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Report on U-Pb geochronology results from legacy (1997–2005) samples from northern Saskatchewan

N.M. Rayner

2020

Canada

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Description of Content

This report contains U-Pb geochronological results for 11 rock samples from northern Saskatchewan collected between 1997 and 2005. These samples were part of a collaborative project between the Geological Survey of Canada and the Geological Survey of Saskatchewan. While results from other samples collected during this project were published previously, the results included here were not, primarily due to uncertainty about the interpretation of the results. The purpose of this report is to release the existing data with the required sample and laboratory metadata along with a limited, preliminary interpretation so that this information available for consideration by future researchers.

This report contains two Excel spreadsheets, each containing the results for either isotope dilution thermal ionization mass spectrometry (ID-TIMS, Appendix 1) analysis or sensitive high resolution ion microprobe (SHRIMP, Appendix 2) analysis conducted at the Geological Survey of Canada. Each spreadsheet consists of a worksheet containing the data and a series of sheets containing the concordia diagram for each sample. For the four samples analysed by SHRIMP, the scanning electron microscope zircon images annotated with the SHRIMP spot location are included as separate Adobe pdf files. Details for each sample (location, lithology, interpretation of results) are summarized below.

Analytical Methods

All samples were disaggregated using standard crushing/pulverizing techniques followed by density separation using the Wilfley table and heavy liquids. Zircon and monazite grains were selected after examination under a binocular microscope.

Zircon grains analysed by ID-TIMS and were treated with the air abrasion method (Krogh, 1982) before being submitted for U-Pb chemistry. Monazite grains were not subject to any pre-dissolution treatment. Dissolution of both zircon and monazite in concentrated HF, extraction of U and Pb, and

mass spectrometry followed the methods described by Parrish et al. (1987). Data reduction and numerical propagation of analytical uncertainties follow Roddick (1987).

For SHRIMP analysis, zircons grains were cast in 2.5 cm diameter epoxy mounts along with fragments of the GSC laboratory standard zircon (z6266, with $^{206}Pb/^{238}U$ age = 559 Ma). The mid-sections of the zircons were exposed using 9, 6, and 1 μm diamond compound. The internal features of the zircons (such as zoning, structures, alteration, etc.) were characterized in cathodoluminescence (CL) and/or back-scattered electron mode (BSE) utilizing a scanning electron microscope. Hard-copy images of the zircon grains were numbered and annotated with the location of the SHRIMP spot. Scans of these annotated images are included as separate files for each sample. SHRIMP analytical procedures followed those described by Stern (1997). Off-line data processing was accomplished using customized in-house software. The 1σ external errors of $^{206}Pb/^{238}U$ ratios reported in the data table incorporate the error in calibrating the reference material. Common Pb correction utilized the Pb composition of the surface blank (Stern, 1997).

For both TIMS and SHRIMP results, Isoplot v. 4.15 (Ludwig, 2003) was used to generate concordia plots and calculate weighted means. The error ellipses on the concordia diagrams and the weighted mean errors are reported at the 95% confidence level.

Results

Lab number: 5624
Sample number: CXA98-T223
Lithological description: Coarse-grained, foliated, hornblende-biotite-titanite-magnetite granodiorite
Location: Reindeer Lake
Latitude: 57.51479°N
Longitude: -102.58090°W

This sample yielded an igneous crystallization age of 1843±2 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 3 single grain ID-TIMS fractions (MSWD = 0.42, Appendix 1).

****

Lab number: 5625
Sample number: CXA98-D93
Lithological description: Coarse-grained, hornblende-biotite bearing monzogranite
Location: Reindeer Lake
Latitude: 56.87133°N
Longitude: -102.25693°W

This sample yielded an igneous crystallization age of 1863±2 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 4 multi-grain ID-TIMS fractions (MSWD = 1.8, Appendix 1). One single grain fraction, whose slightly younger $^{207}Pb/^{206}Pb$ age was statistically distinct, was excluded from the calculation of the age. This analysis might reflect a small amount of ancient Pb-loss.

****

Lab number: 5859
Sample number: CXA98-D397
Lithological description: Medium grained, foliated hornblende-biotite tonalite
Location: South shore of Reindeer Lake, on island north of Deep Bay
Latitude: 56.51427°N
Longitude: -102.91857°W

This sample yielded an igneous crystallization age of 1863±5 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 4 multi-grain ID-TIMS fractions (MSWD = 3.6, Appendix 1). Three fractions were excluded from the calculation of the age.

****

Lab number: 6068
Sample number: CXA97-A142
Lithological description: medium grained, foliated, recrystallized, homogeneous, biotite -hornblende tonalite
Location: Small un-named island north of Reynolds Island, Reindeer Lake
Latitude: 56.69353°N
Longitude: -102.50045°W

This sample yielded an igneous crystallization age of 1810±5 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 9 SHRIMP analyses of high U zircon rims (MSWD = 1.7, Appendix 2, IP310-6068.pdf). Low U zircon cores form a population with an age of 1844±8 Ma (n=11, MWSD = 1.15) which is interpreted as an inherited component.

****

Lab number: 6112
Sample number: CXA98-D108
Lithological description: Pinkish-grey foliated biotite granite, medium to coarse-grained, mostly recrystallized
Location: Shoreline on Reindeer Lake just out of Paskwachi Bay, south side.
Latitude: 57.20644°N
Longitude: -101.99761°W

This sample yielded an igneous crystallization age of 1833±2 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 3 multi-grain ID-TIMS fractions (MSWD = 0.11, Appendix 1). Two fractions were excluded from the calculation of the age.

****

Lab number: 7829
Sample number: CXA-98-L48
Lithological description: tonalite, intrusive into Burntwood, south of the Levesque Bay assemblage
Location: n/a
Latitude: 56.47178°N
Longitude: -102.95446°W

This sample yielded an estimated igneous crystallization age of 1850±2 Ma, based on the $^{207}Pb/^{206}Pb$ age of a single multi-grain concordant fraction (Appendix 1). Three other fractions return discordant results.

****

Lab number: 7877
Sample number: RM0301-114
Lithological description: felsic volcanic fragmental
Location: Reindeer Lake, north of Patterson Island
Latitude: 57.71263°N
Longitude: -102.61306°W

Only 5 zircon grains were recovered from this sample, of which only 3 were of sufficient quality for SHRIMP analysis (Appendix 2, IP325-7877.pdf). The weighted mean $^{207}Pb/^{206}Pb$ age of these 3 analyses is 2641±41 Ma (MSWD = 2.7). This is tentatively interpreted as the crystallization age of the volcanic fragmental, however we cannot exclude the possibility that these are inherited/detrital grains.

****

Lab number: 7881
Sample number: 0001-064
Lithological description: medium to coarse grained, massive to weakly foliated pink leucogranodiorite intrudes supracrustals of the Sickle group
Location: east central Laurie Lake
Latitude: 56.57009°N
Longitude: -102.01405°W

This sample yielded an igneous crystallization age of 1846±18 Ma, based on the weighted mean $^{207}Pb/^{206}Pb$ age of 7 SHRIMP zircon analyses (MSWD = 0.38, Appendix 2, IP325-7881.pdf). A metamorphic age of 1803±1 Ma was determined from the weighted mean $^{207}Pb/^{206}Pb$ age of 2 single-grain TIMS monazite fractions (MSWD = 0.57, Appendix 1). One slightly younger monazite fraction (1799.5 Ma) was excluded from the calculation of the metamorphic age.

****

Lab number: 7882
Sample number: 0001-0063
Lithological description: hornblende granodiorite belonging to the LaRonge/Lynn Lake belt, intrusive into interpreted volcanic rocks
Location: east central Laurie Lake
Latitude: 56.55574°N
Longitude: -102.00762°W

This sample yielded an estimated igneous crystallization age of 1845±3 Ma, based on the $^{207}Pb/^{206}Pb$ age of a single, multi-grain, concordant fraction (Appendix 1). Two other fractions return discordant results.

****

Lab number: 7883
Sample number: 0001-184
Lithological description: medium to coarse grained leucotonalite intrusive into psammitic to pelitic turbidites of the Duck Lake assemblage as well as into volcanic rocks of the Lawrence Point assemblage
Location: southeast of the Duck Lake channel at Reindeer Lake
Latitude: 56.58054°N
Longitude: -102.94031°W

This sample was dated by both multi-grain TIMS (Appendix 1) and SHRIMP (Appendix 2, IP385-7883.pdf) techniques. Three TIMS fractions yielded precise but discordant $^{207}Pb/^{206}Pb$ dates of 1798.3±2.2 Ma (1.75% discordant), 1801.7±2 Ma (1.79% disc.) and 1812.7±2 Ma (3.13% disc.). All three fractions had in excess of 500 ppm U. The Tukey's biweight $^{207}Pb/^{206}Pb$ mean age determined from the SHRIMP analyses is 1847±10 Ma (n=25, 3 rejects). This includes both high U (up to 3200 ppm) and low U (down to 50 ppm) zircon and is tentatively interpreted as the crystallization age of the leucogranite. The younger, discordant TIMS results are interpreted to reflect Pb-loss.

****

Lab number: 8781
Sample number: CXA98-D042
Lithological description: diorite
Location: Reindeer Lake
Latitude: 56.51375°N
Longitude: -103.21048°W

Five TIMS fractions (1-2 grains per fraction) were analyzed from this sample (Appendix 1). The best estimate for the crystallization age is the upper intercept of a regression through the three most precise results, 1849±13 Ma (MSWD = 0.00). Alternatively, a minimum age for the crystallization of the diorite is 1835±2 Ma, which is the $^{207}Pb/^{206}Pb$ age of the most concordant fraction (0.35% discordant).

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Krogh, T.E. 1982: Improved accuracy of U-Pb zircon ages by the creation of more concordant systems using an air abrasion technique. Geochimica et Cosmochimica Acta, **46**, 637-649.

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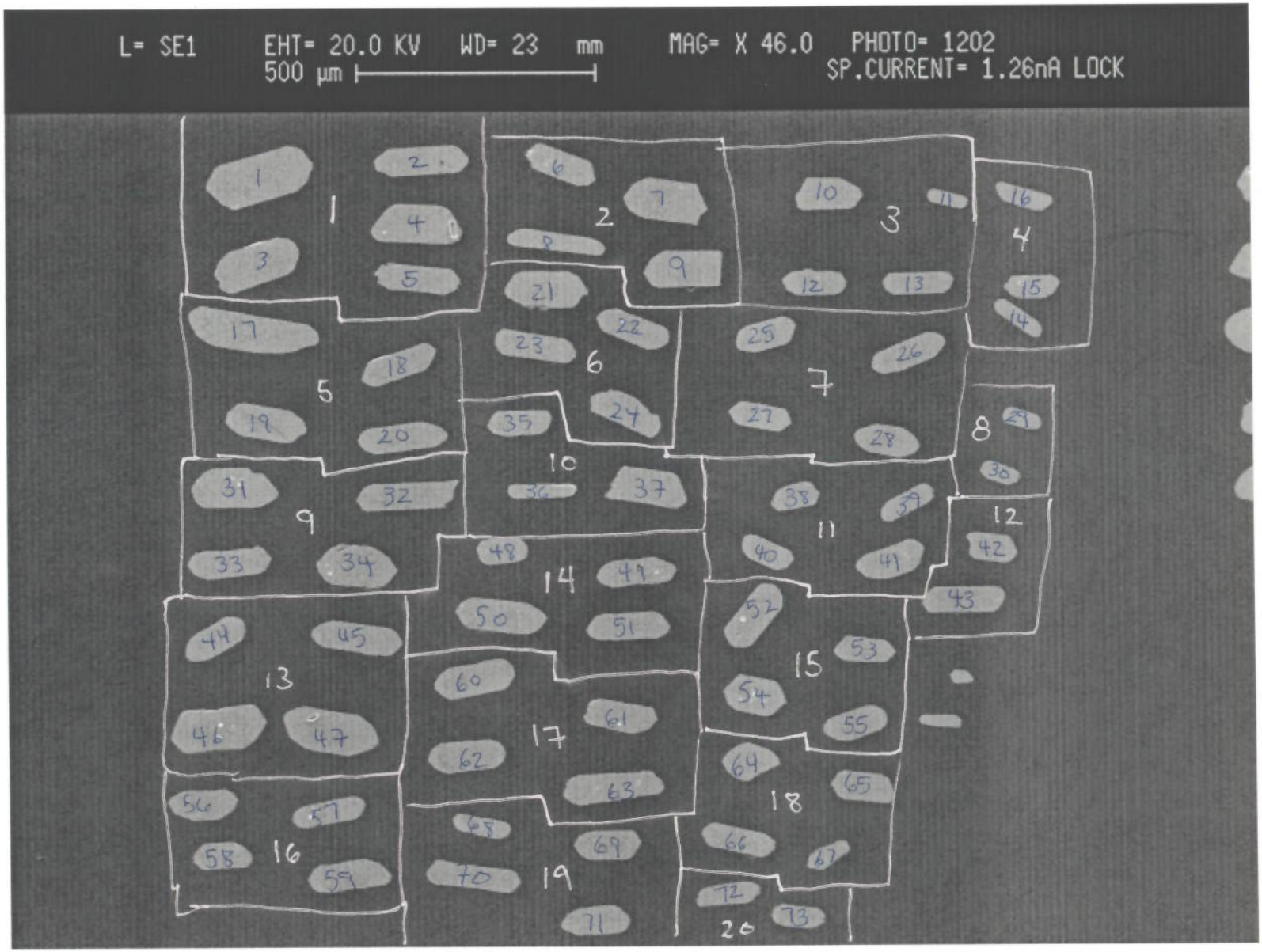
Parrish, R.R., Roddick, J.C., Loveridge, W.D. and Sullivan, R.W. 1987: Uranium-lead analytical techniques at the geochronology laboratory, Geological Survey of Canada; *in* Radiogenic Age and Isotopic Studies: Report 1, Geological Survey of Canada. **87**-2, 3–7.

Stern, R.A. 1997: The GSC Sensitive High Resolution Ion Microprobe (SHRIMP): analytical techniques of zircon U-Th-Pb age determinations and performance evaluation: in Radiogenic Age and Isotopic Studies, Report 10, Geological Survey of Canada, Current Research 1997-F, p. 1-31.



IP 310

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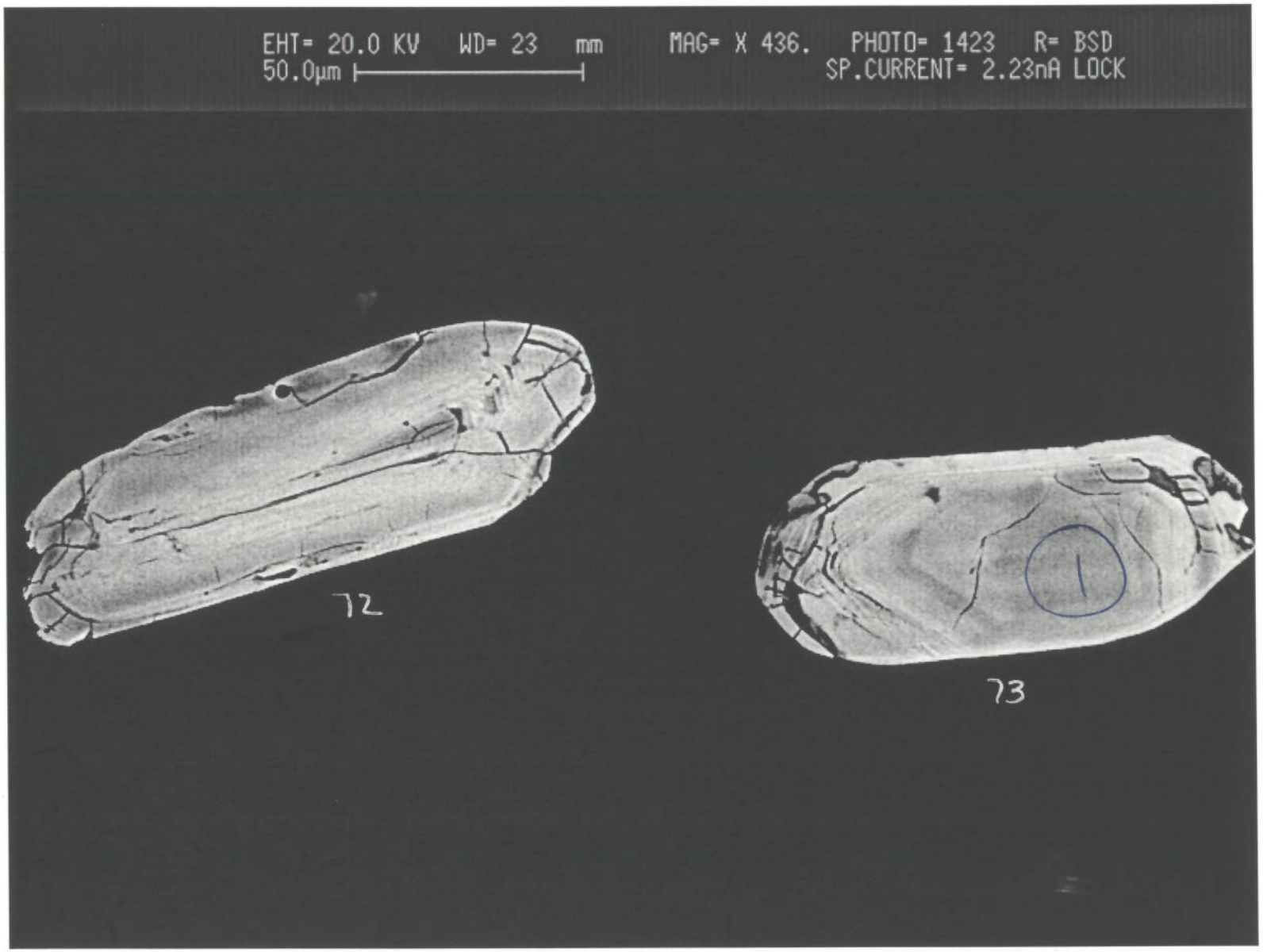
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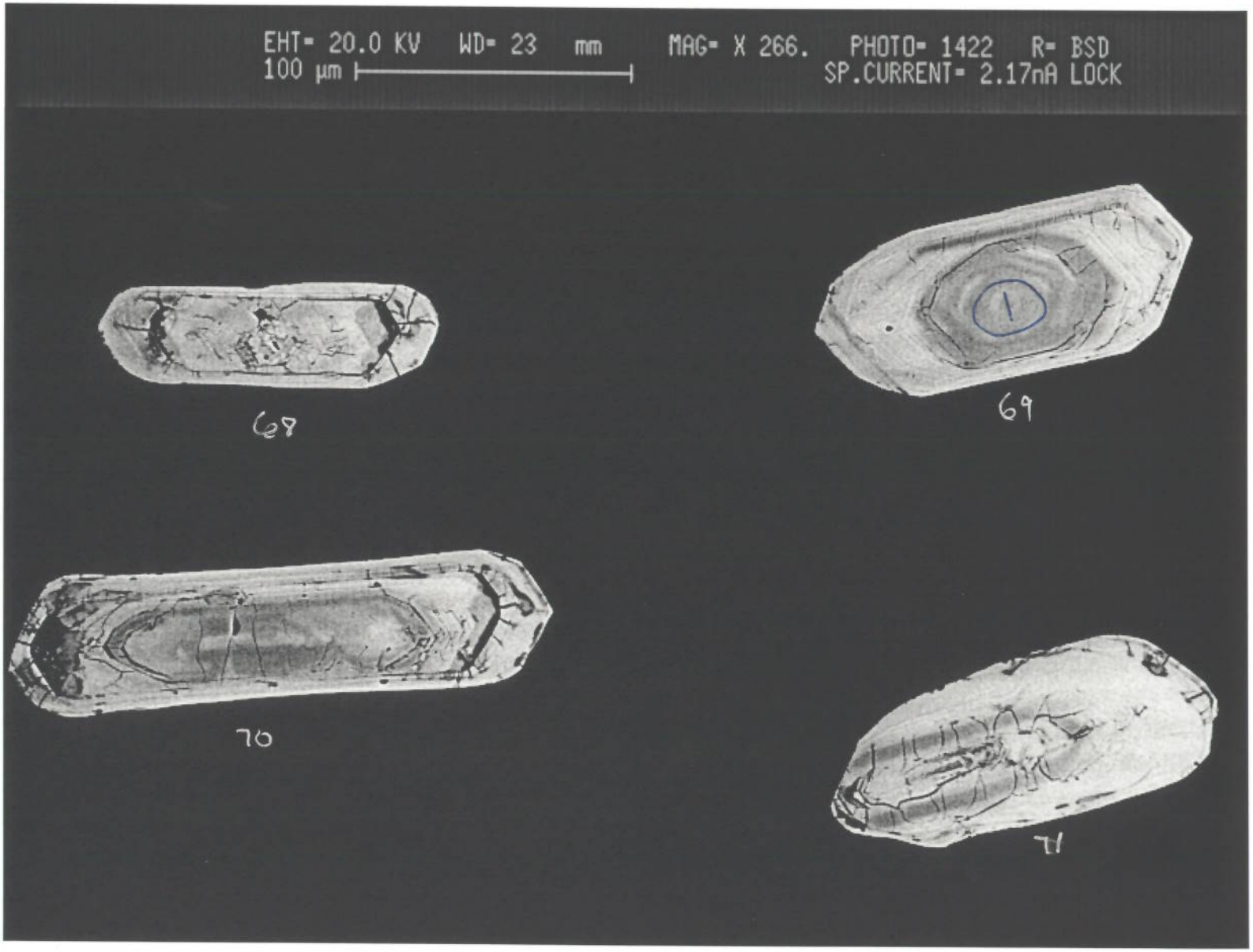
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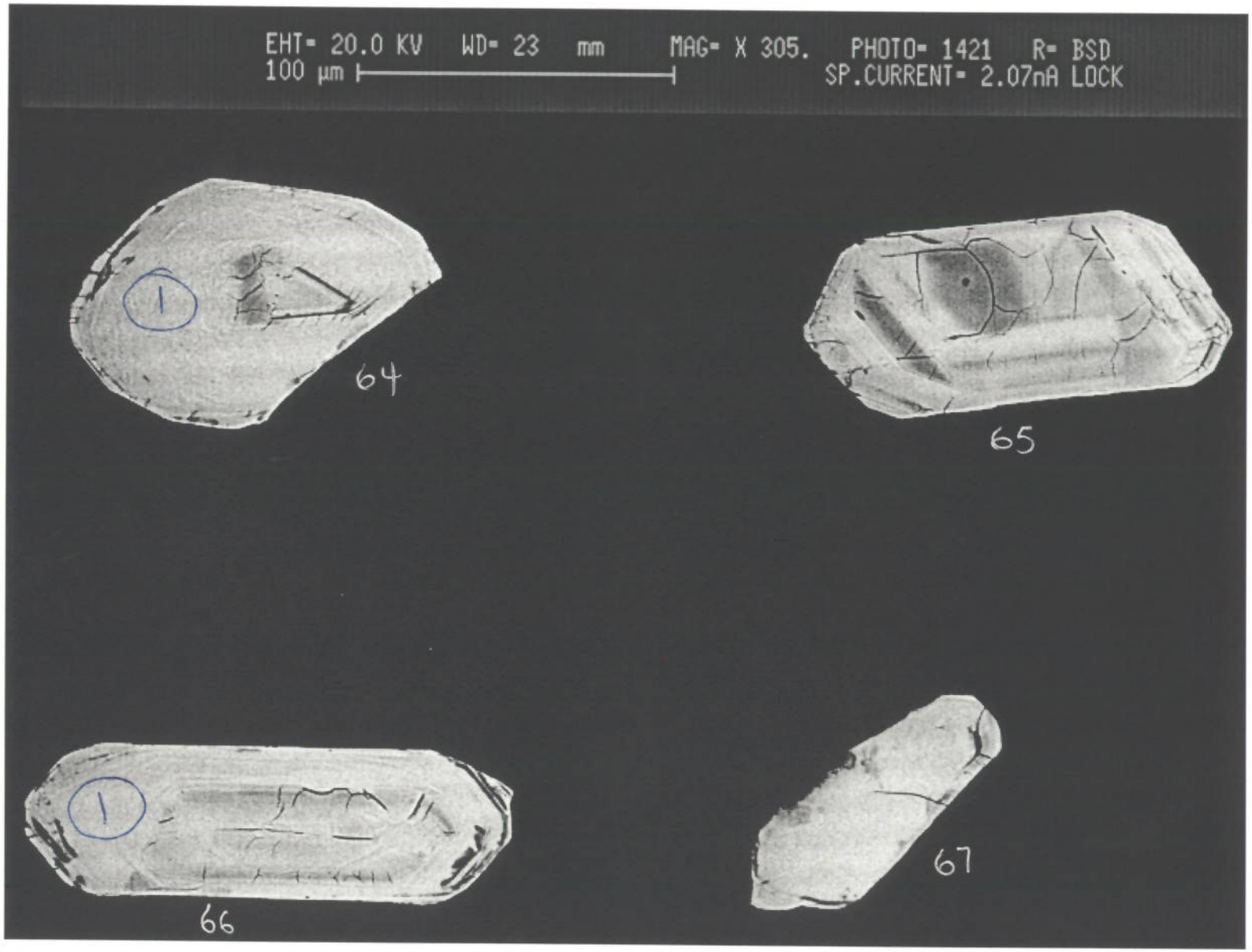
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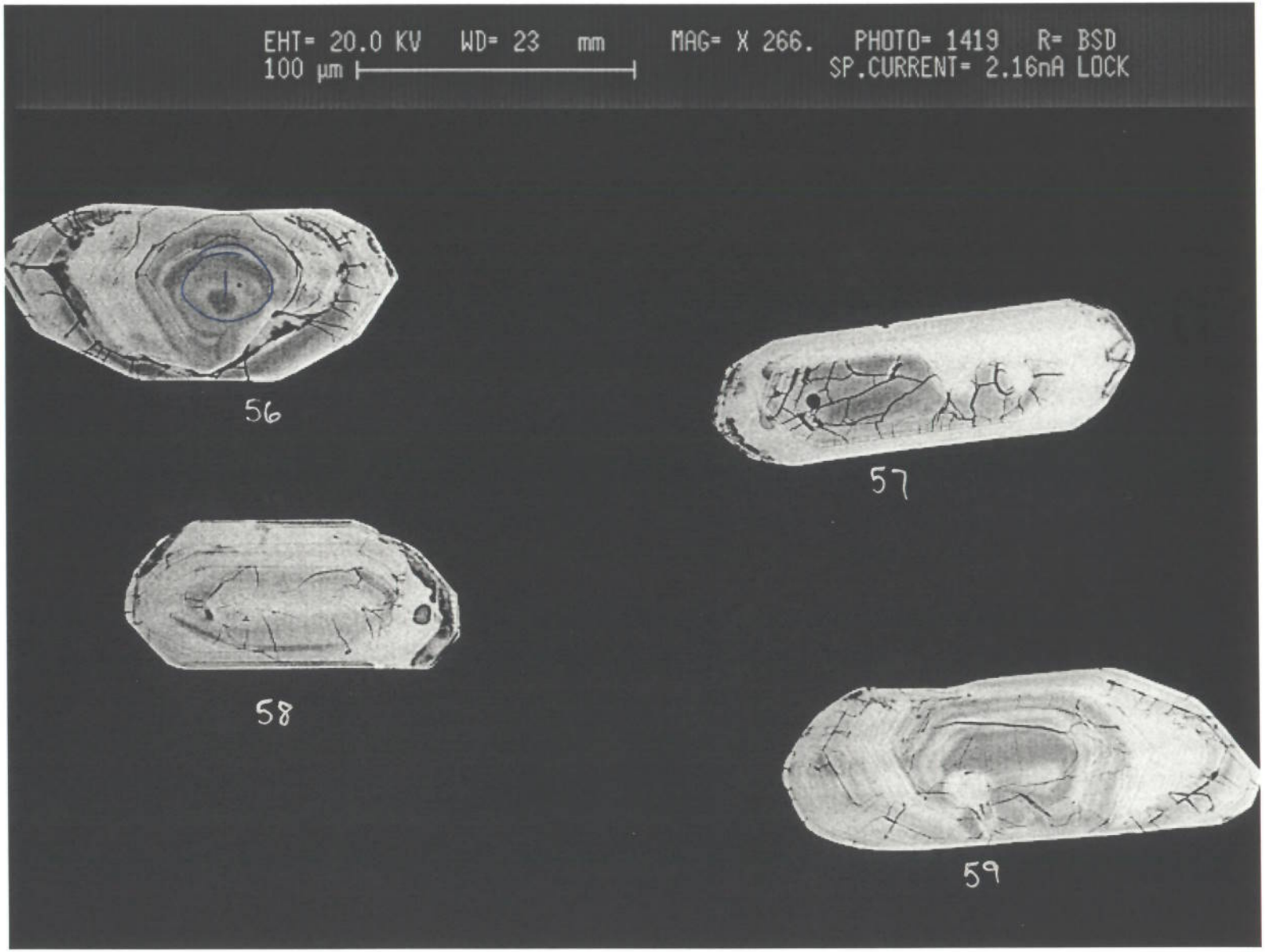
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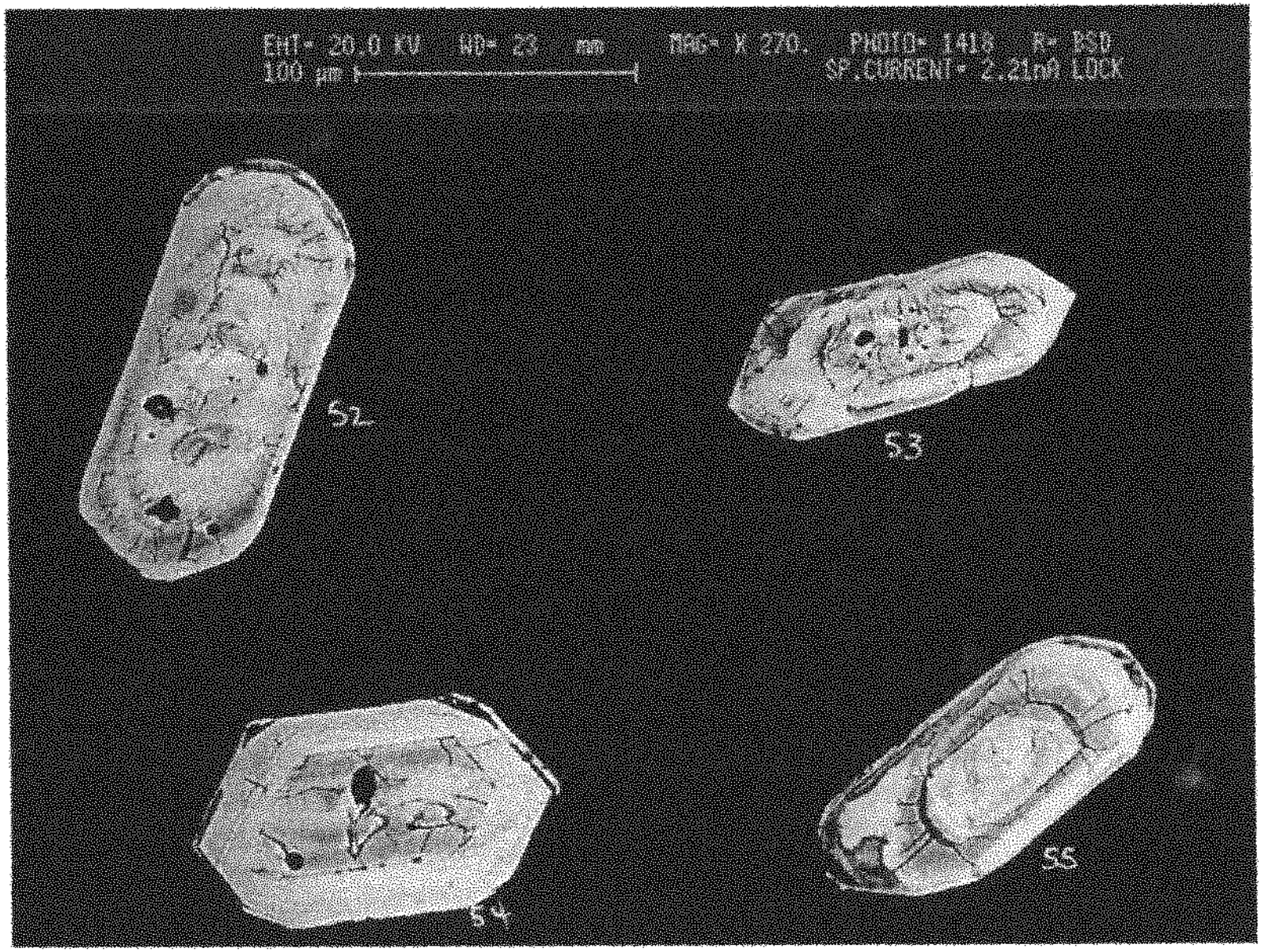
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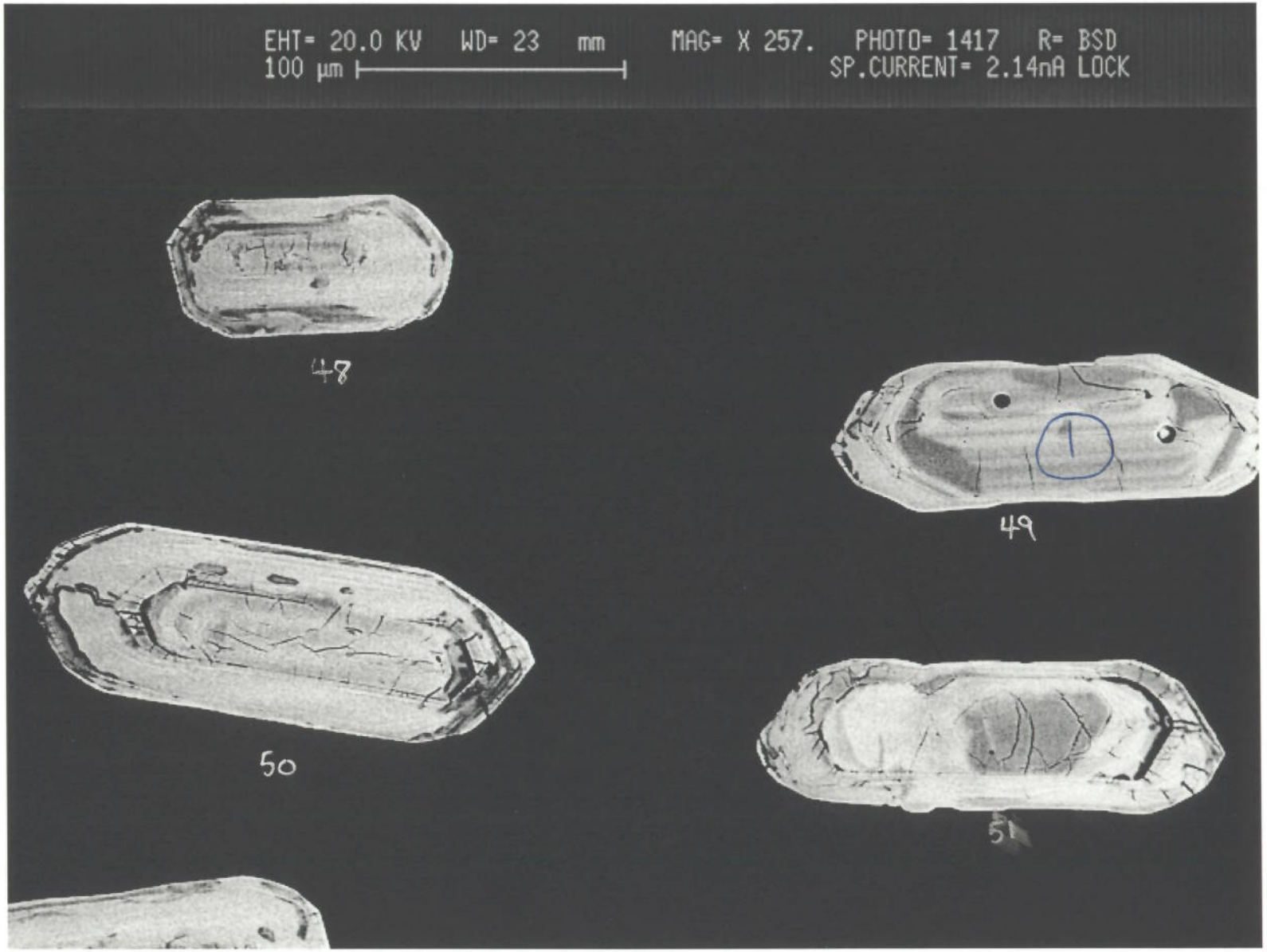
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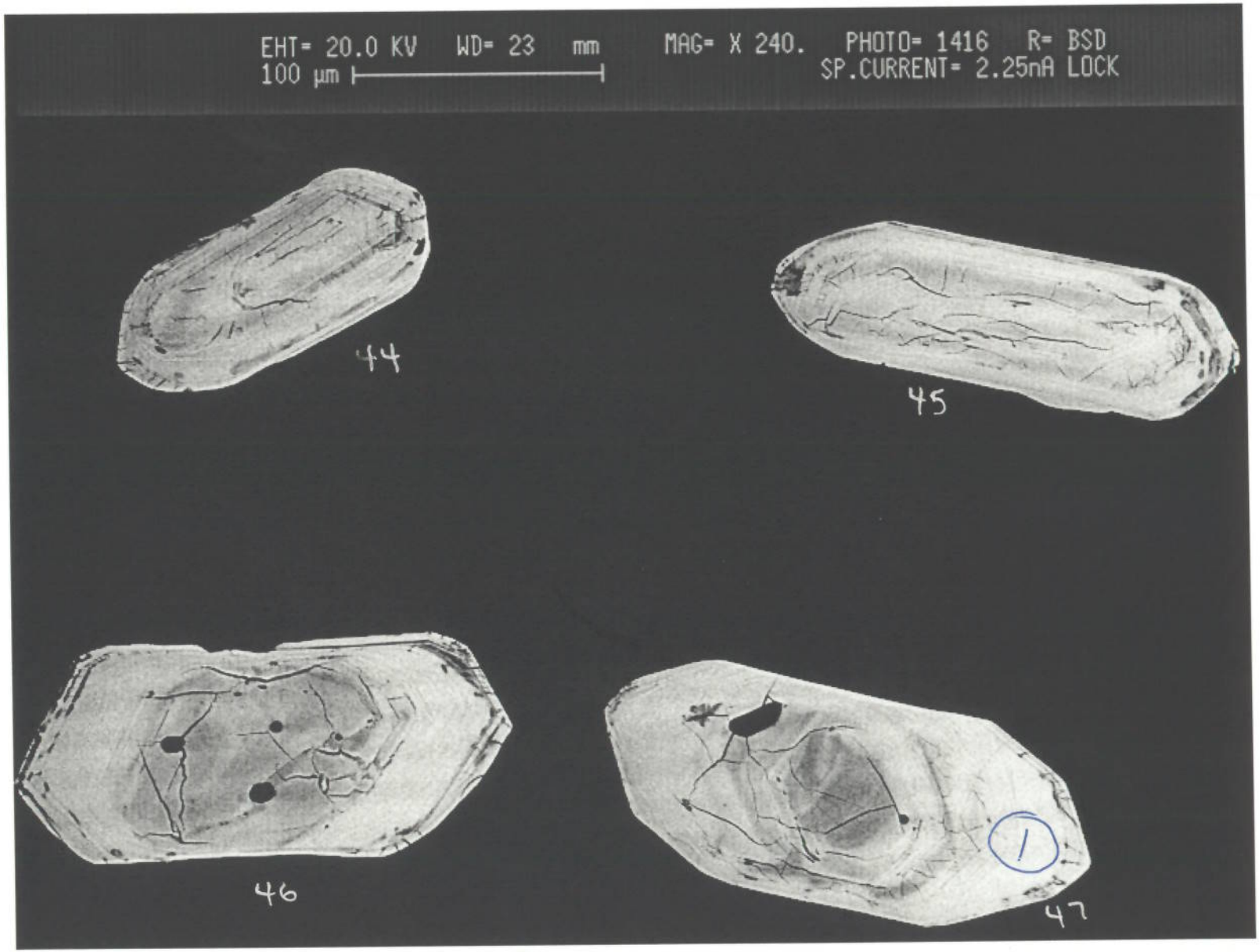
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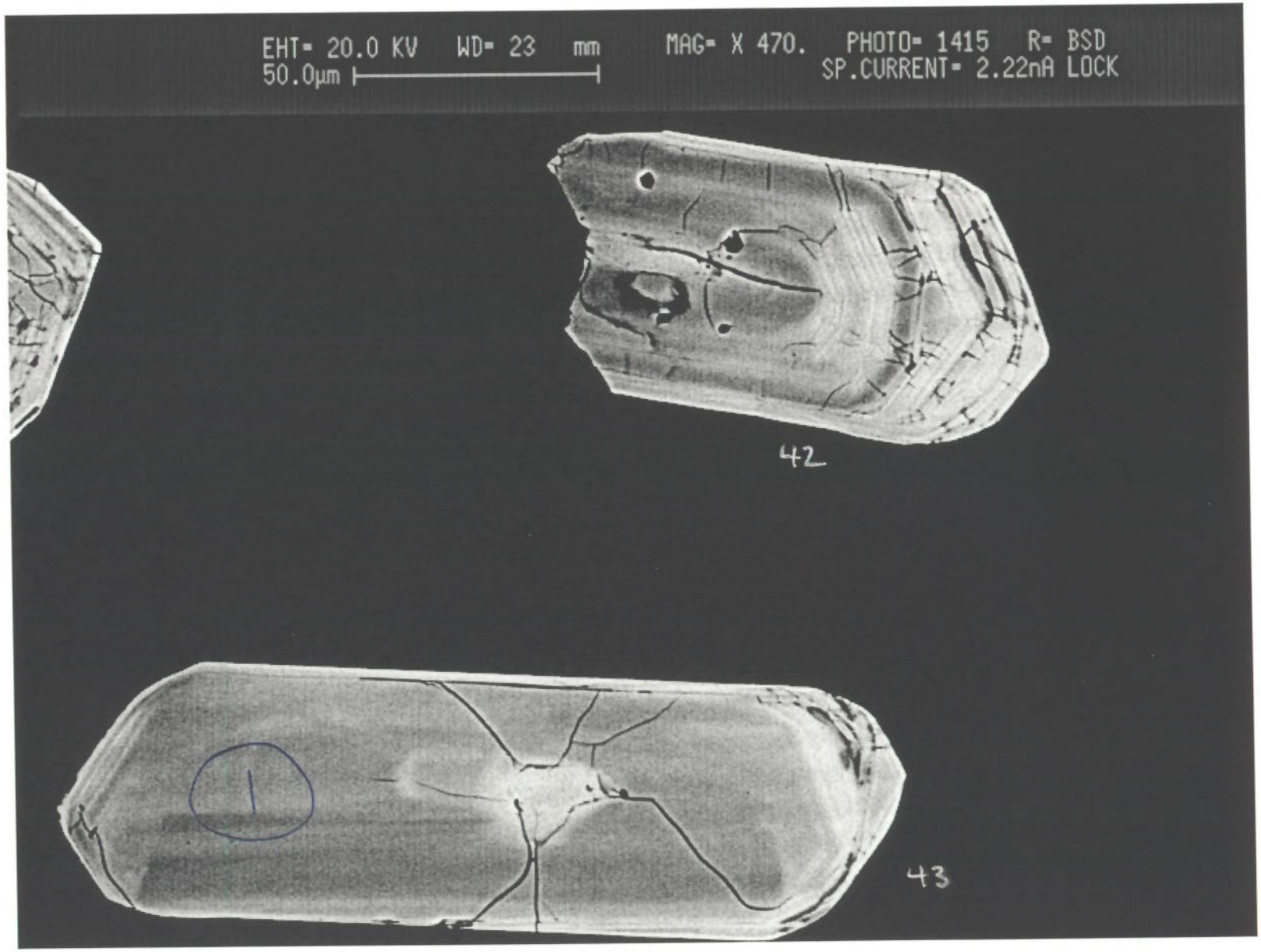
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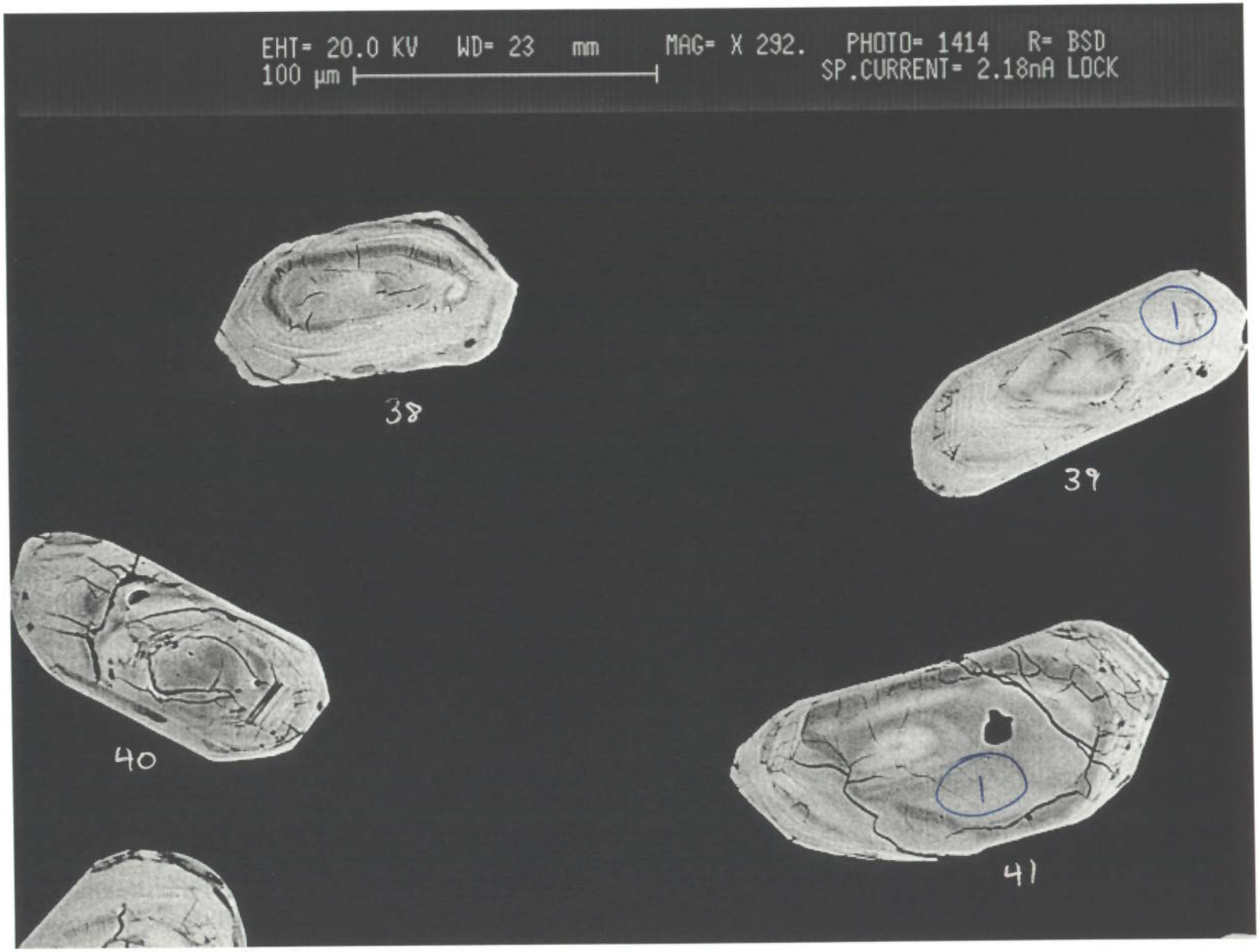
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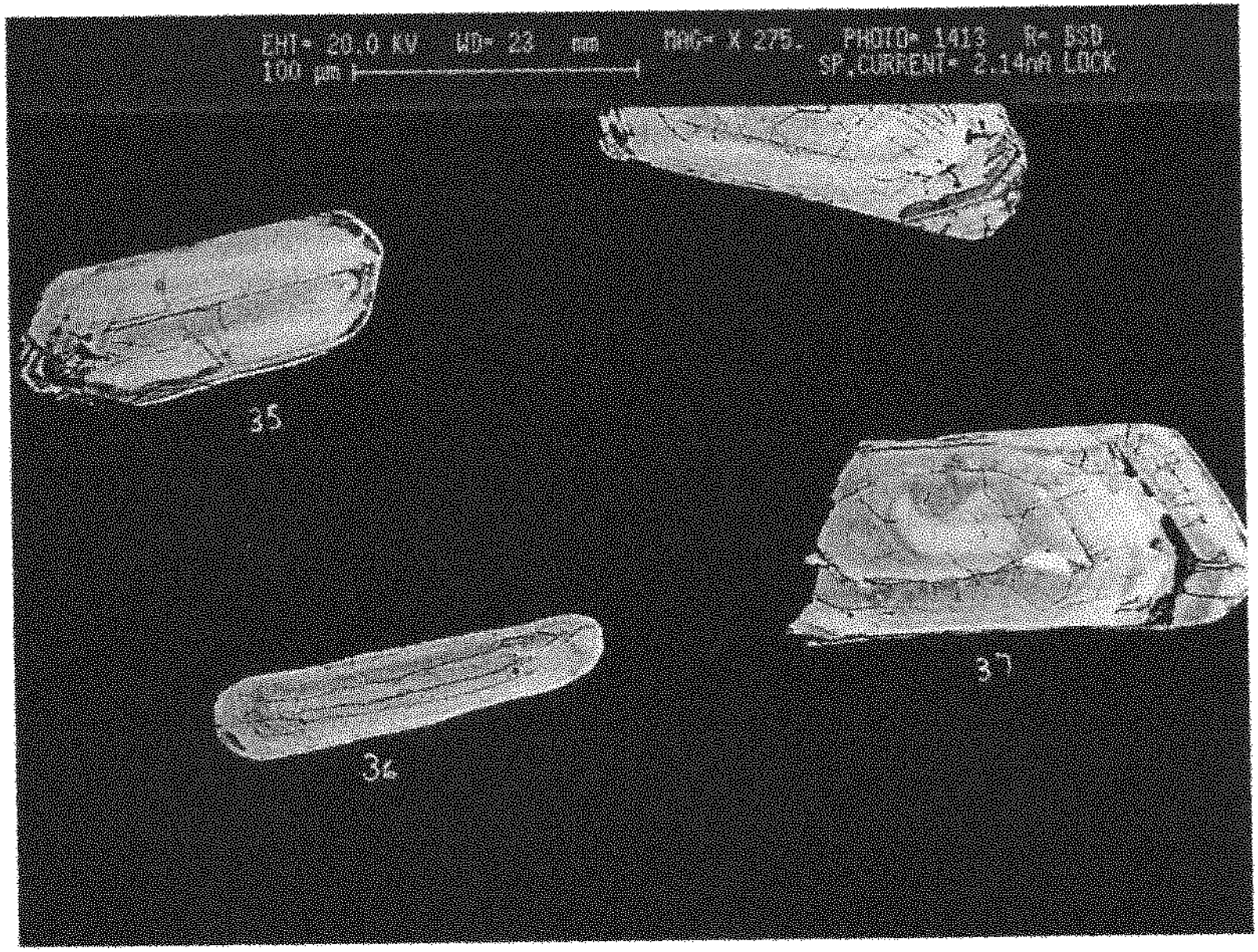
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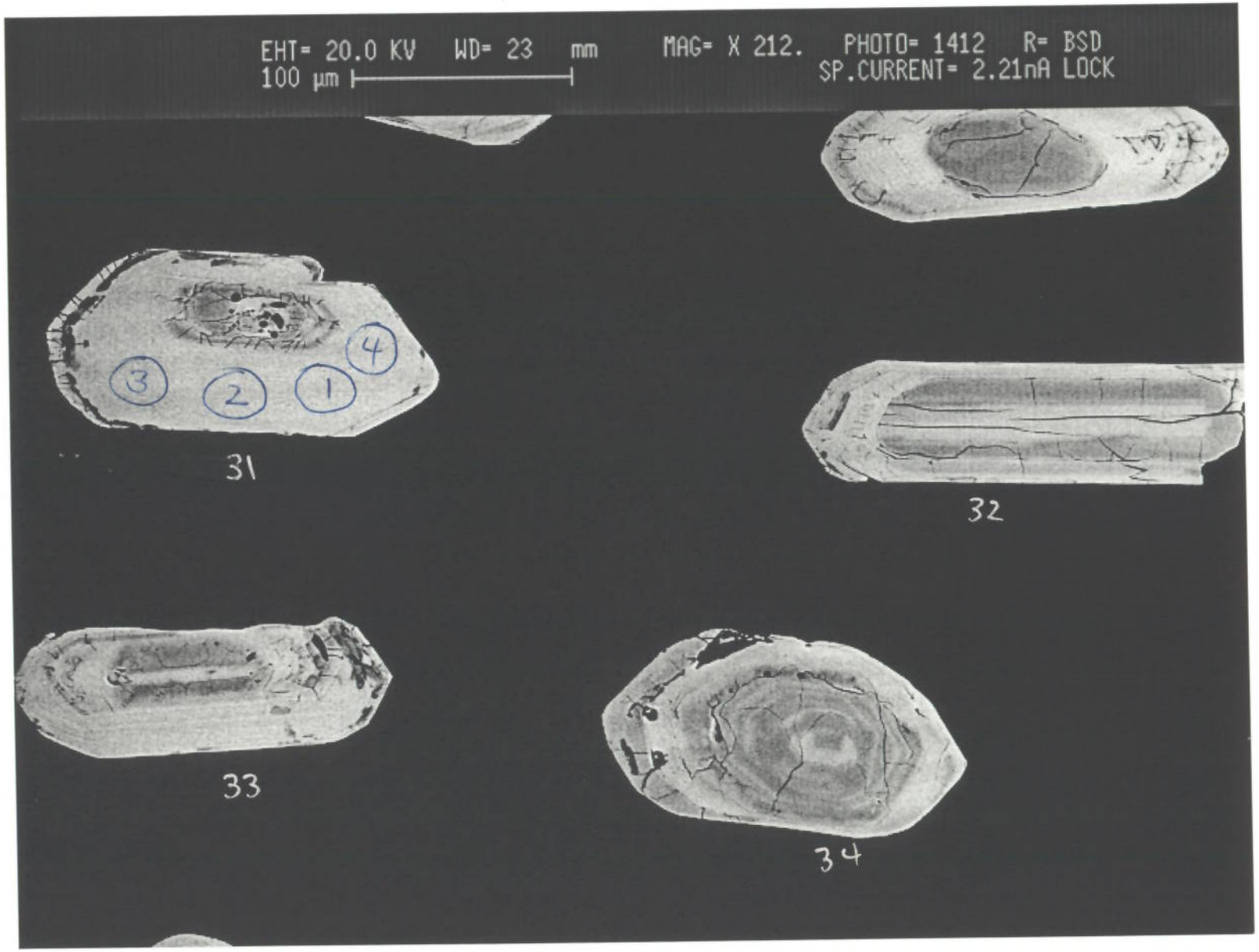
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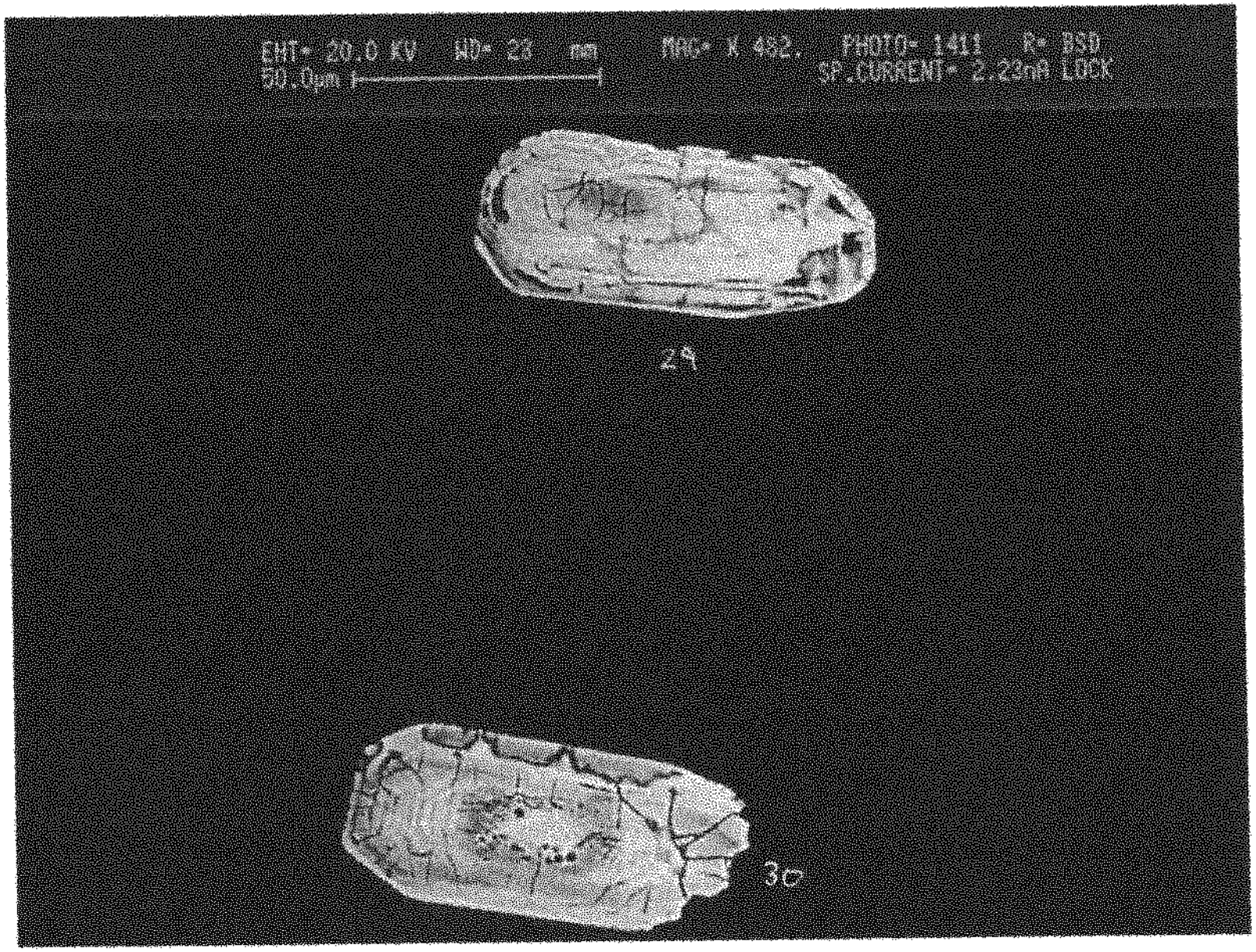
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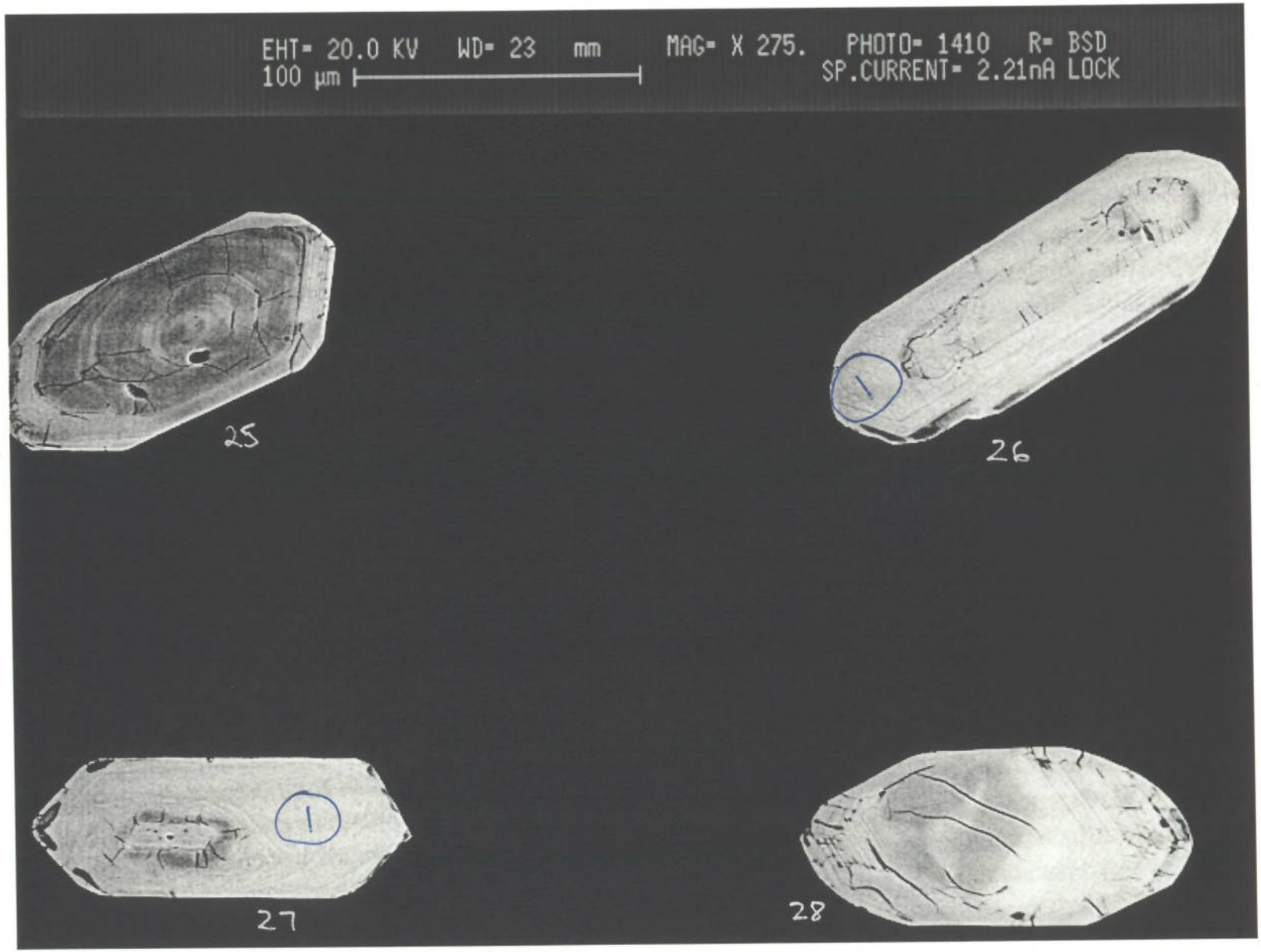
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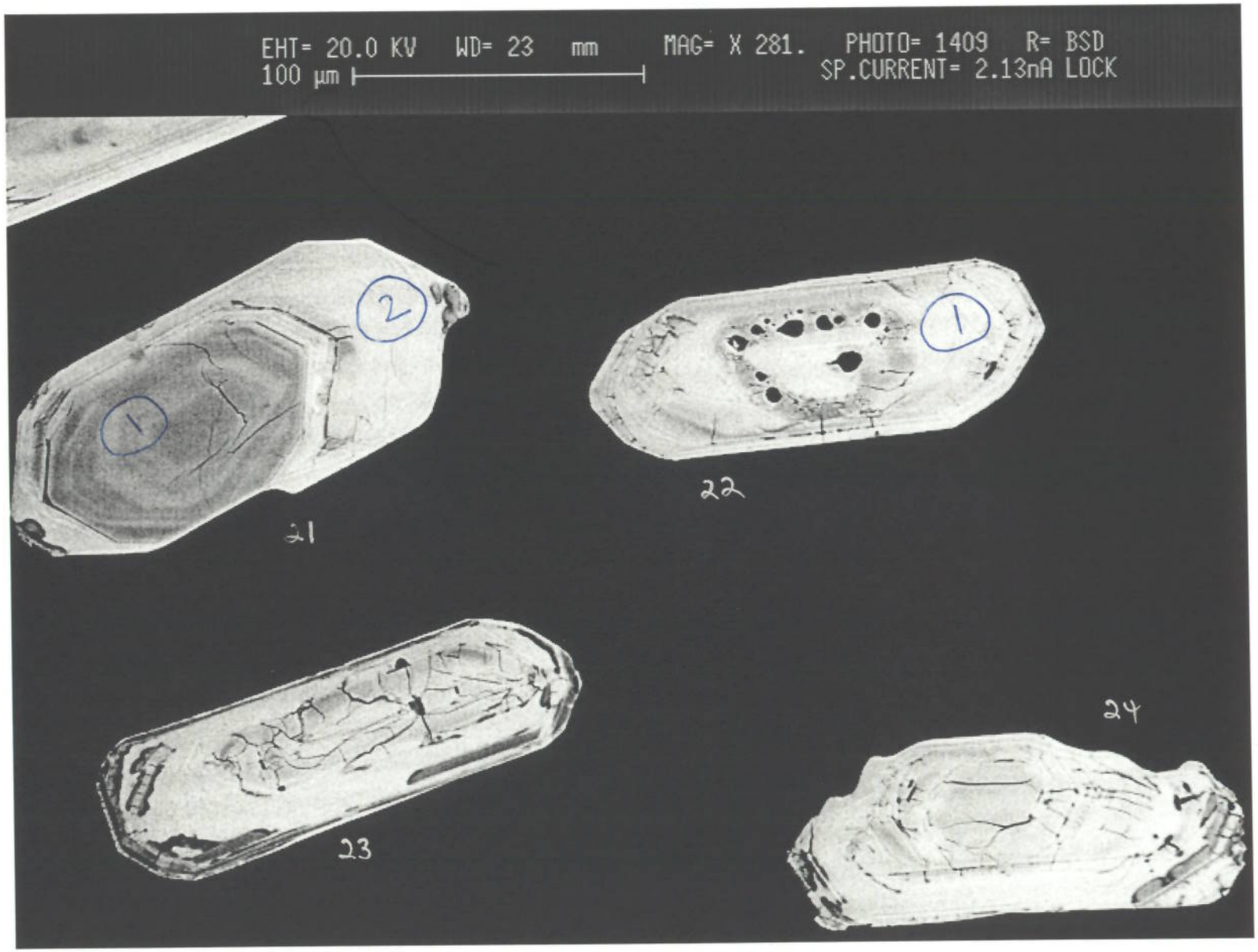
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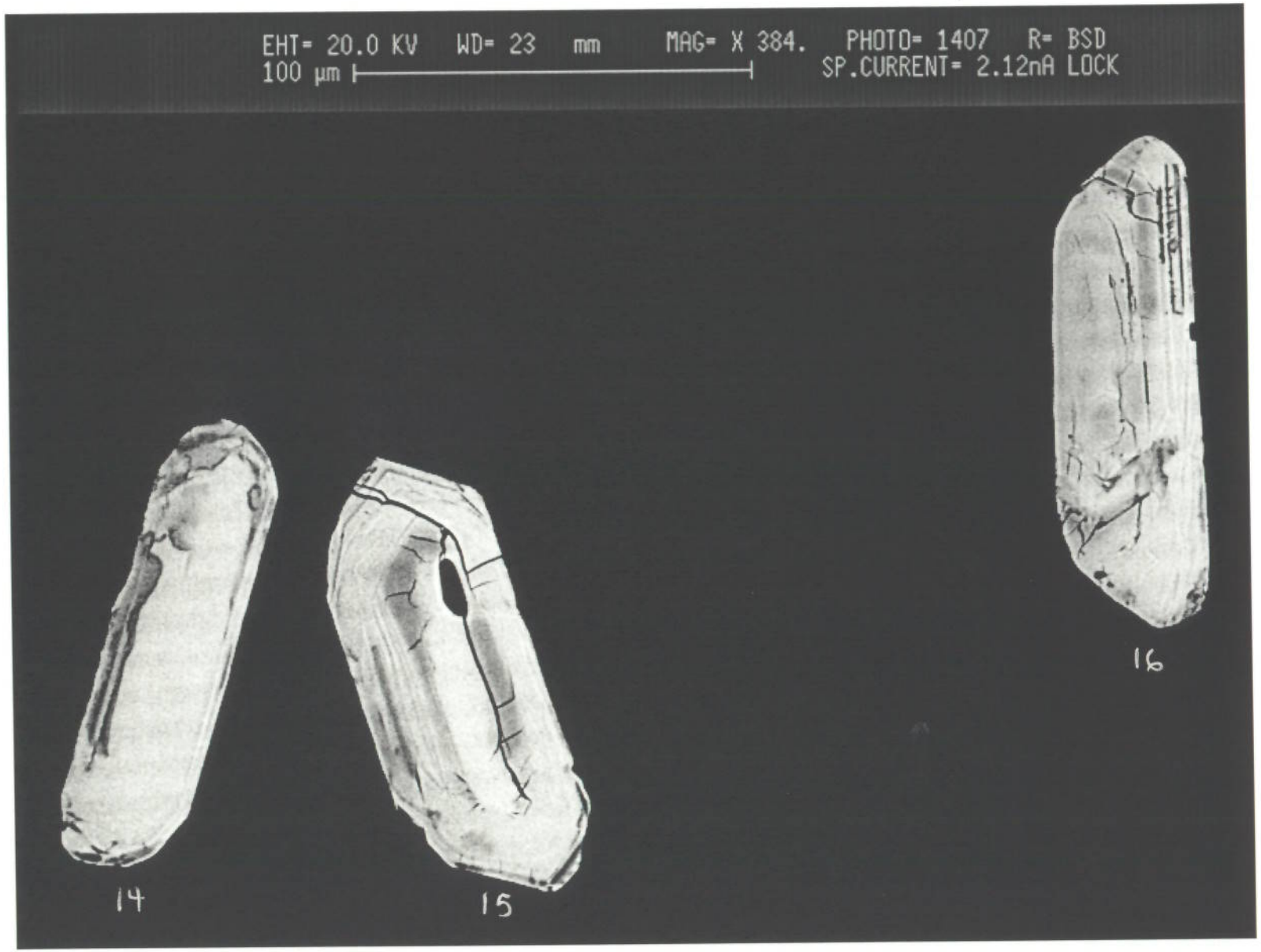
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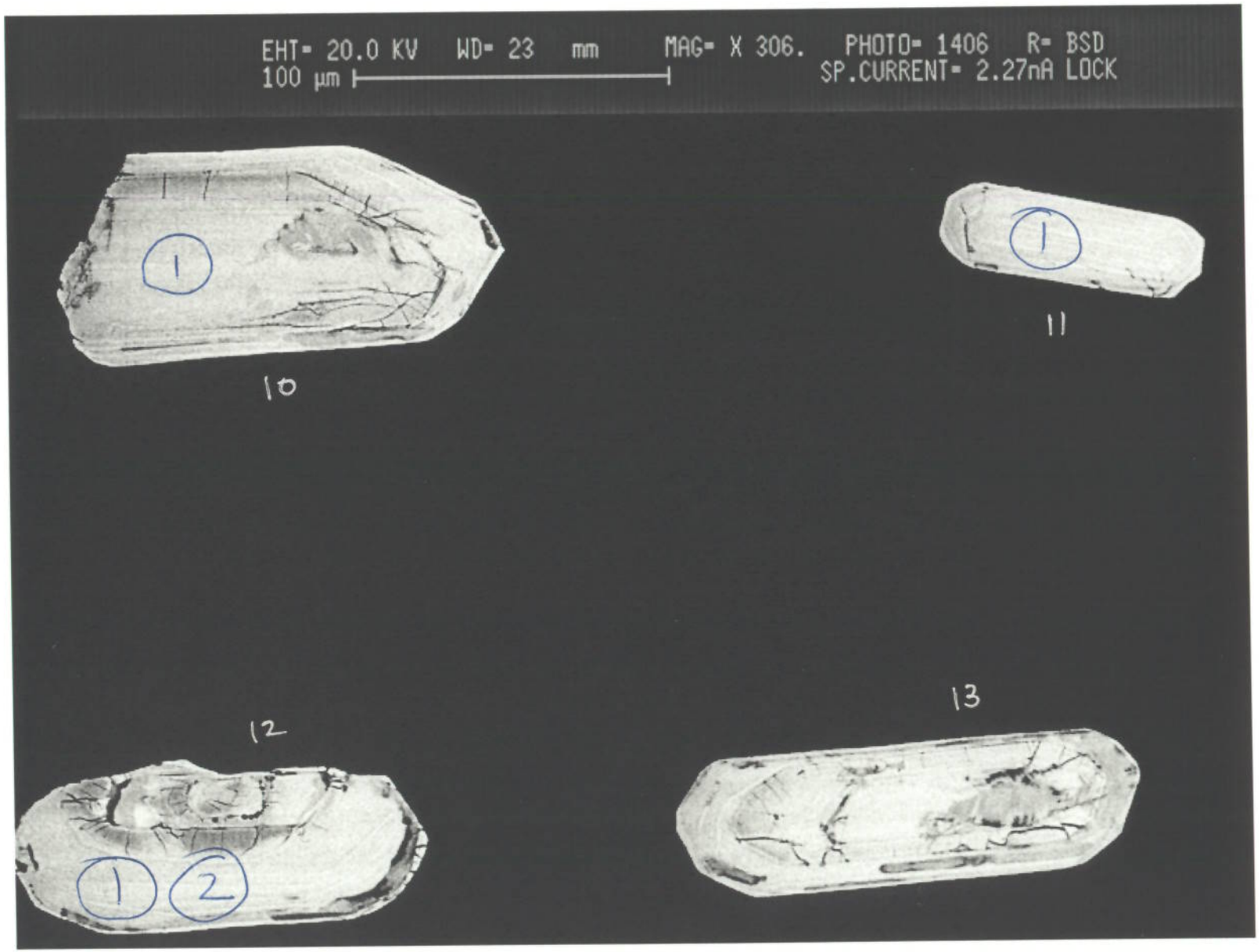
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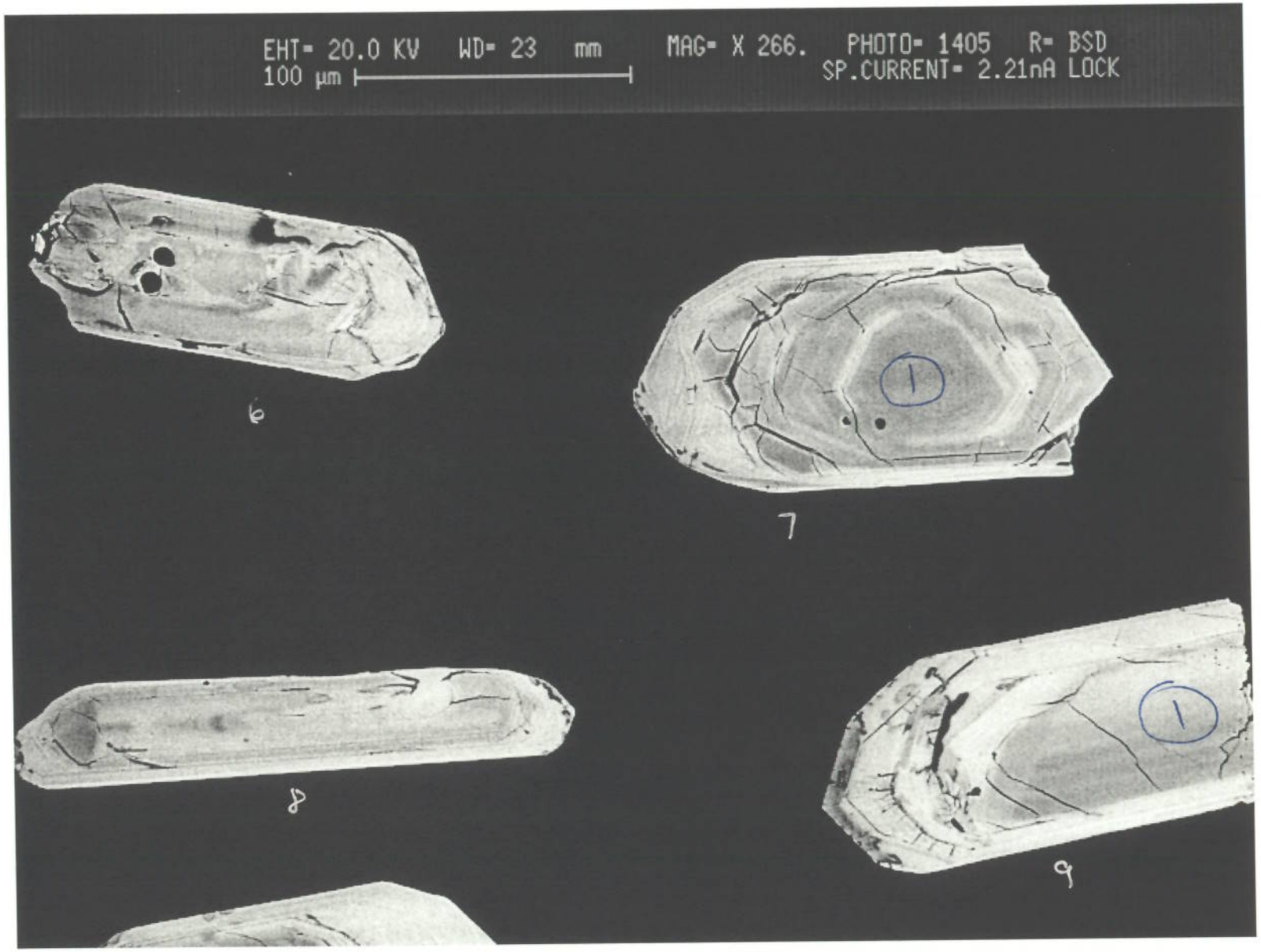
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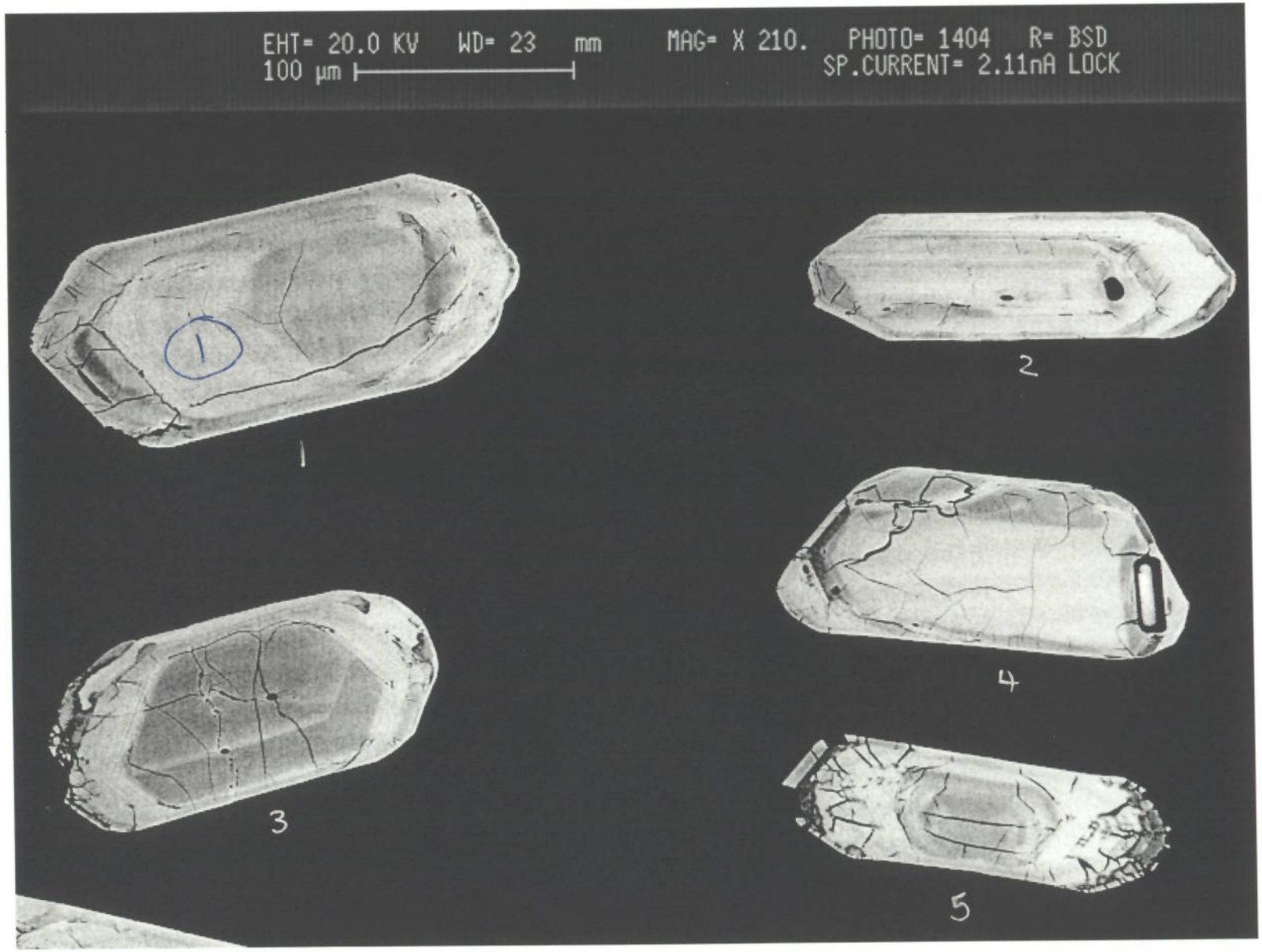
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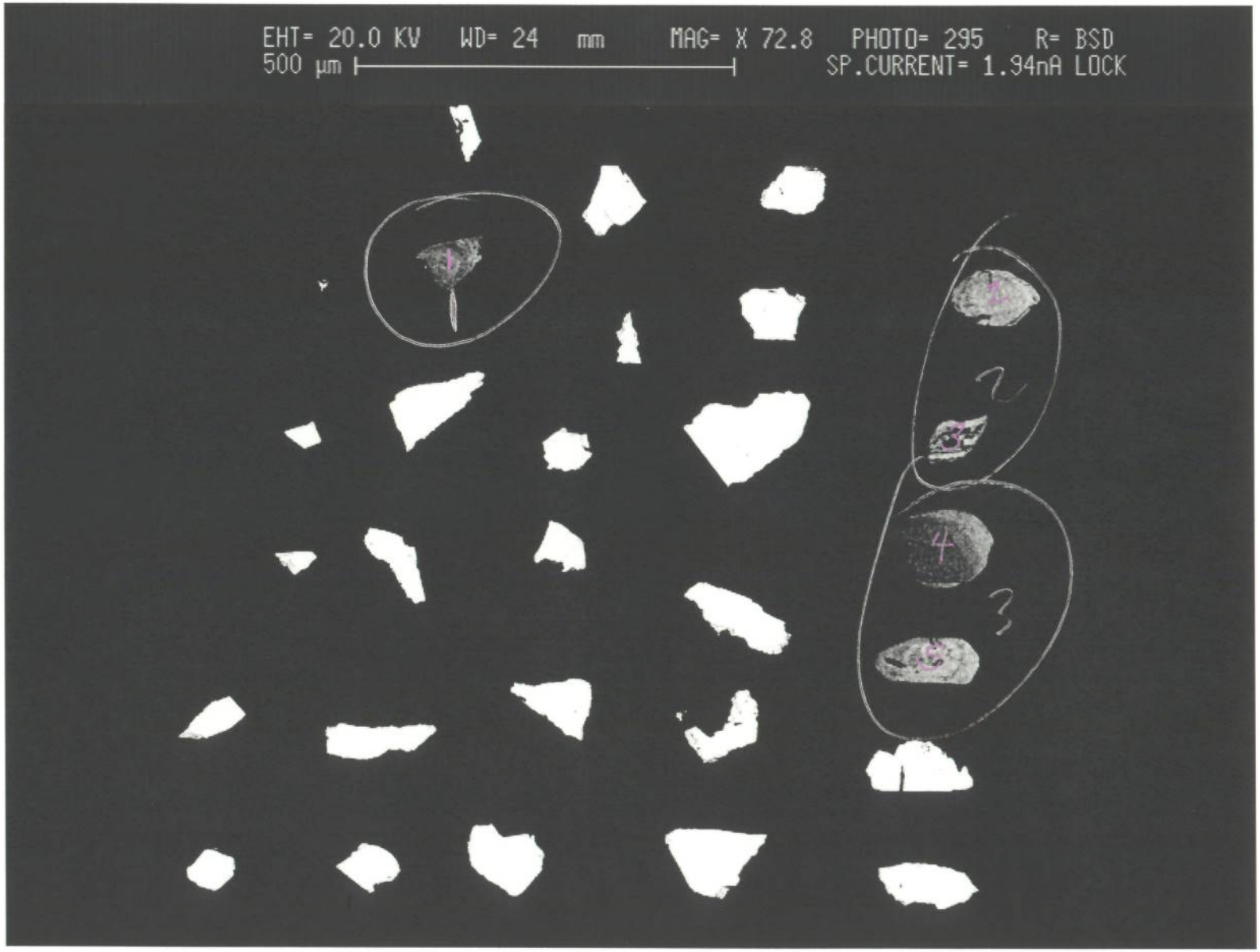
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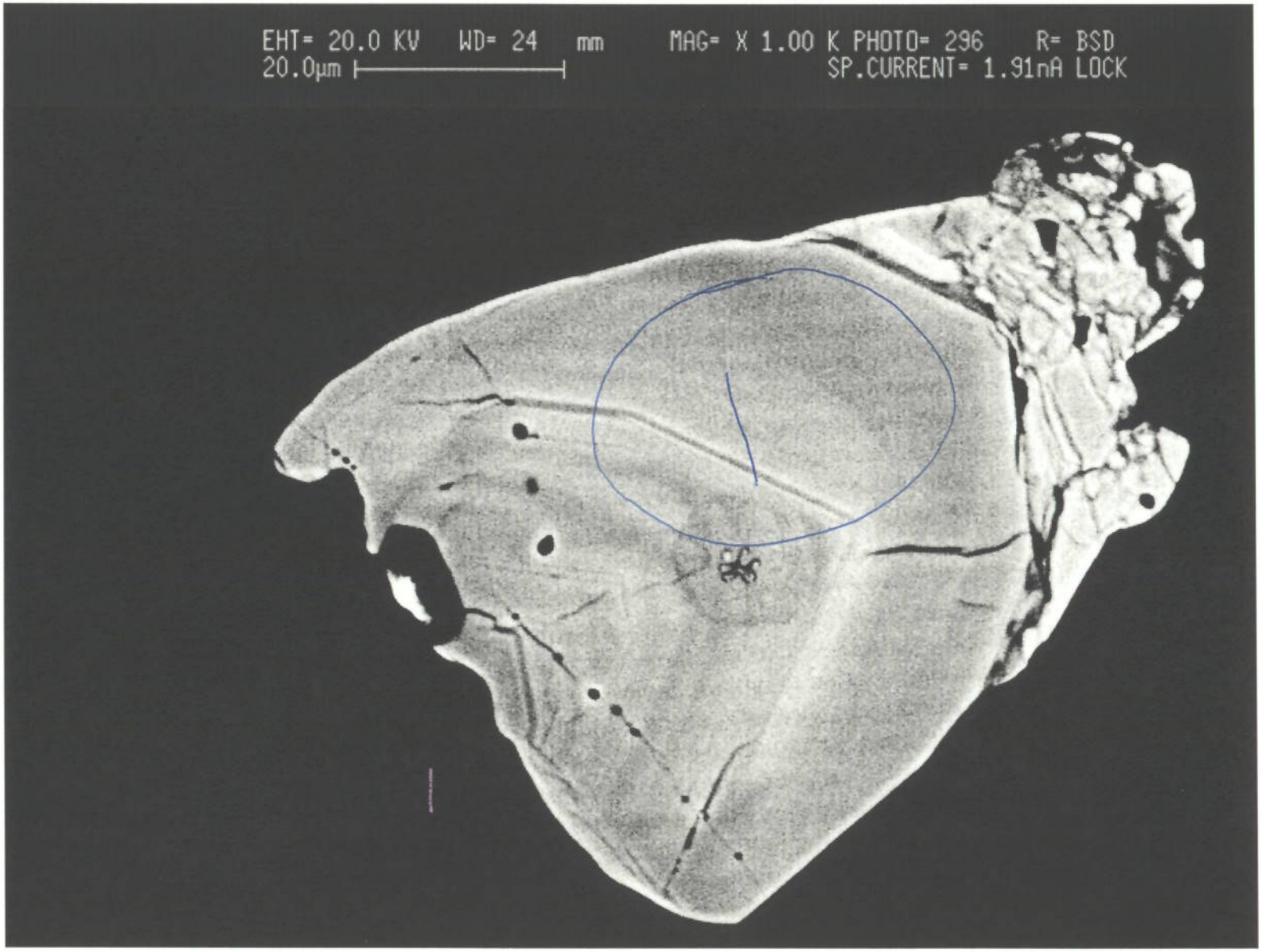
7877 mgr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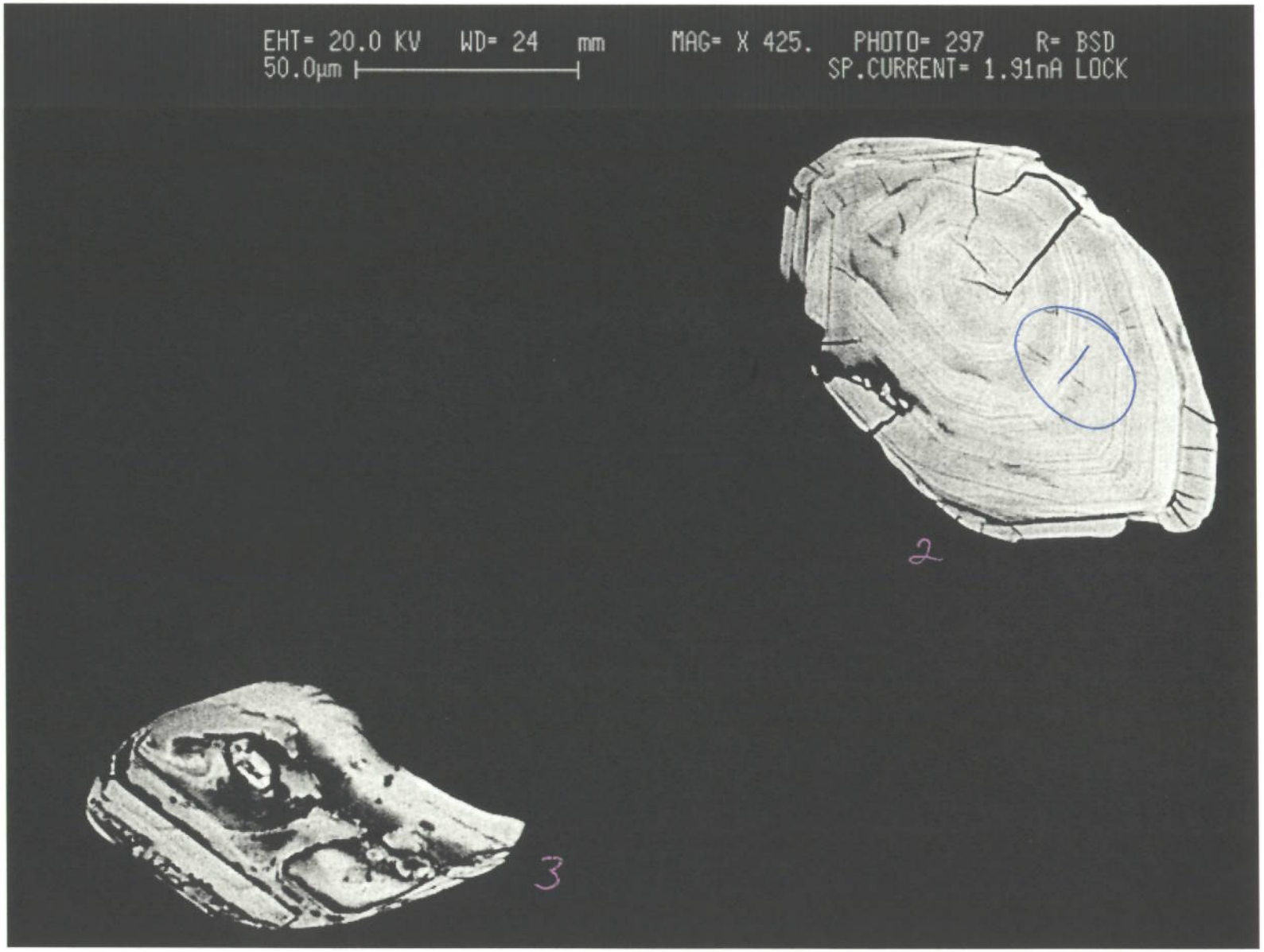
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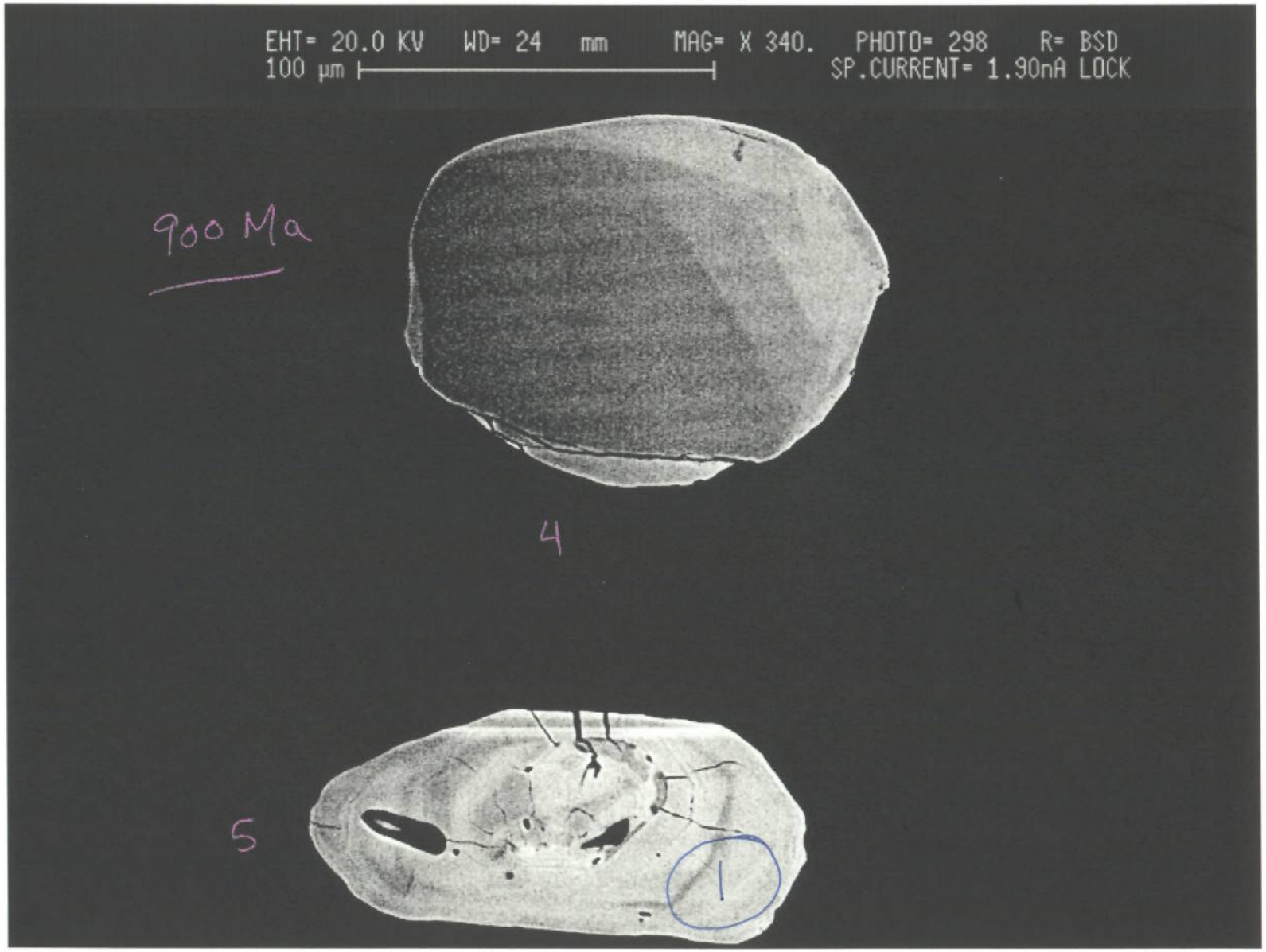
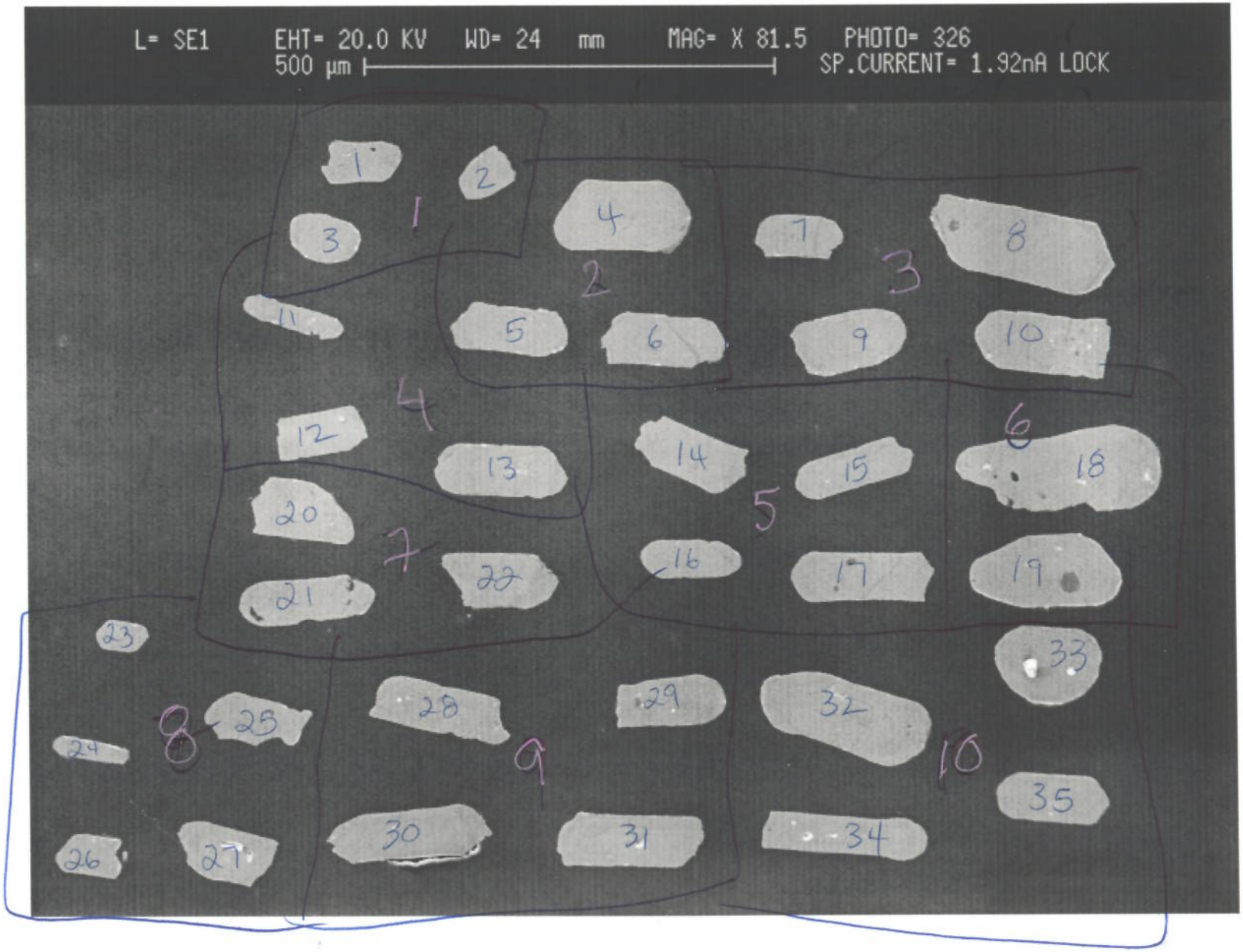
7877-2

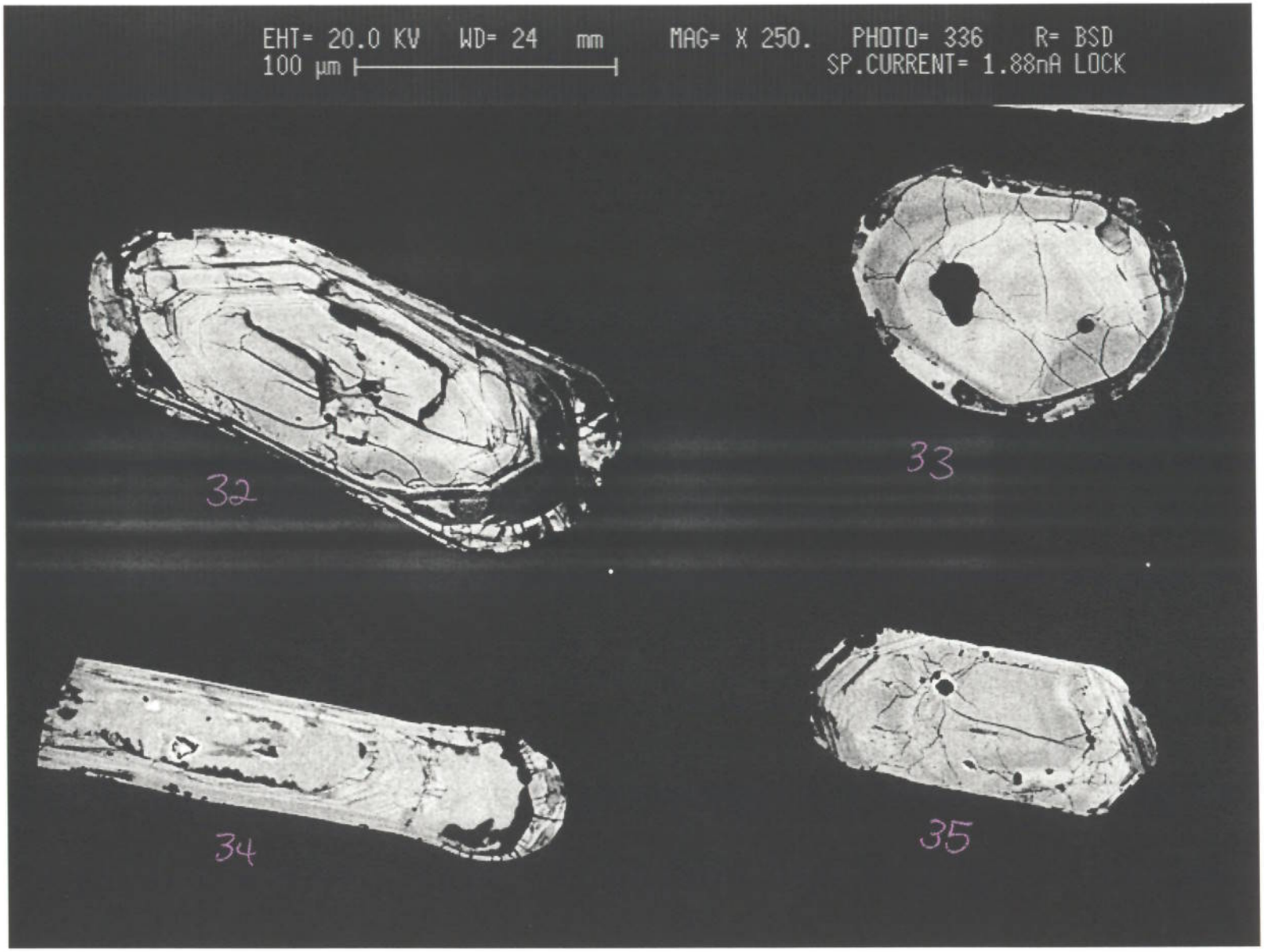

EHT= 20.0 KV WD= 24 mm MAG= X 340. PHOTO= 298 R= BSD
100 µm
SP.CURRENT= 1.90nA LOCK
900 Ma
4
5
1

7877-3

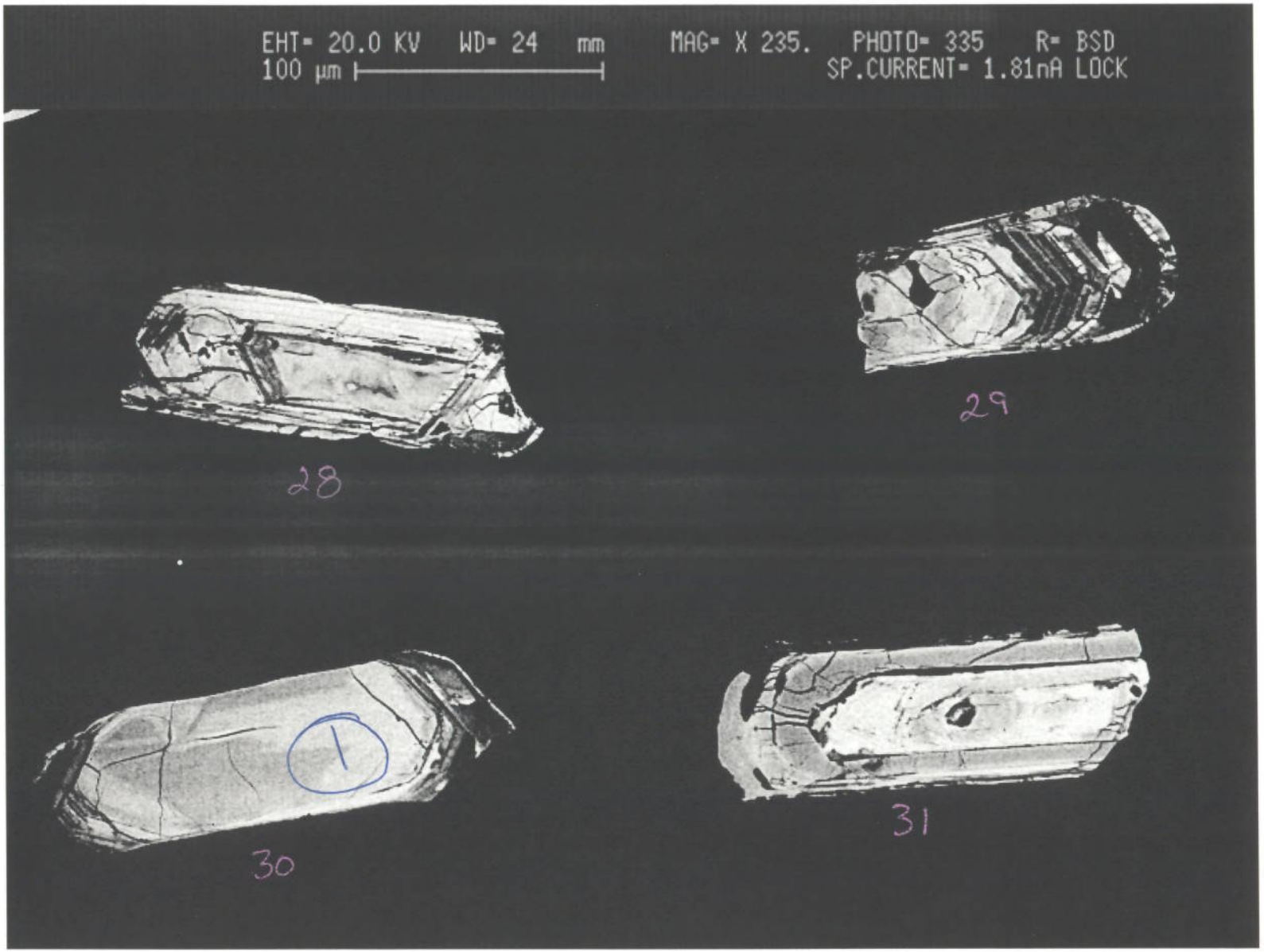


IP 325

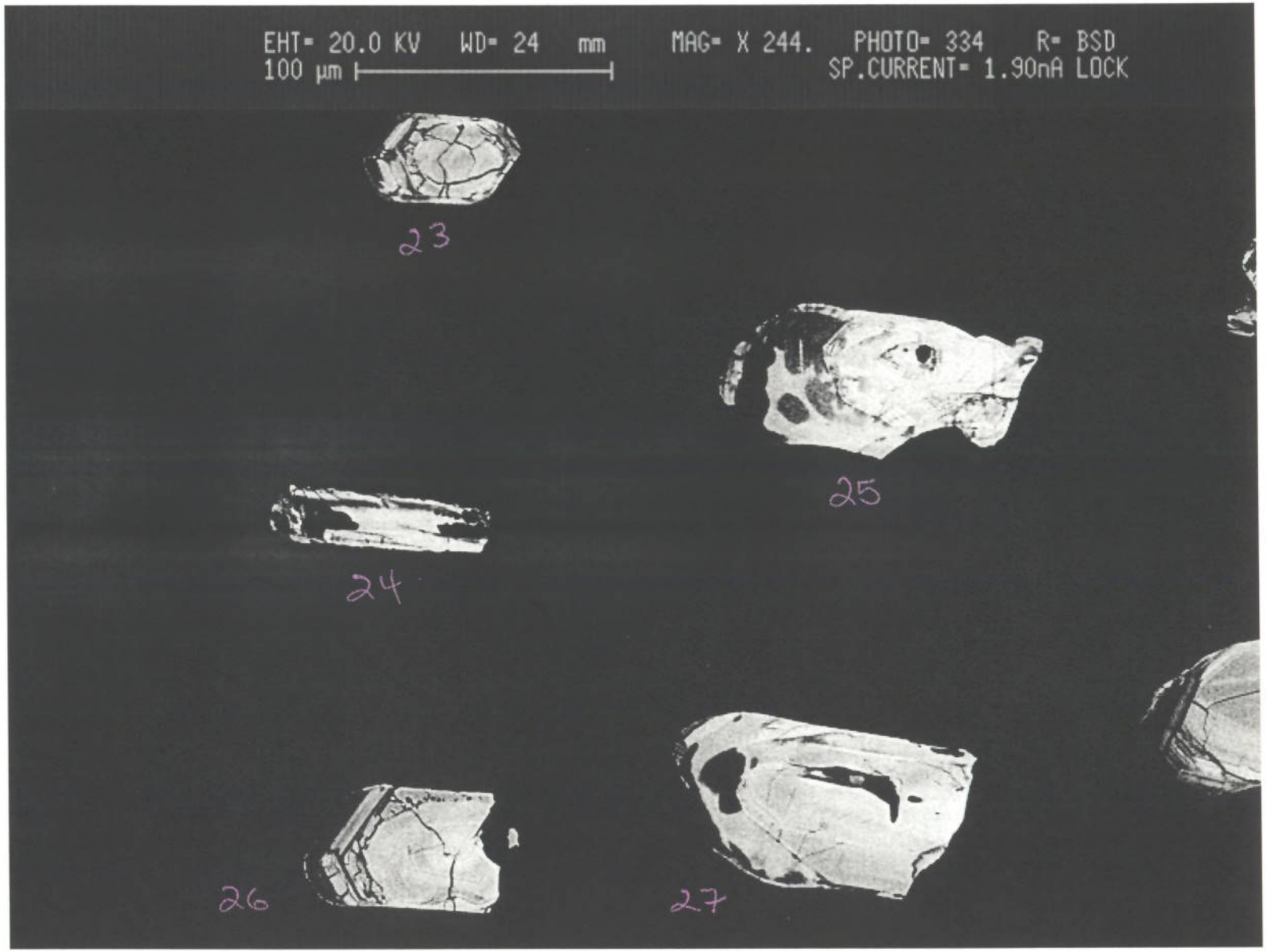
788 image


EHT= 20.0 KV WD= 24 mm
100 µm
MAG= X 250. PHOTO= 336 R= BSD
SP.CURRENT= 1.88nA LOCK
32
33
34
35

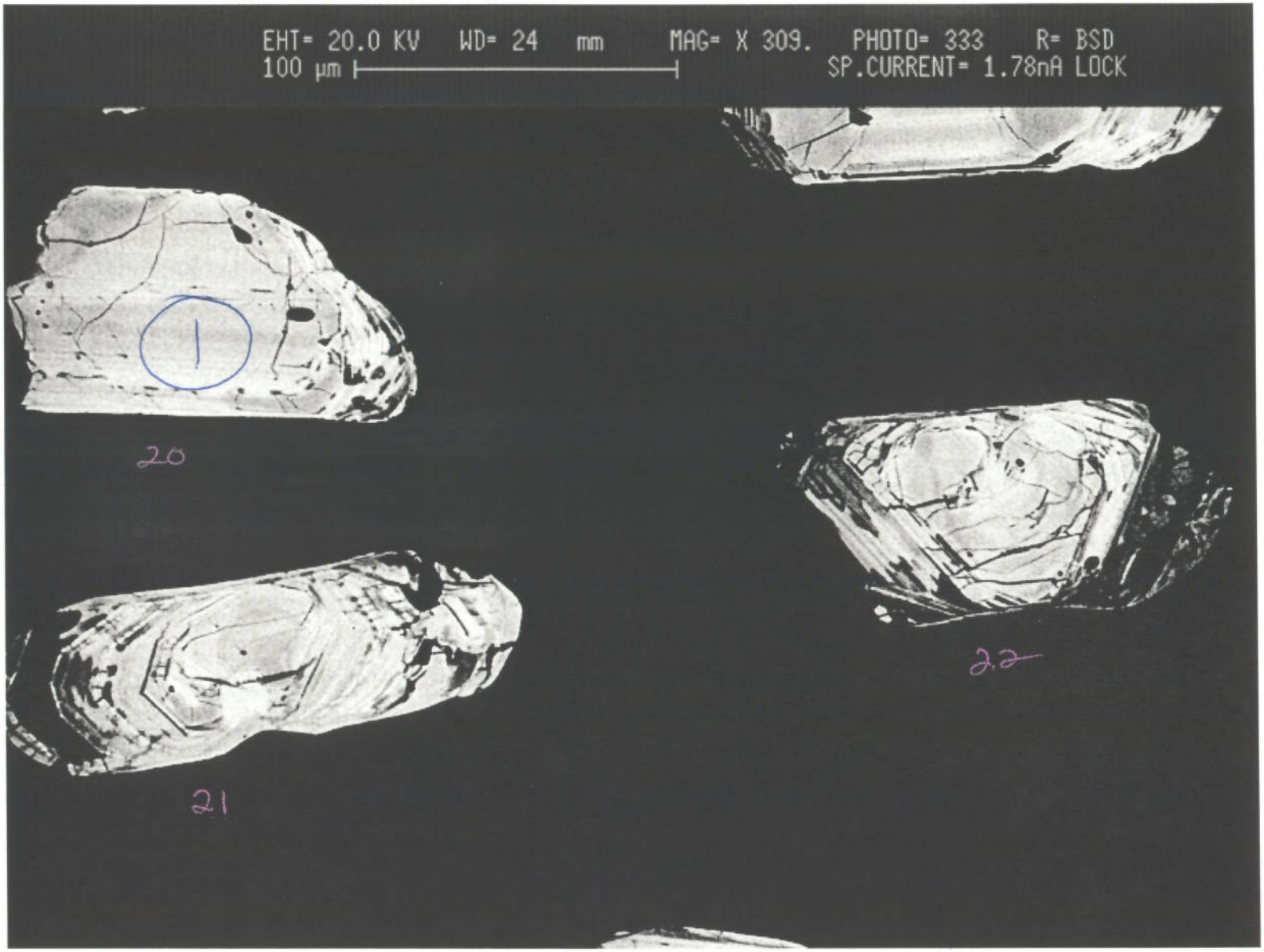
7881-10


EHT= 20.0 KV WD= 24 mm
100 µm
MAG= X 235. PHOTO= 335 R= BSD
SP.CURRENT= 1.81nA LOCK
28
29
30
31
1

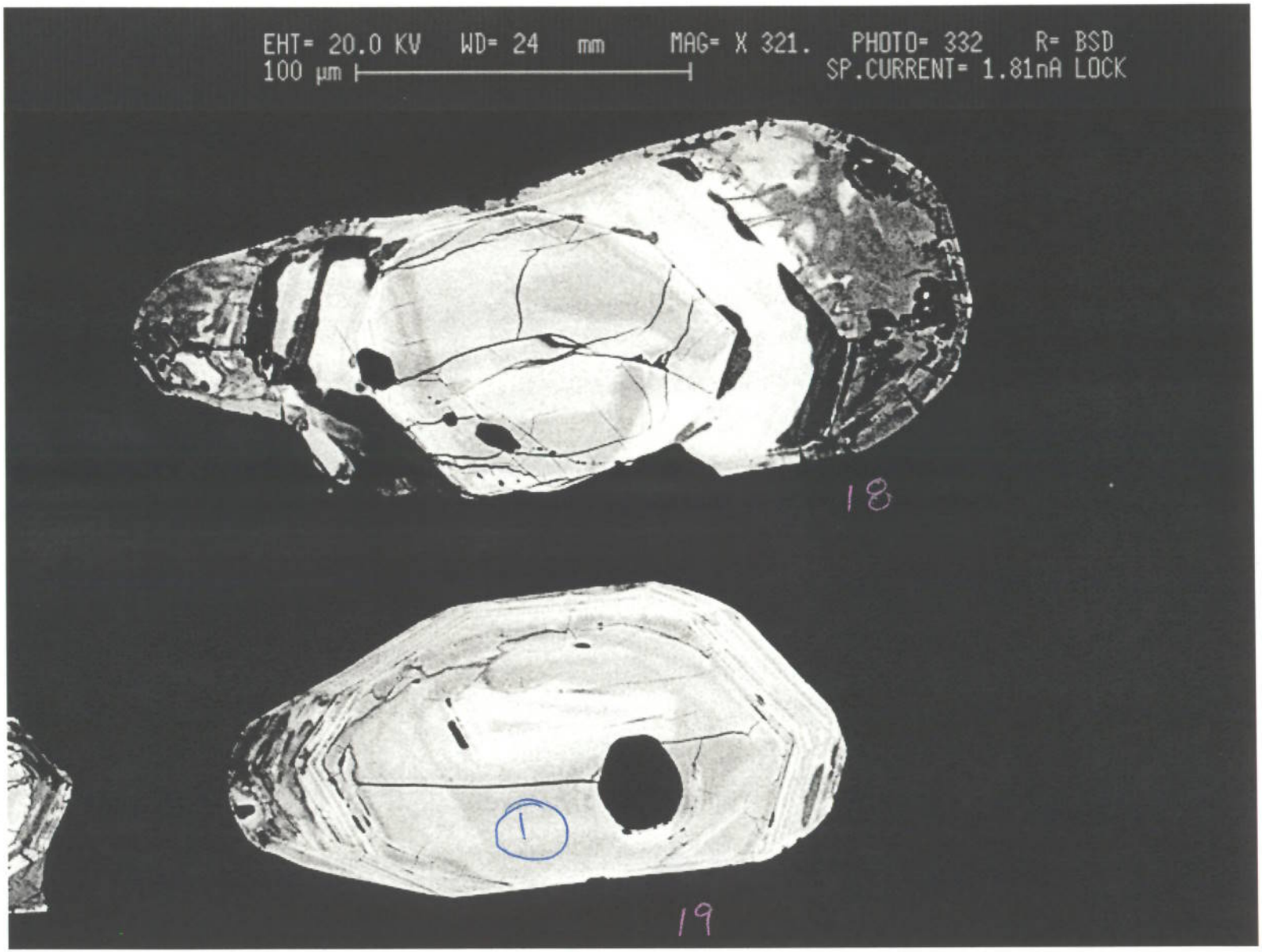
7881-9


EHT= 20.0 KV WD= 24 mm
100 µm
MAG= X 244. PHOTO= 334 R= BSD
SP.CURRENT= 1.90nA LOCK
23
25
24
26
27

7381-8


EHT= 20.0 KV WD= 24 mm MAG= X 309. PHOTO= 333 R= BSD
100 µm
SP.CURRENT= 1.78nA LOCK
1
20
21
22

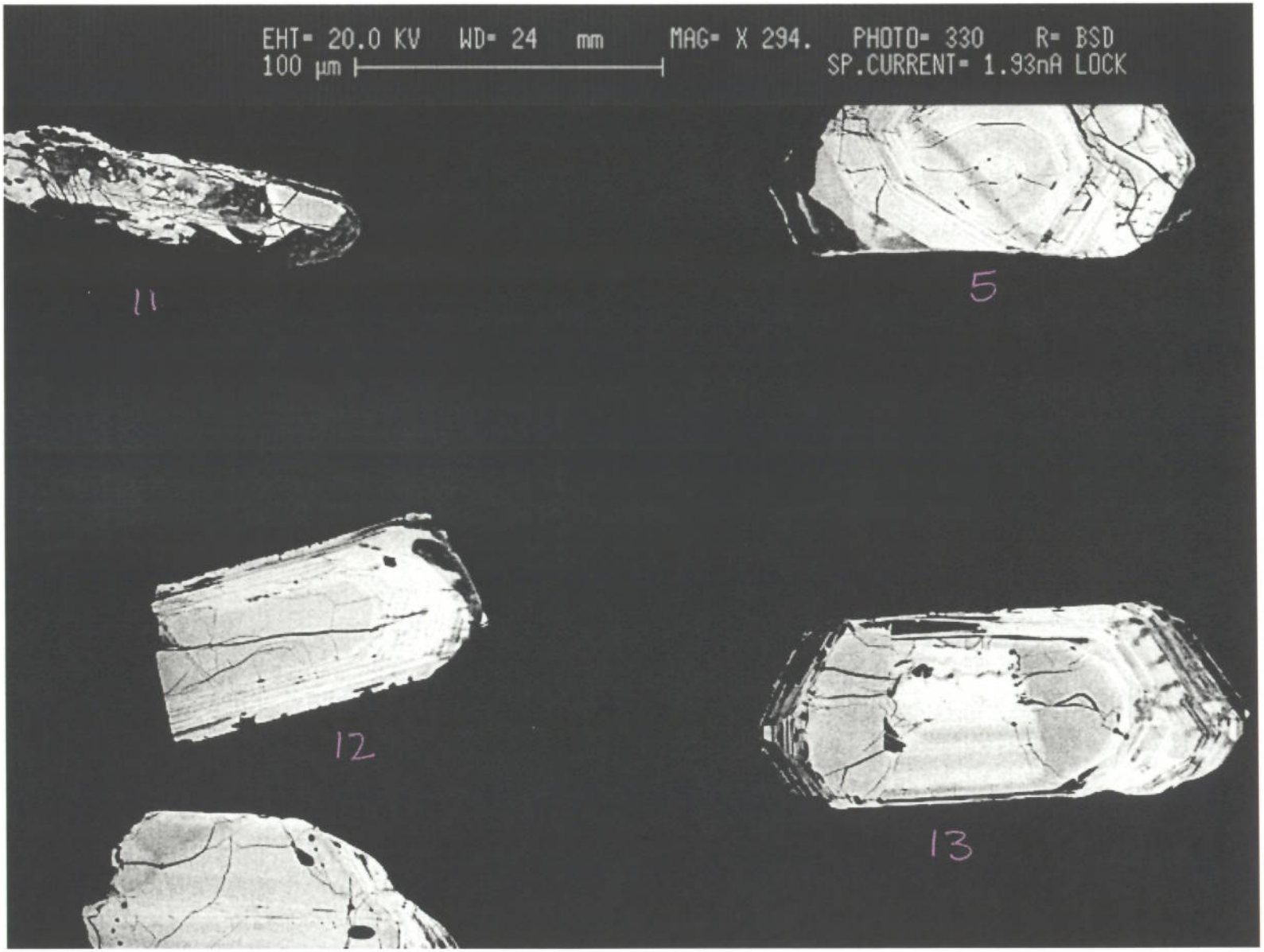
7381-7


EHT= 20.0 KV WD= 24 mm MAG= X 321. PHOTO= 332 R= BSD
100 µm
SP.CURRENT= 1.81nA LOCK
18
1
19

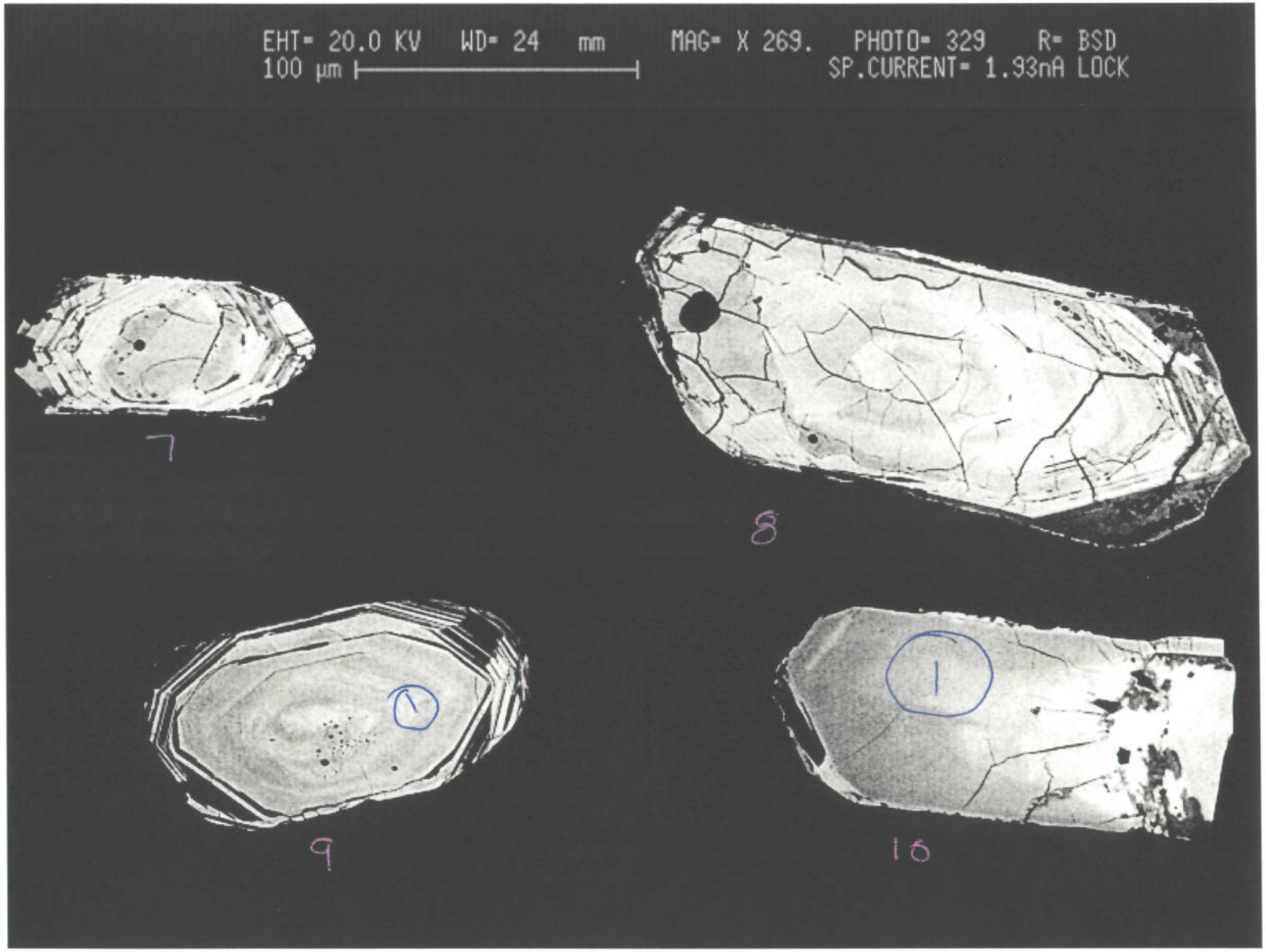
7881-6

EHT= 20.0 KV WD= 24 mm MAG= X 312. PHOTO= 331 R= BSD
100 µm
SP.CURRENT= 1.95nA LOCK
2
1
14
15
16
17

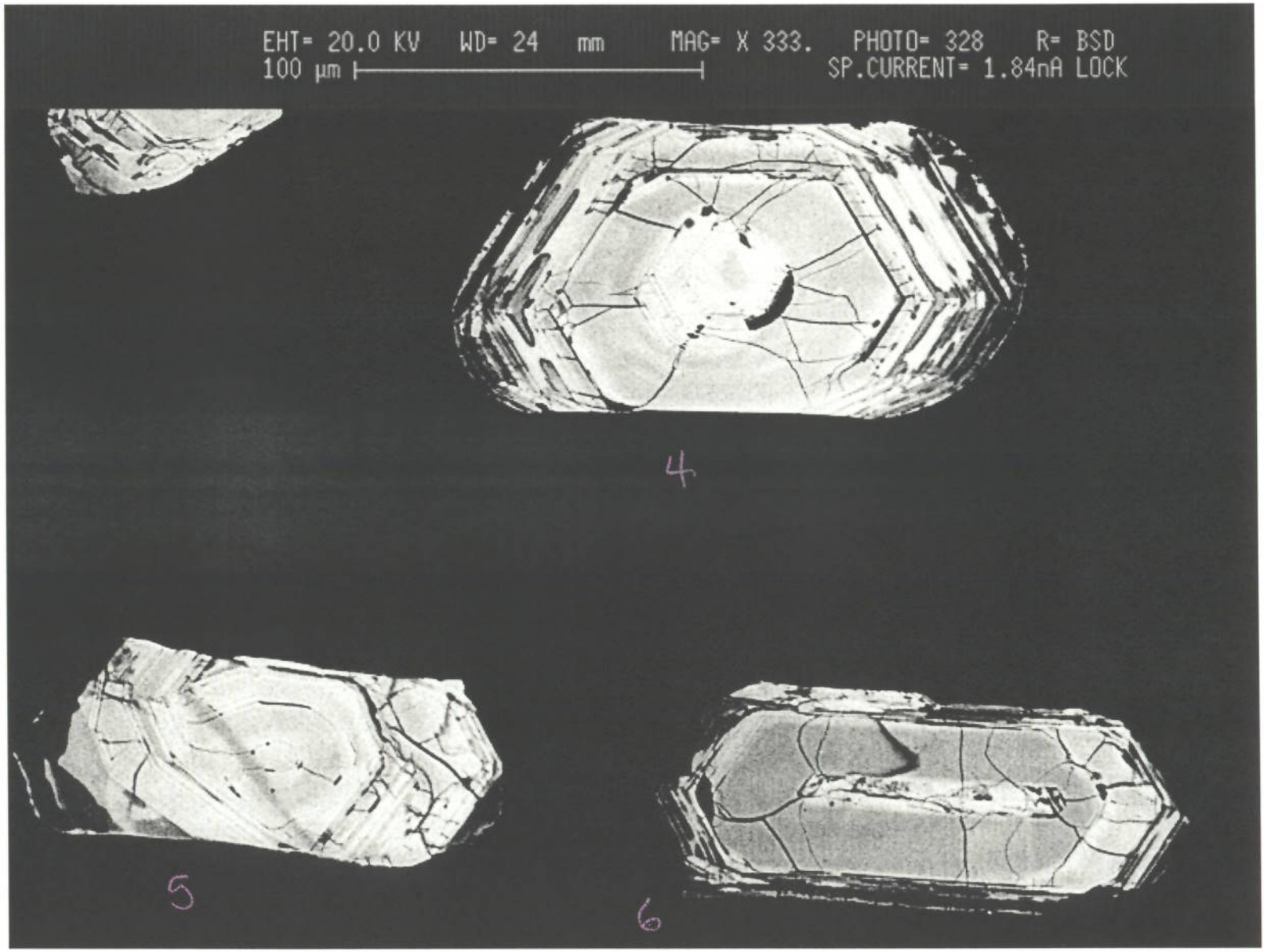
7881-5


EHT= 20.0 KV WD= 24 mm MAG= X 294. PHOTO= 330 R= BSD
100 µm
SP.CURRENT= 1.93nA LOCK
11
5
12
13

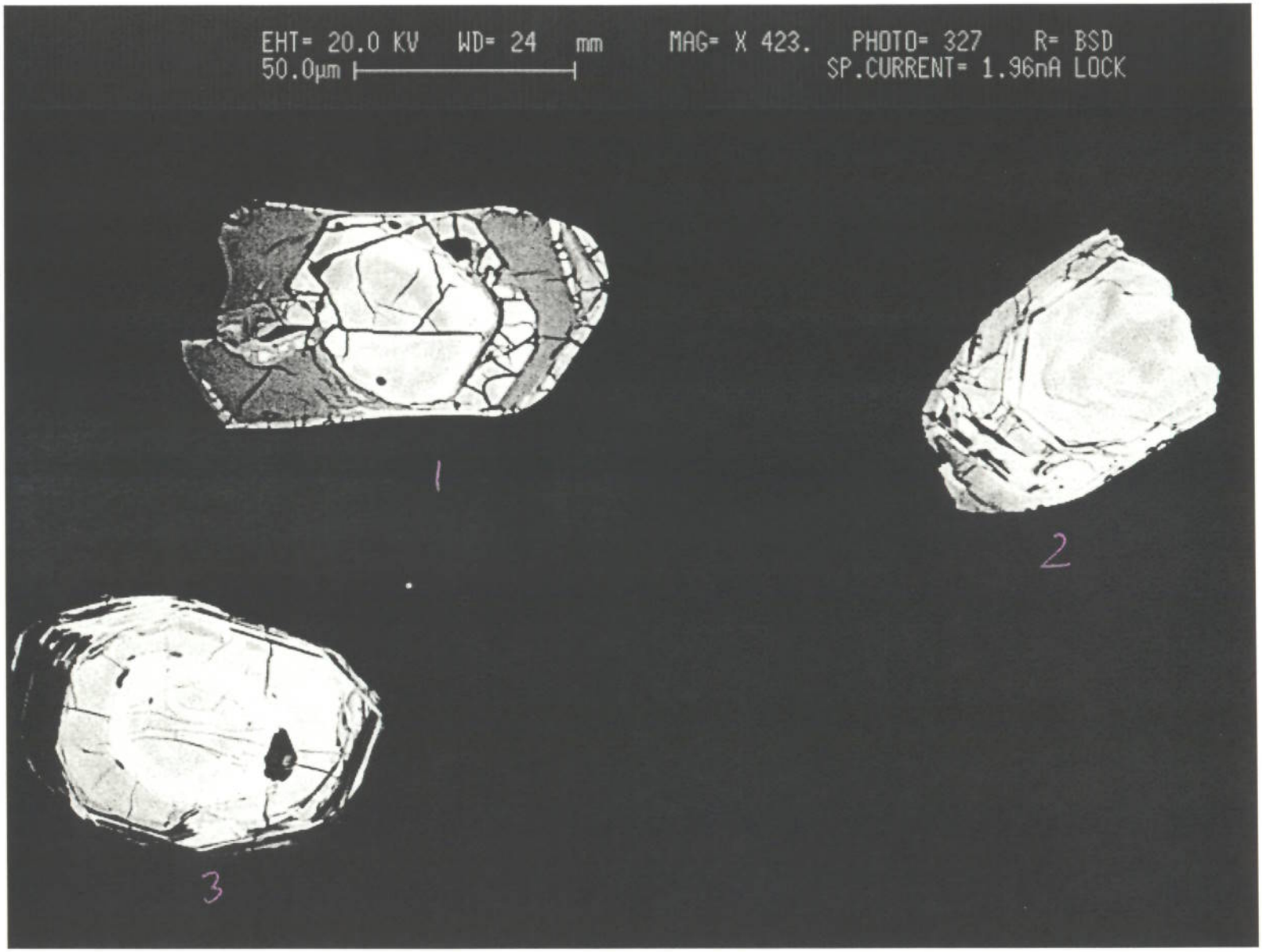
7881-4


EHT= 20.0 KV WD= 24 mm
100 µm
MAG= X 269. PHOTO= 329 R= BSD
SP.CURRENT= 1.93nA LOCK
7
8
9
10

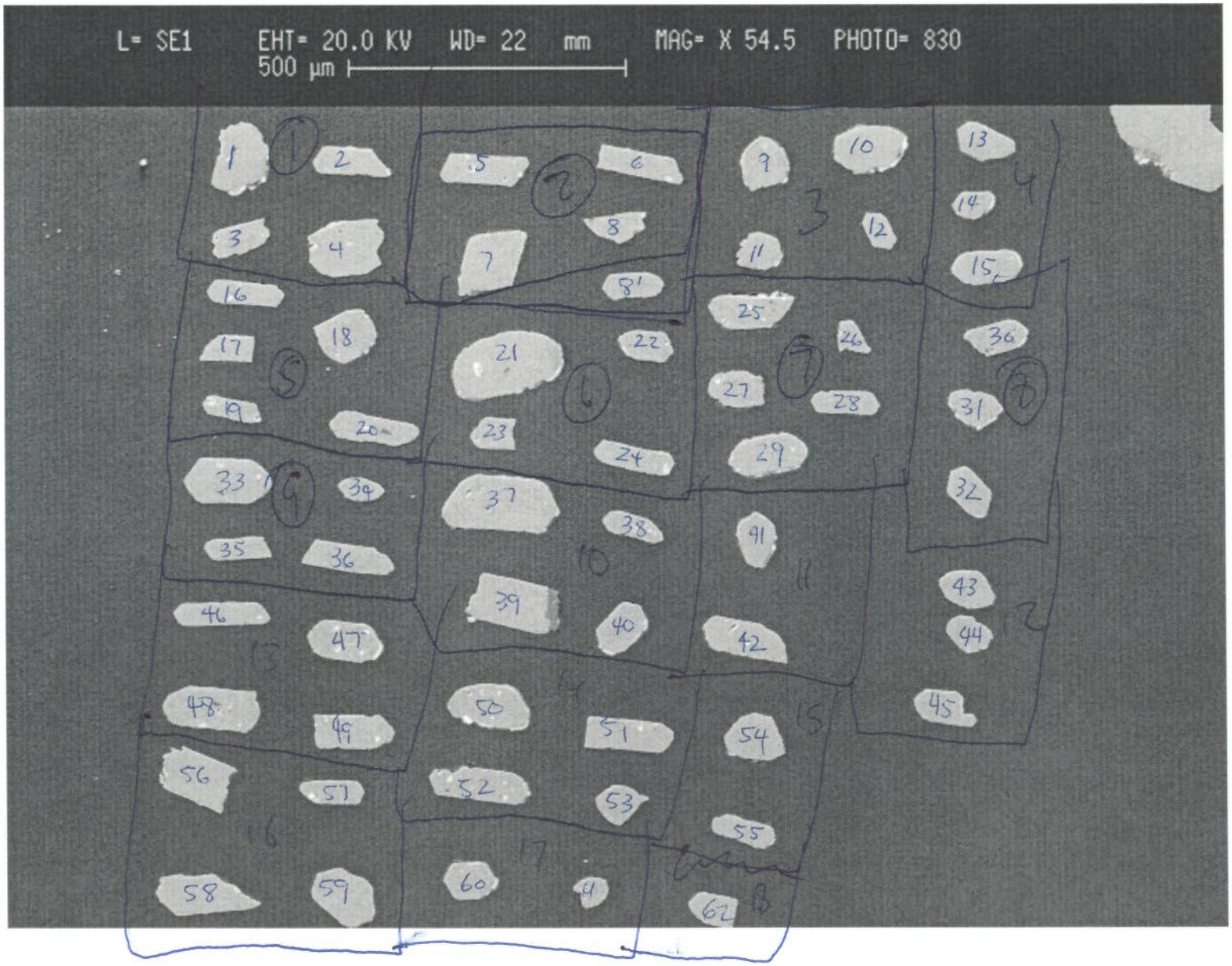
7881-3


EHT= 20.0 KV WD= 24 mm MAG= X 333. PHOTO= 328 R= BSD
100 µm
SP.CURRENT= 1.84nA LOCK
4
5
6

7981-2

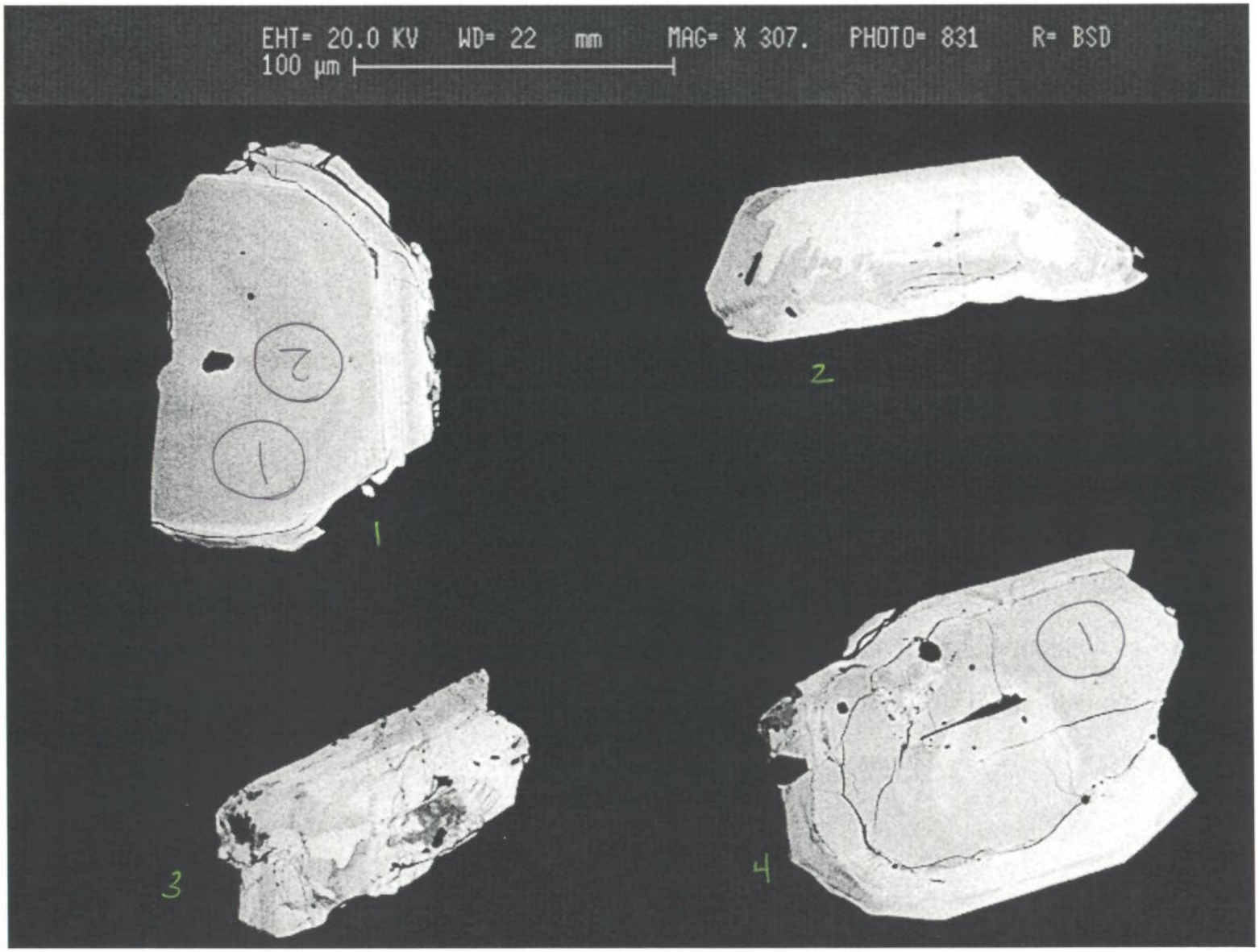

EHT= 20.0 KV WD= 24 mm
50.0µm
MAG= X 423. PHOTO= 327 R= BSD
SP.CURRENT= 1.96nA LOCK
1
2
3

7381-1

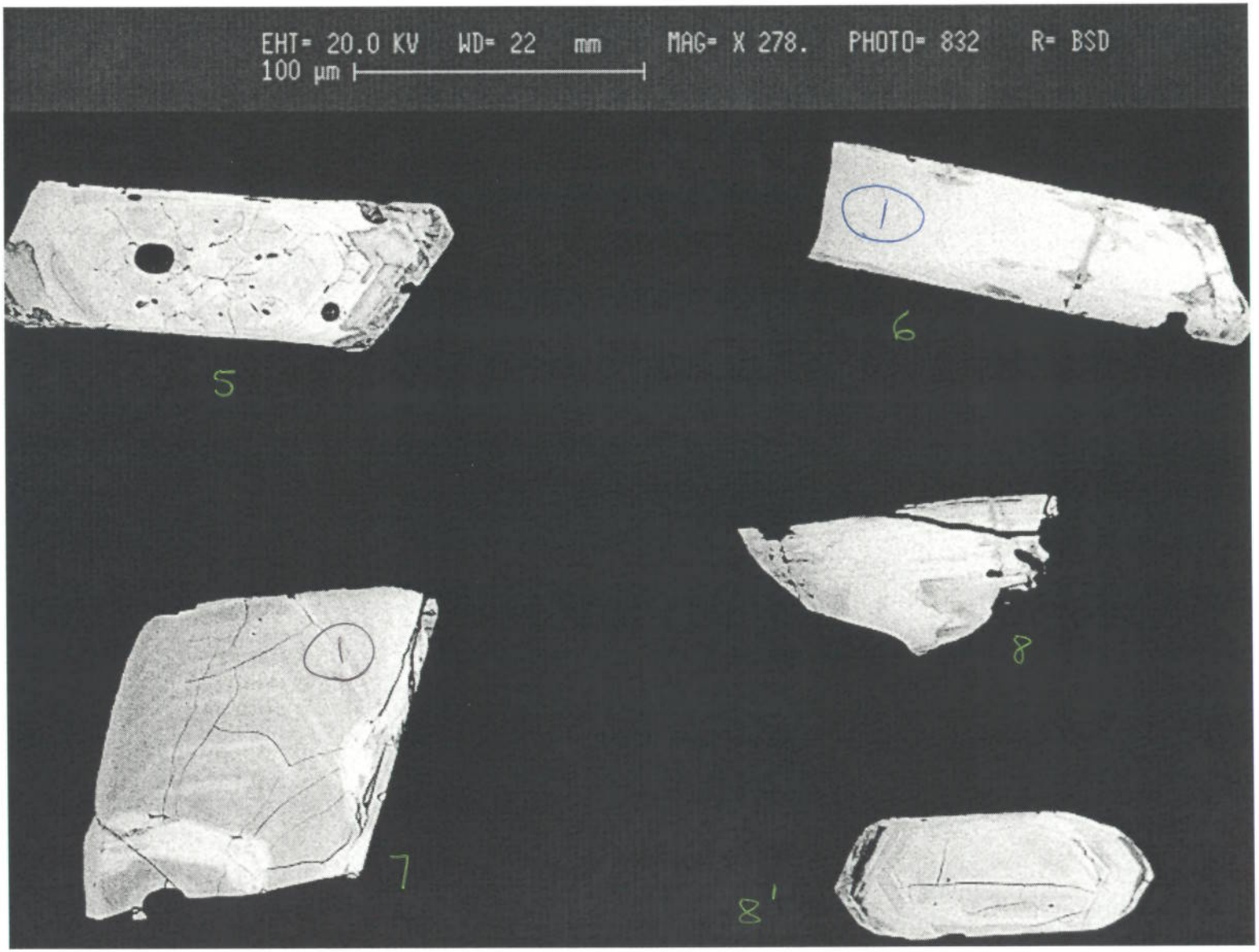


1P385

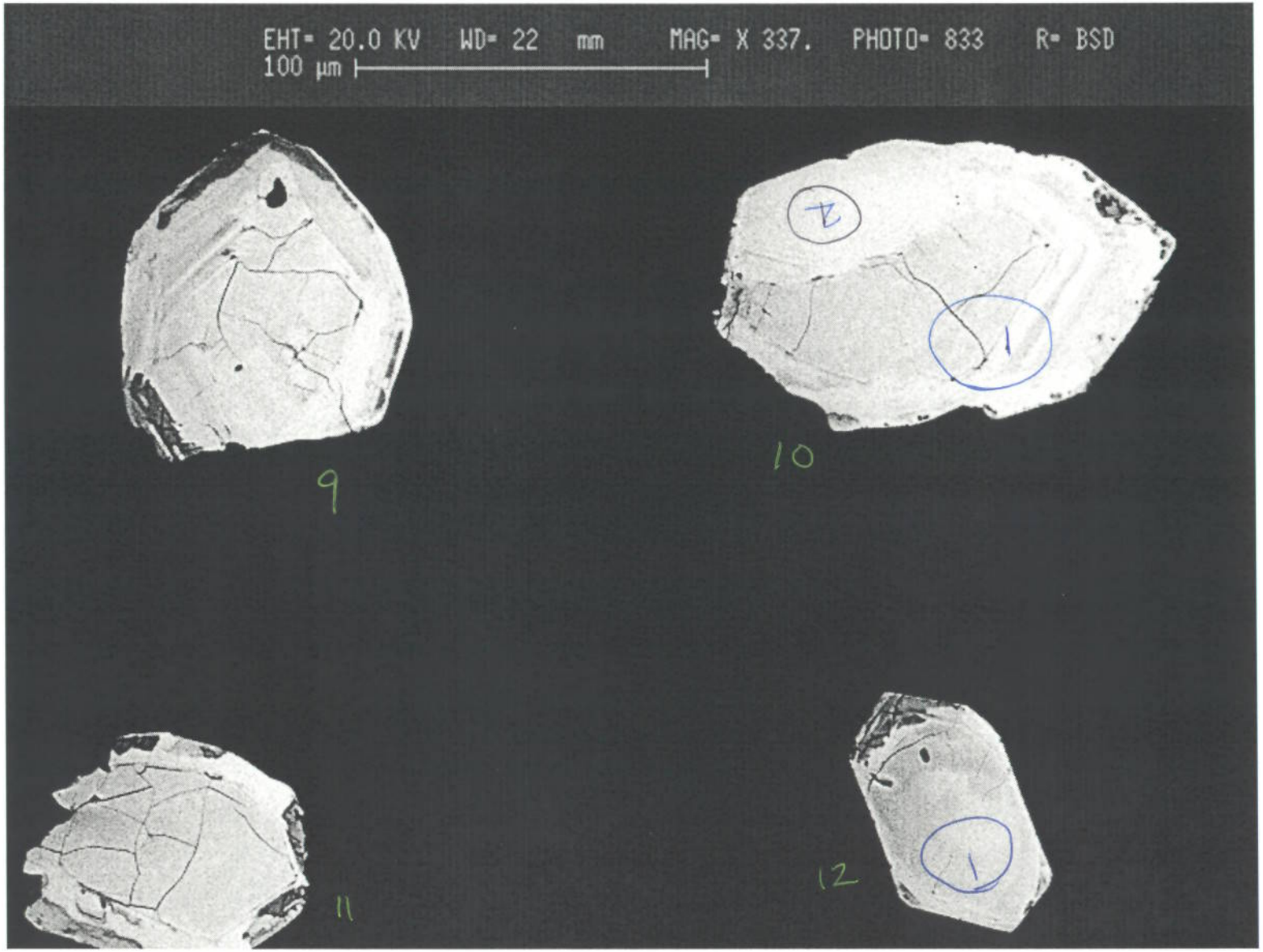
7883mgR



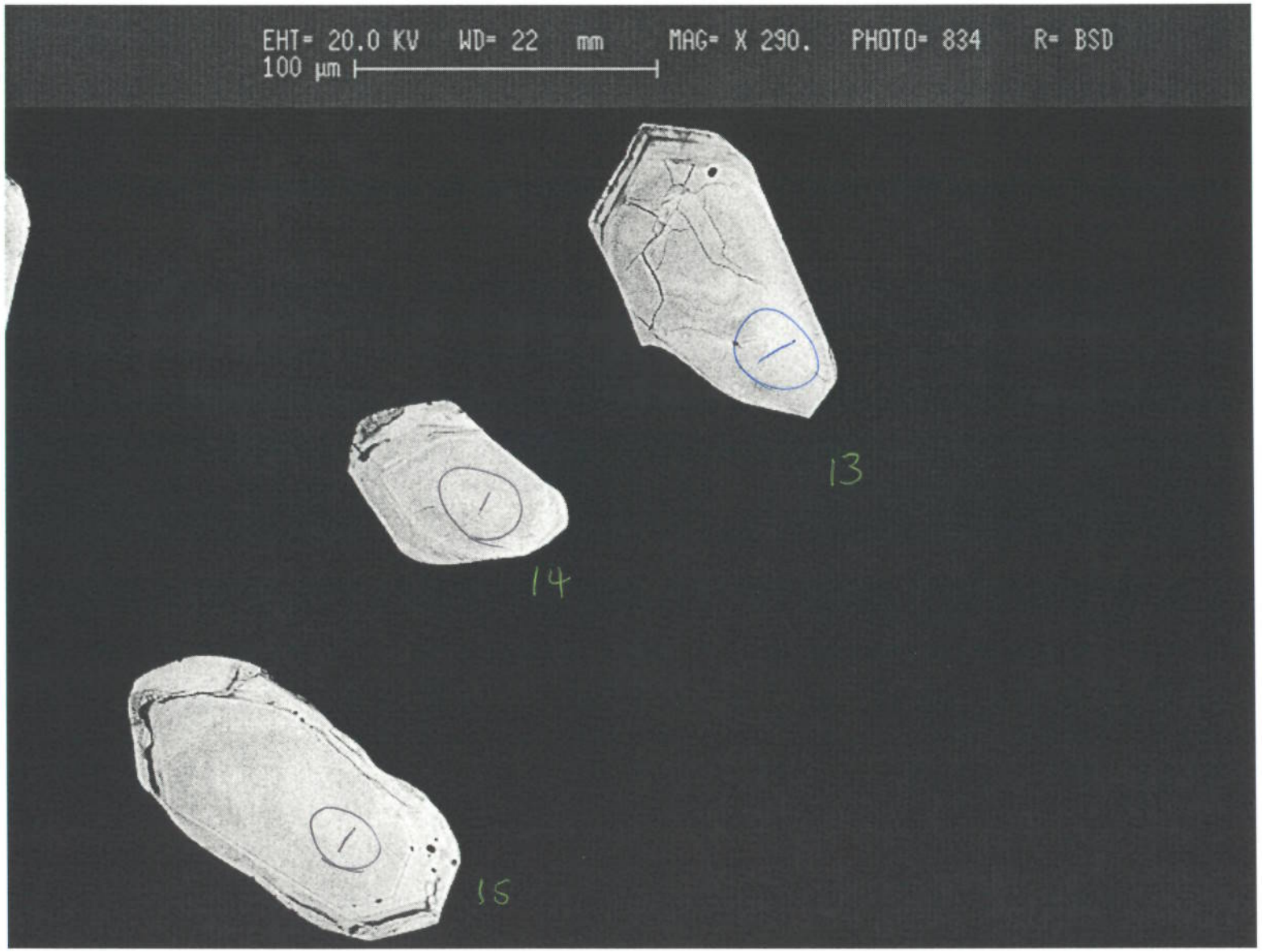
7883-1



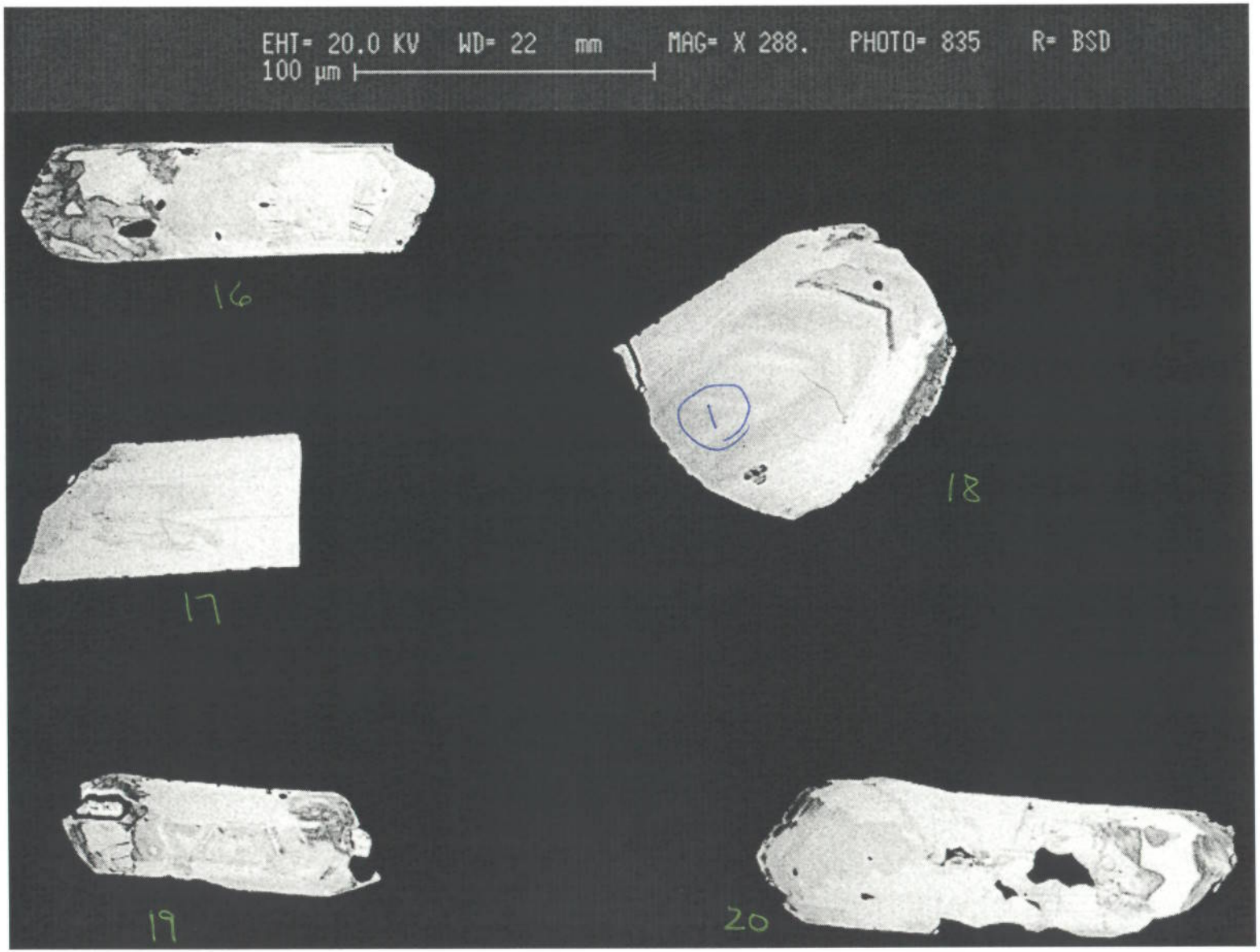
7883-2



7883-3

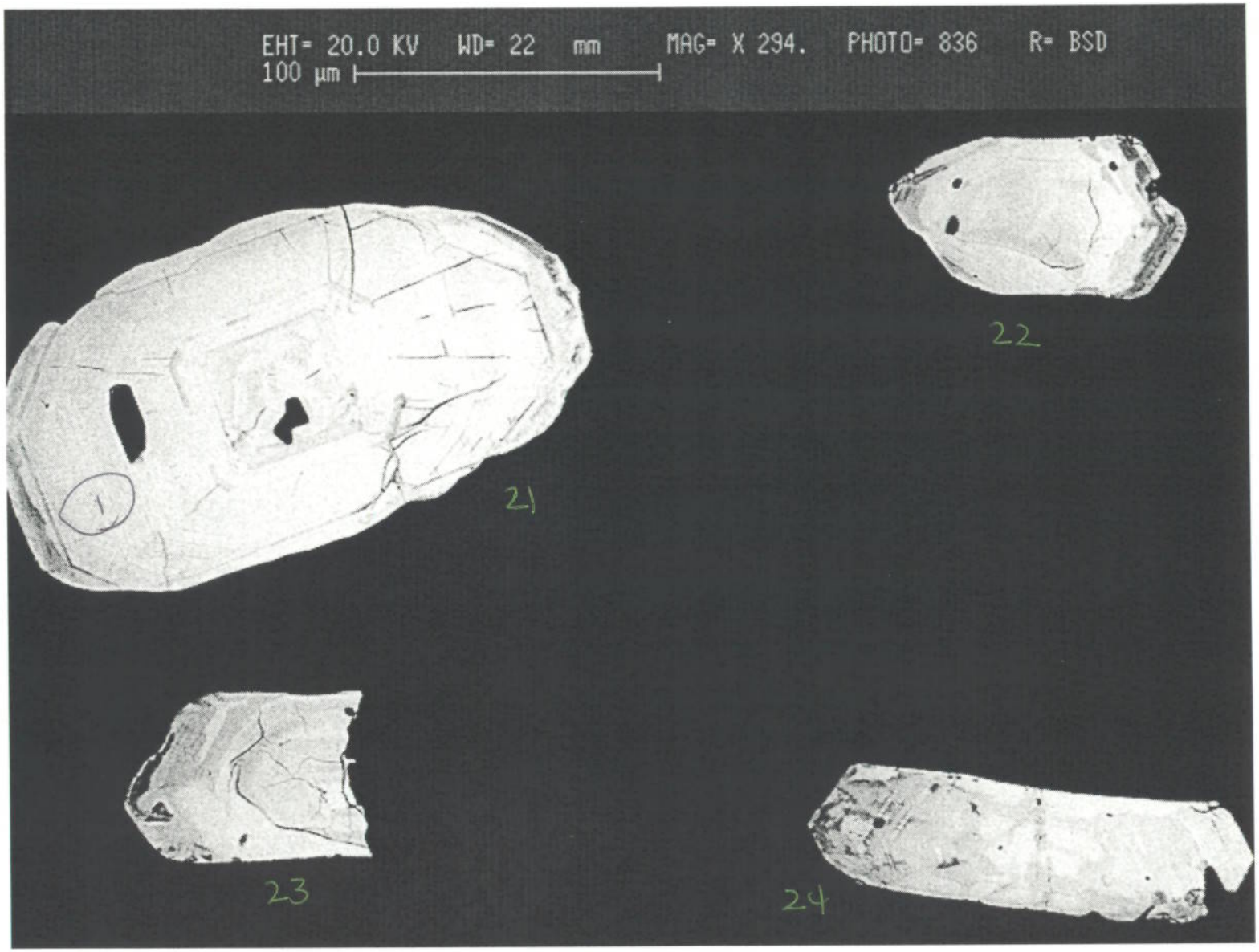


7883-4

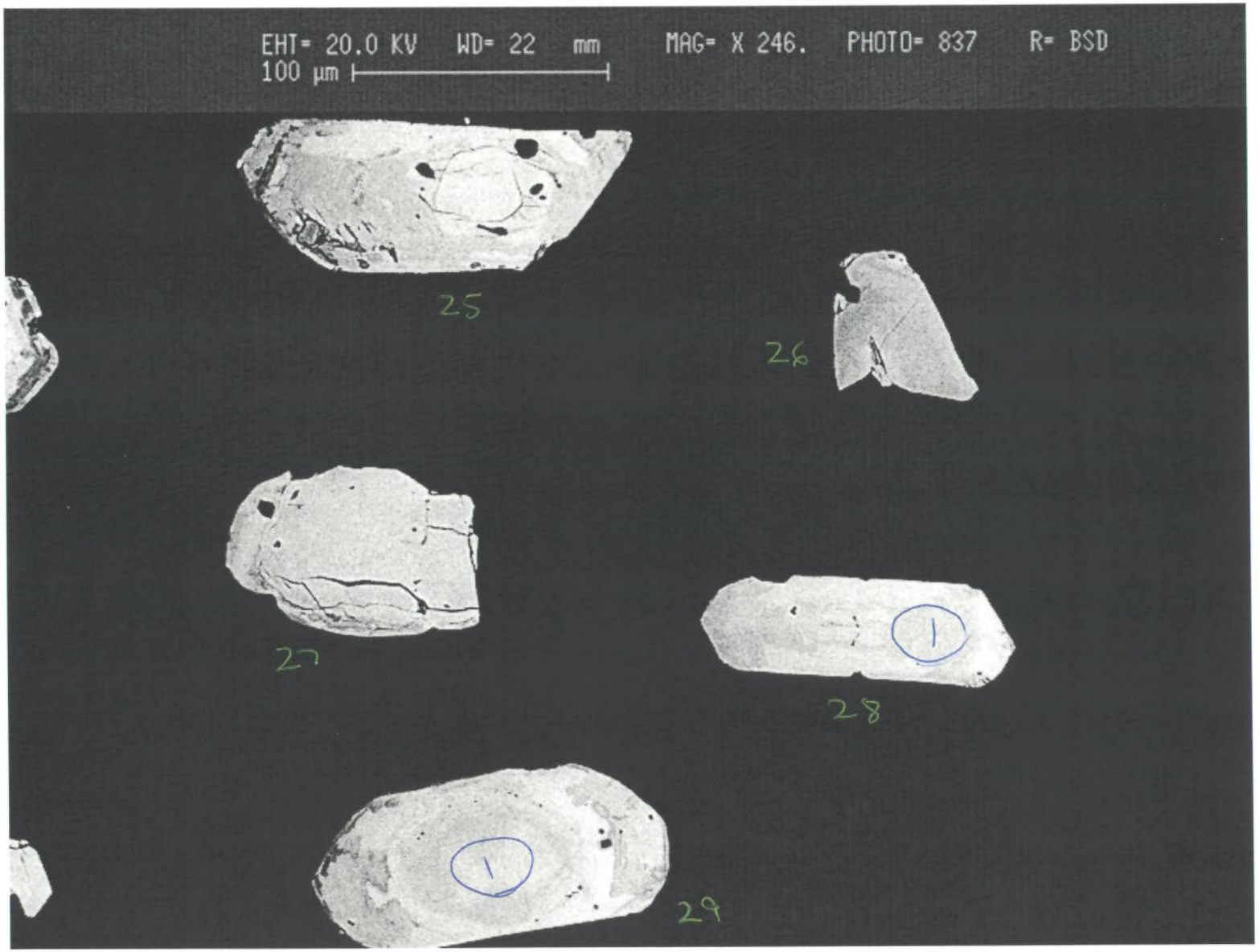


7883-5

9

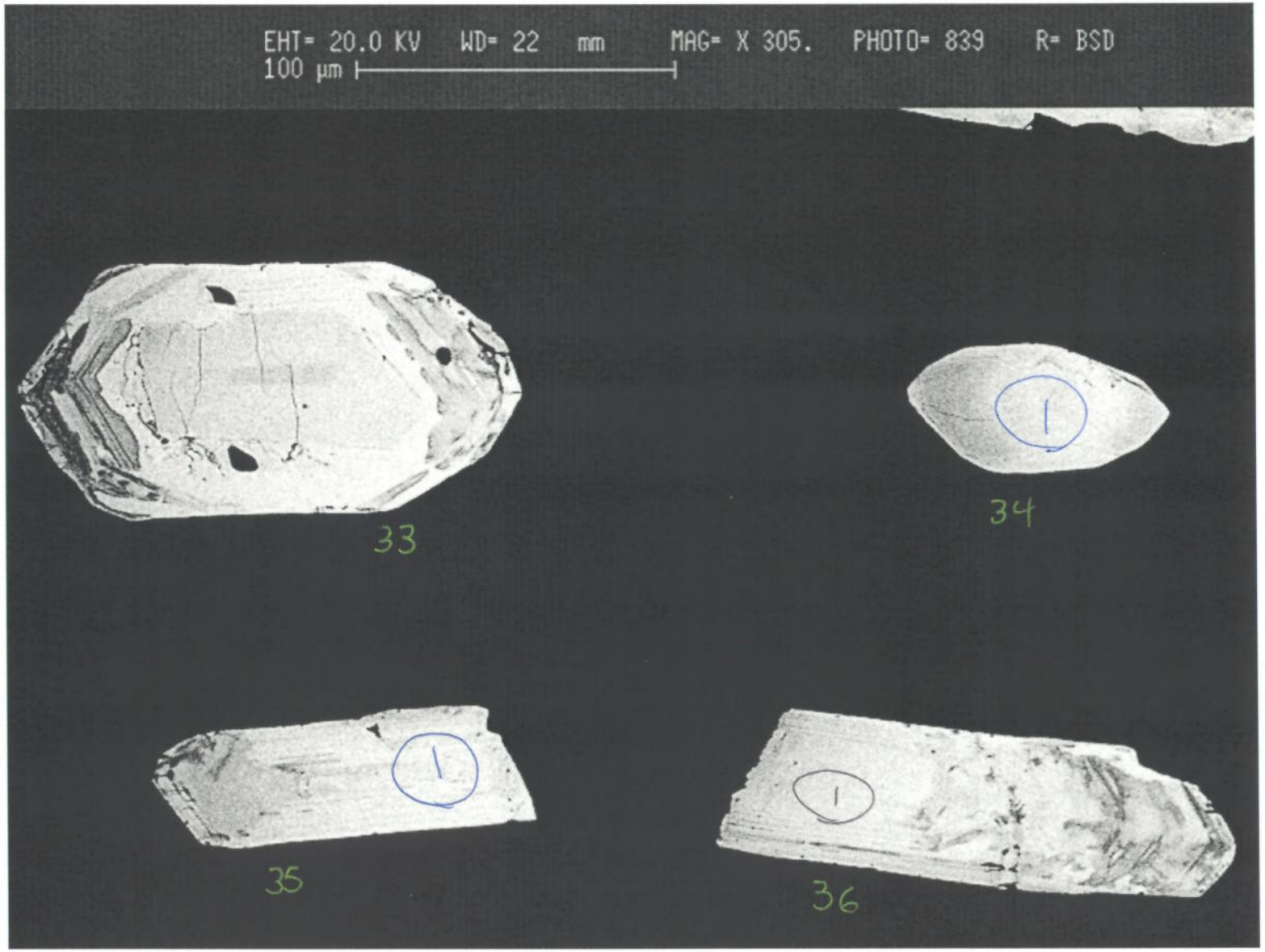


7883-6



78883-7

7388-8



7888-9

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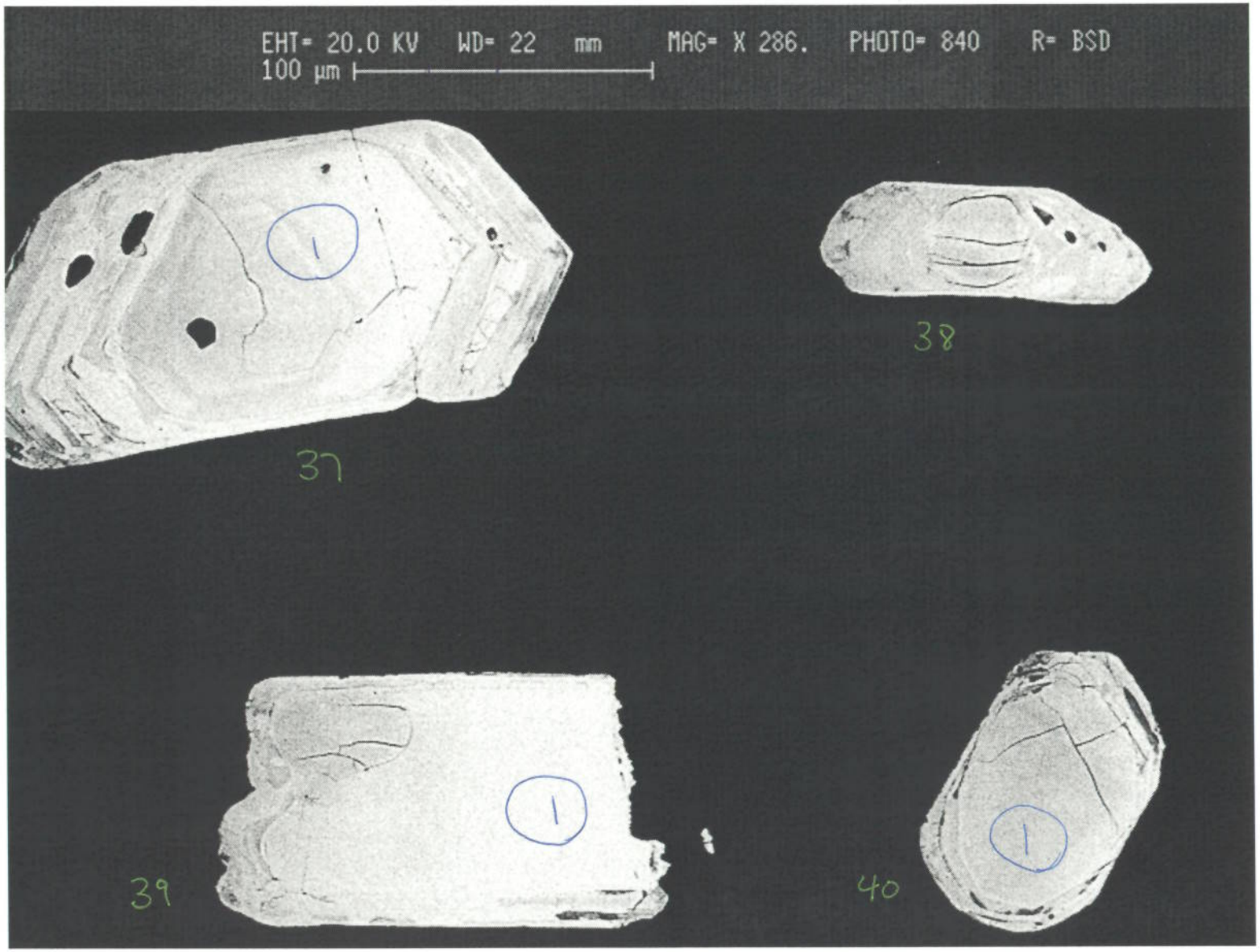
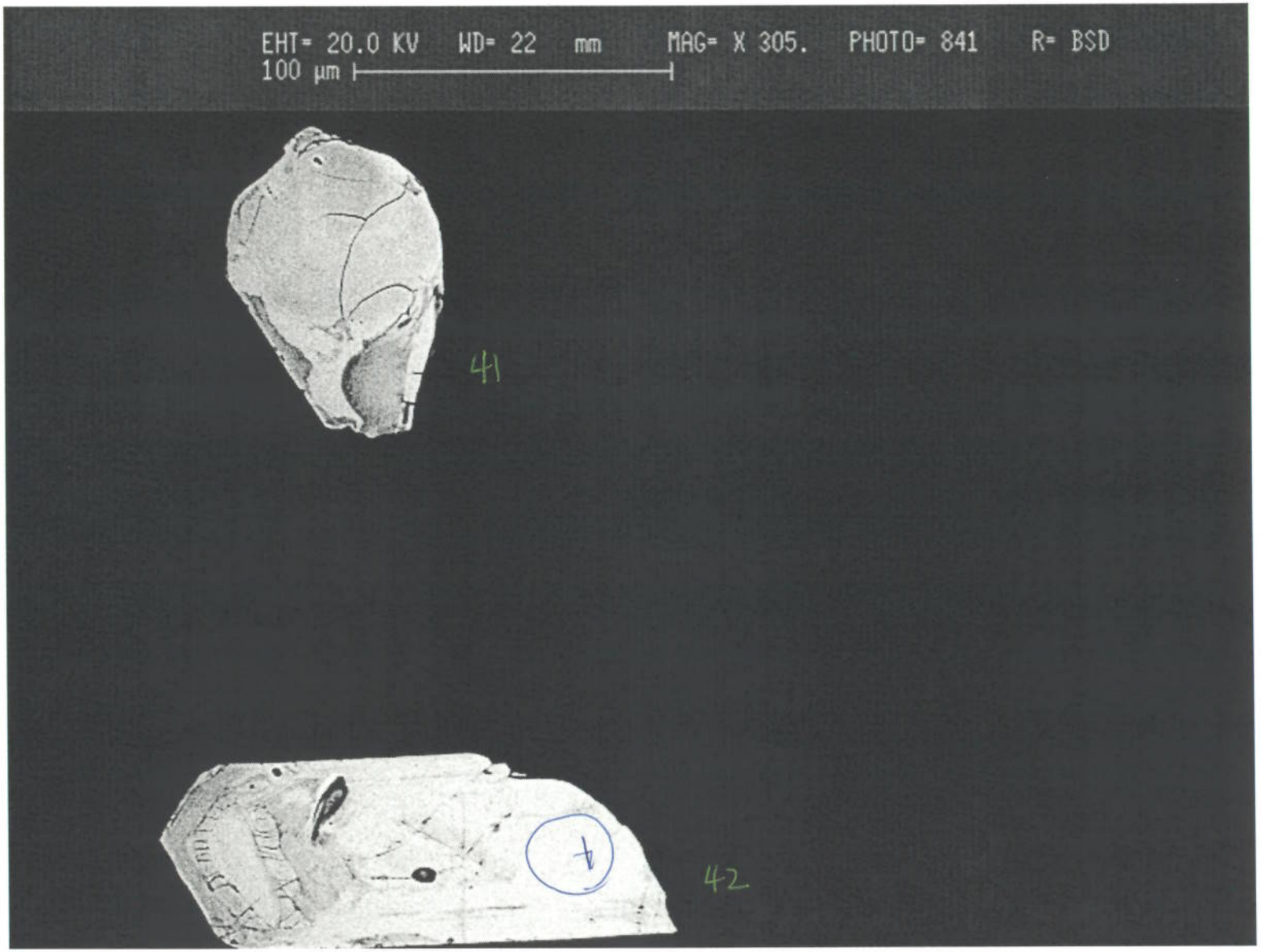
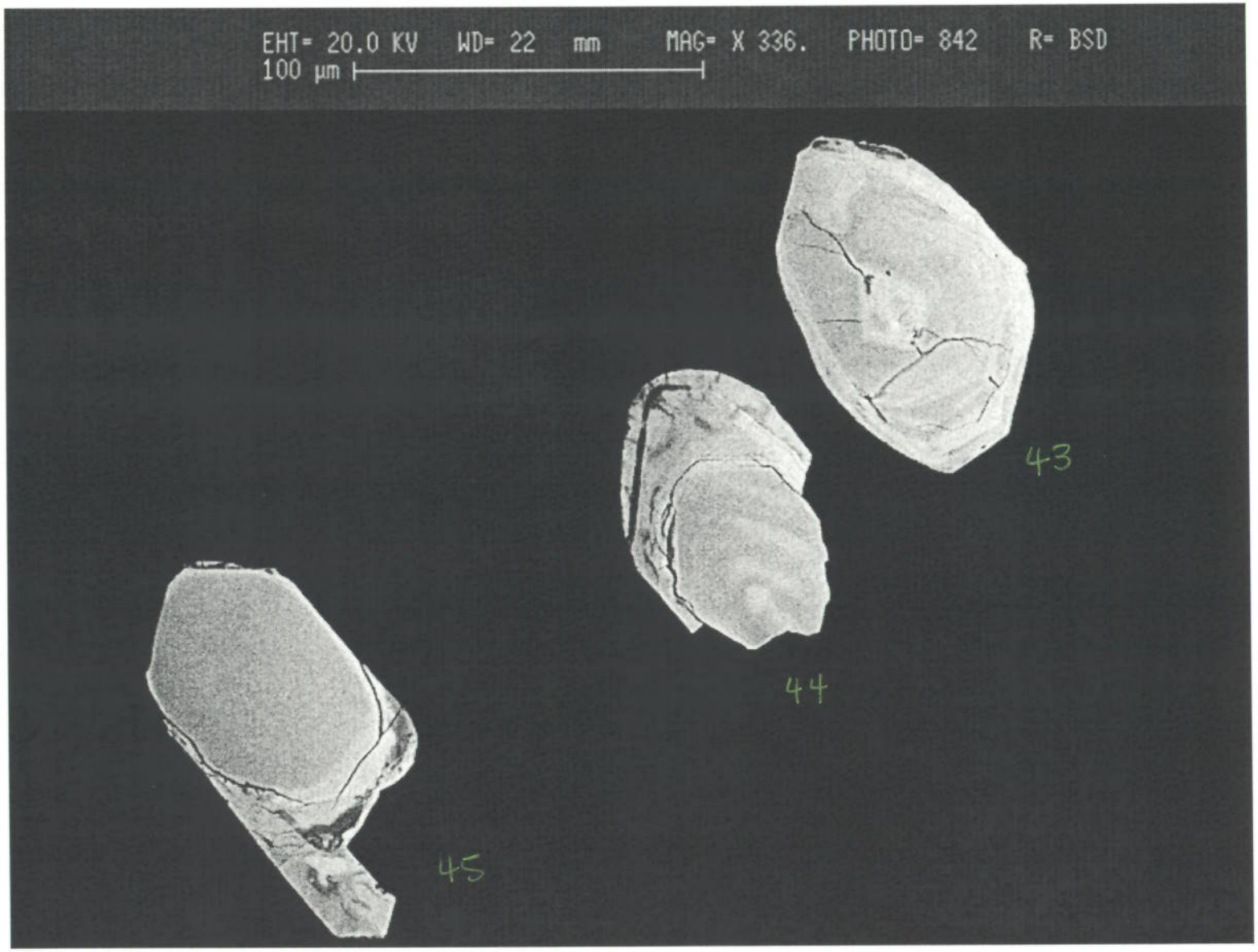


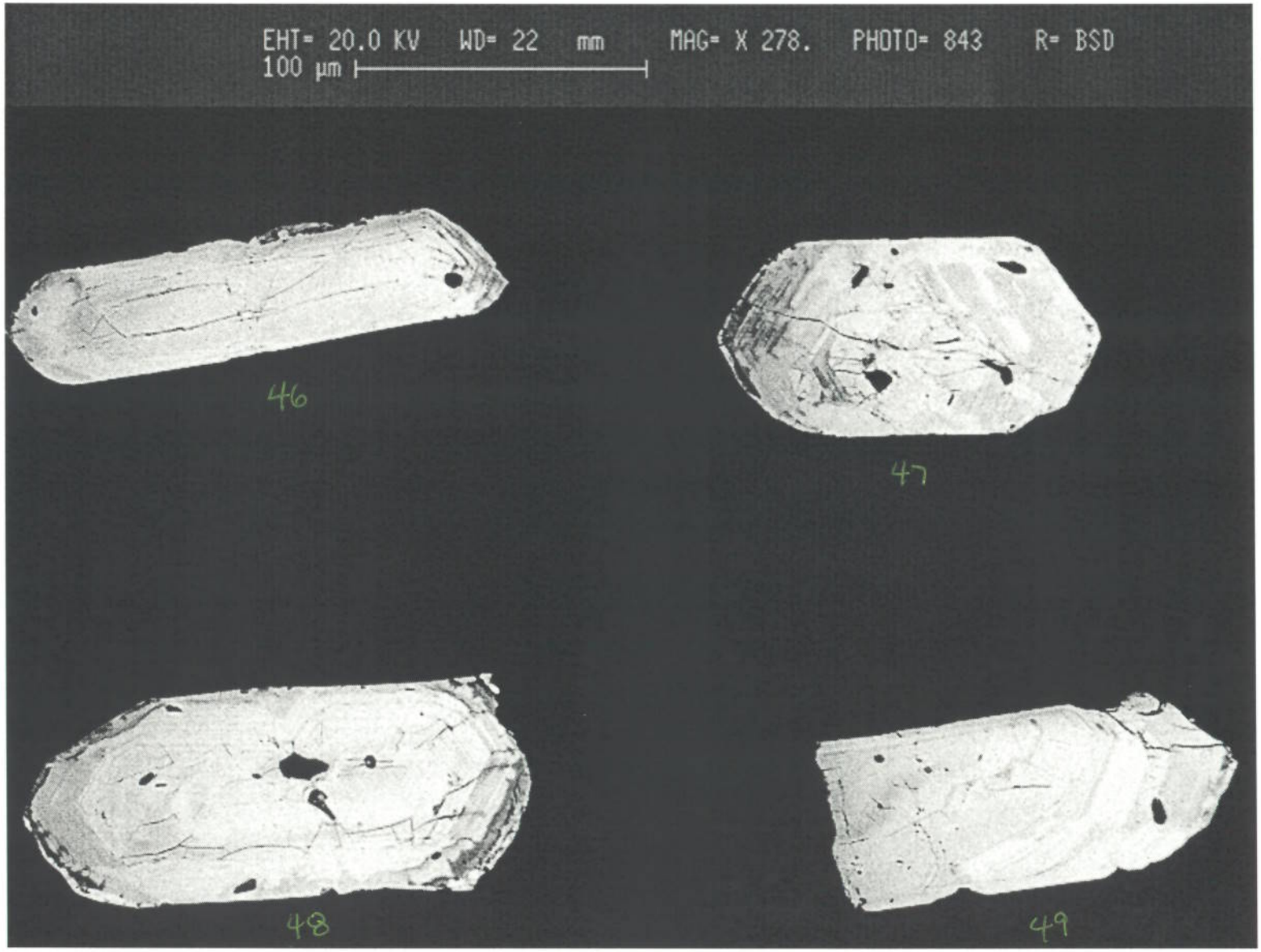
7888 10



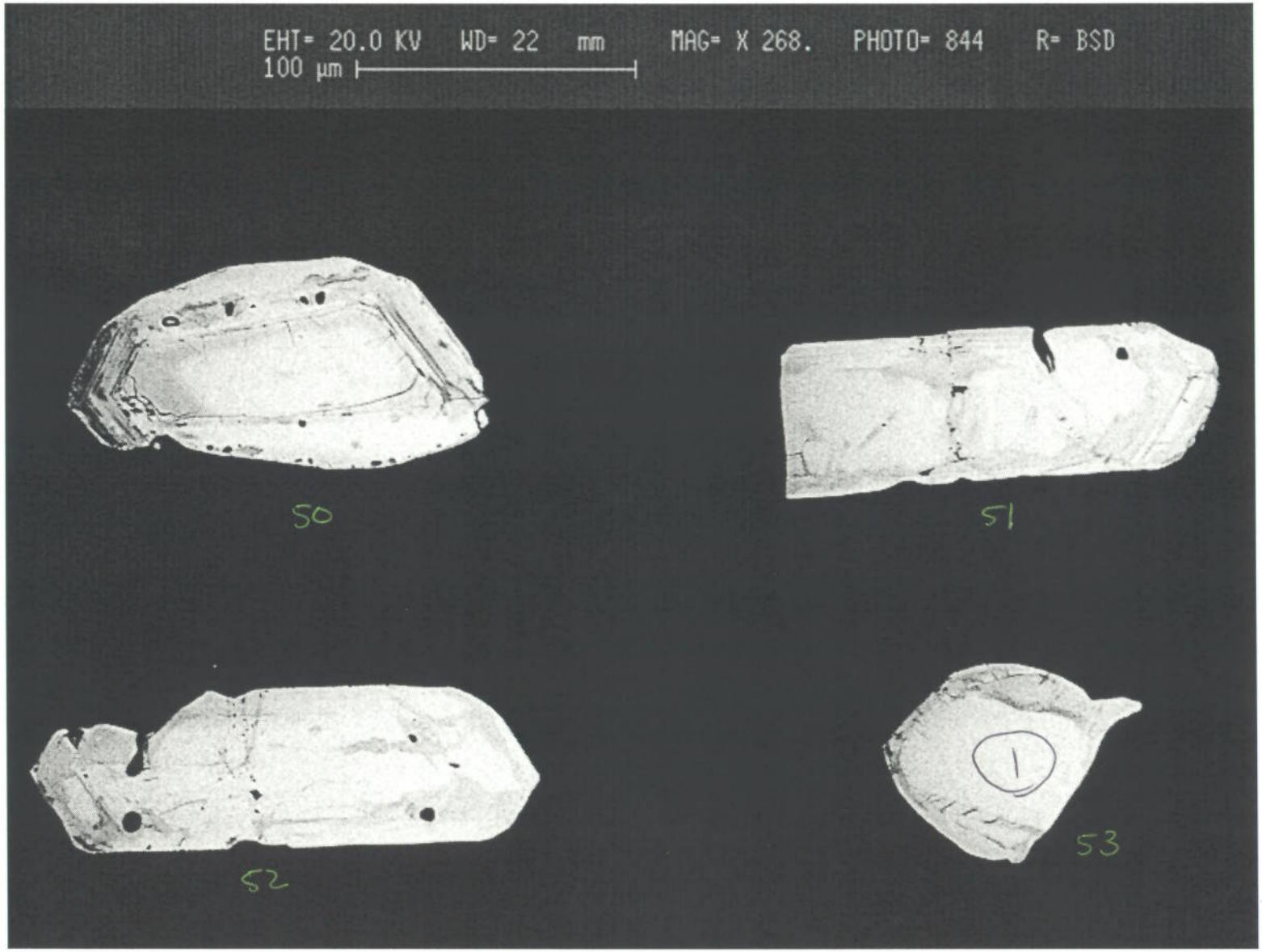
7888-11



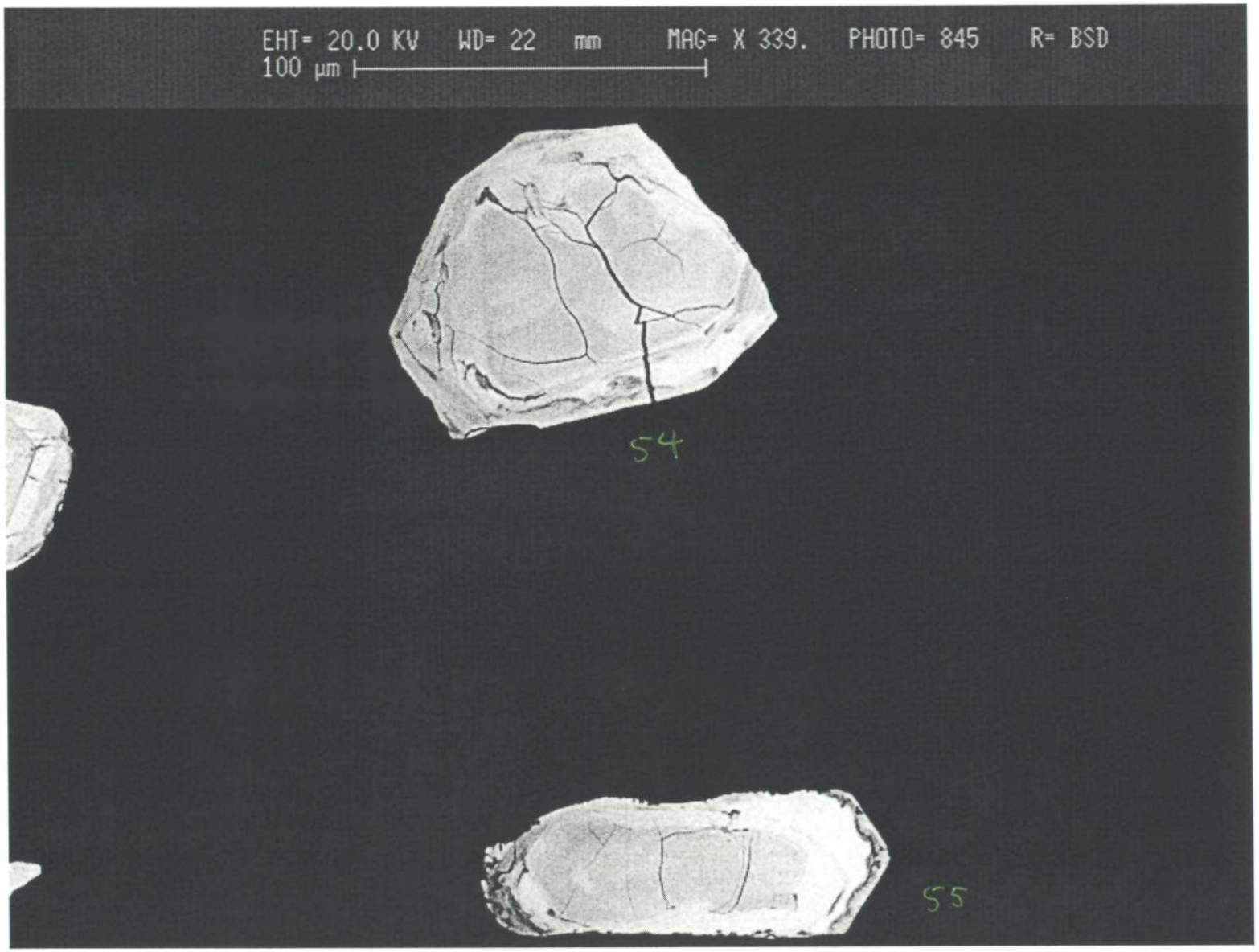
7888-12



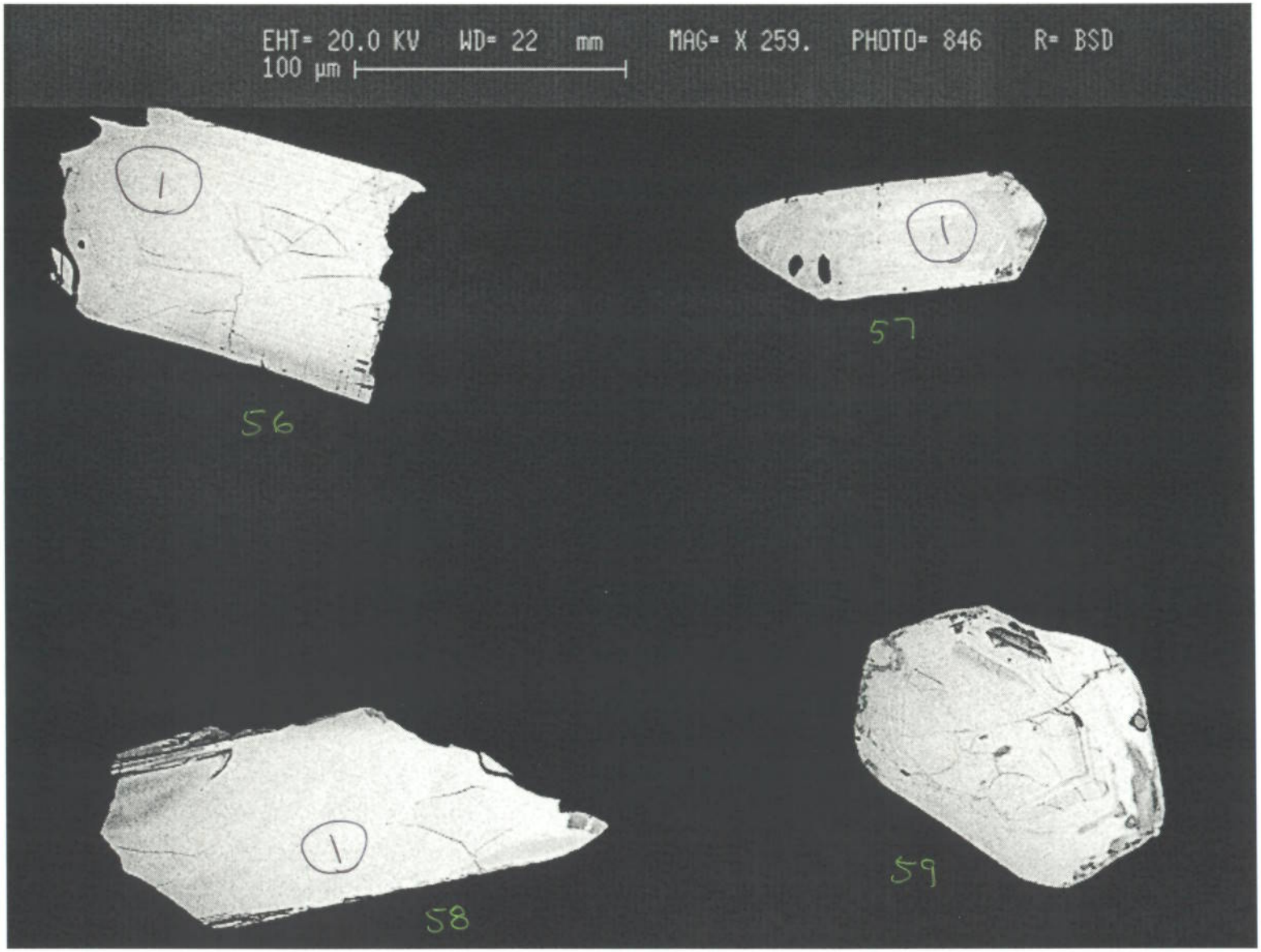
7888-13



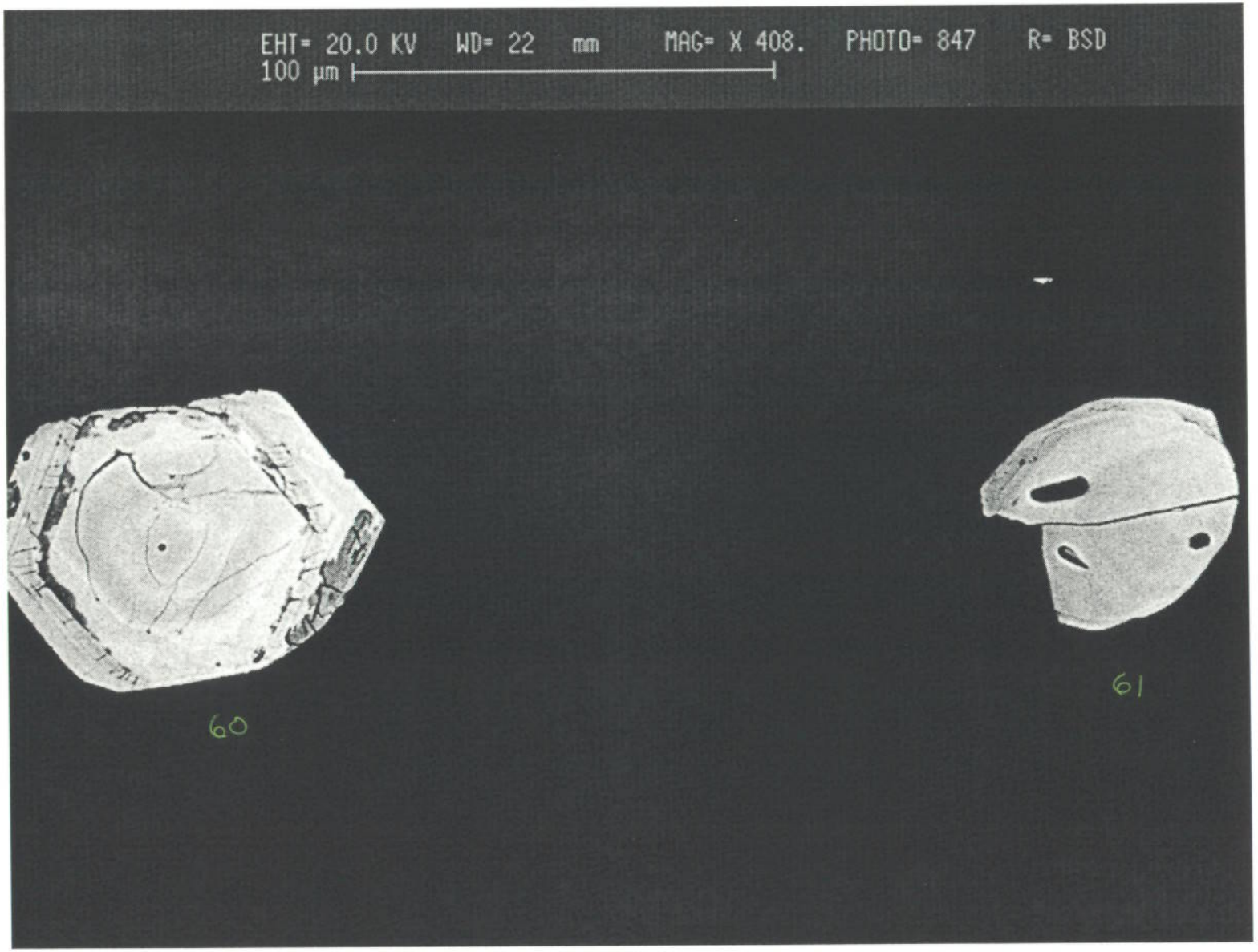
7888-14



7-888-15



7888-16



7888-17

7888-19