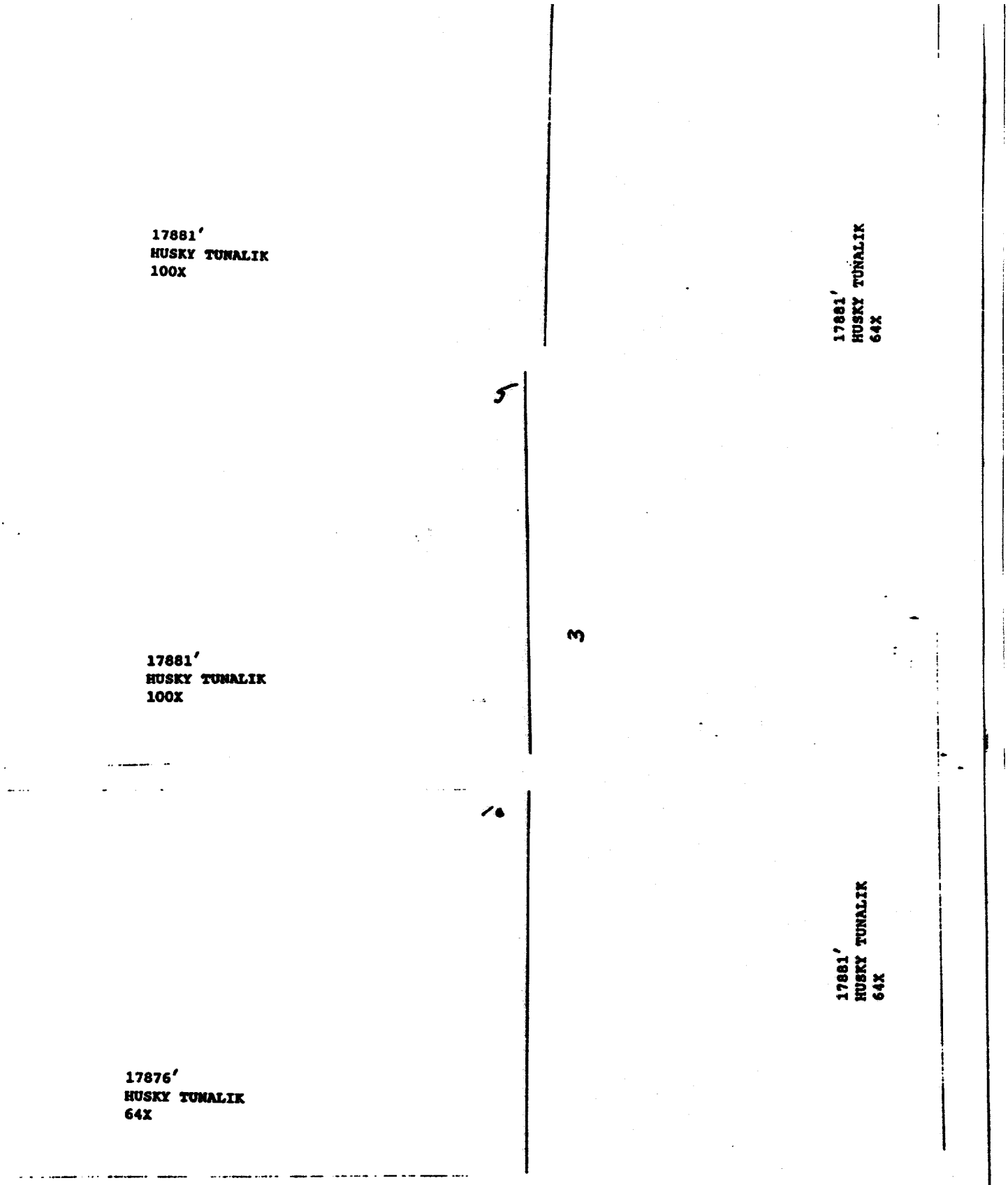
51

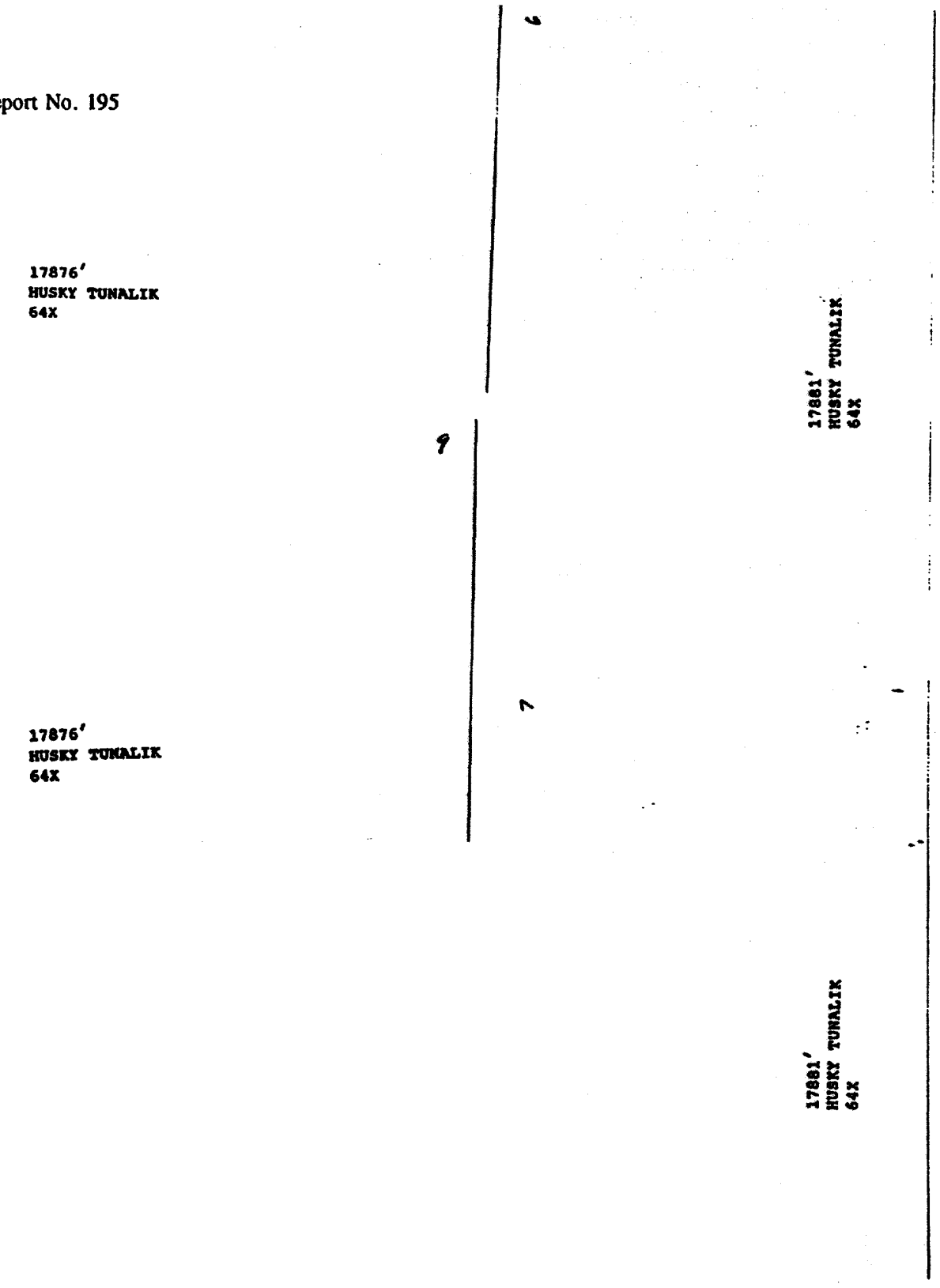


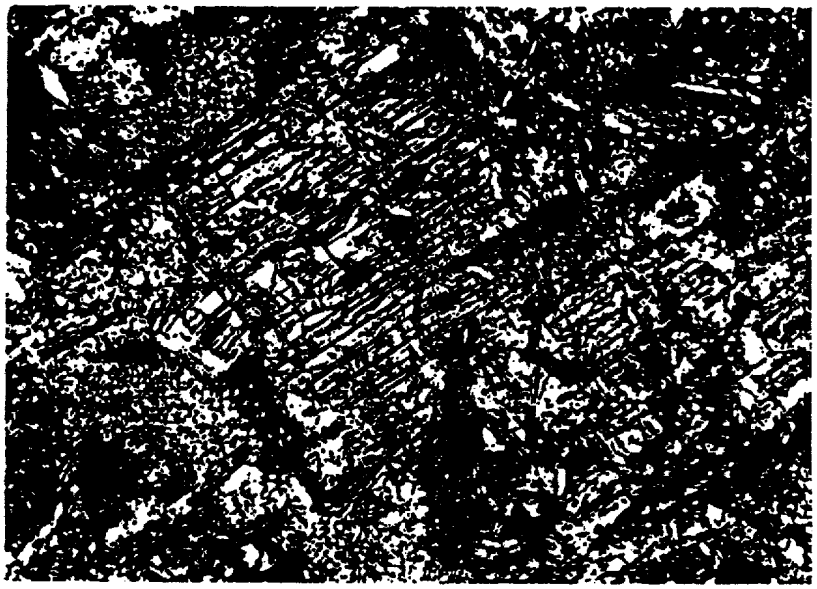

17881'
HUSKY TUNALIK
64X
17881'
HUSKY TUNALIK
40X
17881'
HUSKY TUNALIK
64X
17881'
HUSKY TUNALIK
40X

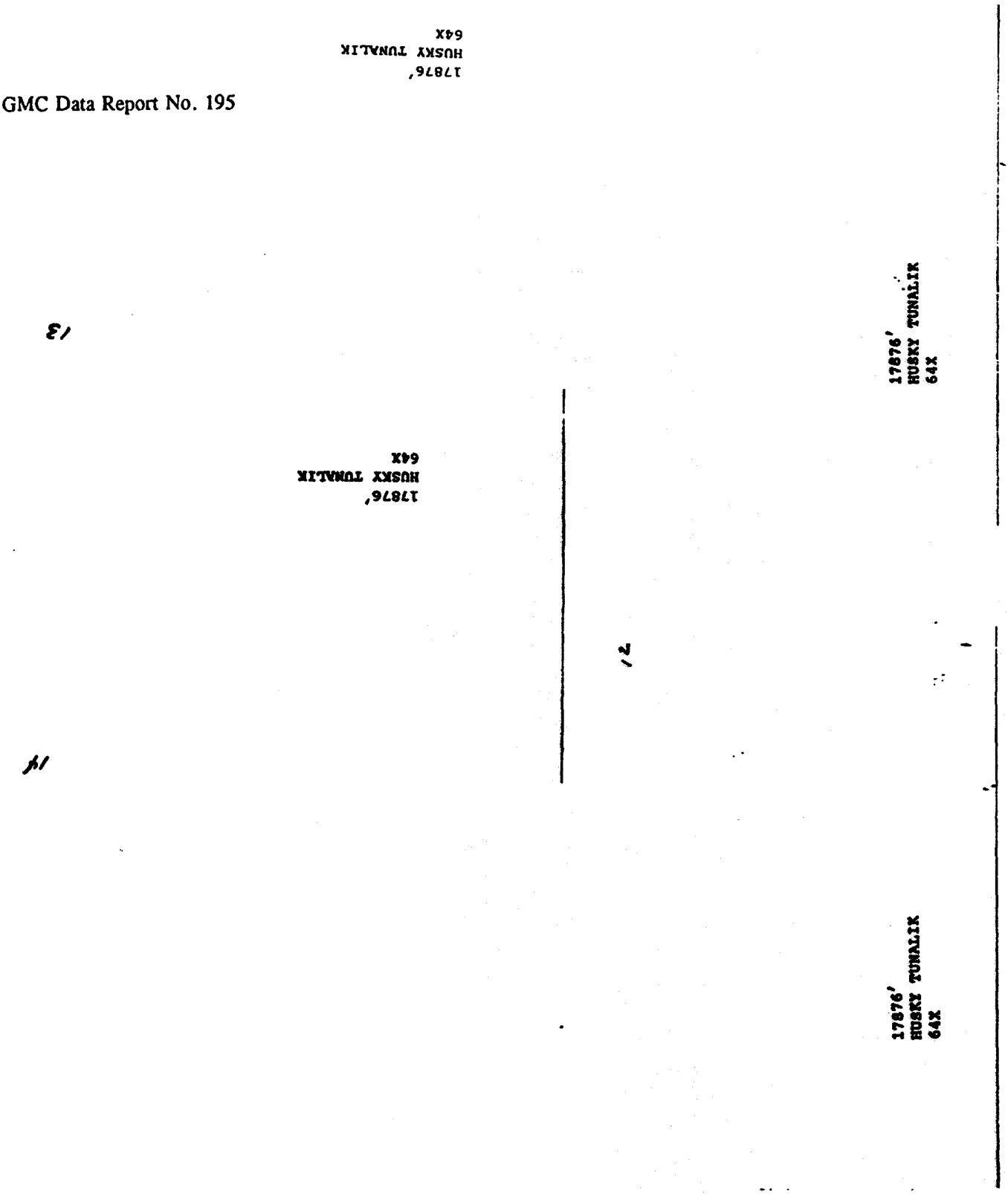


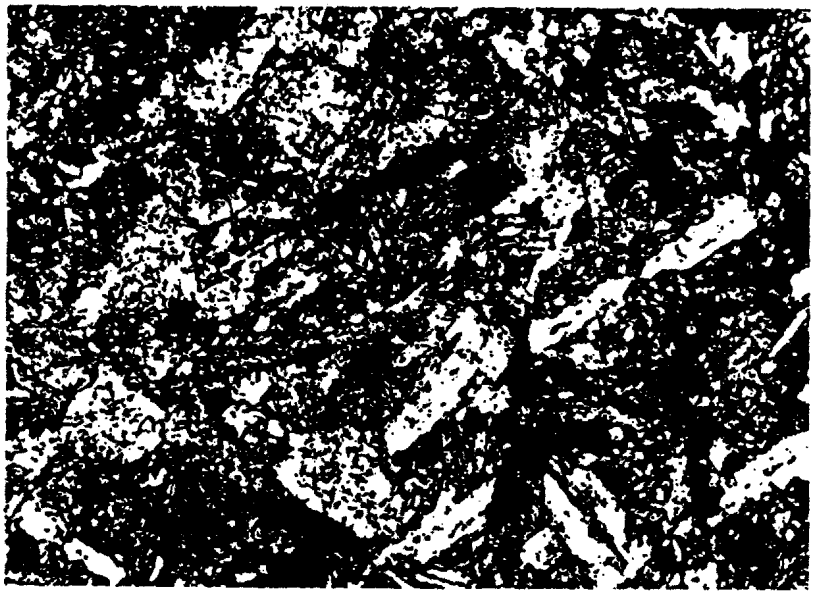



17881'
HUSKY TUNALIK
100X
17881'
HUSKY TUNALIK
64X
5
3
17881'
HUSKY TUNALIK
100X
17881'
HUSKY TUNALIK
64X
17876'
HUSKY TUNALIK
64X


17876'
HUSKY TUNALIK
64X
17876'
HUSKY TUNALIK
64X
17881'
HUSKY TUNALIK
64X
17881'
HUSKY TUNALIK
64X
6
9
7




17876'
HUSKY TUNALIK
64X
17876'
HUSKY TUNALIK
64X
17876'
HUSKY TUNALIK
64X
13
12
11

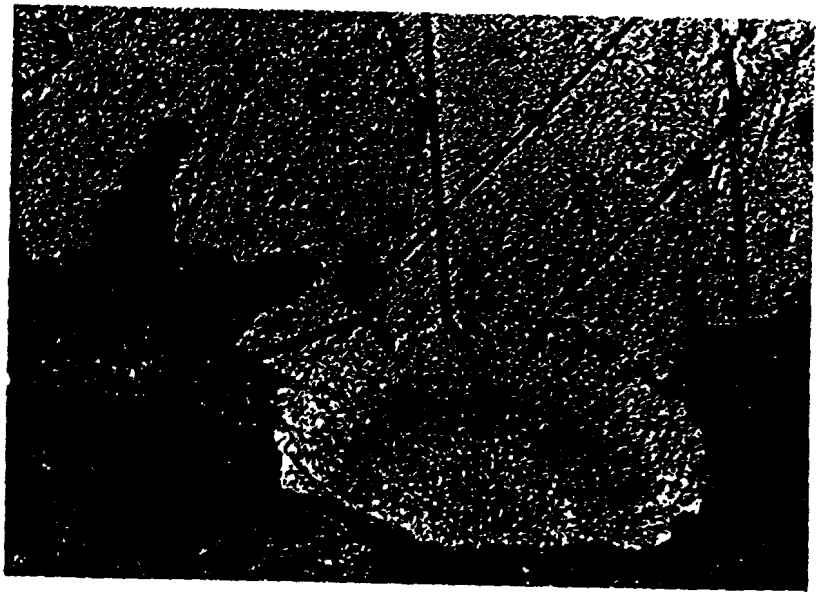


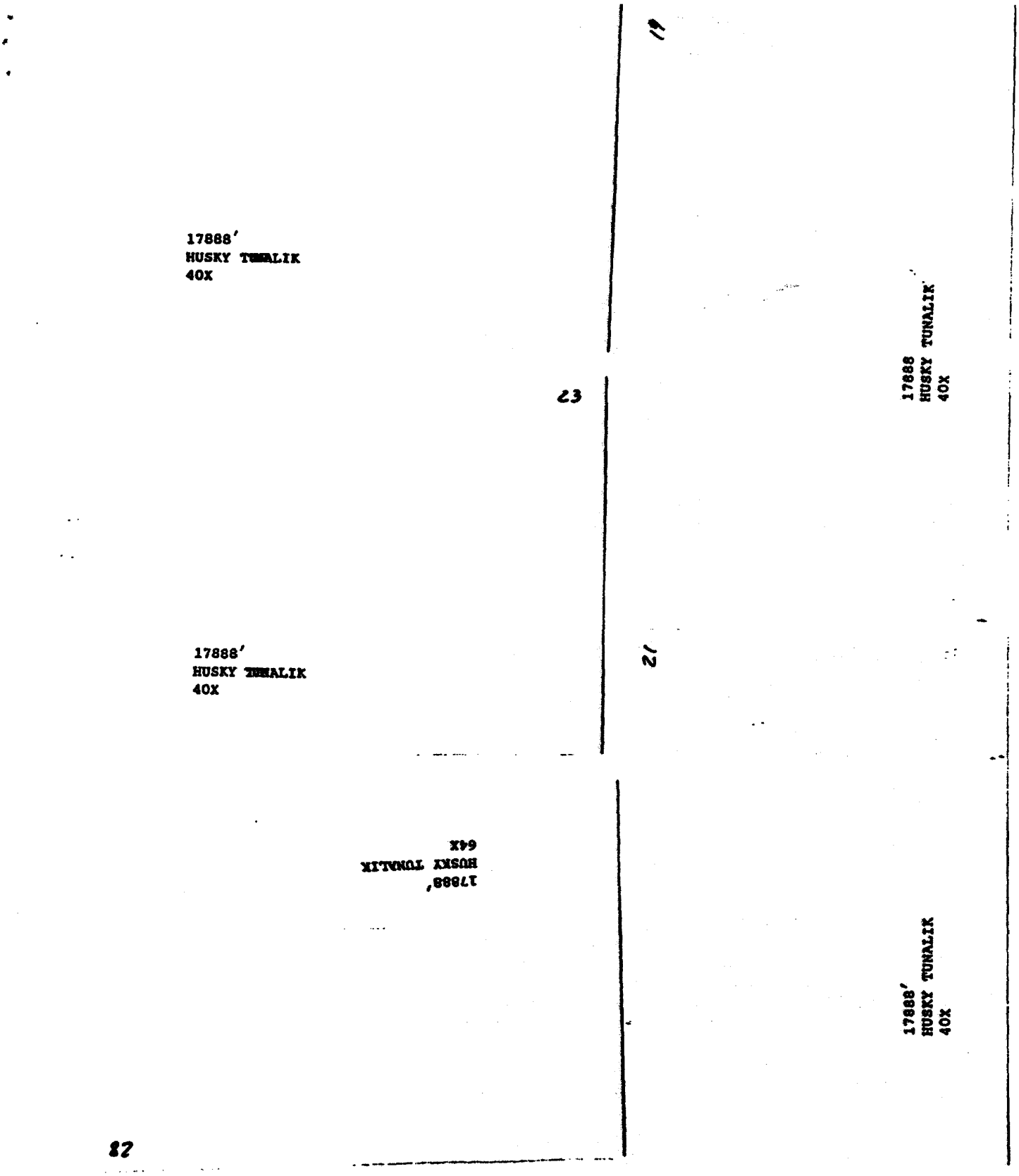
17876'
HUSKY TUNALIK
64X

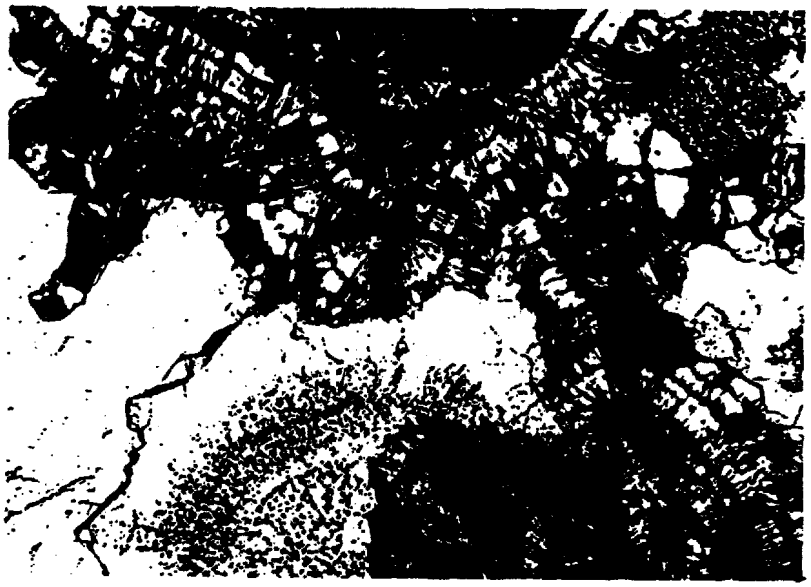
17876'
HUSKY TUNALIK
100X

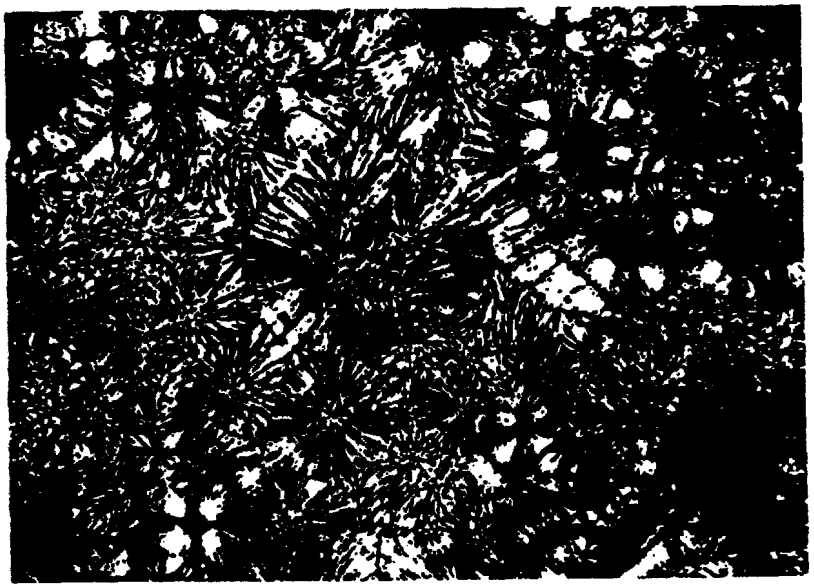
17876'
HUSKY TUNALIK
64X

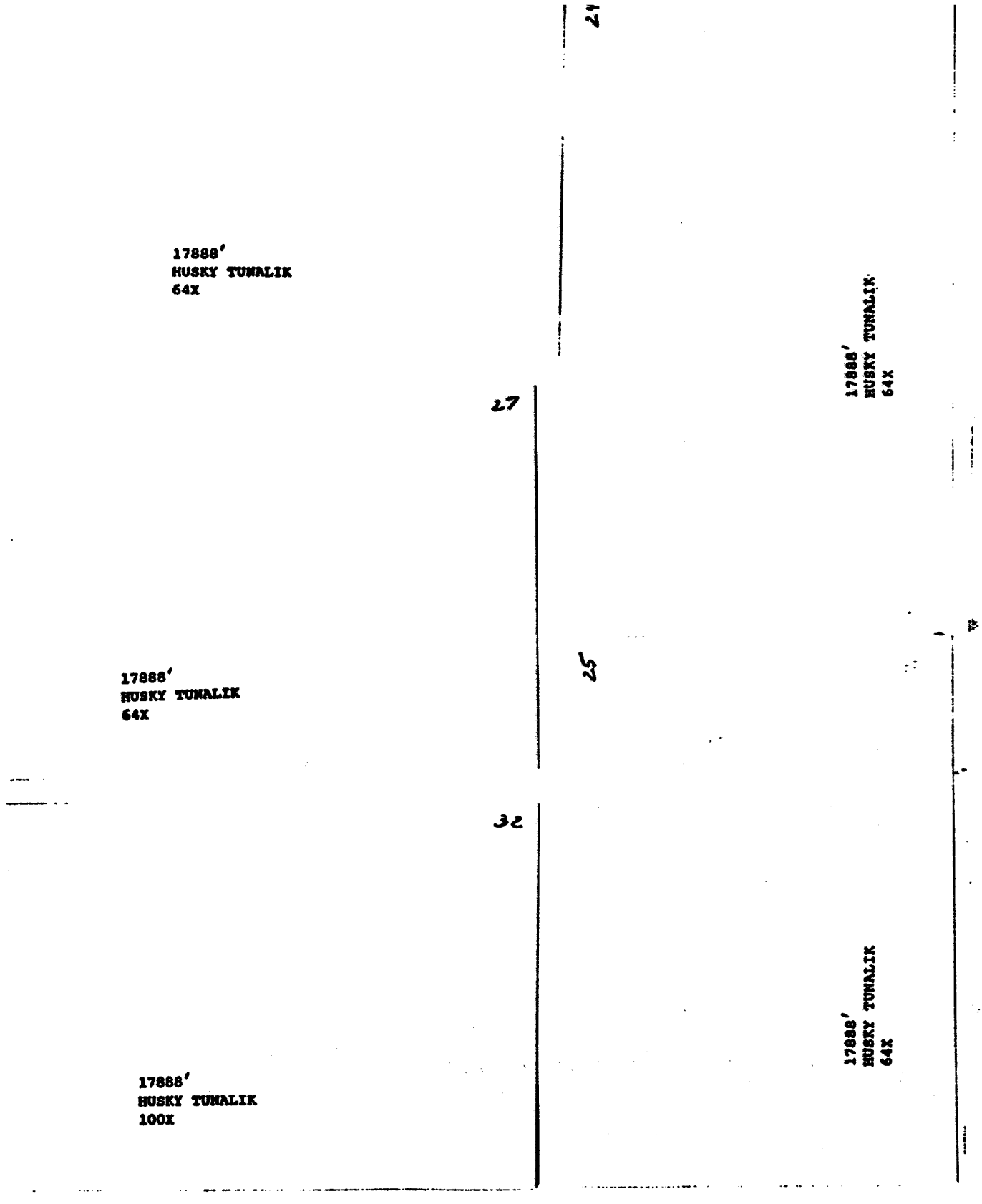
17876'
HUSKY TUNALIK
100X

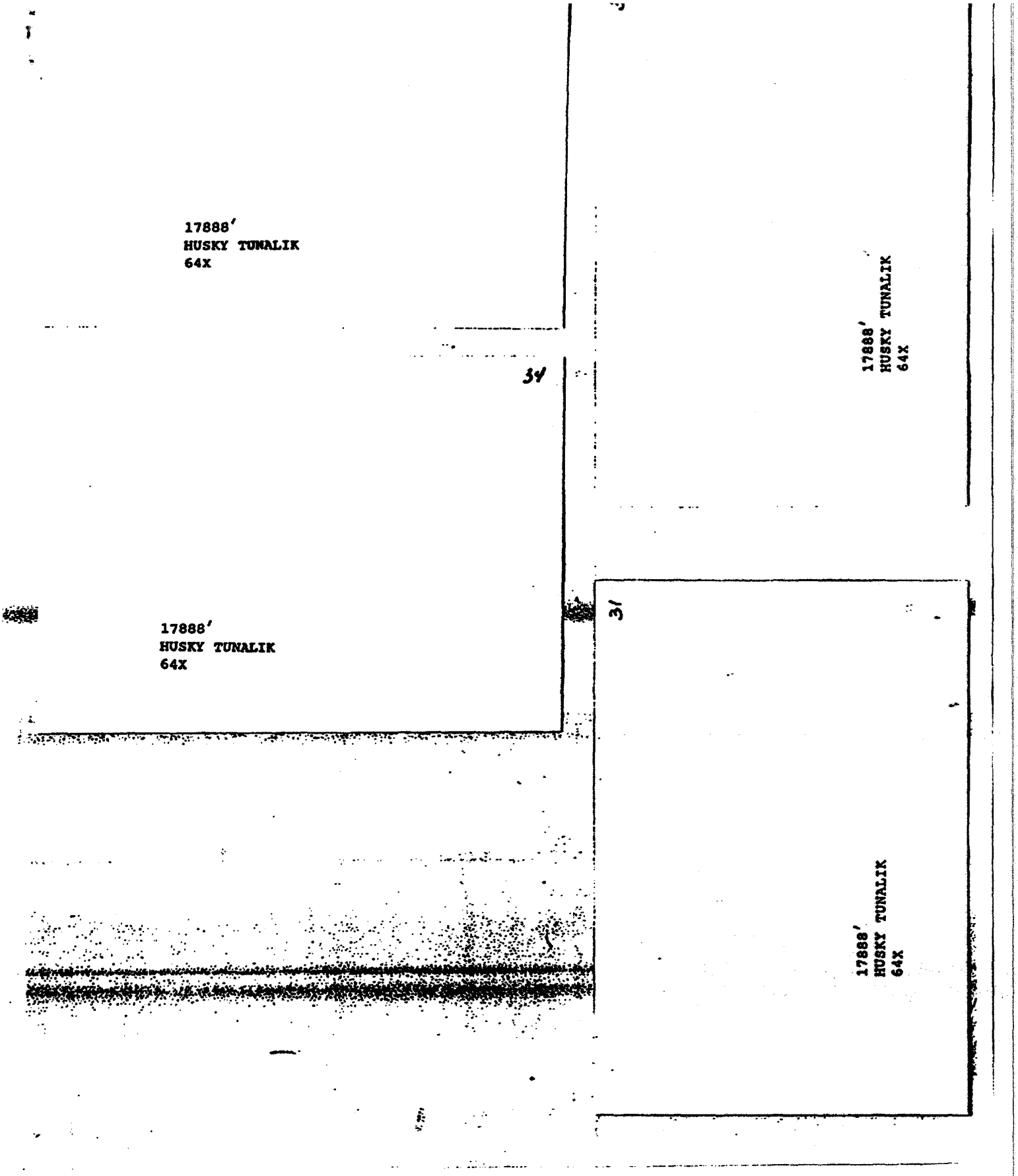



17888'
HUSKY TUNALIK
40X
17888'
HUSKY TUNALIK
40X
17888'
HUSKY TUNALIK
40X
17888'
HUSKY TUNALIK
40X
17888'
HUSKY TUNALIK
64X
19
23
21
82






17888'
HUSKY TUNALIK
64X
17888'
HUSKY TUNALIK
64X
17888'
HUSKY TUNALIK
64X
17888'
HUSKY TUNALIK
100X
17888'
HUSKY TUNALIK
64X
27
25
32


17888'
HUSKY TUNALIK
64X
34
17888'
HUSKY TUNALIK
64X
17888'
HUSKY TUNALIK
64X
31
17888'
HUSKY TUNALIK
64X