

# COSMIC DUST CATALOG

(PARTICLES FROM COLLECTION FLAG W7013)

Planetary Materials Branch  
Publication 75  
JSC 22425

COMPILED BY

COSMIC DUST PRELIMINARY EXAMINATION TEAM (CDPET)

Volume 8  
Number 1

NOVEMBER 1986



National Aeronautics and  
Space Administration

Lyndon B. Johnson Space Center  
Houston, Texas

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(Particles from Collection Flag W7013)

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November, 1986

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## CONTENTS

	<u>PAGE NO.</u>
1. INTRODUCTION	
2. PROCESSING OF PARTICLES	
3. PRELIMINARY EXAMINATION OF PARTICLES	
4. CATALOG FORMAT	
5. ANALYSES OF REFERENCE MATERIALS	
6. SAMPLE REQUESTS	
7. ACKNOWLEDGEMENTS	
8. PARTICLE TABLE OF CONTENTS PARTICLE DESCRIPTIONS	1

## 1. INTRODUCTION

Since May, 1981, the National Aeronautics and Space Administration (NASA) has used aircraft to collect cosmic dust (CD) particles from Earth's stratosphere. Specially designed dust collectors are prepared for flight and processed after flight in an ultraclean (Class 100) laboratory constructed for this purpose at the Lyndon B. Johnson Space Center (JSC) in Houston, Texas. Particles are individually retrieved from the collectors, examined and cataloged, and then made available to the scientific community for research. Cosmic dust thereby joins lunar samples and meteorites as an additional source of extraterrestrial materials for scientific study.

This catalog summarizes preliminary observations on 123 particles retrieved from collection surface W7013. This surface was a flat plate "flag" (with a  $30 \text{ cm}^2$  surface area) which was coated with silicone oil and then flown aboard a NASA WB57-F aircraft during a series of flights that were made within west-central North America from May through July, 1981. This flag was installed in a specially constructed wing pylon which ensured that the necessary level of cleanliness was maintained between periods of active sampling. During successive periods of high altitude (20 km) cruise, the flag was exposed in the stratosphere by pilot command and then retracted into sealed storage containers prior to descent. In this manner, a total of 65 hours of stratospheric exposure was accumulated for flag W7013.

## 2. PROCESSING OF PARTICLES

Particle mounts designed for the JEOL 100CX scanning transmission electron microscope (STEM) are currently the standard receptacles for CD particles in the JSC laboratory. Each mount consists of a graphite frame (size ~3x6x24 mm) onto which a Nucleopore<sup>TM</sup> filter (0.4  $\mu$ m pore size) is attached. A conductive coat of carbon is vacuum evaporated onto the mount and then a microscopic reference pattern is "stenciled" onto the carbon-coated filter by vacuum evaporation of aluminum through an appropriately sized template. CD particles are individually removed from collection flags using glass needle micromanipulators under a binocular stereomicroscope. Each particle is positioned on an aluminum free area of a Freon cleaned, carbon coated filter and washed in place with hexane to remove silicone oil. Each mount is normally limited to 16 particles. All processing and storage of each particle is performed in a Class 100 clean room.

### 3. PRELIMINARY EXAMINATION OF PARTICLES

Each rinsed particle is examined, before leaving the Class 100 clean room processing area, with a petrographic research microscope equipped with transmitted, reflected and oblique light illuminators. At a magnification of 500X, size, shape, transparency, color, and luster are determined and recorded for each particle.

After optical description, each mount (with uncoated particles) is examined by scanning electron microscopy (SEM) and X-ray energy dispersive spectrometry (EDS). This work, as well as the acquisition of secondary - electron images of each particle, is performed with a JEOL 100CX STEM operated in the SEM mode and at an accelerating voltage of 40 kV. Images are therefore of relatively low contrast and resolution due to deliberate avoidance of conventionally applied conductive coats (carbon or gold palladium) which might interfere with later elemental analyses of particles. EDS data are collected with a Si(Li) detector and PGT 4000T analyzer. Using an accelerating voltage of 40 kV, each particle is raster scanned and its X-ray spectrum recorded over the 0-10 keV range by counting for 200 sec. No system (artifact) peaks of significance appear in the spectra.

It should be pointed out that the SEM/EDS procedure used in preparing this catalog is different than that used in preparing Cosmic Dust Catalogs, Volumes 4-7. In these catalogs, EDS analysis was performed using the JEOL 35CF SEM operated at 20 kV. Only the EDS spectra exhibit differences that are likely to be noticed. These differences are a slightly higher background and more efficient excitation of high atomic number elements for EDS spectra collected at 40kV relative to those collected at 20kV. However, each catalog includes spectra of the same selected comparison

standards, which allows comparison of spectra from one catalog to the next to be made. Please refer to Section 5 for a more complete discussion.

Following SEM/EDS examination, each particle mount is stored in a dry nitrogen gas atmosphere in a sealed cabinet.

#### 4. CATALOG FORMAT

Each page in the main body of the catalog is devoted to one particle and consists of an SEM image, an EDS spectrum, and a brief summary of preliminary examination data obtained by optical microscopy. The unique identification number assigned to the particle appears at the top of the page. Sources of the descriptive data are as follows:

SIZE ( $\mu\text{m}$ ) is measured using the original SEM image and its known magnification factor. For an irregularly shaped particle, the minimum dimension in the plane of the field of view is located and determined; then a second (maximum) dimension is measured at a right angle to the first. For a spherical or equidimensional particle, only a single size is recorded.

SHAPE is generalized to be spherical (S), equidimensional (E), or irregular (I). Particles having shape intermediate between S and E, or E and I, are not uncommon and may be denoted as S/E or E/I, etc.

TRANSPARENCY (abbreviated TRANS.) is determined by optical microscopy to be transparent (T), translucent (TL), or opaque (O). Significant variations in transparency within a particle are annotated on the SEM image.

COLOR is determined by optical microscopy using oblique (fiber optic, quartz halogen) illumination supplemented with normal reflected (tungsten lamp) illumination. The distinction of dark (Dk.) from light (Lt.) particles is unambiguous, although the distinction of colorless (CL) from pale colored conditions is sometimes problematical. Complex colorations of individual particles may be noted in the "COMMENTS" column and annotated on the SEM image.

LUSTER is determined by optical microscopy using reflected normal (tungsten lamp) illumination and supplemented with oblique (fiber optic,



quartz halogen) illumination. Commonly applied descriptions, adopted from mineralogical usage, include dull (D), metallic (M), submetallic (SM), subvitreous (SV), vitreous (V), and resinous (R). Lustres transitional between categories or difficult to identify are indicated accordingly (D/SM, SV/V, etc.).

TYPE indicates a provisional first order identification of each particle based on its morphology (from SEM image), elemental composition (from EDS spectrum), and optical properties. We emphasize that, for catalog purposes, types are defined for their descriptive and curatorial utility, not as scientific classifications. These tentative categorizations, which reflect judgements based on the collective experience of the CDPET, should not be construed to be firm identifications and should not dissuade any investigator from requesting any given particle for detailed study and more complete identification. In the absence of any generally accepted taxonomy for stratospheric dust, the precise identification of each particle in our inventory is beyond the scope and intent of our collection and curation program. Indeed, the reliable identification and scientific classification of cosmic dust is one of many important research tasks that we hope this catalog will stimulate. We indicate particle "TYPE" only to aid the users of this catalog (especially those new to small particle analysis) in distinguishing possible cosmic dust particles from other particles which are invariably collected during stratospheric dust sampling. In this catalog, particles are organized according to their type. Categories used in this catalog are defined as follows:

AOS: Aluminum oxide sphere. An AOS is transparent, subvitreous to vitreous in luster, colorless to pale yellow and at least approximately spherical. However, shape may range from

nearly perfect sphericity to pronounced ellipticity and surface texture may range from very smooth to rough. Other spheres or irregularly shaped material may be attached to its surface. Al is the distinctively dominant (or only) peak in its EDS spectrum. A sphere displaying the attributes of an AOS except with major elements in addition to Al may be listed as "AOS?" or "?". Transparent Al rich particles of irregular shape would probably be listed as "TCA?". (AOS particles are products of solid fuel rocket exhausts.)

C: Cosmic dust (variety unspecified) or other extraterrestrial material. In the strict sense, "cosmic dust" refers only to those particles which have not been modified during passage from interplanetary space to Earth's stratosphere. In this catalog, though, particle type "C" is used to conveniently group together all particles which are judged to be of extra-terrestrial origin, including those that have apparently experienced strong ablational heating or melting. Type "C" particles are provisionally identified as those having one of the three following sets of attributes:

- (a) irregular to spherical, opaque, dark colored particles composed mostly of Fe with minor Ni or S.
- (b) irregular to spherical, translucent to opaque, dark-colored particles containing various proportions of Mg, Si, and Fe with traces of Al, Ca, S, or Ni.
- (c) irregular to faceted or blocky, transparent to translucent particles containing mostly Mg, Si, and Fe but with traces of Al or Ca, S, or Ni.

Category (a) and (b) particles commonly display either complex, porous aggregate type morphologies or distinctively spherical shapes and dull to metallic lusters which distinguish them from terrestrial minerals. Their EDS spectra are reminiscent of those exhibited by meteoritic Fe Ni or FeS minerals, or combinations of Fe Ni S phases with olivine and/or pyroxene. Category (c) particles display morphologies and EDS spectra which suggest that they are fragments of olivine or pyroxene crystals, neither of which are significant components of stratospheric volcanic ash. Particles which do not fall easily into categories (a), (b), or (c) but which possess some of the same attributes may be classified here as "C?".

TCA: Terrestrial contamination (artificial or man made). Particles included in the "TCA" category are commonly irregular in shape (though a few may be spherical) and may be transparent, translucent, or opaque. Their EDS spectra commonly show Al, Fe, or Si as the principal peaks but with a variety of minor peaks including those of Ti, V, Cr, Mn, Ni, Cu, or Zn and at abundances which are frequently much greater than those expected in common minerals. However, such compositions are similar to those expected for certain metal alloys. In some cases, a high intensity (relative to intensities of characteristic x ray peaks) of continuum radiation occurs in the EDS spectrum, suggesting that low atomic number elements not detectable by the EDS (e.g., H, C, N, O) are abundant in the particle. Such "TCA" particles are

tacitly inferred to by synthetic carbon based materials. (This category probably includes particles produced by or derived from aircraft operation or collector hardware, or possibly spacecraft debris. However, some of these particles are worthy of additional research and may represent true extraterrestrial "low Z" material).

TCN: Terrestrial contamination (natural). "TCN" particles may be transparent to opaque and may exhibit a variety of colors. However, they are commonly irregular in shape and distinctively rich in Si and Al with minor abundances of Na, K, Ca, or Fe. Morphologies and EDS spectra of most "TCN" particles compare favorably with respective properties of silica polymorphs, feldspar, or silicic volcanic glass, three materials which are principal components of stratospheric volcanic ash. In addition, platy or porous aggregate type particles of light color and Si, Al rich composition may be silicic clay minerals, common phases in Earth's surface soils. Irregular, reddish Fe rich particles may also be products of terrestrial rock weathering. Recognition of these and other phases as "TCN" particles is based mostly on CDPET's collective mineralogical experience and comparison with reference samples. Less commonly, the "TCN" category may include distinctive particles with apparently non random shapes which are rich in low atomic number elements (as inferred from their EDS spectra having high levels of continuum x radiation and relatively small peaks for characteristic x rays). Those rare particles are distinguished from "TCA" particles by

their unusual, organized morphologies and probably represent biological contaminants.

?: Identification uncertain. This category includes particles which do not unequivocally resemble those grouped together as AOS, C, TCA, or TCN. In addition, the "?" symbol is liberally used to reiterate the tentative identifications of other types of particles.

Again, this system for provisional classification of particles is presented only as a first order attempt to distinguish particles which are probably extraterrestrial in origin from those which are probably contaminants. Many particles, especially those cataloged as type "?", will require careful research examination before they can be satisfactorily identified.

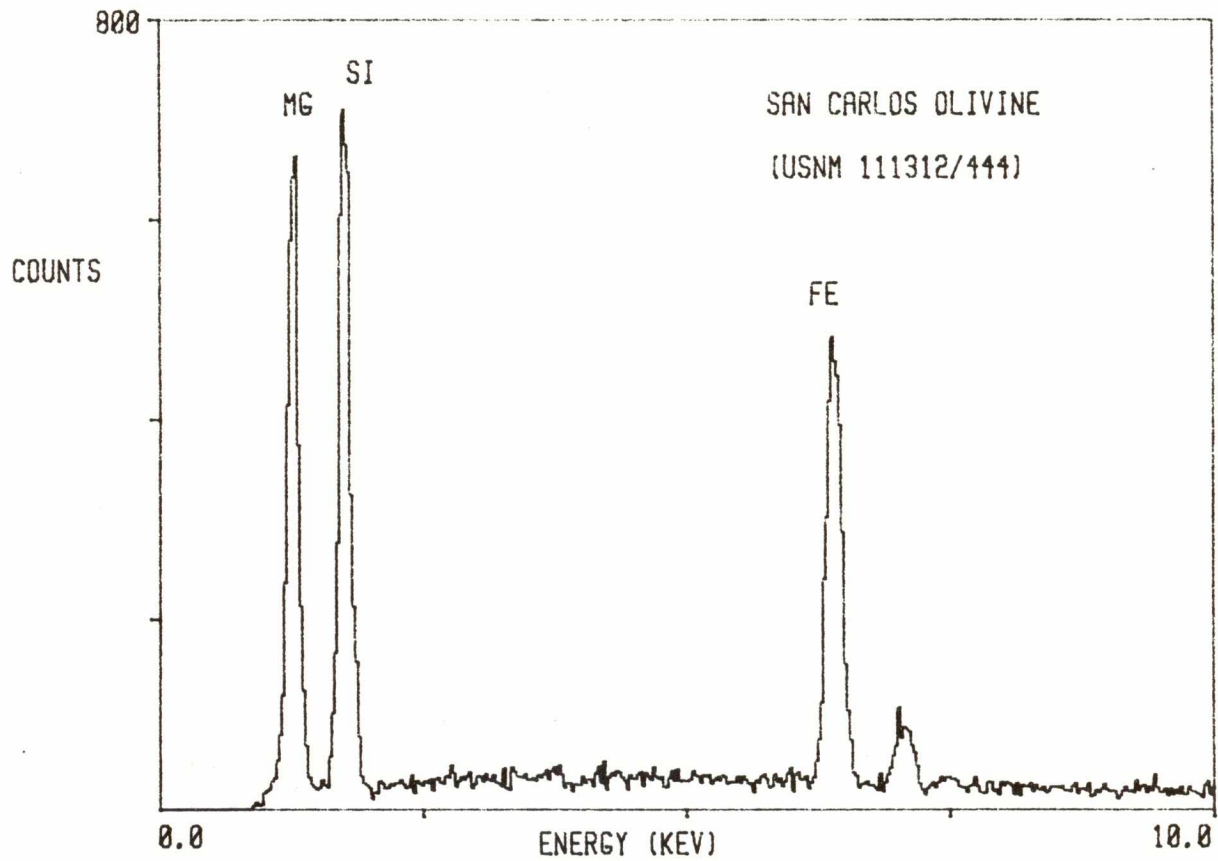
COMMENTS are included for particles with special features or histories. Particles lost during or after preliminary SEM examination, or particles with possible genetic relationships to other particles are noted here.

## 5. ANALYSES OF REFERENCE MATERIALS

The usefulness of the SEM images and EDS spectra provided for particles in this catalog is enhanced by comparison with similar data products obtained for mineral standards of known composition. Accordingly, a typical EDS spectrum is presented for each of three standard minerals prepared as polished grain mounts (San Carlos olivine, USNM 111312/444; diopside JLC 99 63; Kakanui hornblende, USNM 143965). Analyses of these optically flat surfaces eliminate inter sample geometrical variations so that effects of detection limits and compositional variations, in general, on relative peak heights in the raw spectra can be more readily assessed. Even so, the polished grain spectra should not be over interpreted because no corrections have been attempted for atomic number, absorption, or fluorescence effects. The spectra are presented simply as additional aids to the meaningful use of the sample particle EDS spectra. Investigators who might wish to compare performance characteristics of their EDS analytical systems with those of the system used by CDPET in preparing these catalog data should contact Curator/Cosmic Dust at the address given in Section 6. A short term loan of a polished grain mineral standard can then be arranged.

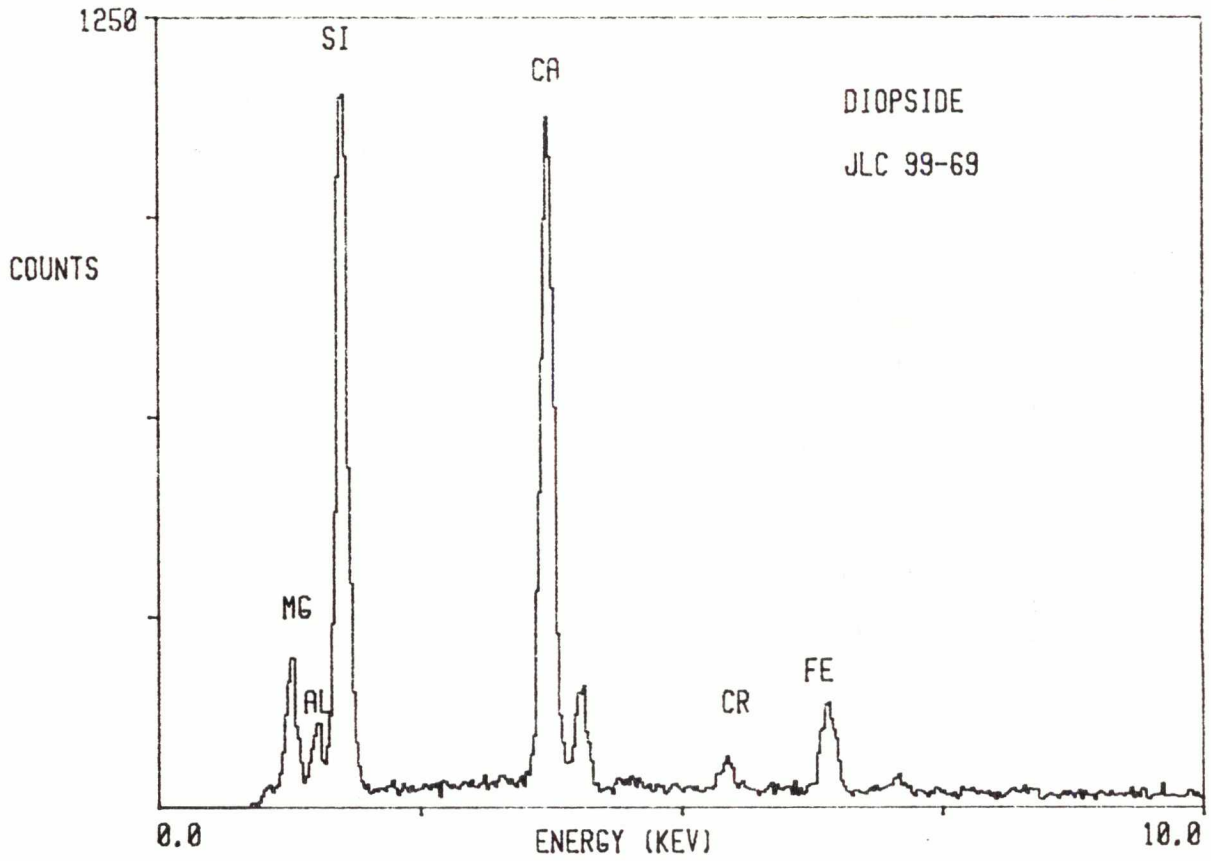
As pointed out in Section 3, the EDS spectra included in this catalog were obtained using a primary electron energy of 40 kV whereas spectra in Catalogs 4 through 7, were obtained with a different instrument operated at 20 kV. Although the effects on EDS spectra to be expected from such a change are well known from X-ray spectrometric analysis, they are worth pointing out to avoid confusion among the readers of this catalog. The major effects of concern to Cosmic Dust Catalog users can be seen by comparing the two "Allende (C3) Meteorite Bulk Powder" spectra, one of

which was obtained at 40 kV and the other at 20 kV, as presented in Cosmic Dust Catalogs 4 through 7 (only spectra collected at 40kV are presented in this catalog). In the 20 kV spectrum, the Si peak is more intense than the principal peak of Fe whereas the opposite is true for the 40 kV spectrum. In general, the 40 kV spectra in this catalog will show peaks of heavy elements enhanced relative to peaks of light elements when compared with 20 kV spectra published in Catalogs 4 through 7. The explanation is based both on geometrical differences between X-ray paths in the two EDS systems (the JEOL 35CF system is actually more favorable for light element analysis) and on electron and X-ray physics (X-ray emission by heavy elements is more intense at 40 kV than at 20 kV). Thus, readers are cautioned against attempting to quantitatively intercompare 40 kV spectra in this catalog with 20 kV spectra in previous catalogs. Still, the spectra in each catalog should continue to serve as originally intended. Namely, the sample and standard spectra in any given catalog will represent a self consistent data set.

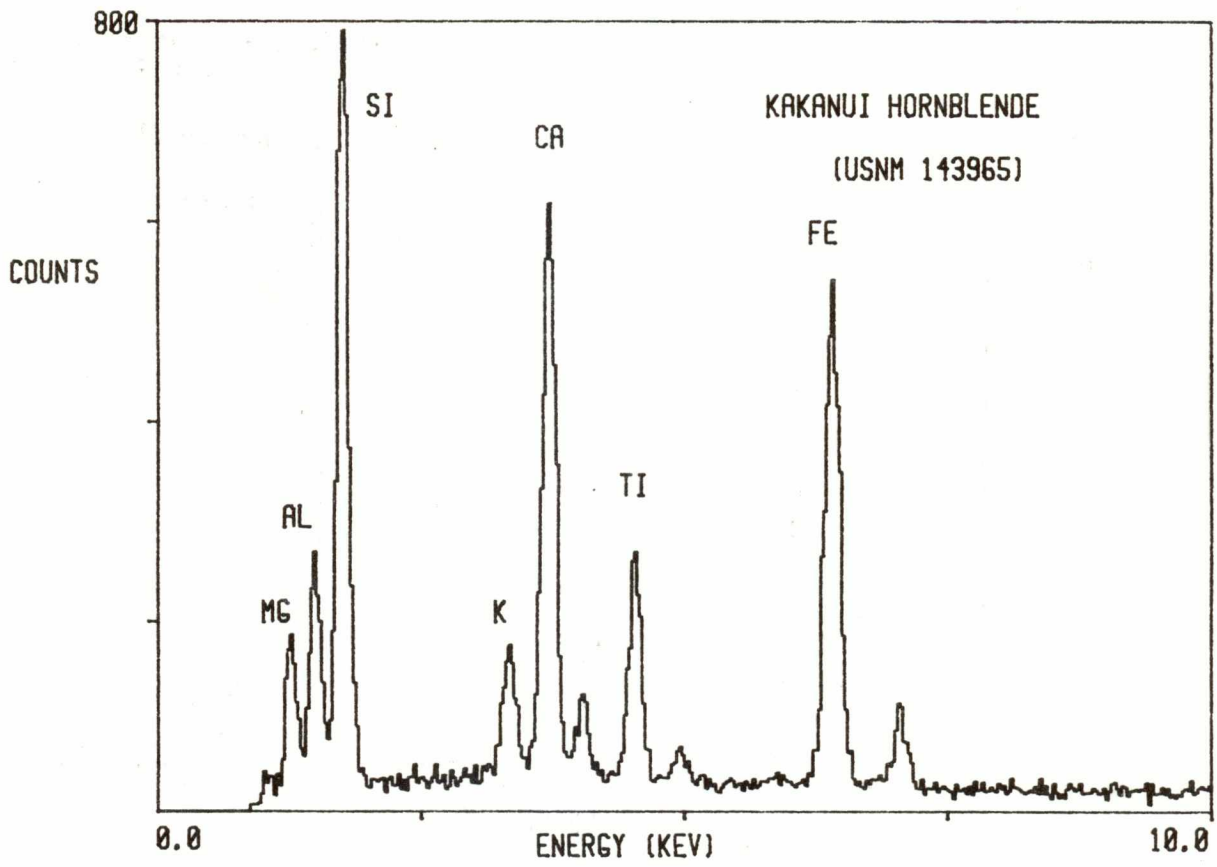


WEIGHT %													
SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	NiO	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	H <sub>2</sub> O	TOTAL
40.81	-	-	-	-	9.55	0.37	0.14	49.42	<0.05	-	-	-	100.29

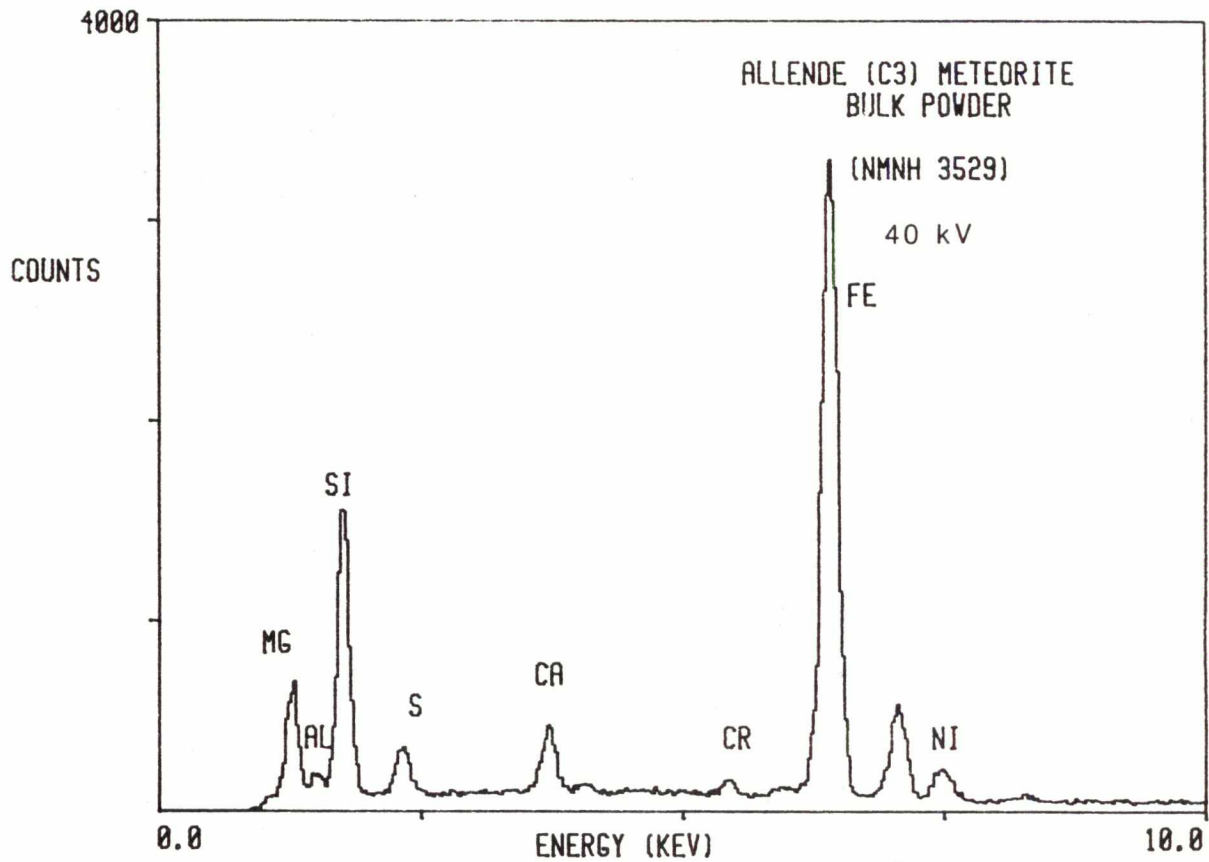




WEIGHT %												TOTAL	
SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	NiO	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	H <sub>2</sub> O	
51.93	0.46	6.31	9.96	1.80	2.34	0.04	0.07	16.05	19.64	1.39	-	-	99.99



WEIGHT %													TOTAL
SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	NiO	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	H <sub>2</sub> O	
40.37	4.72	14.90	-	3.30	7.95	-	0.09	12.80	10.30	2.60	2.05	0.94	100.02



WEIGHT %											
SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	FeO	MnO	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	C
34.23	0.15	3.27	0.52	27.15	0.18	24.62	2.61	0.45	0.03	0.23	0.29
FeS	NiS	CoS	Fe <sup>0</sup>	Ni <sup>0</sup>	Co <sup>0</sup>	TOTAL					
4.03	1.60	0.08	0.17	0.36	0.01	99.98					

## 6. SAMPLE REQUESTS

Scientists desiring to perform detailed research on particles described in this catalog should apply in writing to:

Curator/Cosmic Dust	Telephone: (713) 483-3274
Code SN2	
NASA/Johnson Space Center	FTS: 525-3274
Houston, Texas 77058	
U.S.A.	

Sample requests should refer to specific particle identification numbers and should describe the research being proposed as well as the qualifications and facilities of the investigator making the request. Additionally, requests for particles not yet passed through preliminary examination will be considered if the requester can demonstrate a strong need for them. NASA will arrange for a review of the scientific merits of each request and will inform the requester of the results. Approval of a sample request does not imply or include funding for the proposed research. Questions about NASA funding should be directed to:

Dr. Donald D. Bogard  
Discipline Scientist  
Planetary Materials and Geochemistry Program  
Code SN 4  
NASA/Johnson Space Center  
Houston, TX 77058

Although foreign scientists are welcome to request samples, NASA cannot provide funds to be spent outside the U.S.A. by citizens of other countries.

## 7. ACKNOWLEDGEMENTS

Norm La Fleur and co workers (NASA/Ames Research Center, Moffett Field, California) performed the loading and unloading of the cosmic dust collectors on the WB57-F aircraft and provided flight log data.

Eugene Jarosewich (Smithsonian Institution, Washington, D.C.) kindly provided mineral standards and the Allende chondrite powder.

## 8. PARTICLE TABLE OF CONTENTS

Since particles are arranged in this catalog by type, rather than sequentially by mount and number as in previous catalogs, we include a sequential listing of particles and the page on which they may be found, for the user's reading pleasure.

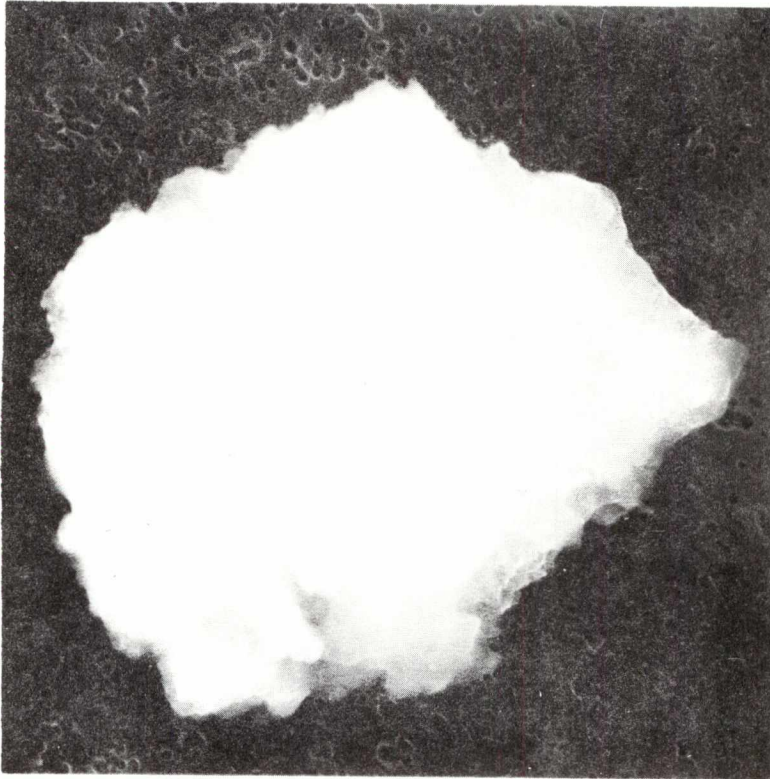
<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>
A1	66	B6	76	C10	85	E3	27
A2	2	B7	11	C11	86	E4	123
A3	122	B8	77	C13	59	E5	28
A4	3	B9	78	C16	21	E6	29
A5	67	B10	79	D1	60	E7	30
A6	68	B11	80	D3	87	E8	96
A7A	4	B12	12	D5	61	E9	31
A7B	5	B13	13	D6	88	E10	97
A8	6	B14	14	D8	22	E11	98
A9	69	B15	15	D9	89	E12	99
A11	7	B16	58	D10	90	E13	124
A12	8	B17	16	D11	23	E14	100
A13	70	C1	17	D12	24	E15	32
A14	9	C2	18	D13	91	E16	101
A15	71	C3	19	D14	25	E17	33
B1	72	C4	81	D15	92	F1	34
B2	73	C6	20	D16	93	F2	102
B3	74	C7	82	D17	94	F3	35
B4	75	C8	83	E1	26	F4	36
B5	10	C9	84	E2	95	F5	37

<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>	<u>PARTICLE</u>	<u>PAGE</u>
F6	103	G2	107	G14	63	H11	127
F7	104	G3	126	G15	110	H12	128
F8	38	G4	62	G16	111	H13	129
F9	39	G5	108	H3	112	H14	117
F10	105	G6	44	H4	50	H15	118
F12	40	G7	45	H5	51	H17	53
F13	41	G9	46	H6	52	H18	119
F14	125	G10	47	H7	113	H19	120
F15	106	G11	48	H8	114	H20	54
F16	42	G12	49	H9	115	H23	64
G1	43	G13	109	H10	116	H24	55

# COSMIC DUST

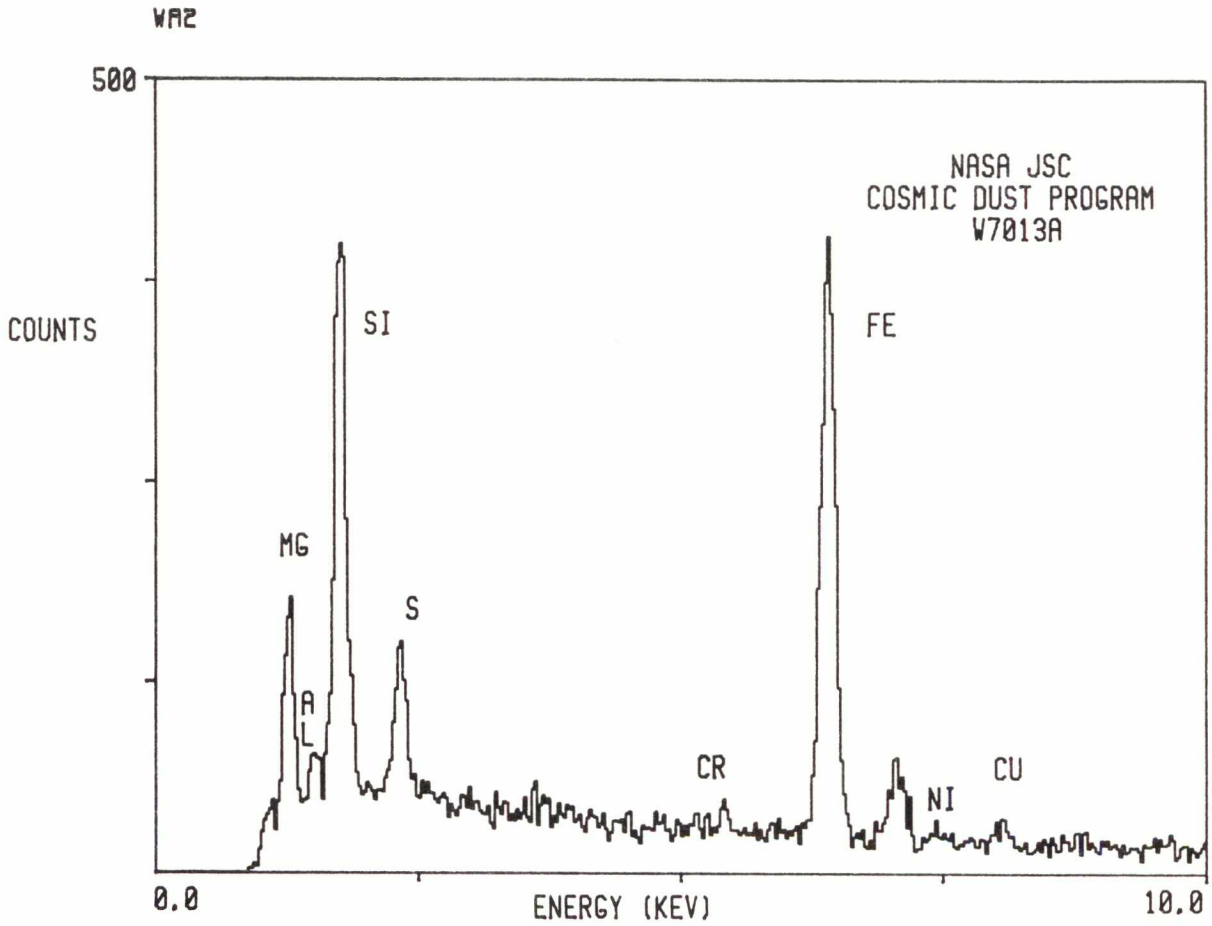


W7013 A 2

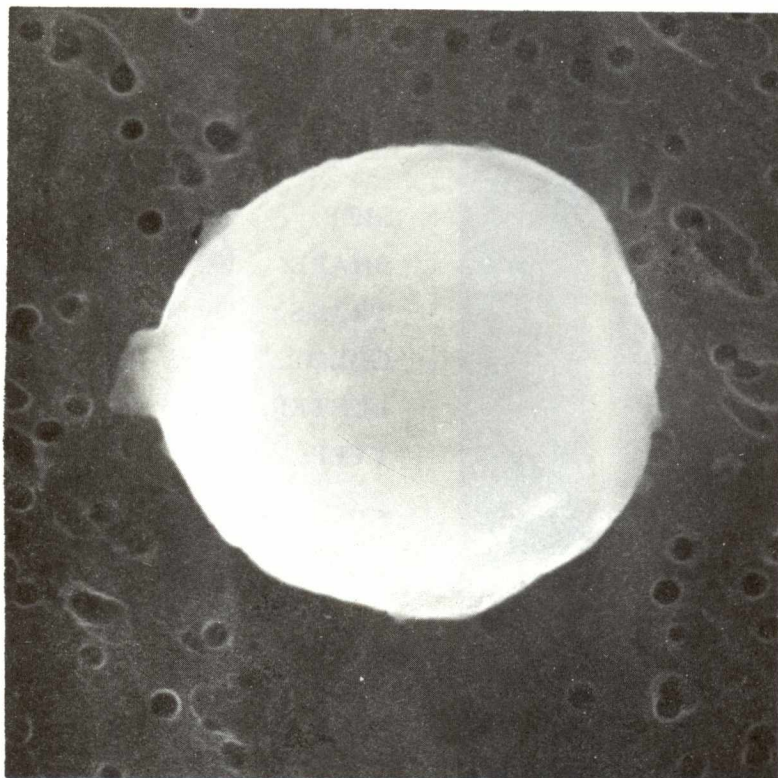


SIZE: 22  
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TRANS.: O/TL  
COLOR: Yellow to black  
LUSTER: R  
TYPE: C  
COMMENTS:  
Some TL grains

S-86-40297

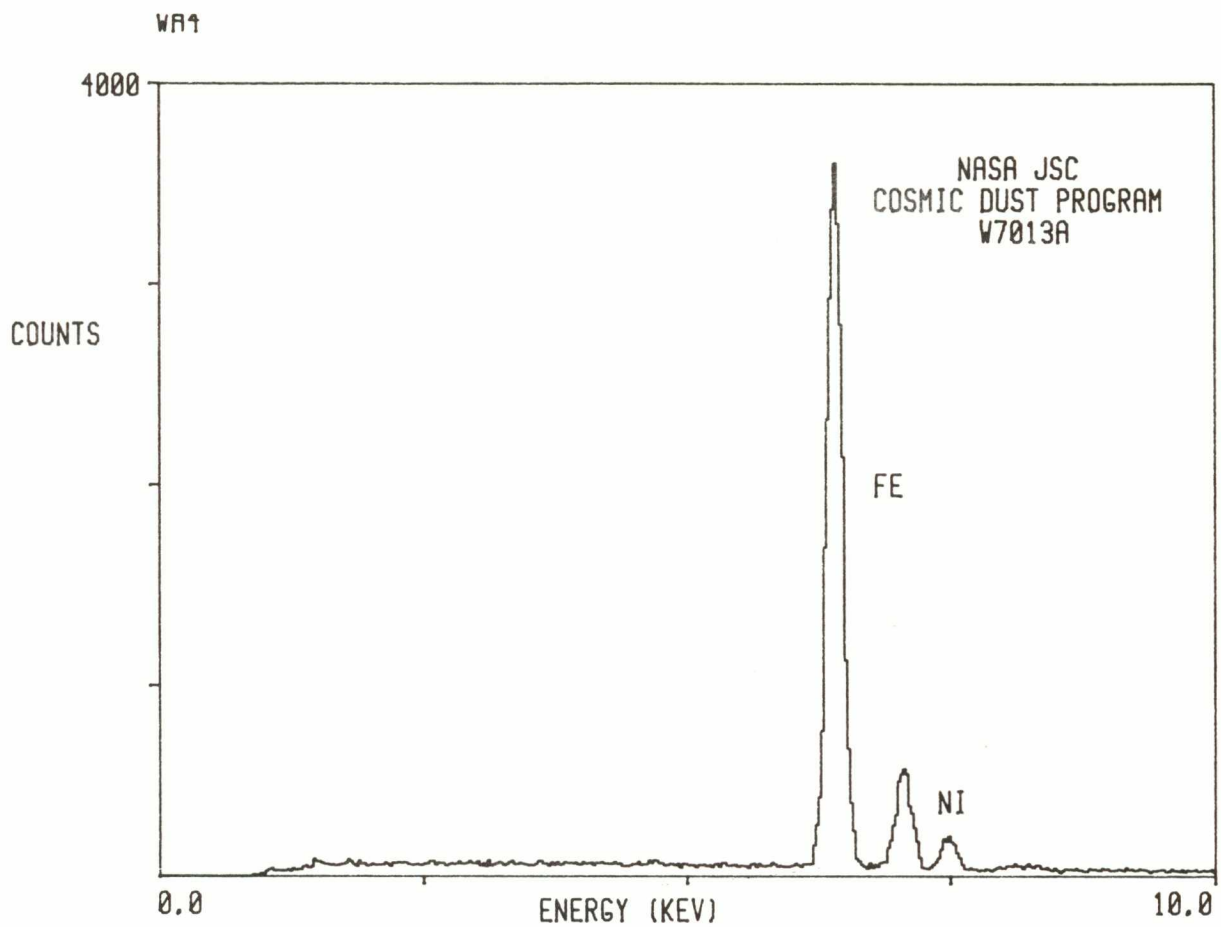


W7013 A 4

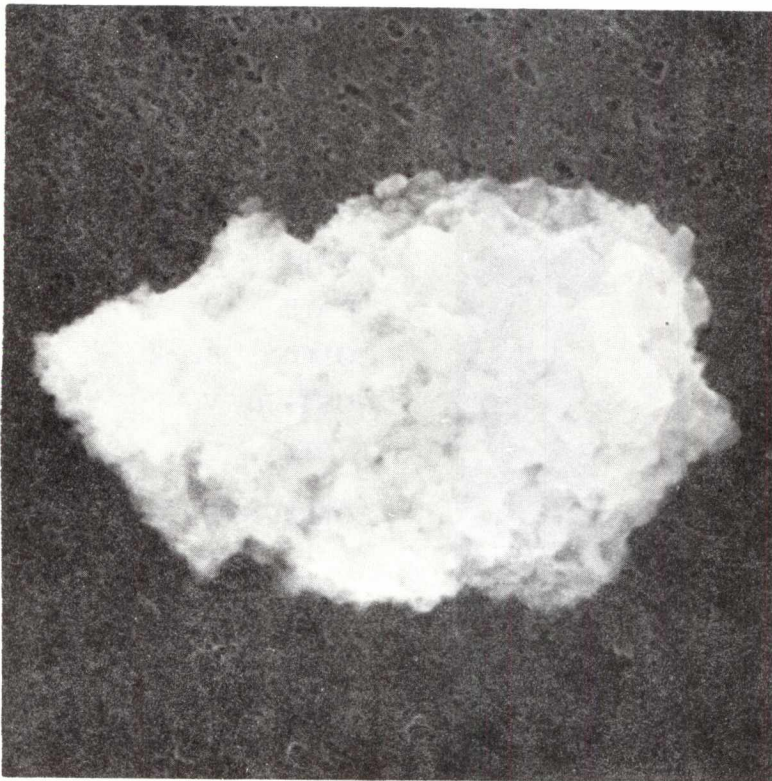


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TRANS.: O  
COLOR: Black  
LUSTER: V  
TYPE: C  
COMMENTS:

S-86-40299



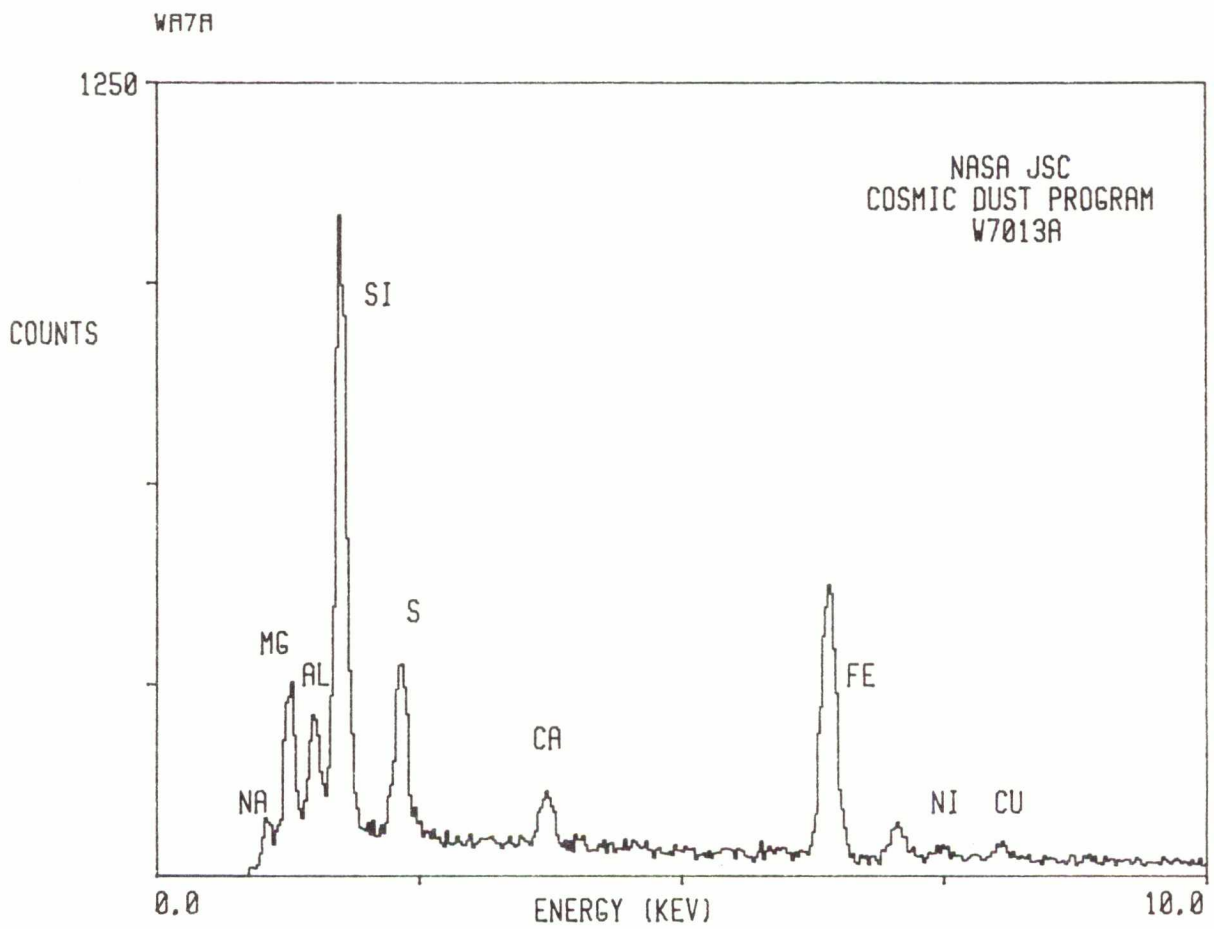
W7013 A 7A



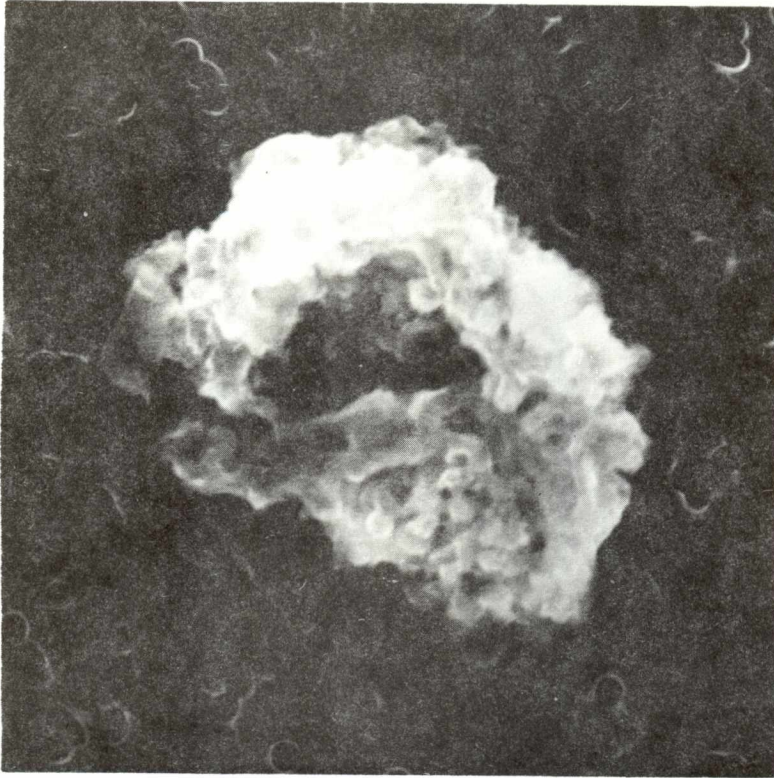
SIZE: 22  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: D/M  
TYPE: C

COMMENTS:  
Particle B is  
fragment of  
particle A

S-86-40302

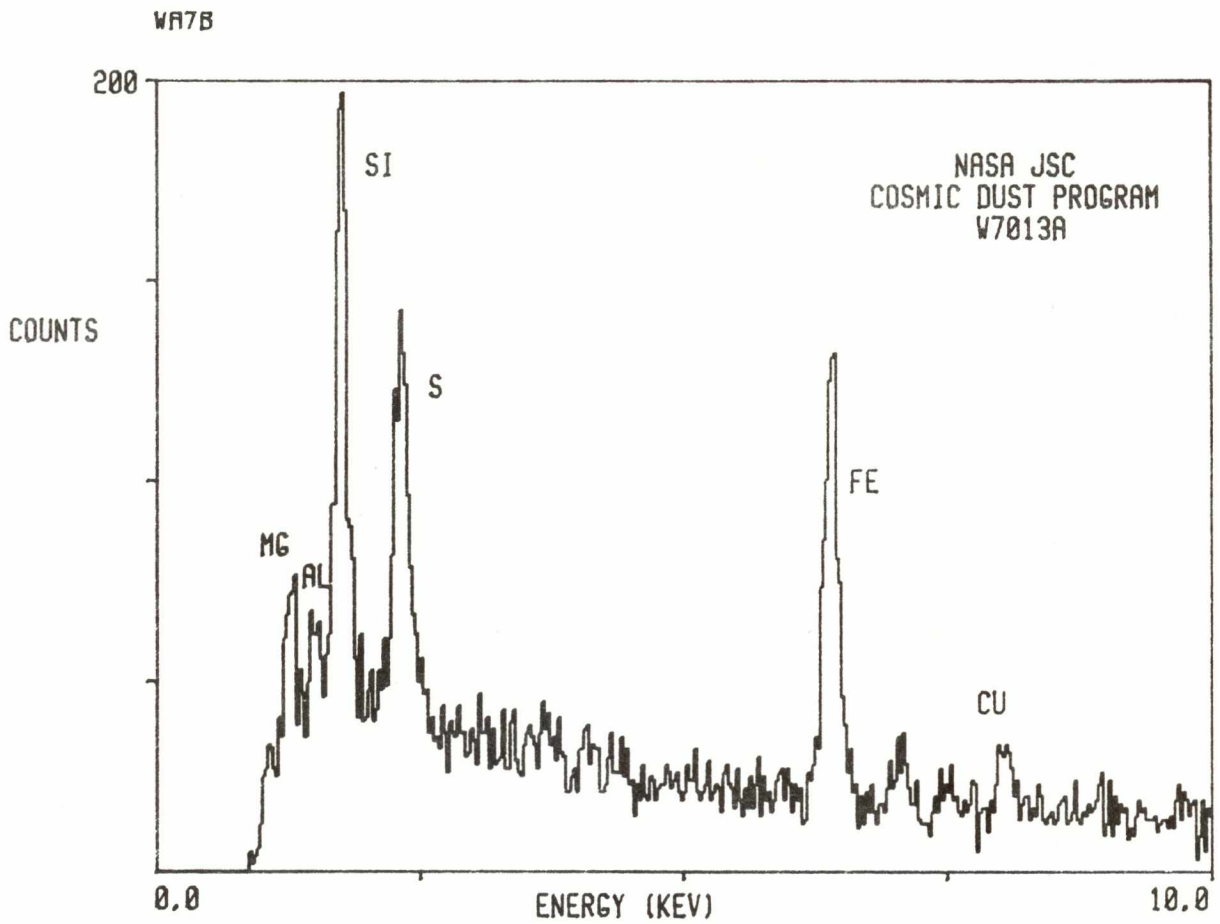


W7013 A 7B

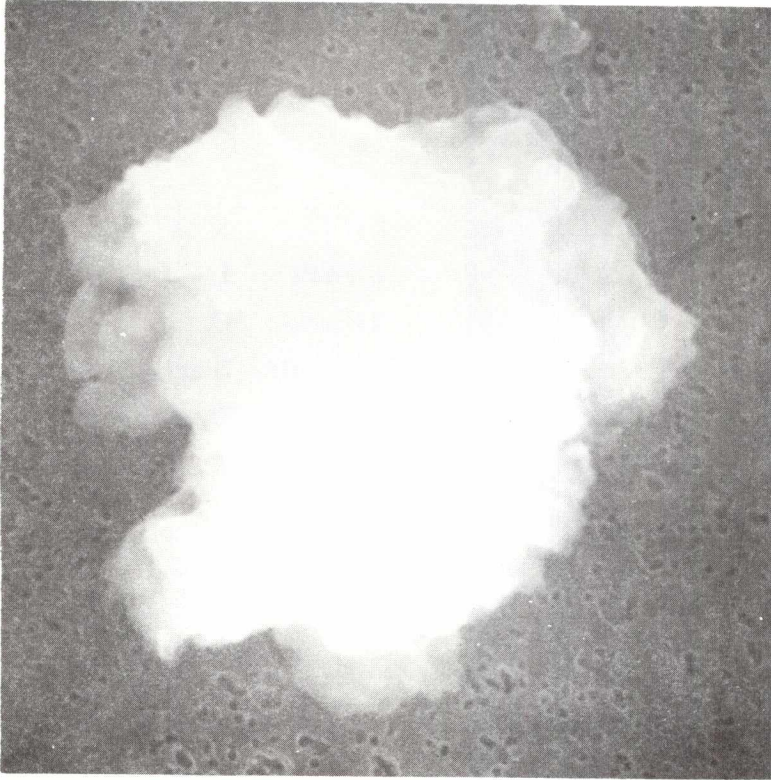


SIZE: 5  
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TRANS.: O  
COLOR: Black  
LUSTER: D/M  
TYPE: C  
COMMENTS:  
Fragment of  
particle A

S-86-40303

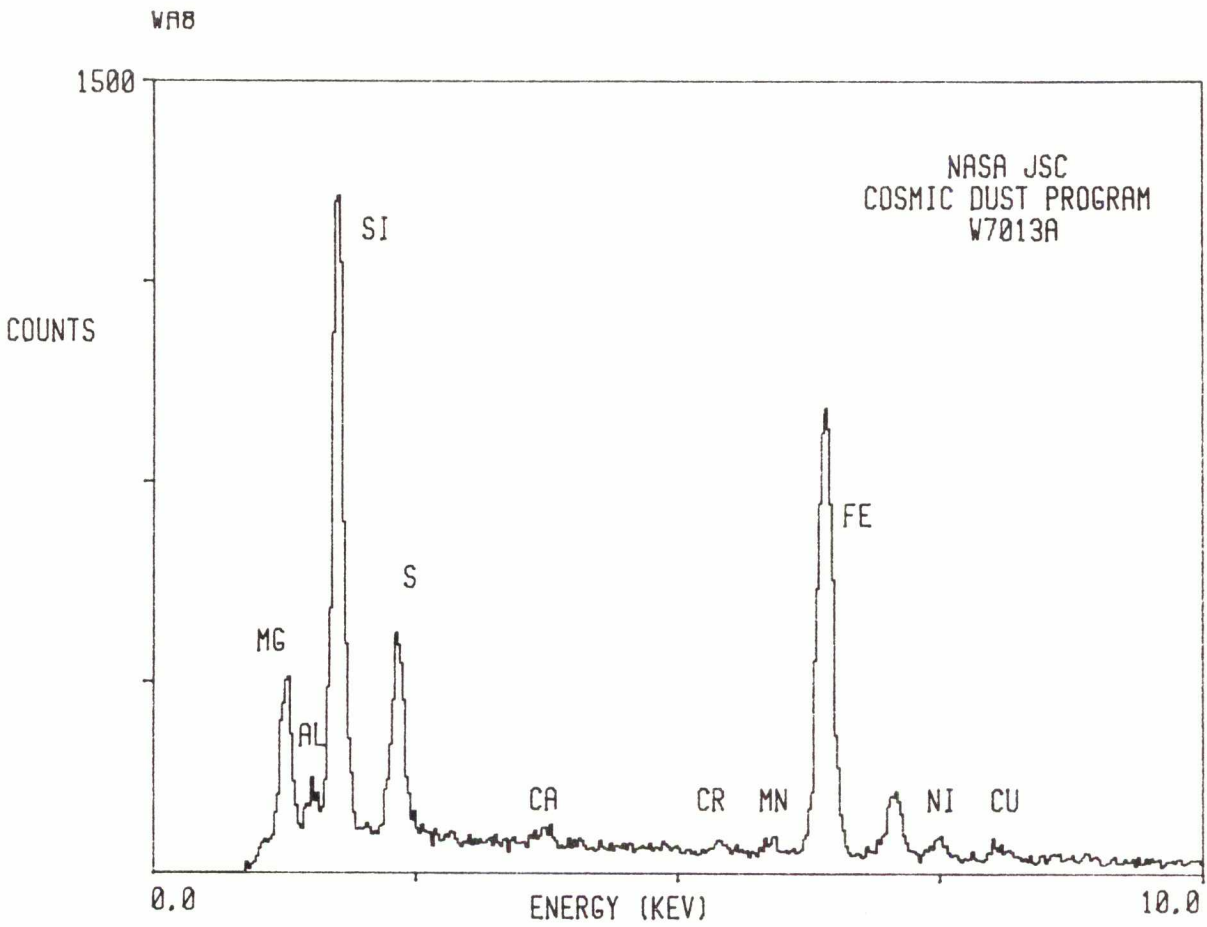


W7013 A 8

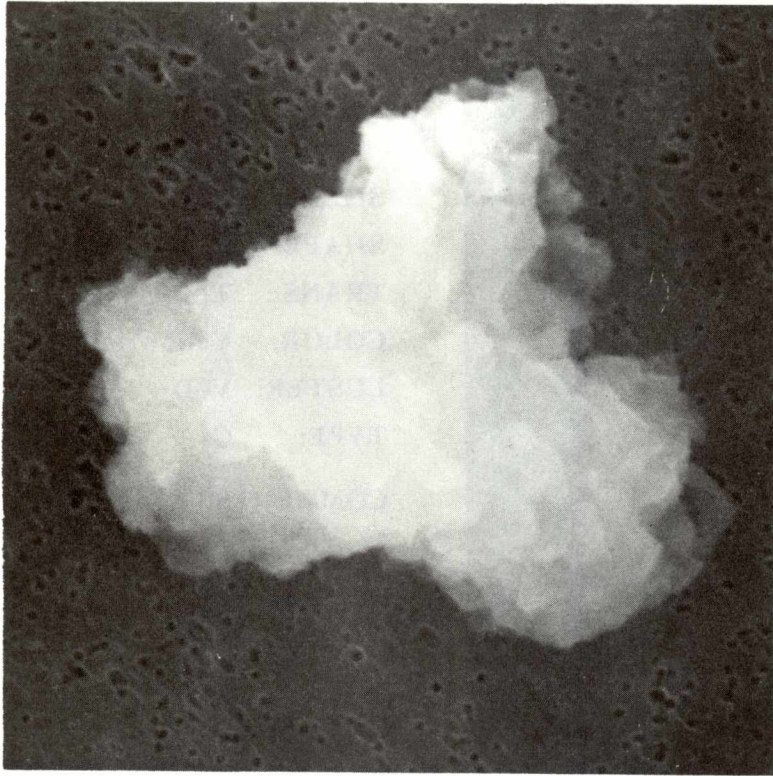


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TRANS.: O  
COLOR: Yellow to black  
LUSTER: D/M  
TYPE: C  
COMMENTS:

S-86-40304



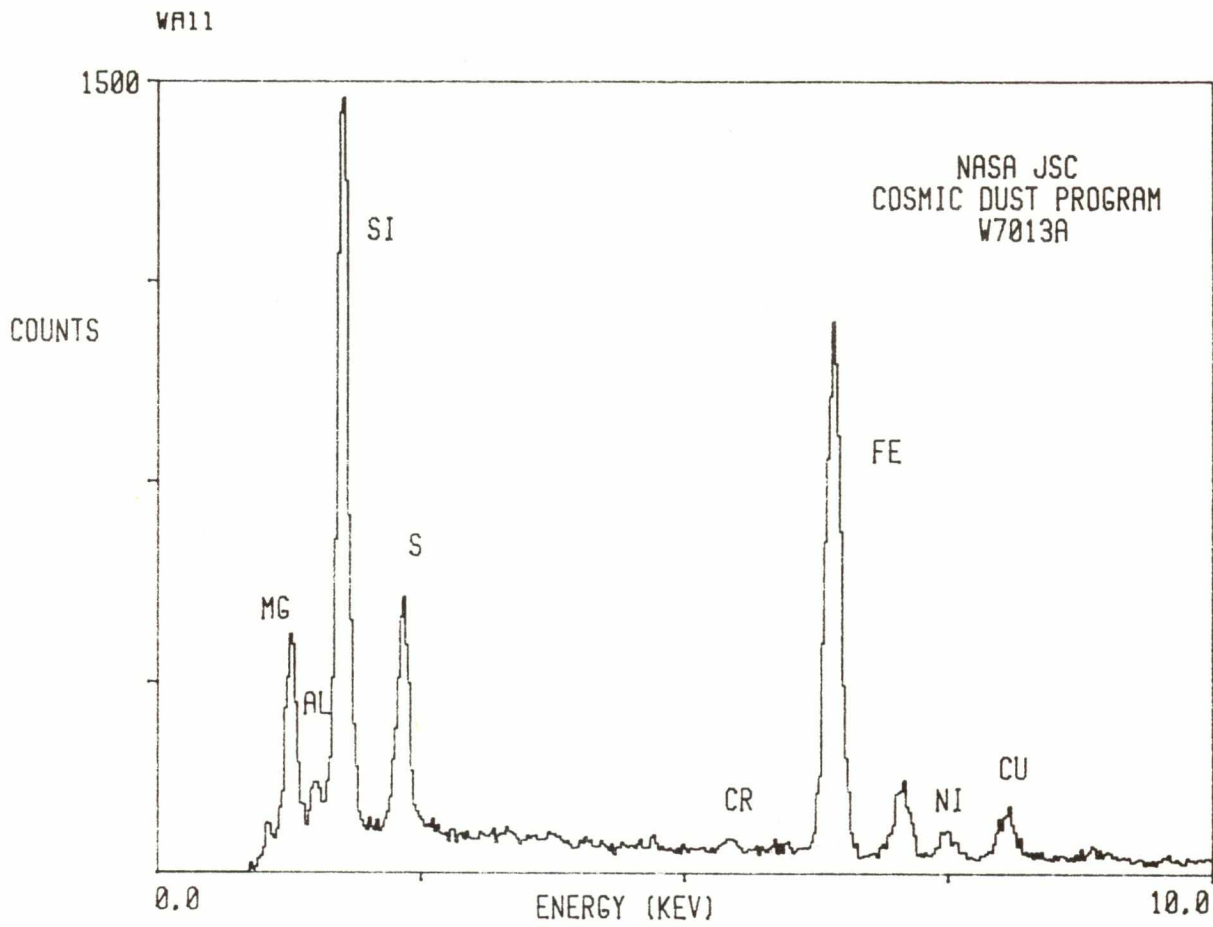
W7013 A 11



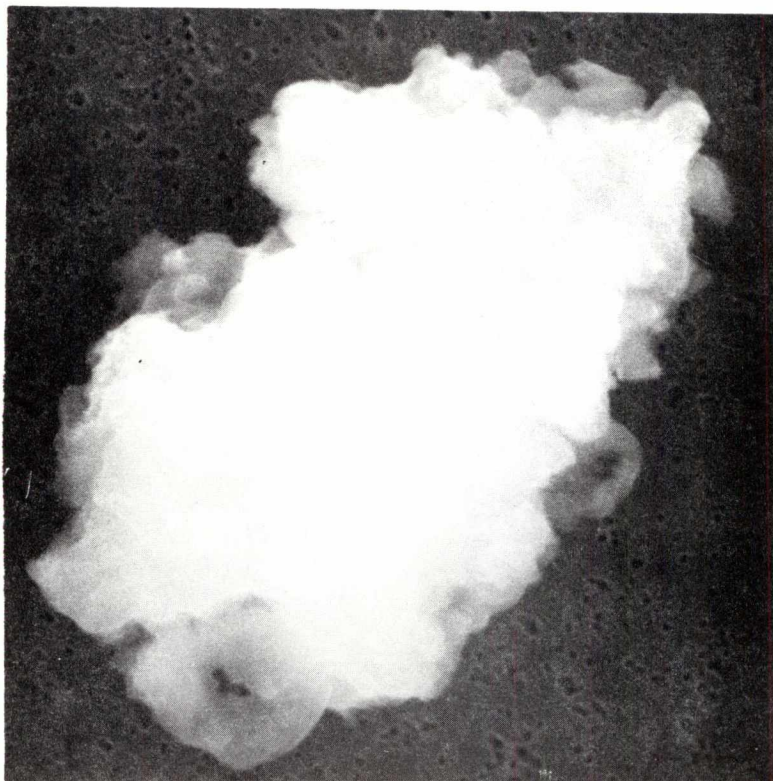
SIZE: 20x19  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: C

COMMENTS:  
Related to  
W7013A12

S-86-40306



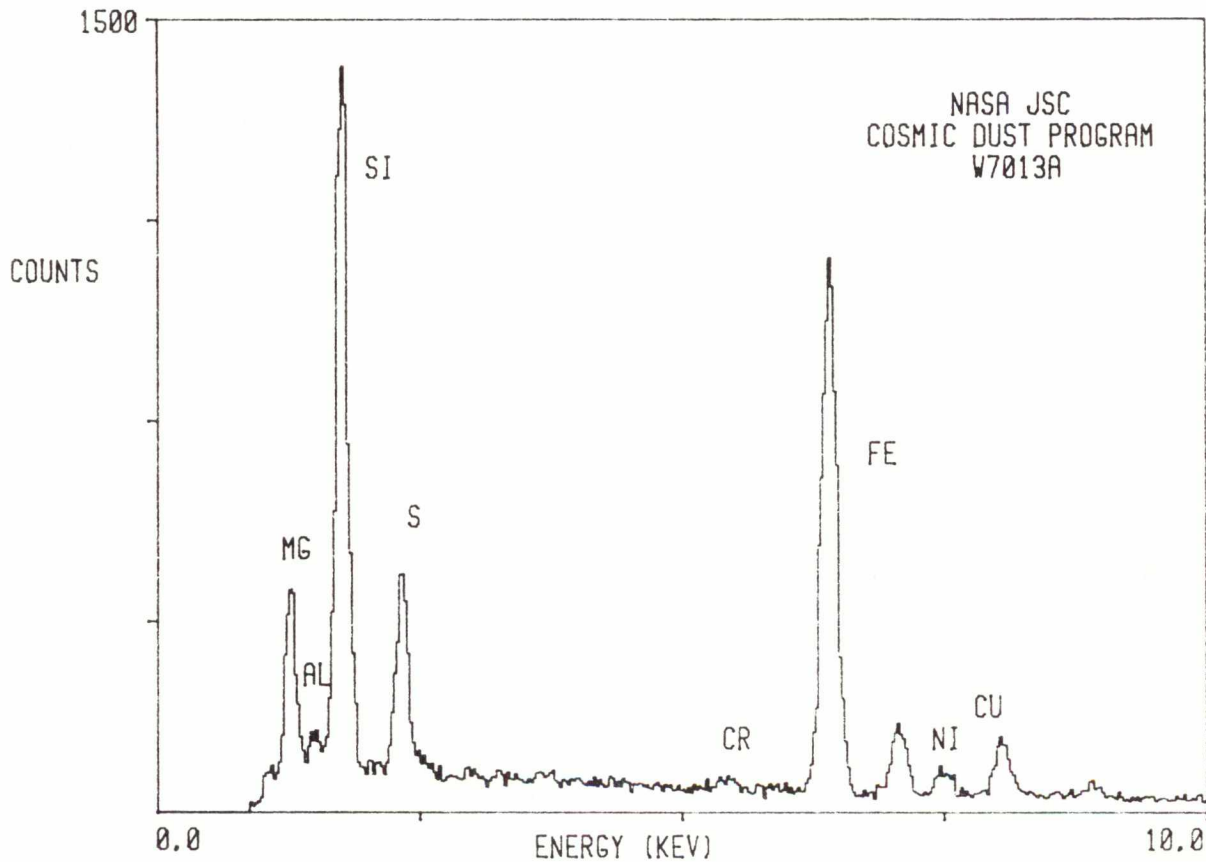
W7013 A 12



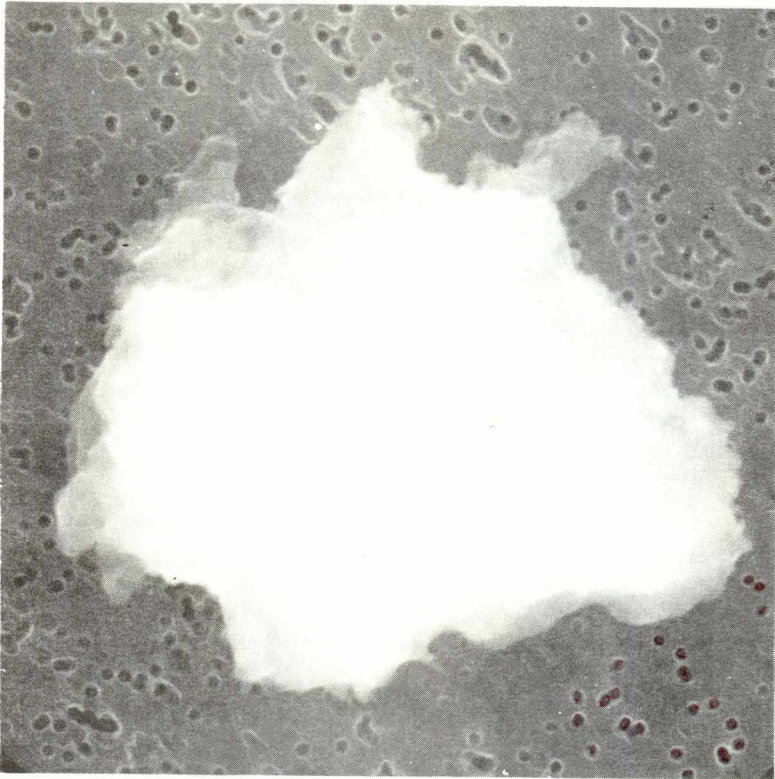
SIZE: 25x18  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: C  
COMMENTS:  
Related to  
W7013A11

S-86-40307

WA12



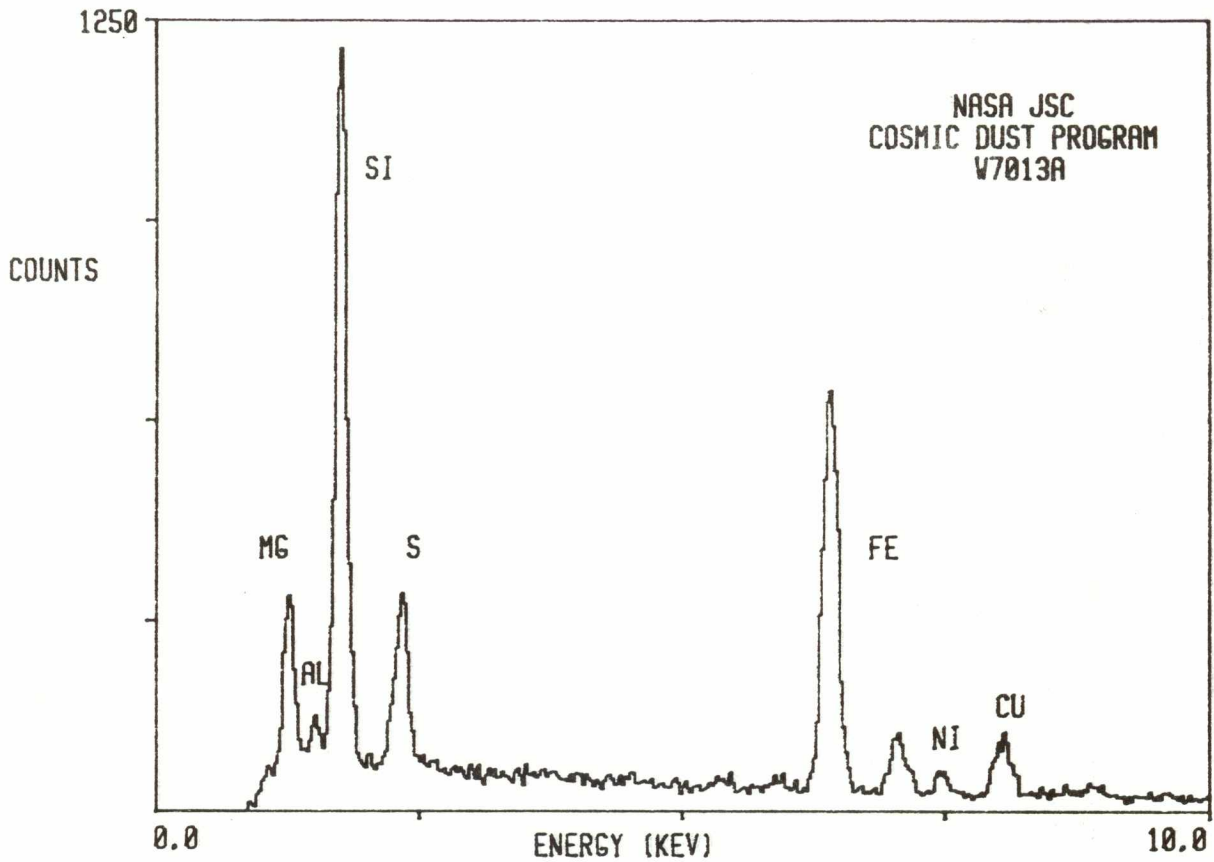
W7013 A 14



SIZE: 15  
SHAPE: E  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: C  
COMMENTS:

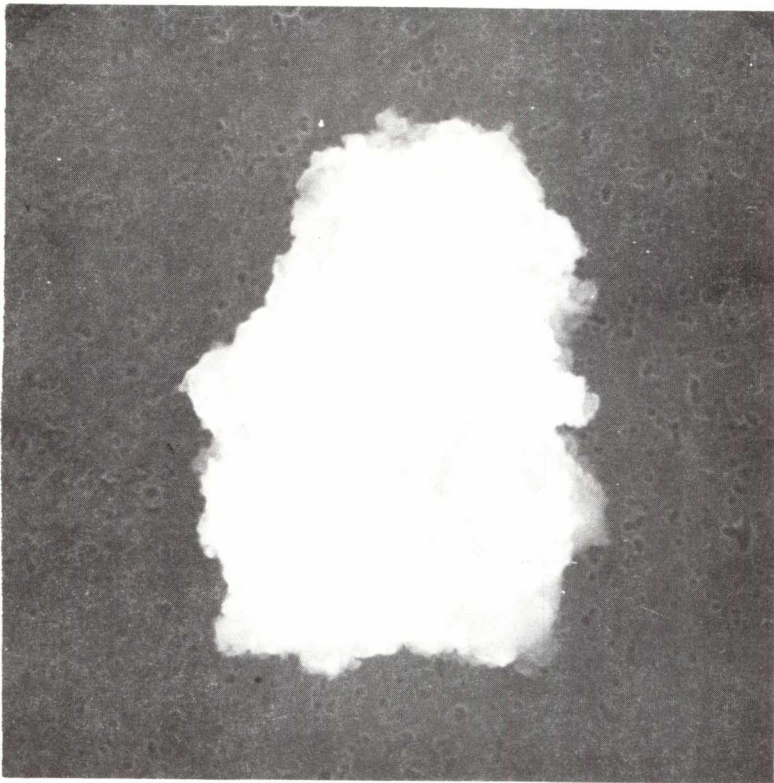
S-86-40309

WA11





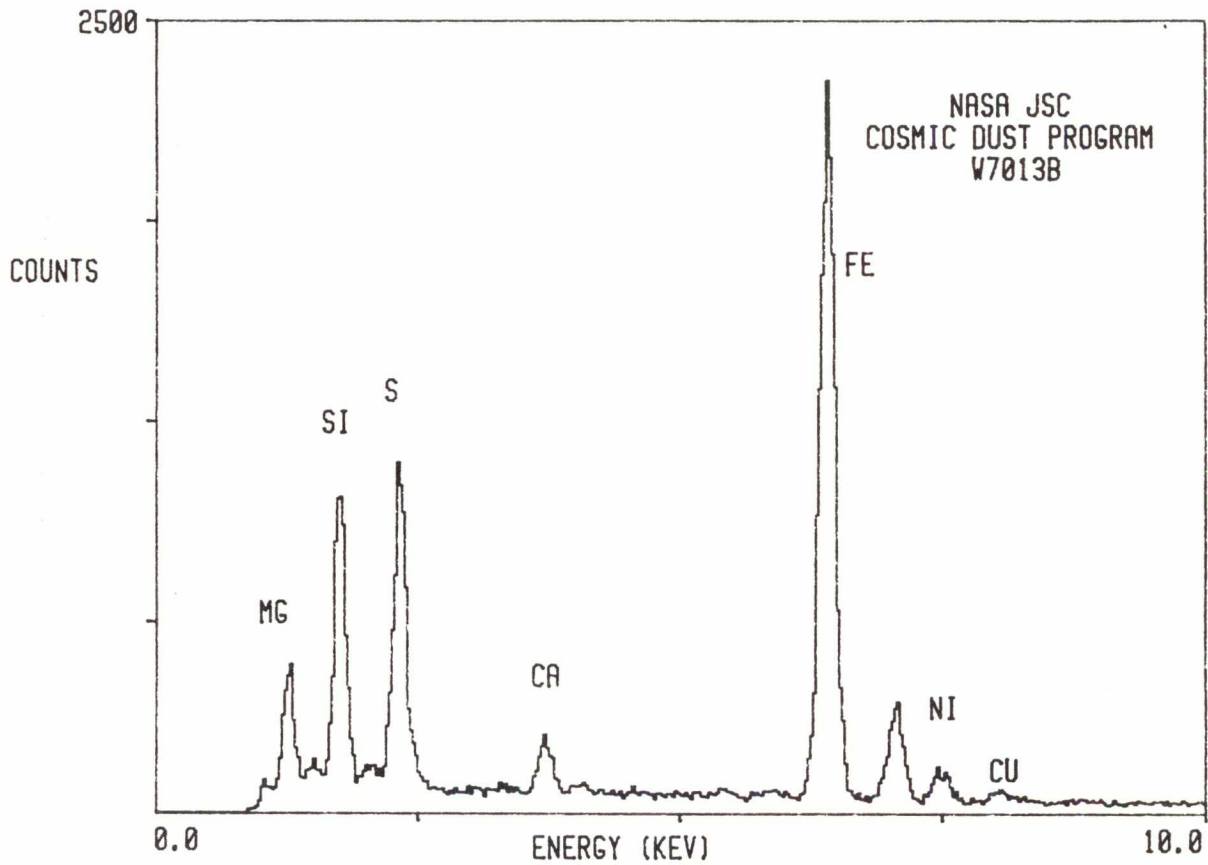
W7013 B 5



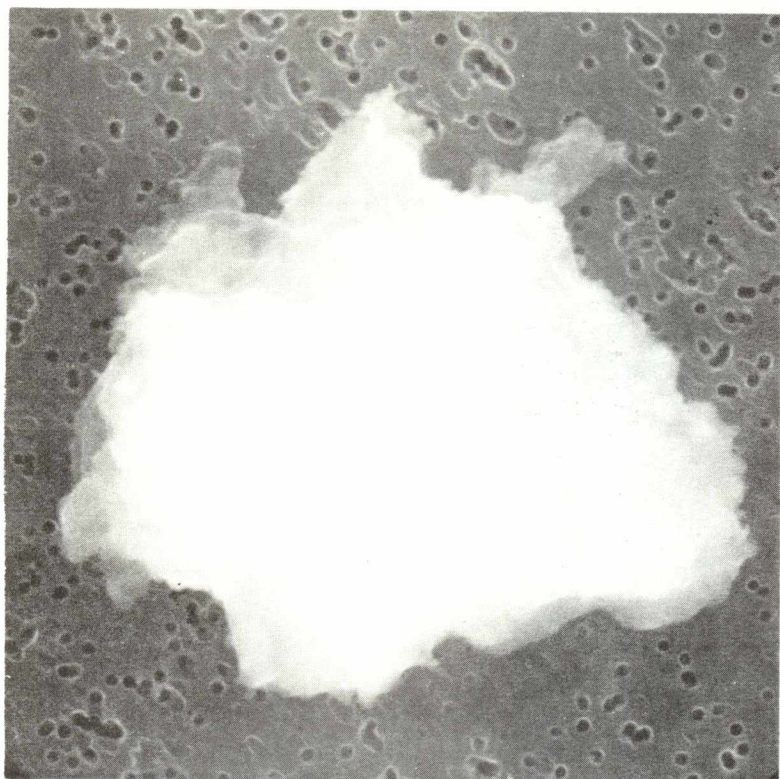
SIZE: 20x12  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: R/M  
TYPE: C?  
COMMENTS:

S-86-40315

WB5

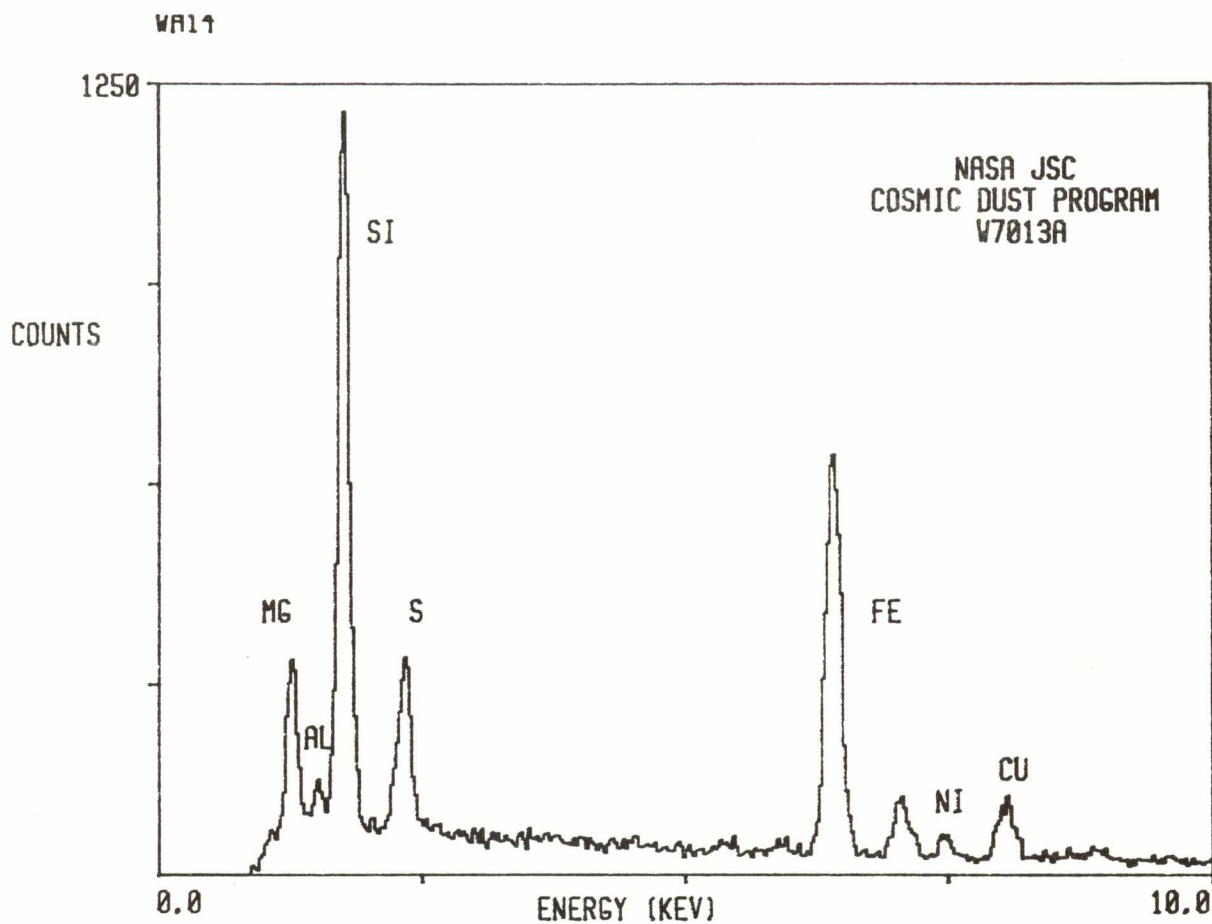


# W7013 A 14

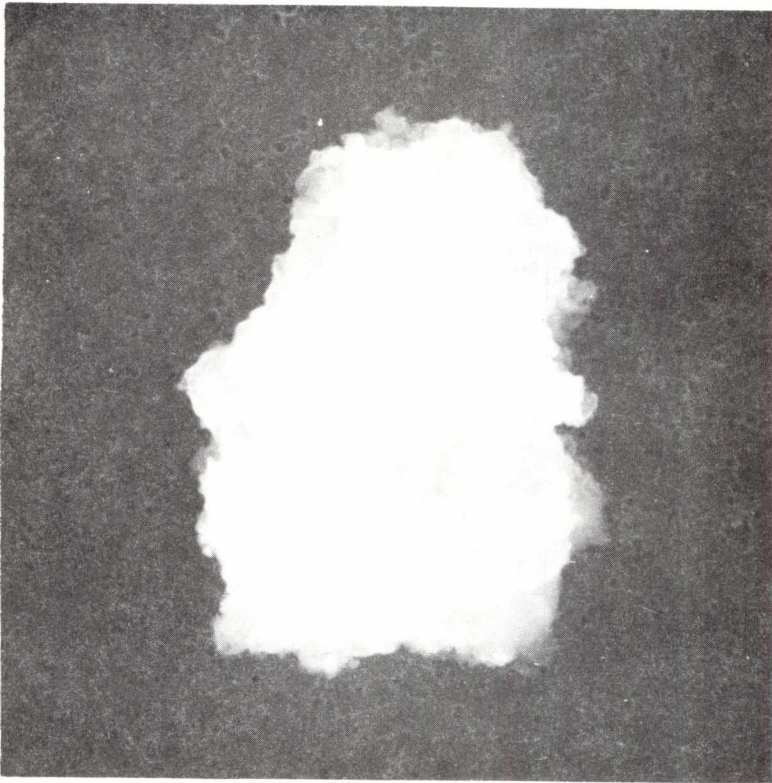


SIZE: 15  
SHAPE: E  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: C  
COMMENTS:

S-86-40309



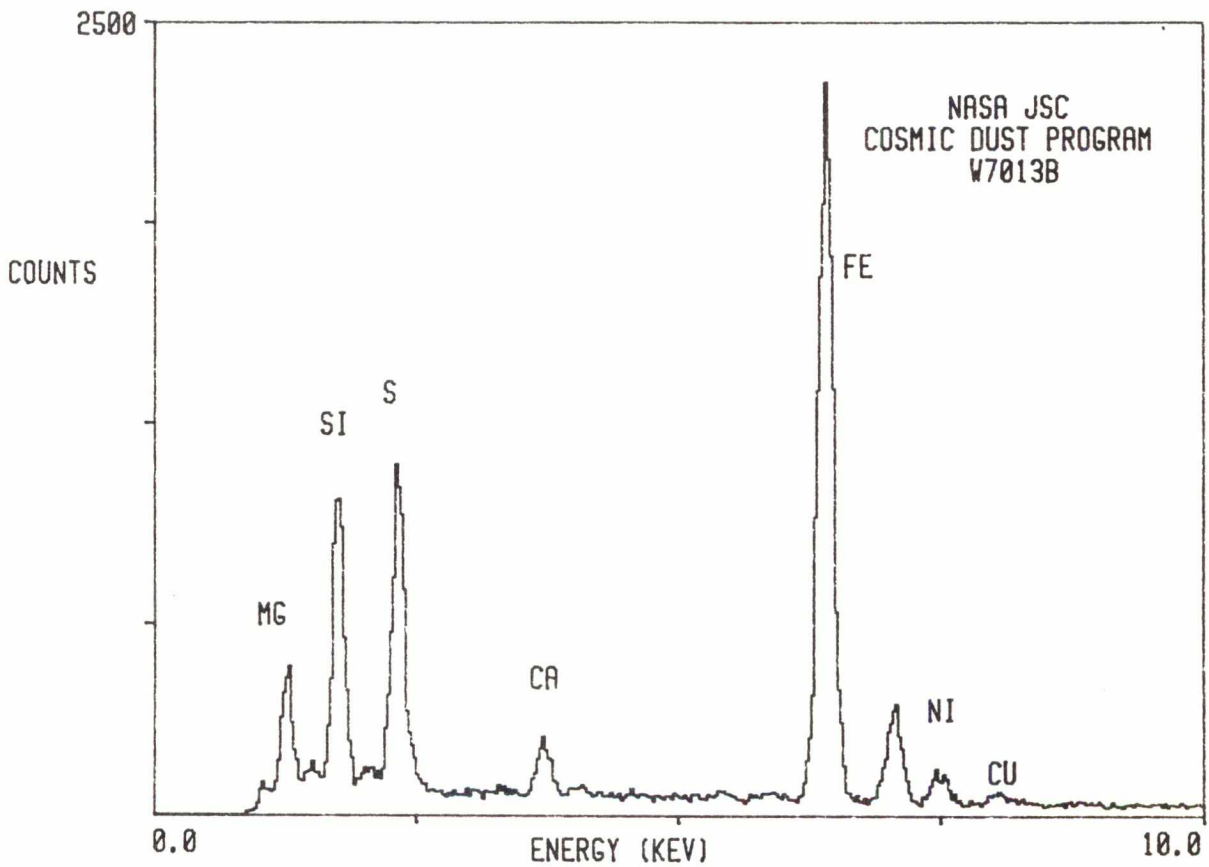
W7013 B 5



SIZE: 20x12  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: R/M  
TYPE: C?  
COMMENTS:

S-86-40315

WB5



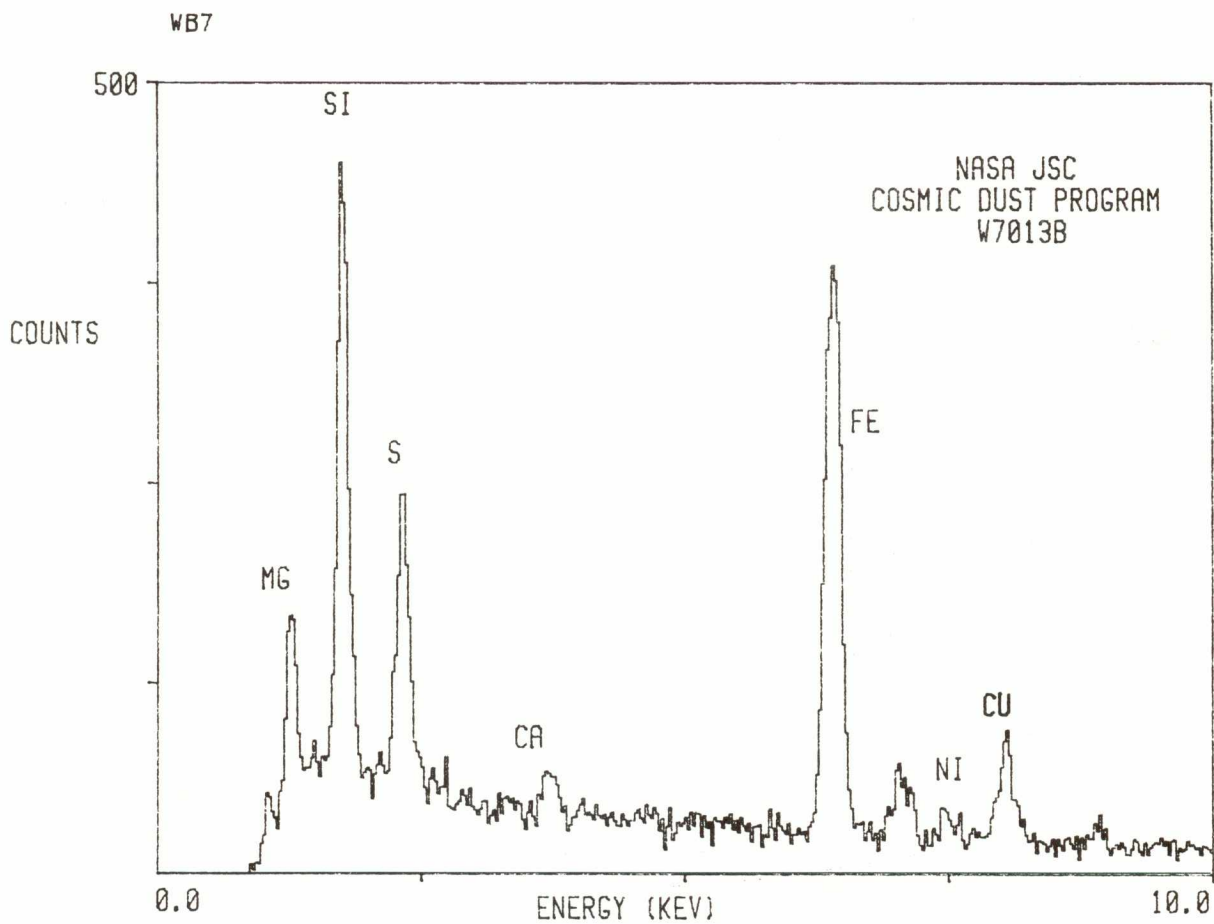
W7013 B 7



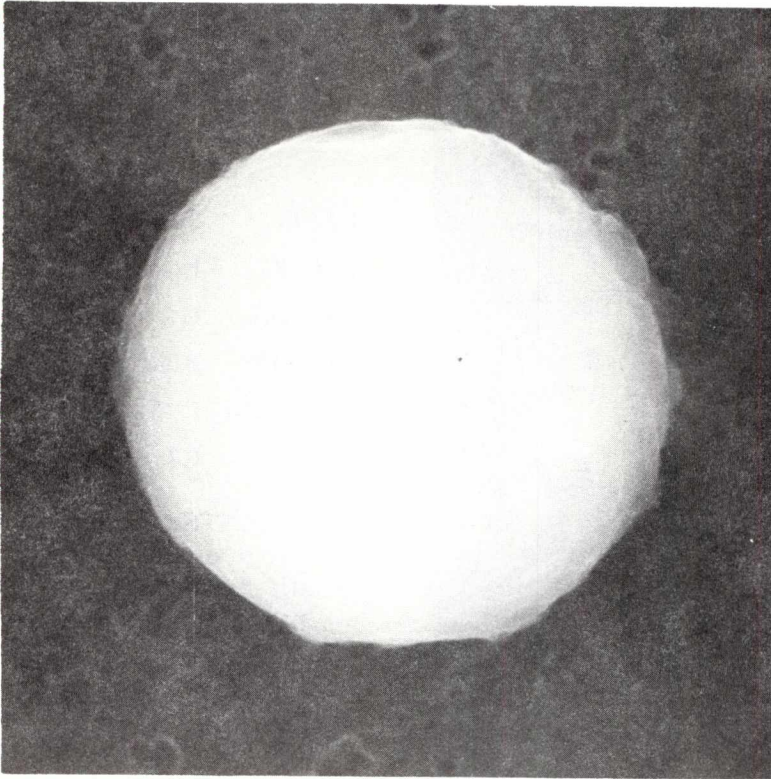
SIZE: 30  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: D/M  
TYPE: C?

COMMENTS:  
Field size of  
disaggregated  
particle

S-86-40317



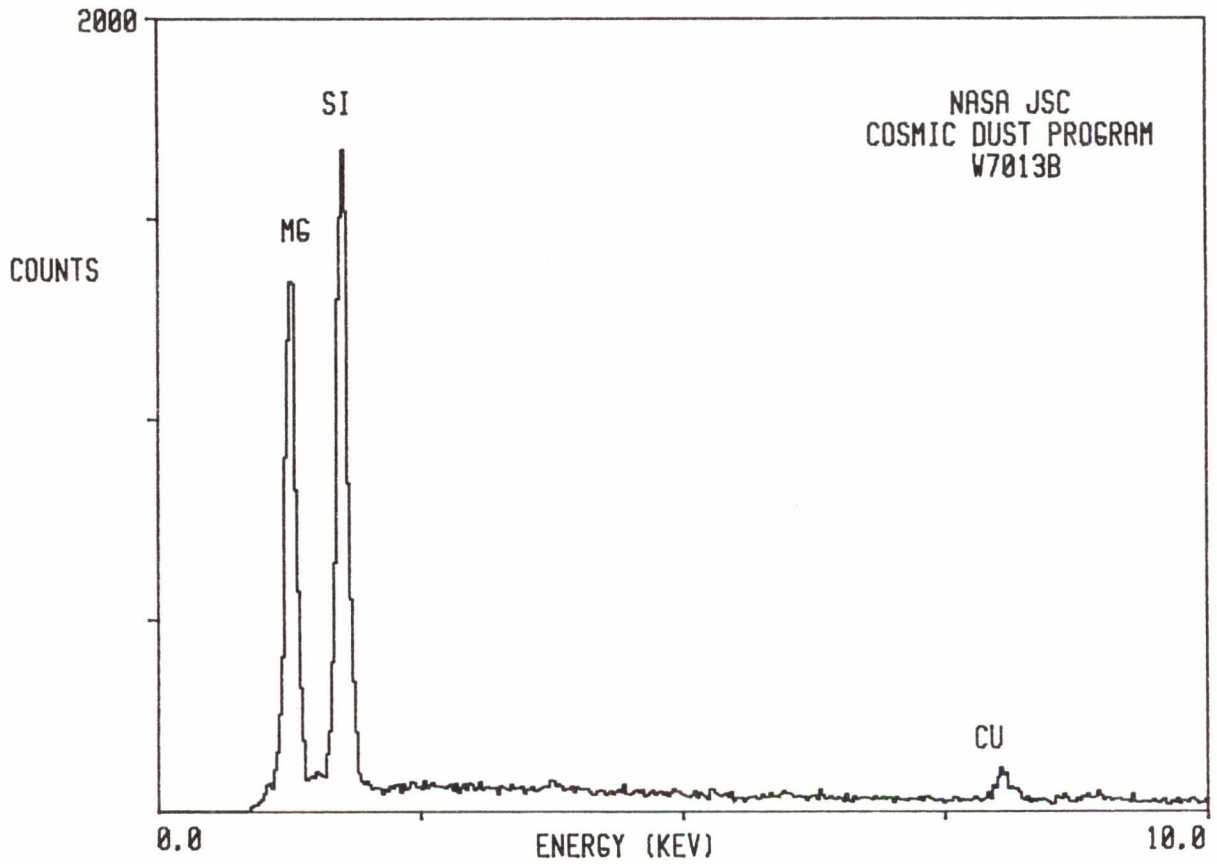
W7013 B 12



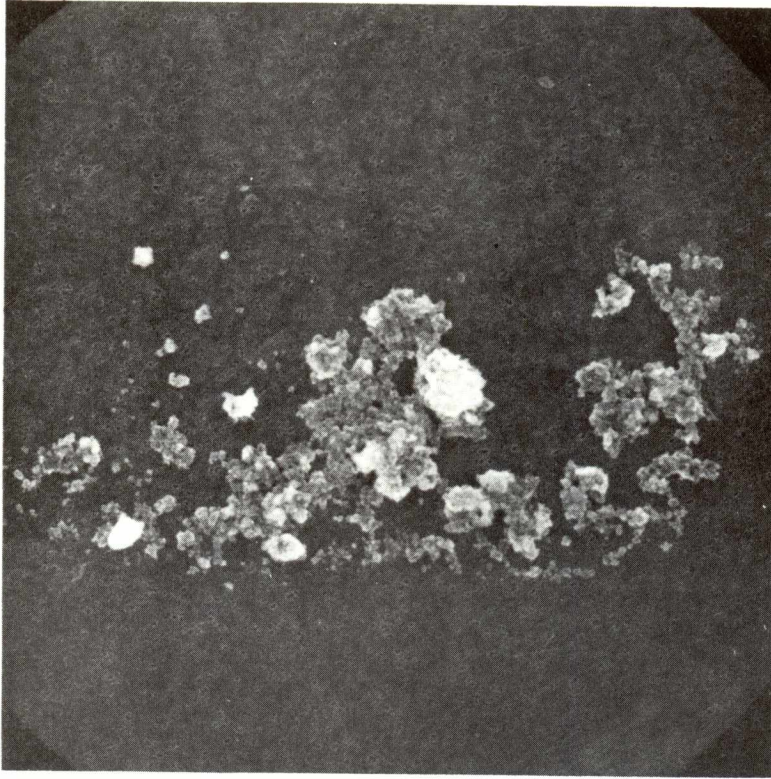
SIZE: 10  
SHAPE: S  
TRANS.: TL/T  
COLOR: Yellow  
LUSTER: V  
TYPE: C?  
COMMENTS:

S-86-40322

WB12



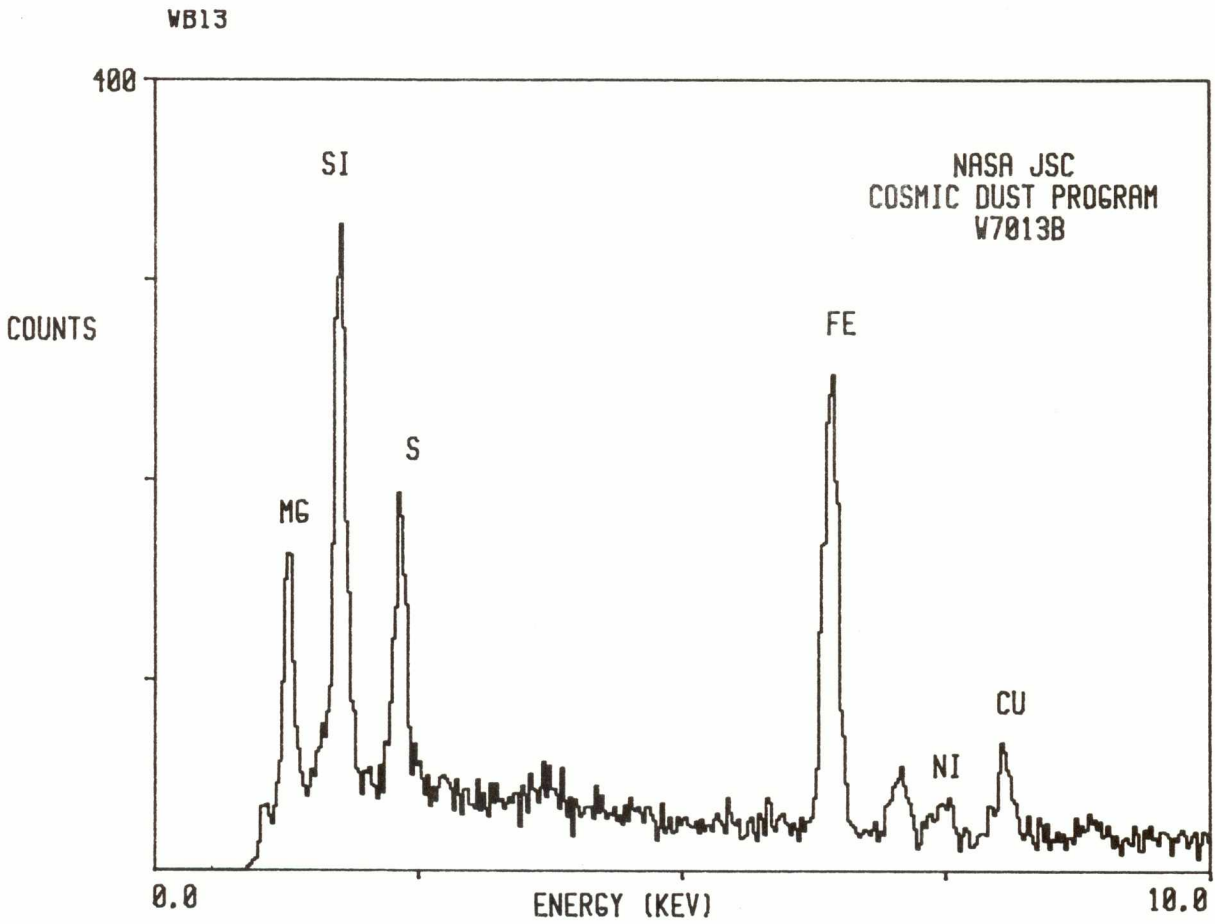
W7013 B 13



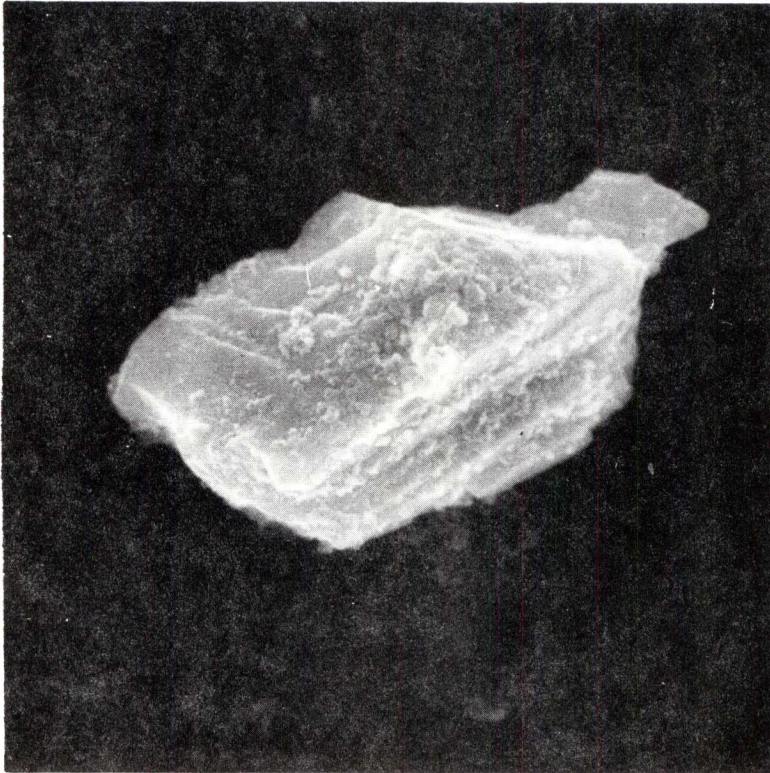
SIZE: 70X50  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: C?

COMMENTS:  
Field size of  
disaggregated  
particle

S-86-40323



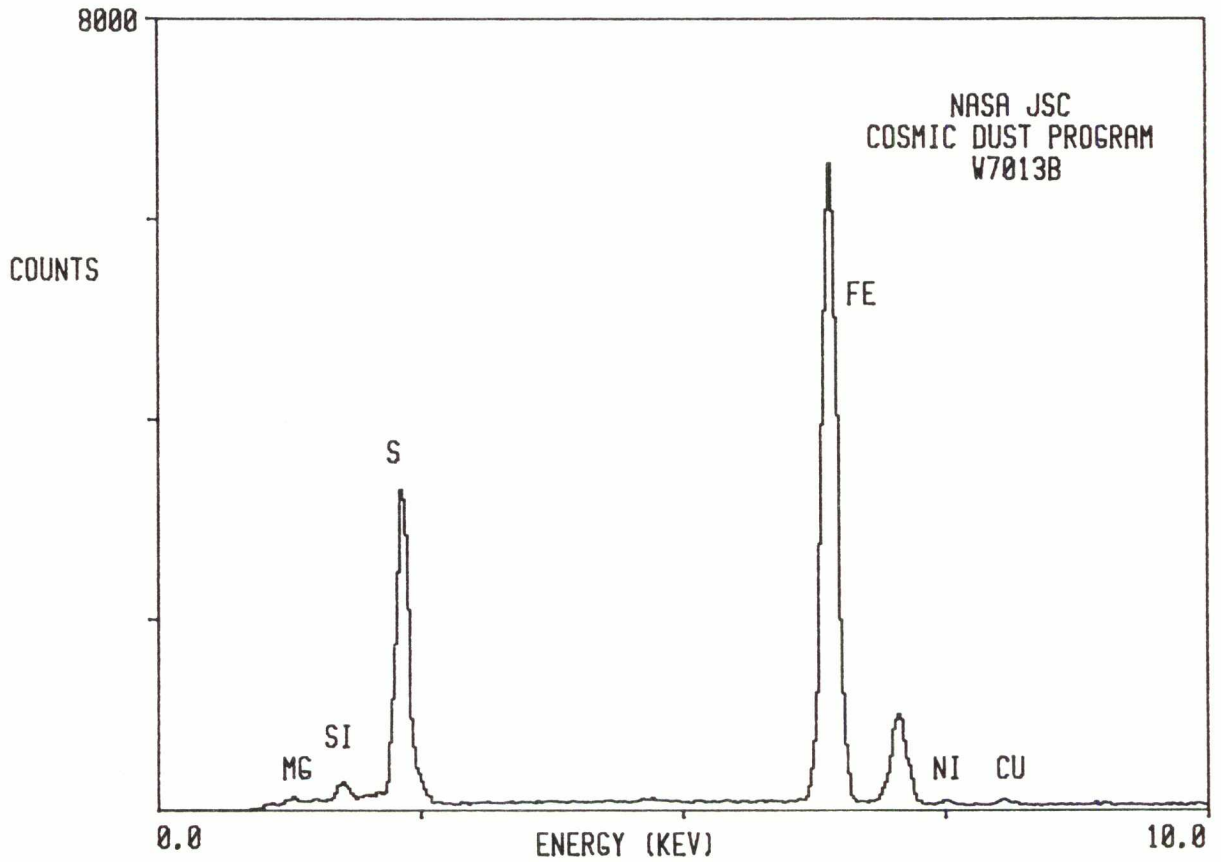
W7013 B 14



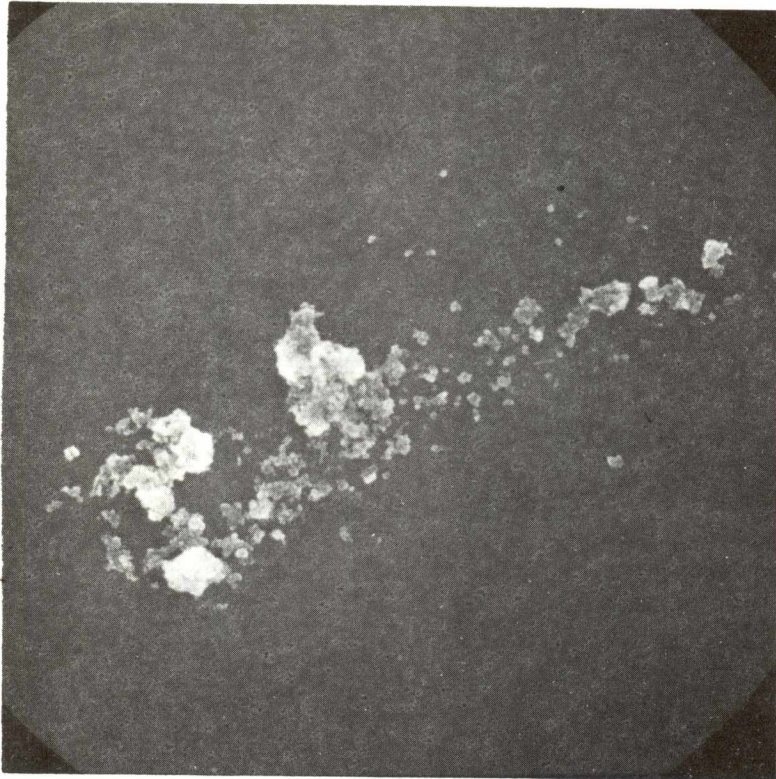
SIZE: 30x20  
SHAPE: I  
TRANS.: O  
COLOR: Yellow to black  
LUSTER: M/D  
TYPE: C?  
COMMENTS:  
Large grain  
surrounded by  
smaller fragments

S-86-40324

WB11



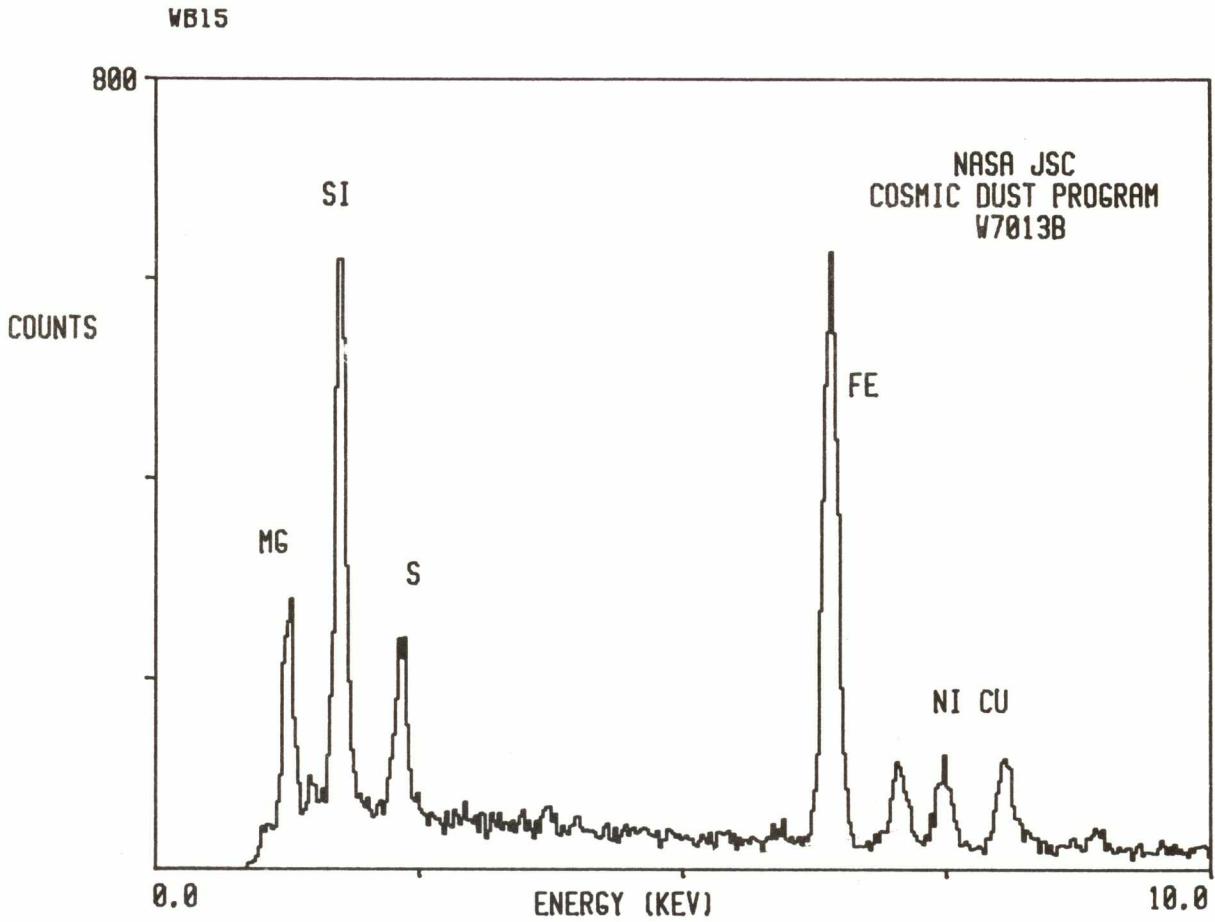
W7013 B 15



SIZE: 80x30  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: C

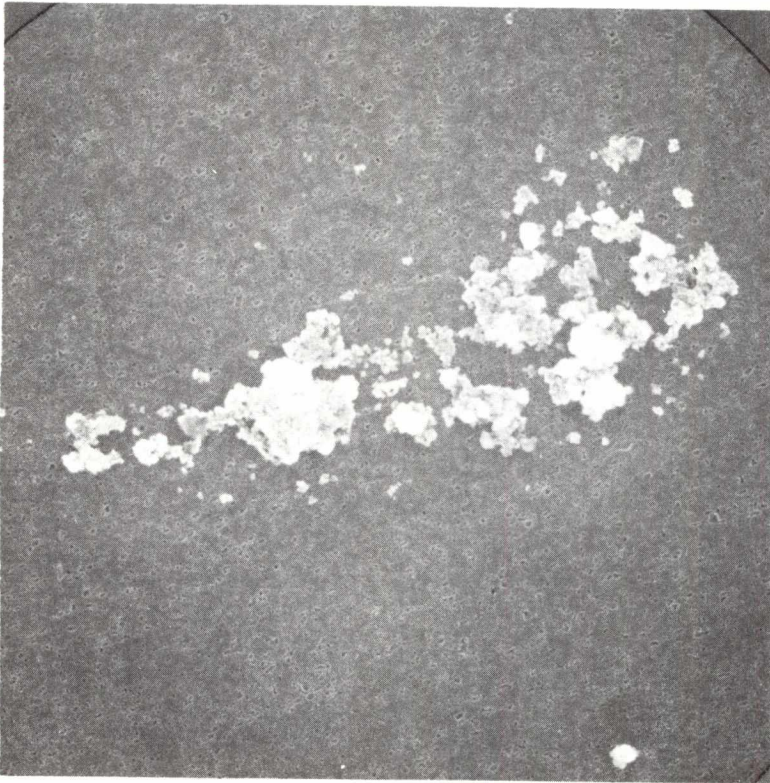
COMMENTS:  
Field size of  
fragmented cosmic  
aggregate,  
comprised mainly  
of 3 grains. May  
be related to  
W7013B16

S-86-40325





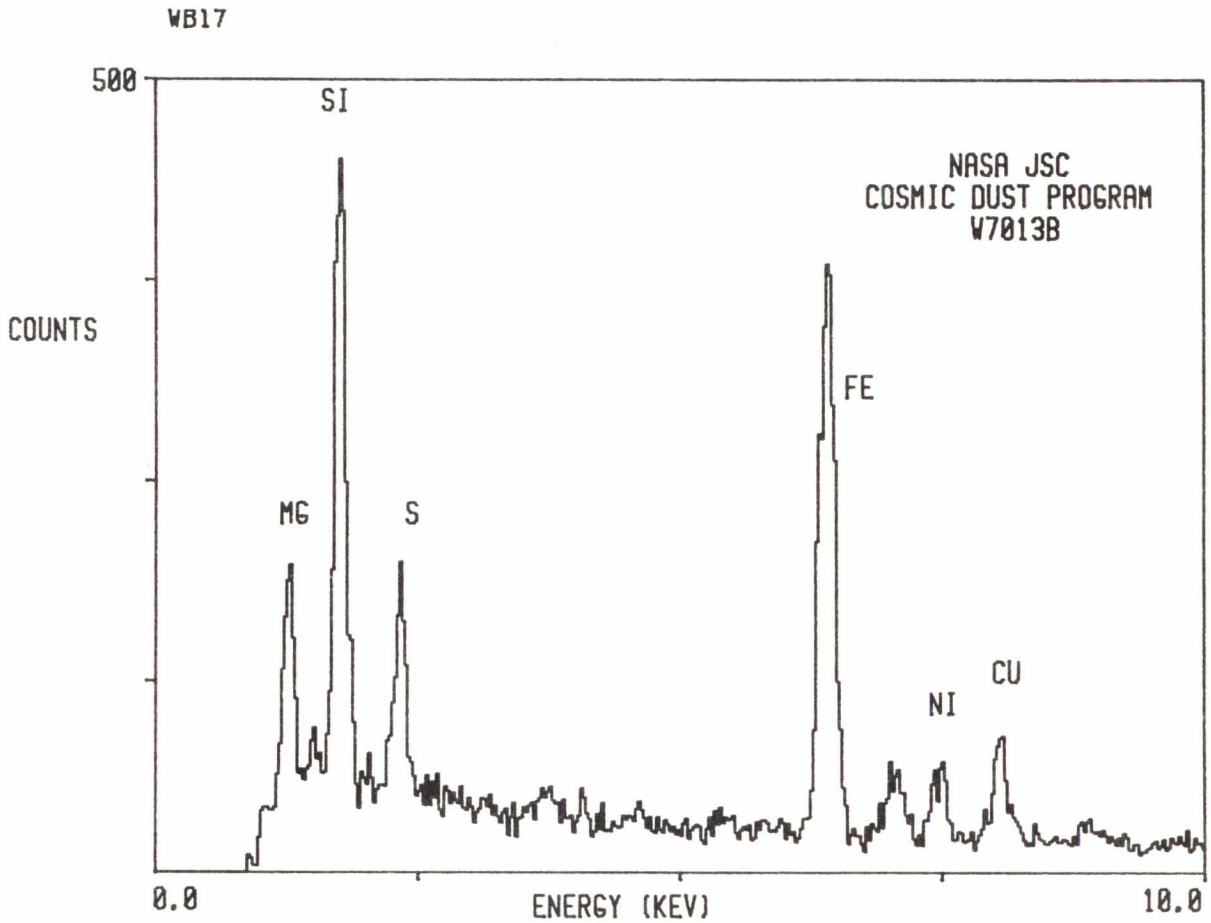
W7013 B 17



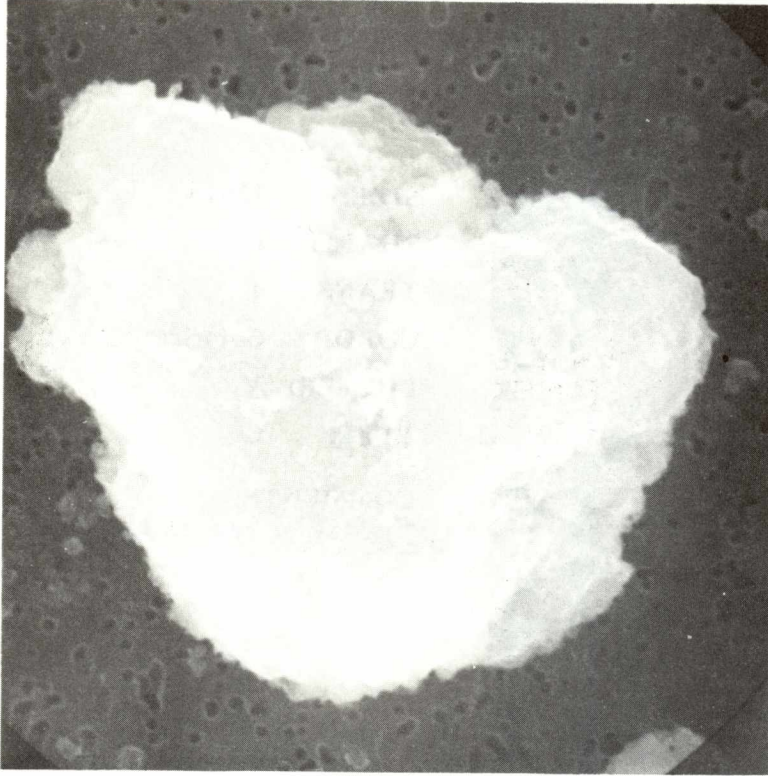
SIZE: 70x20  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: C

COMMENTS:  
Large field of a  
fragmented  
aggregate

S-86-40327



W7013 C 1



SIZE: 20x15

SHAPE: I

TRANS.: O

COLOR: Black

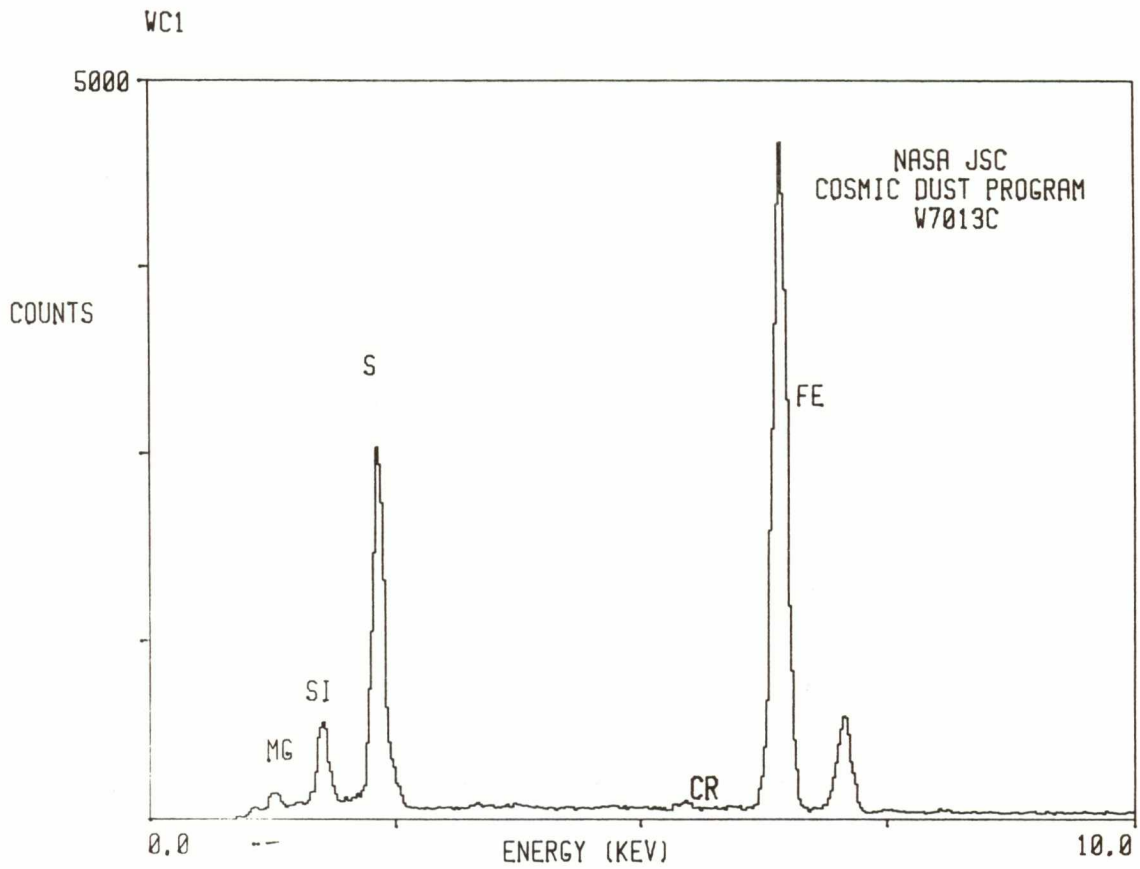
LUSTER: SM/D

TYPE: C

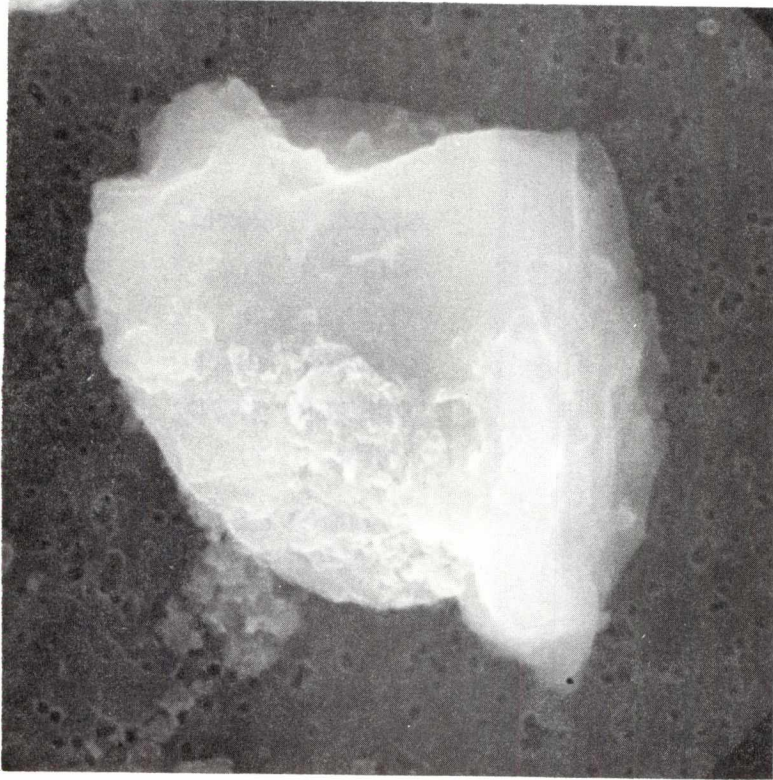
COMMENTS:

May be related to  
W7013C2

S-86-40328



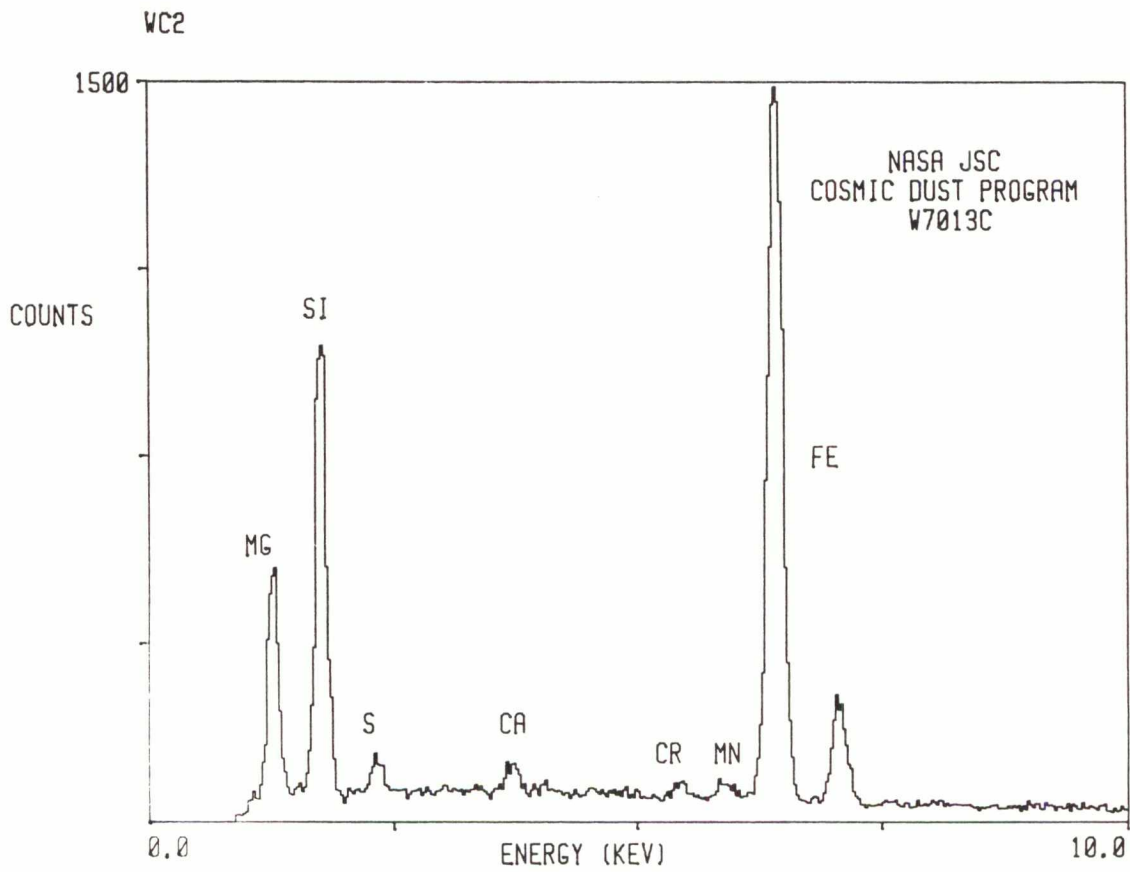
W7013 C 2



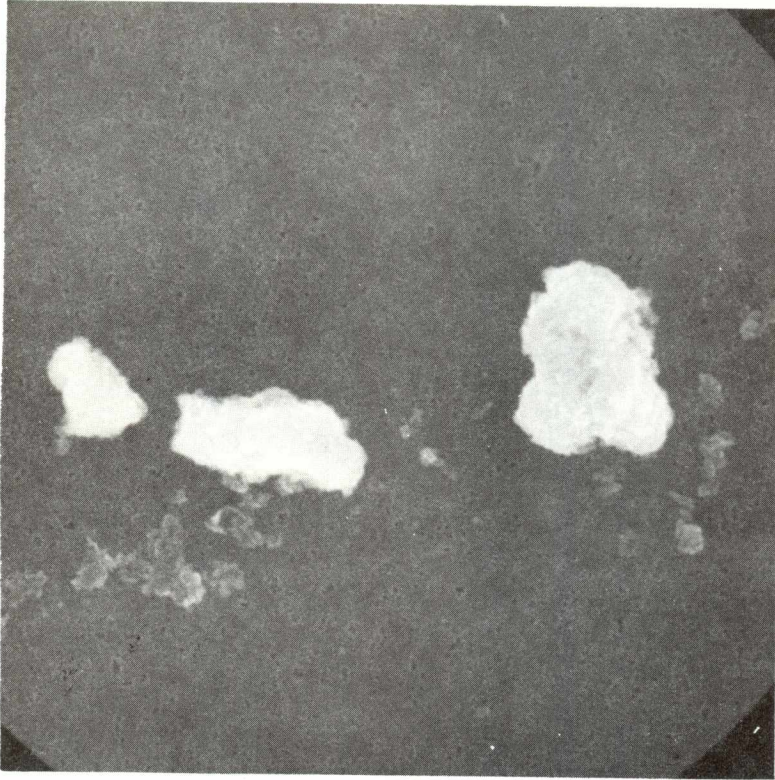
SIZE: 18x10  
SHAPE: I  
TRANS.: T  
COLOR: Colorless  
LUSTER: V  
TYPE: C

COMMENTS:  
May be related to  
W7013C1

S-86-40329



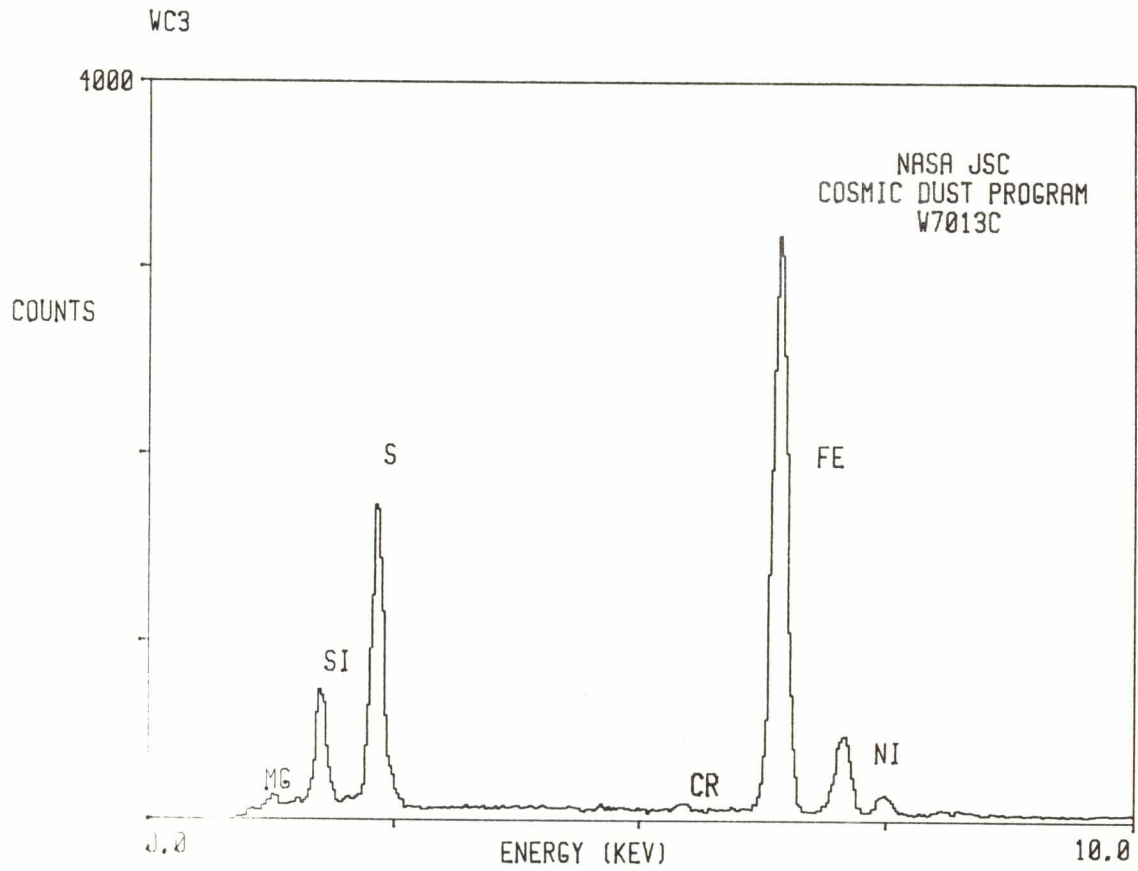
W7013 C 3



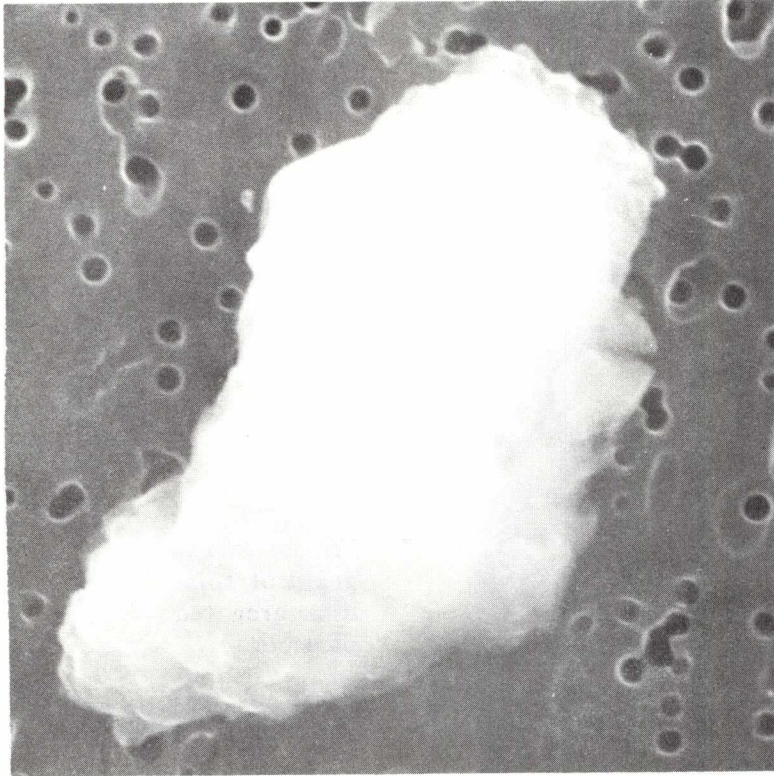
SIZE: 15x10  
SHAPE: I  
TRANS.: TL/O  
COLOR: Black  
LUSTER: SM/D  
TYPE: C

COMMENTS:  
Size of largest  
grain of this  
disaggregated  
particle

S-86-40330

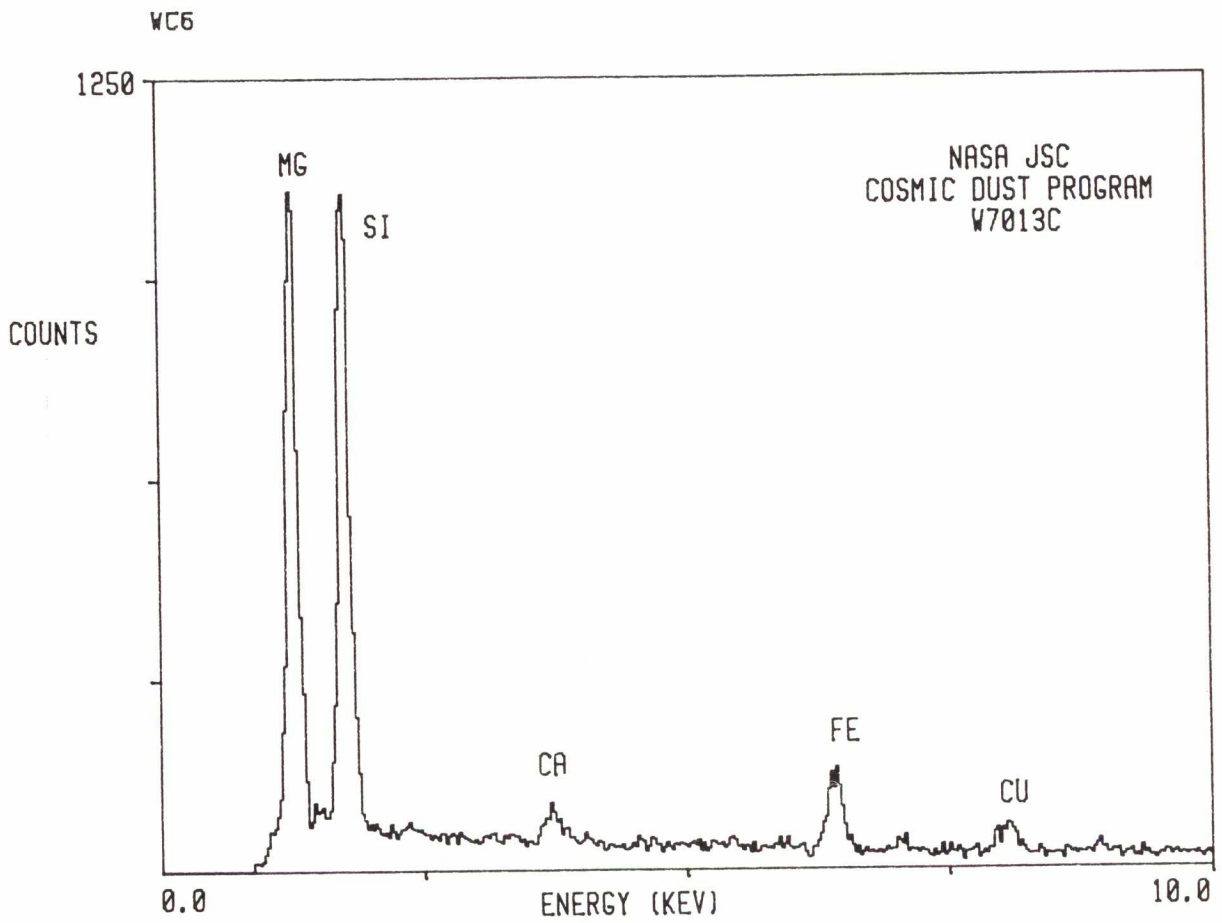


W7013 C 6

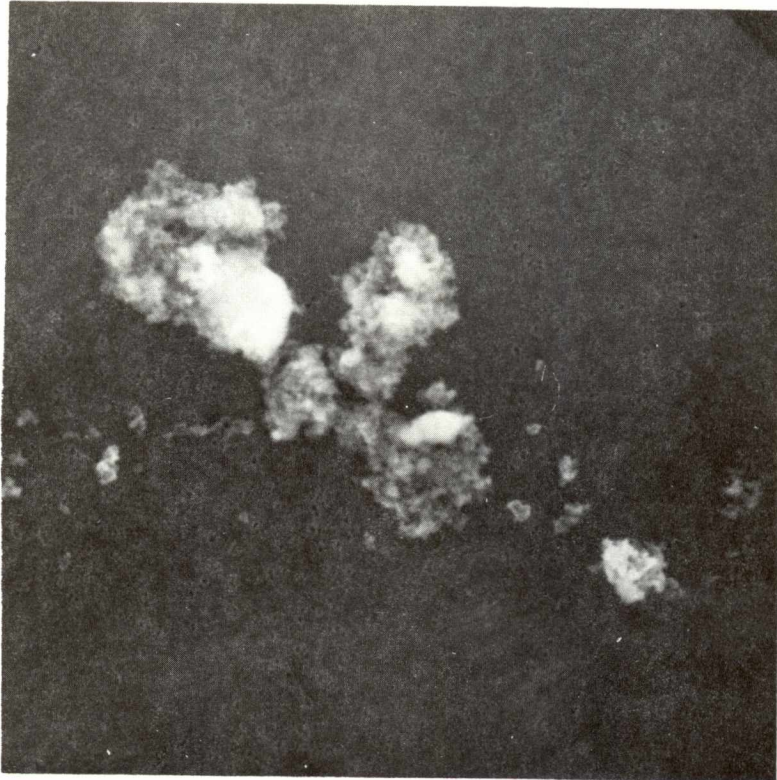


SIZE: 50x40  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/D  
TYPE: C?  
COMMENTS:

S-86-40332



W7013 C 16



SIZE: 25x20

SHAPE: I

TRANS.: O

COLOR: Black

LUSTER: SM/D

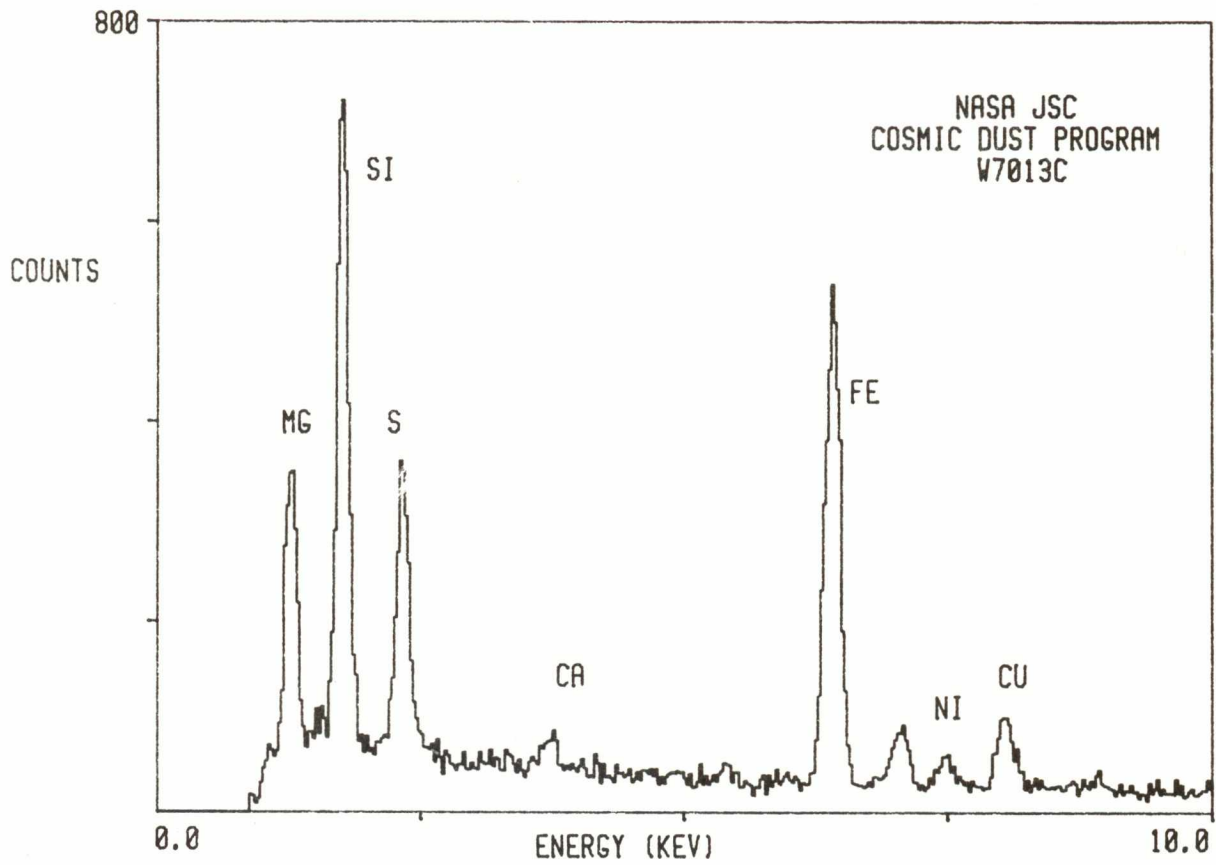
TYPE: C

COMMENTS:

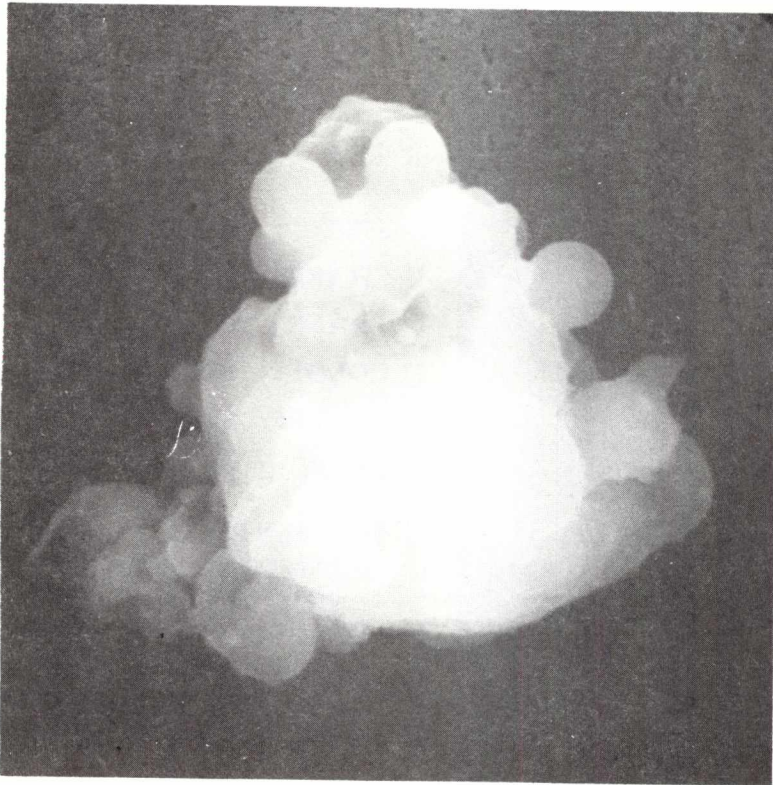
Largest grain size  
of fragmented  
aggregate

S-86-40339

WC16

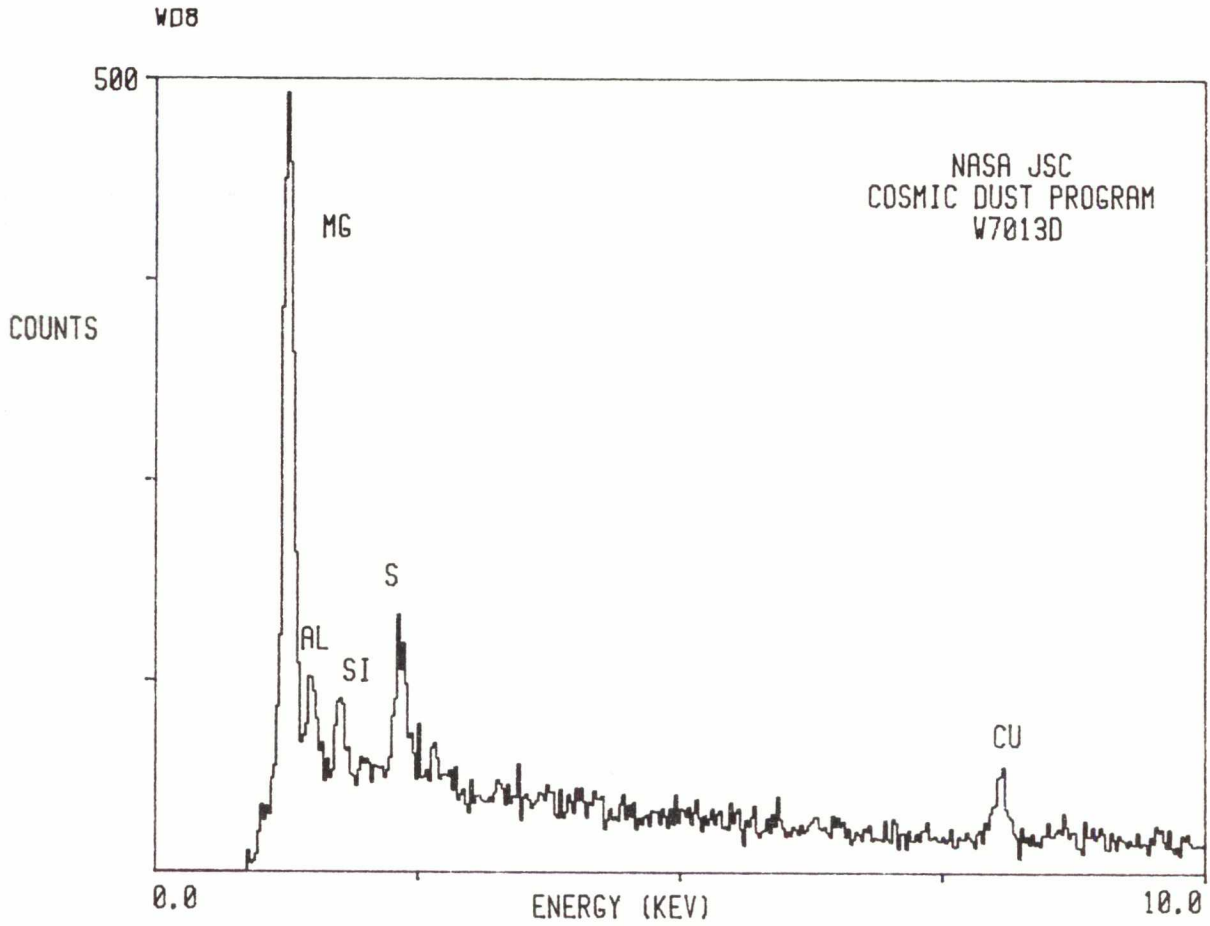


W7013 D 8

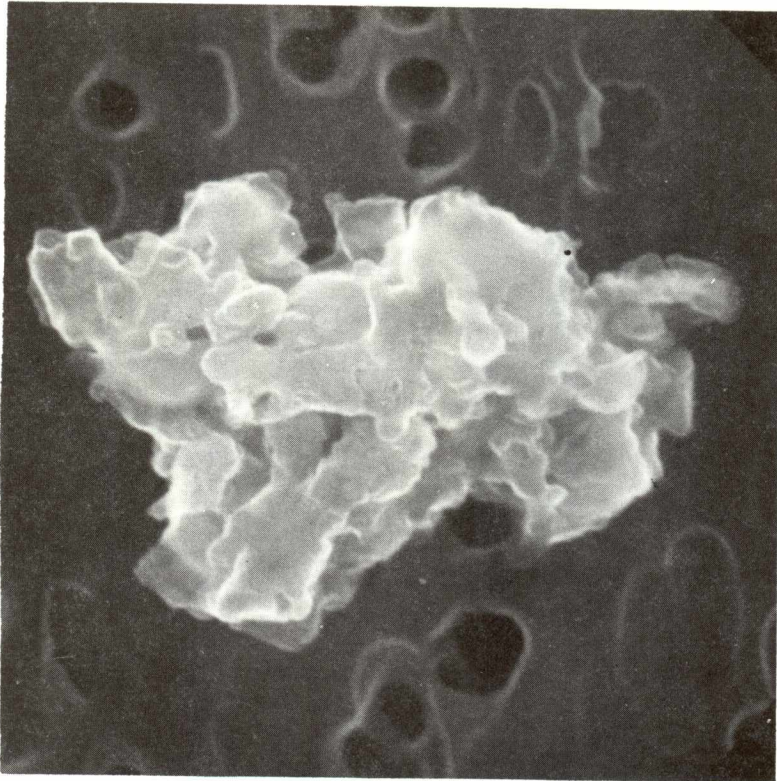


SIZE: 25  
SHAPE: I  
TRANS.: TL/T  
COLOR: Yellow  
LUSTER: V  
TYPE: C?  
COMMENTS:

S-86-40344



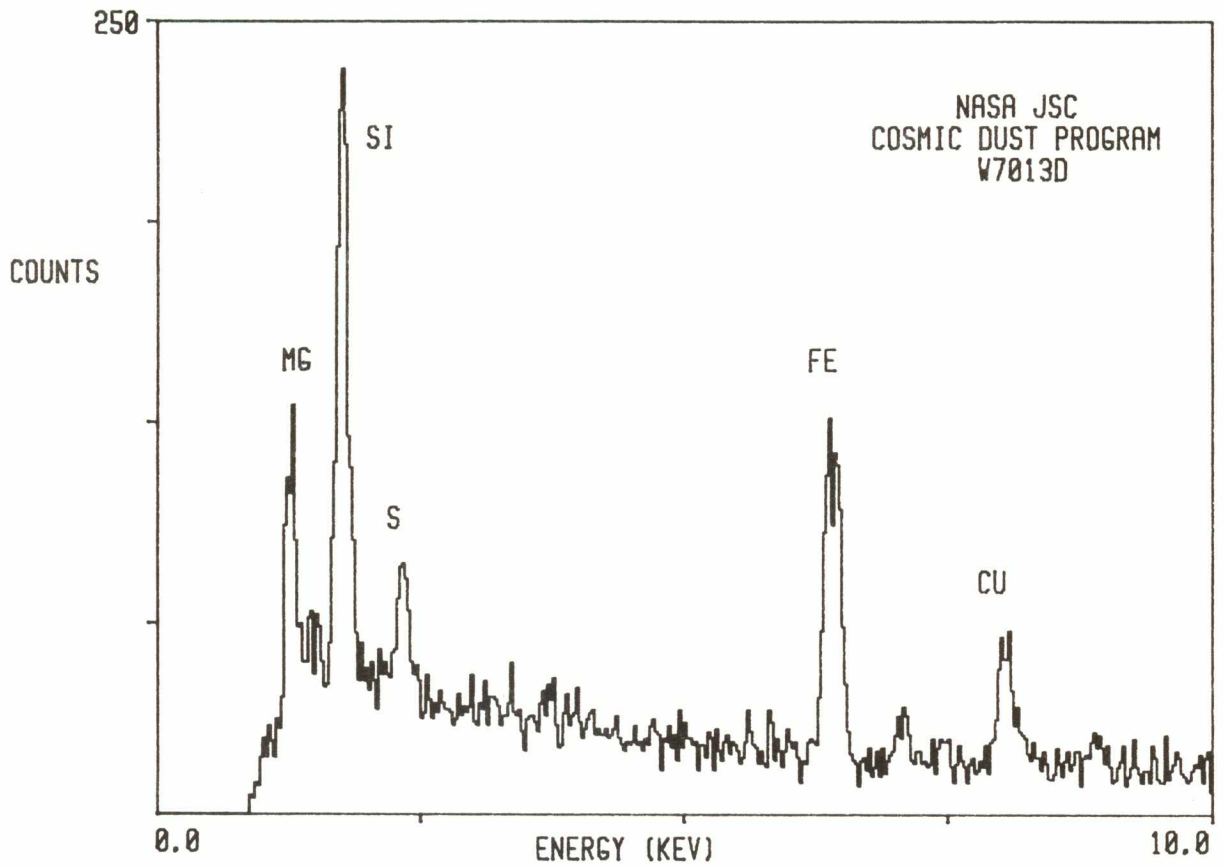
W7013 D 11



SIZE: 3  
SHAPE: E  
TRANS.: O  
COLOR: Black to brown  
LUSTER: R/M  
TYPE: C  
COMMENTS:

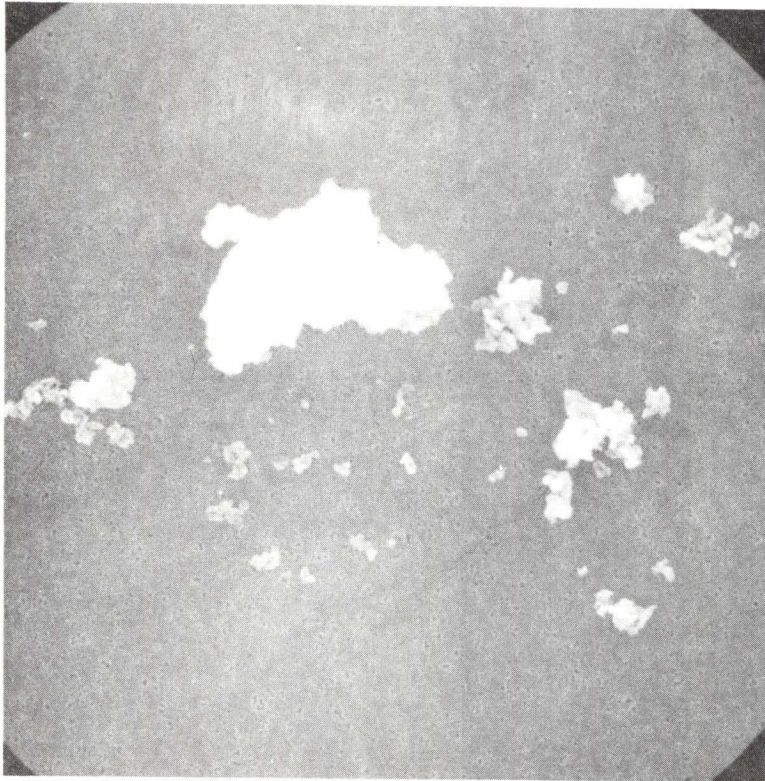
S-86-40347

WD11





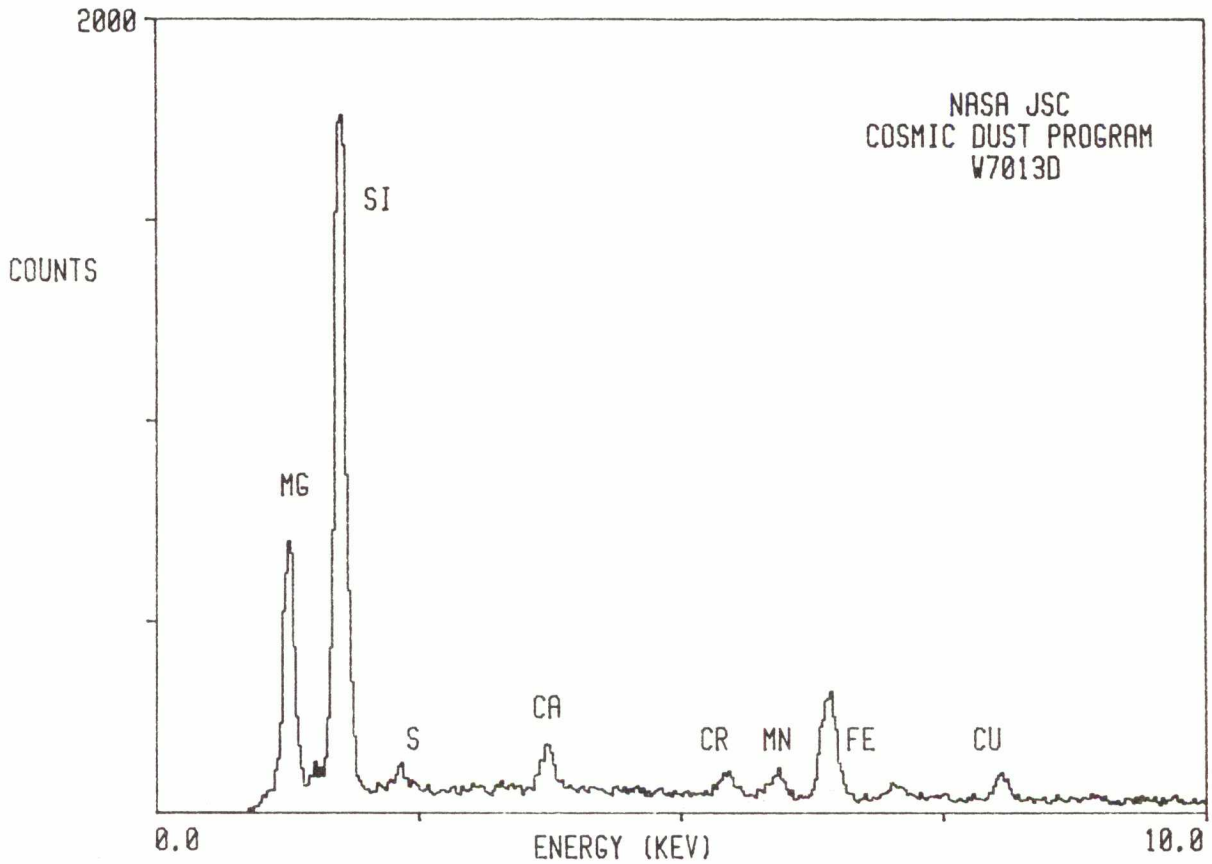
W7013 D 12



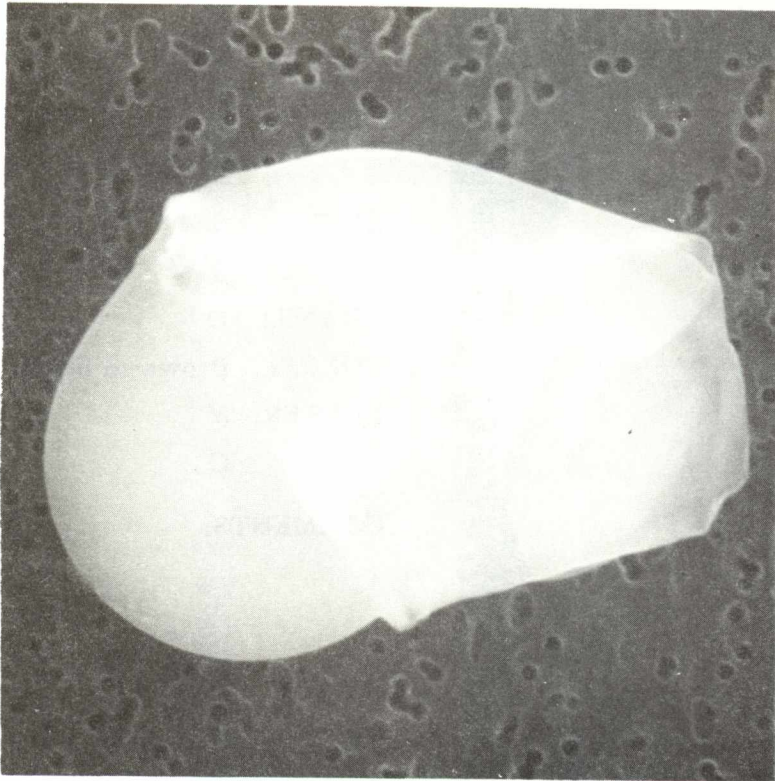
SIZE: 27x20  
SHAPE: I  
TRANS.: TL/O  
COLOR: Black to brown  
LUSTER: SM/D  
TYPE: C?  
COMMENTS:  
Largest grain size  
of fragmented  
aggregate

S-86-40348

W012

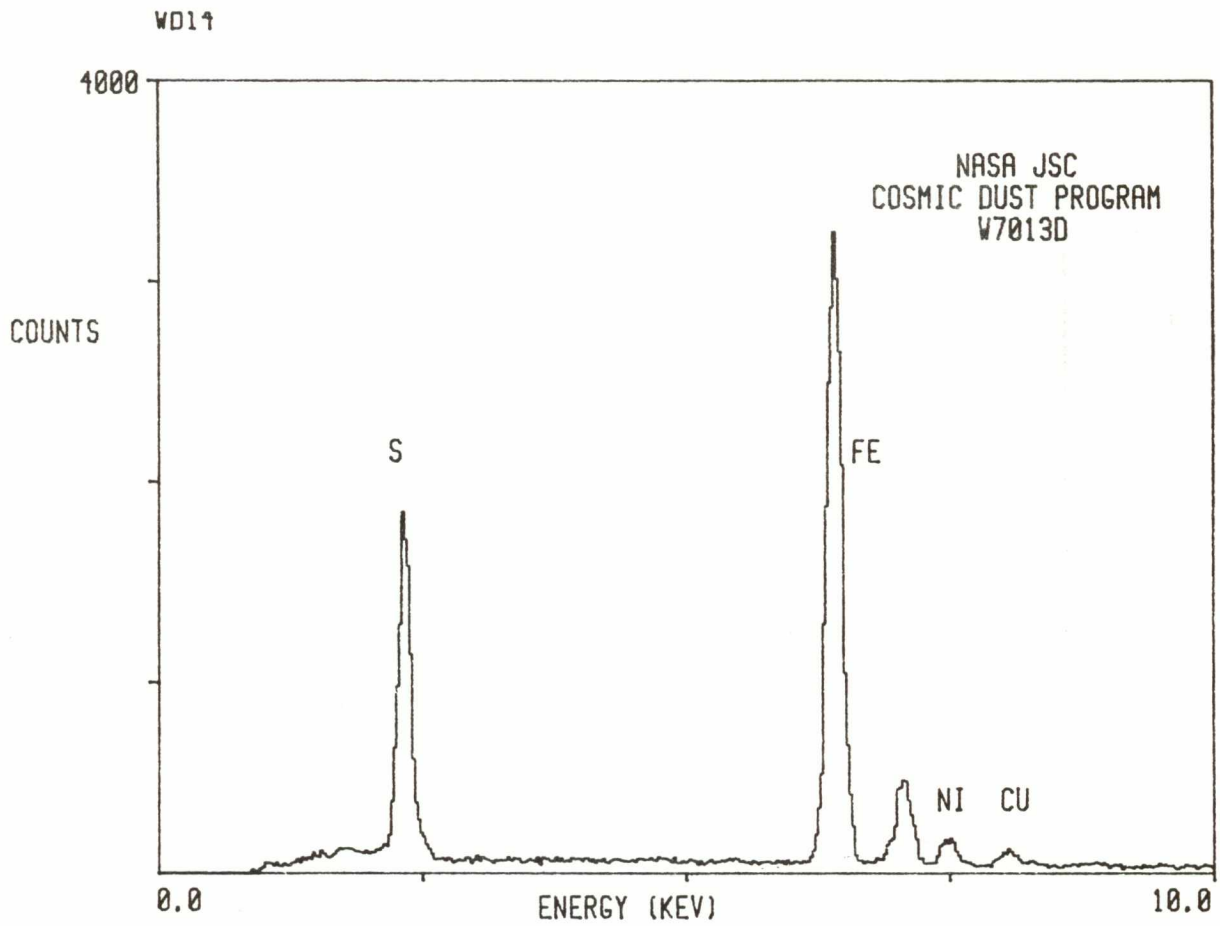


W7013 D 14

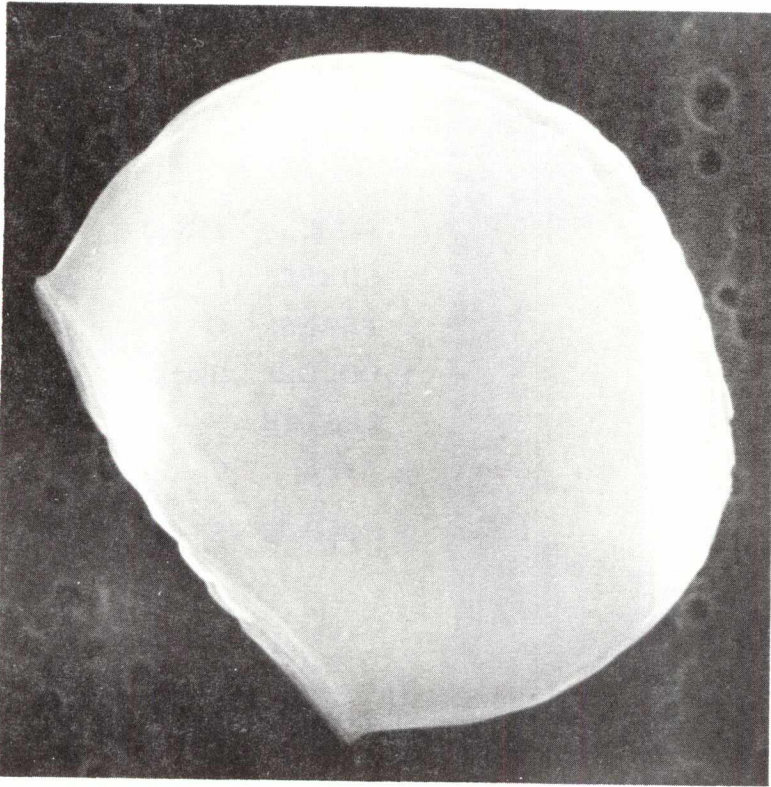


SIZE: 15X10  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: V  
TYPE: C  
COMMENTS:

S-86-40350

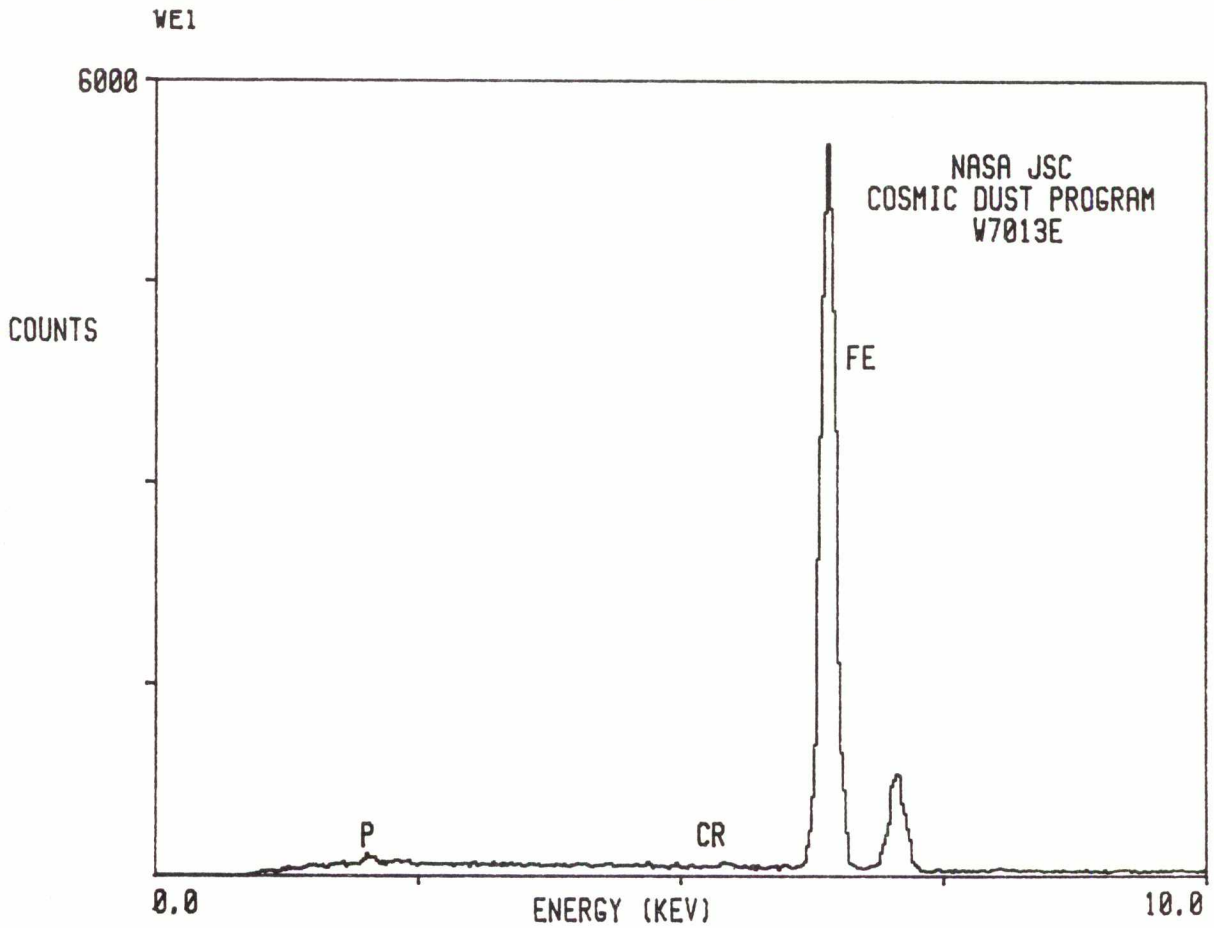


W7013 E 1

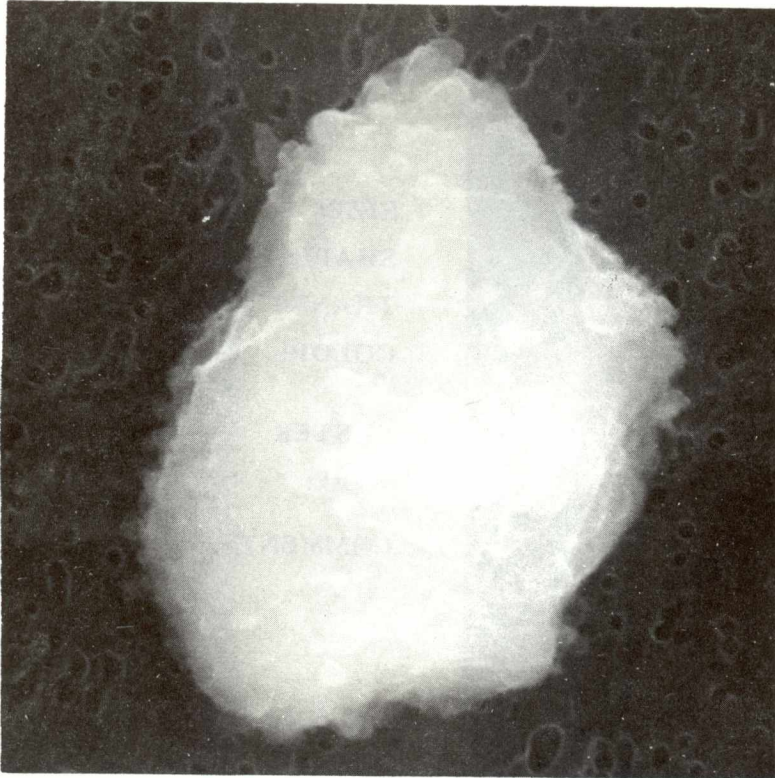


SIZE: 9  
SHAPE: S  
TRANS.: O  
COLOR: Brown to black  
LUSTER: V  
TYPE: C  
COMMENTS:

S-86-40354

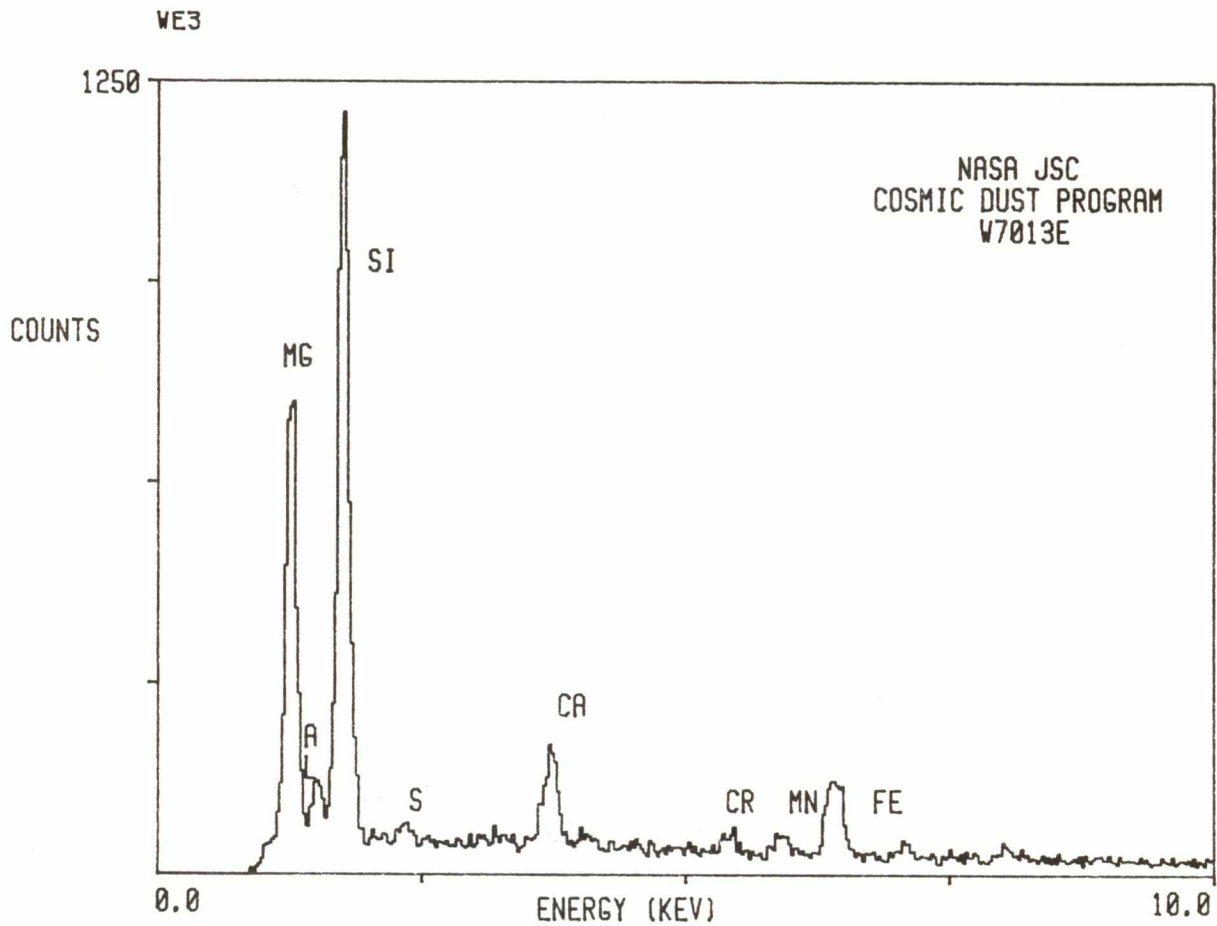


W7013 E 3

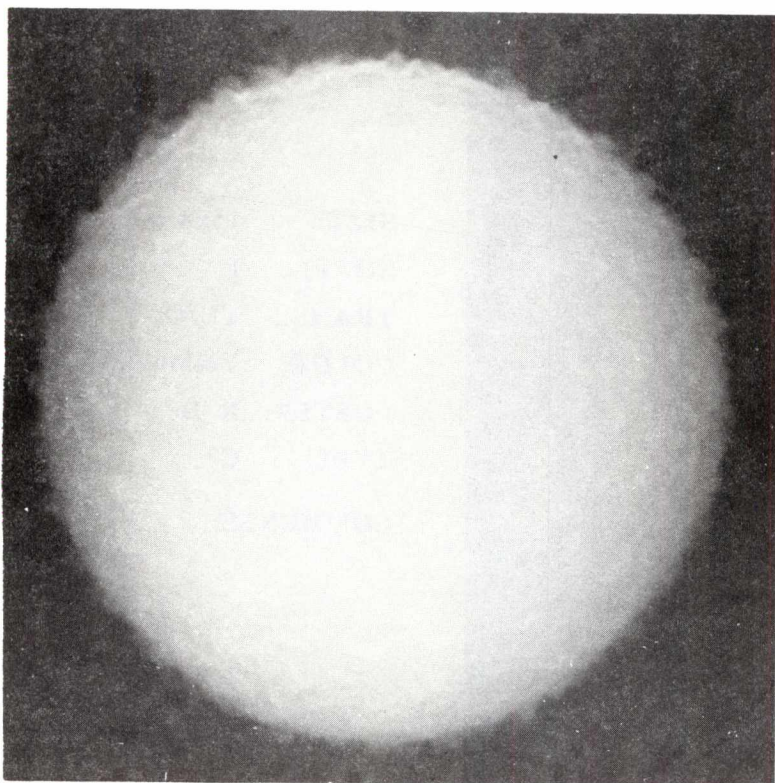


SIZE: 15x8  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: C?  
COMMENTS:

S-86-40356

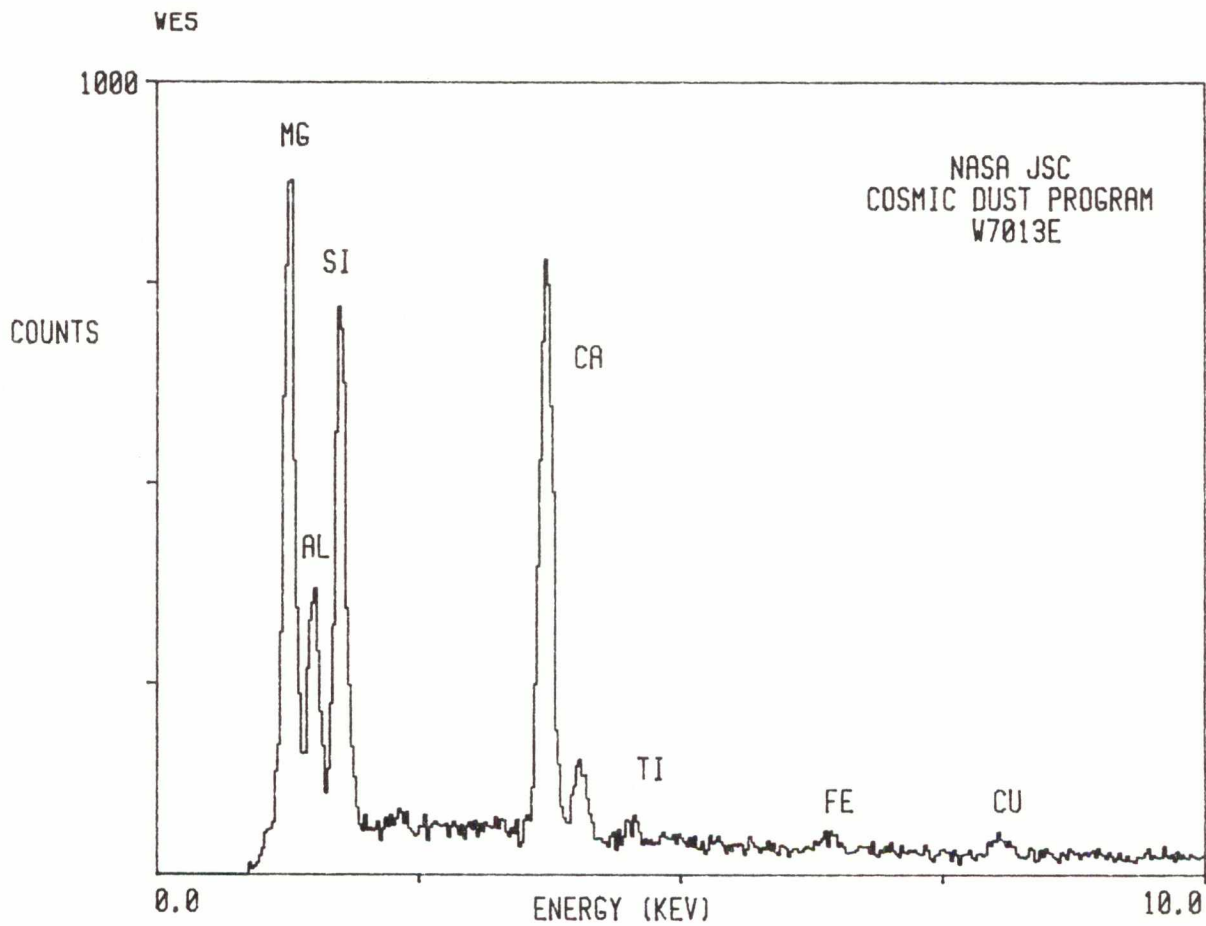


W7013 E 5

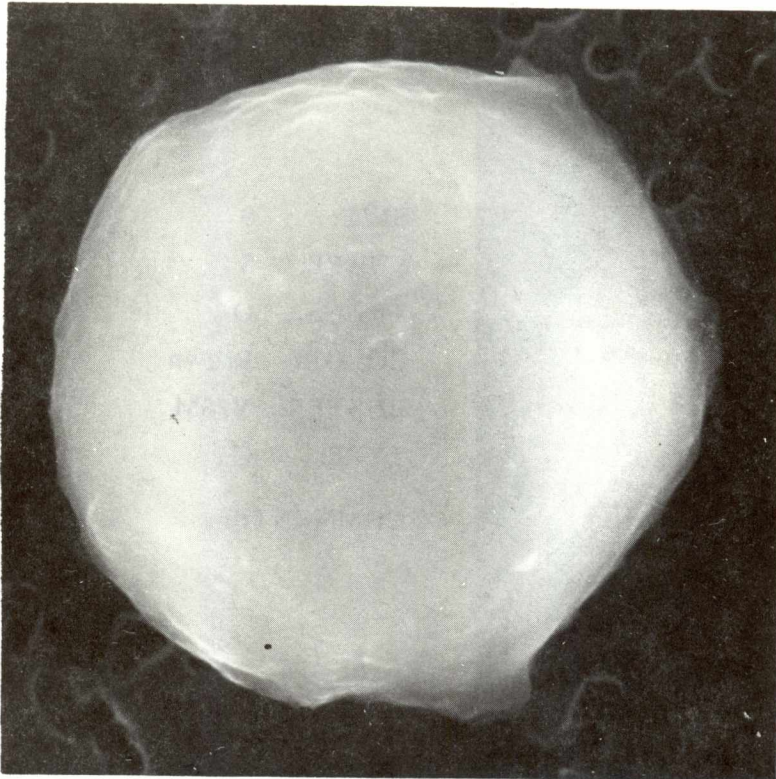


SIZE: 12  
SHAPE: S  
TRANS.: T  
COLOR: Colorless to yellow  
LUSTER: V  
TYPE: C?  
COMMENTS:

S-86-40358

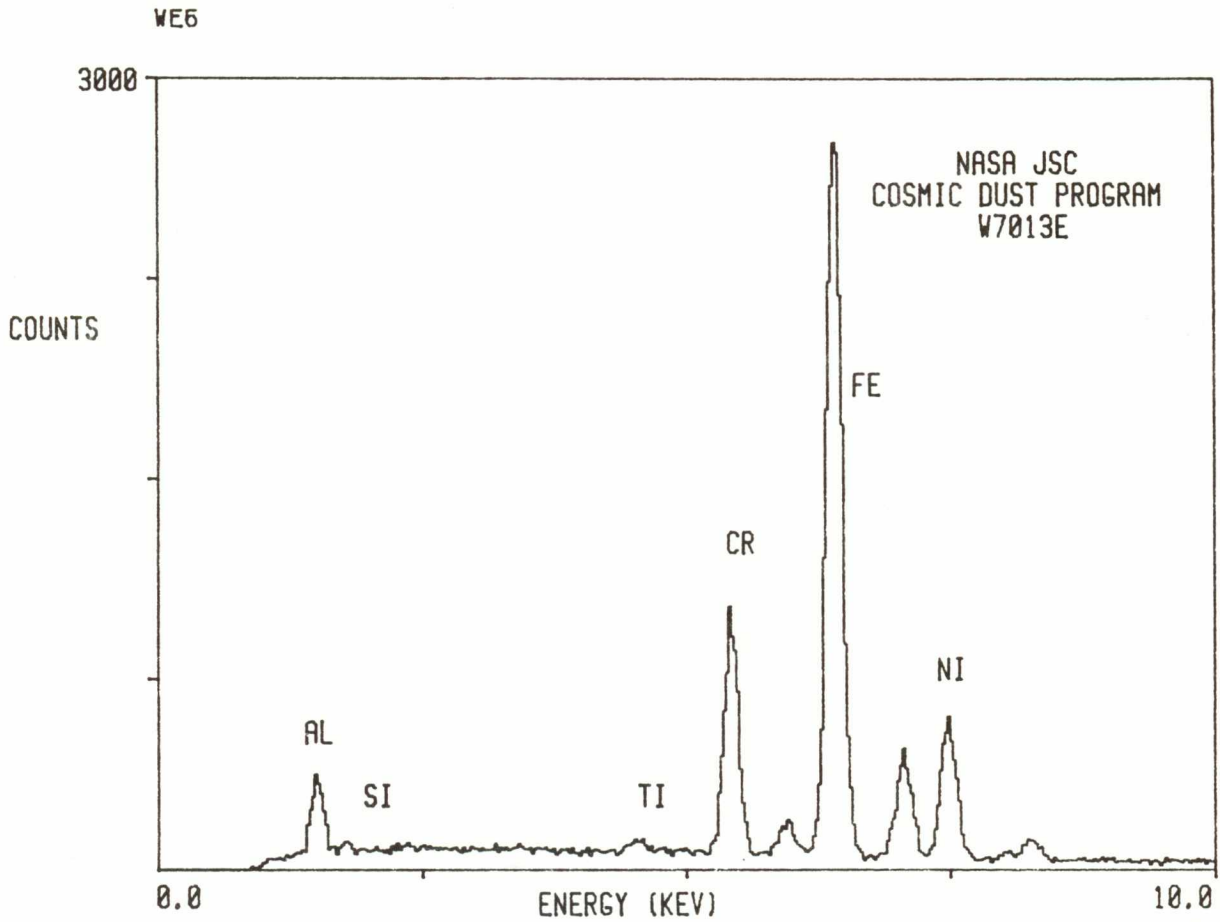


W7013 E 6

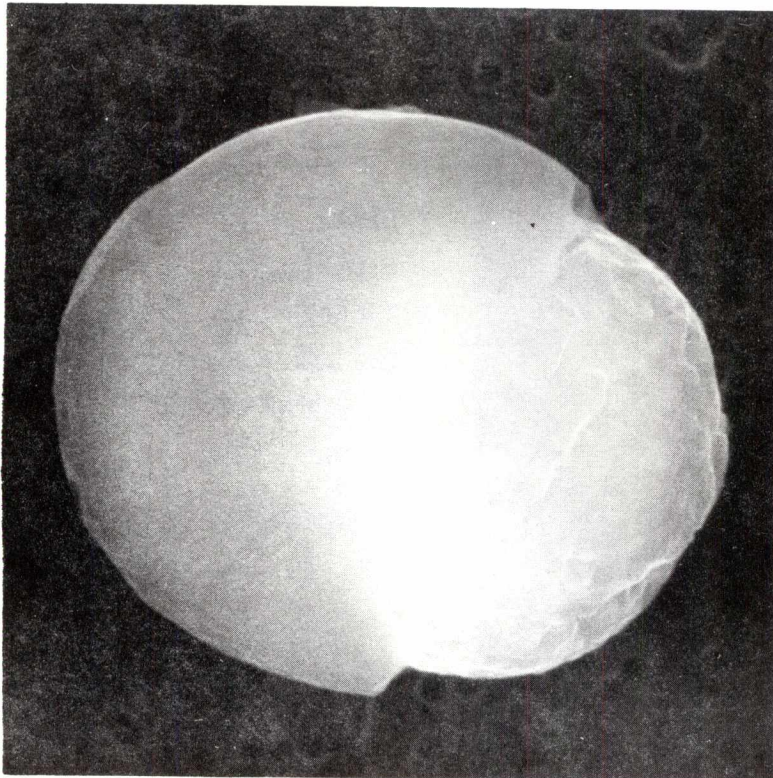


SIZE: 7  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: M/SM  
TYPE: C?  
COMMENTS:

S-86-40359



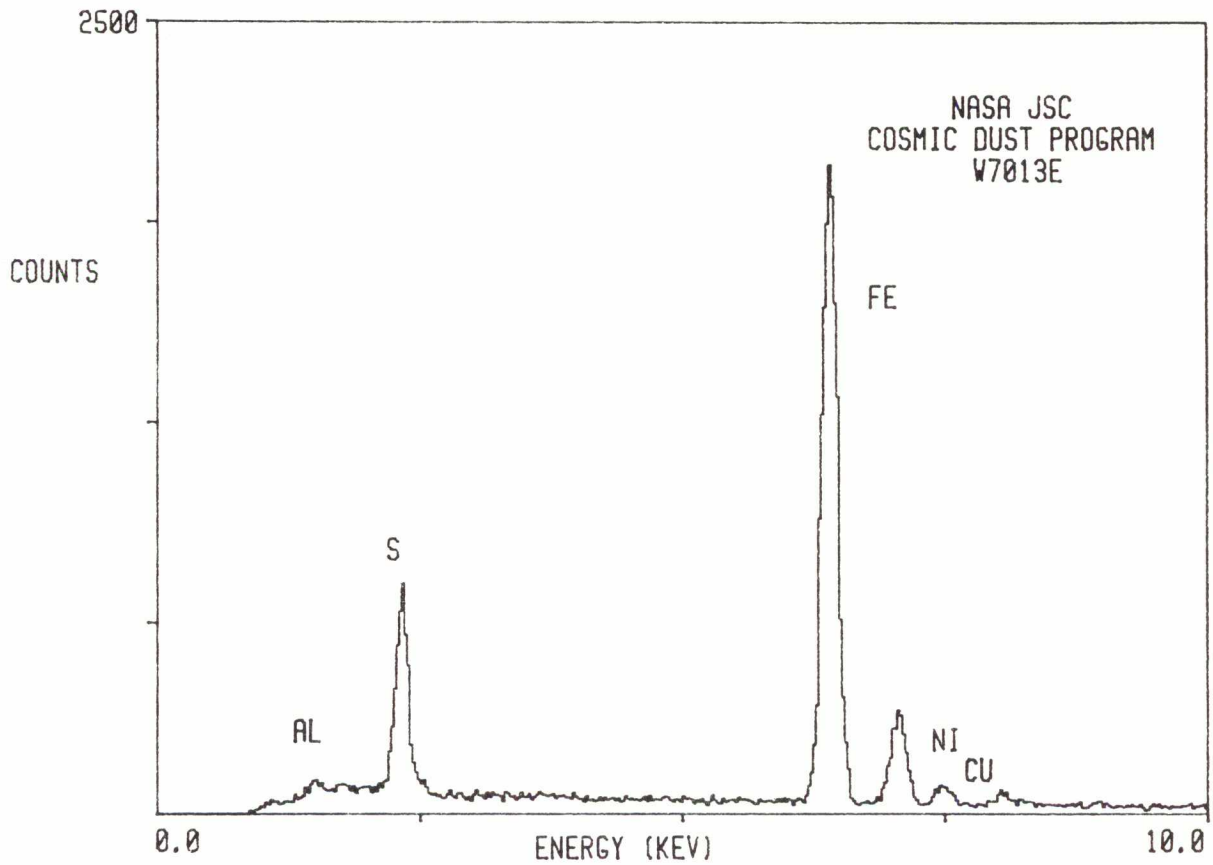
W7013 E 7



SIZE: 9  
SHAPE: S  
TRANS.: O  
COLOR: Brown  
LUSTER: V/SM  
TYPE: C  
COMMENTS:

S-86-40360

WE7

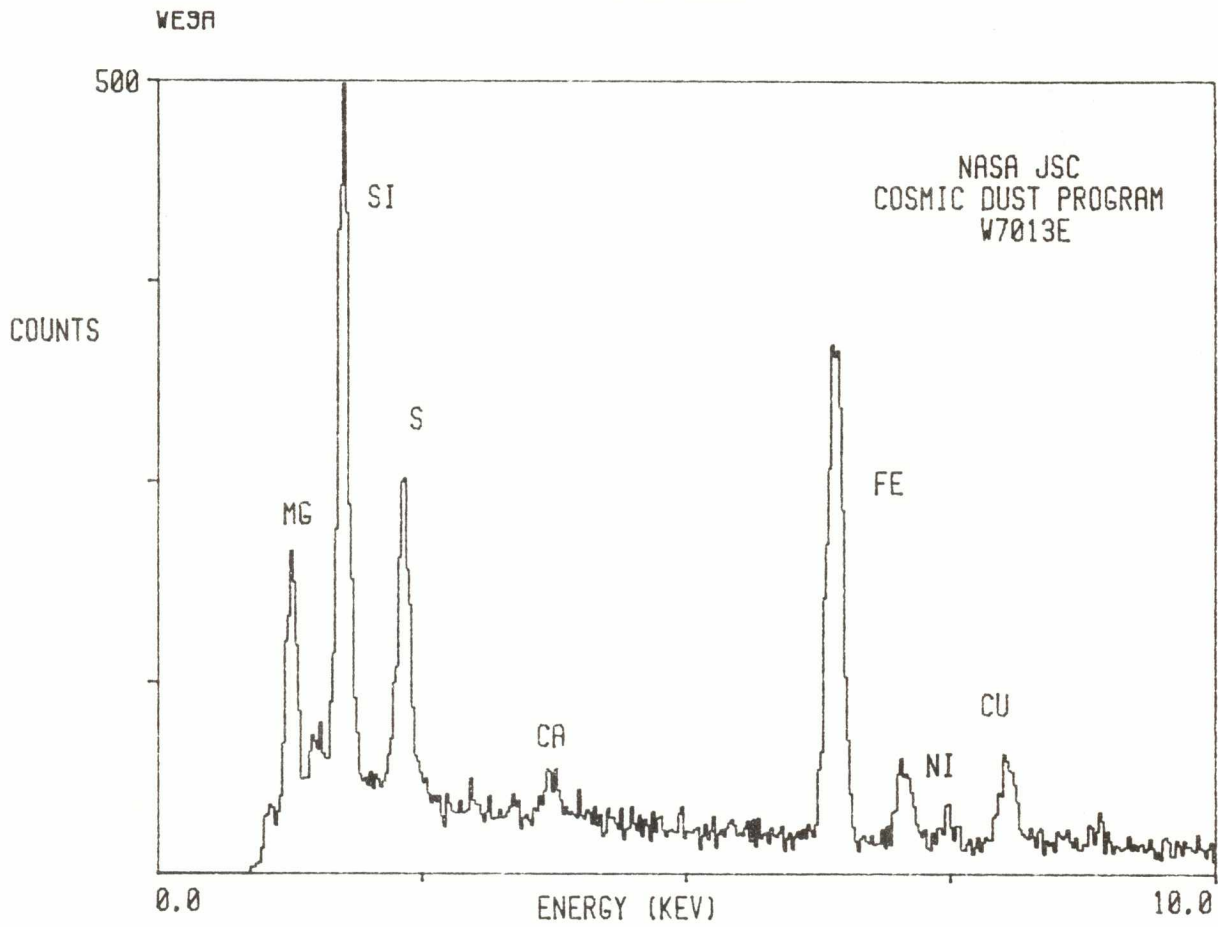


W7013 E 9



SIZE: 14  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:  
Size of largest  
grain

S-86-40362



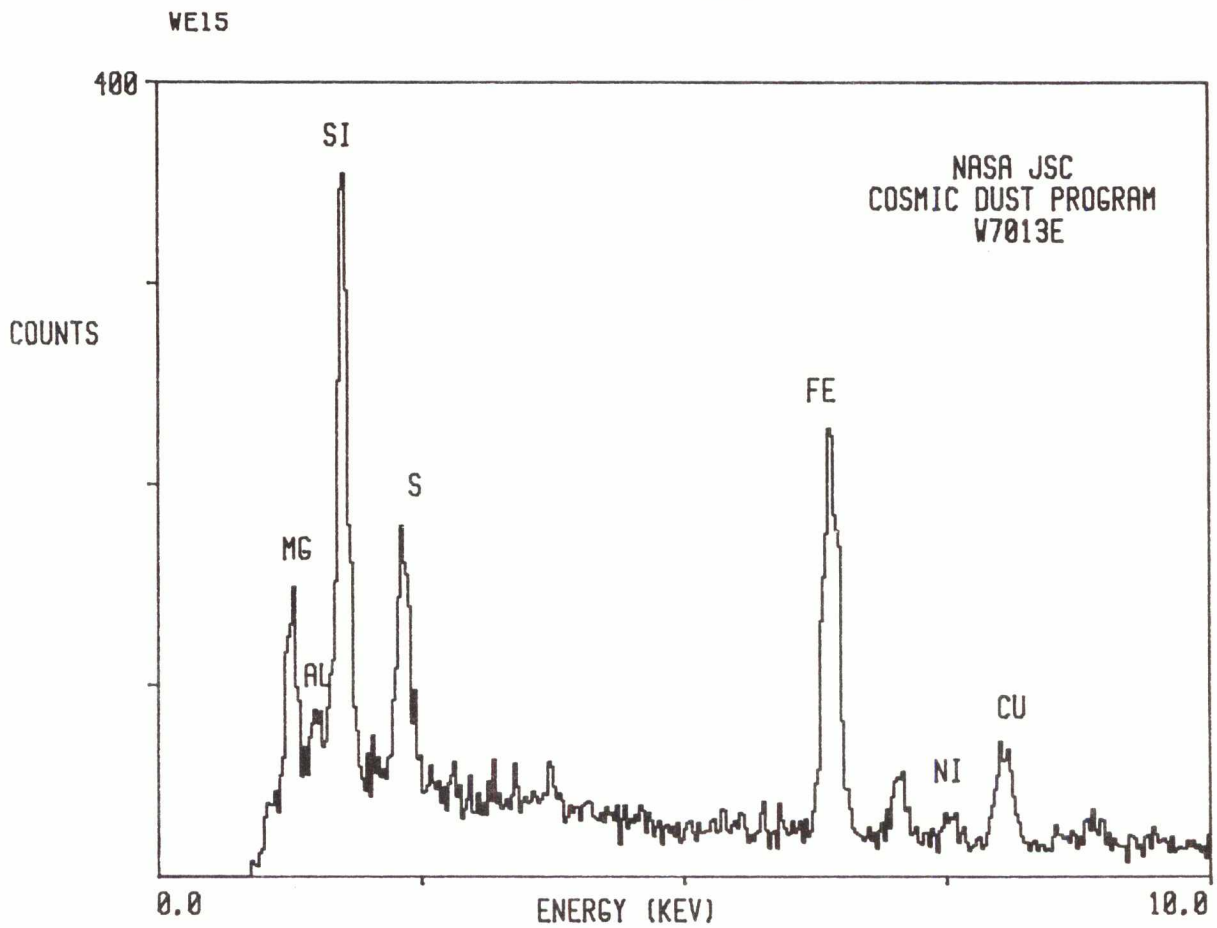


W7013 E 15

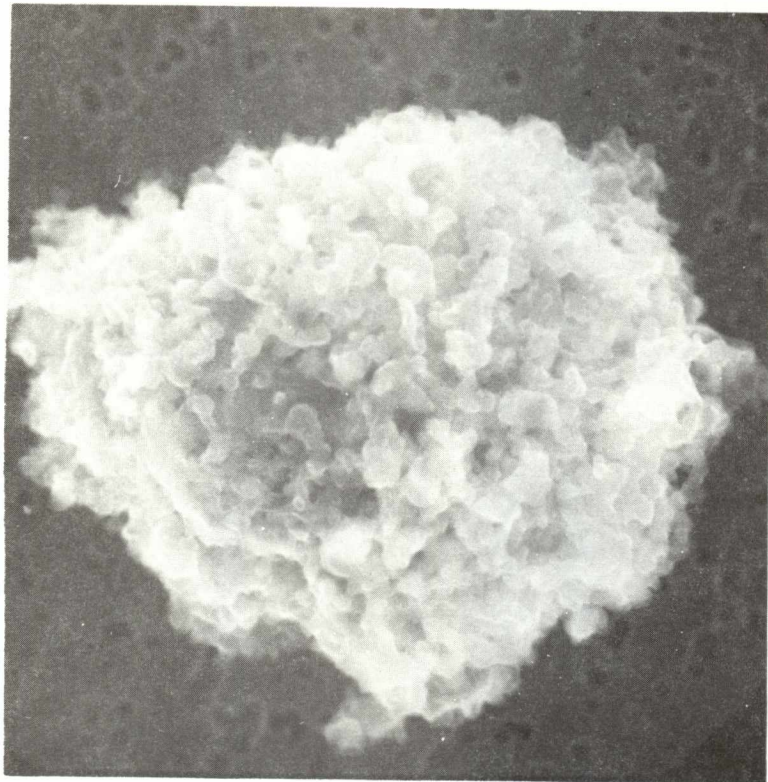


SIZE: 24x15  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:

S-86-40368



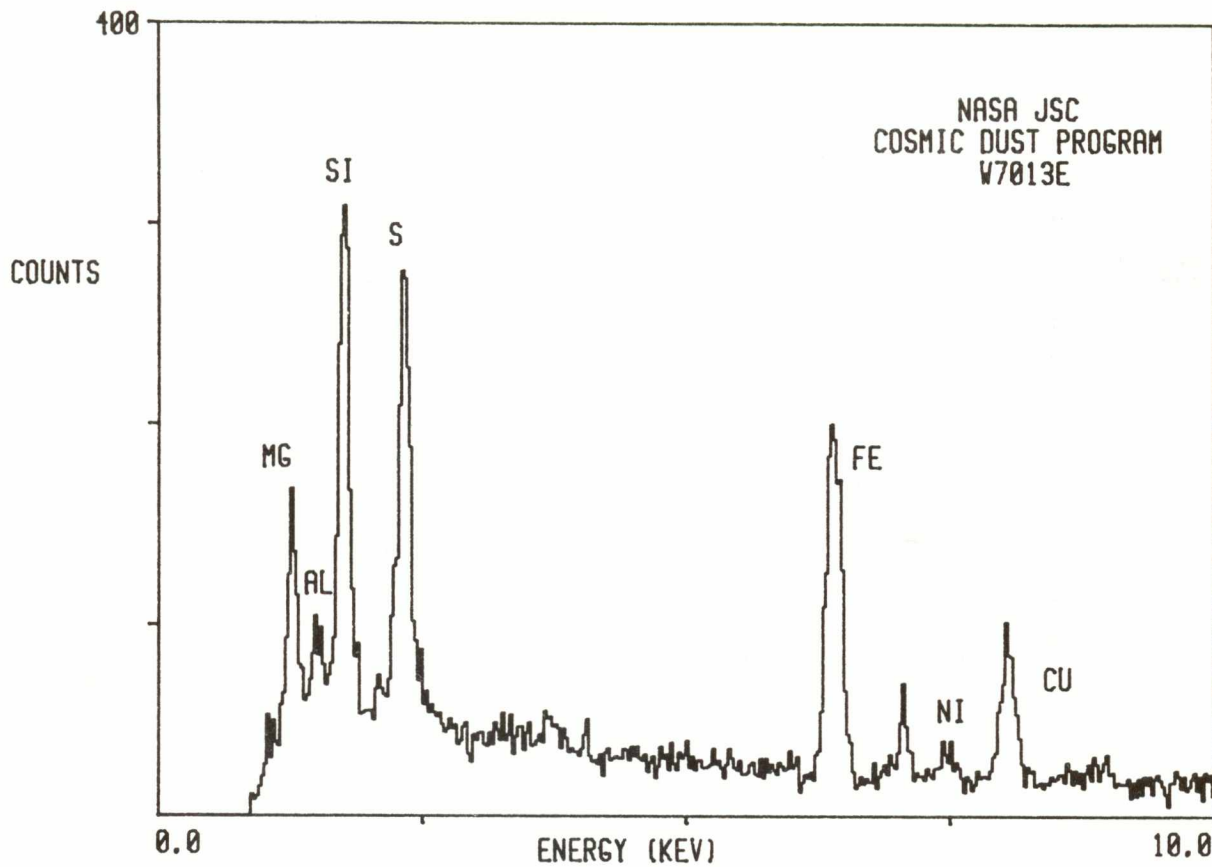
W7013 E 17



SIZE: 13x13  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: R/D  
TYPE: C  
COMMENTS:

S-86-40370

WE17

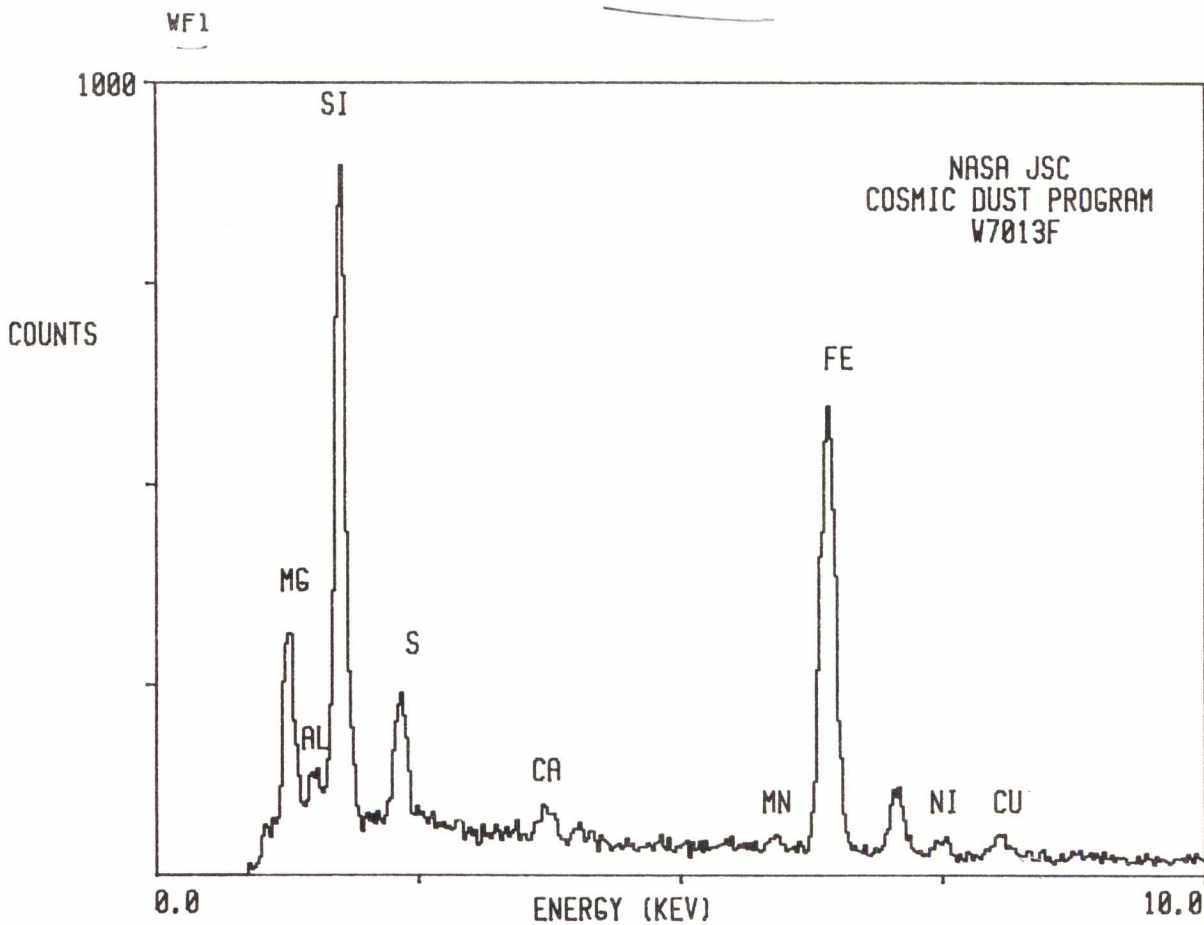


W7013 F 1

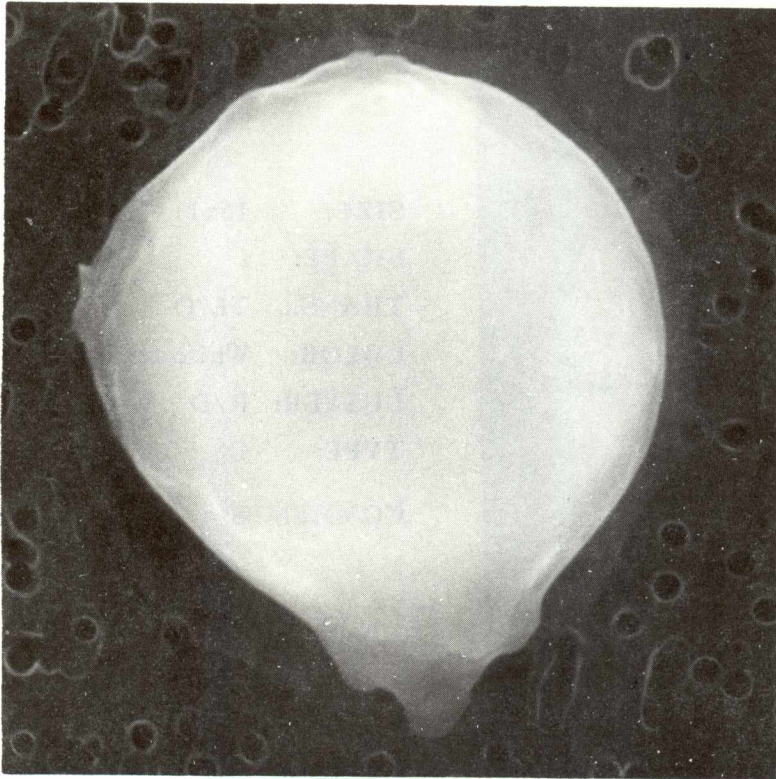


SIZE: 12  
SHAPE: E  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: R/D  
TYPE: C  
COMMENTS:

S-86-40371

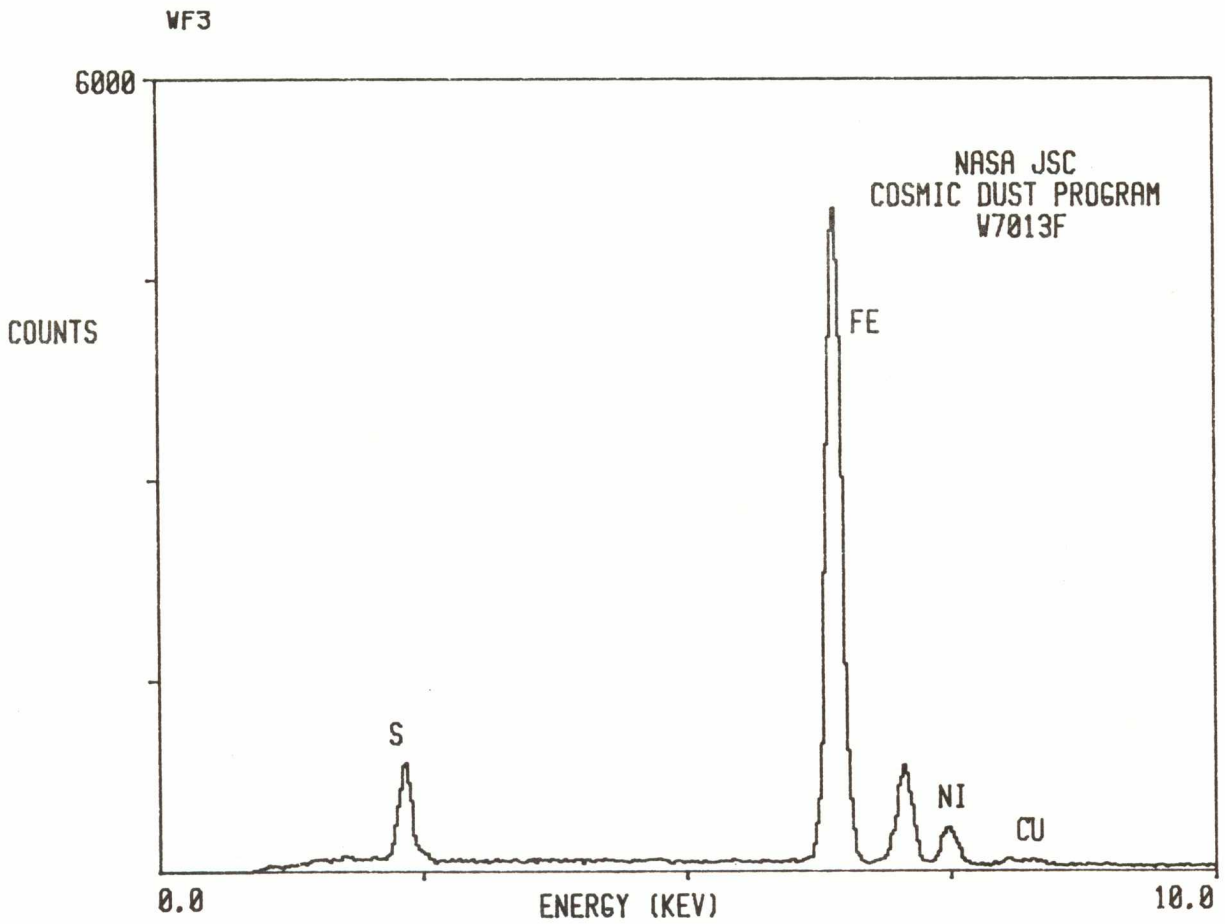


W7013 F 3



SIZE: 8  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: SM/V  
TYPE: C  
COMMENTS:

S-86-40373

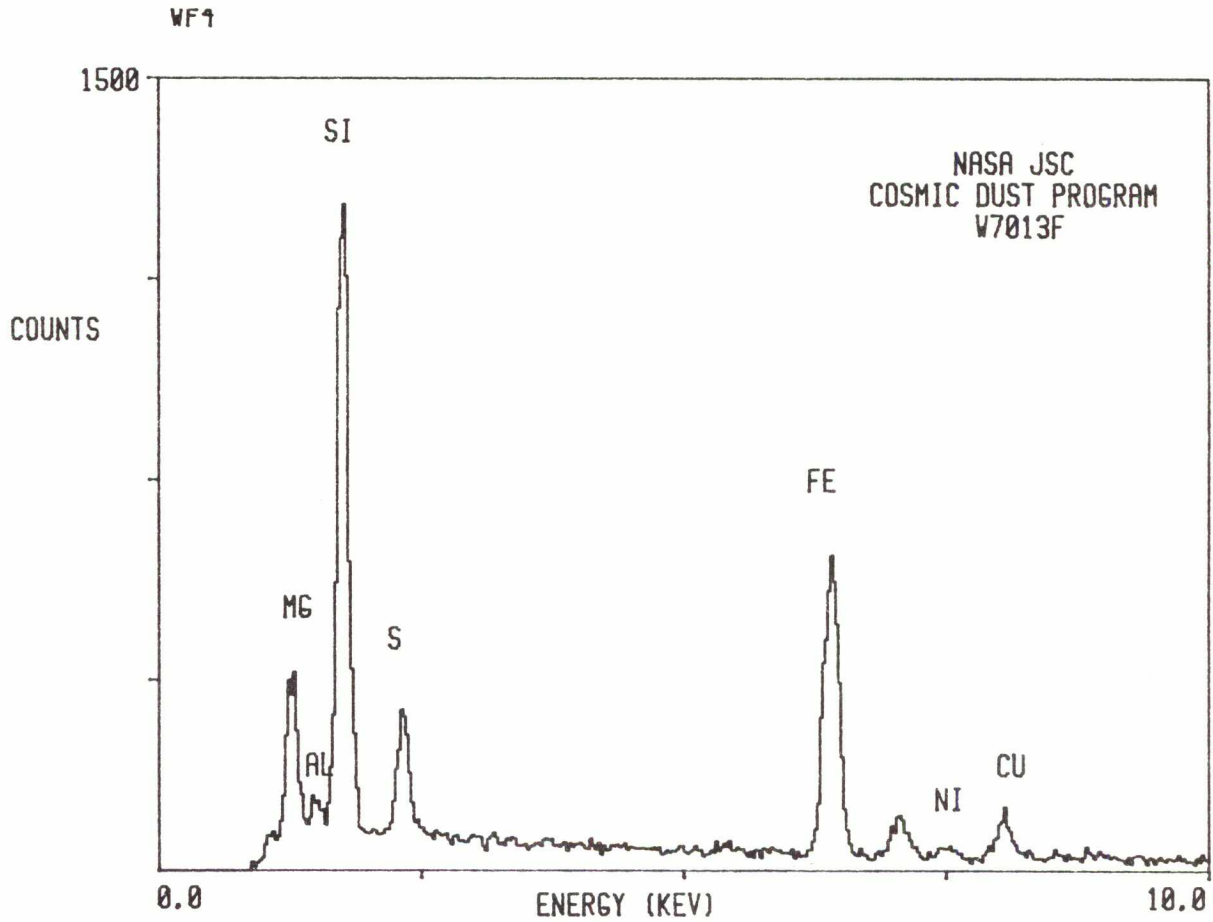


W7013 F 4

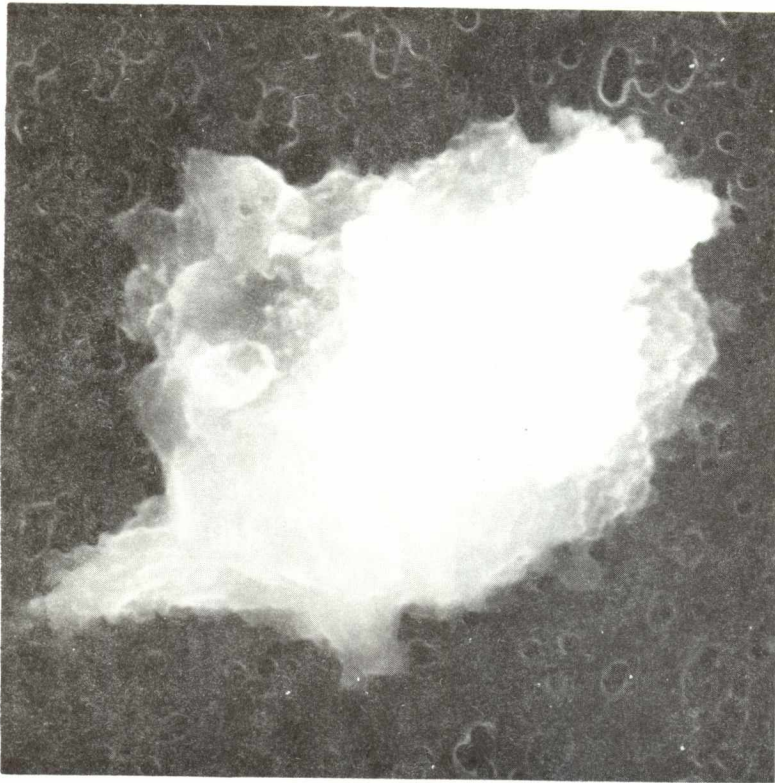


SIZE: 15x11  
SHAPE: I  
TRANS.: TL/O  
COLOR: White to brown  
LUSTER: R/D  
TYPE: C  
COMMENTS:

S-86-40374

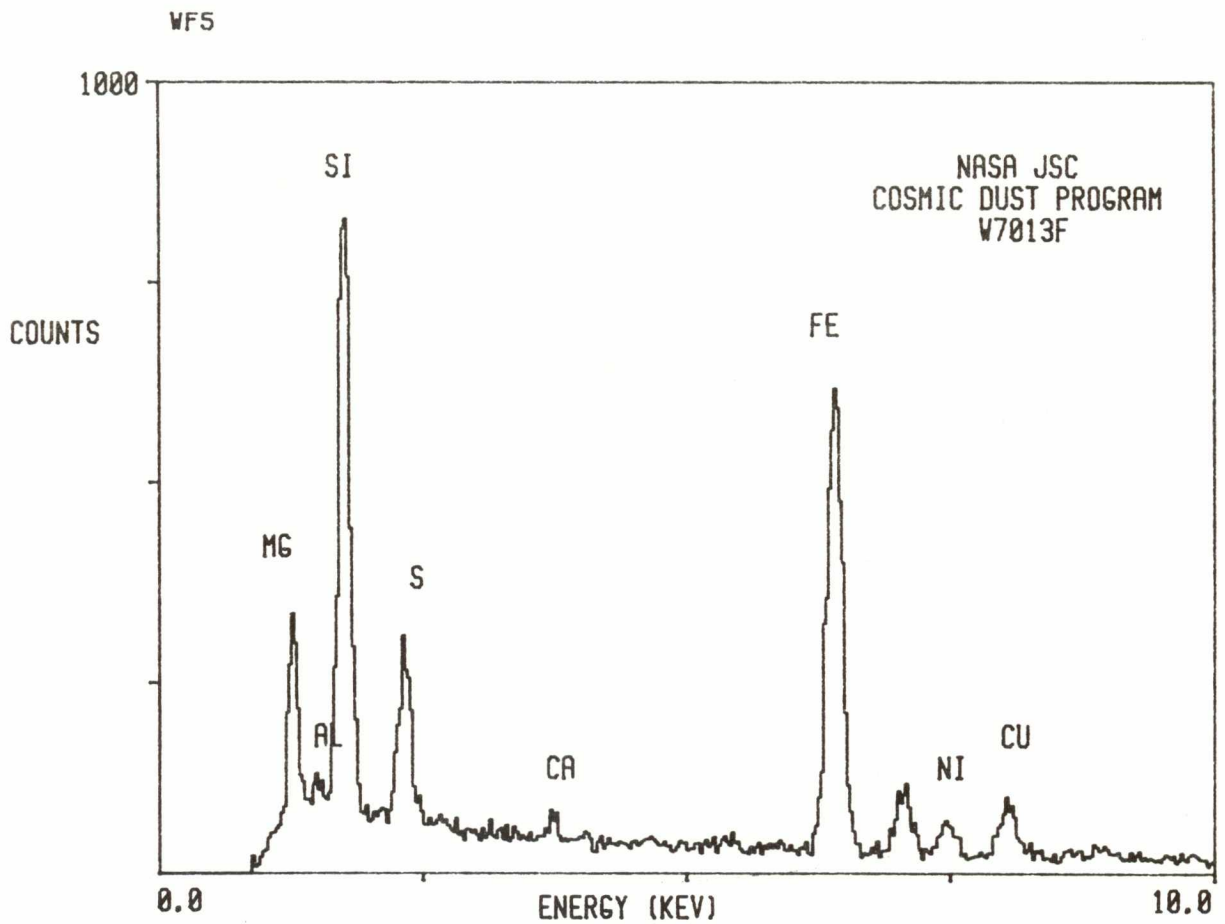


W7013 F 5

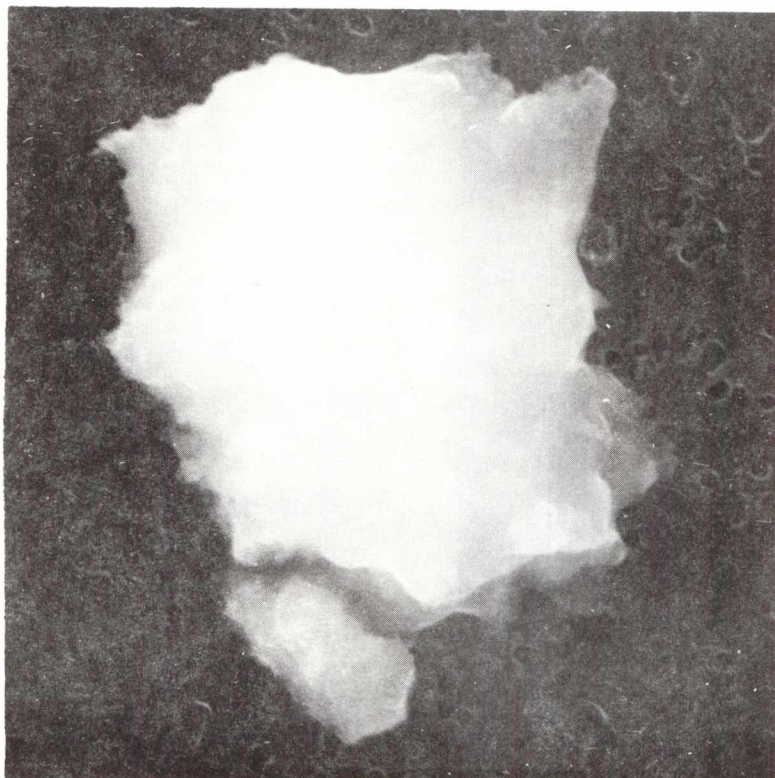


SIZE: 14x9  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: R/D  
TYPE: C  
COMMENTS:

S-86-40375



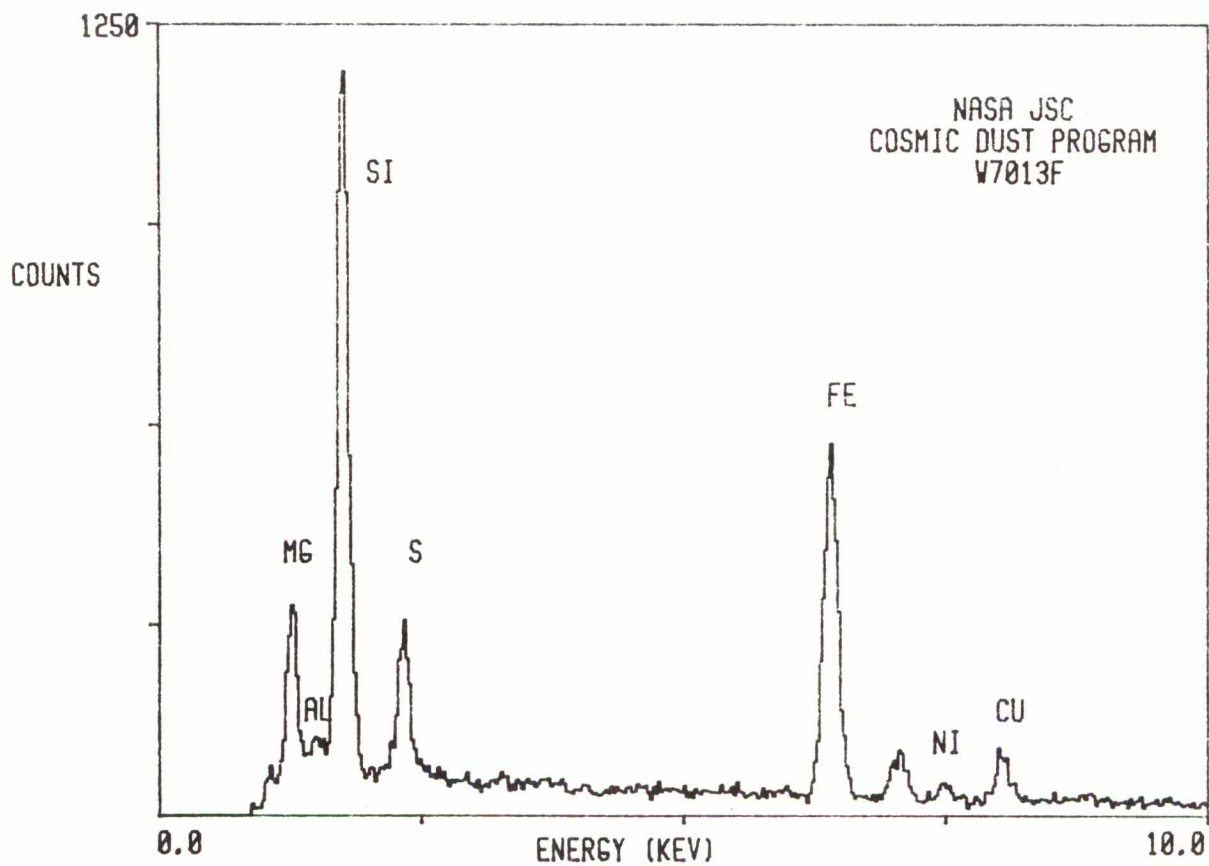
W7013 F 8



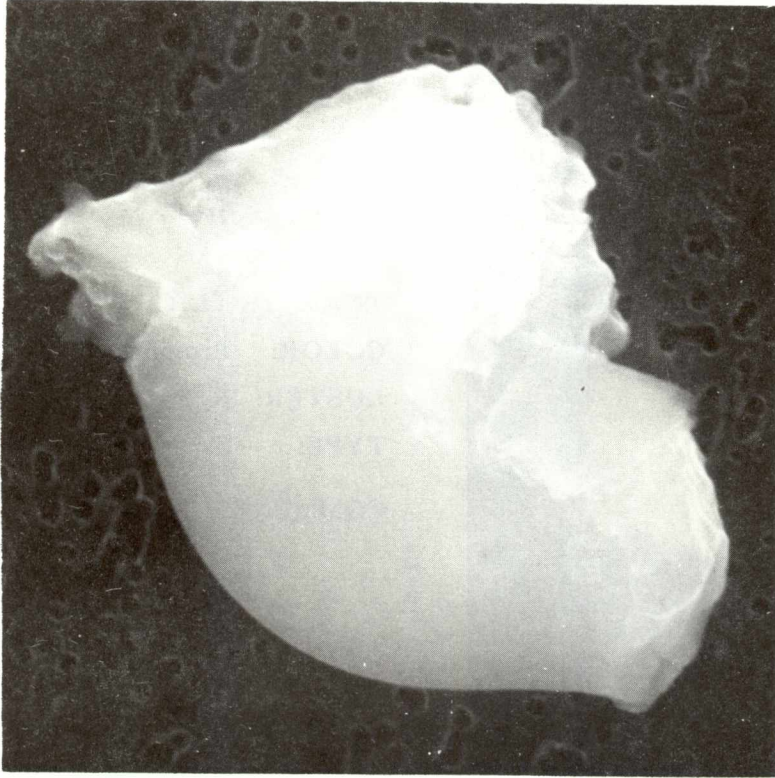
SIZE: 15x13  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:

S-86-40378

WF8

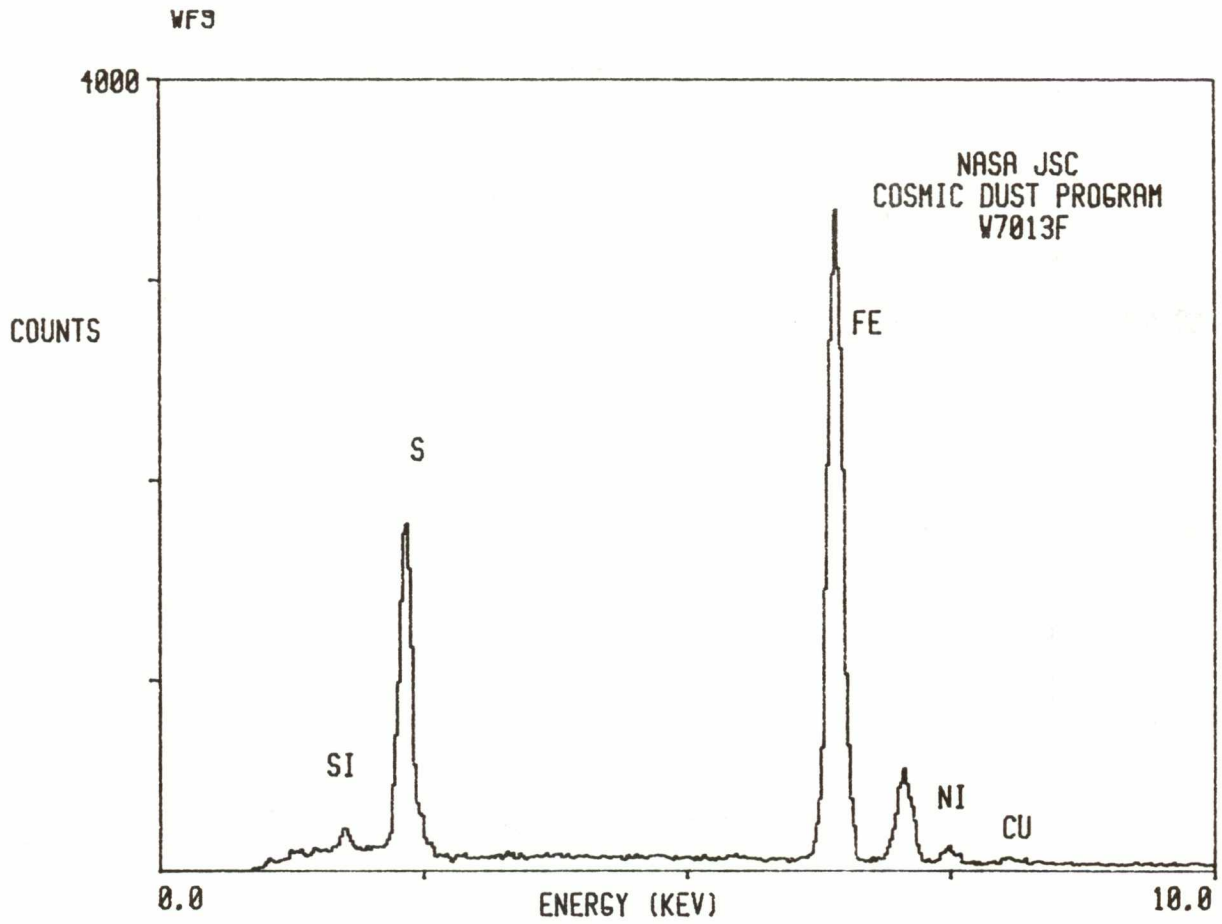


W7013 F 9



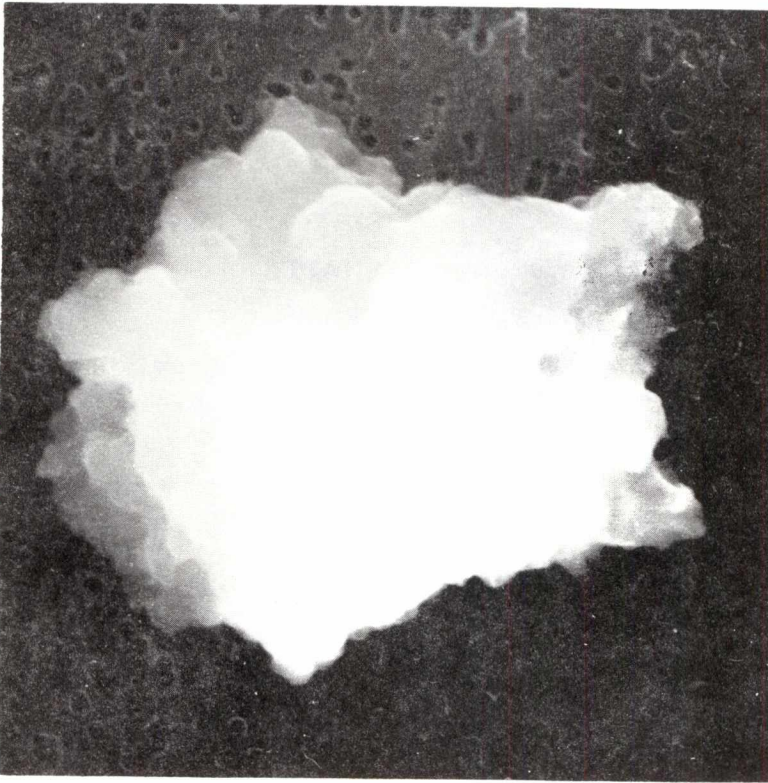
SIZE: 15x12  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/V  
TYPE: C  
COMMENTS:

S-86-40379





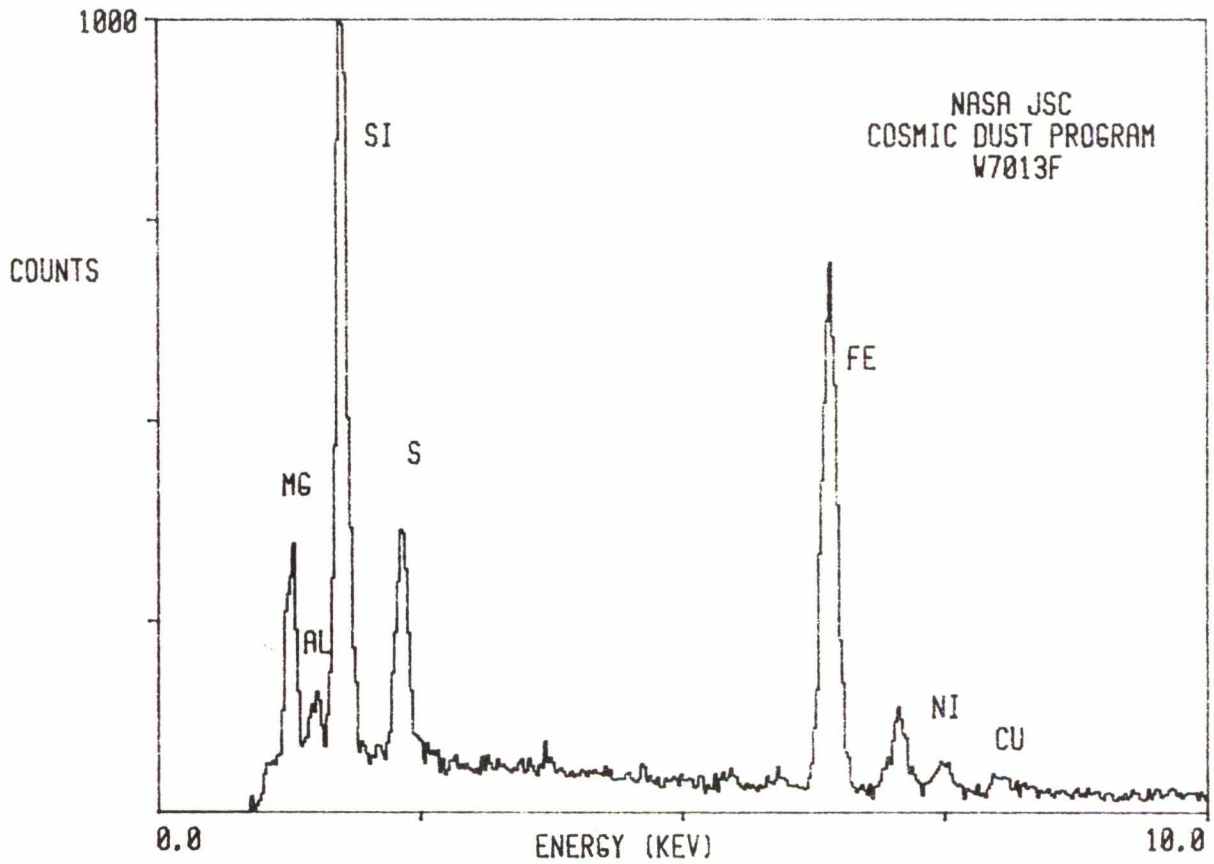
W7013 F 12



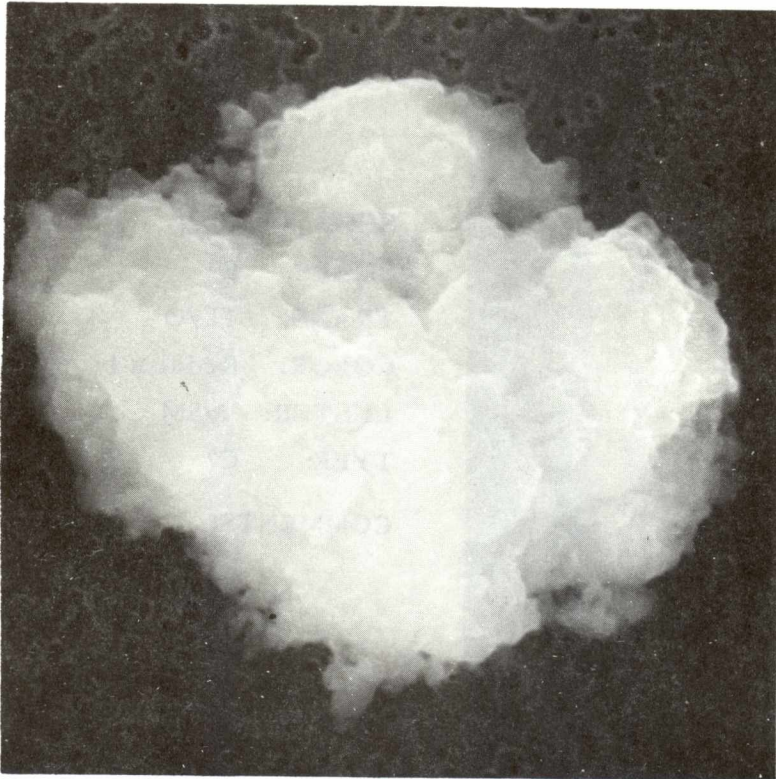
SIZE: 16x13  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: R/D  
TYPE: C  
COMMENTS:

S-86-40381

WF12



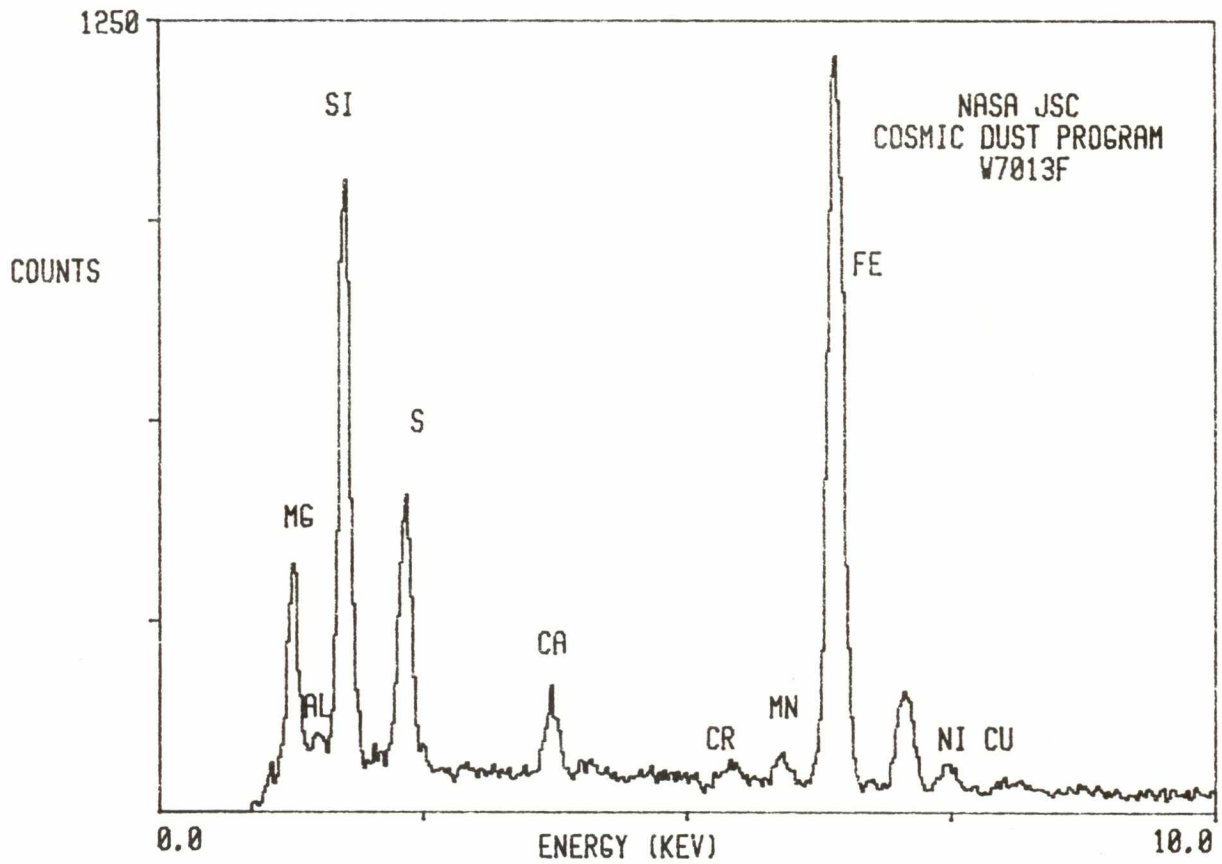
W7013 F 13



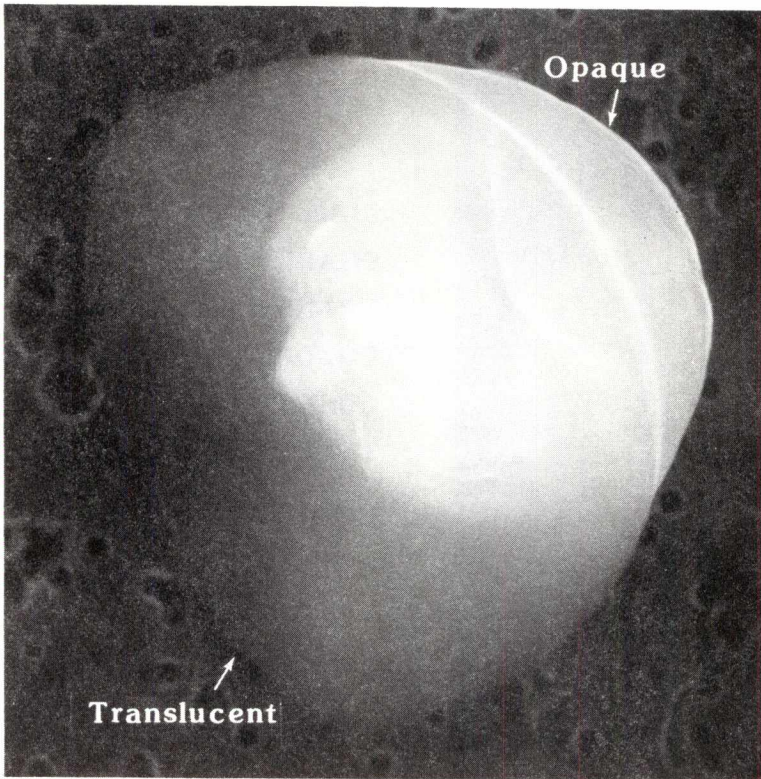
SIZE: 19x17  
SHAPE: I  
TRANS.: TL/O  
COLOR: Golden to brown  
LUSTER: R/V  
TYPE: C  
COMMENTS:

S-86-40382

WF13



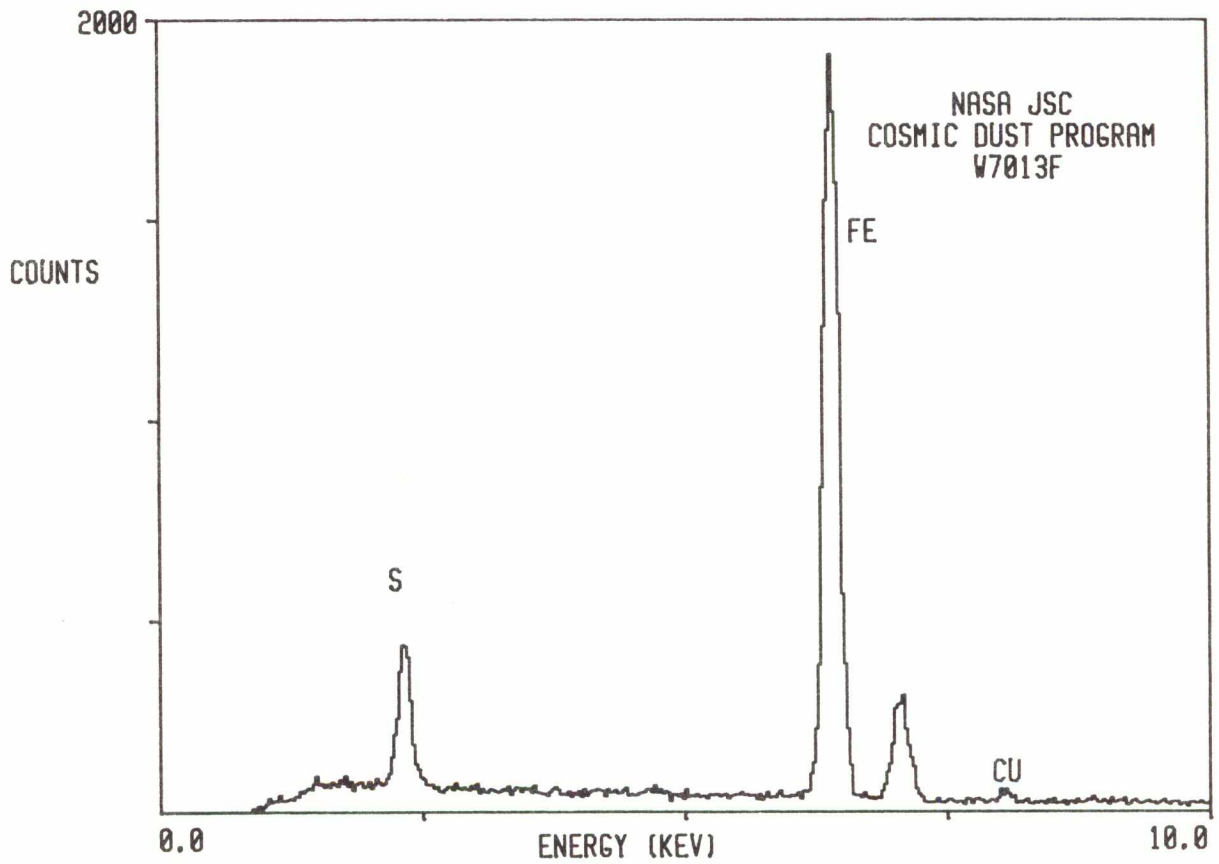
W7013 F 16



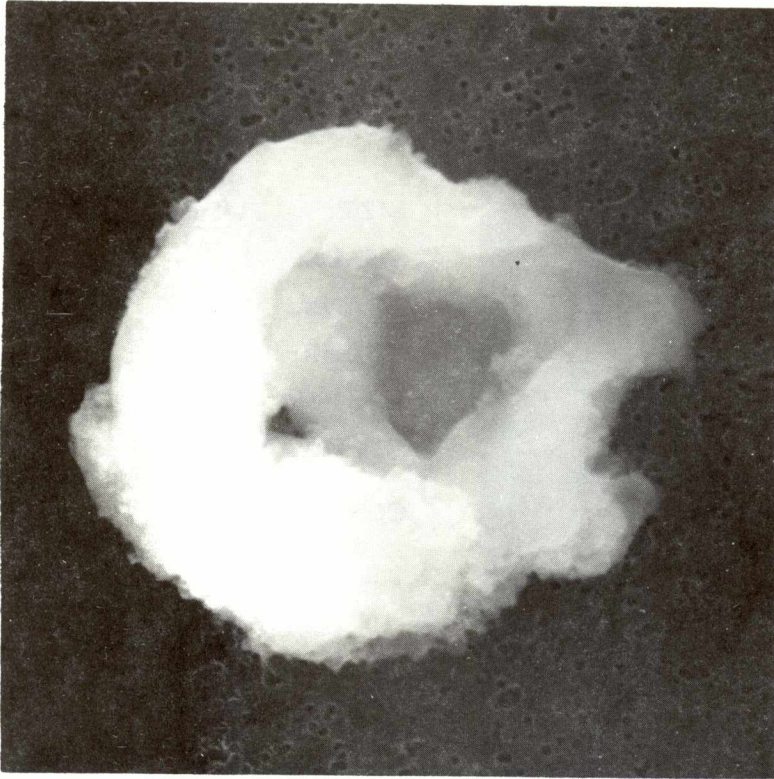
SIZE: 10x9  
SHAPE: E  
TRANS.: TL/O  
COLOR: Reddish-brown  
LUSTER: V/SM  
TYPE: C?  
COMMENTS:

S-86-40385

WF16

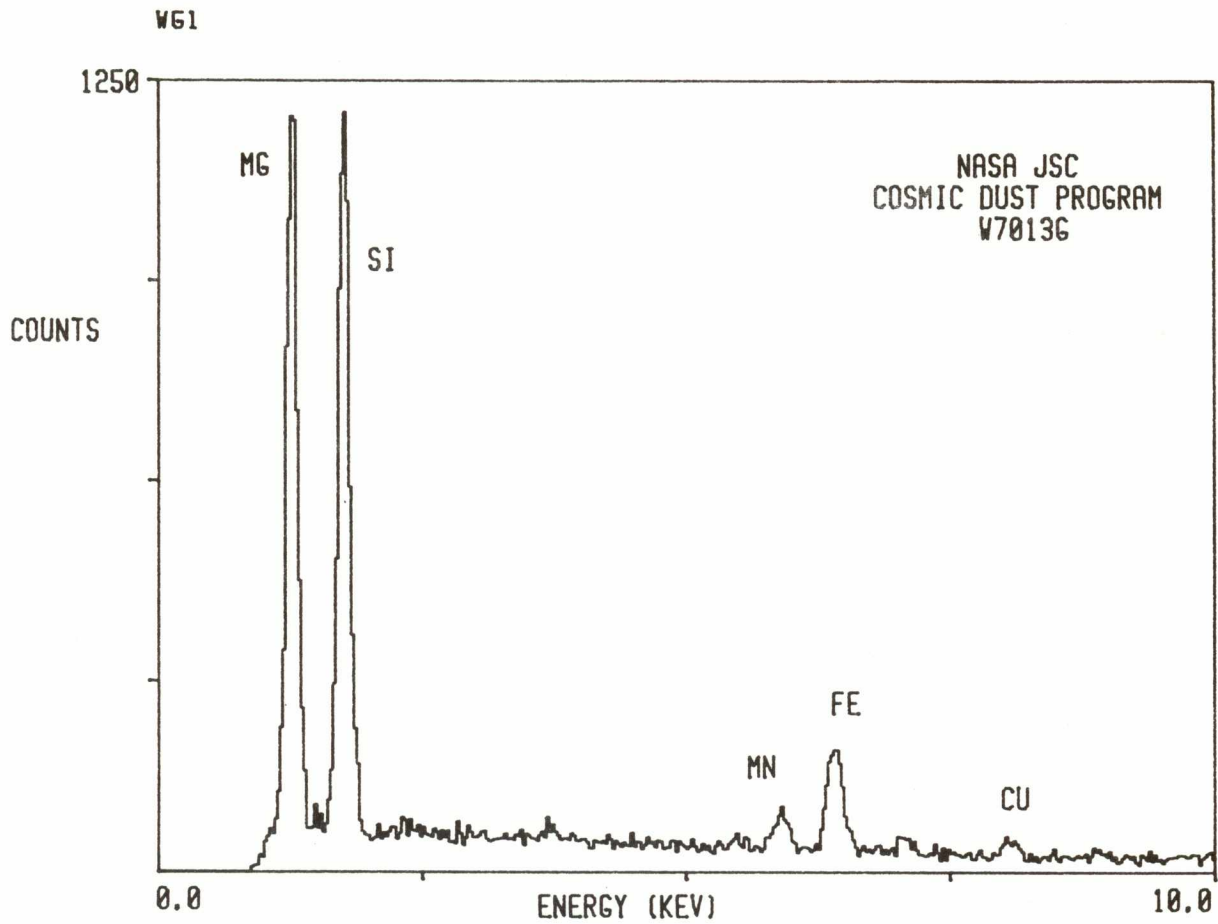


W7013 G 1

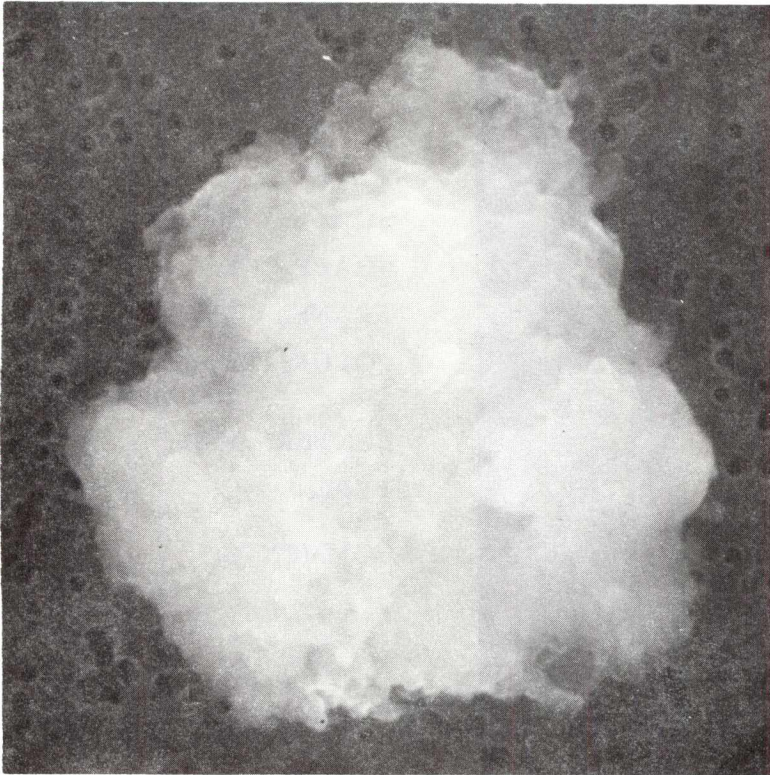


SIZE: 20  
SHAPE: E  
TRANS.: TL/O  
COLOR: White, golden  
and brown  
LUSTER: V/D  
TYPE: C  
COMMENTS:

S-86-40405

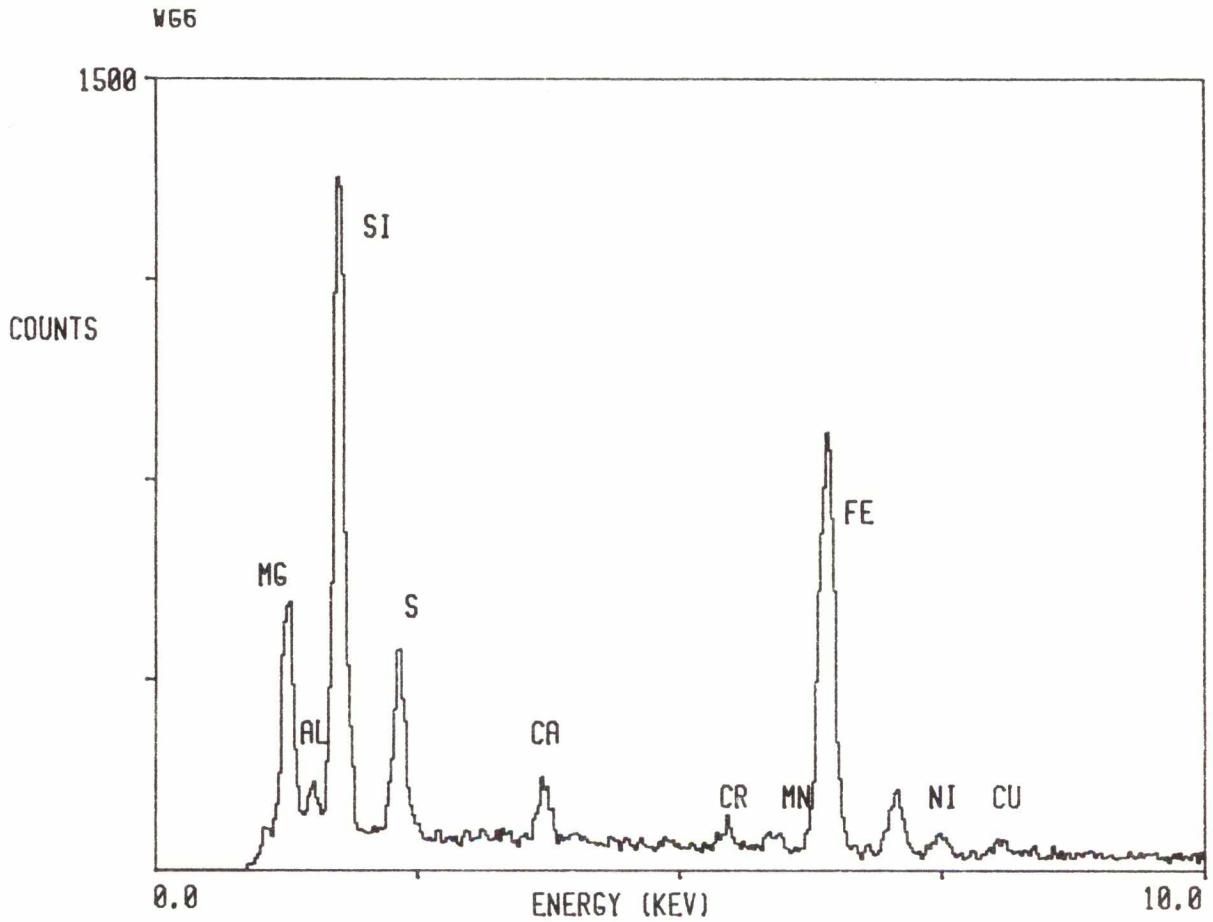


W7013 G 6

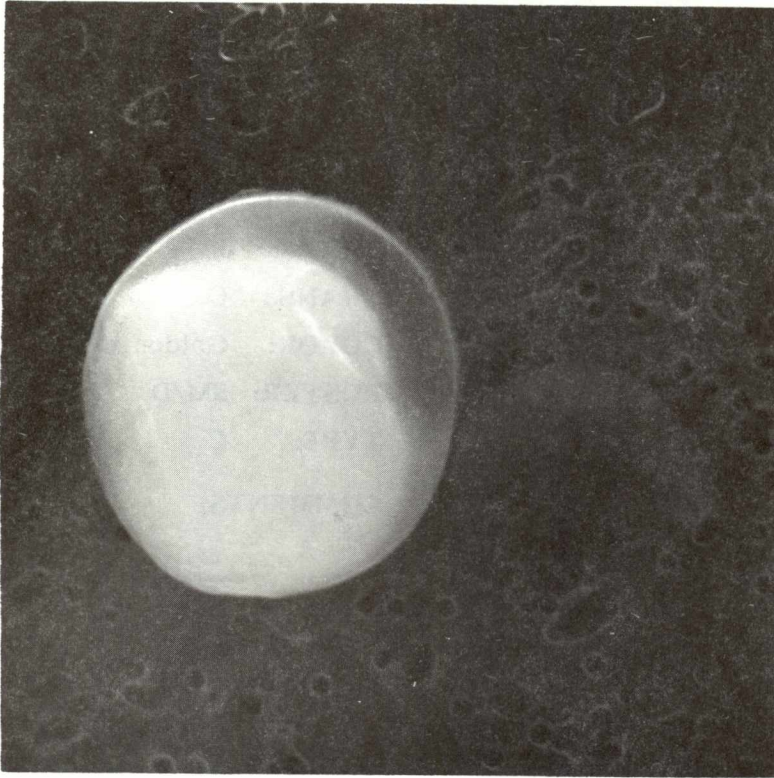


SIZE: 14x13  
SHAPE: I  
TRANS.: TL/O  
COLOR: Golden to black  
LUSTER: V/D  
TYPE: C  
COMMENTS:

S-86-40409



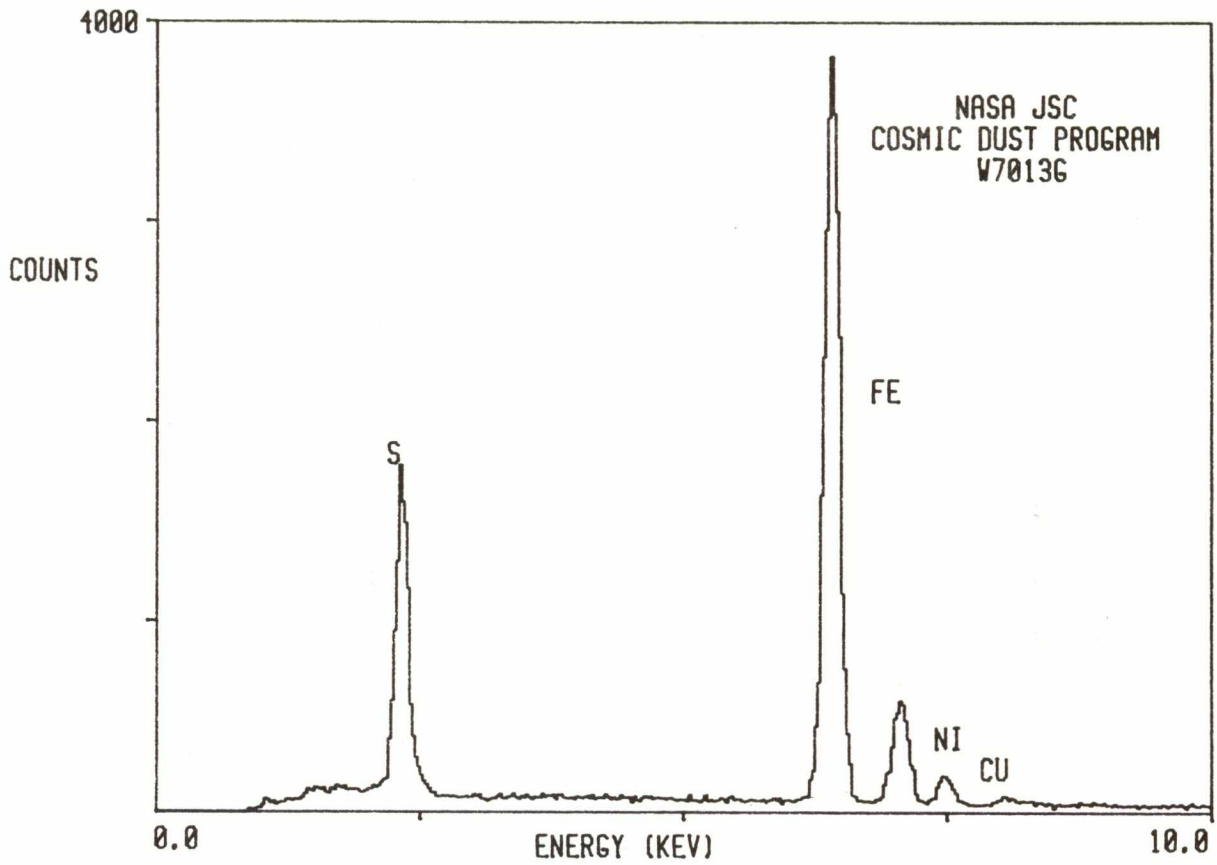
W7013 G 7



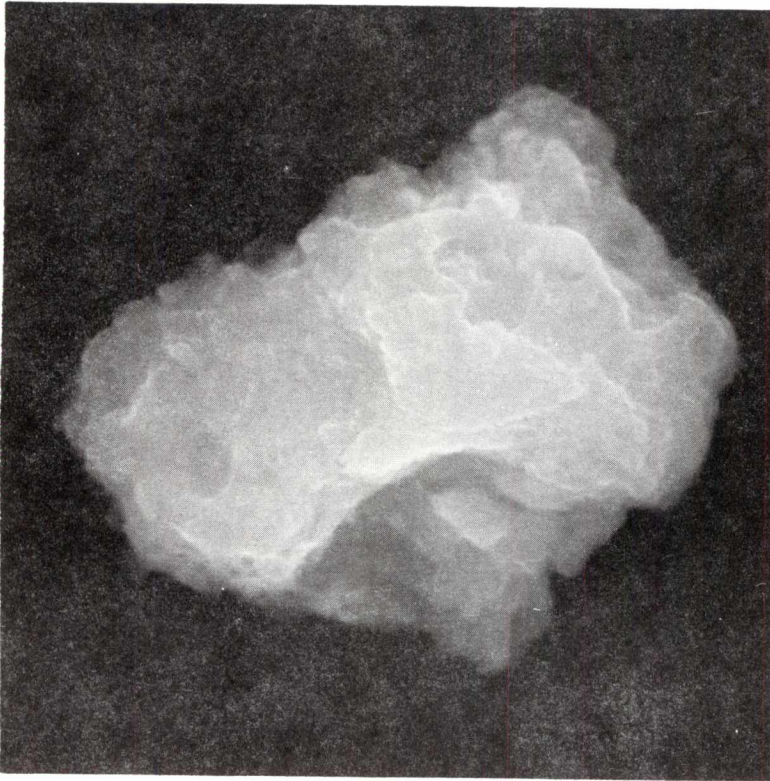
SIZE: 11x7  
SHAPE: S  
TRANS.: T/O  
COLOR: Yellow to brown  
LUSTER: V/SM  
TYPE: C?  
COMMENTS:

S-86-40410

W67

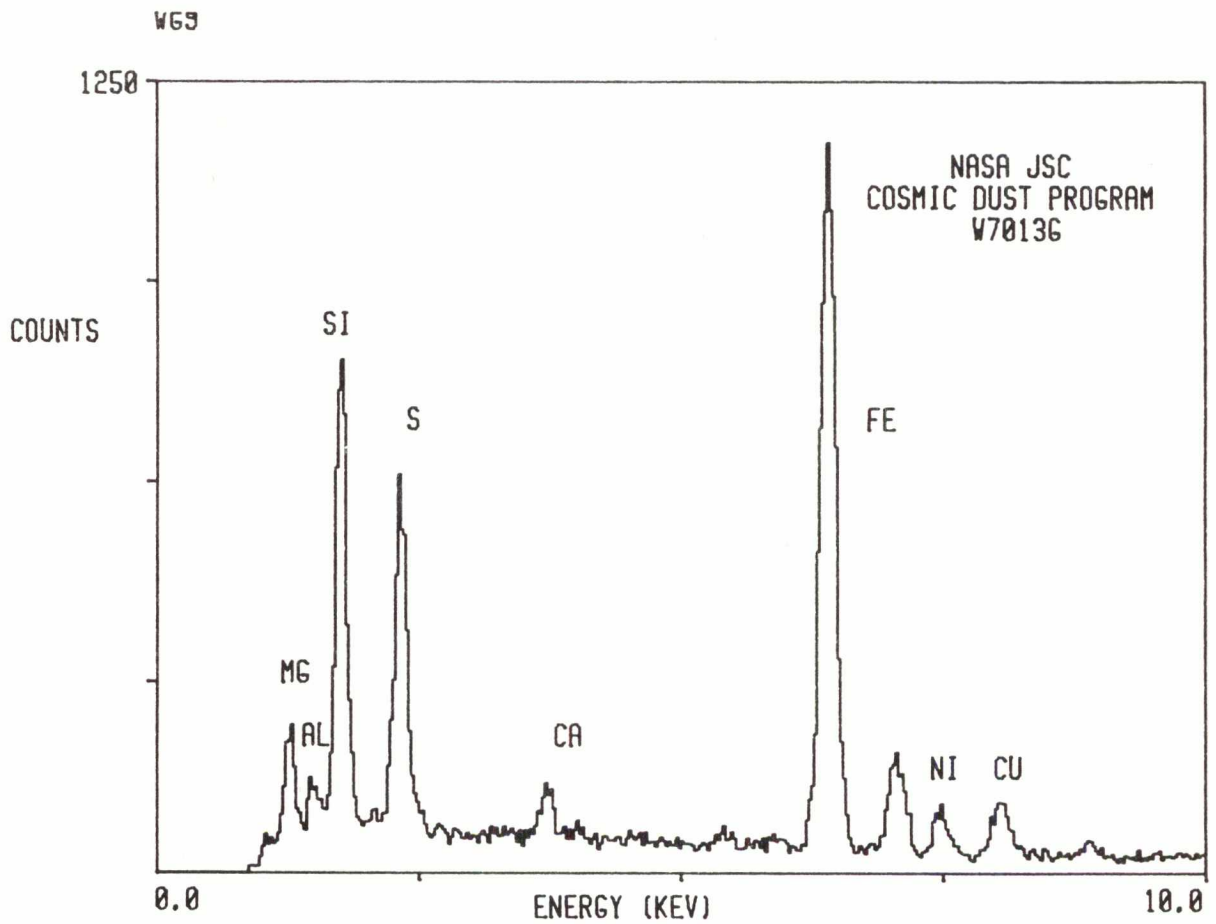


W7013 G 9

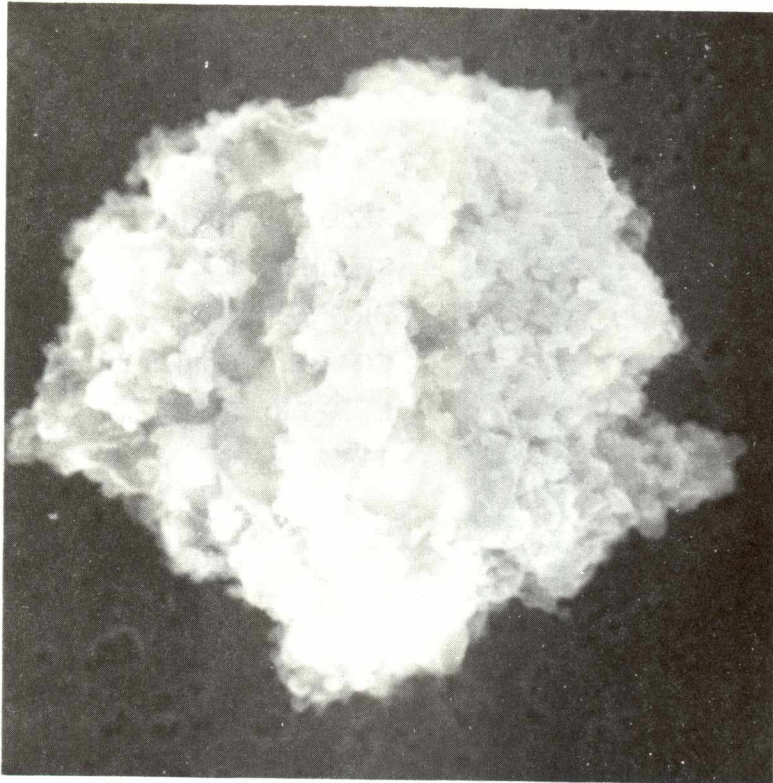


SIZE: 18x14  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:

S-86-40411

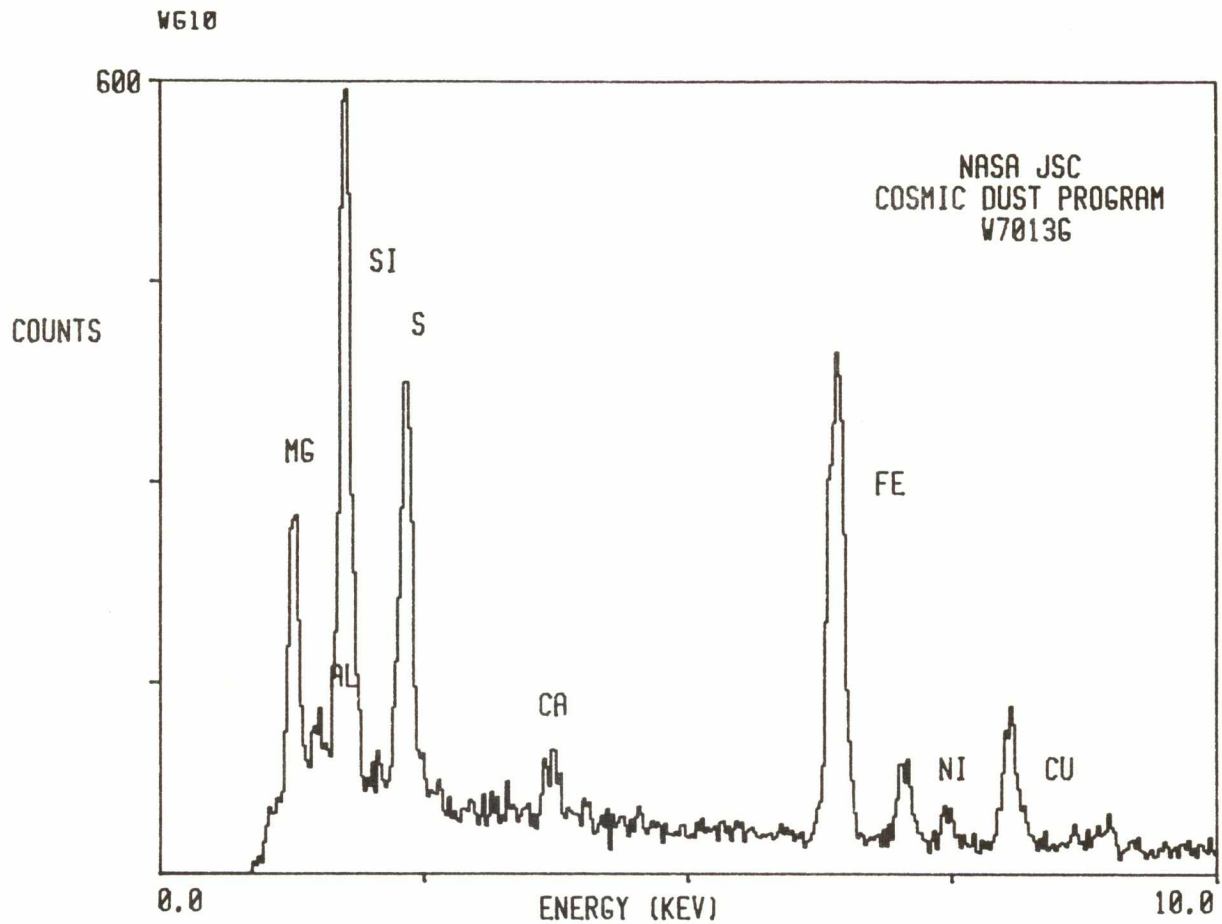


W7013 G 10



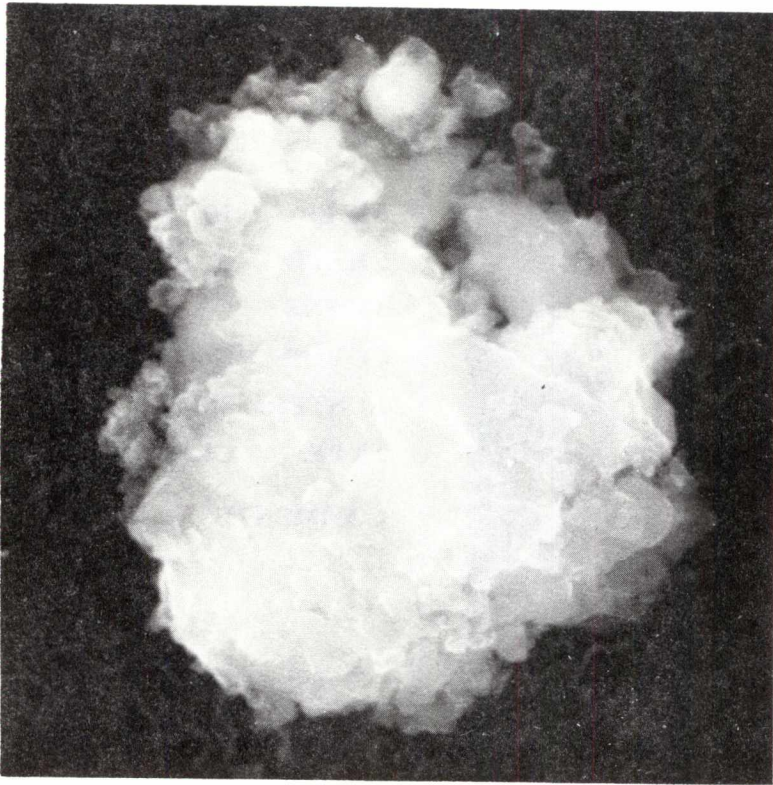
SIZE: 16  
SHAPE: E  
TRANS.: O  
COLOR: Golden to black  
LUSTER: SM/D  
TYPE: C?  
COMMENTS:

S-86-40412



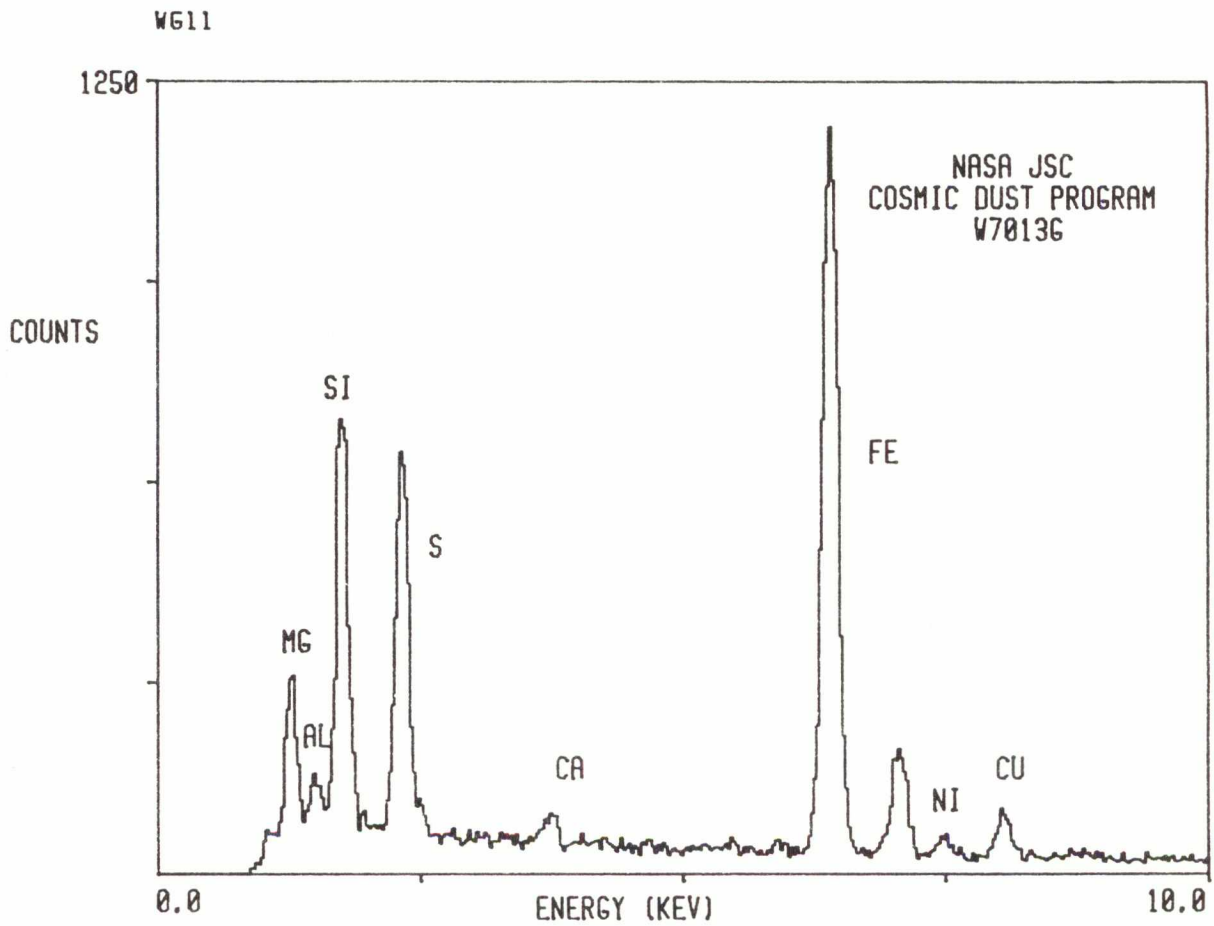


W7013 G 11

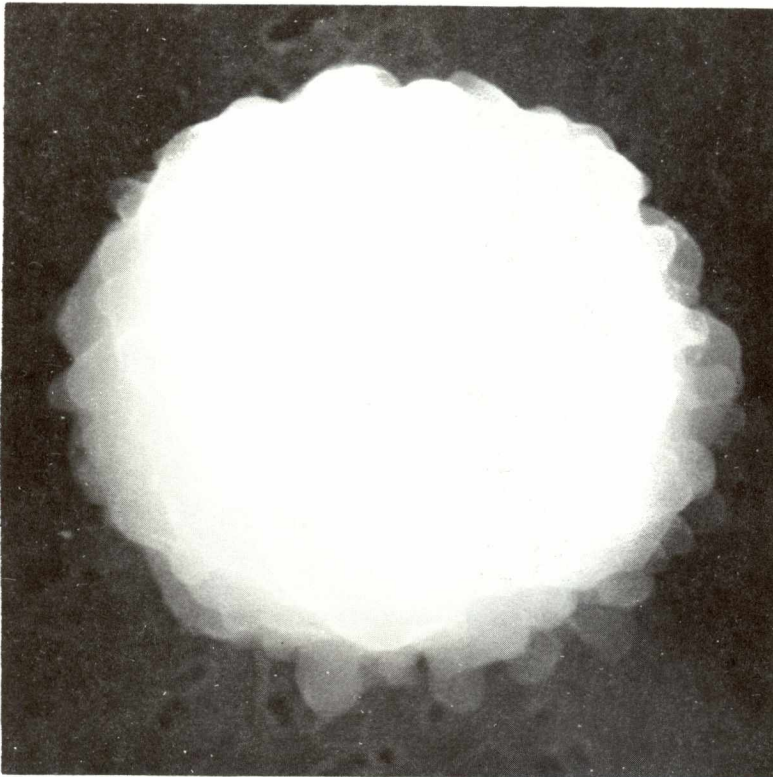


SIZE: 12x10  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:

S-86-40413

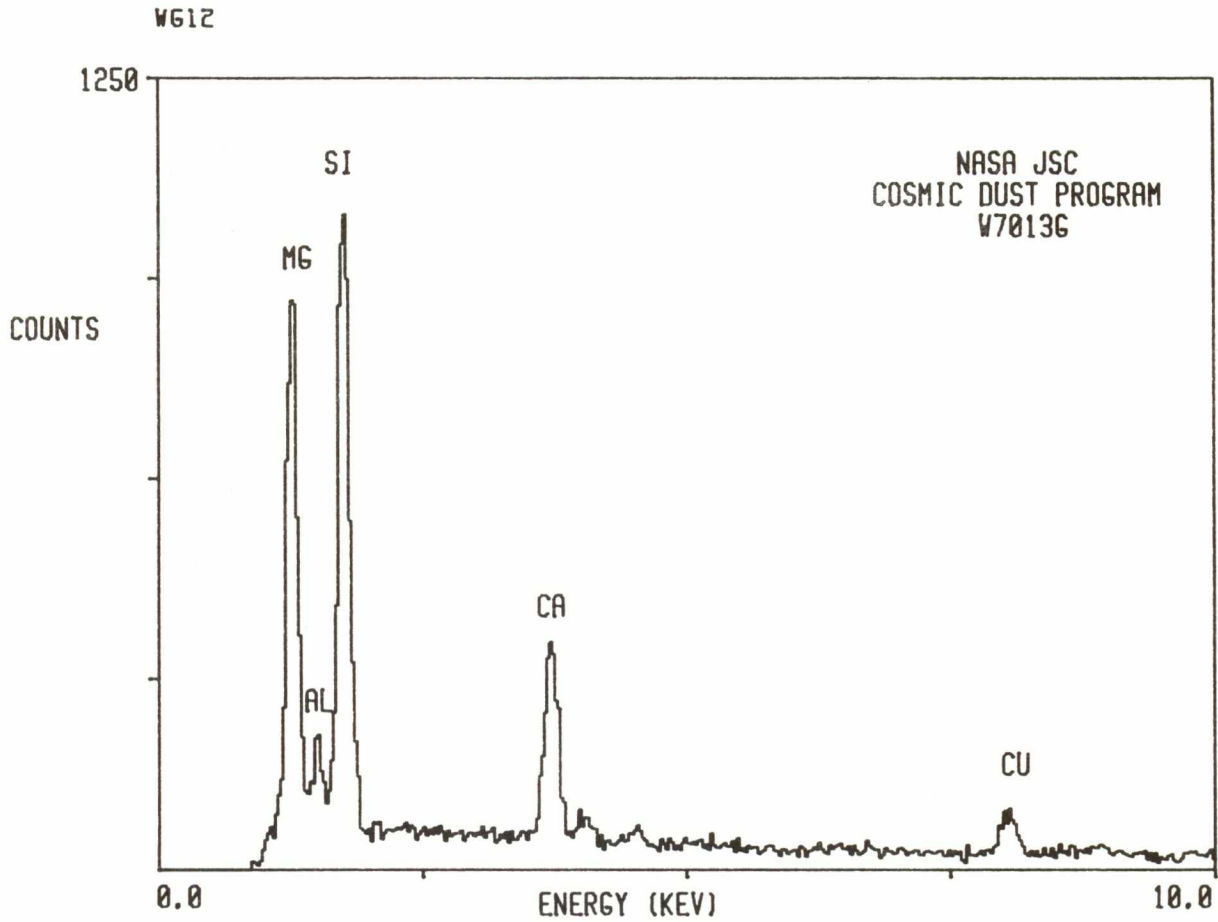


W7013 G 12

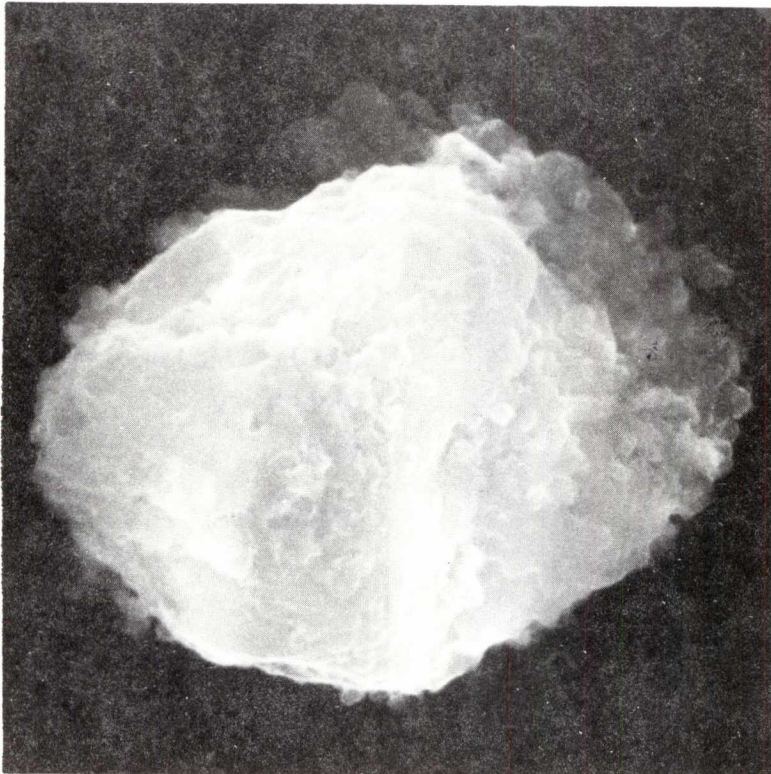


SIZE: 13  
SHAPE: S  
TRANS.: T  
COLOR: Yellow  
LUSTER: V  
TYPE: C  
COMMENTS:

S-86-40414



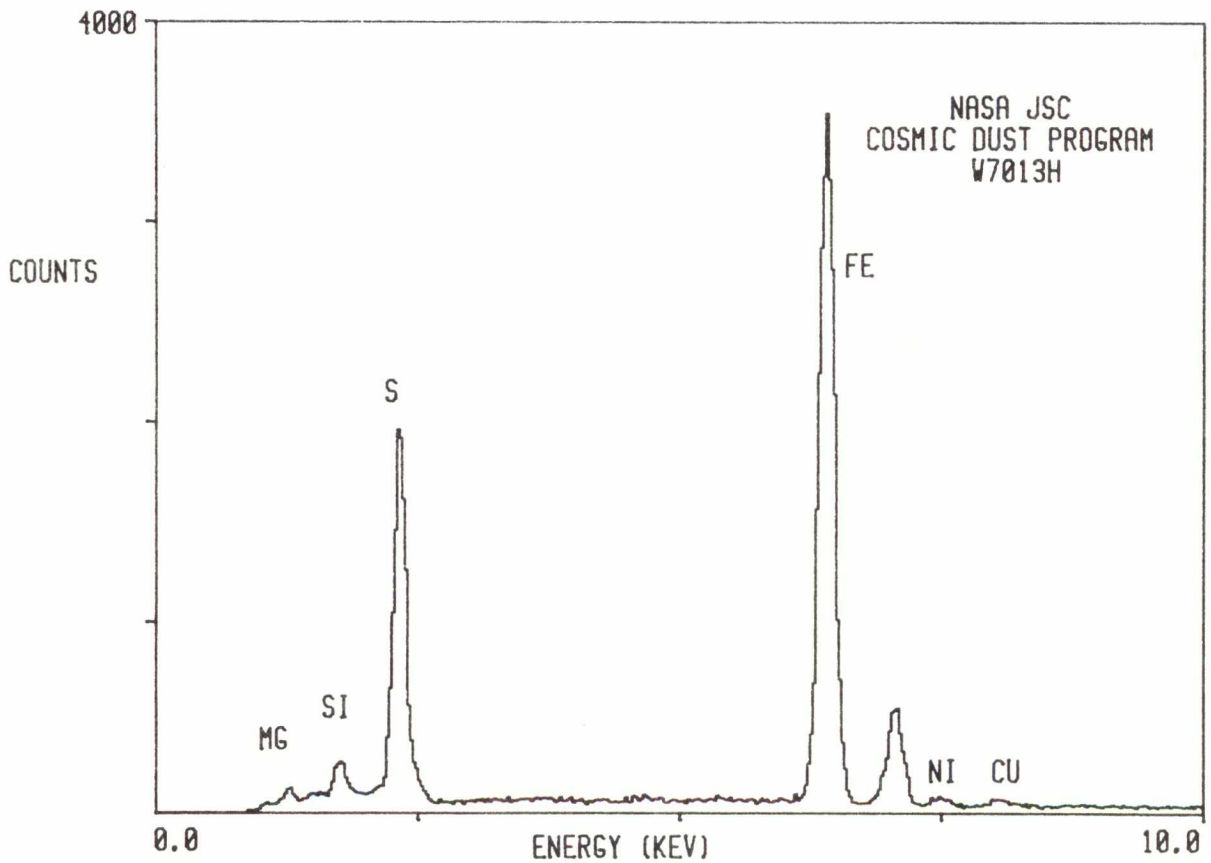
W7013 H 4



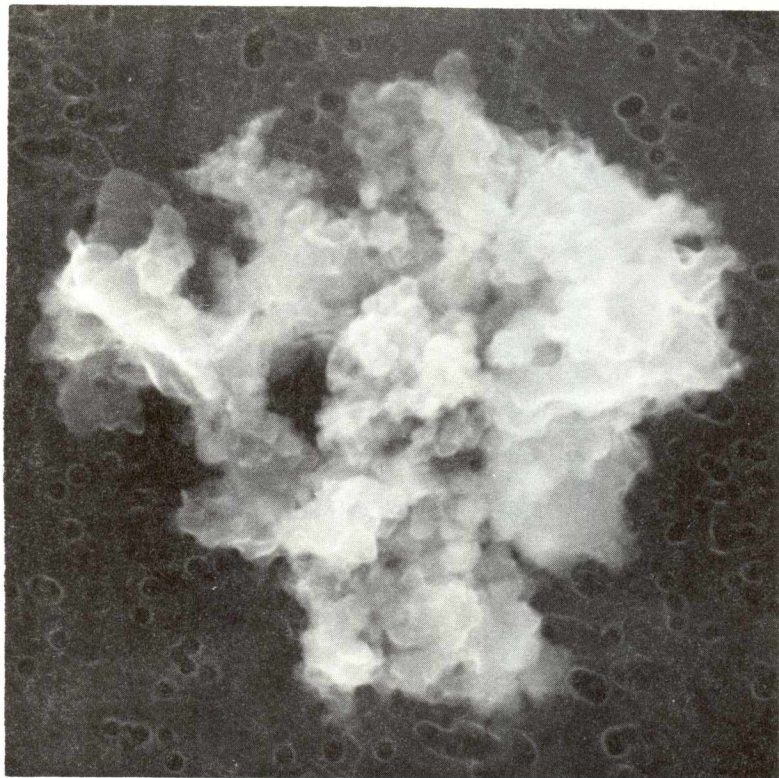
SIZE: 13x10  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: SM/D  
TYPE: C?  
COMMENTS:

S-86-40387

WH1

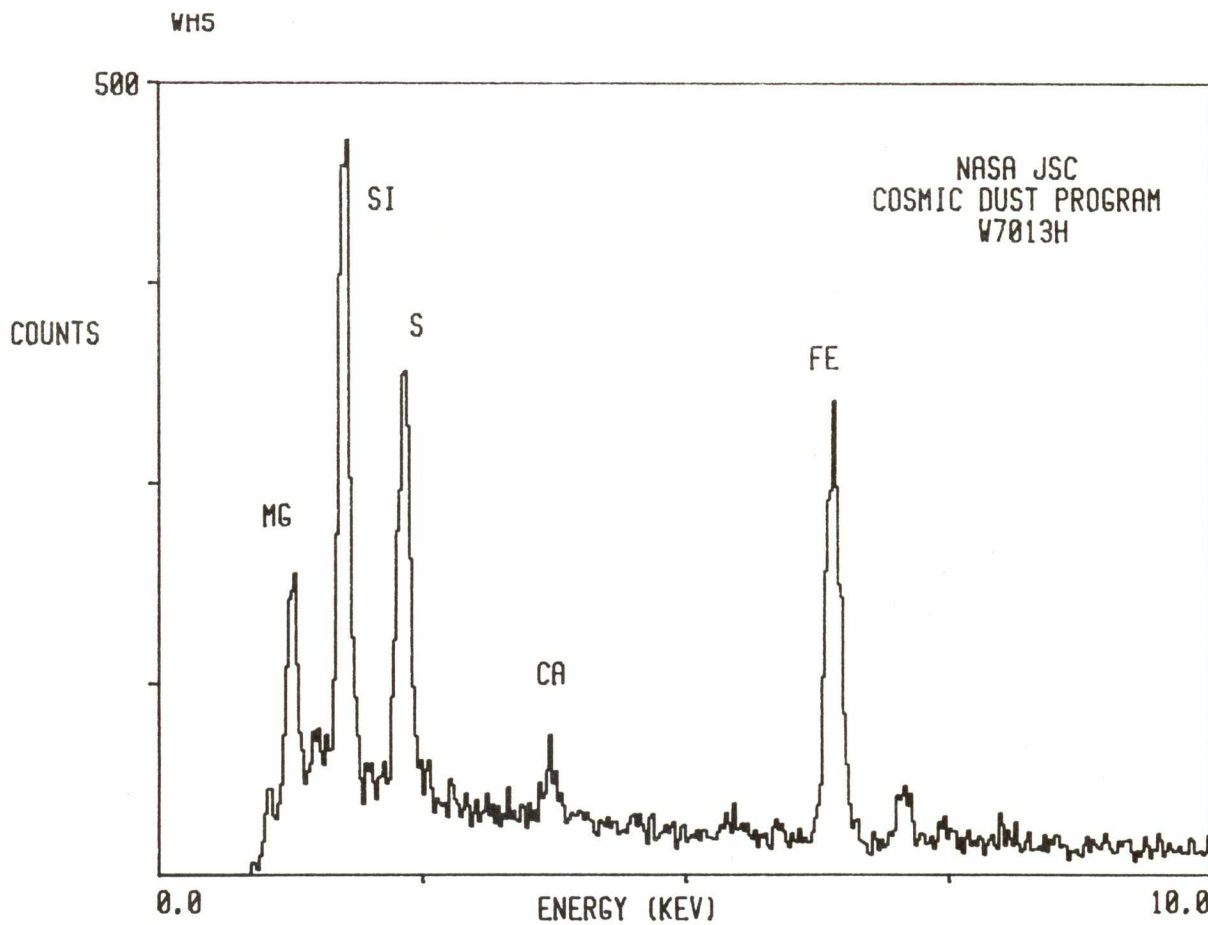


W7013 H 5

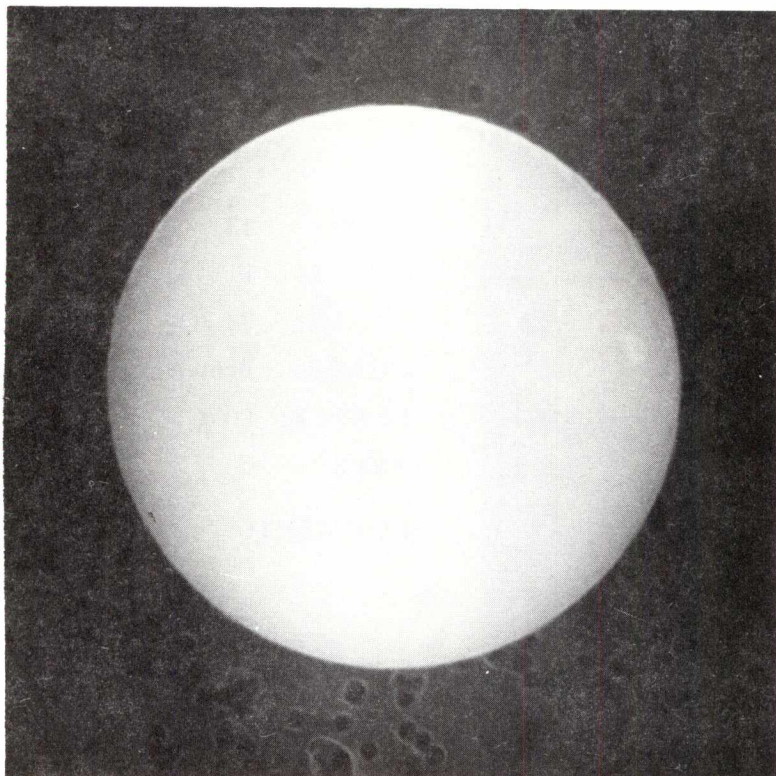


SIZE: 13  
SHAPE: E  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: D/R  
TYPE: C  
COMMENTS:

S-86-40388

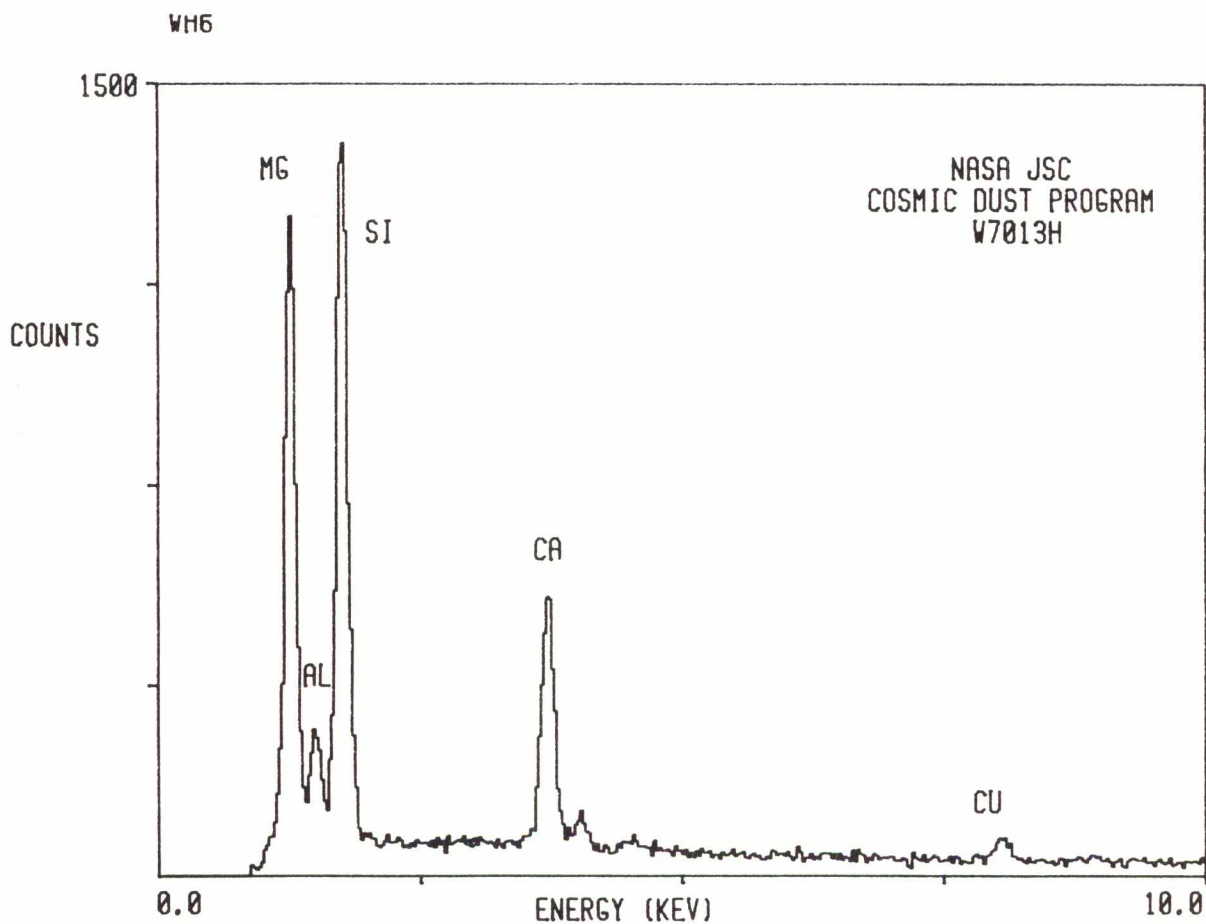


W7013 H 6

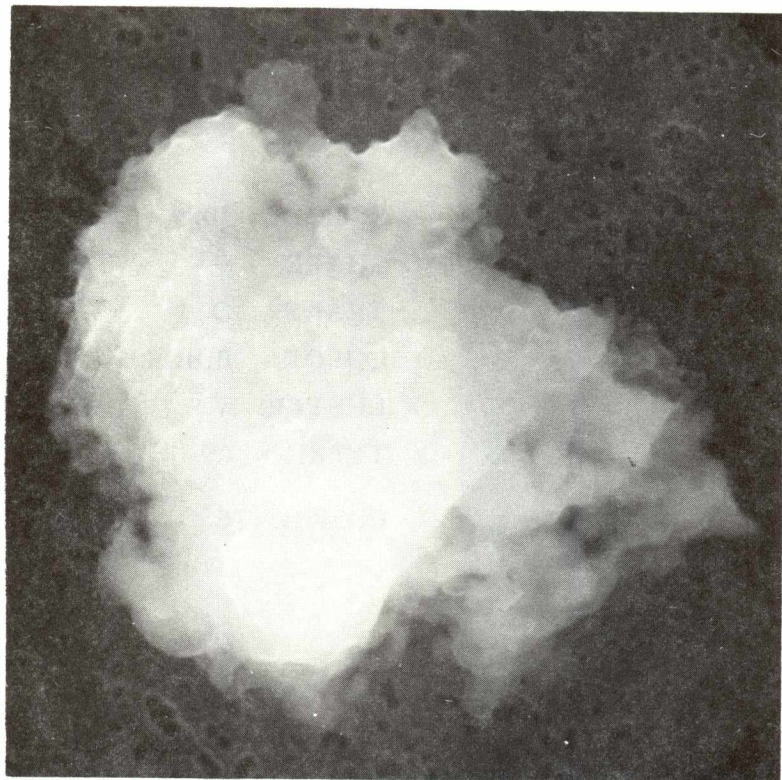


SIZE: 12  
SHAPE: S  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: C?  
COMMENTS:

S-86-40389



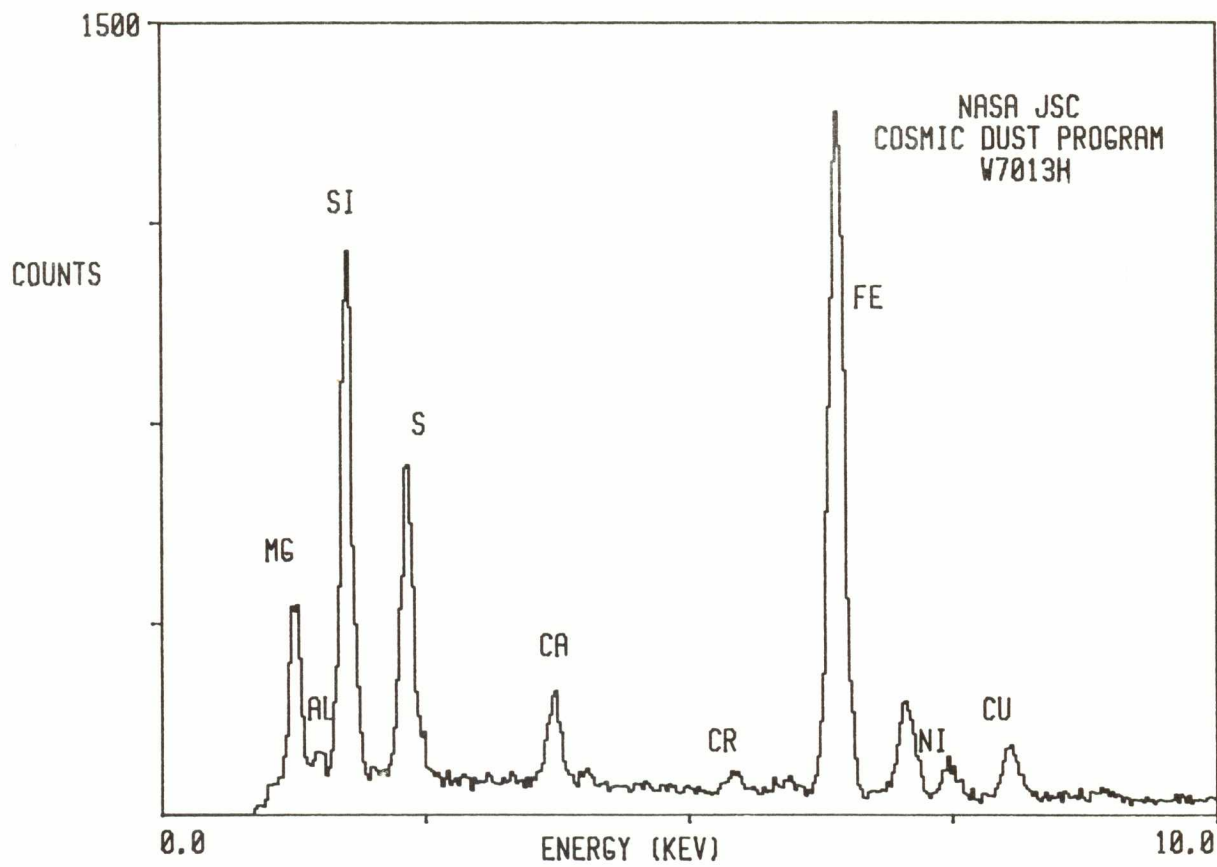
W7013 H 17



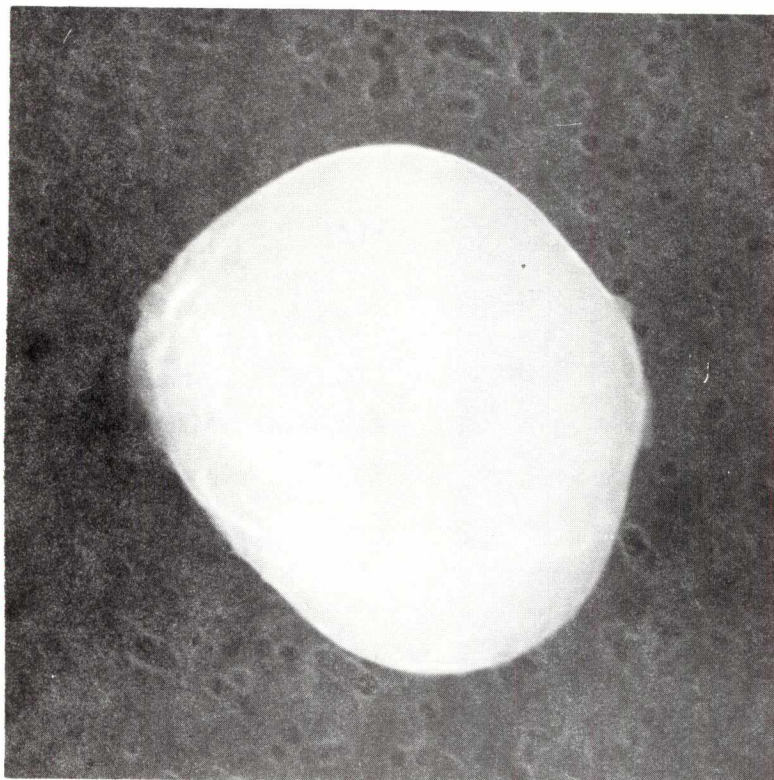
SIZE: 16x15  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: SM/D  
TYPE: C  
COMMENTS:

S-86-40399

WH17



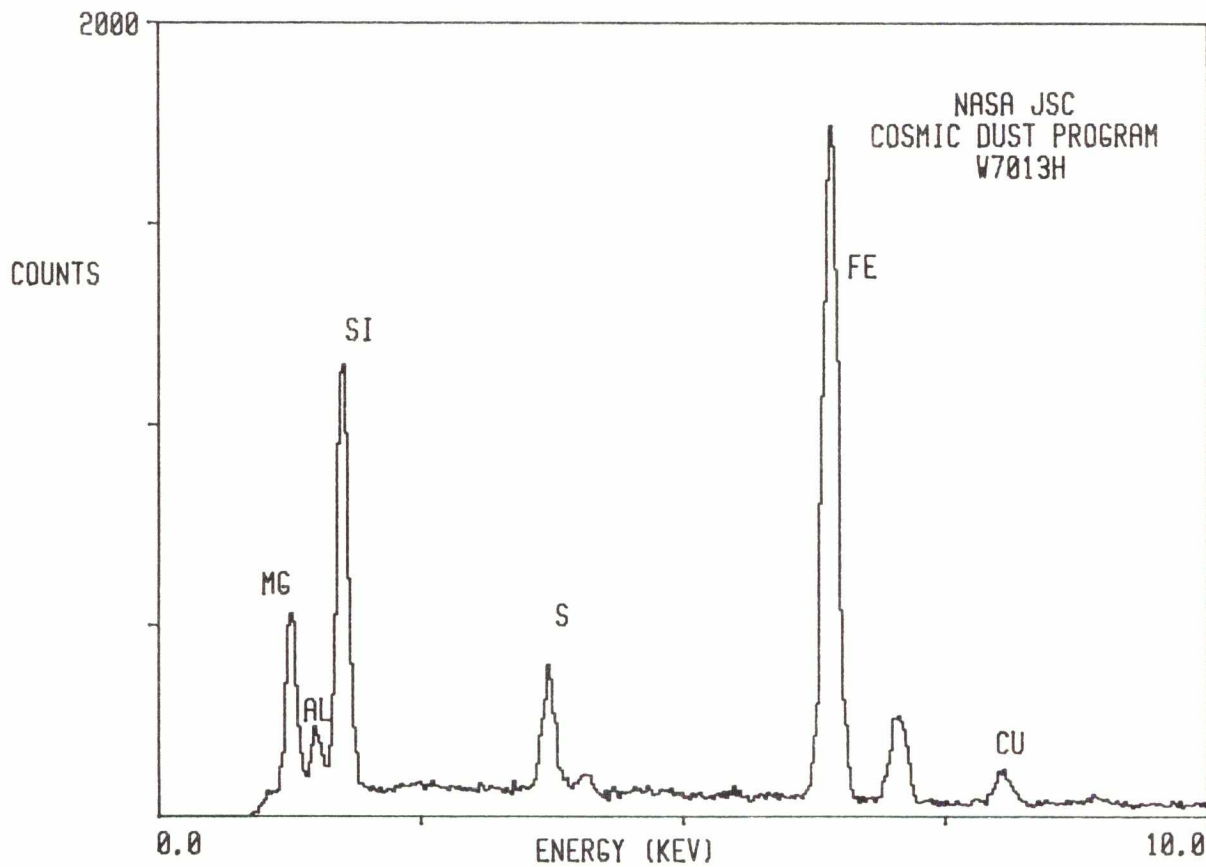
W7013 H 20



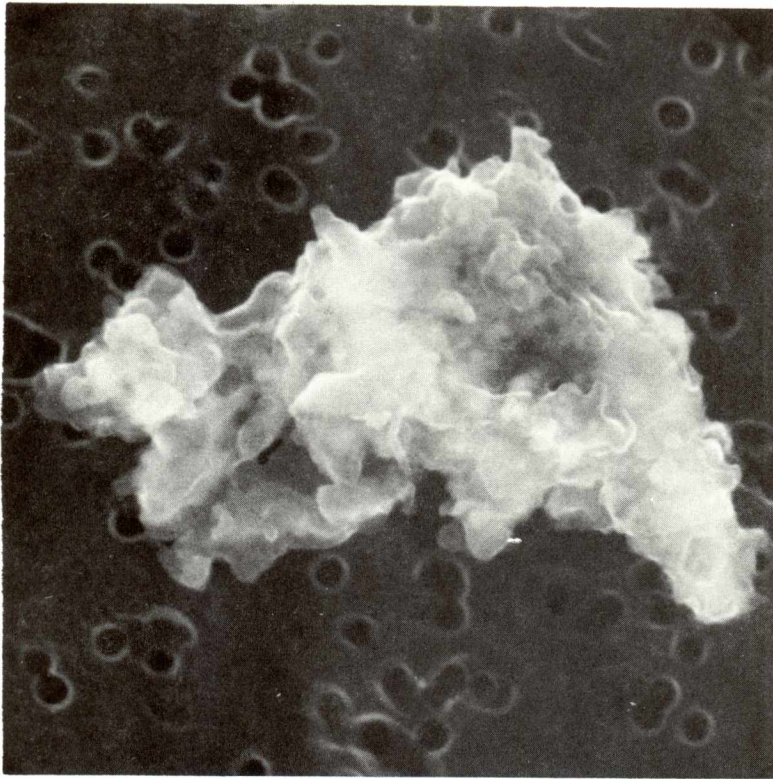
SIZE: 10x9  
SHAPE: S  
TRANS.: O  
COLOR: Brown  
LUSTER: V  
TYPE: C?  
COMMENTS:

S-86-40402

WH20

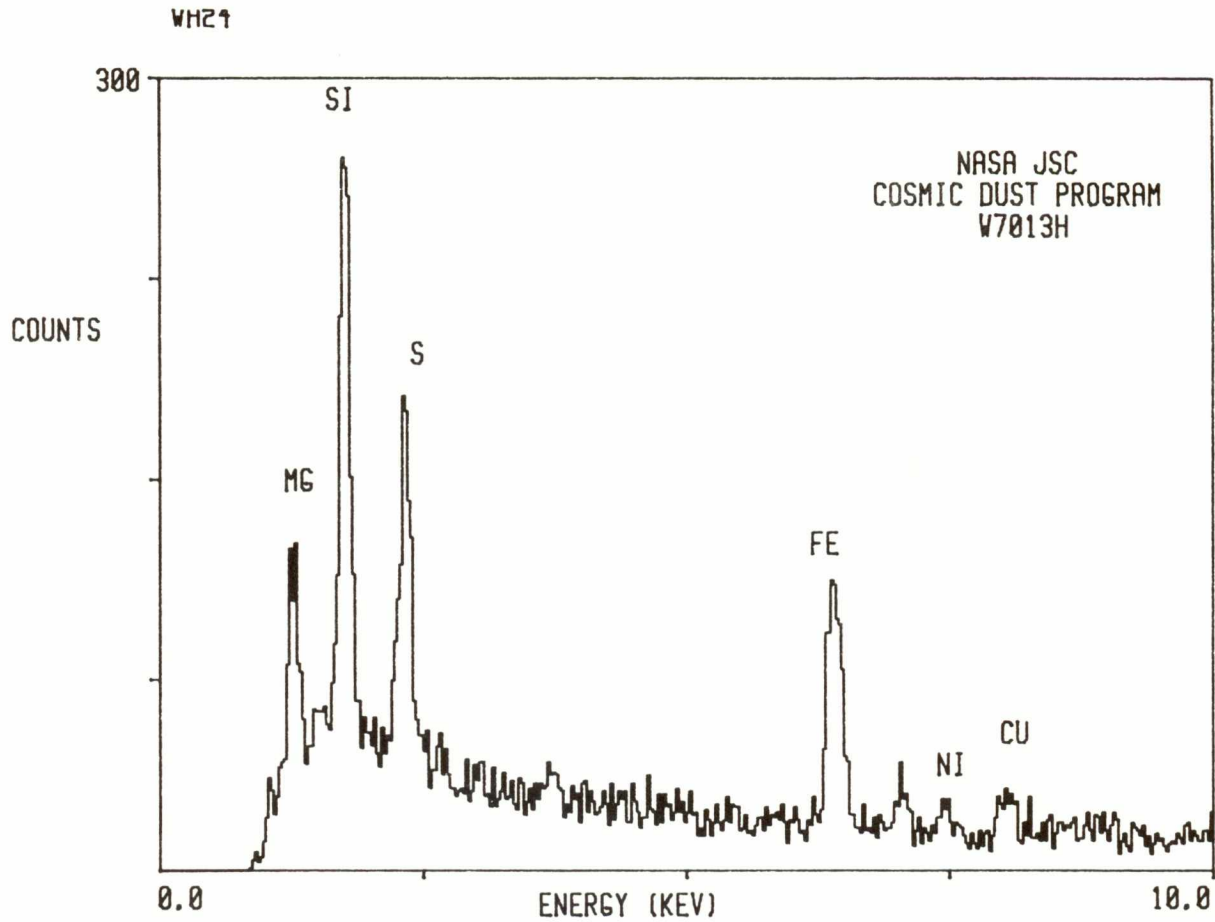


W7013 H 24



SIZE: 9x6  
SHAPE: I  
TRANS.: O  
COLOR: Brown to black  
LUSTER: D/SM  
TYPE: C  
COMMENTS:

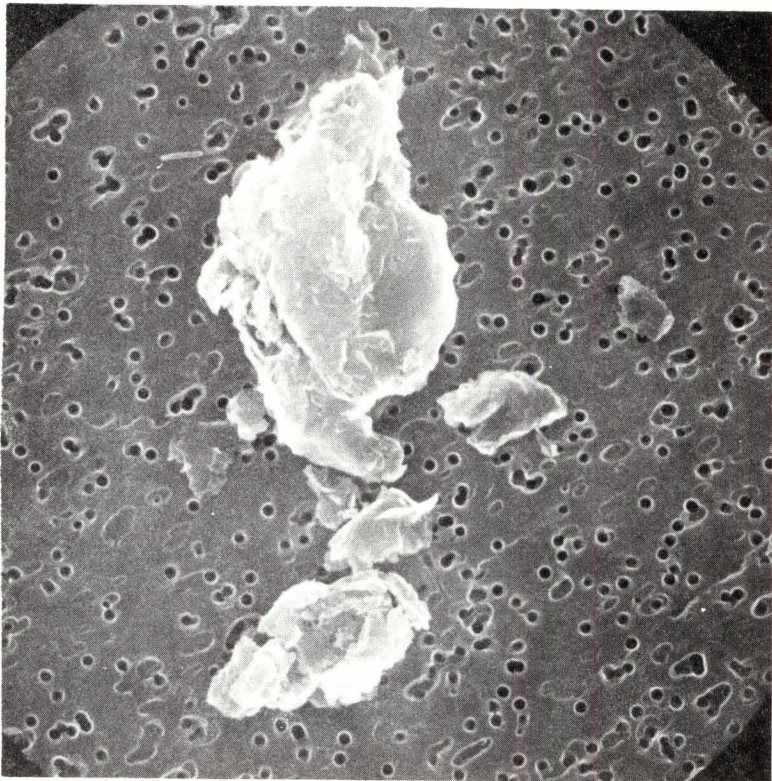
S-86-40404





**UNCERTAIN**

W7013 B 16

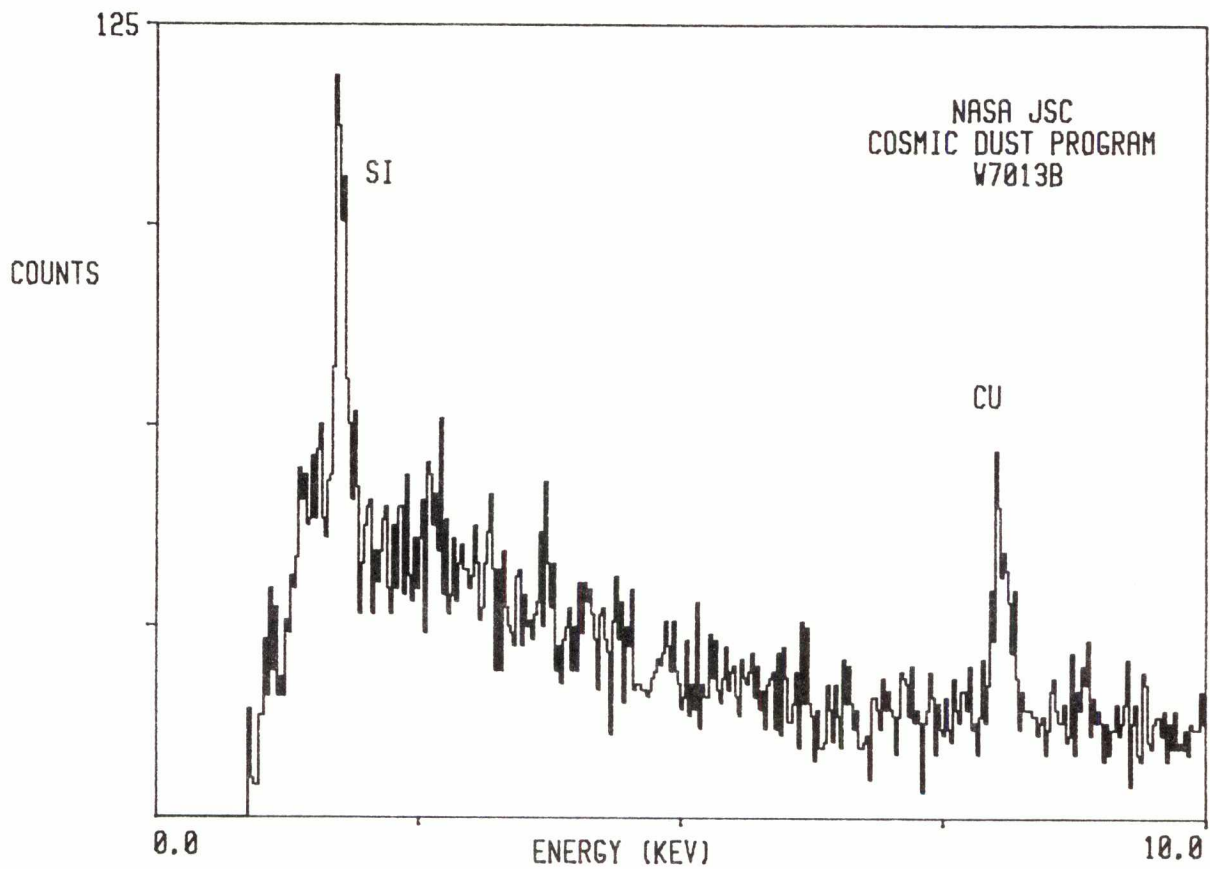


SIZE: 10x6  
SHAPE: I  
TRANS.: O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: ?

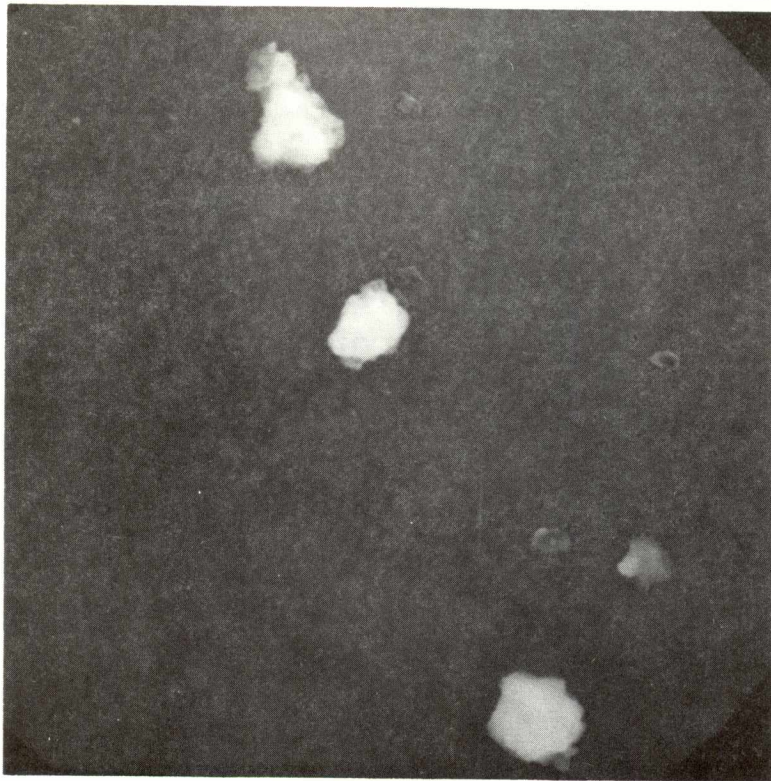
COMMENTS:  
May be related to  
W7013B15

S-86-40326

WB16

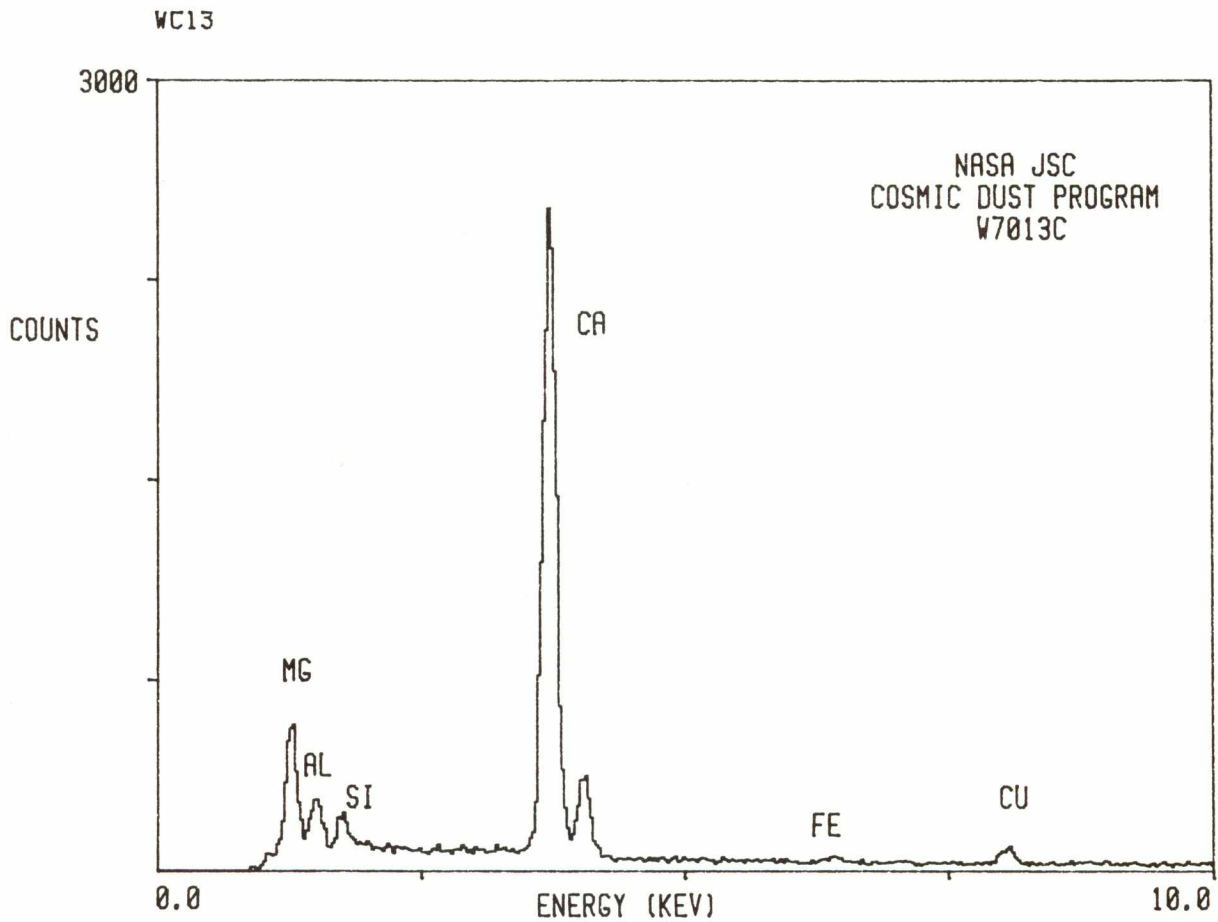


W7013 C 13

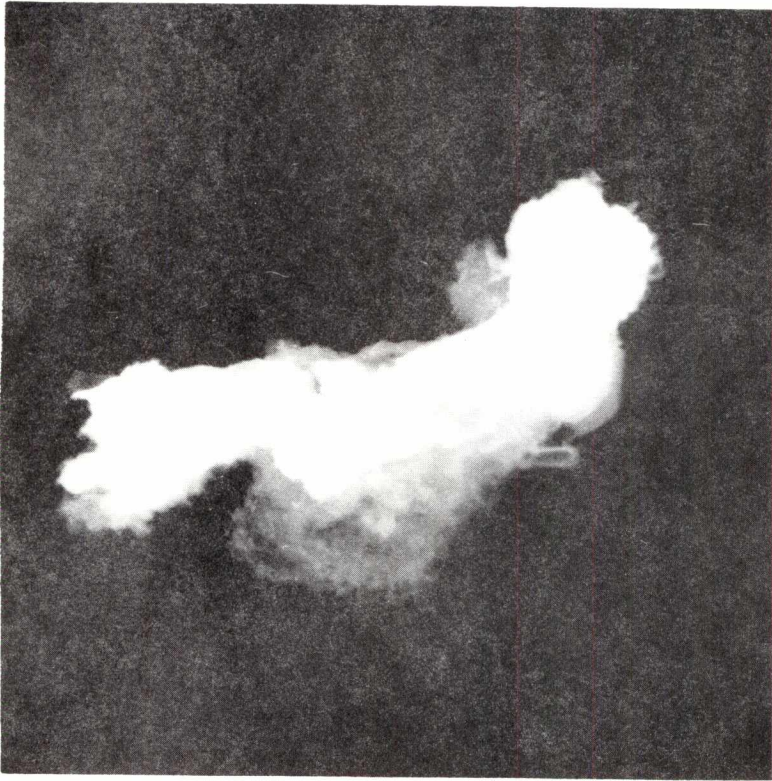


SIZE: 20  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: ?  
COMMENTS:  
3 related  
fragments

S-86-40338

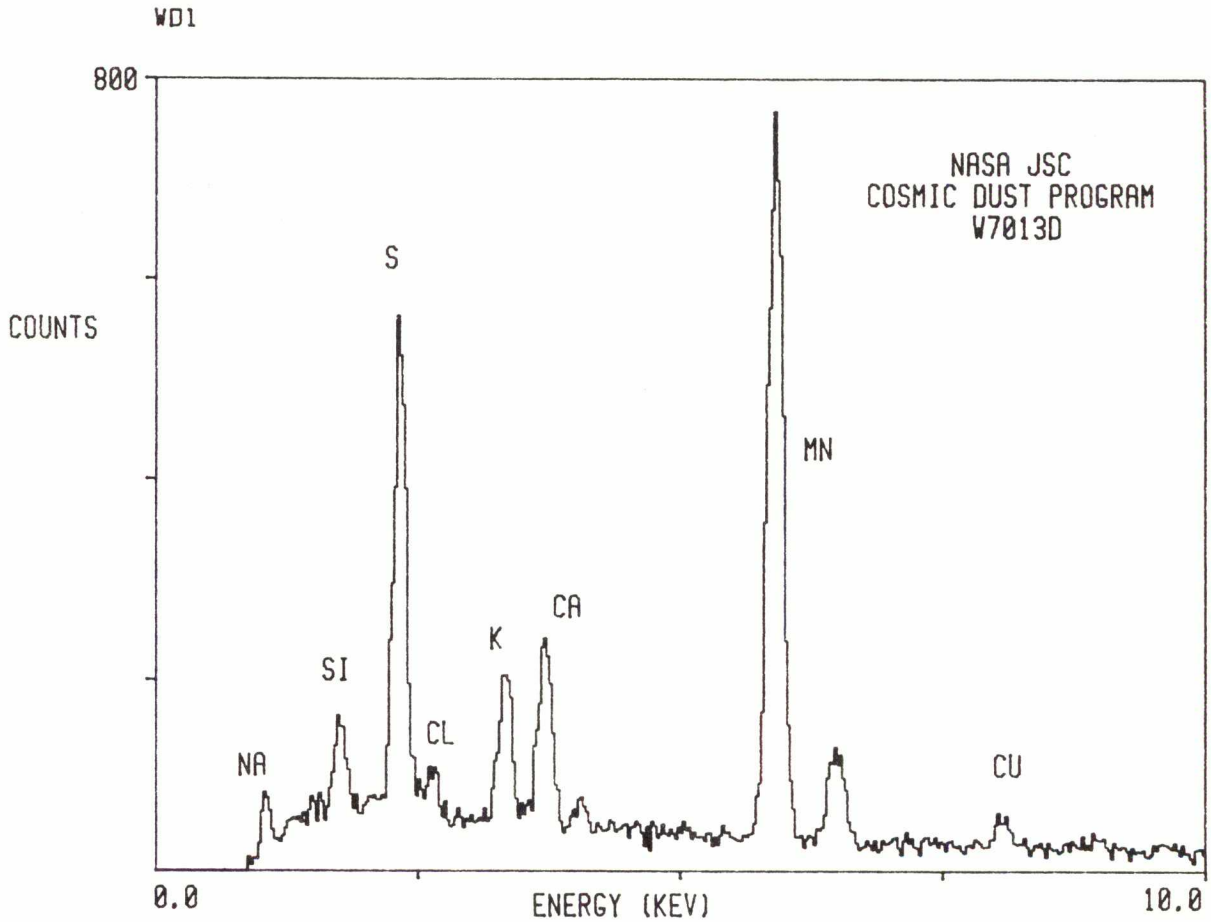


W7013 D 1

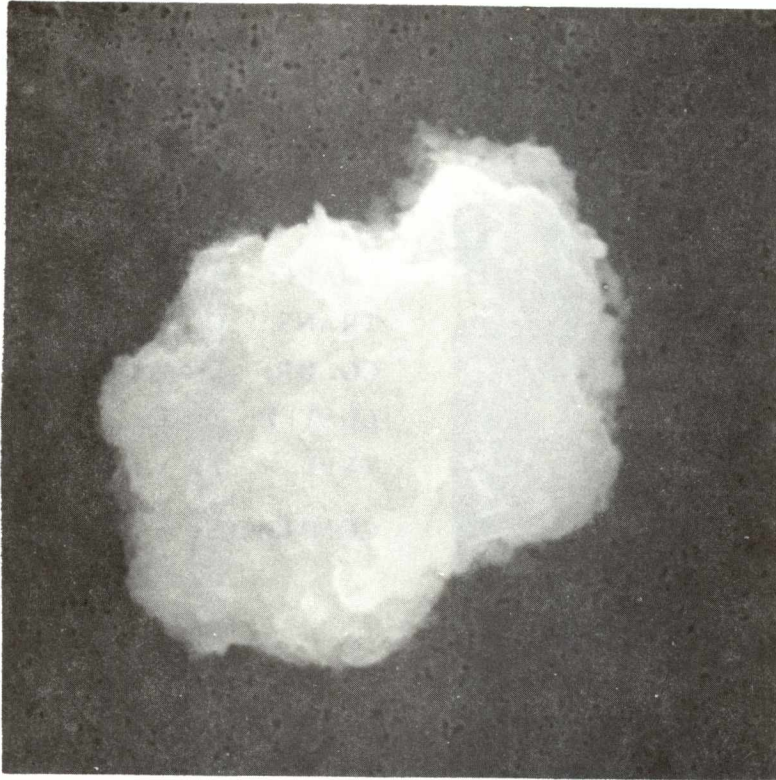


SIZE: 70x30  
SHAPE: I  
TRANS.: O  
COLOR: Yellow  
LUSTER: V/D  
TYPE: ?  
COMMENTS:

S-86-40340



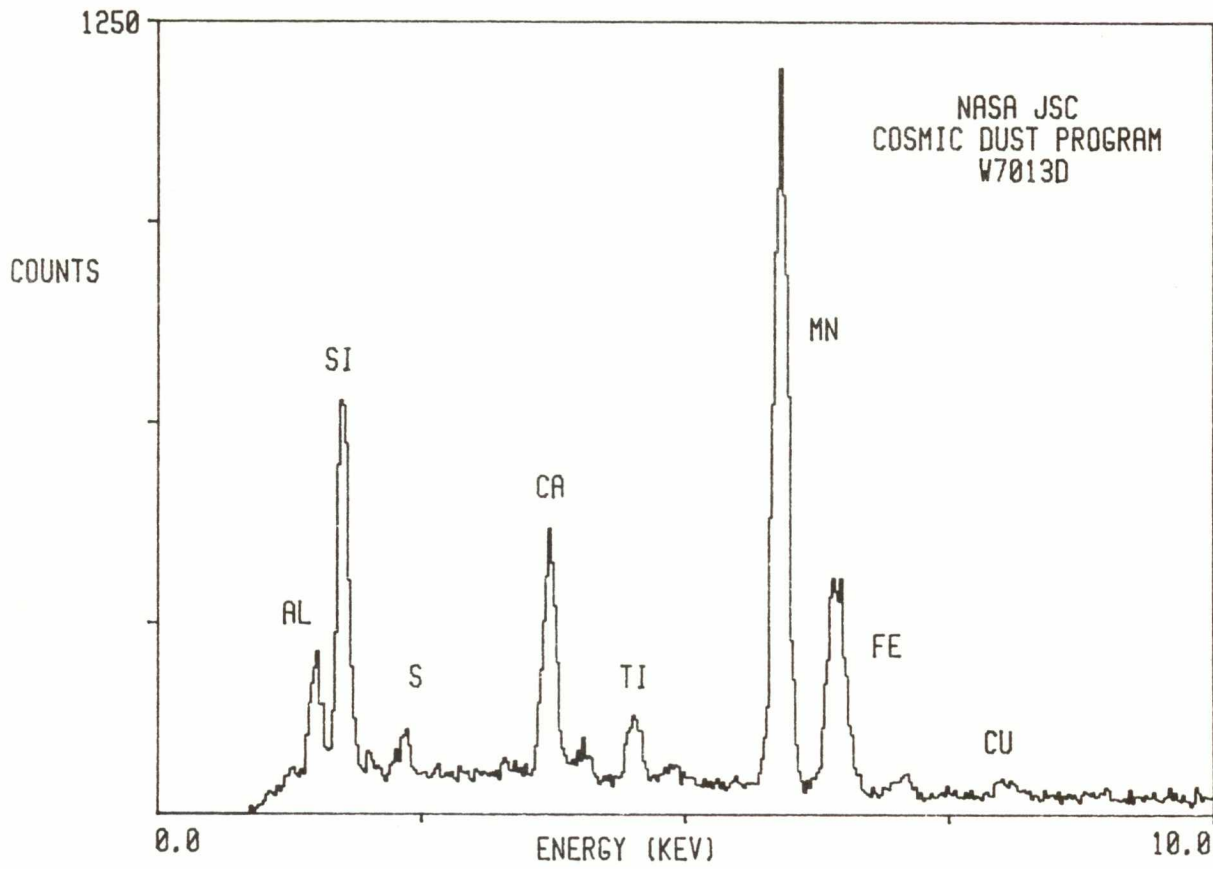
W7013 D 5



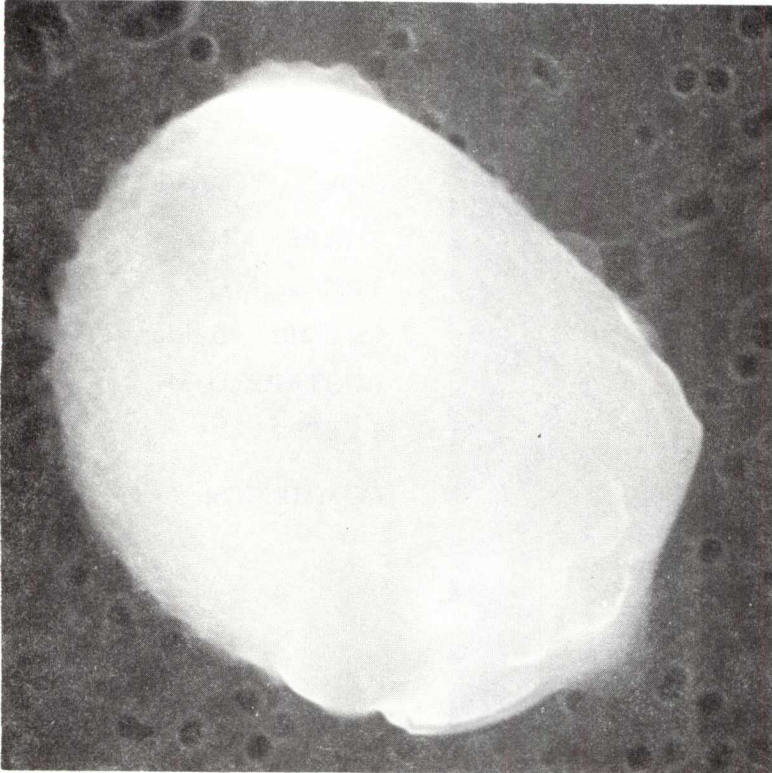
SIZE: 28x20  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: D/M  
TYPE: ?  
COMMENTS:

S-86-40342

WD5

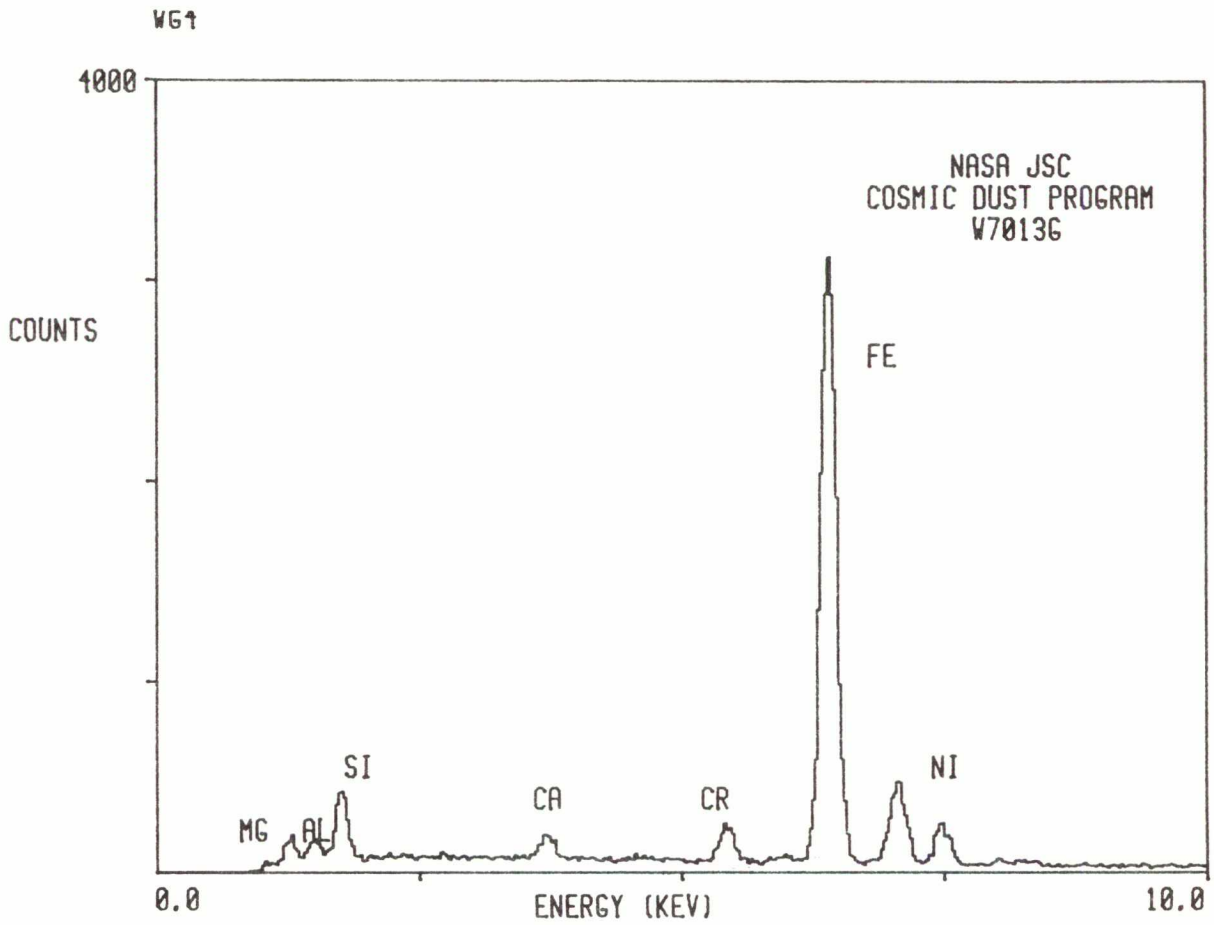


W7013 G 4

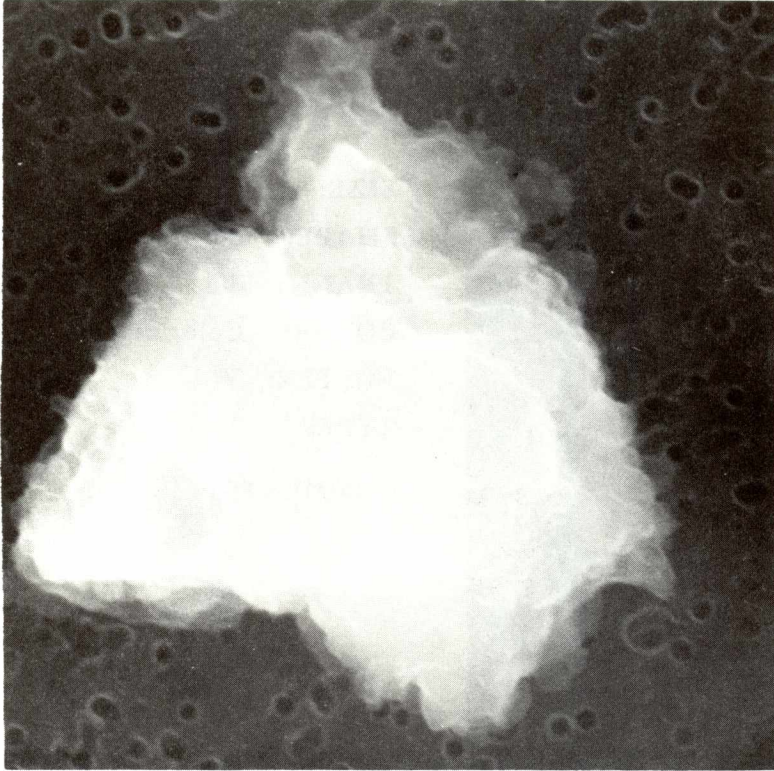


SIZE: 10x8  
SHAPE: S  
TRANS.: O  
COLOR: Brown to black  
LUSTER: SM/D  
TYPE: ?  
COMMENTS:

S-86-40407

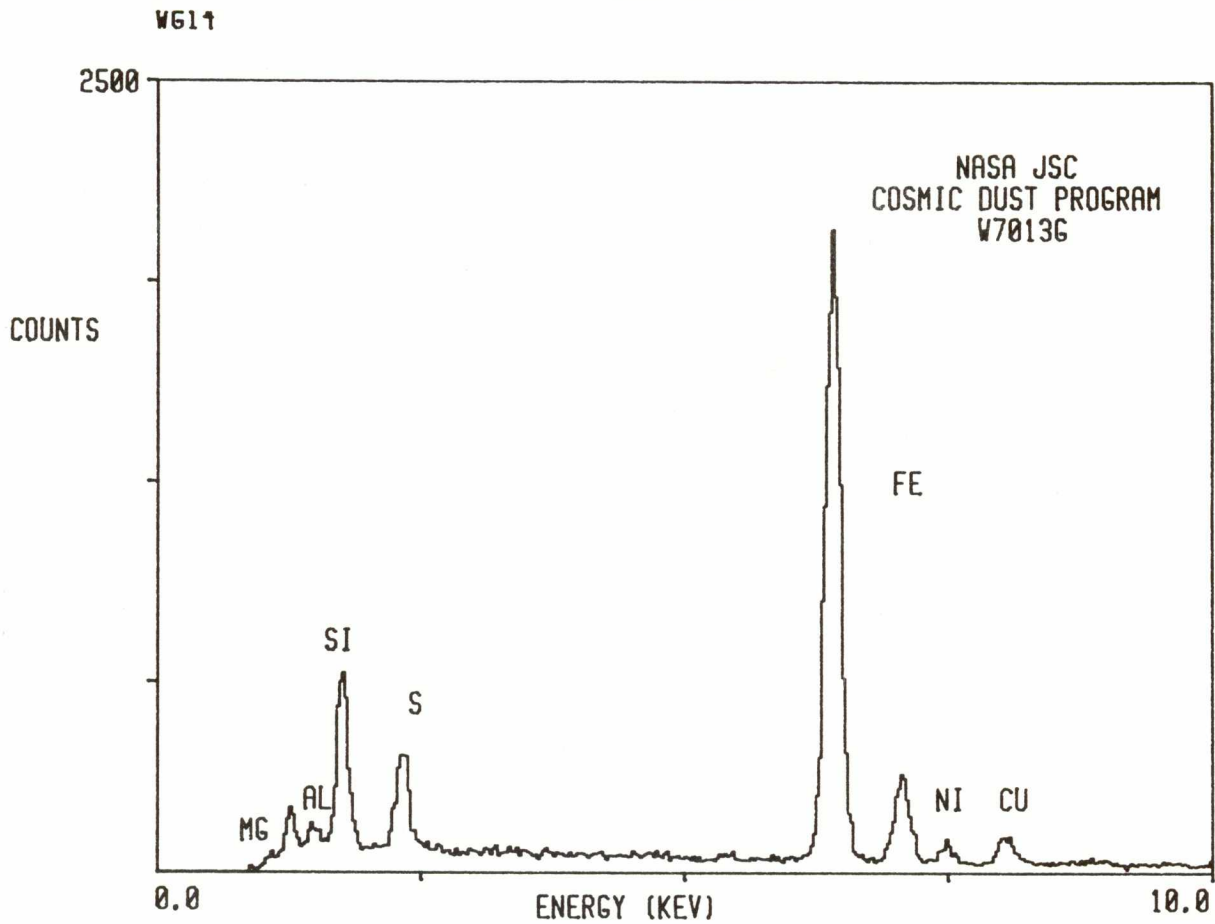


W7013 G 14

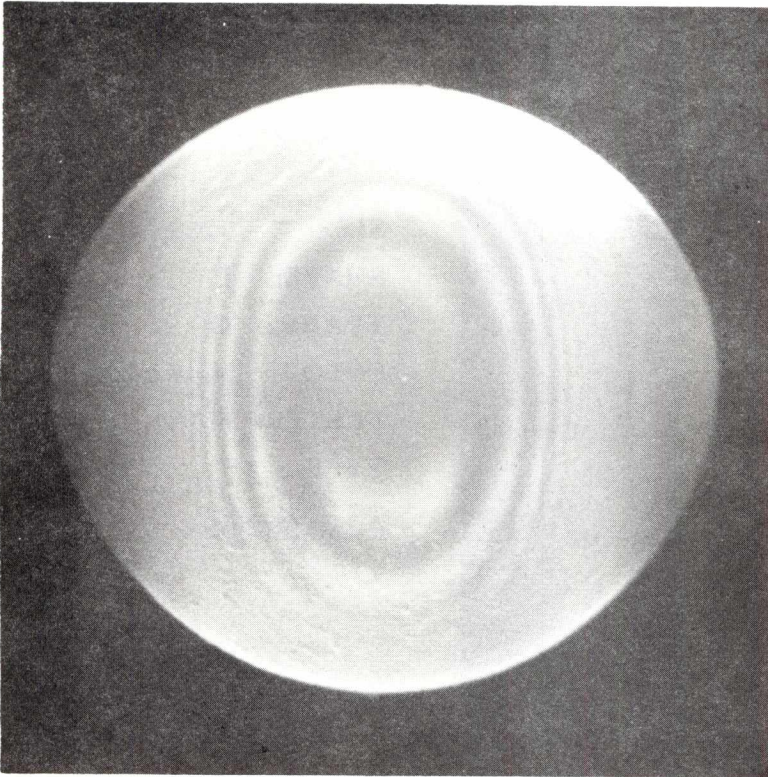


SIZE: 12x9  
SHAPE: I  
TRANS.: O  
COLOR: Brown to black  
LUSTER: SM/D  
TYPE: ?  
COMMENTS:

S-86-40416

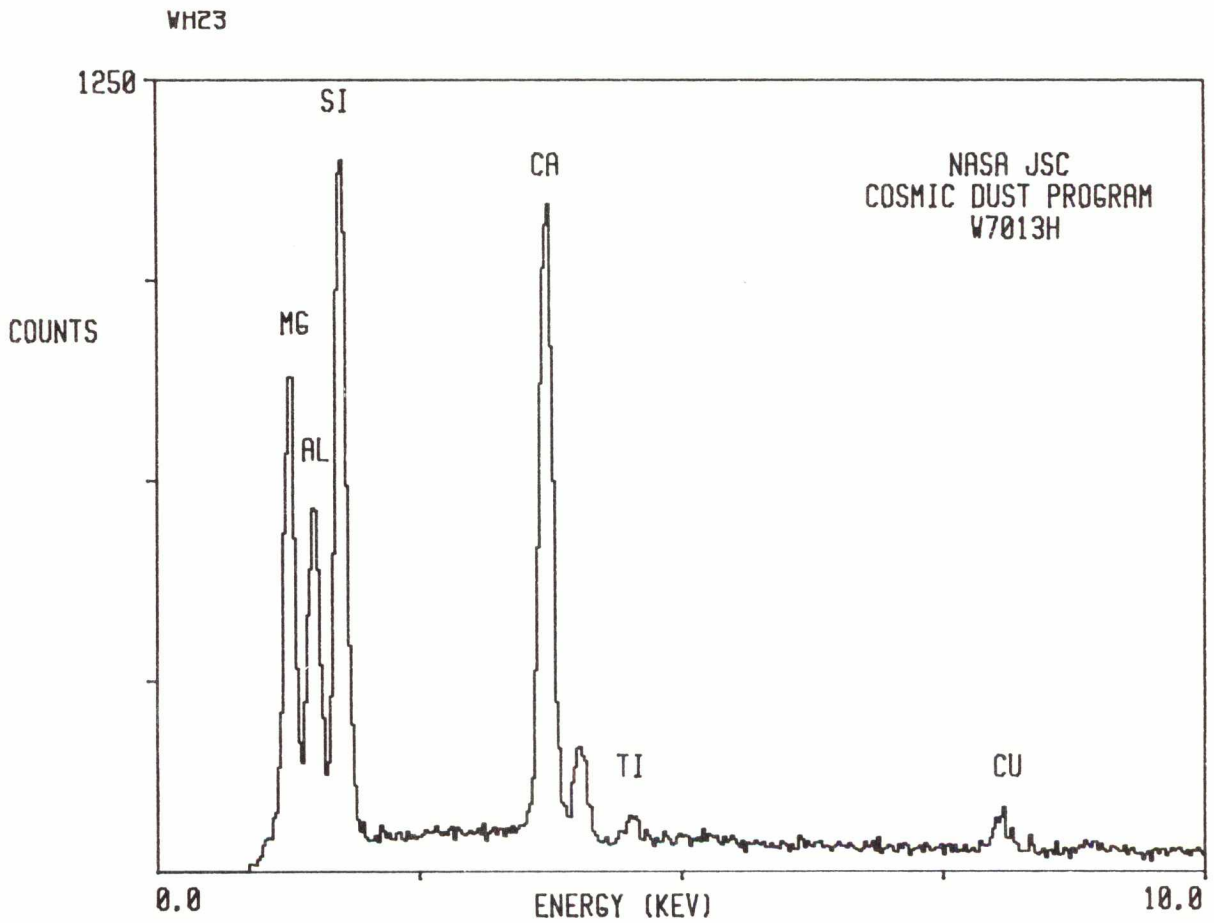


W7013 H 23



SIZE: 15  
SHAPE: S  
TRANS.: T  
COLOR: Colorless  
LUSTER: V  
TYPE: ?  
COMMENTS:

S-86-40403





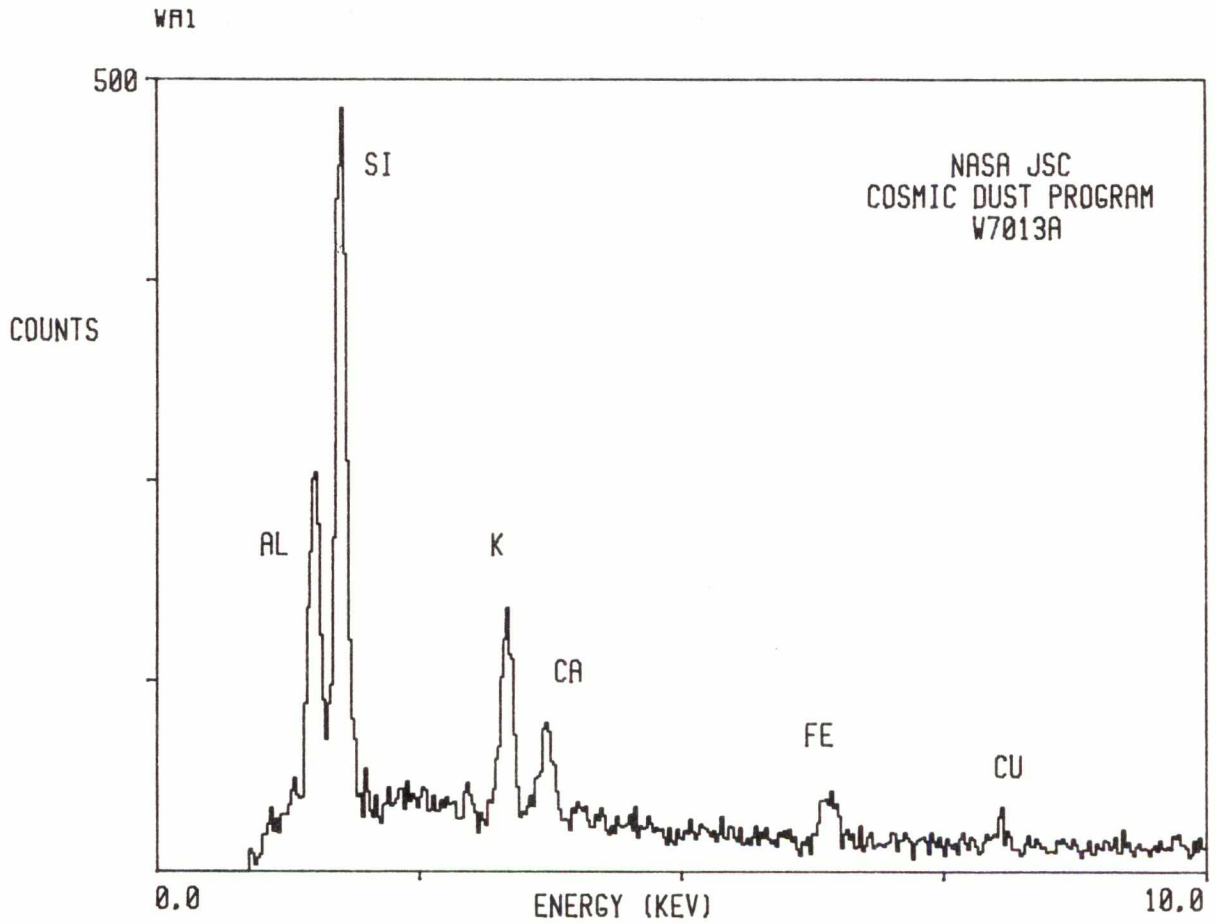
## TERRESTRIAL CONTAMINATION

W7013 A 1

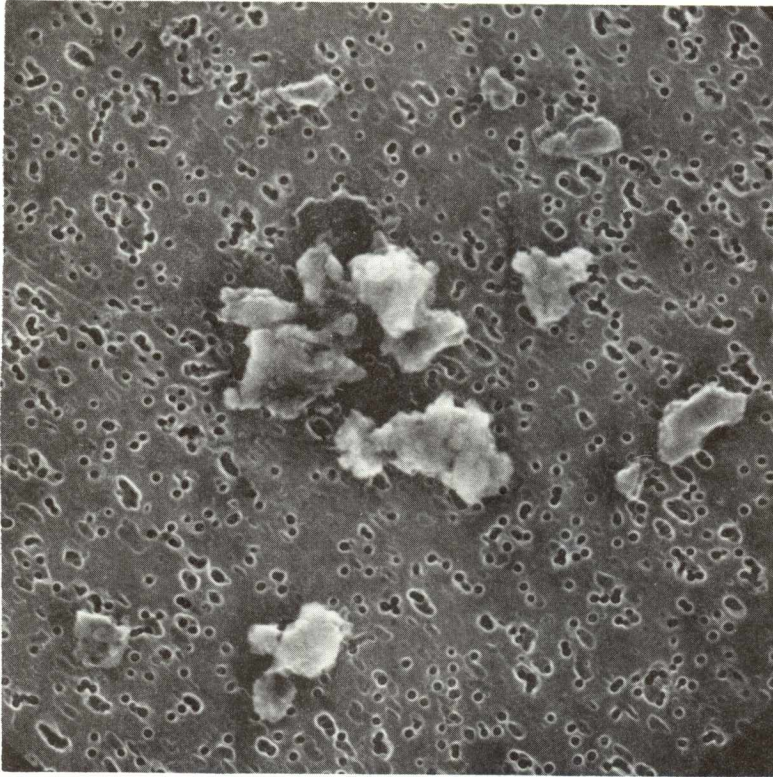


SIZE: 20  
SHAPE: E  
TRANS.: T  
COLOR: Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40296



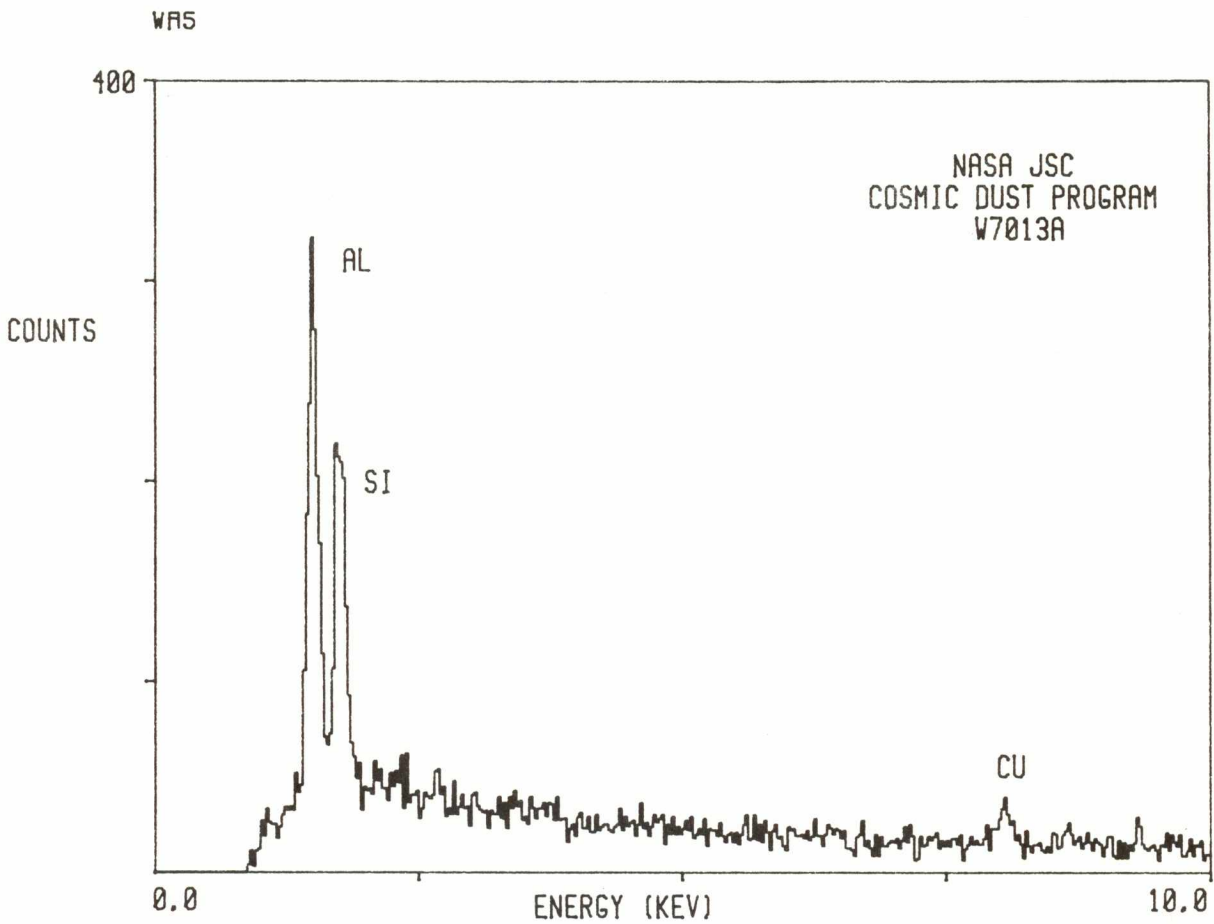
W7013 A 5



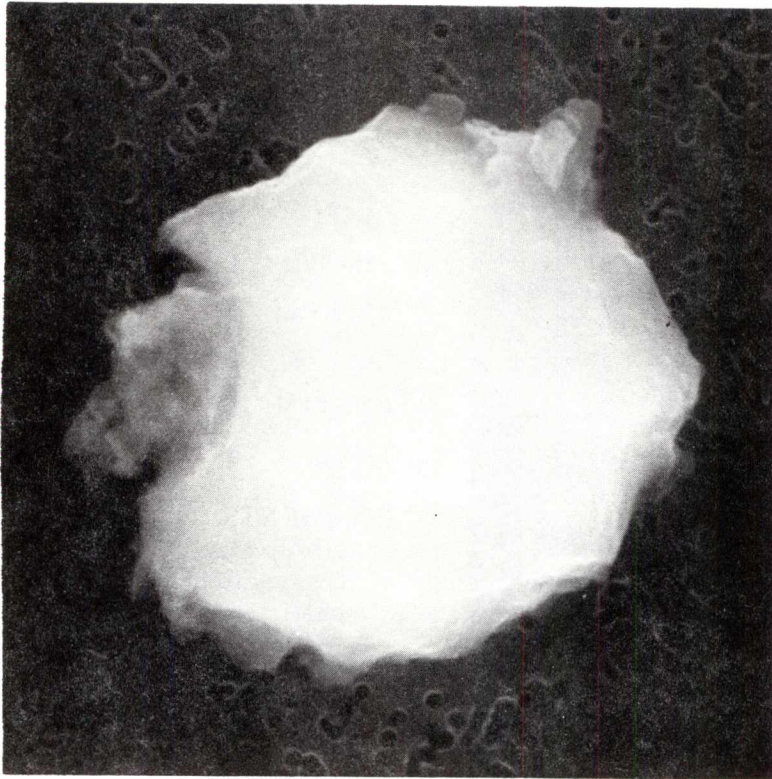
SIZE: 10x4  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: D  
TYPE: TCA

COMMENTS:  
Group size;  
fragmented  
particle

S-86-40300

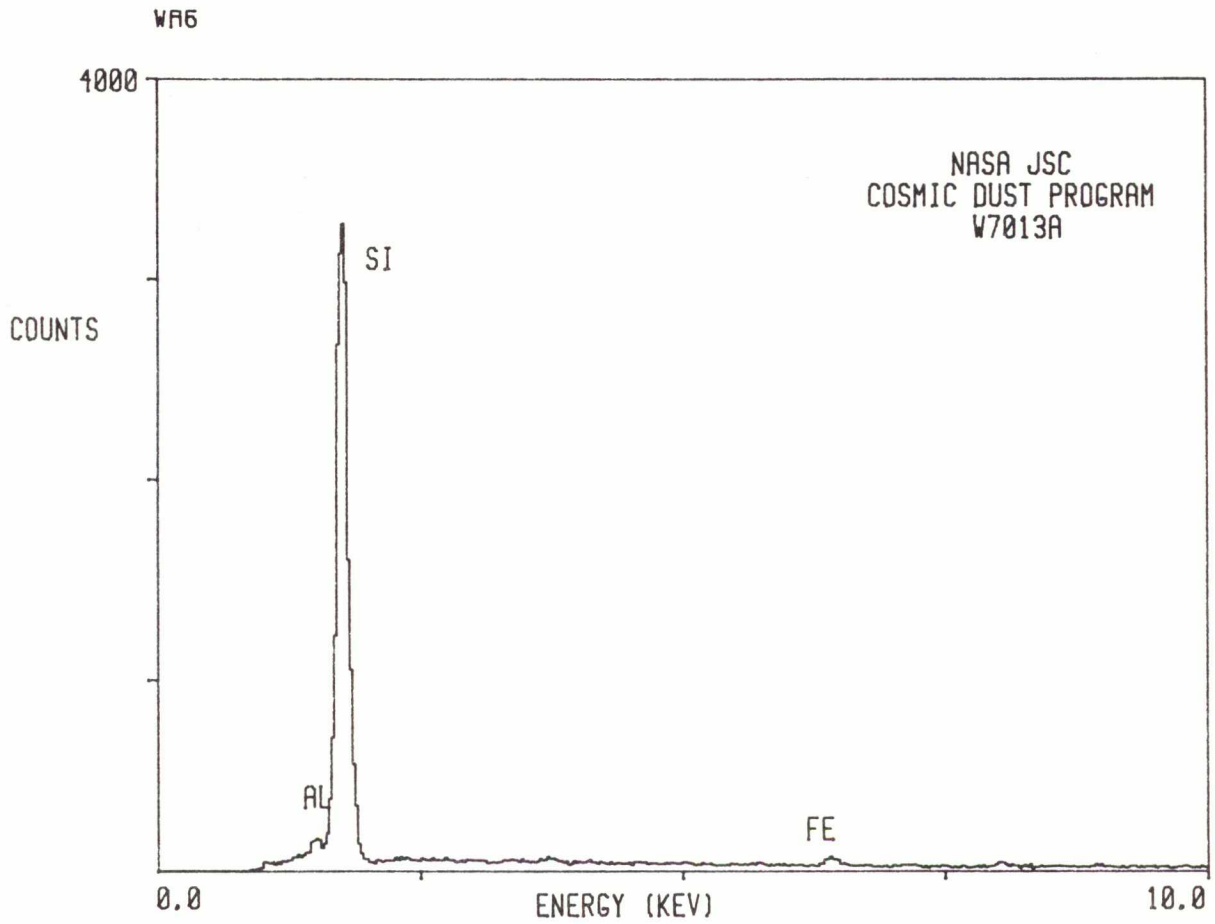


W7013 A 6

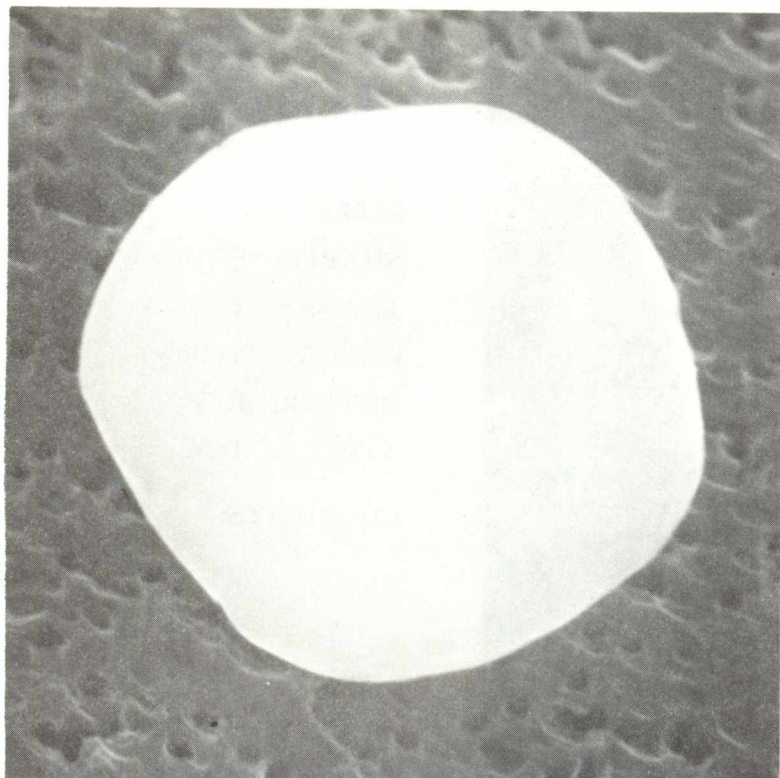


SIZE: 14  
SHAPE: E  
TRANS.: T  
COLOR: Yellow  
LUSTER: V  
TYPE: TCA  
COMMENTS:

S-86-40301

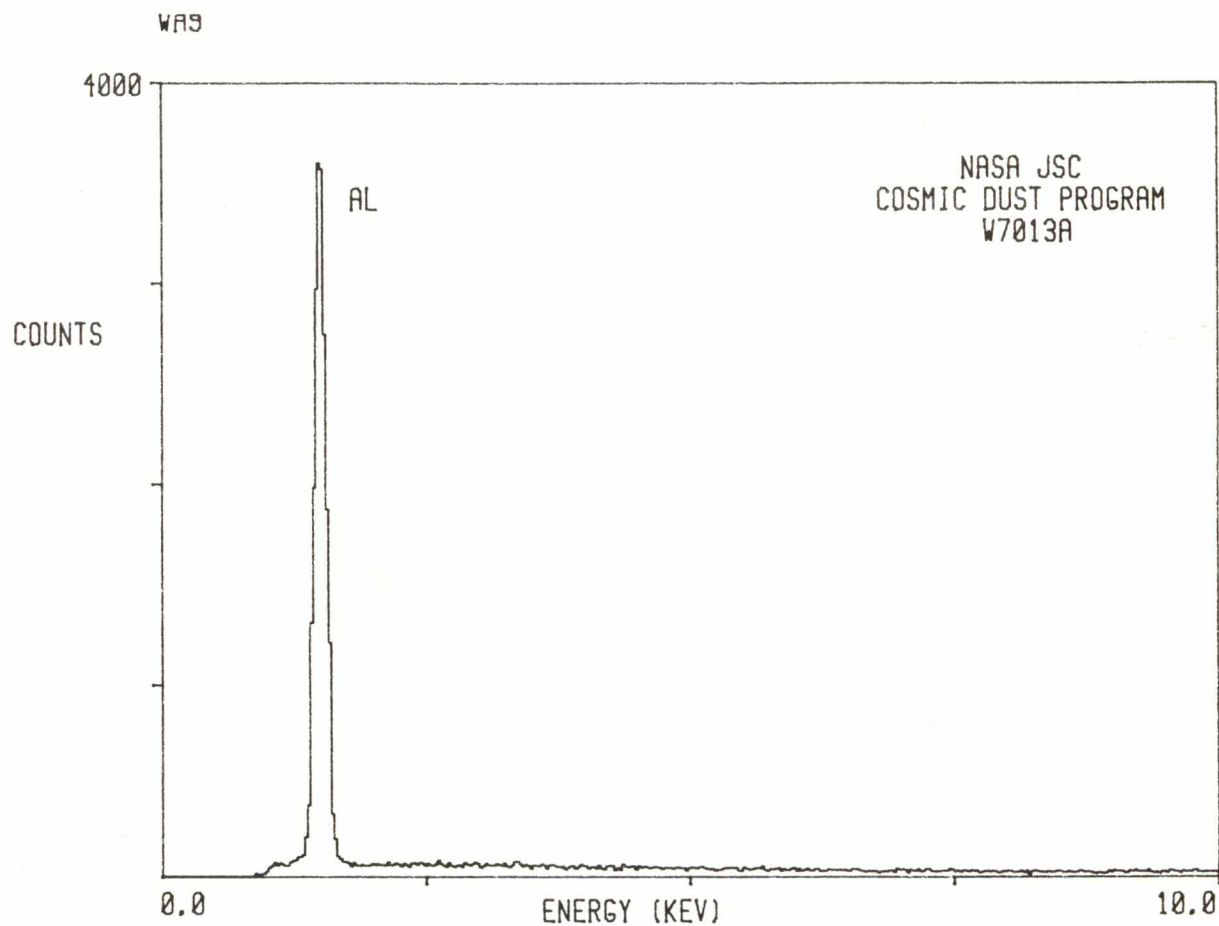


W7013 A 9

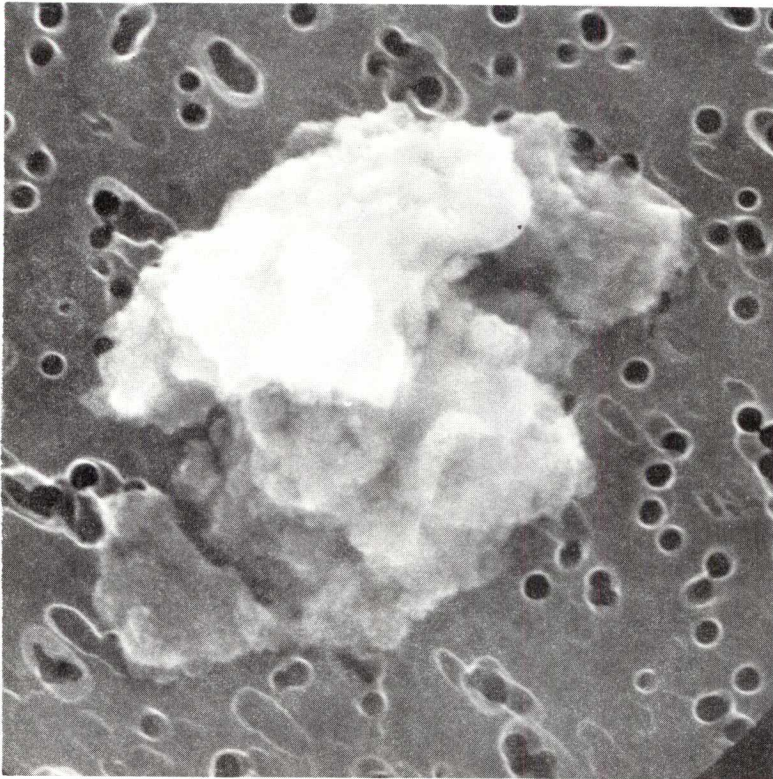


SIZE: 6  
SHAPE: E  
TRANS.: O  
COLOR: Black  
LUSTER: M/D  
TYPE: TCA  
COMMENTS:

S-86-40305



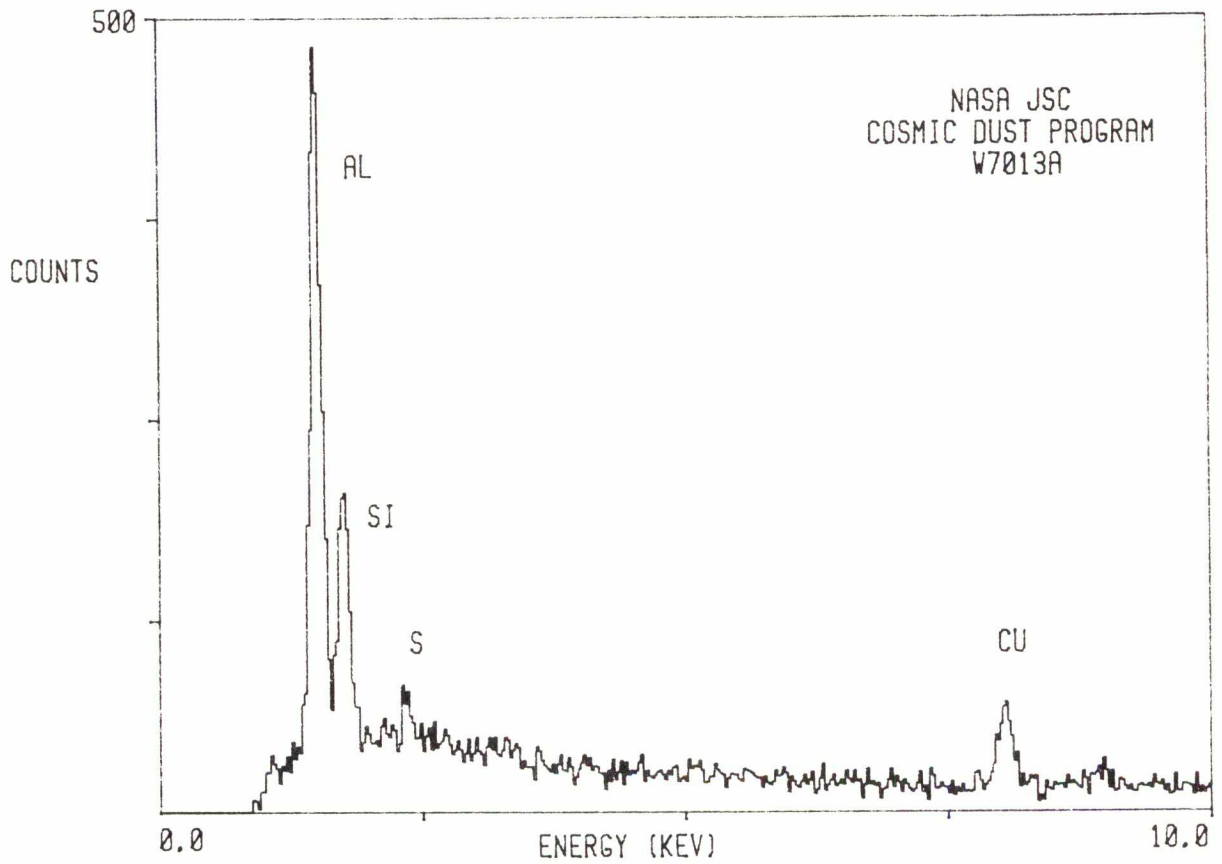
W7013 A 13



SIZE: 6  
SHAPE: E  
TRANS.: TL  
COLOR: Yellow  
LUSTER: R/V  
TYPE: TCA  
COMMENTS:

S-86-40308

W7013A

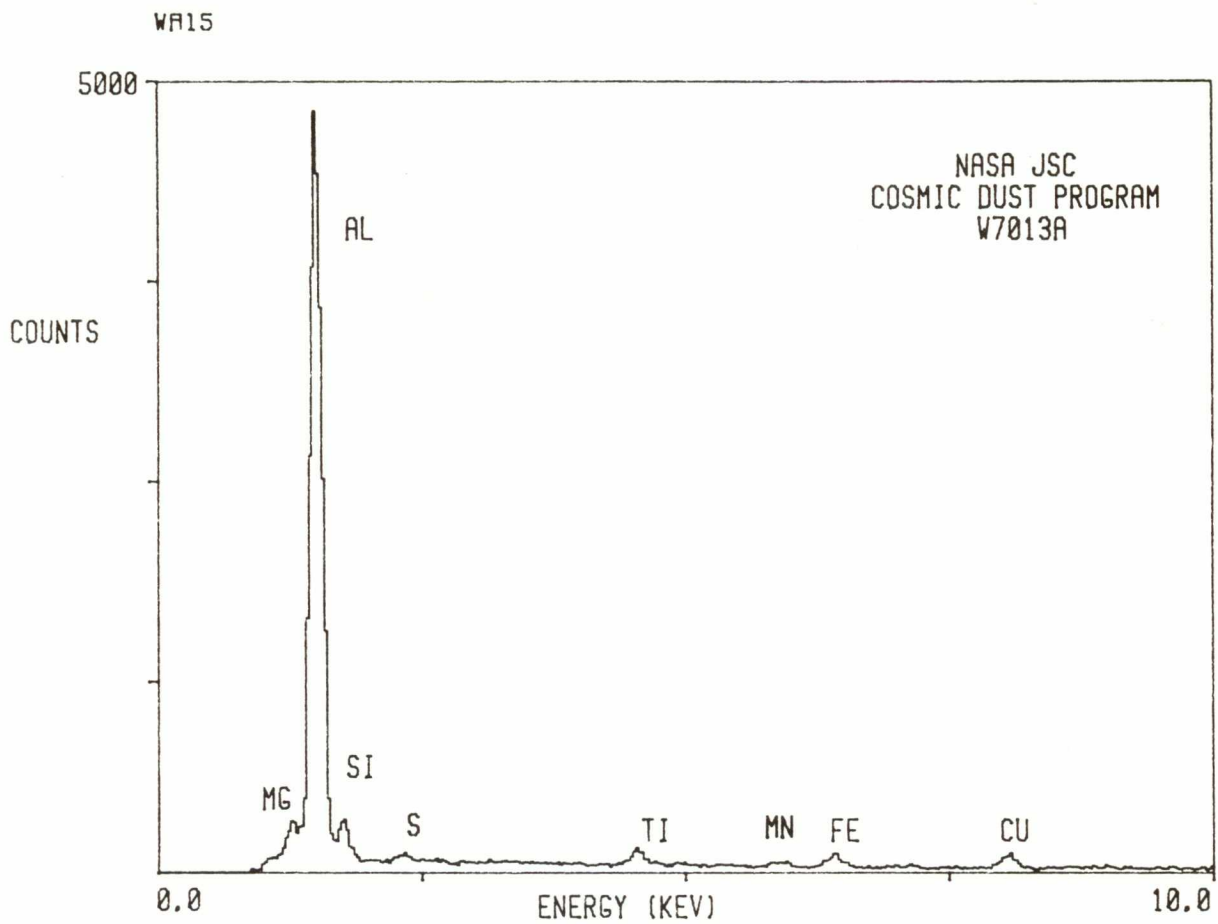


W7013 A 15

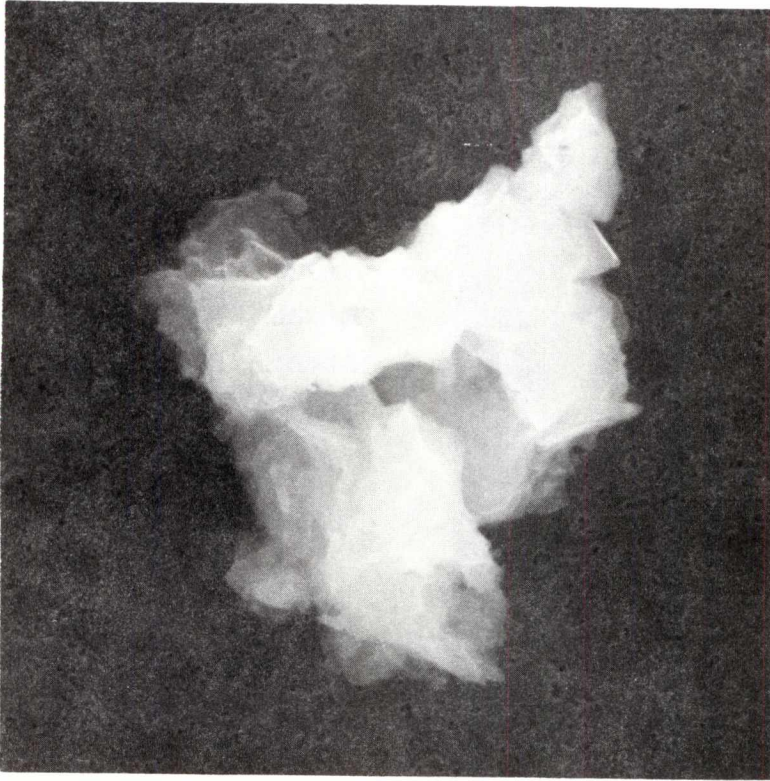


SIZE: 13  
SHAPE: E  
TRANS.: TL/O  
COLOR: Black  
LUSTER: R/D  
TYPE: TCA  
COMMENTS:

S-86-40310

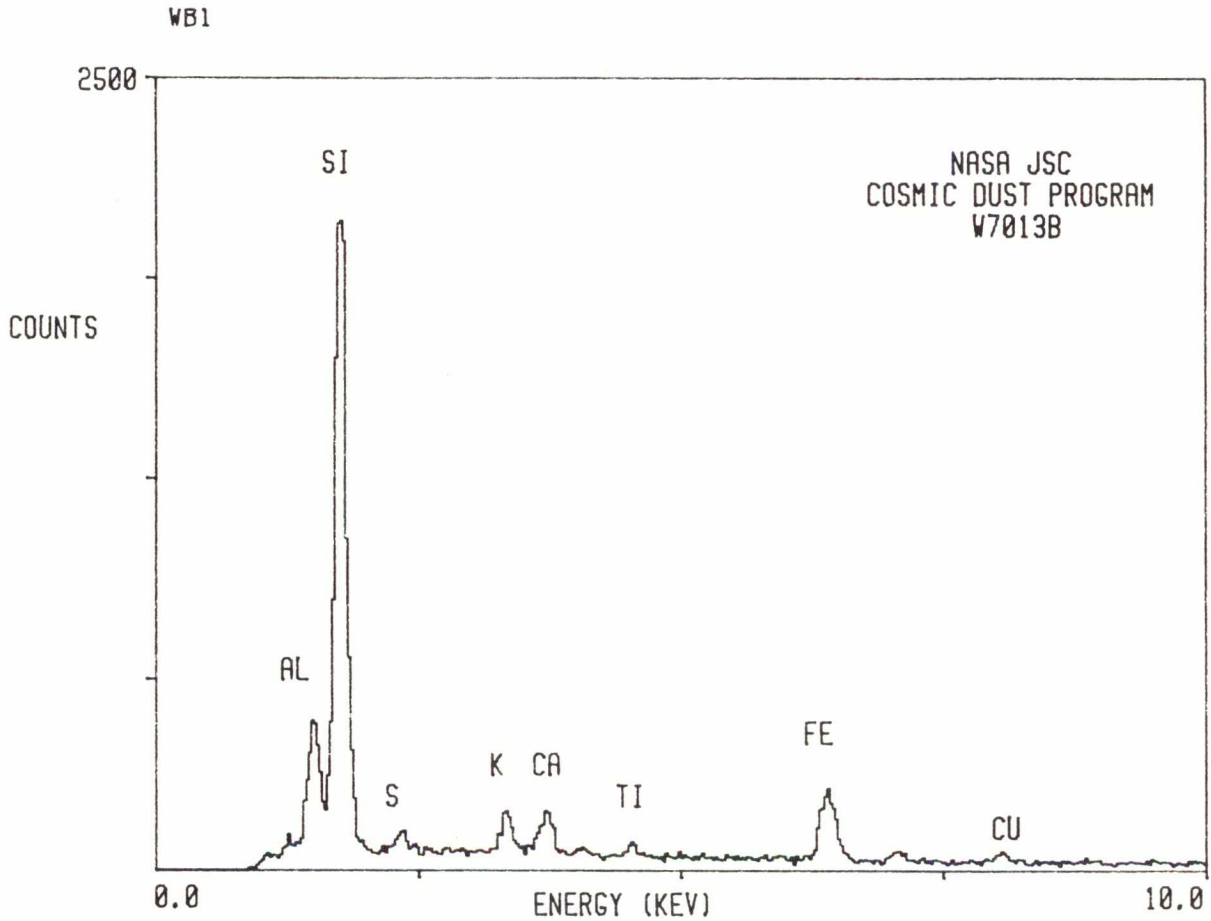


W7013 B 1



SIZE: 35x18  
SHAPE: I  
TRANS.: TL/T  
COLOR: Colorless to Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40311



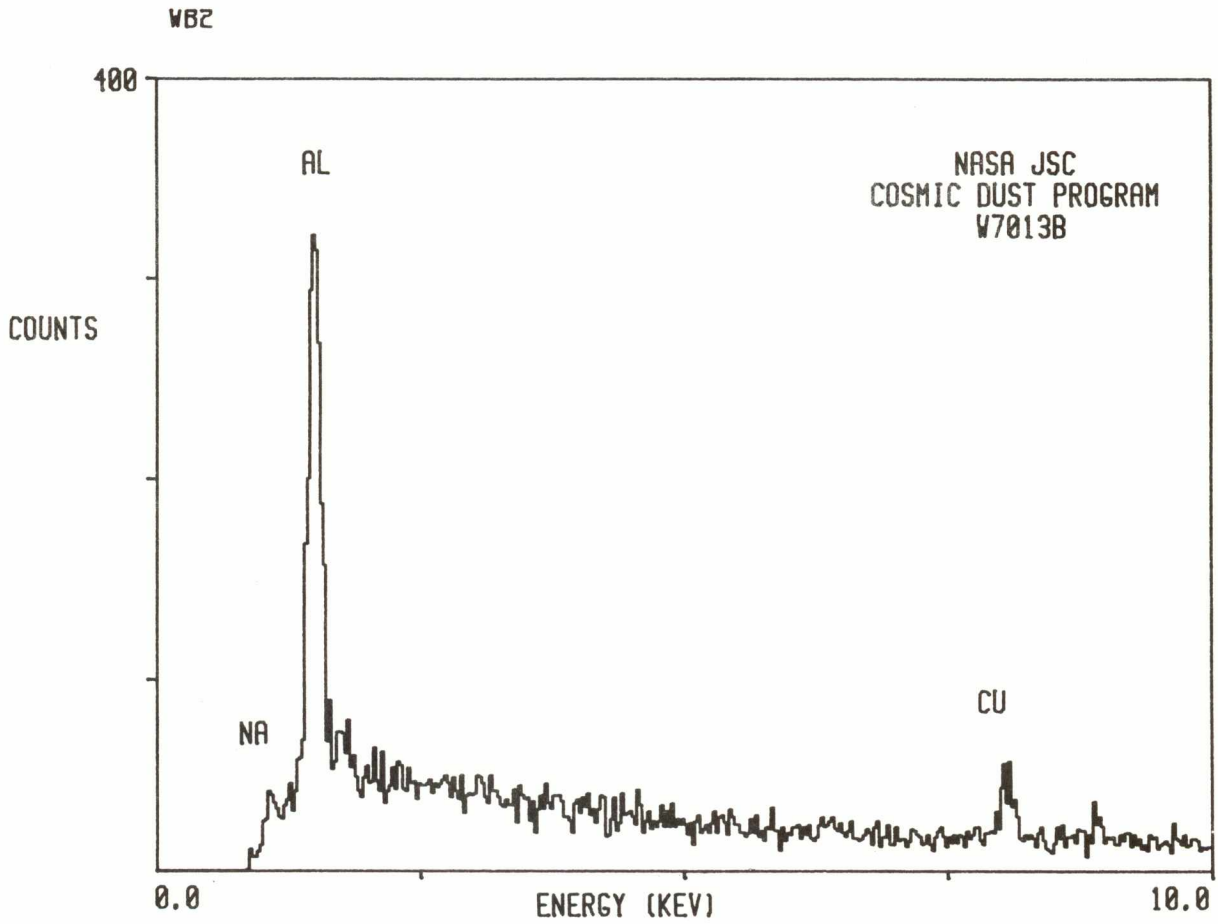


W7013 B 2

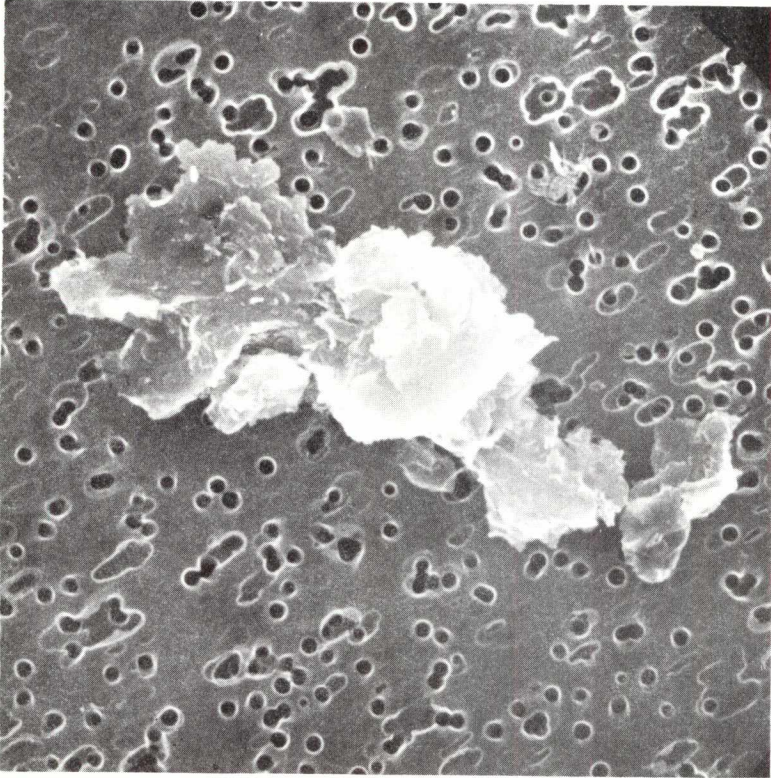


SIZE: 11x10  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: M/D  
TYPE: TCN  
COMMENTS:

S-86-40312



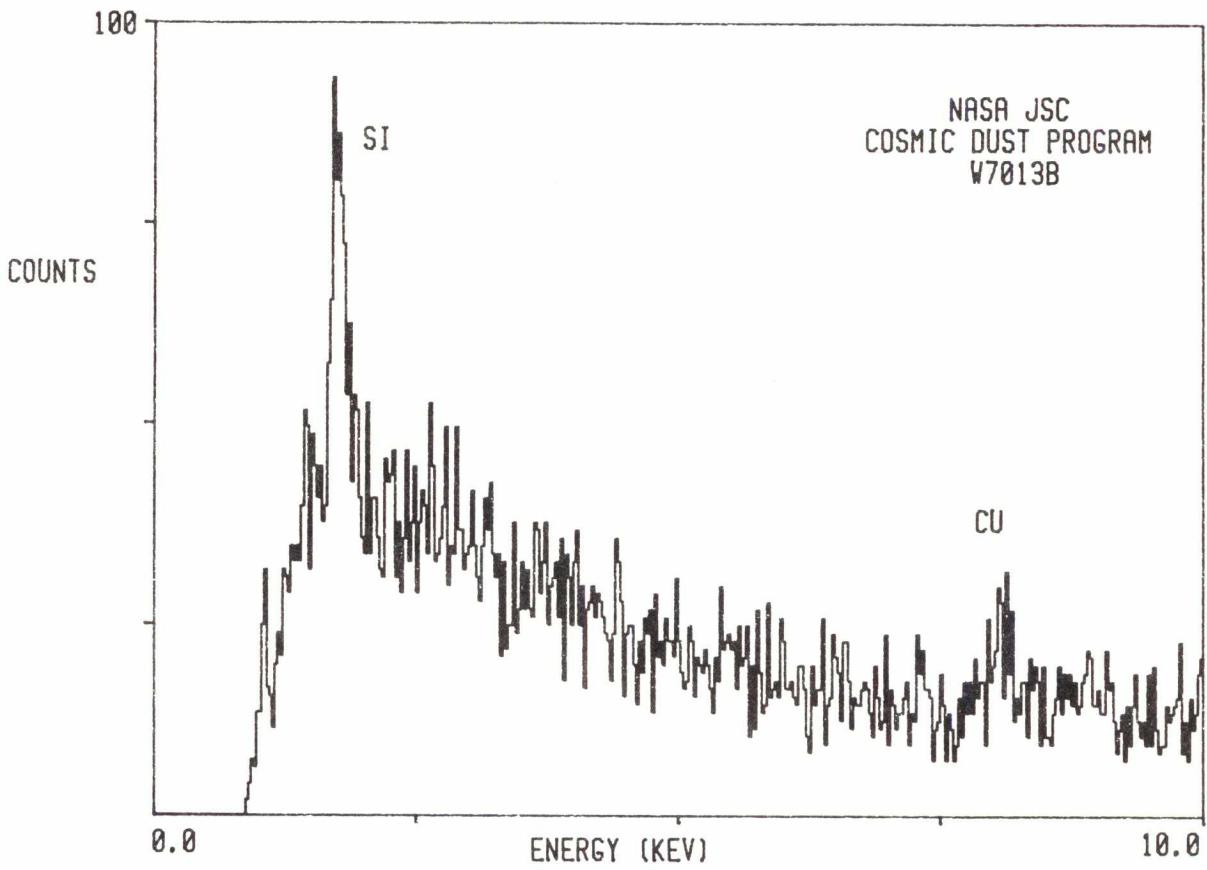
W7013 B 3



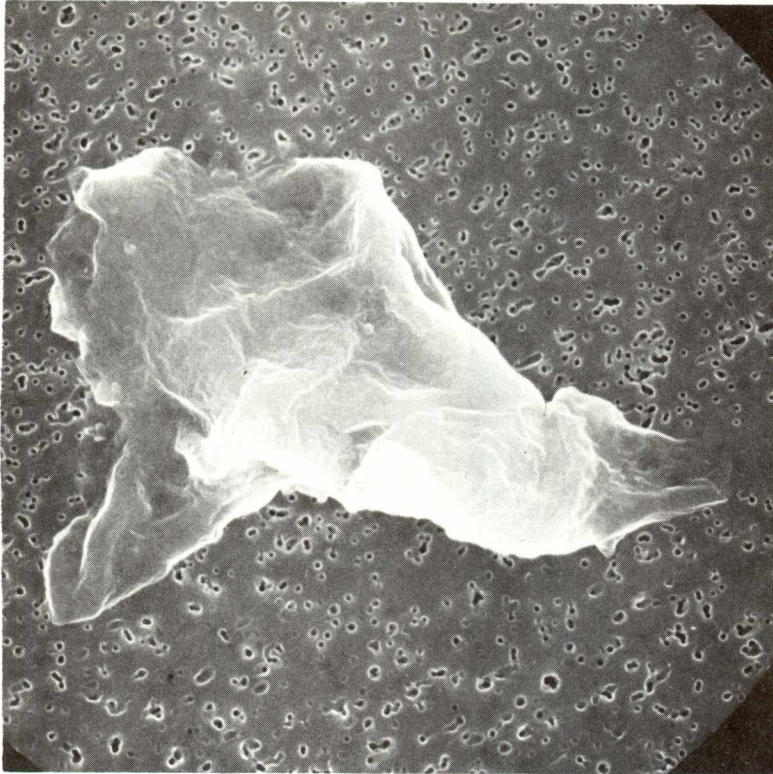
SIZE: 10x3  
SHAPE: I  
TRANS.: O  
COLOR: Golden to black  
LUSTER: M/D  
TYPE: TCA  
COMMENTS:

S-86-40313

WB3

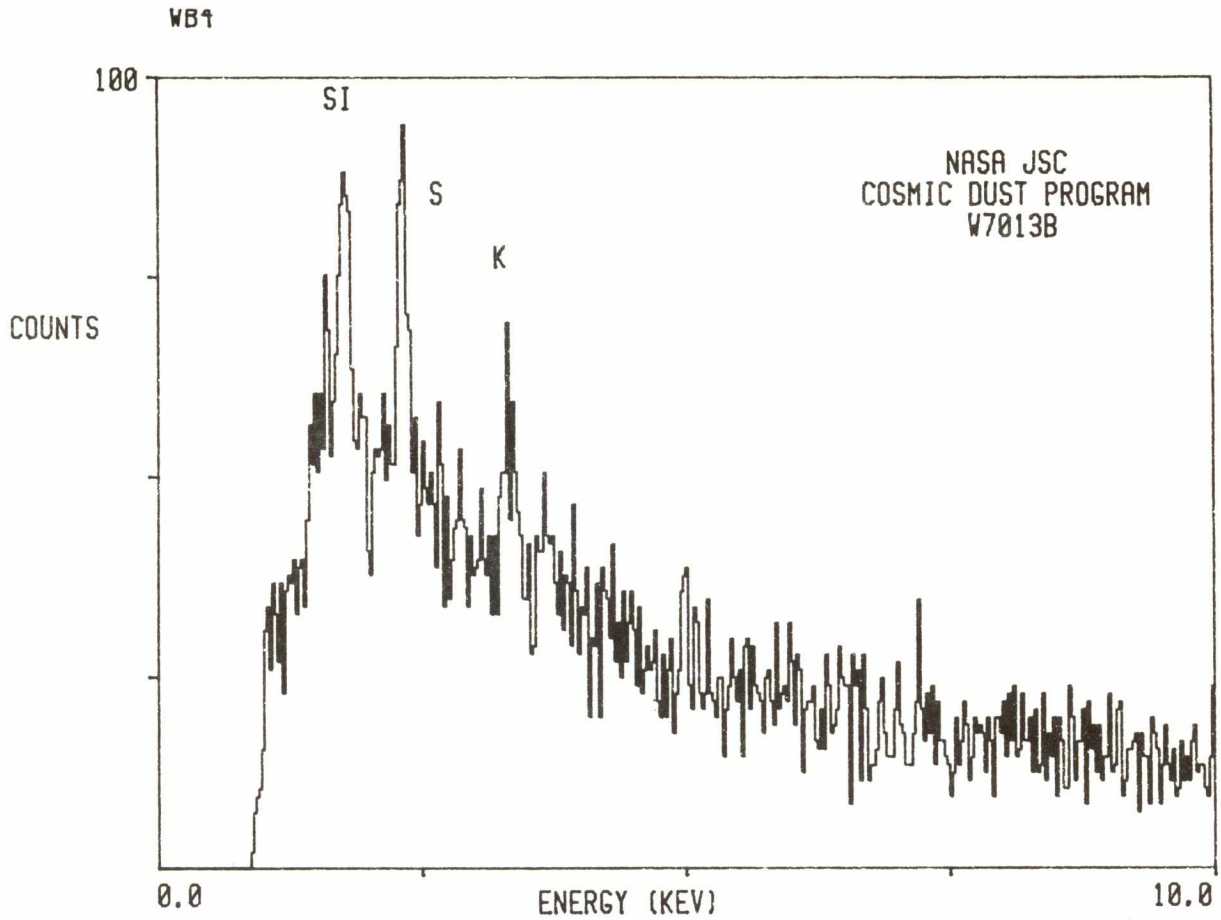


W7013 B 4

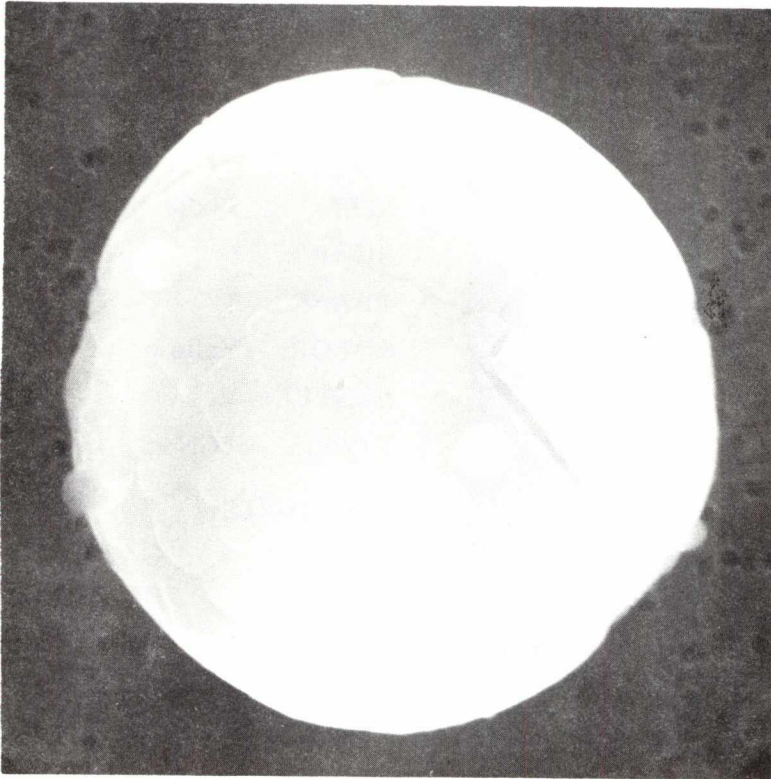


SIZE: 30x20  
SHAPE: I  
TRANS.: T  
COLOR: Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40314

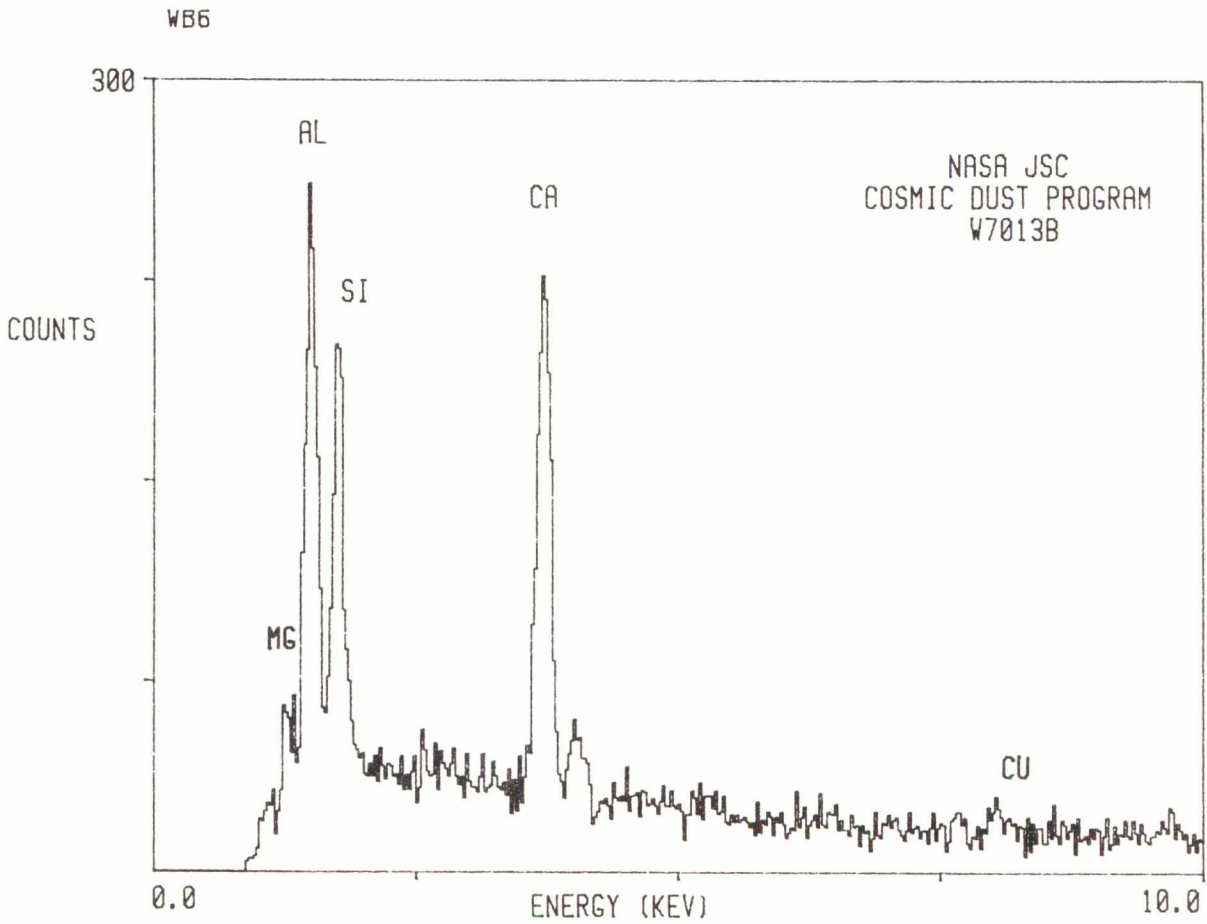


W7013 B 6

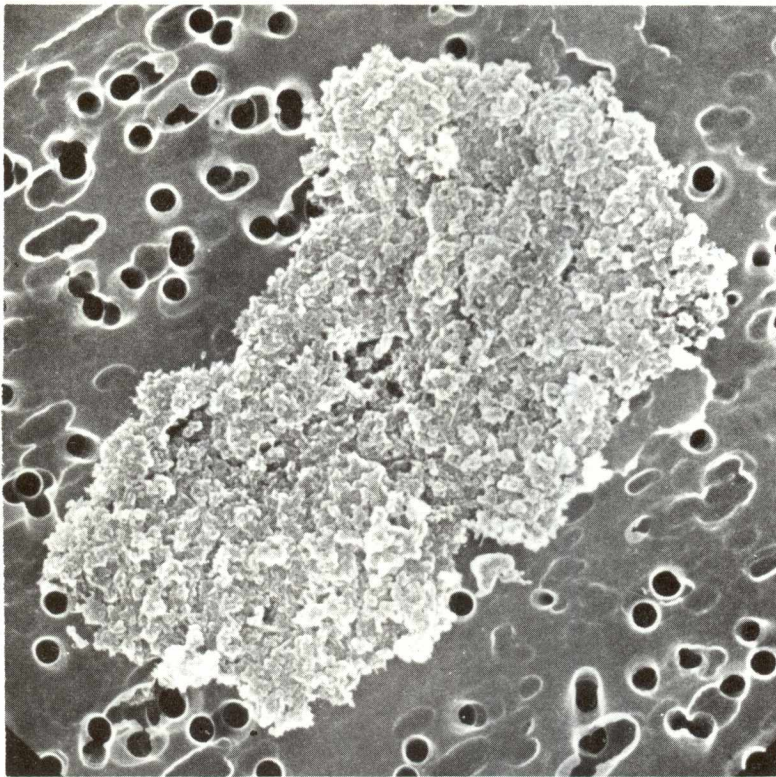


SIZE: 15  
SHAPE: S  
TRANS.: T  
COLOR: Colorless to yellow  
LUSTER: V  
TYPE: TCA  
COMMENTS:

S-86-40316



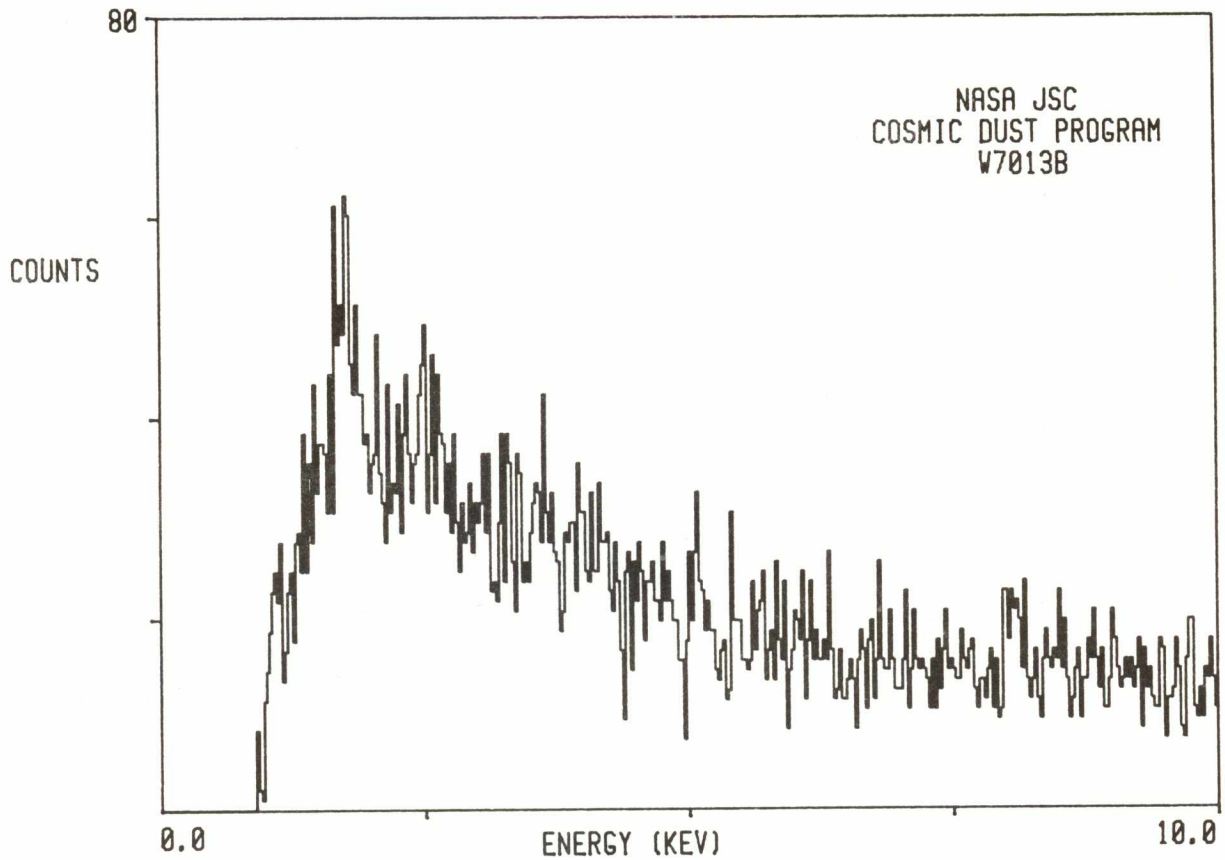
W7013 B 8



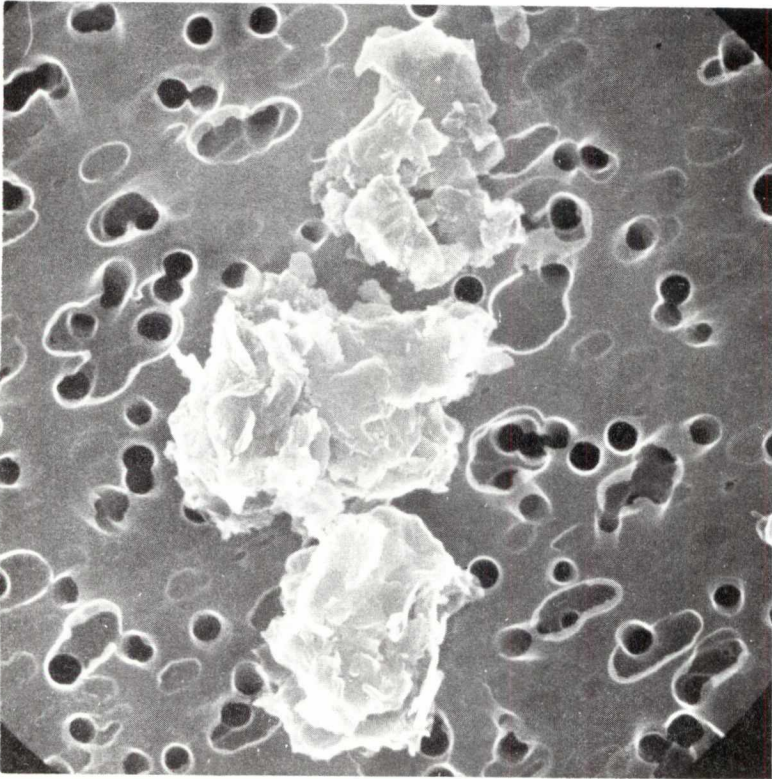
SIZE: 9x5  
SHAPE: I  
TRANS.: TL/O  
COLOR: Green to black  
LUSTER: D  
TYPE: TCA?  
COMMENTS:

S-86-40318

WB8

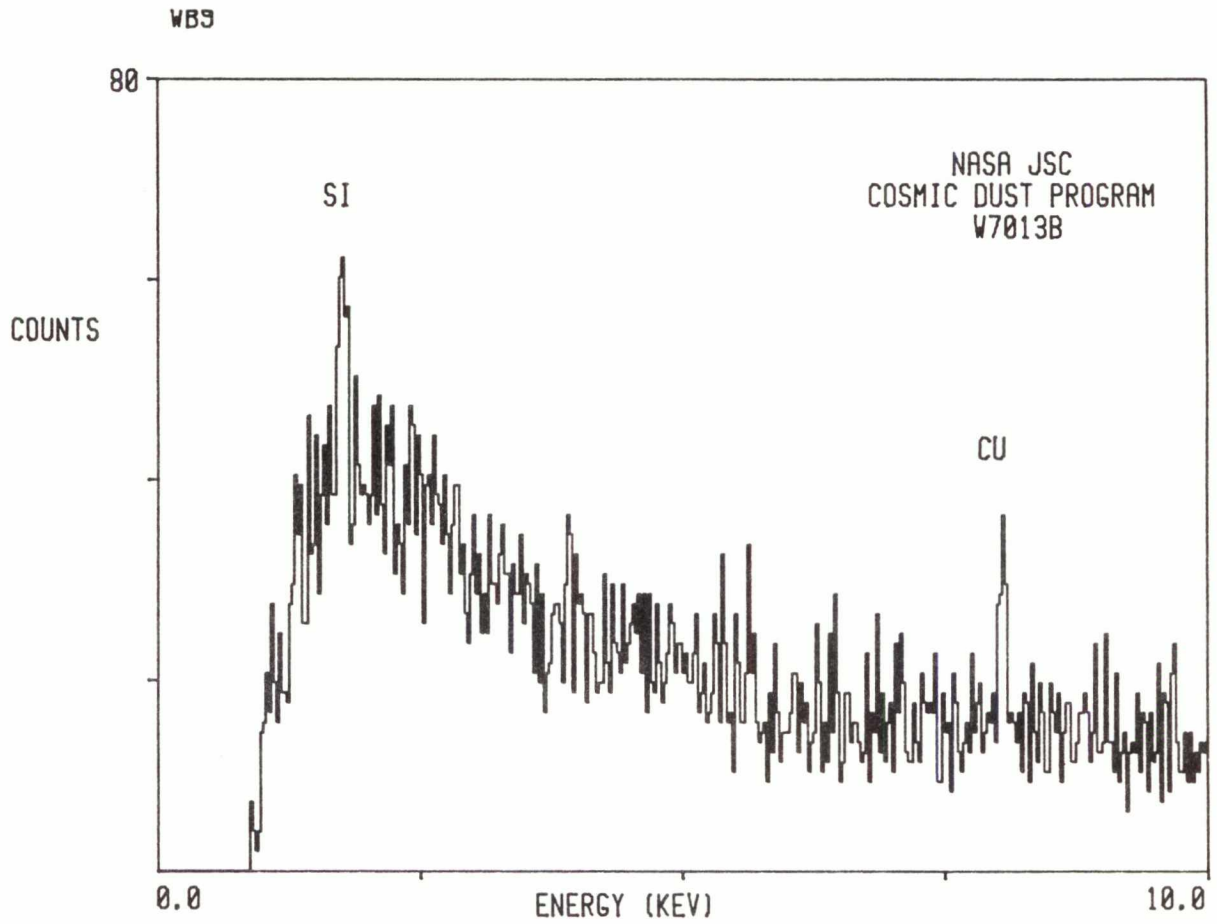


W7013 B 9

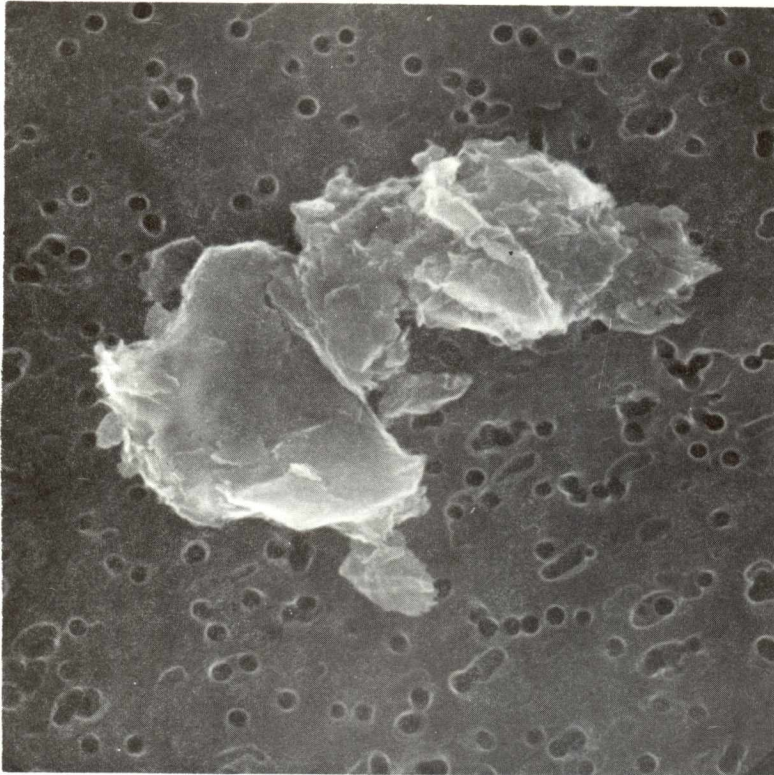


SIZE: 7x3  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: M/D  
TYPE: TCA  
COMMENTS:

S-86-40319

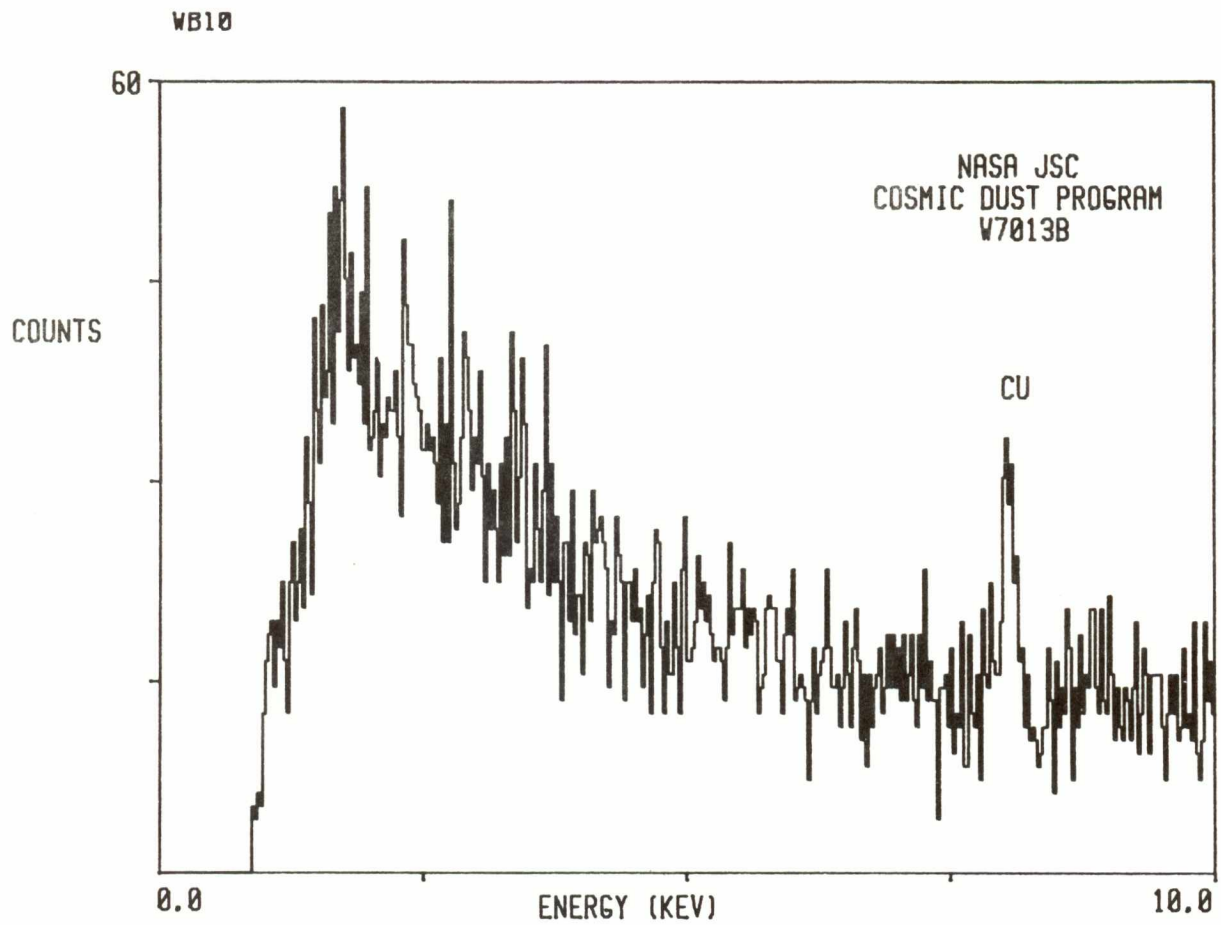


W7013 B 10

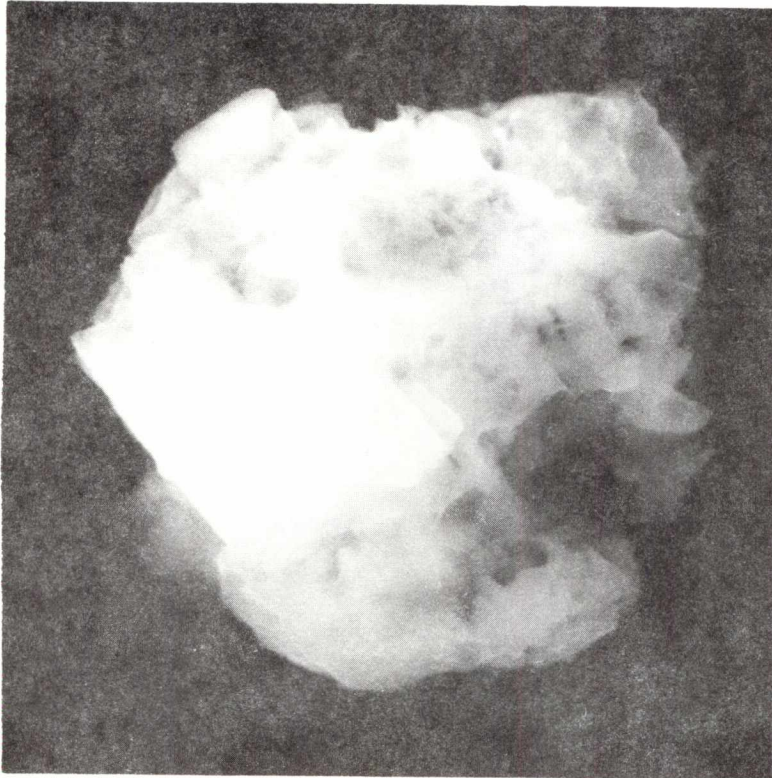


SIZE: 10x6  
SHAPE: I  
TRANS.: O  
COLOR: Gold to black  
LUSTER: M  
TYPE: TCA  
COMMENTS:

S-86-40320

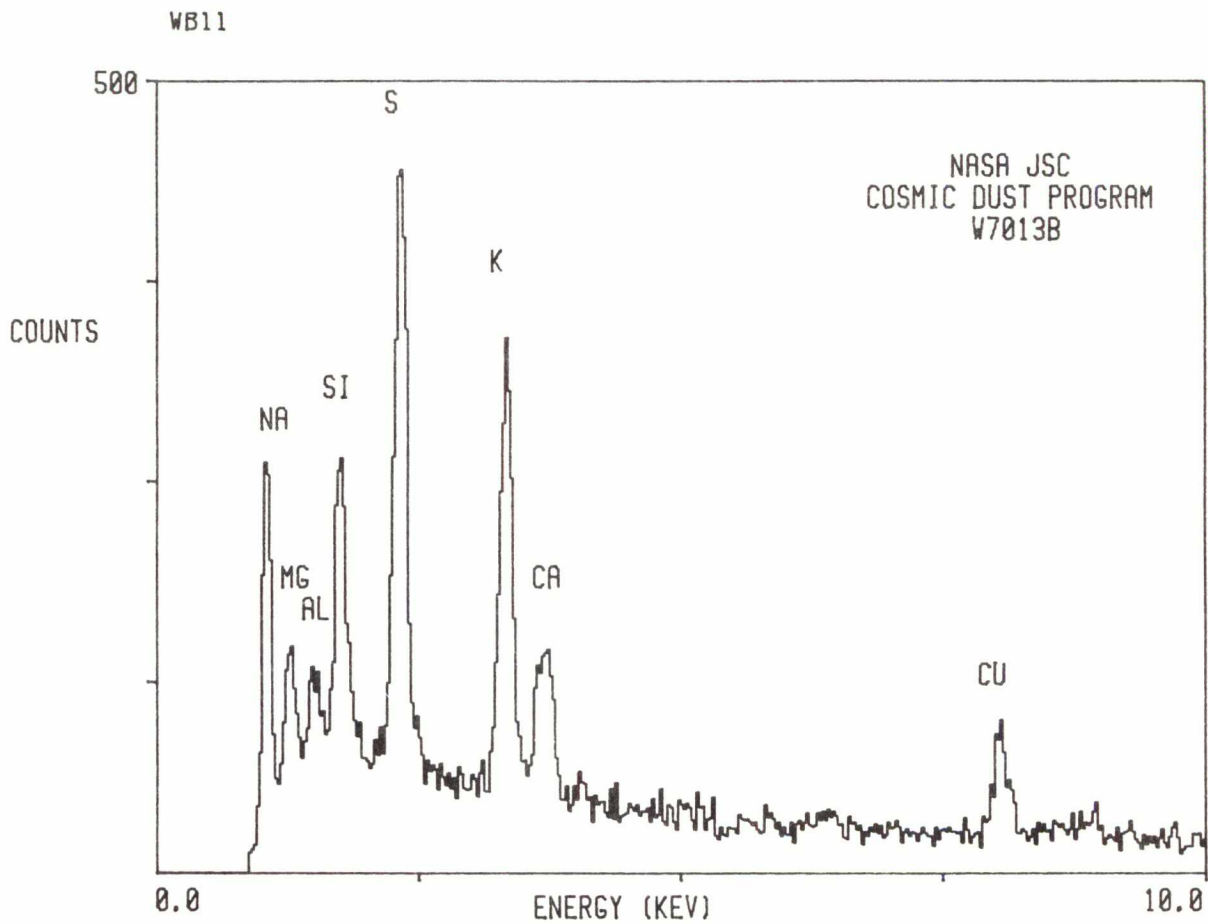


W7013 B 11



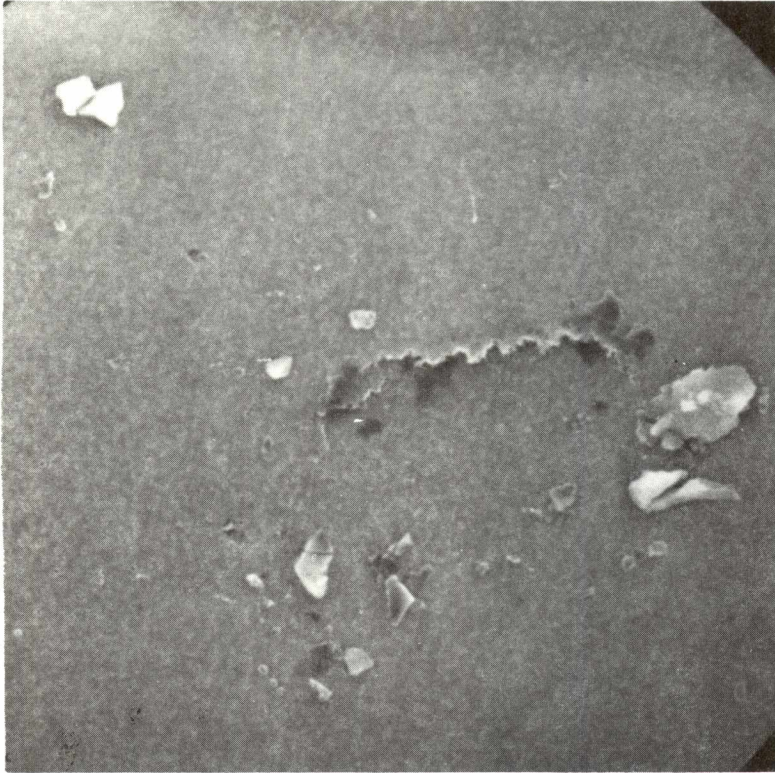
SIZE: 30  
SHAPE: E  
TRANS.: TL/O  
COLOR: Yellow  
LUSTER: R/D  
TYPE: TCN  
COMMENTS:

S-86-40321





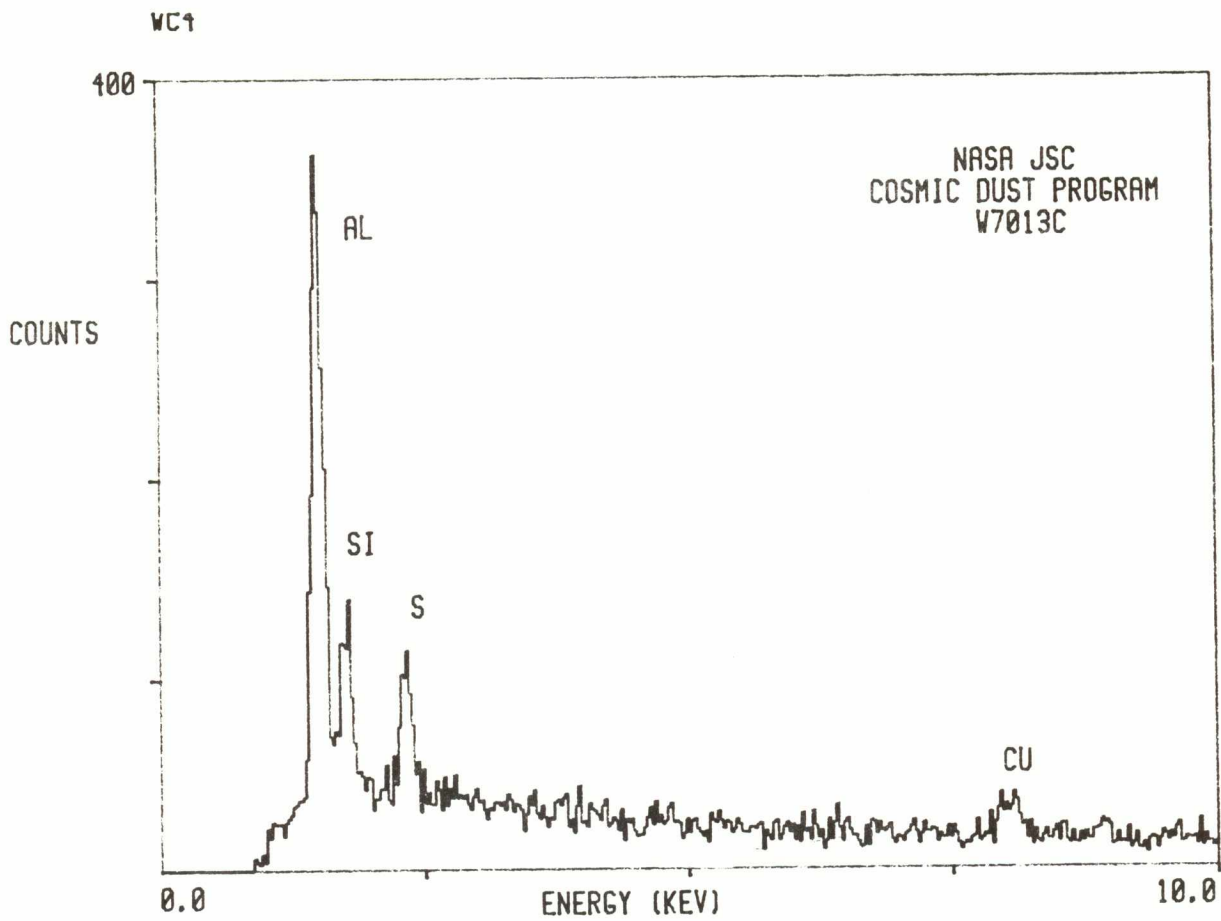
W7013 C 4



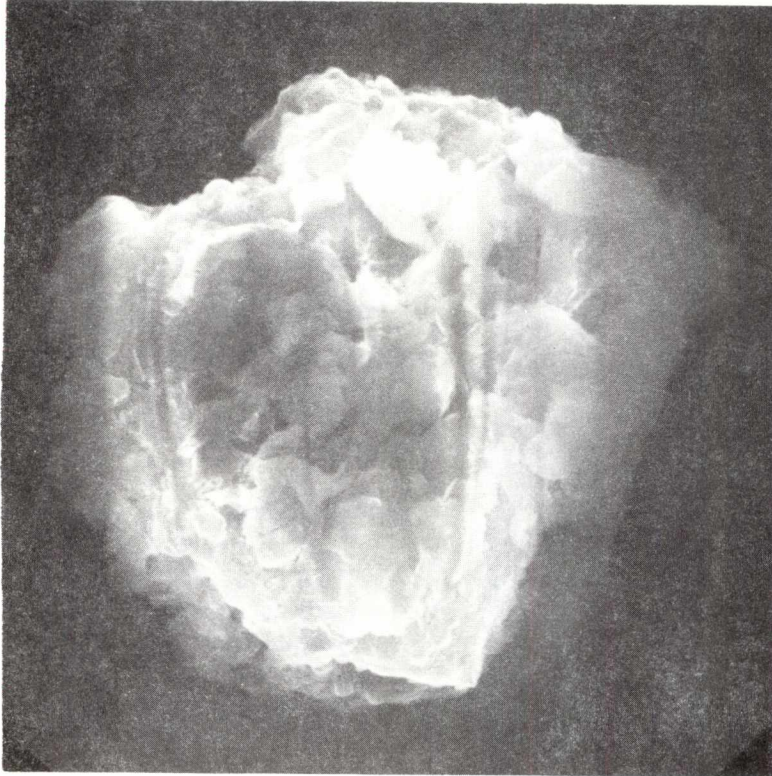
SIZE: 20x15  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: TCA

COMMENTS:  
Size of largest  
grain; Large grain  
with associated  
fragments

S-86-40331

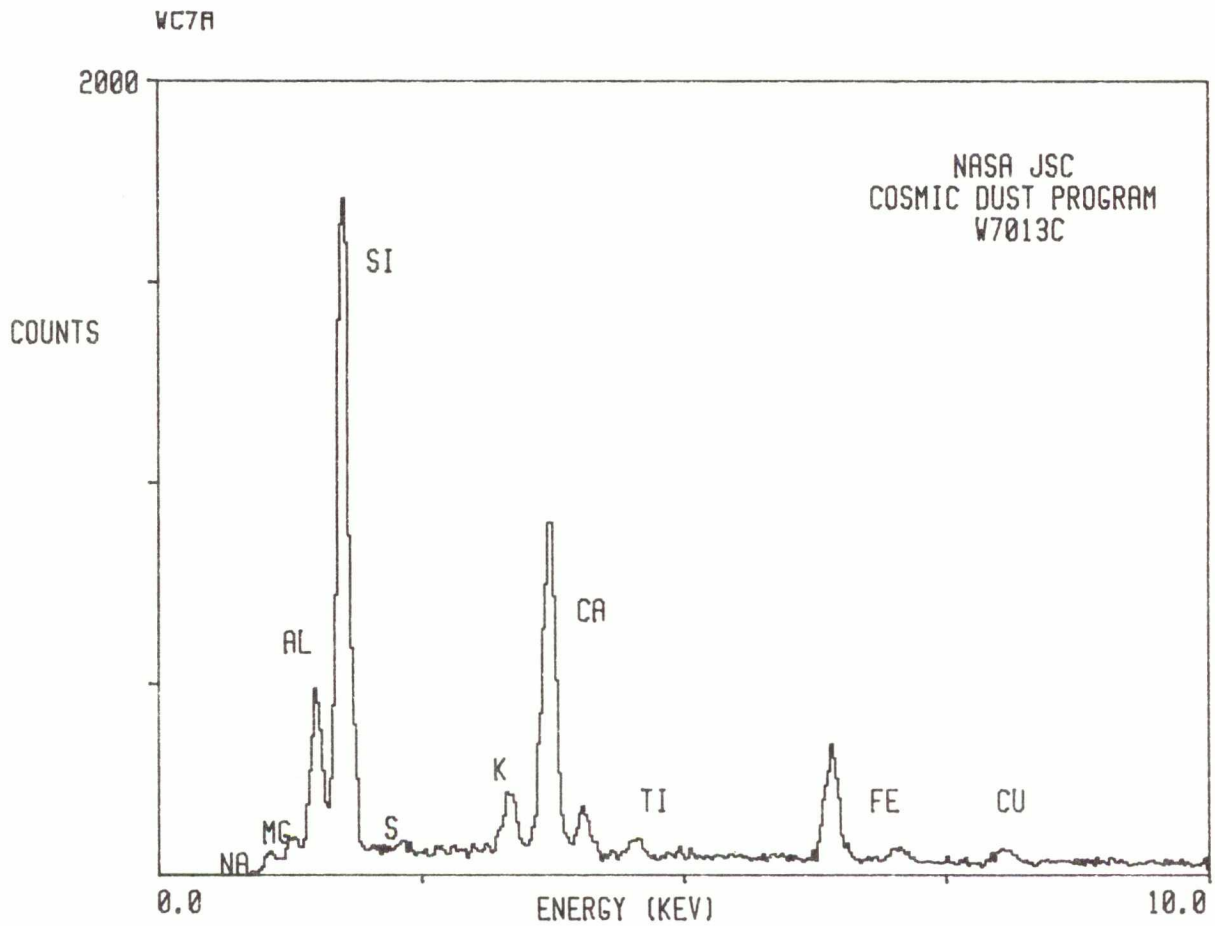


W7013 C 7

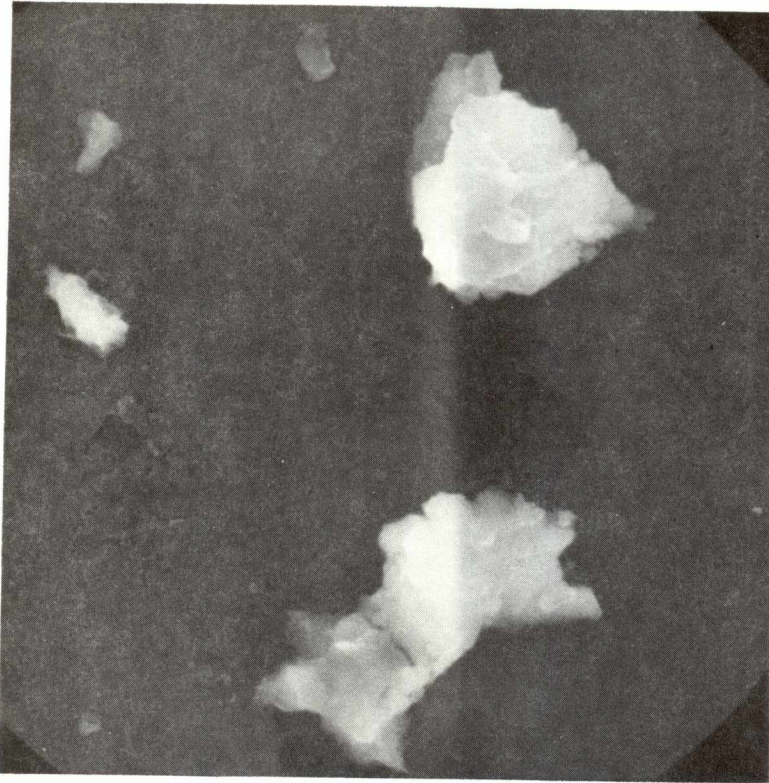


SIZE: 30  
SHAPE: E  
TRANS.: TL  
COLOR: Yellow to brown  
LUSTER: V/D  
TYPE: TCN  
COMMENTS:

S-86-40333

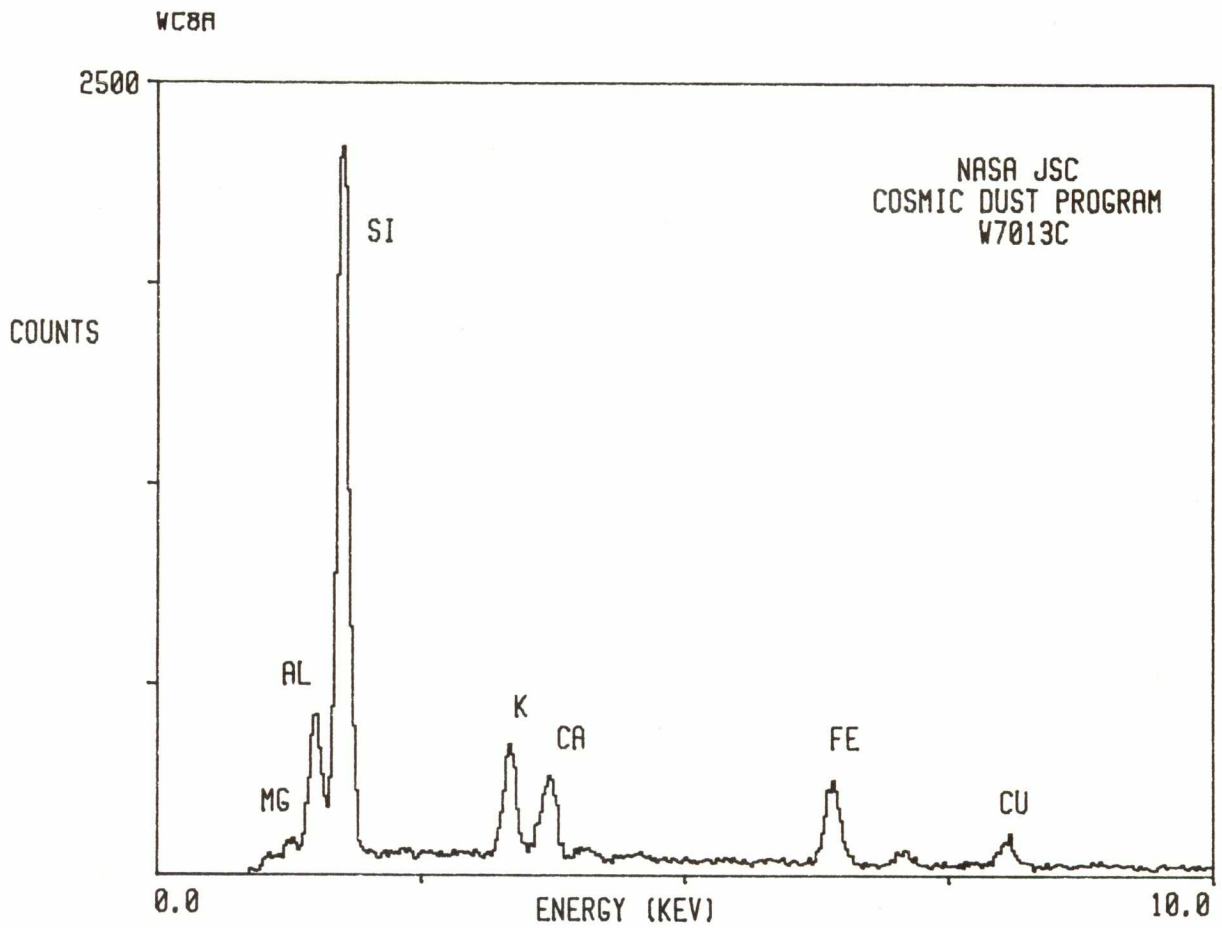


W7013 C 8

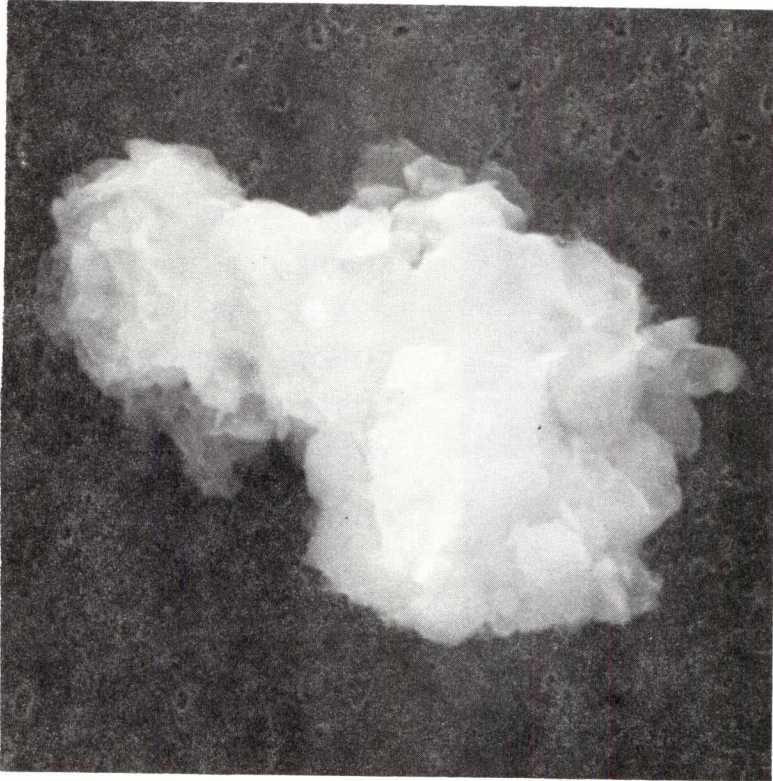


SIZE: 100  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40334

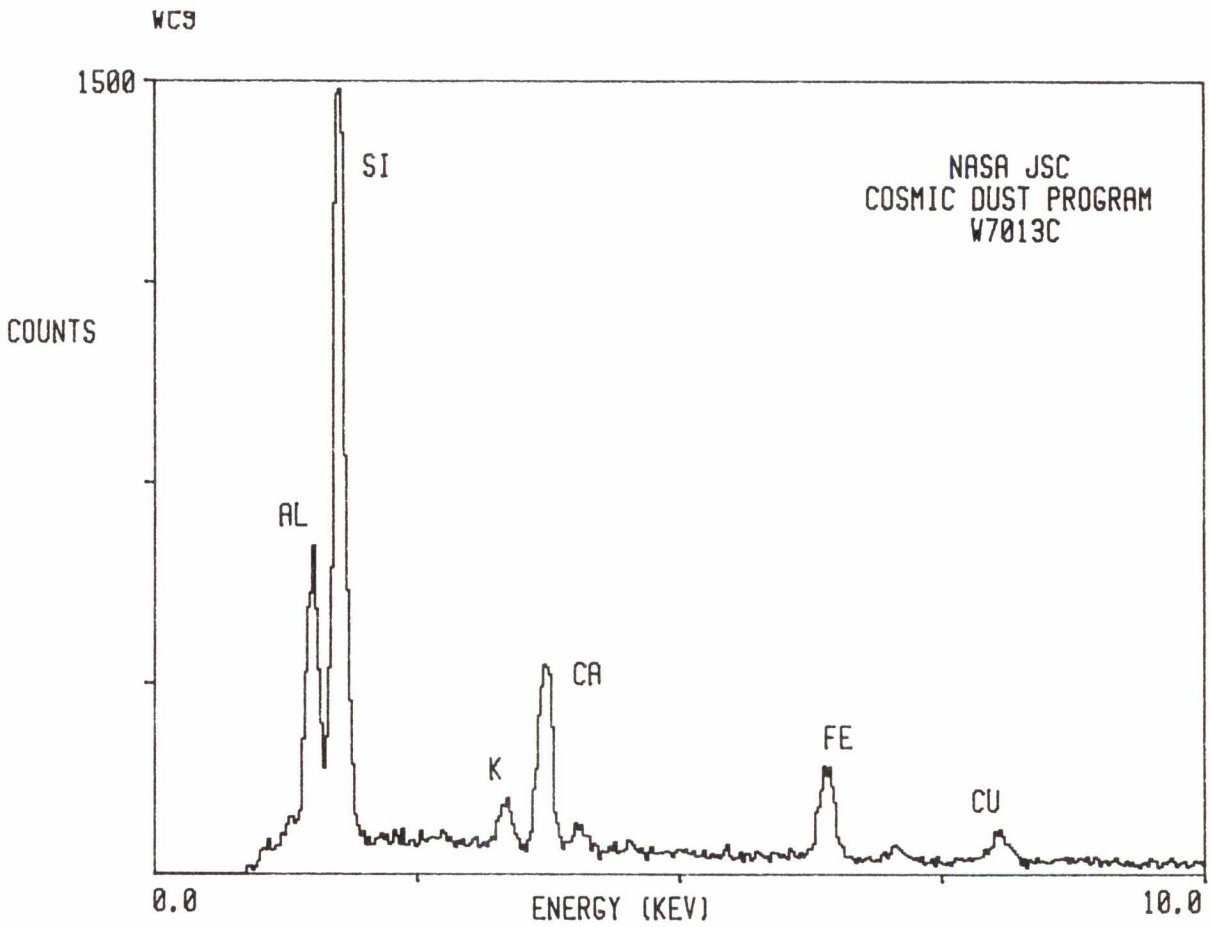


W7013 C 9

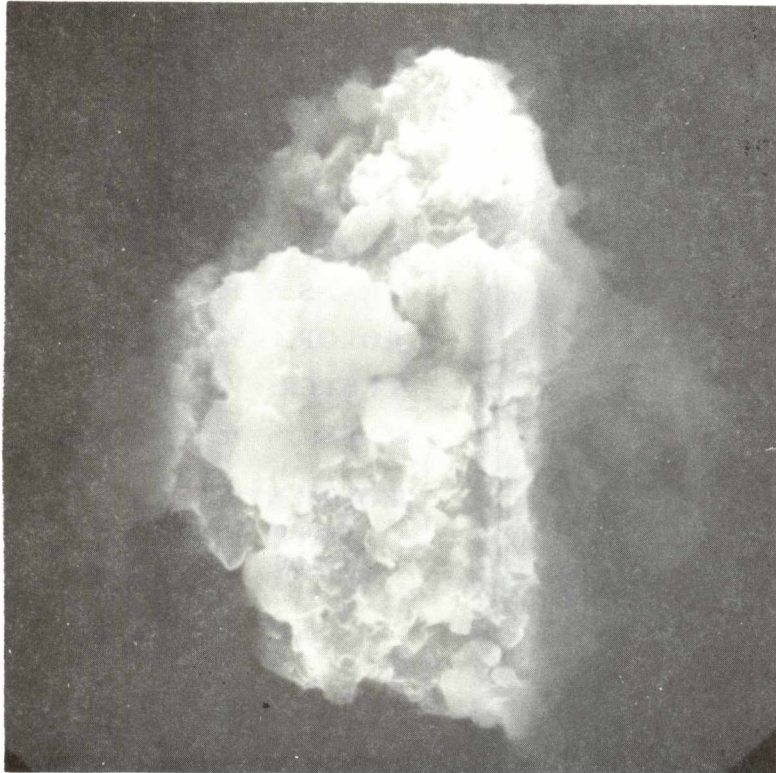


SIZE: 25x10  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40335

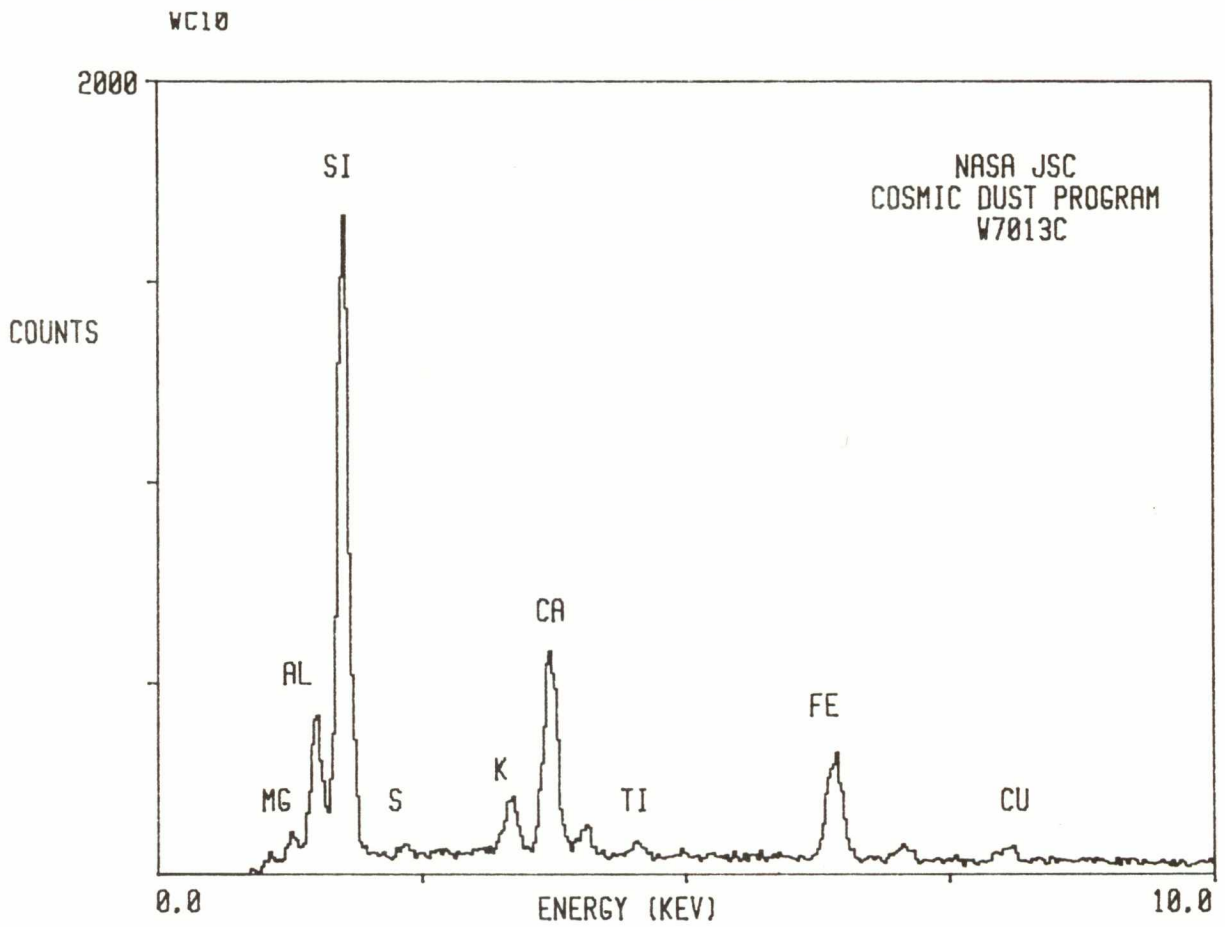


W7013 C 10



SIZE: 70x60  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow to black  
LUSTER: V  
TYPE: TCN?  
COMMENTS:

S-86-40336

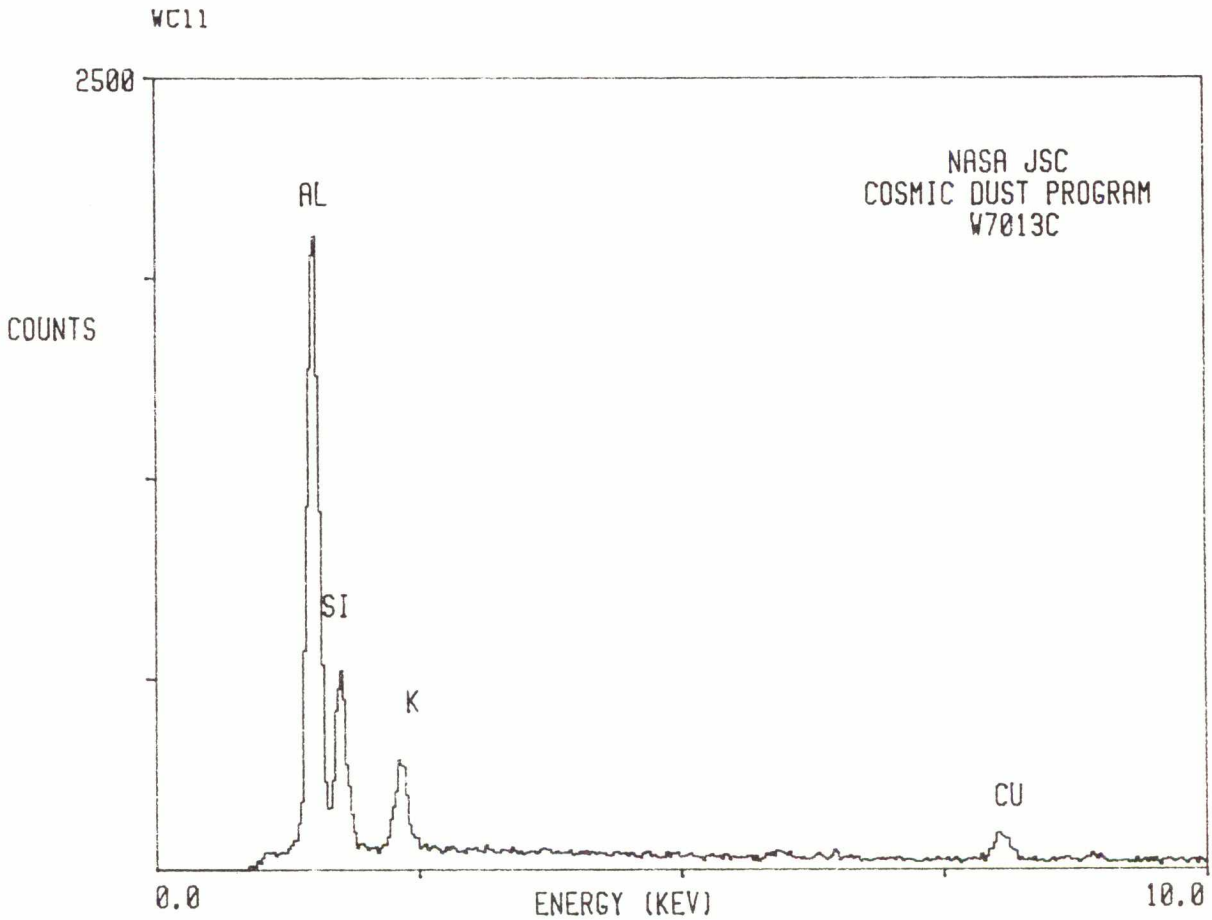


W7013 C 11

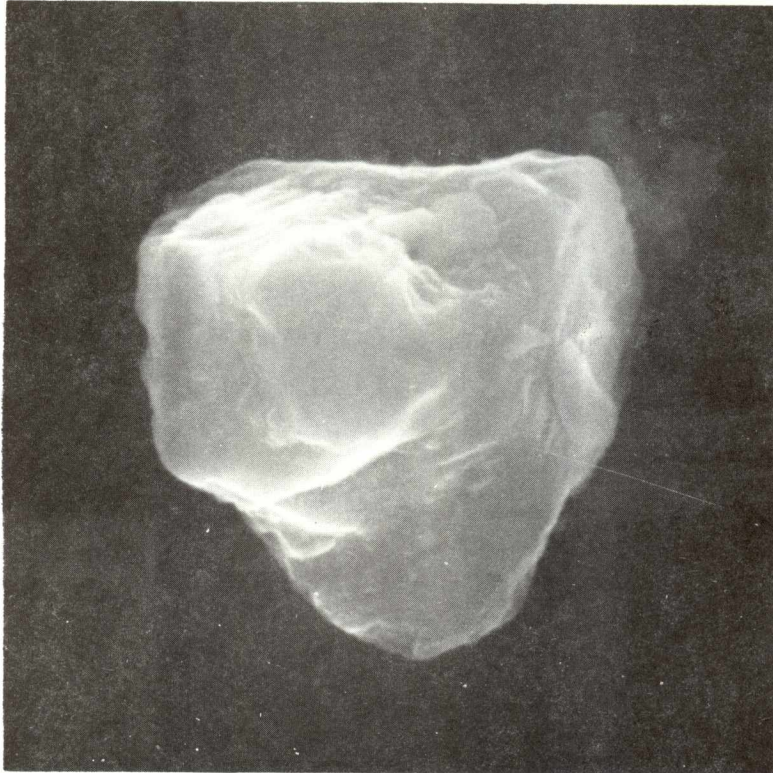


SIZE: 120x100  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: TCN  
COMMENTS:  
Size of largest  
grain

S-86-40337

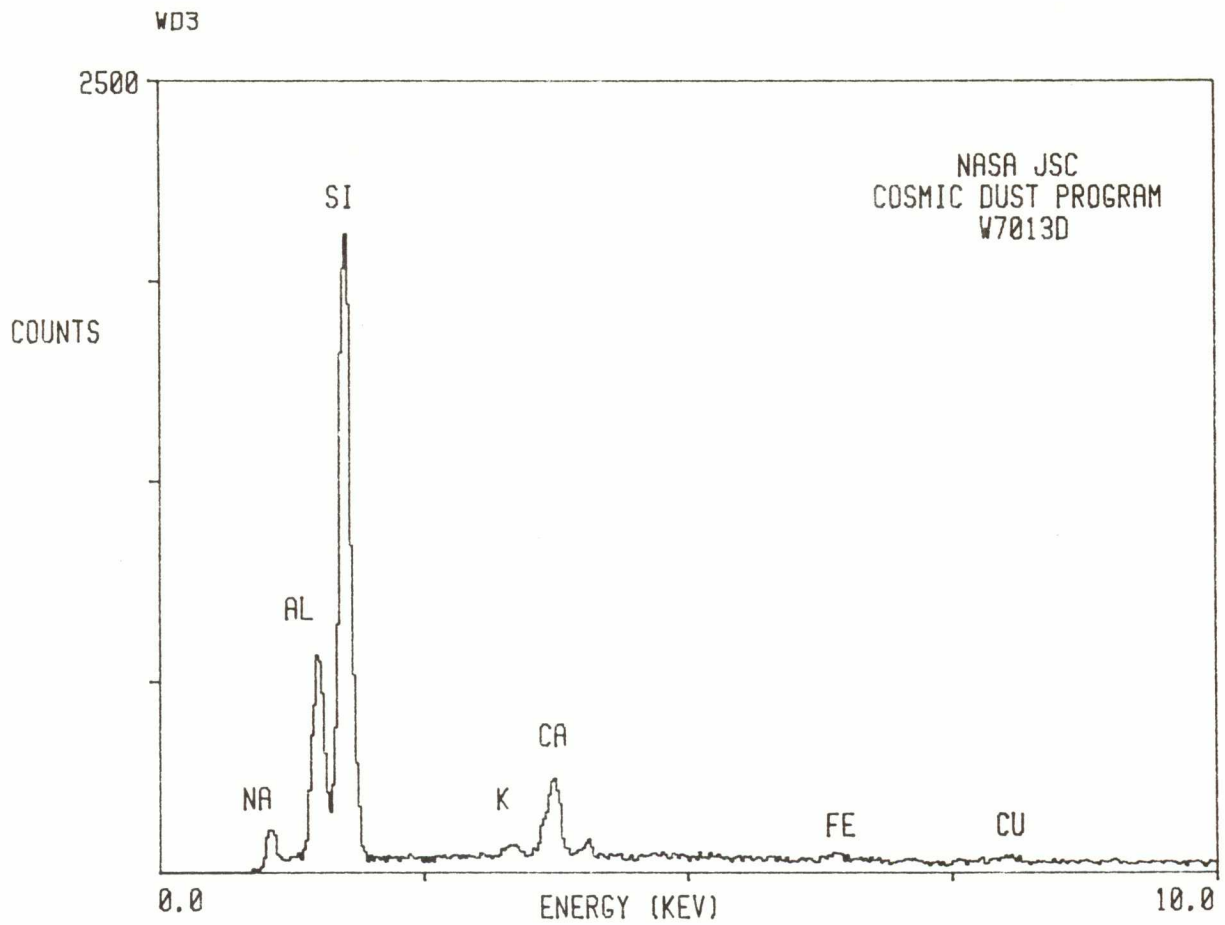


W7013 D 3

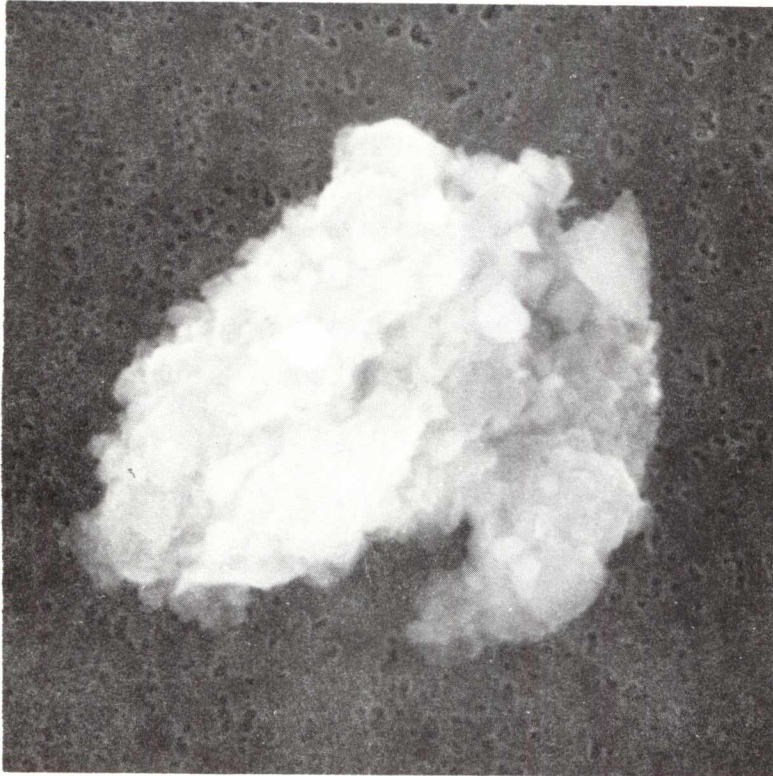


SIZE: 35x22  
SHAPE: I  
TRANS.: T  
COLOR: White to colorless  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40341

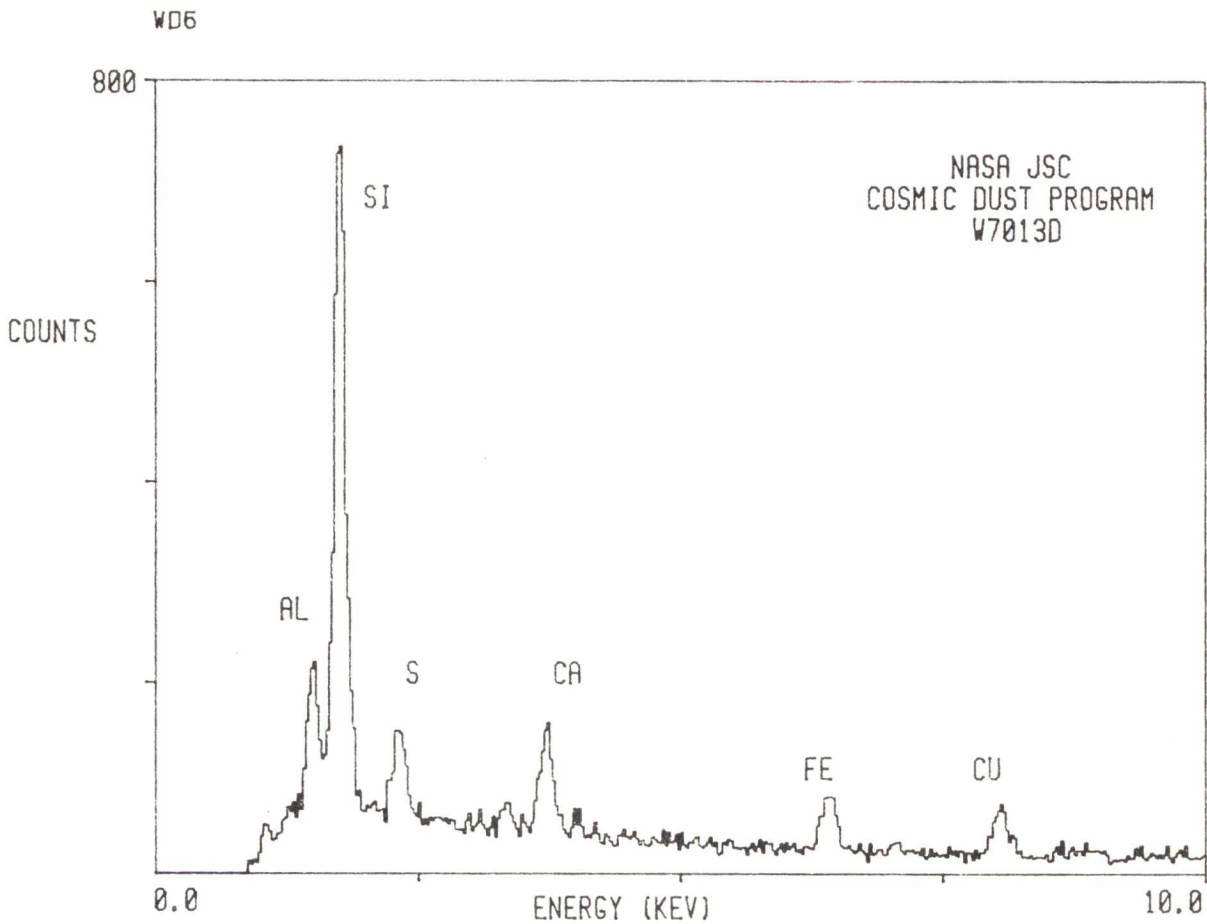


W7013 D 6



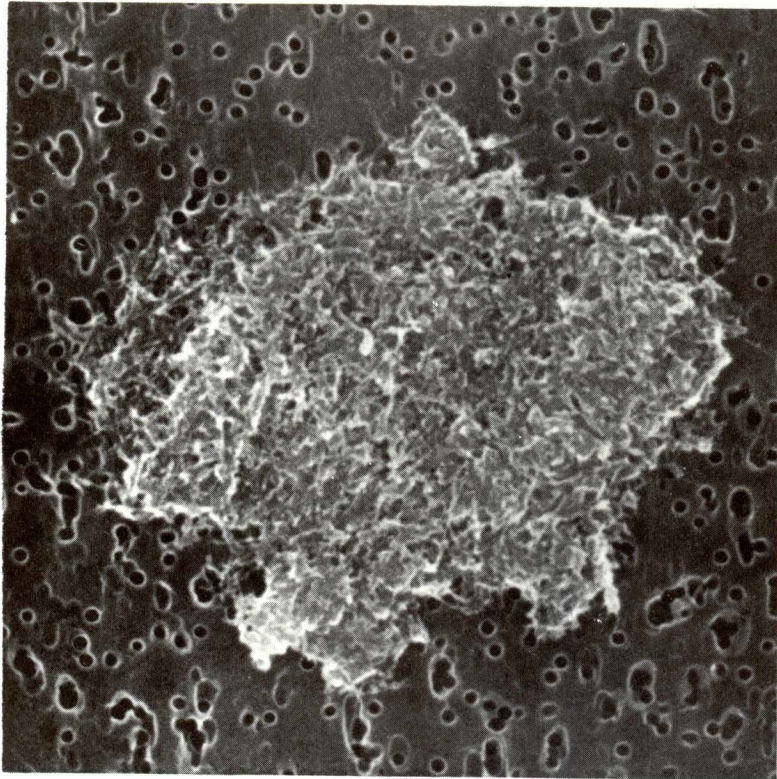
SIZE: 25x20  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: R/D  
TYPE: TCA  
COMMENTS:

S-86-40343



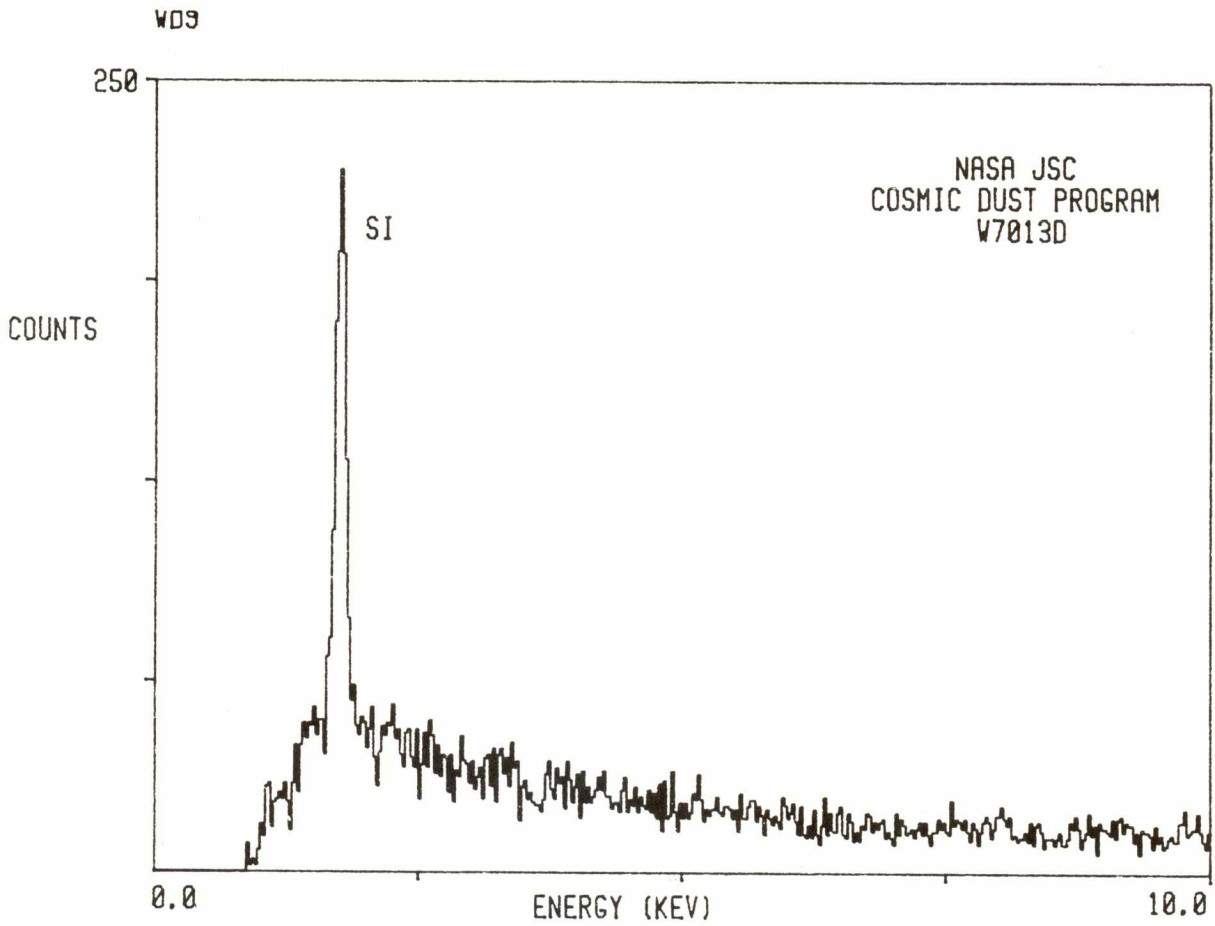


W7013 D 9

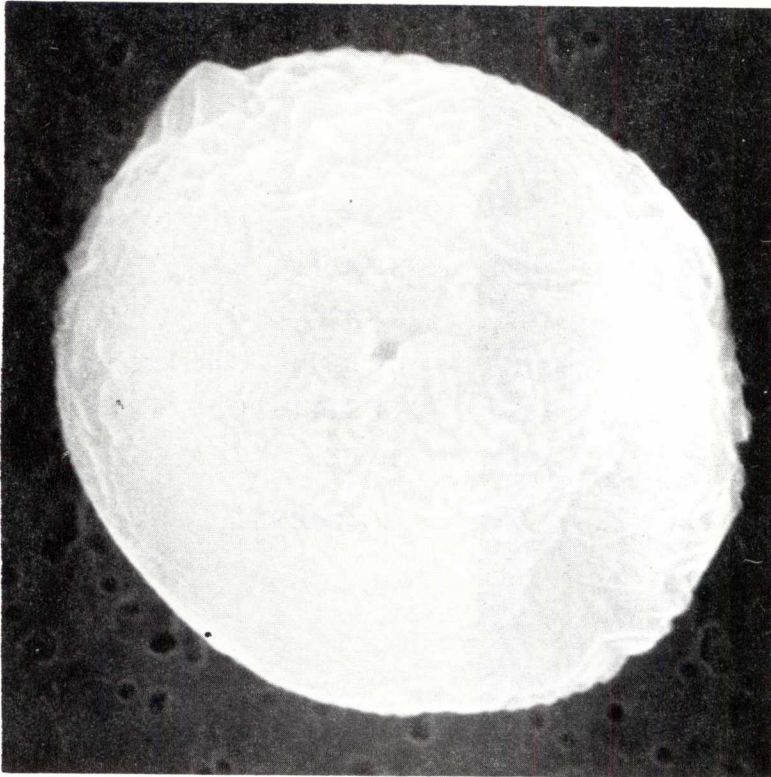


SIZE: 17  
SHAPE: E  
TRANS.: O  
COLOR: Colorless  
LUSTER: D  
TYPE: TCA  
COMMENTS:

S-86-40345

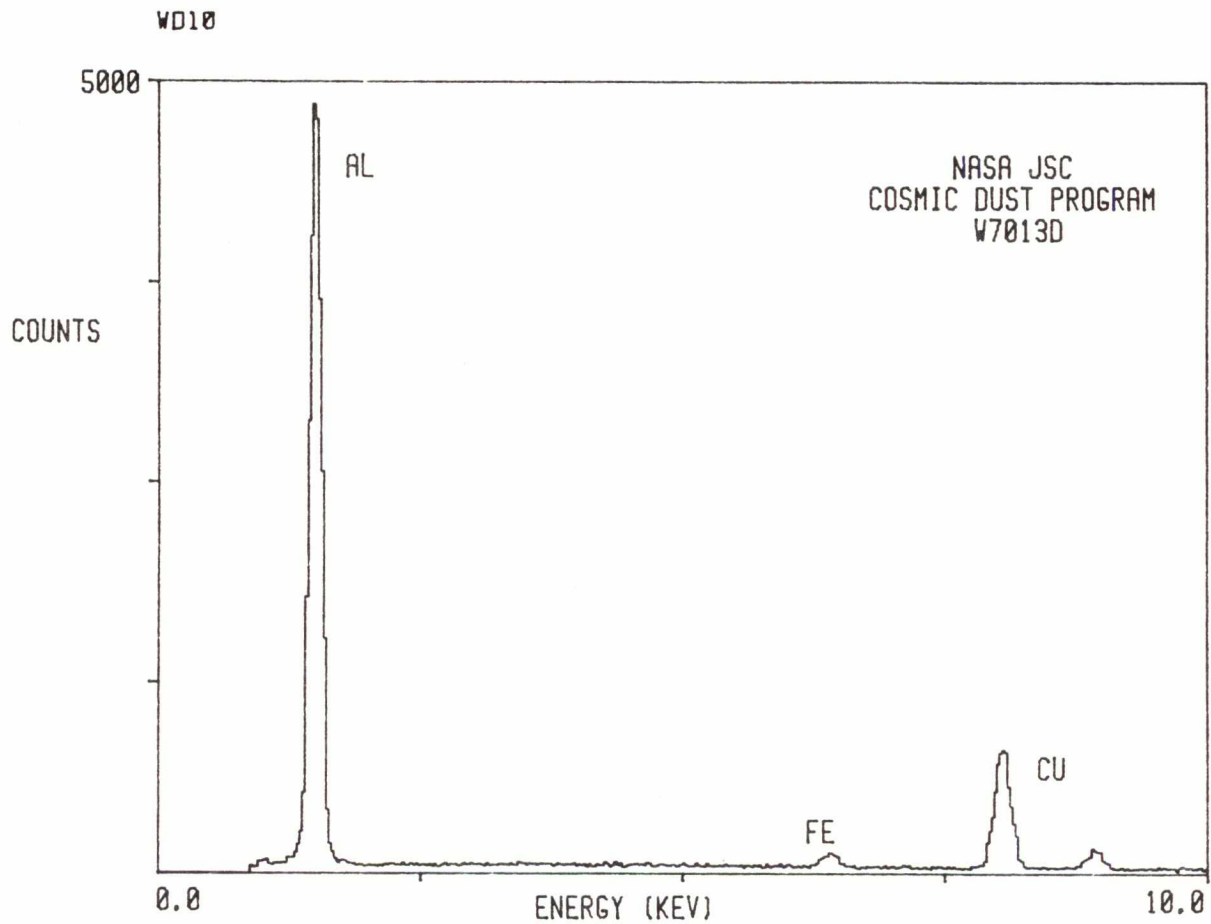


W7013 D 10

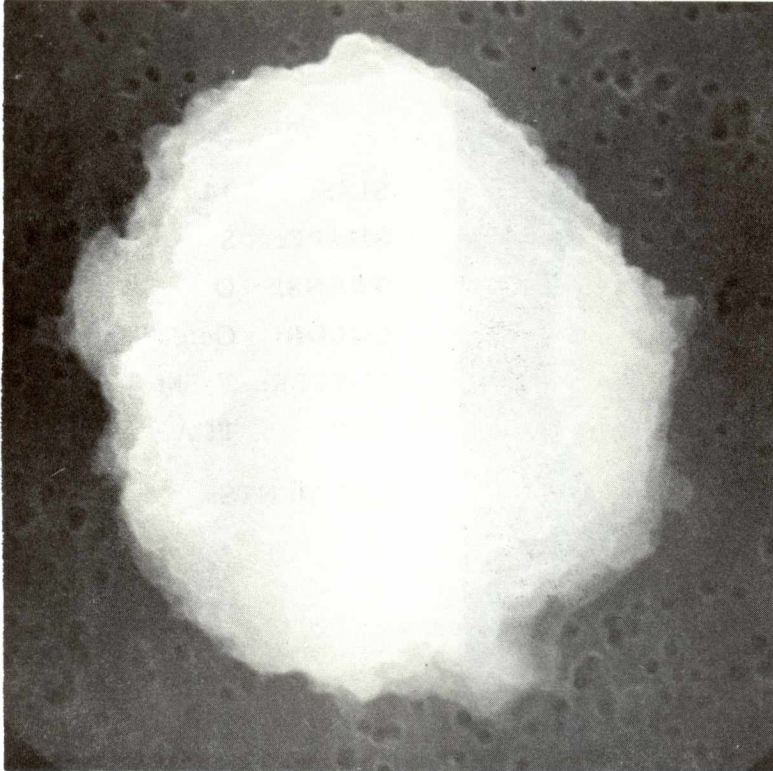


SIZE: 11  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: V/D  
TYPE: TCA  
COMMENTS:

S-86-40346

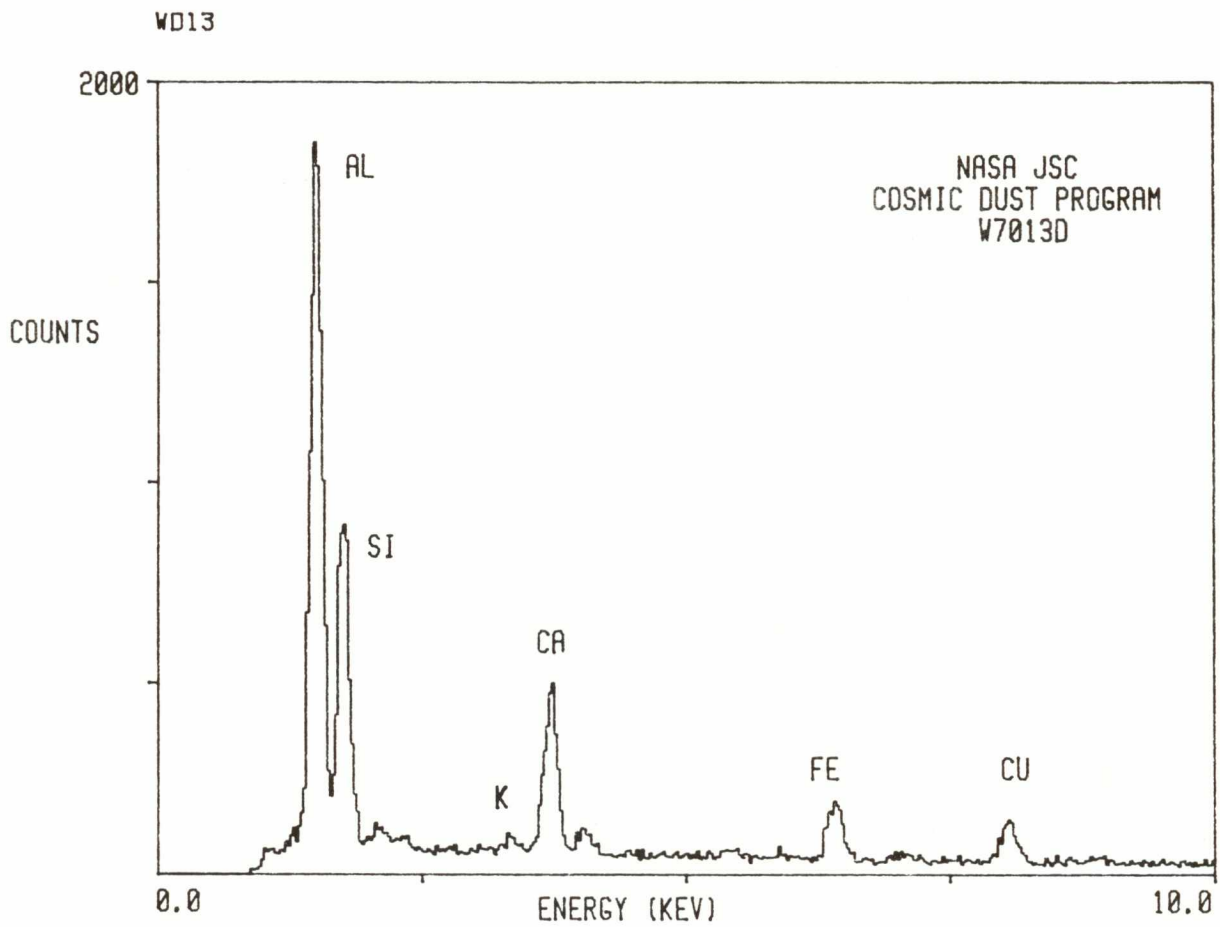


W7013 D 13

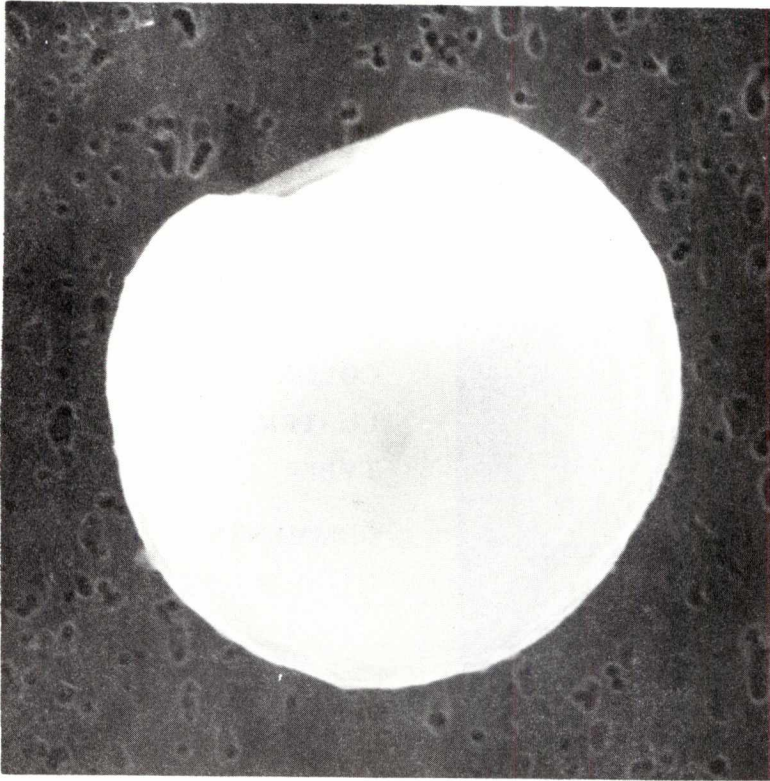


SIZE: 13  
SHAPE: S  
TRANS.: TL/O  
COLOR: Golden  
LUSTER: SM/D  
TYPE: TCA  
COMMENTS:

S-86-40349



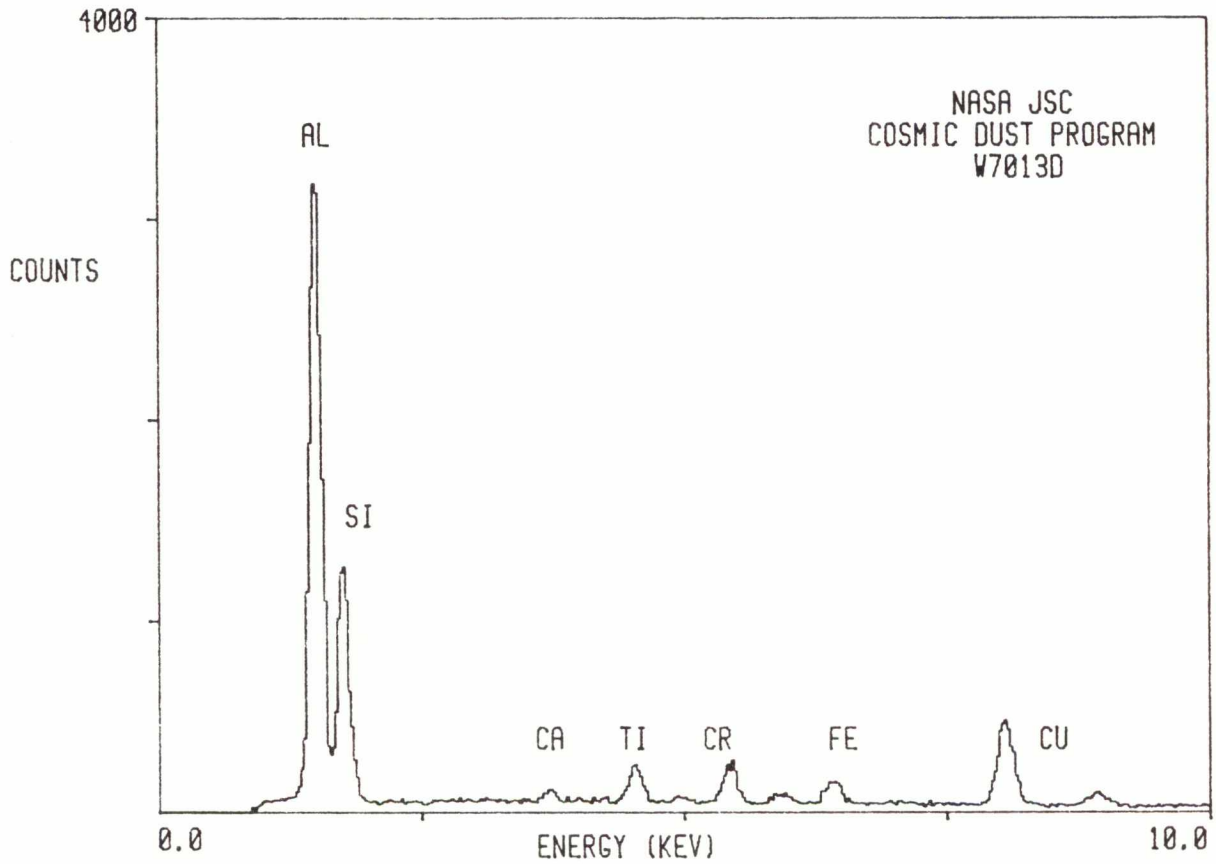
W7013 D 15



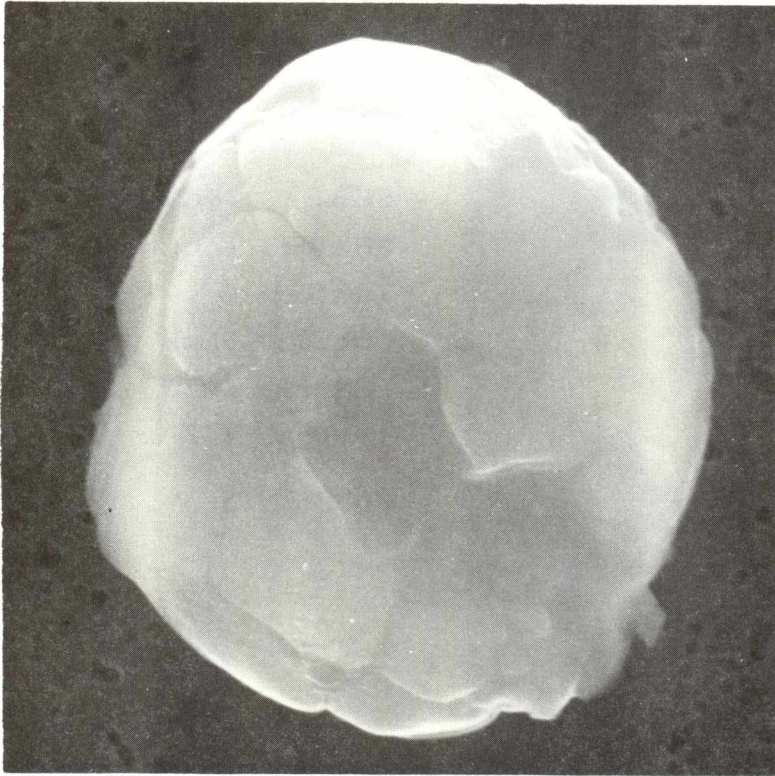
SIZE: 14  
SHAPE: S  
TRANS.: O  
COLOR: Golden to black  
LUSTER: V/SM  
TYPE: TCA  
COMMENTS:

S-86-40351

WD15

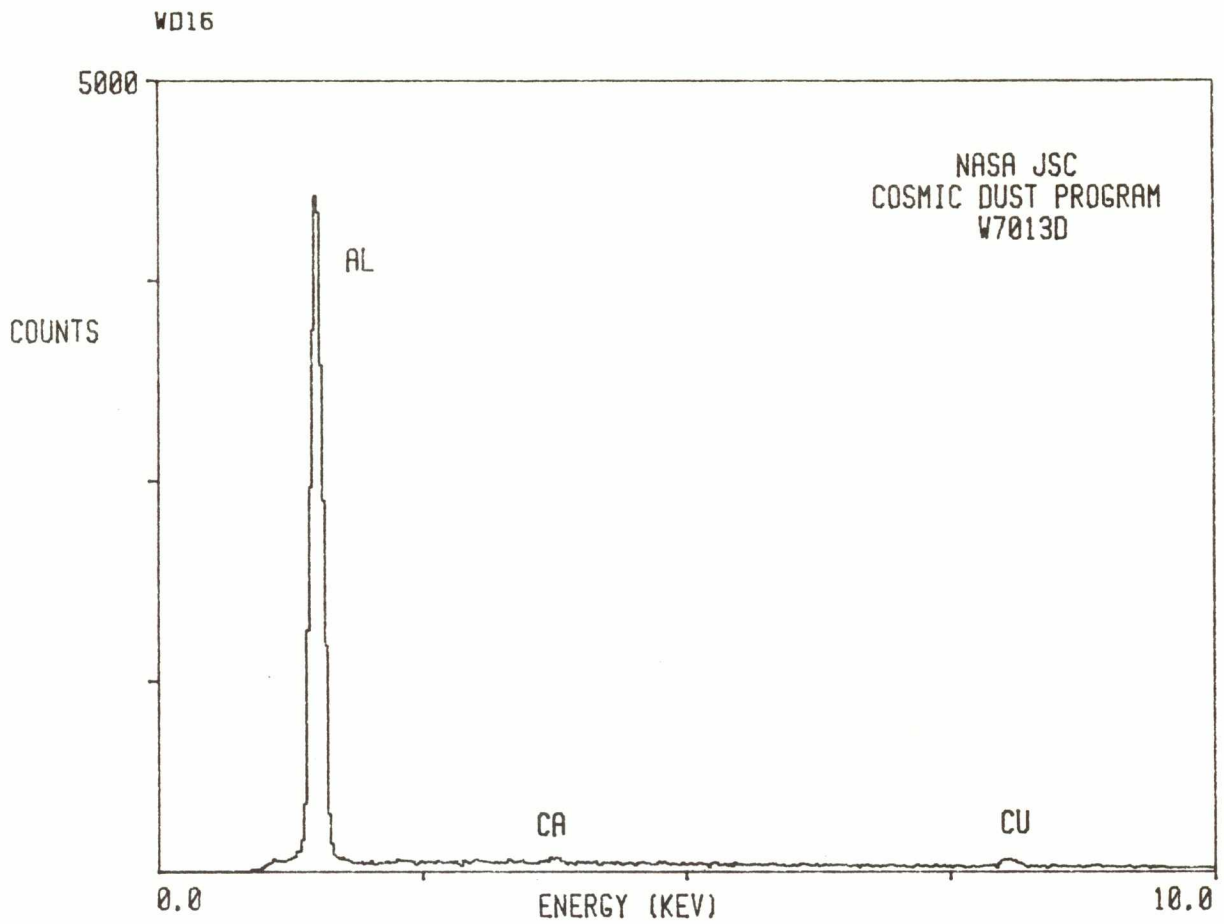


W7013 D 16

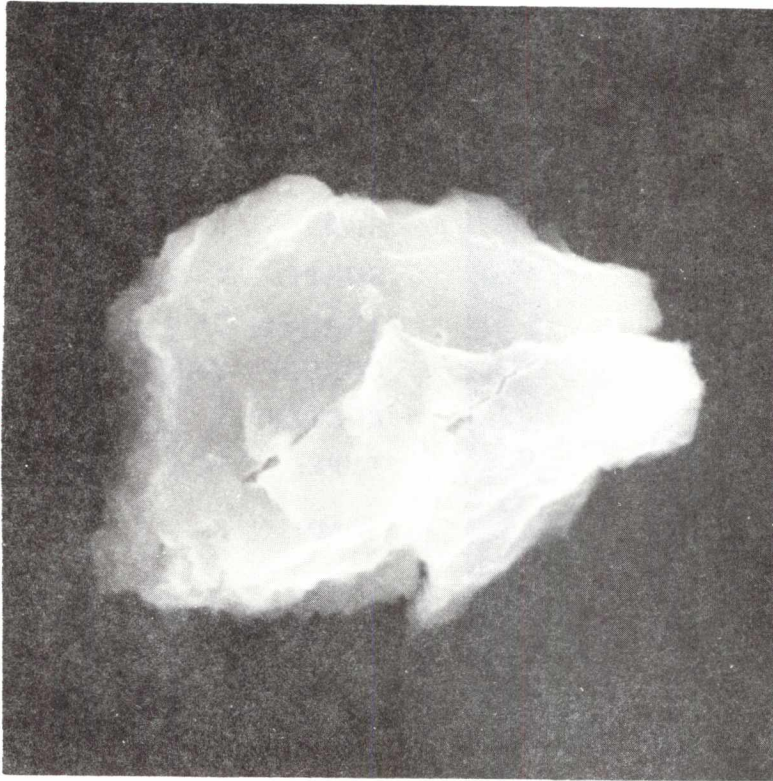


SIZE: 13  
SHAPE: S  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: TCA  
COMMENTS:

S-86-40352

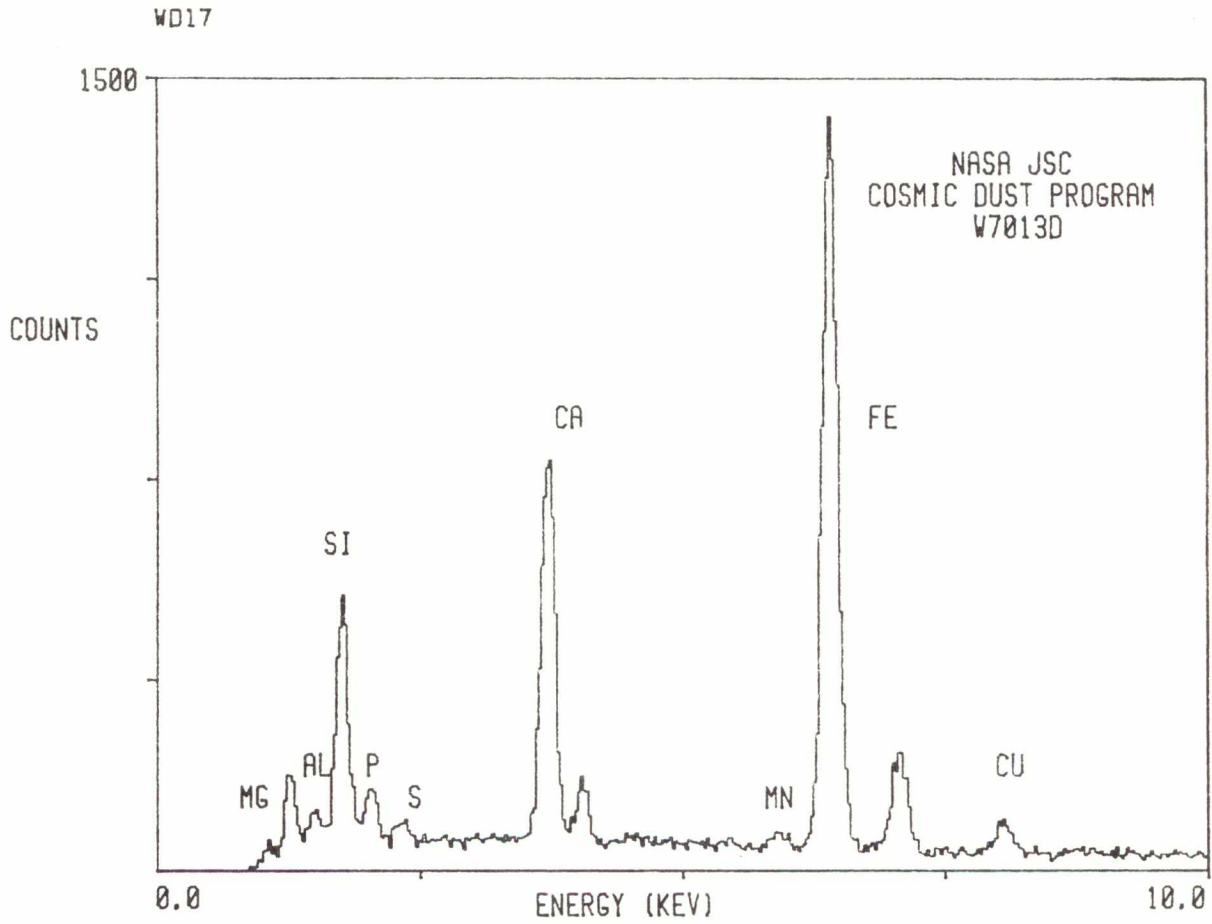


W7013 D 17

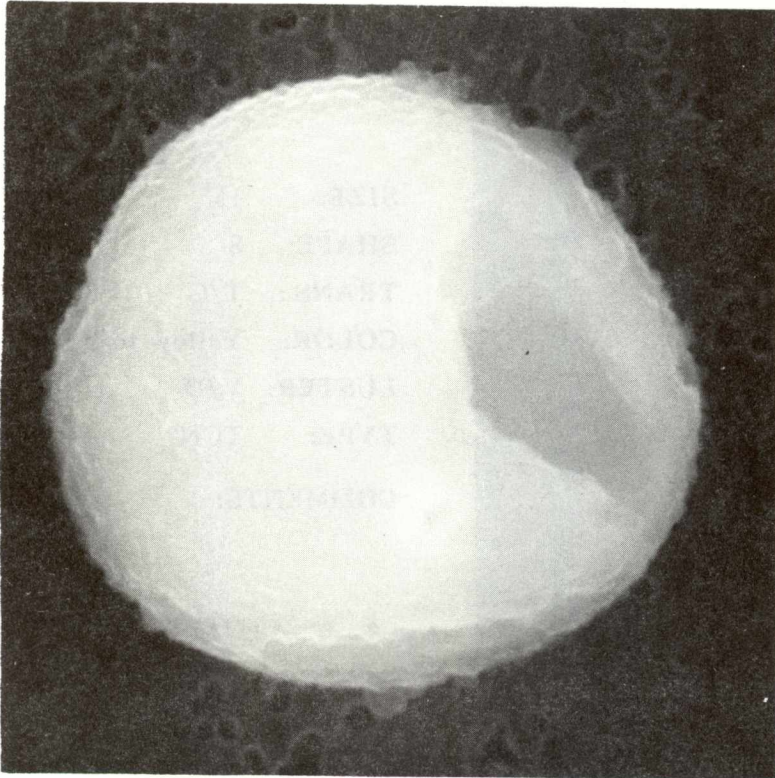


SIZE: 28x22  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/D  
TYPE: TCN  
COMMENTS:

S-86-40353

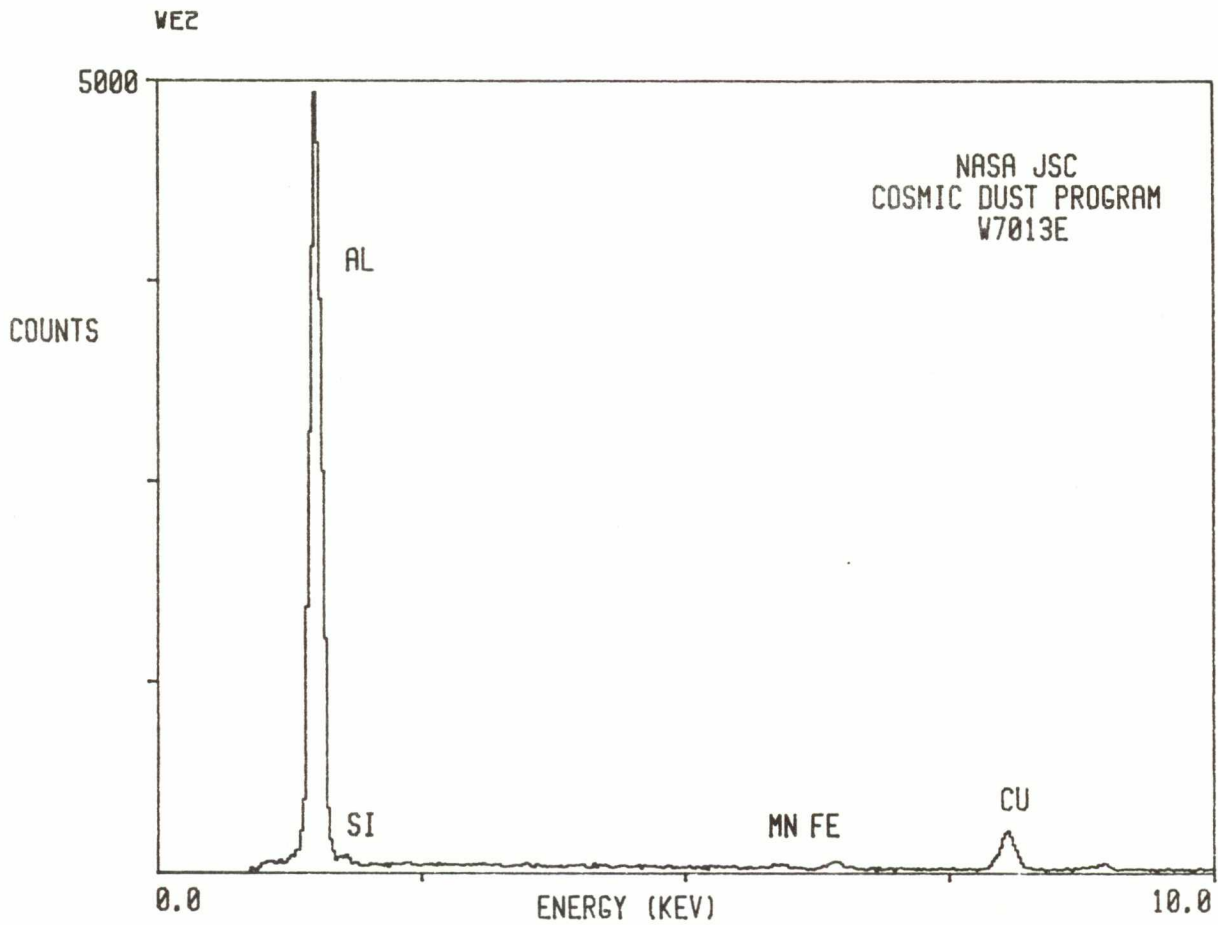


W7013 E 2

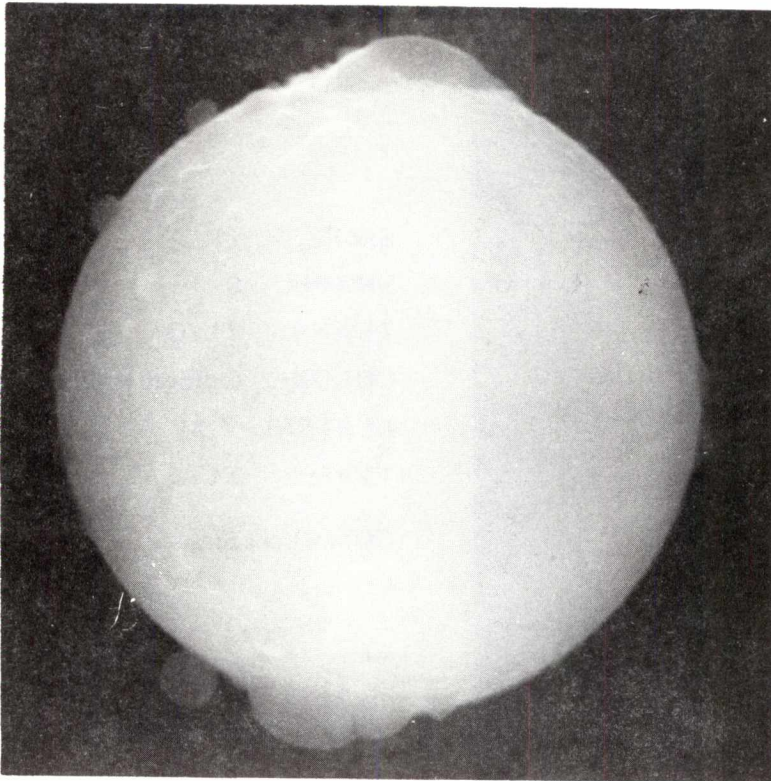


SIZE: 11  
SHAPE: S  
TRANS.: TL/O  
COLOR: Golden to black  
LUSTER: V/M  
TYPE: TCA  
COMMENTS:

S-86-40355

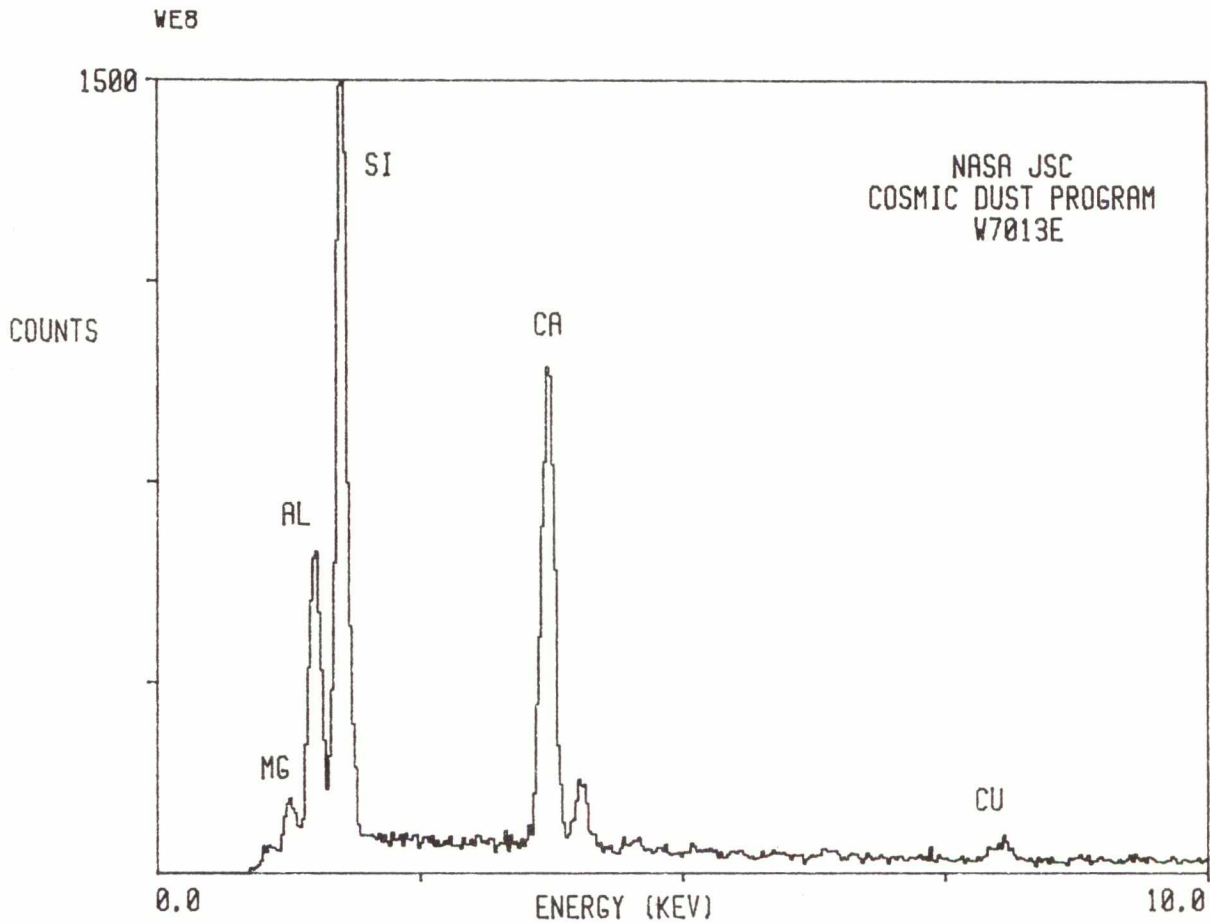


W7013 E 8



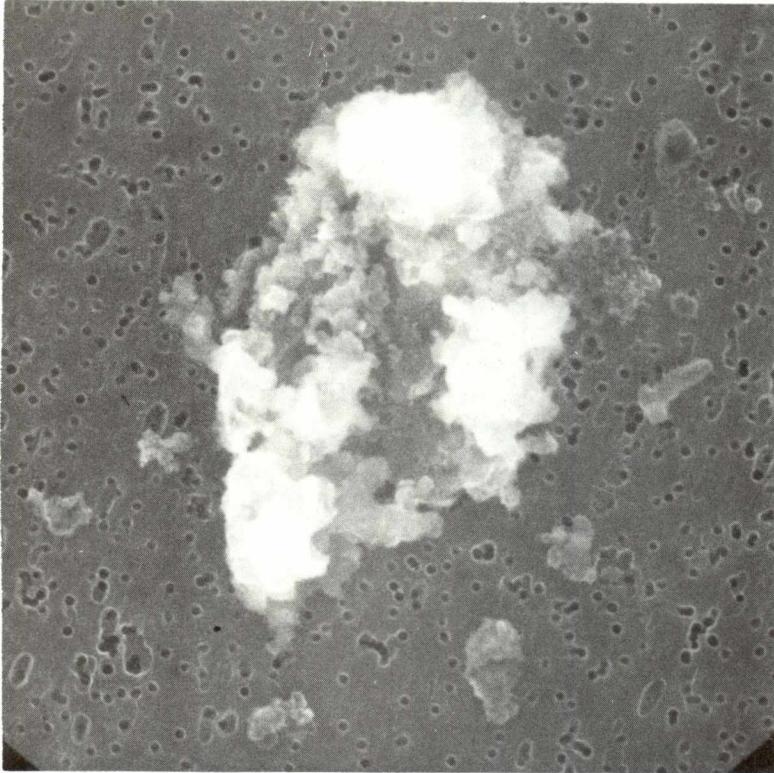
SIZE: 15  
SHAPE: S  
TRANS.: T/O  
COLOR: Yellow to brown  
LUSTER: V/D  
TYPE: TCN?  
COMMENTS:

S-86-40361



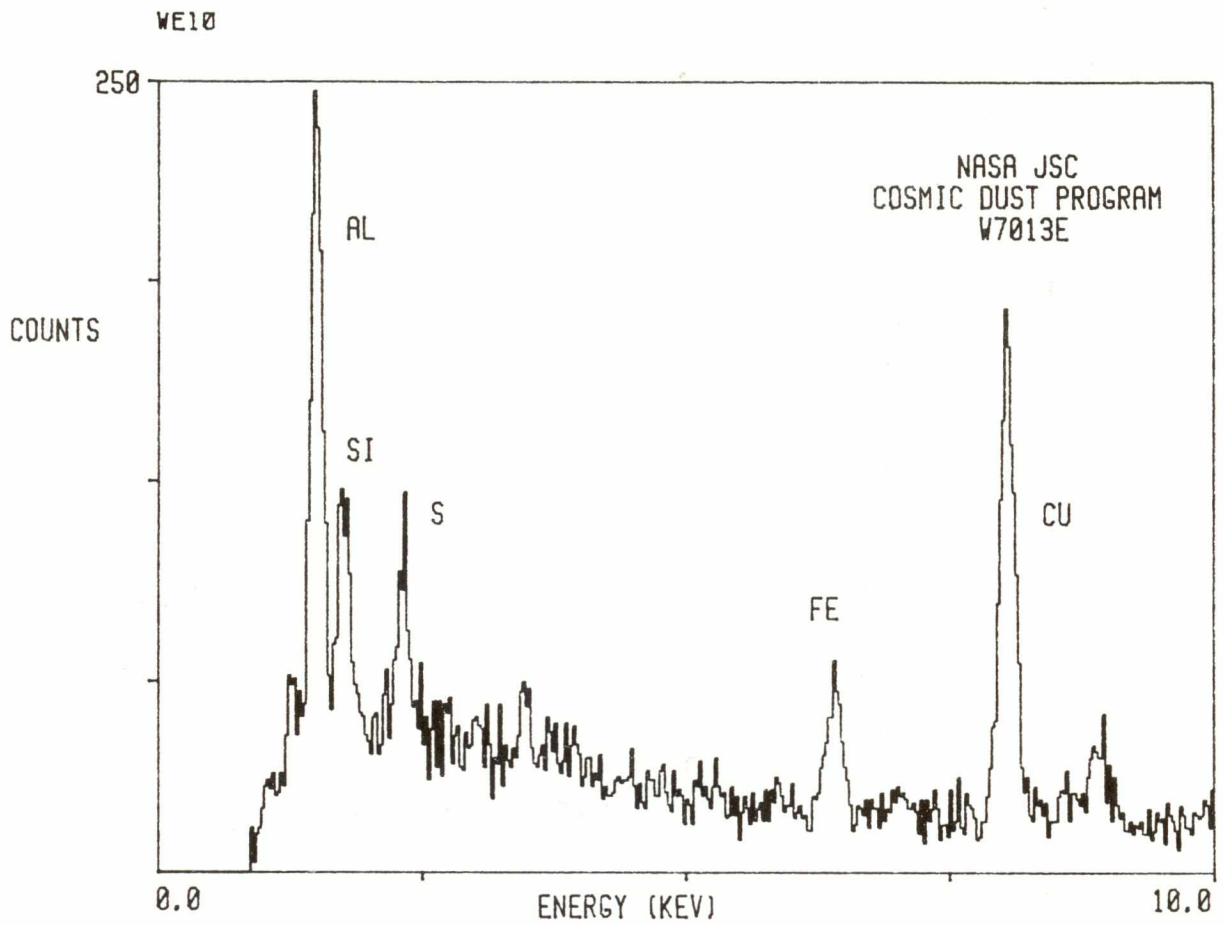


W7013 E 10

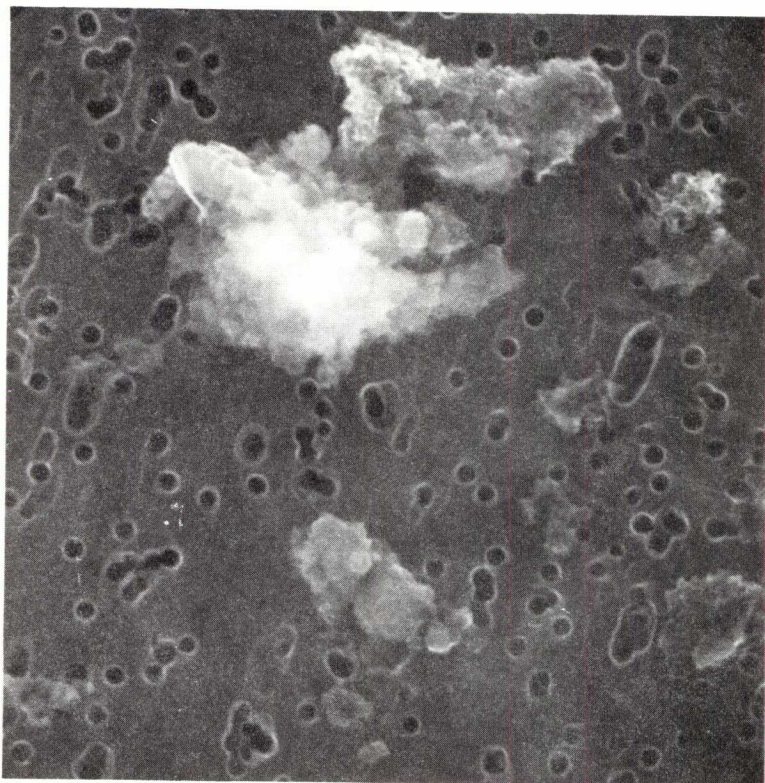


SIZE: 25x12  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: TCA  
COMMENTS:  
Related to  
W7013E11

S-86-40363



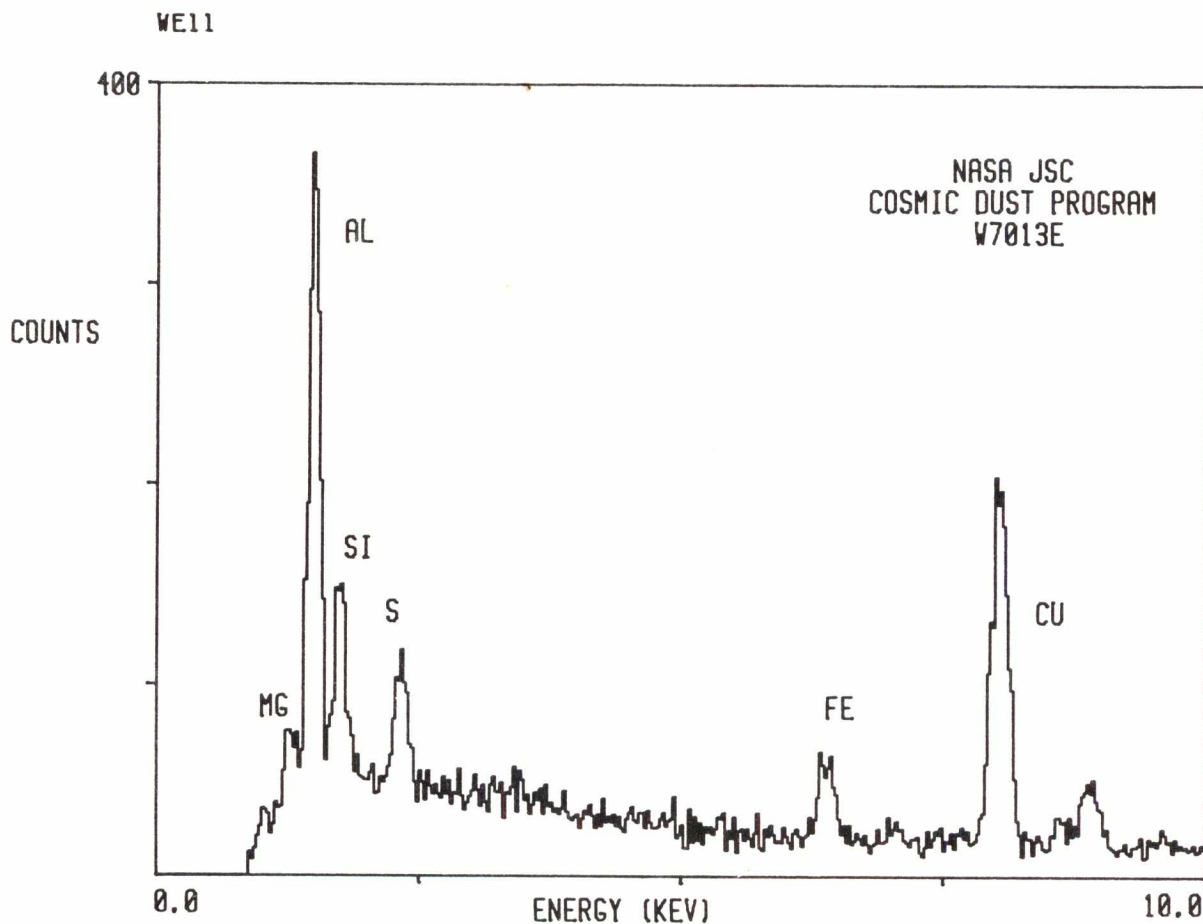
W7013 E 11



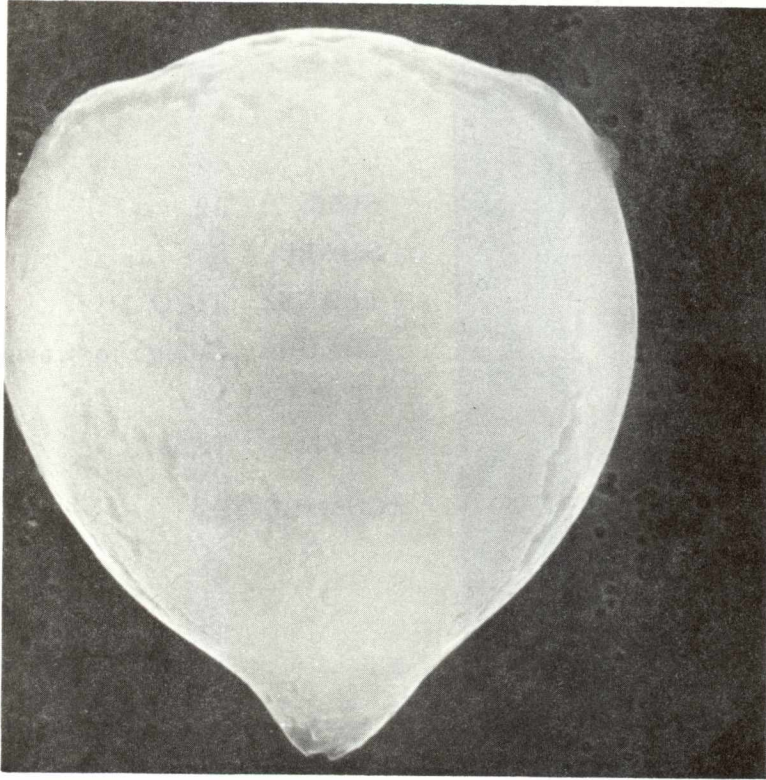
SIZE: 8x7  
SHAPE: I  
TRANS.: TL/O  
COLOR: Yellow to black  
LUSTER: V/D  
TYPE: TCA

COMMENTS:  
Related to  
W7013E12

S-86-40364

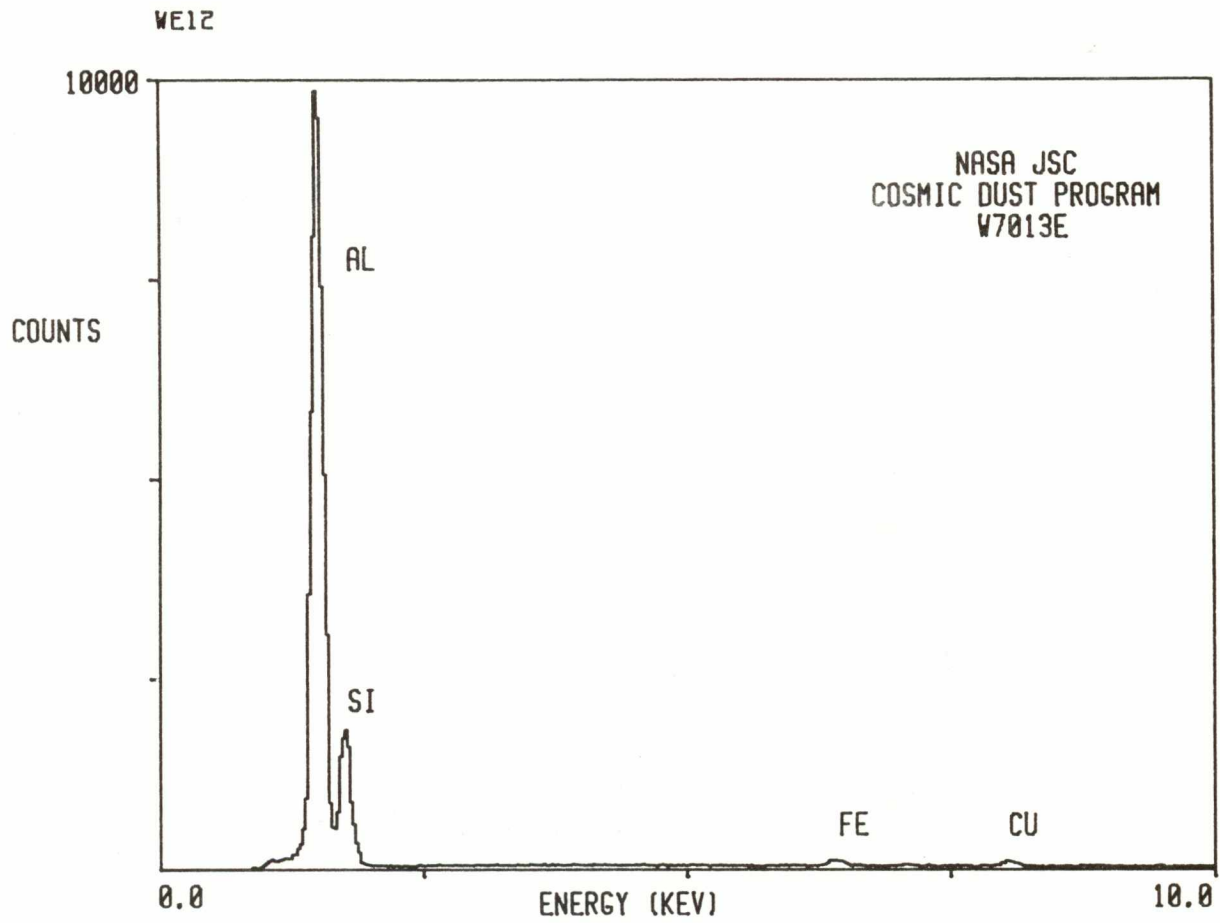


W7013 E 12

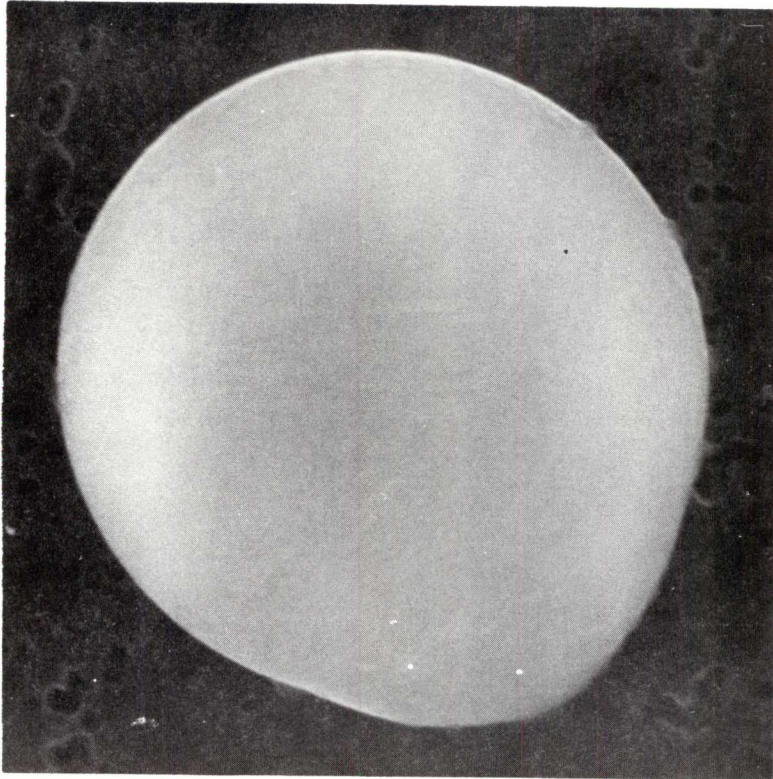


SIZE: 20x18  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: M  
TYPE: TCA  
COMMENTS:

S-86-40365

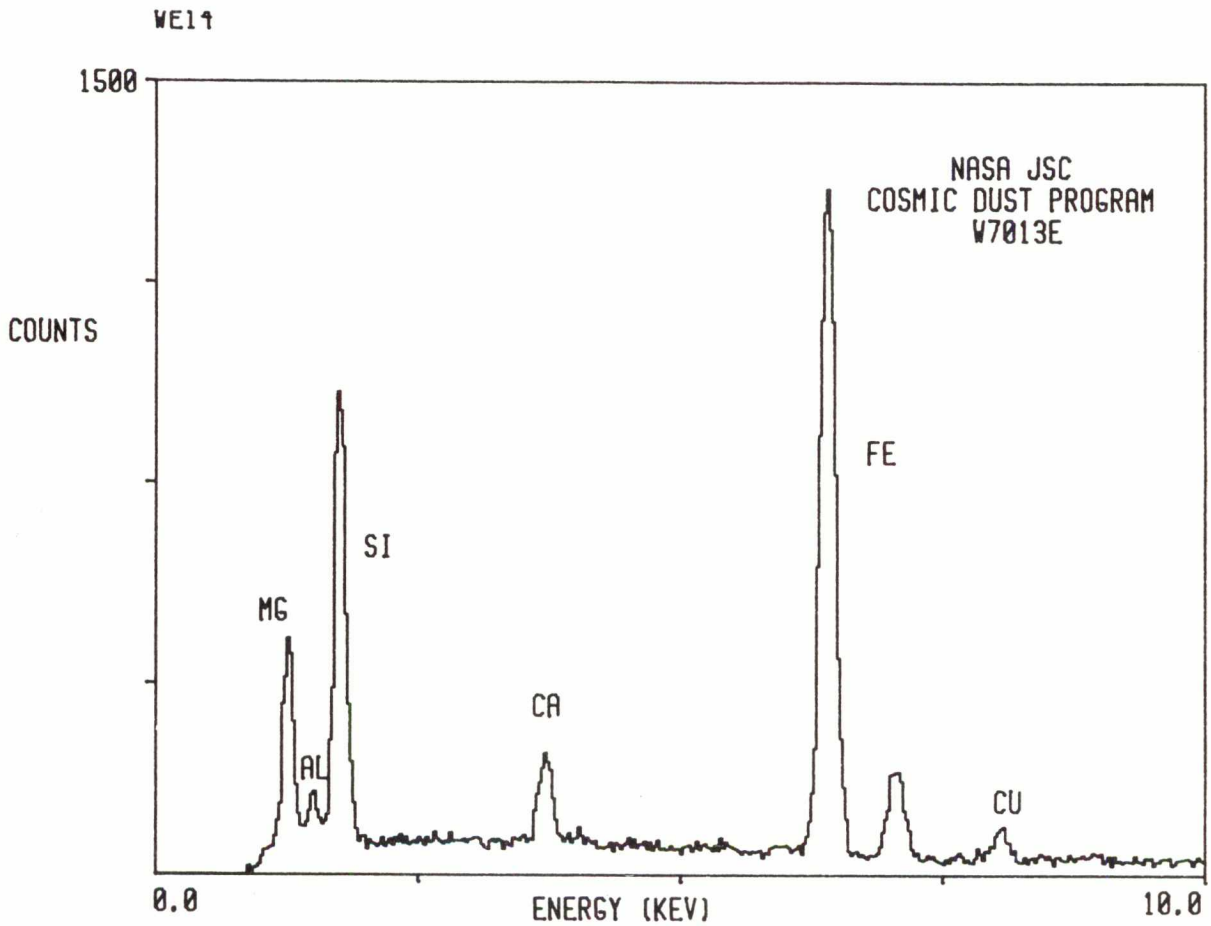


W7013 E 14

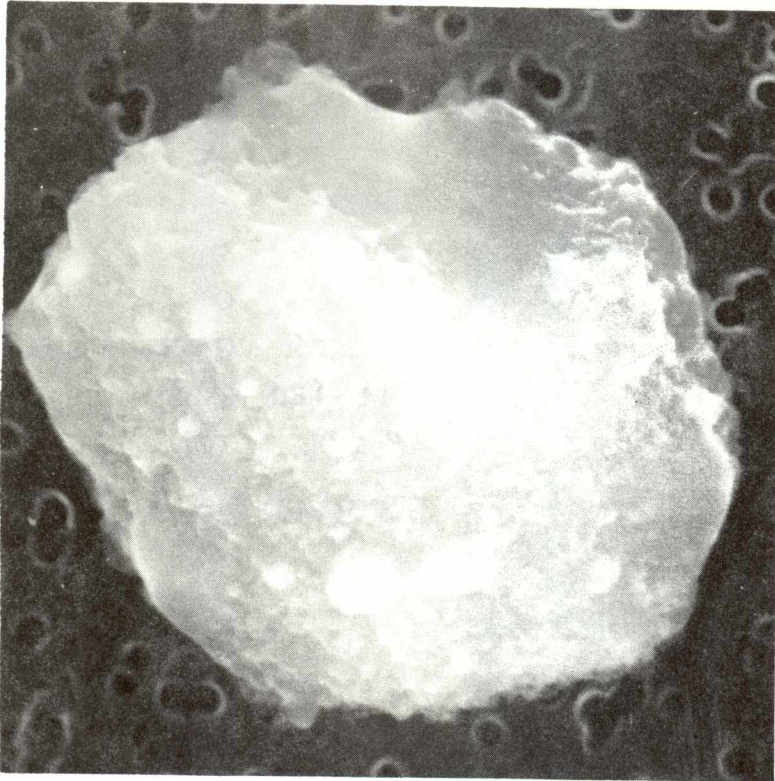


SIZE: 12  
SHAPE: S  
TRANS.: TL/O  
COLOR: Golden to brown  
LUSTER: V  
TYPE: TCN  
COMMENTS:

S-86-40367

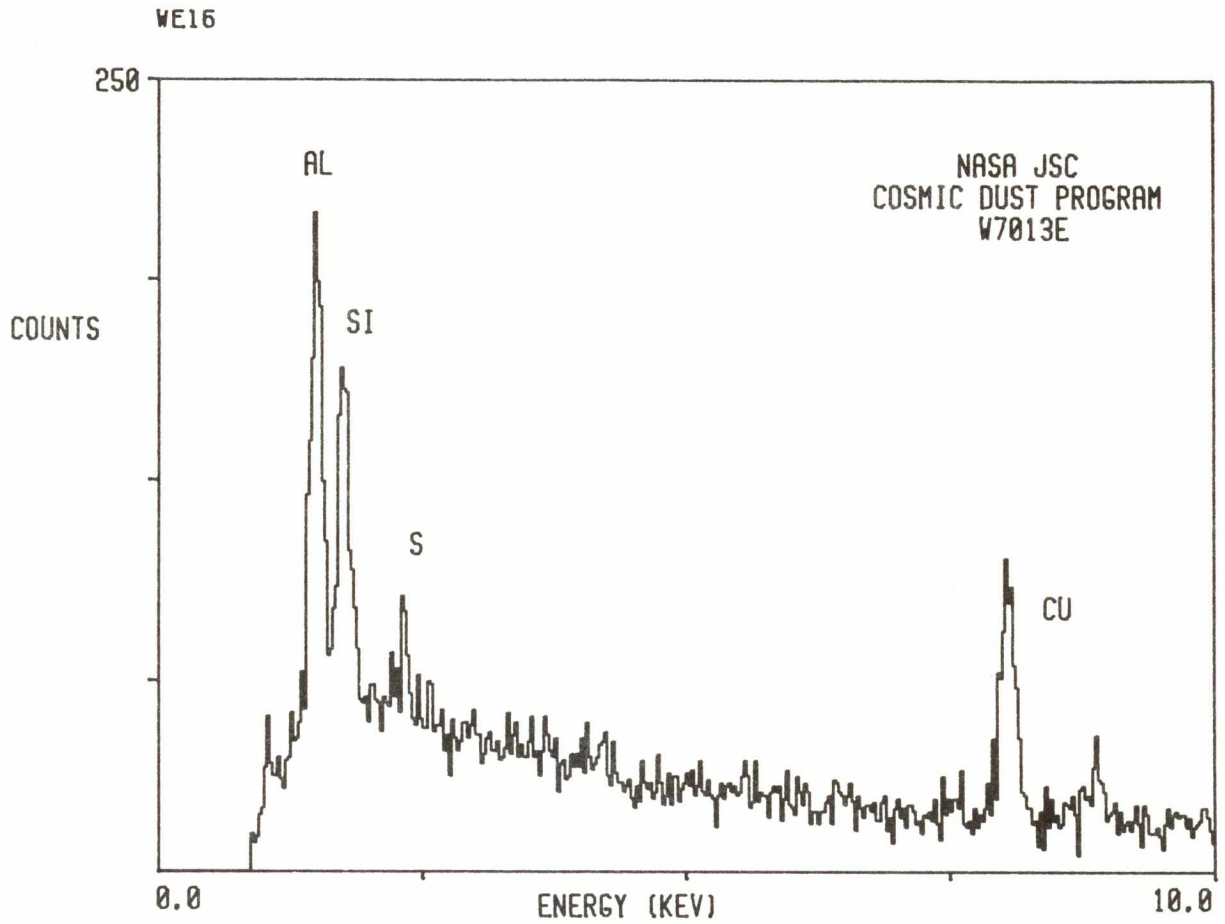


W7013 E 16

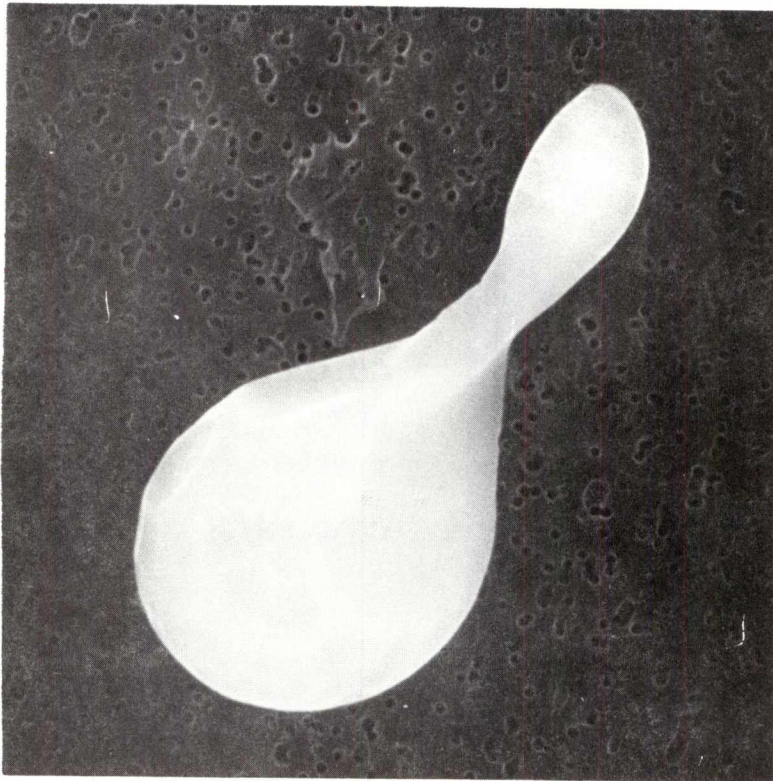


SIZE: 9x8  
SHAPE: E  
TRANS.: O  
COLOR: Golden to black  
LUSTER: R/D  
TYPE: TCA  
COMMENTS:

S-86-40369

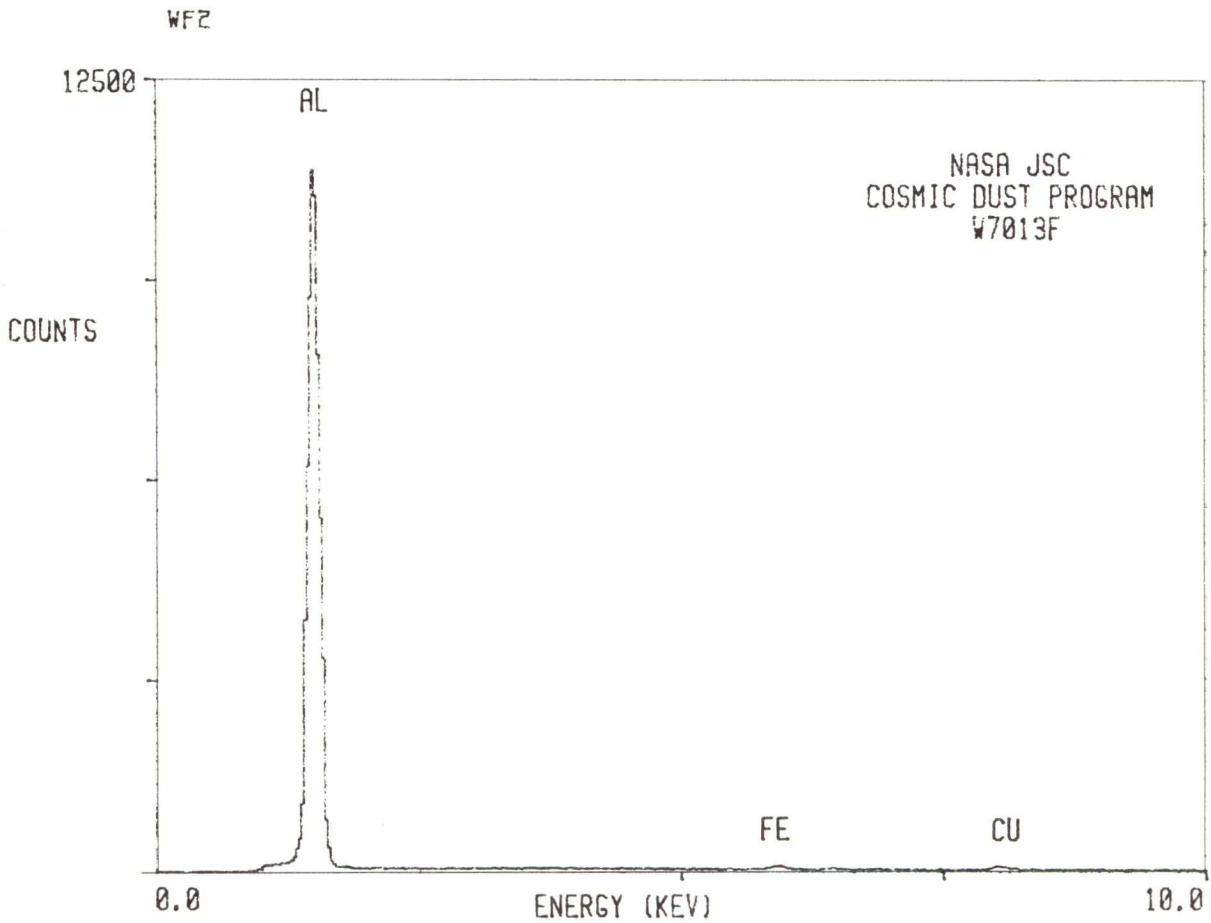


W7013 F 2

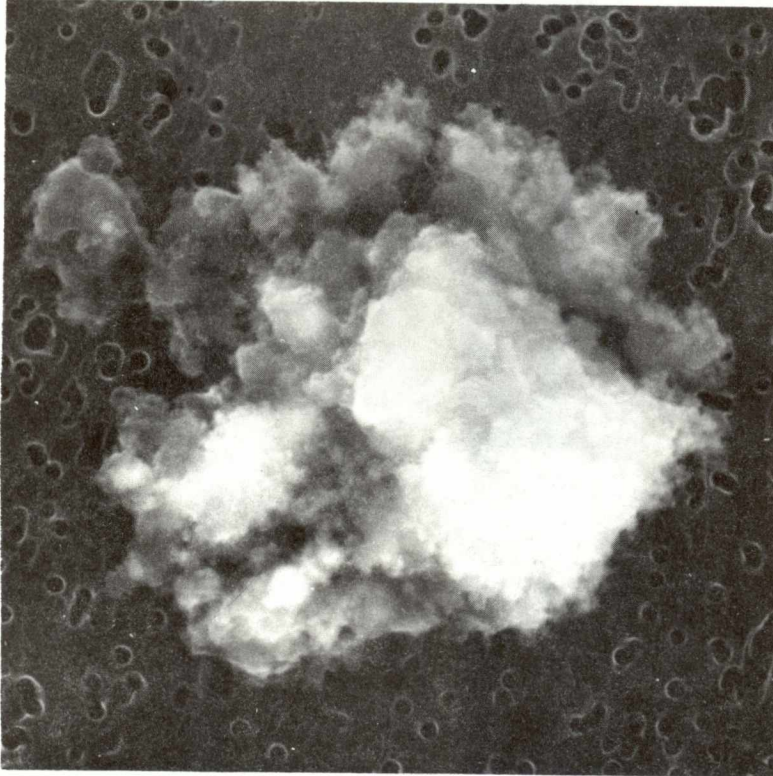


SIZE: 25x12  
SHAPE: S  
TRANS.: O  
COLOR: Golden to brown  
LUSTER: SM/V  
TYPE: TCA  
COMMENTS:

S-86-40372

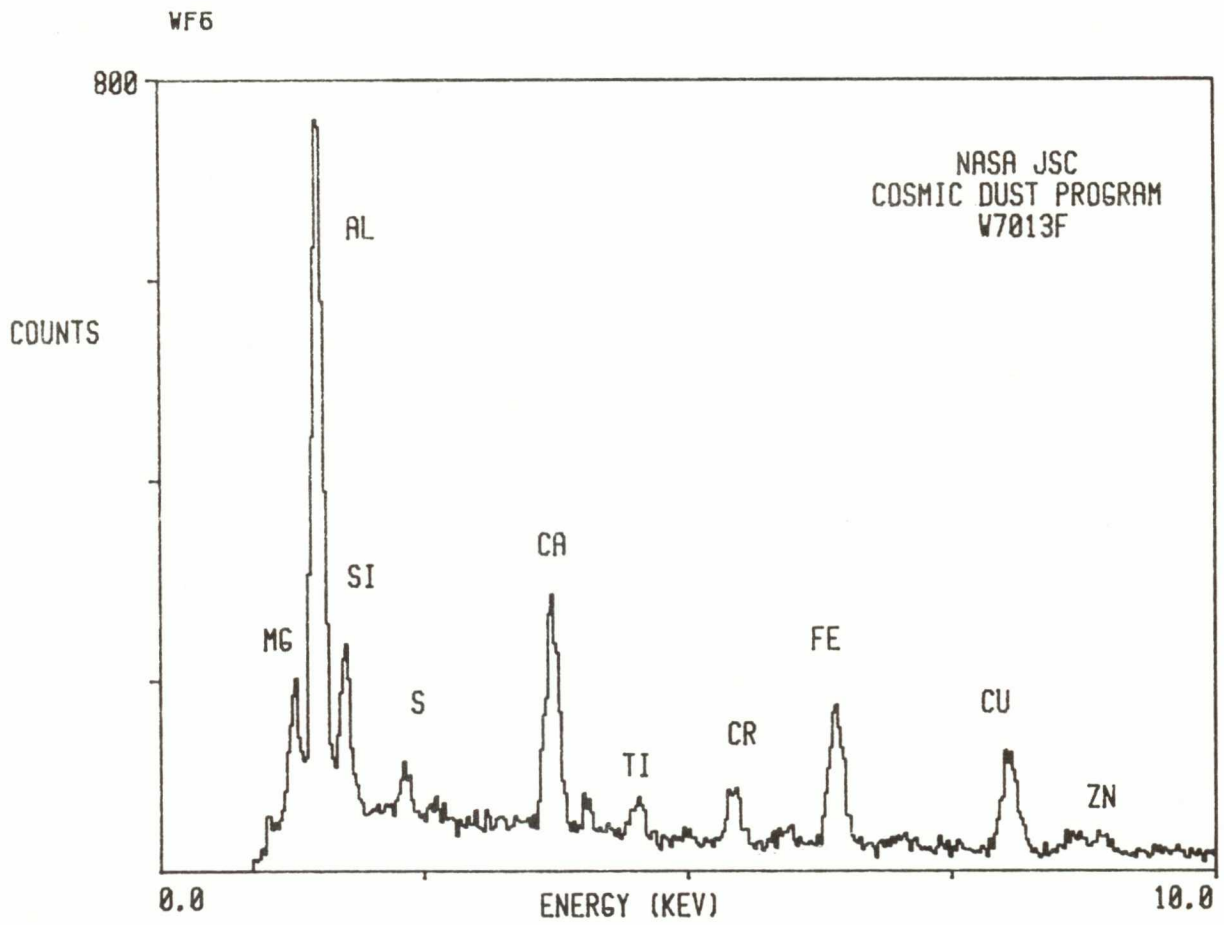


W7013 F 6

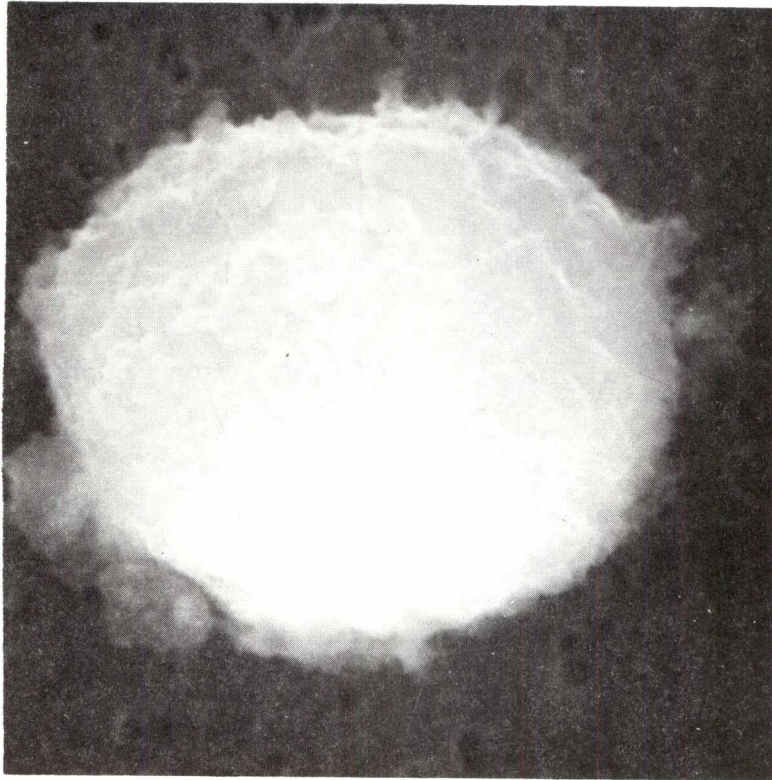


SIZE: 16x15  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: V/D  
TYPE: TCA  
COMMENTS:

S-86-40376



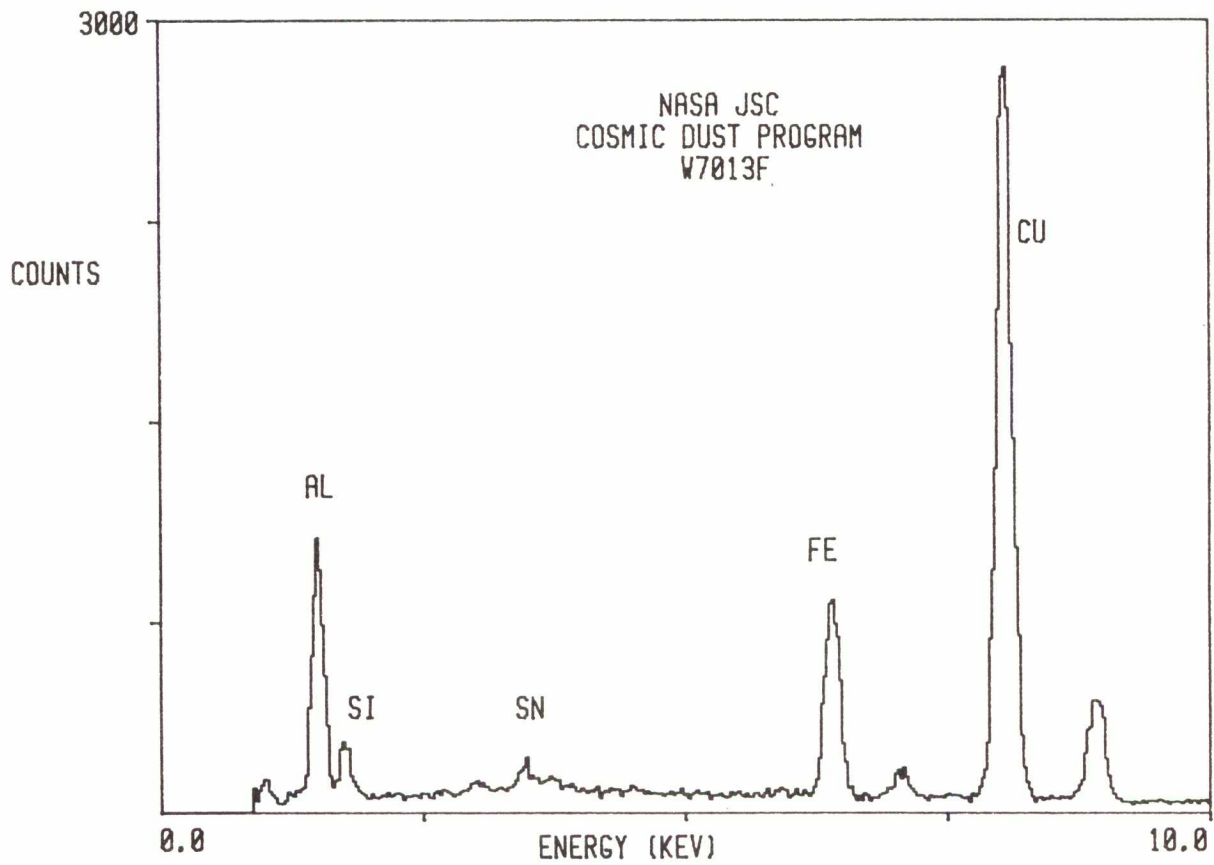
W7013 F 7



SIZE: 10  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: SM/M  
TYPE: TCA  
COMMENTS:

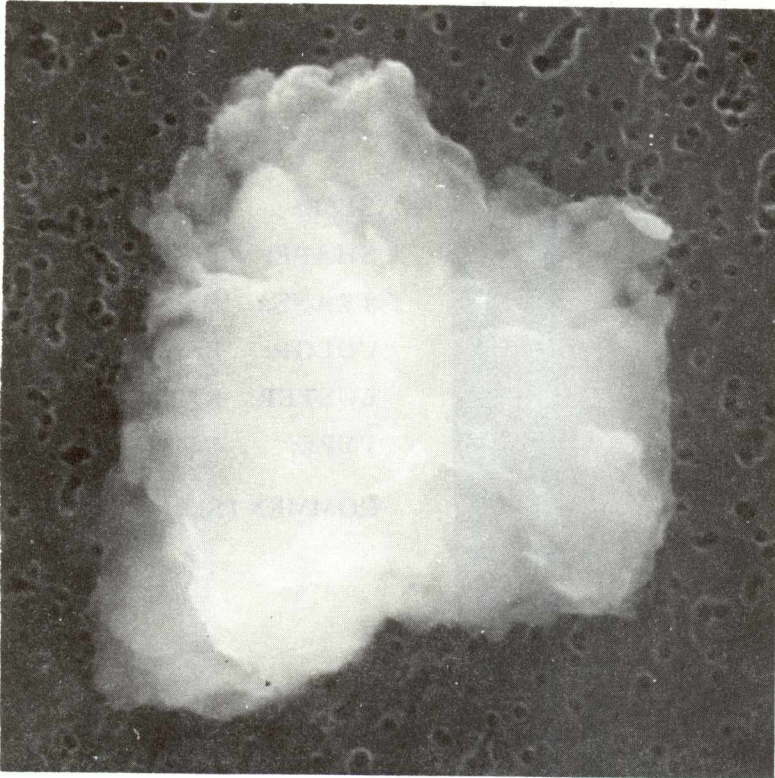
S-86-40377

WF7



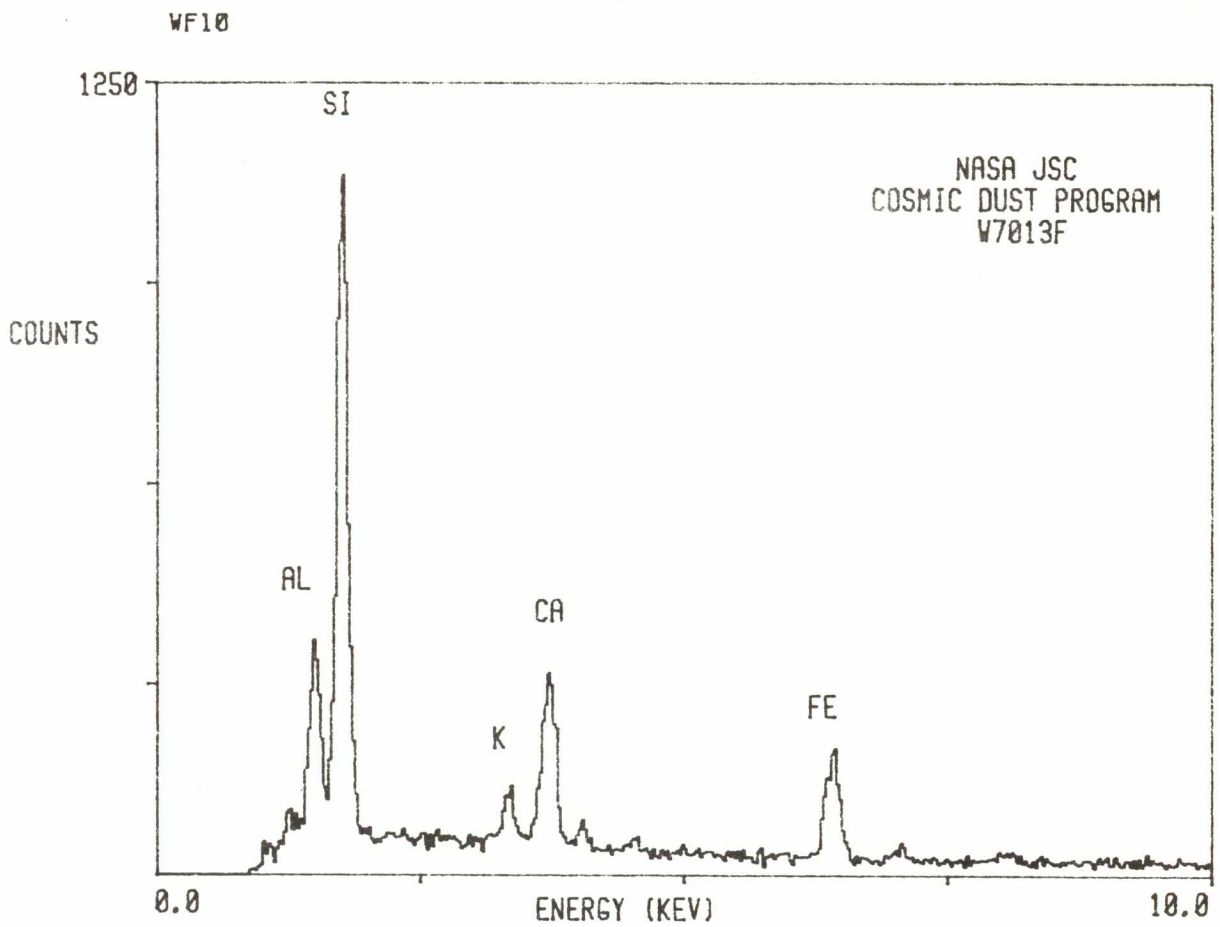


W7013 F 10

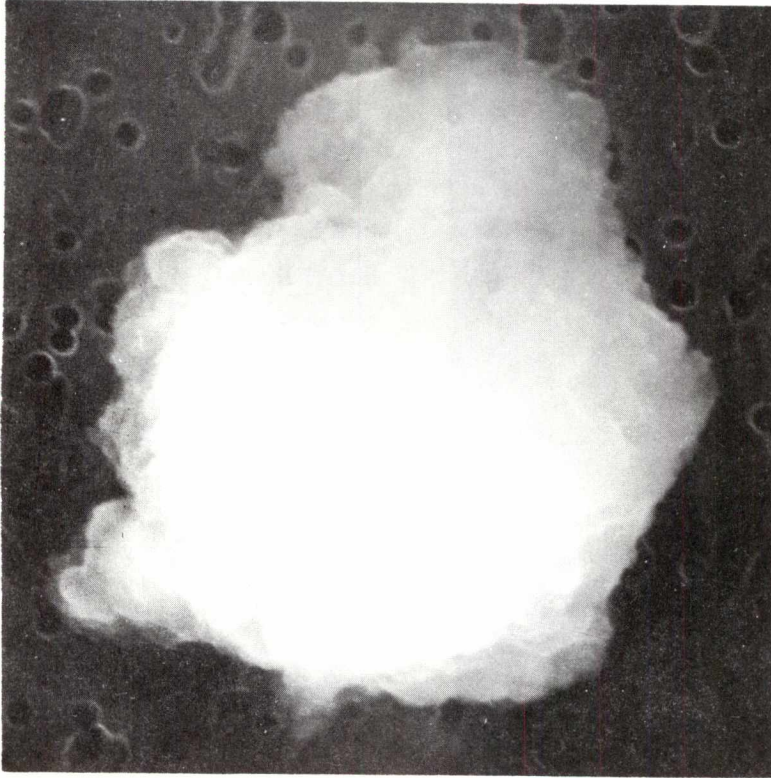


SIZE: 17x15  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow to brown  
LUSTER: V/D  
TYPE: TCN  
COMMENTS:

S-86-40380



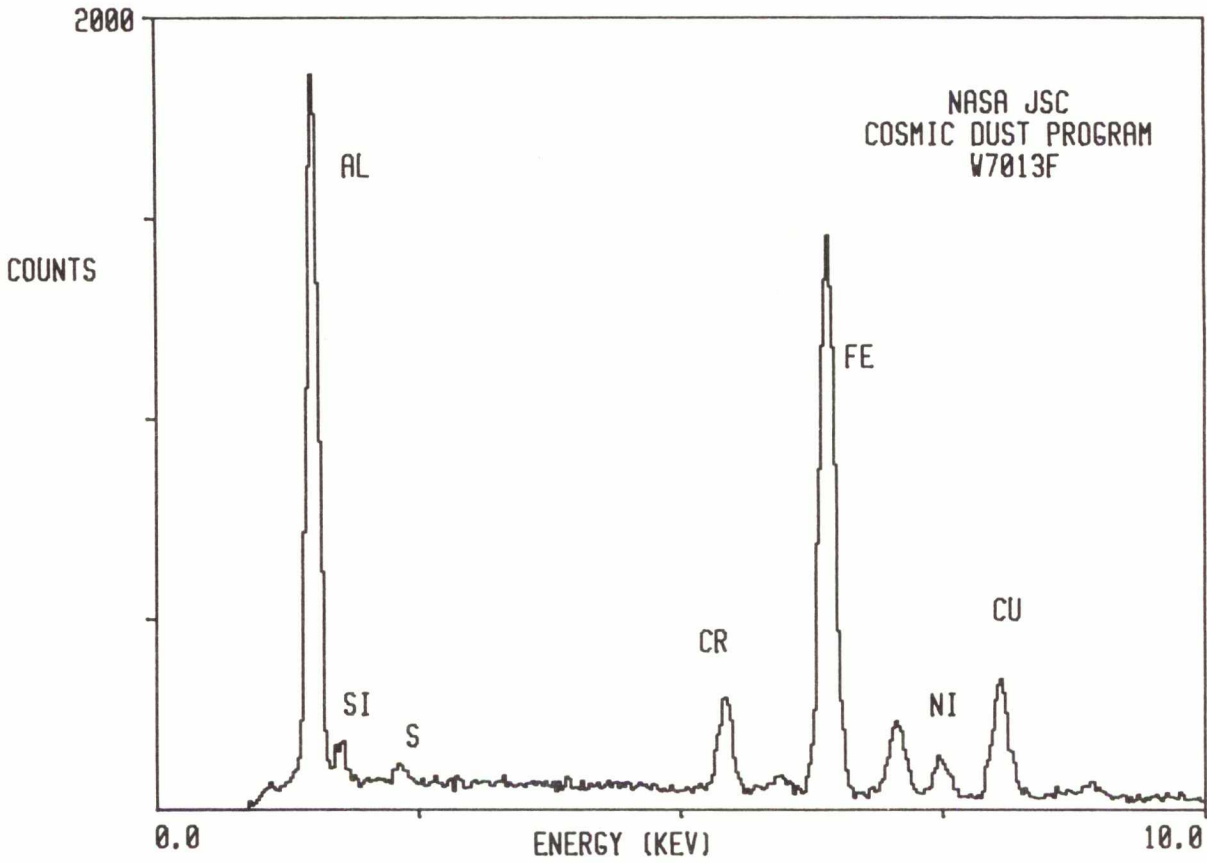
W7013 F 15



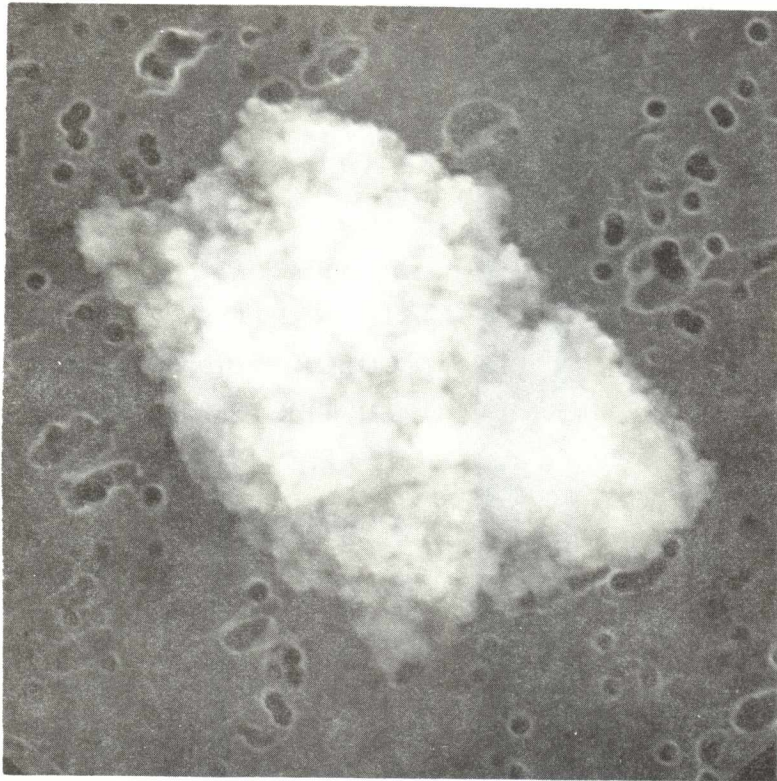
SIZE: 10x8  
SHAPE: I  
TRANS.: O  
COLOR: Brown  
LUSTER: R/SM  
TYPE: TCA  
COMMENTS:

S-86-40384

WF15

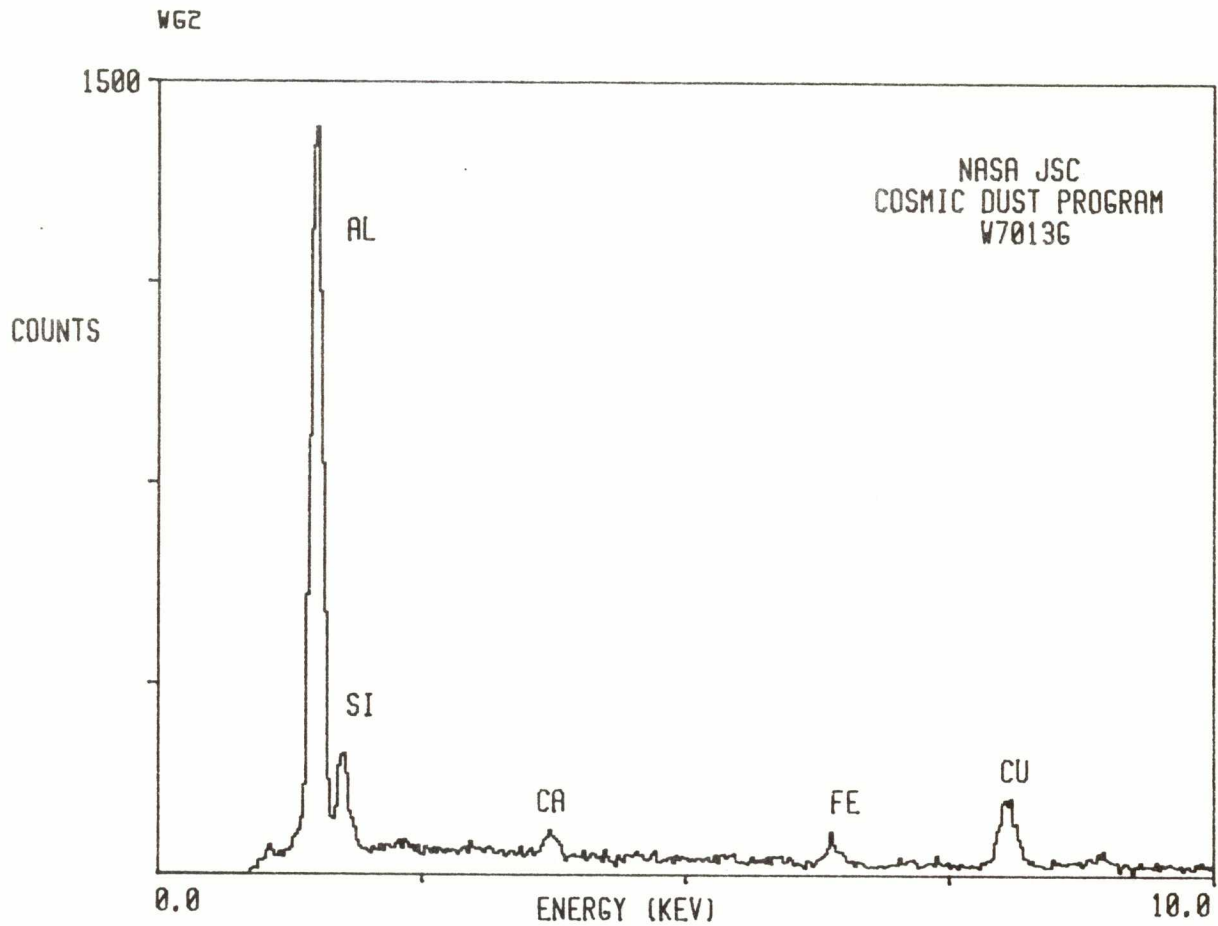


W7013 G 2

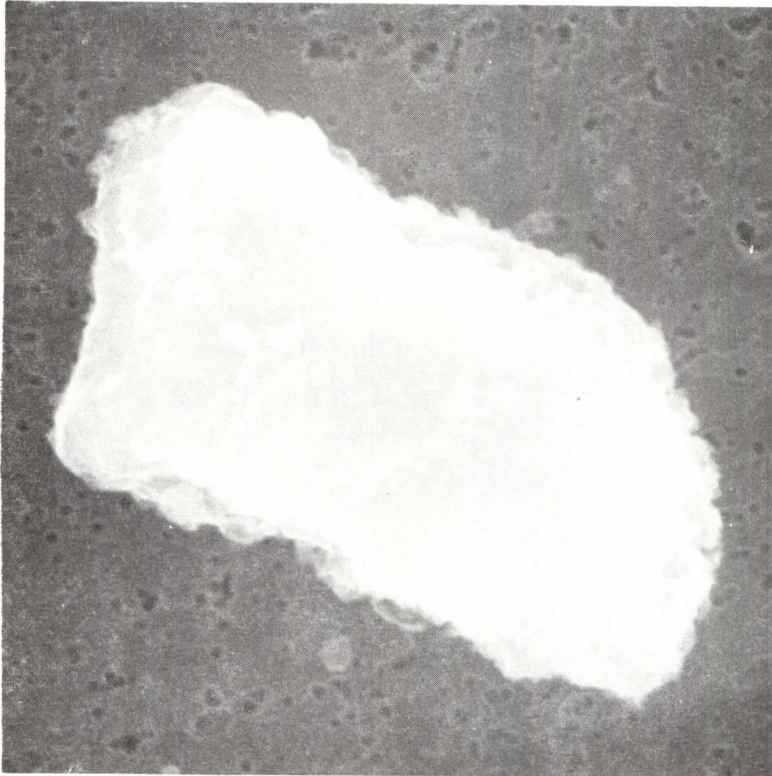


SIZE: 10x7  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/M  
TYPE: TCA  
COMMENTS:

S-86-40406

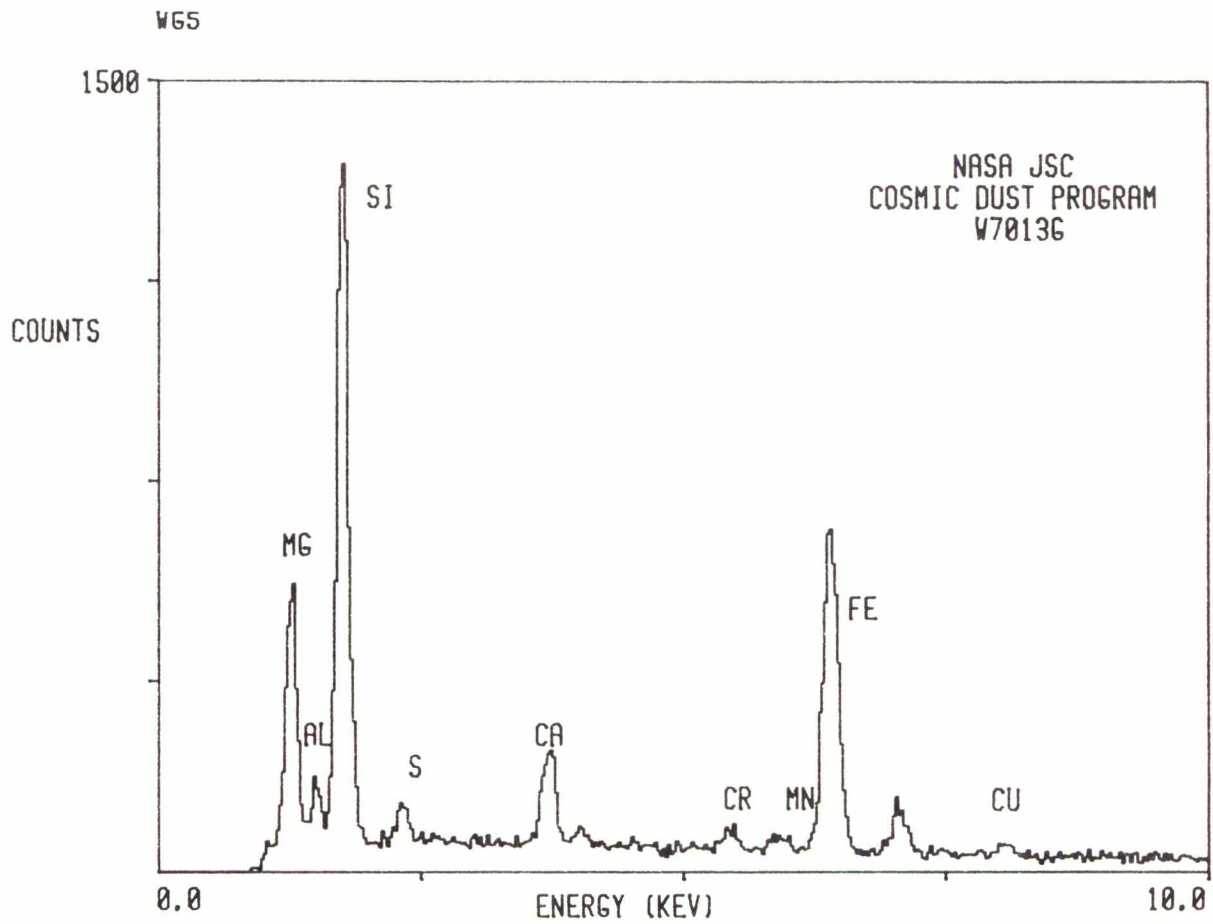


W7013 G 5

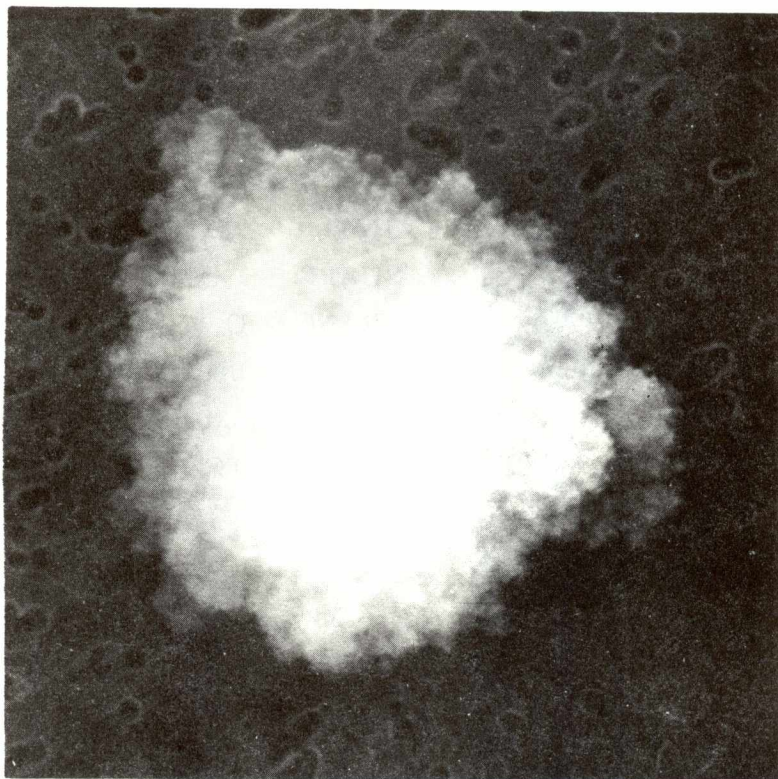


SIZE: 18x11  
SHAPE: I  
TRANS.: O  
COLOR: Brown to black  
LUSTER: SM/D  
TYPE: TCN  
COMMENTS:

S-86-40408



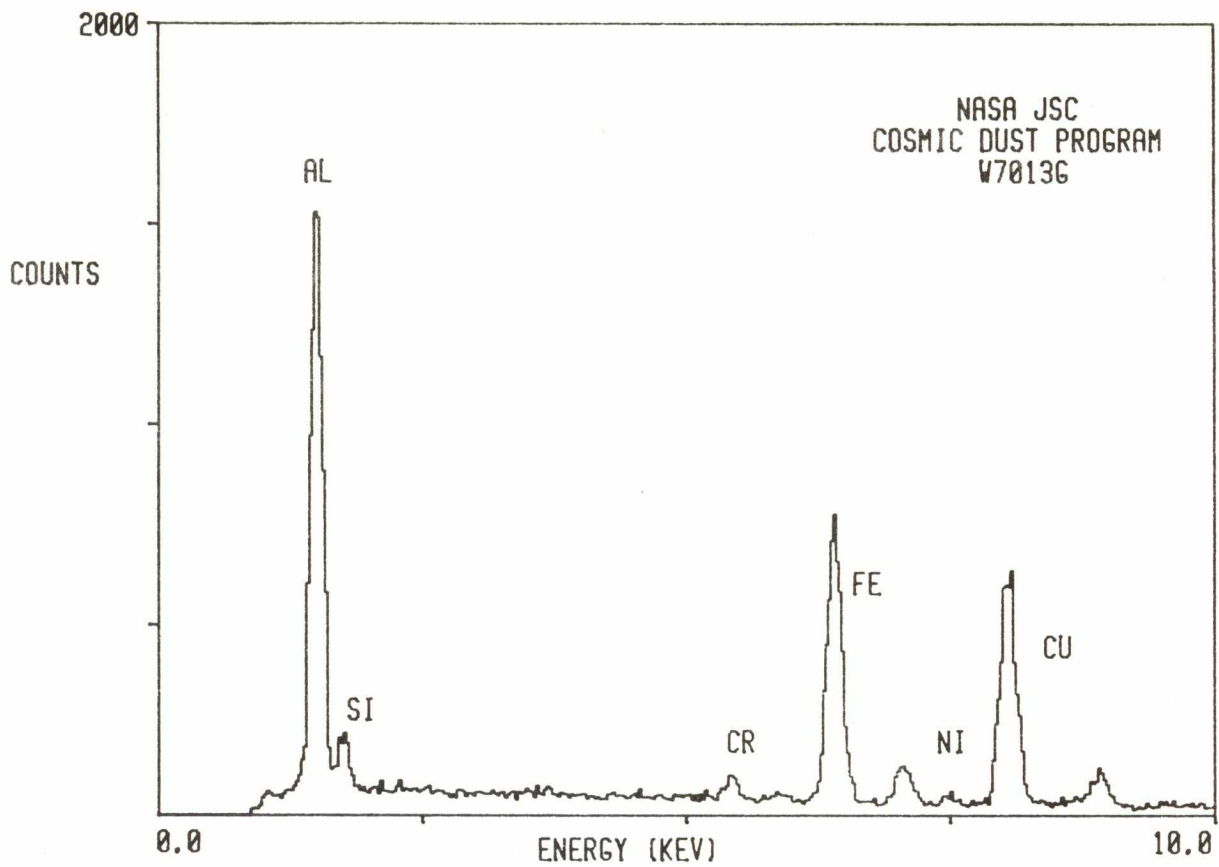
W7013 G 13



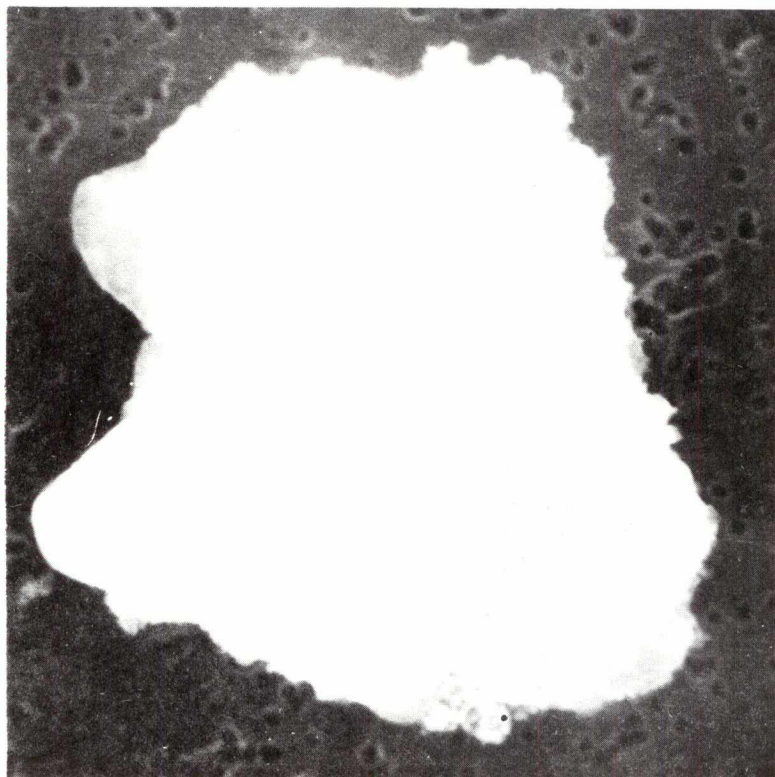
SIZE: 8  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/M  
TYPE: TCA  
COMMENTS:

S-86-40415

W613

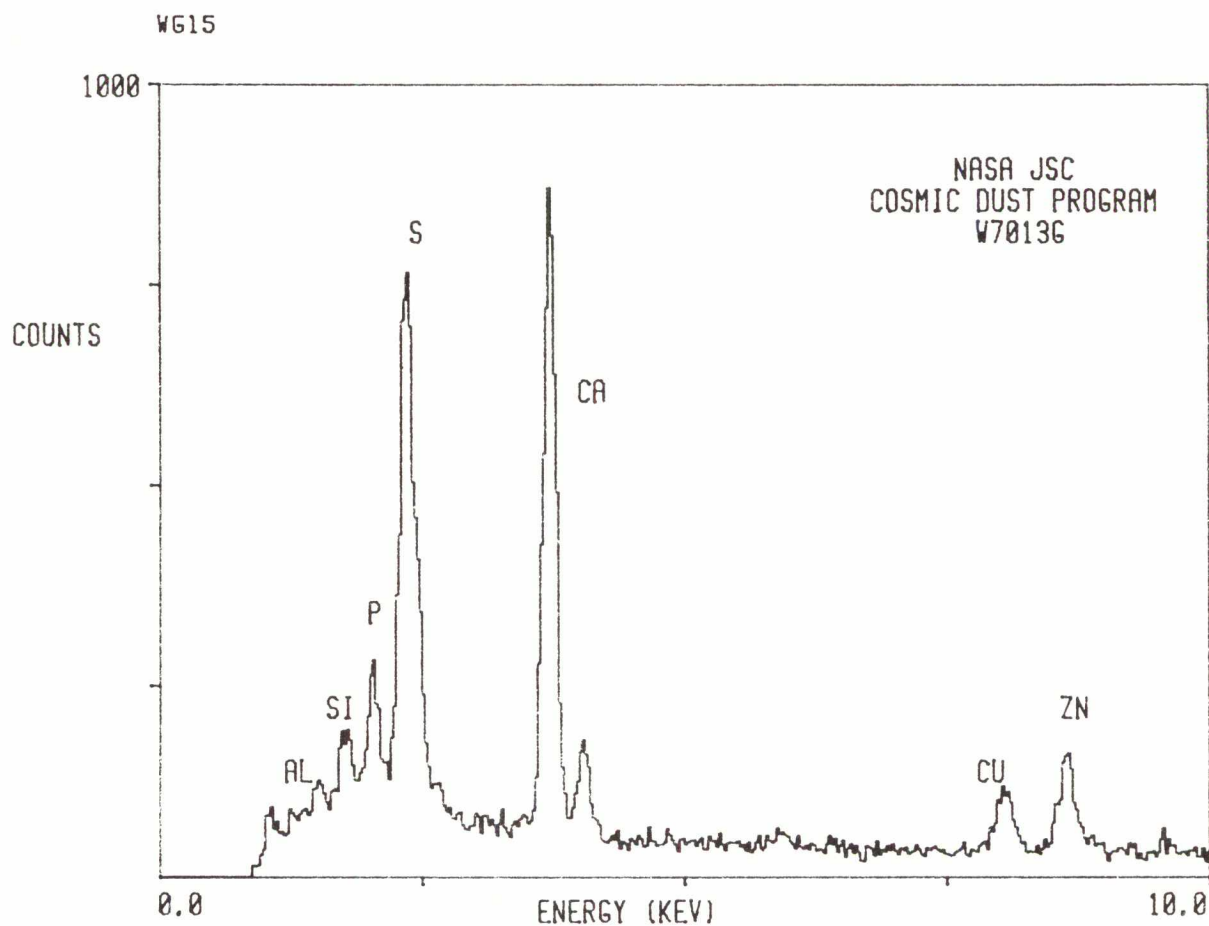


W7013 G 15

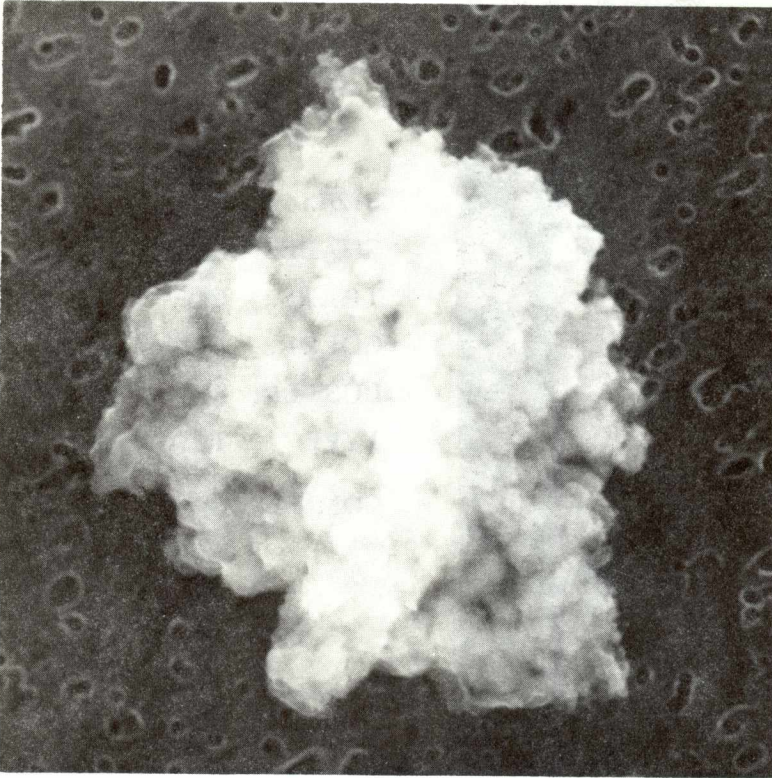


SIZE: 15x14  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: SM/D  
TYPE: TCN  
COMMENTS:

S-86-40417

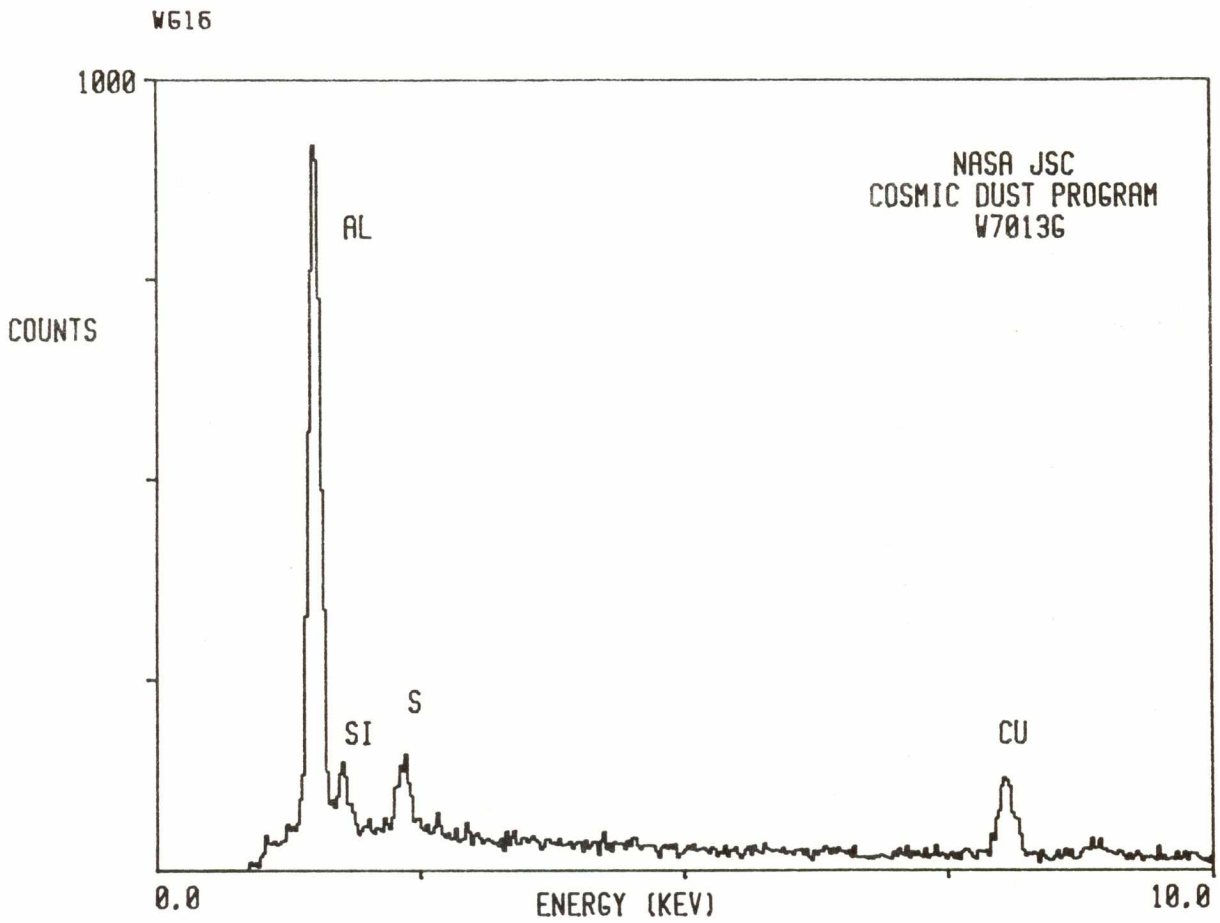


W7013 G 16

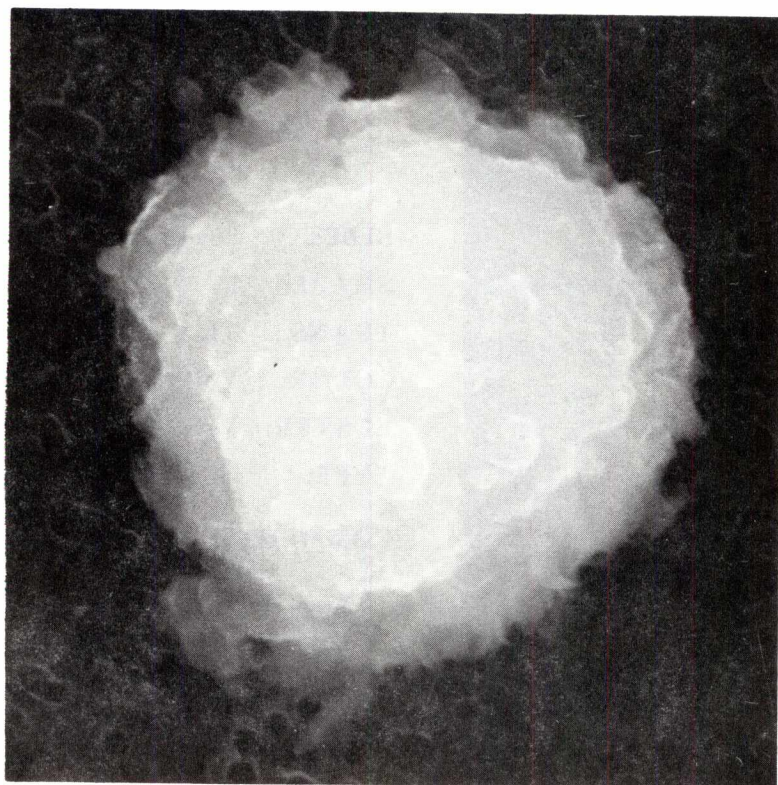


SIZE: 20x15  
SHAPE: I  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V/R  
TYPE: TCA  
COMMENTS:

S-86-40418

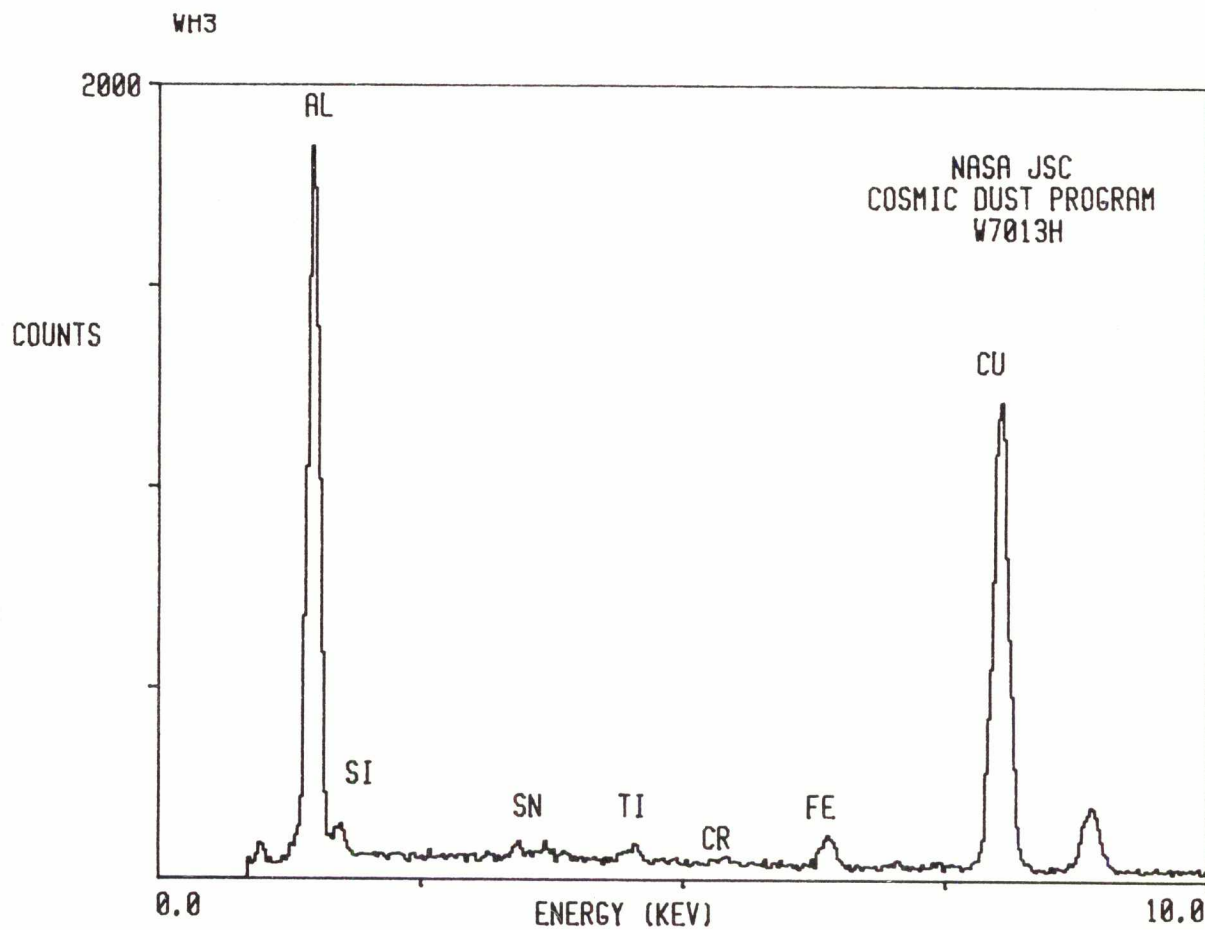


W7013 H 3



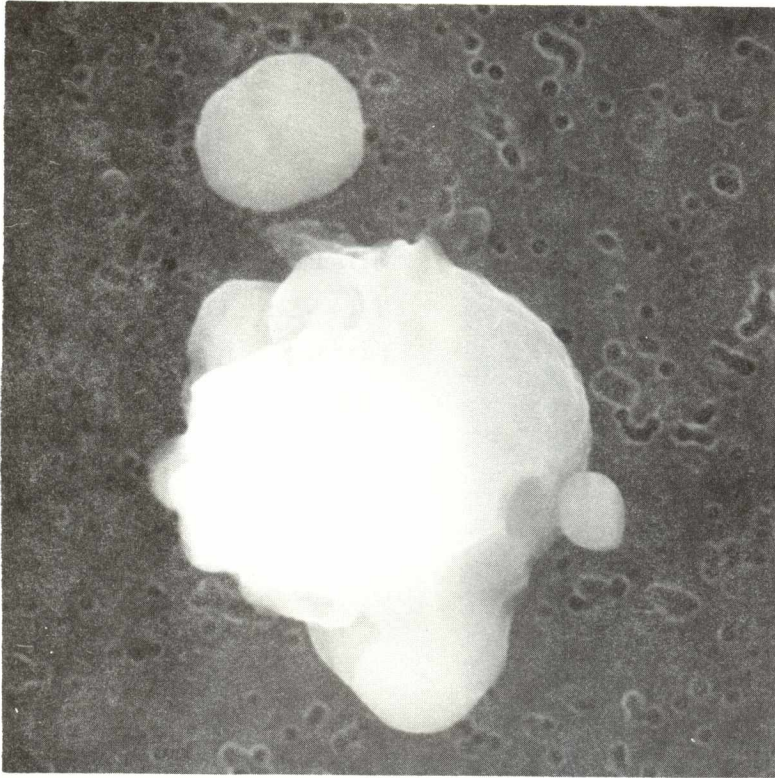
SIZE: 8  
SHAPE: S  
TRANS.: O  
COLOR: Golden  
LUSTER: SM  
TYPE: TCA  
COMMENTS:

S-86-40386





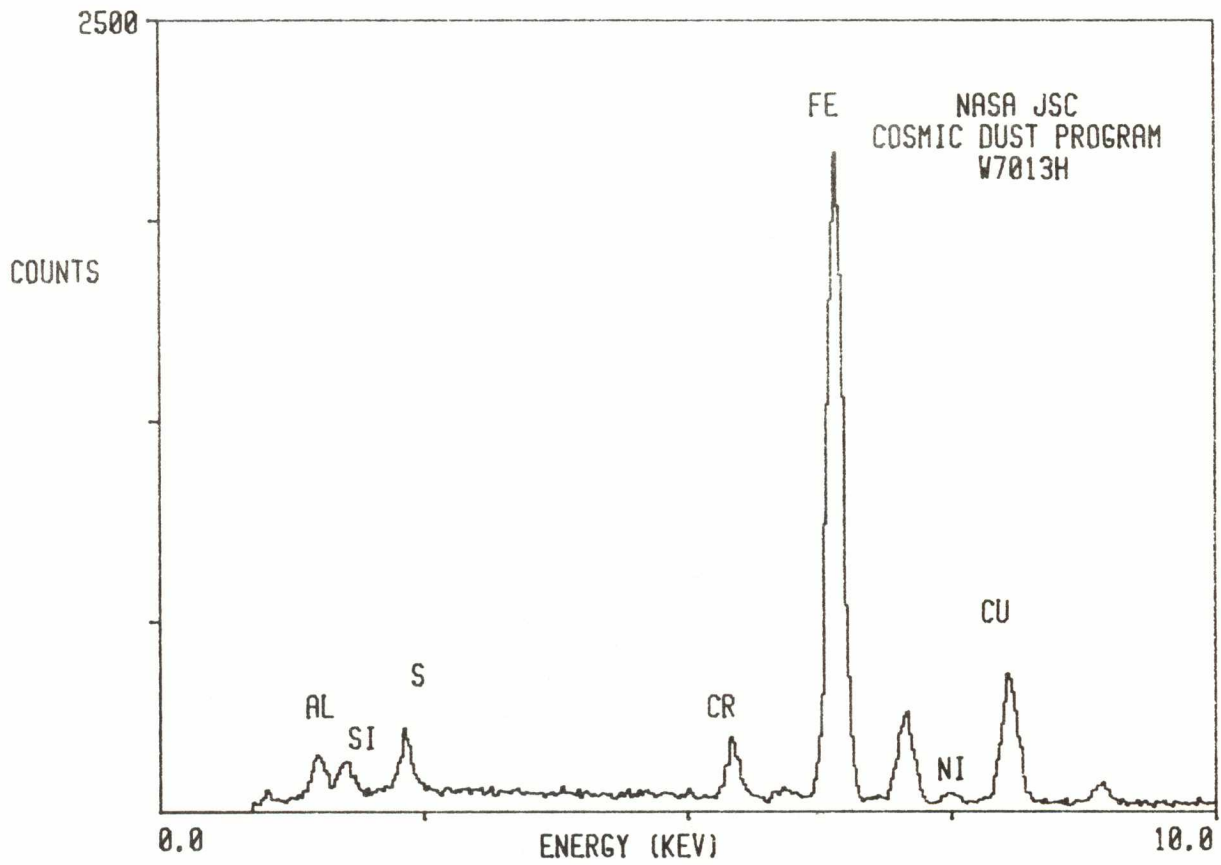
W7013 H 7



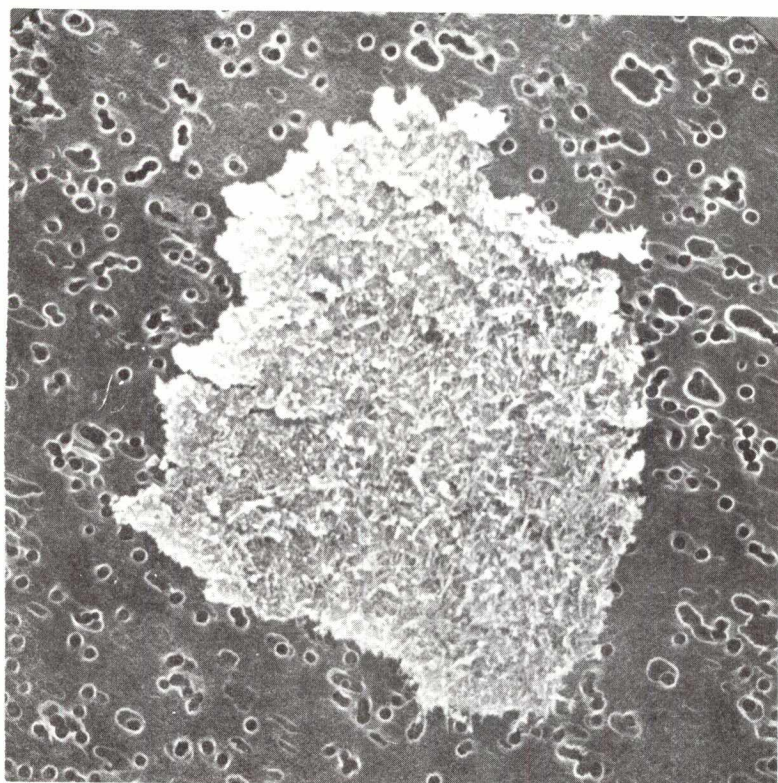
SIZE: 15x10  
SHAPE: I  
TRANS.: T/O  
COLOR: Yellow to brown  
LUSTER: V/SM  
TYPE: TCA  
COMMENTS:

S-86-40390

WH7

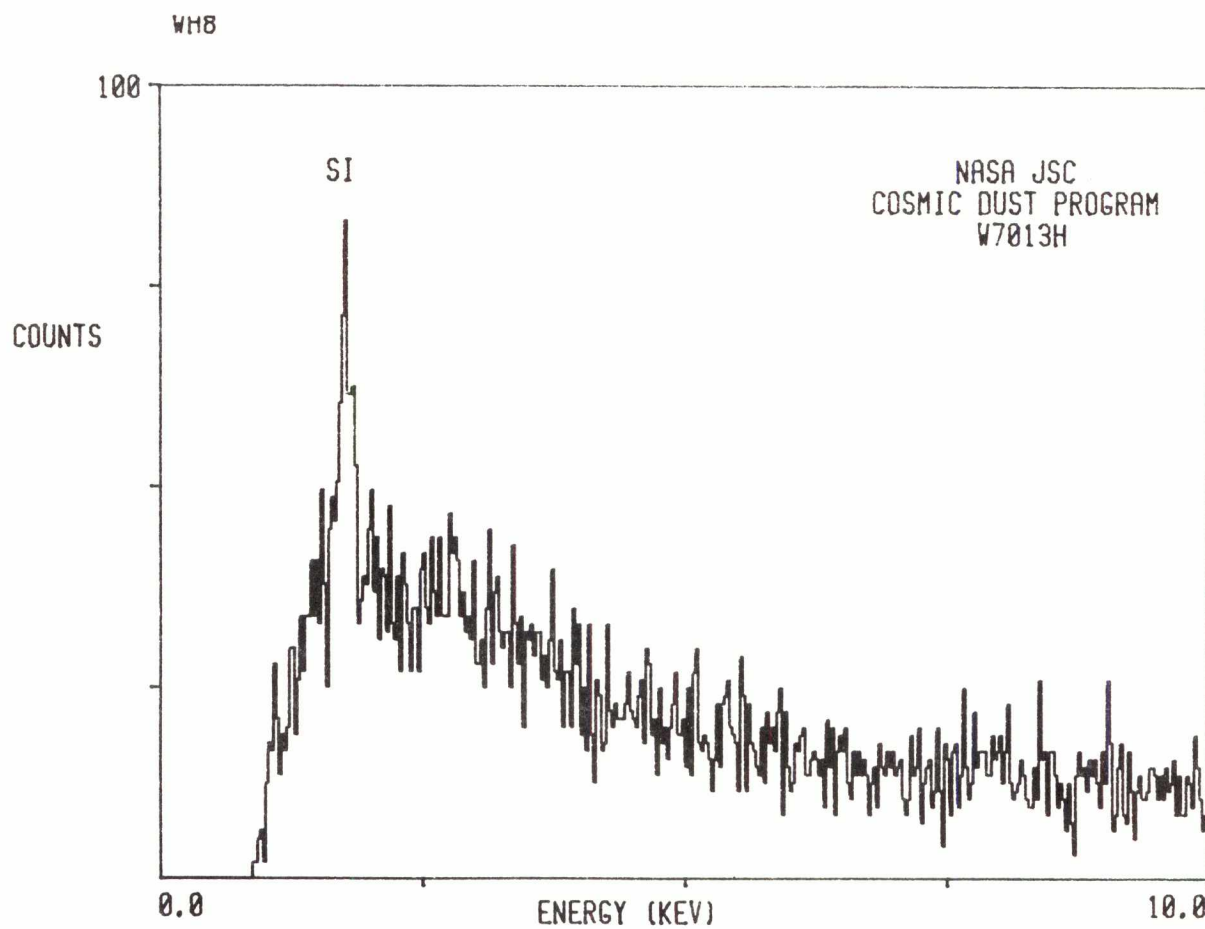


W7013 H 8

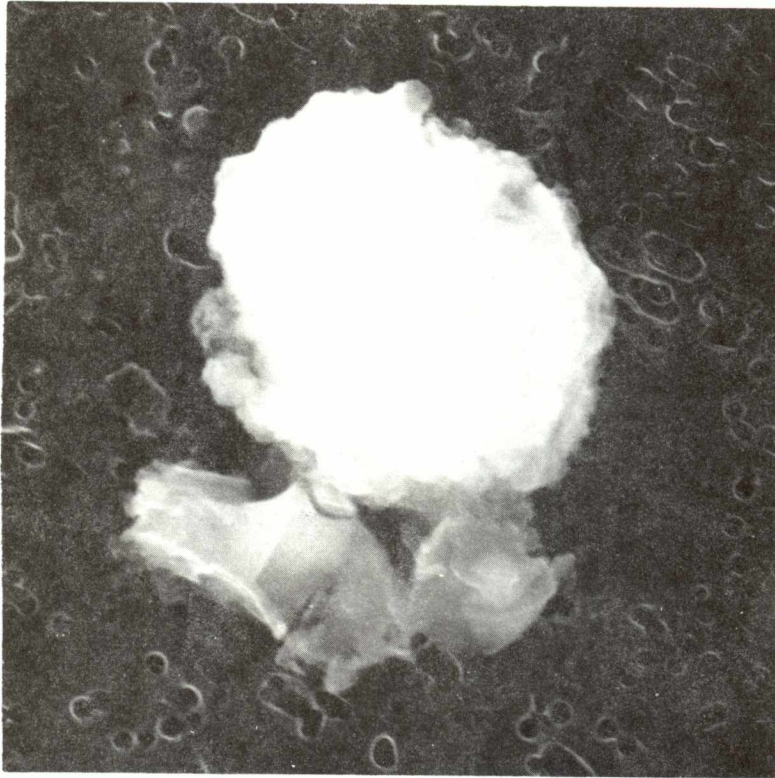


SIZE: 15x11  
SHAPE: I  
TRANS.: TL/O  
COLOR: Brown to black  
LUSTER: D  
TYPE: TCA  
COMMENTS:

S-86-40391

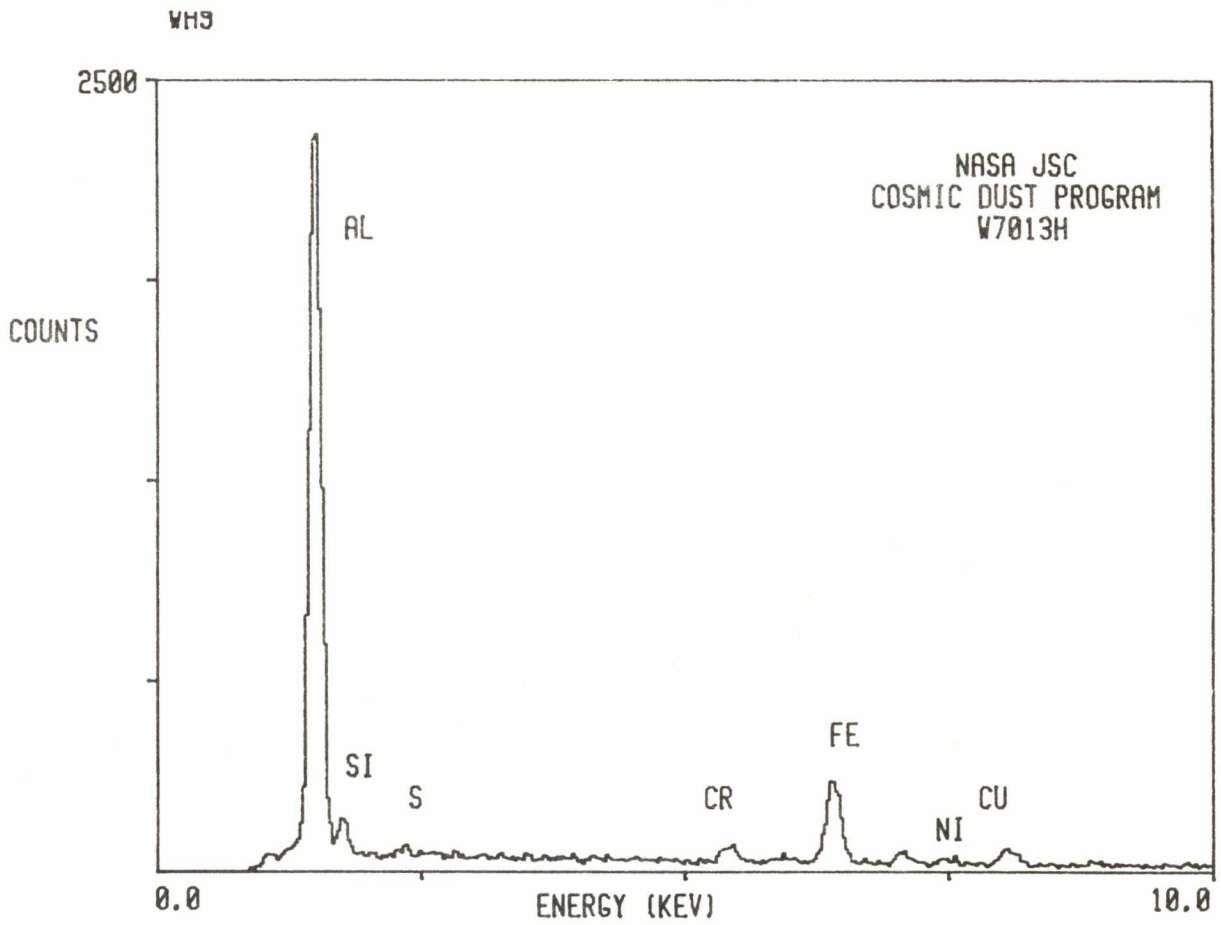


W7013 H 9

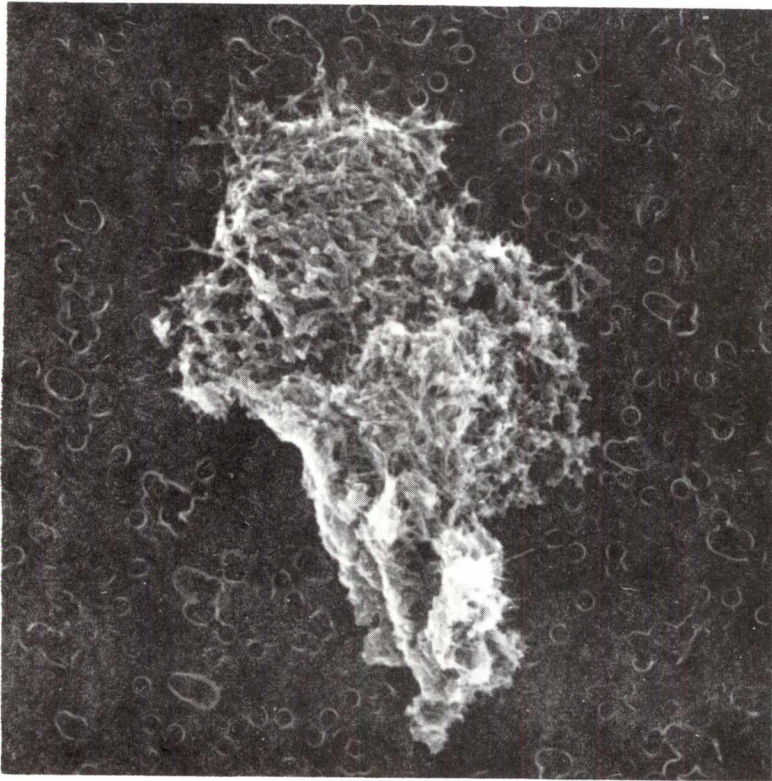


SIZE: 7  
SHAPE: E  
TRANS.: O  
COLOR: Black  
LUSTER: SM  
TYPE: TCA  
COMMENTS:

S-86-40392



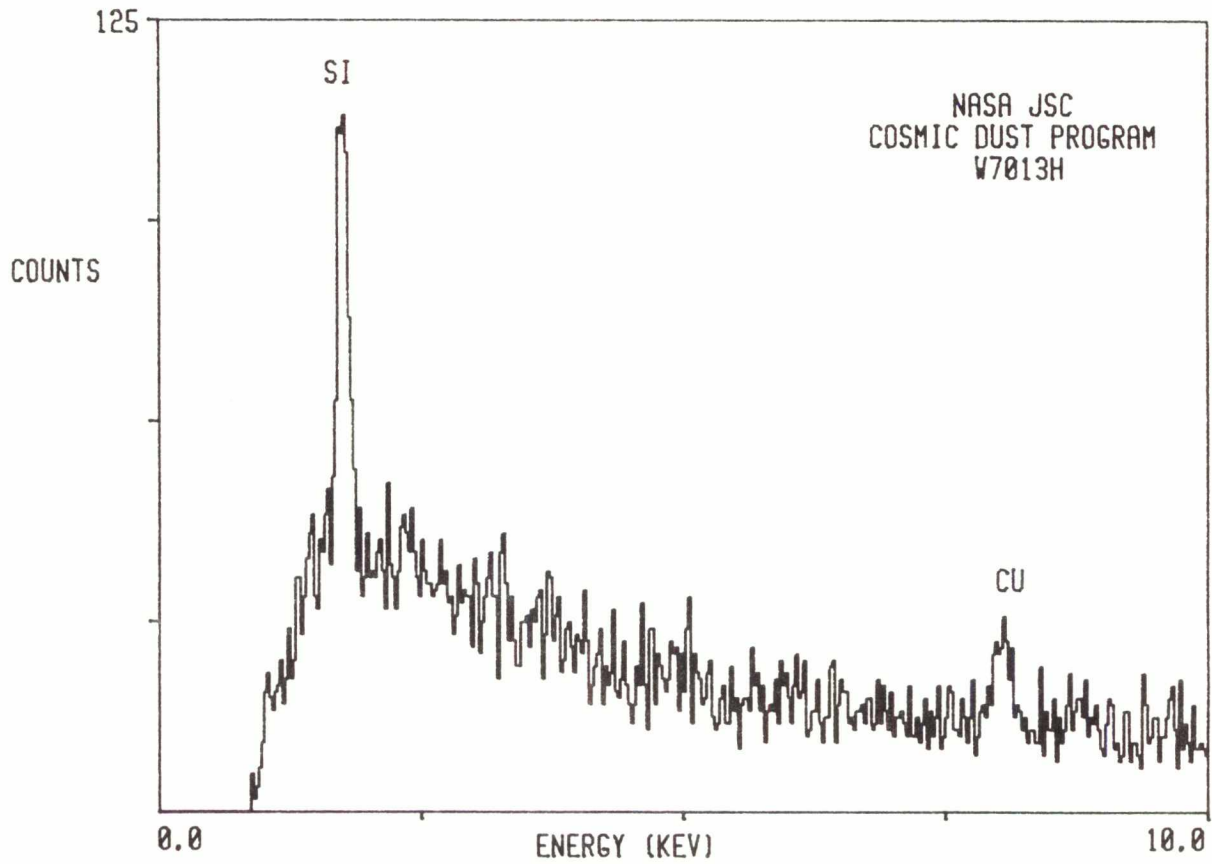
W7013 H 10



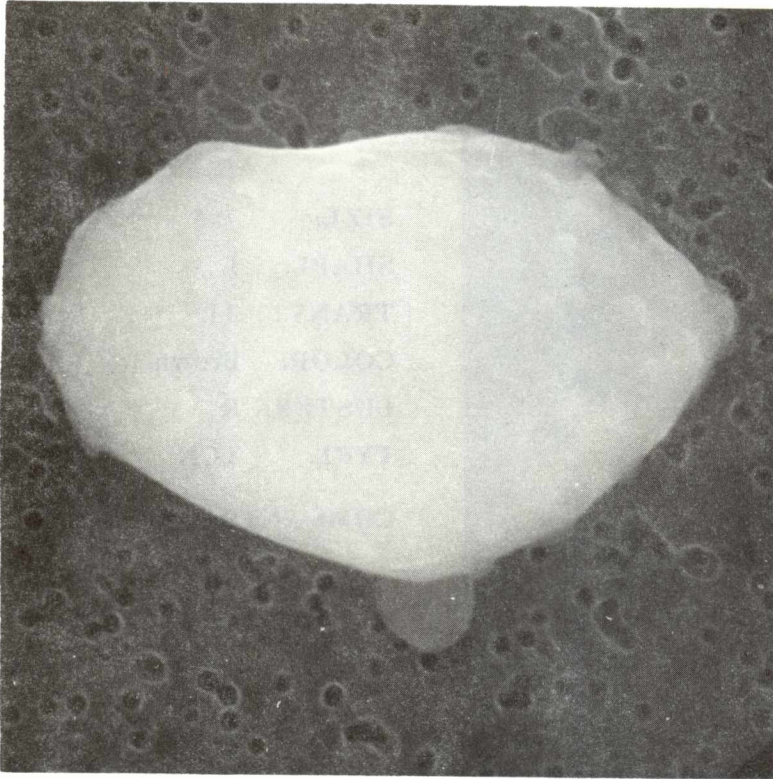
SIZE: 11  
SHAPE: E  
TRANS.: O  
COLOR: Black  
LUSTER: D  
TYPE: TCA  
COMMENTS:

S-86-40393

WH10

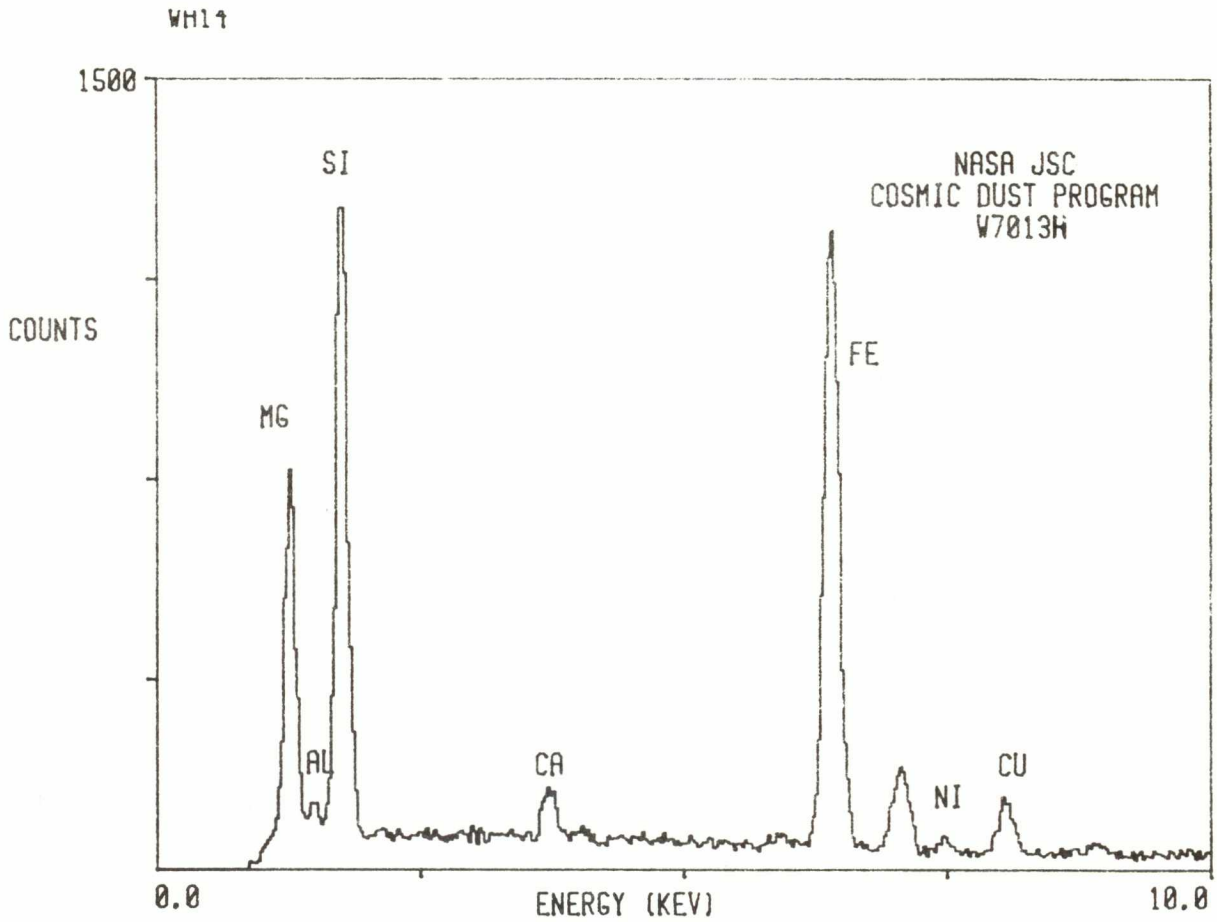


W7013 H 14

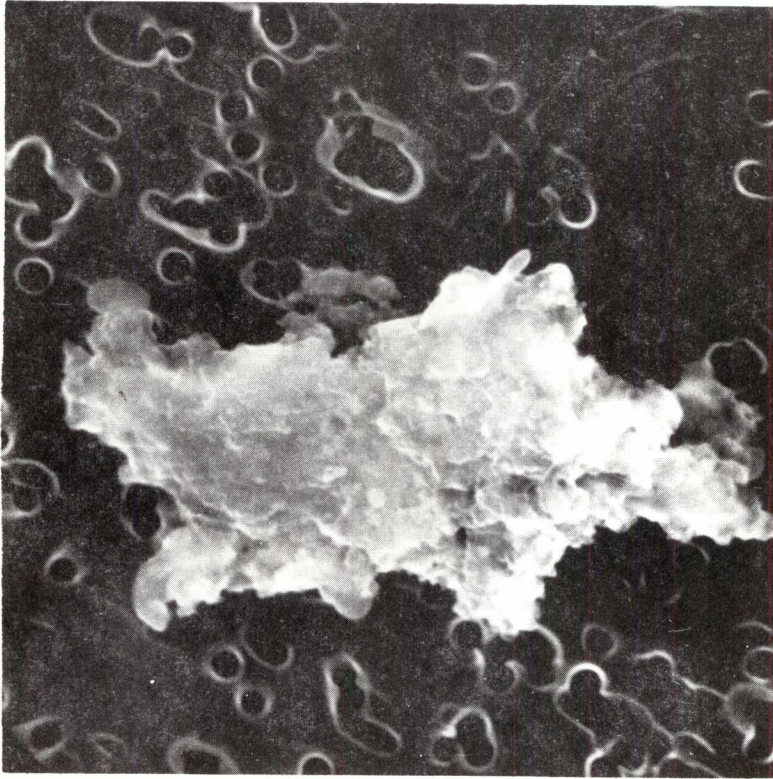


SIZE: 14x8  
SHAPE: I  
TRANS.: O  
COLOR: Black  
LUSTER: V/SM  
TYPE: TCN  
COMMENTS:

S-86-40397

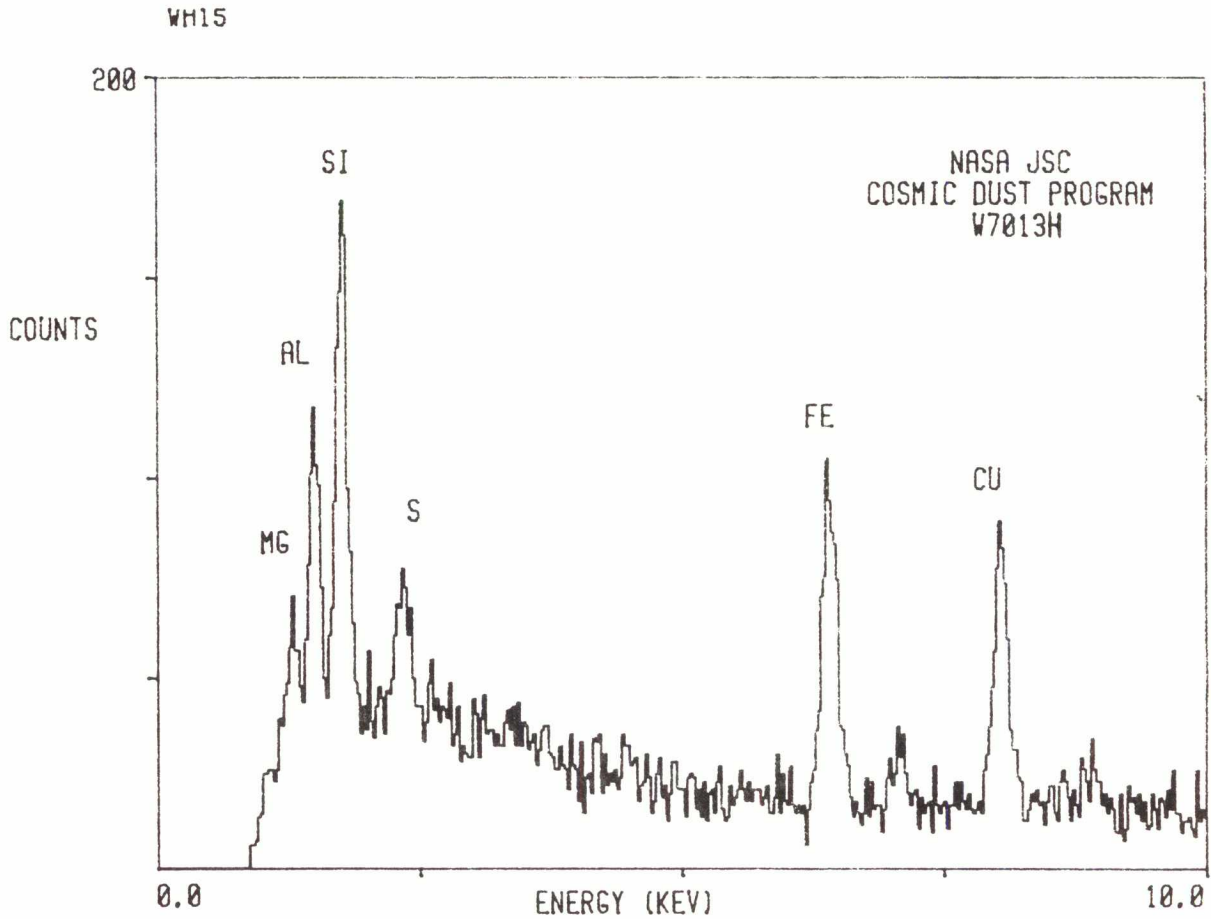


W7013 H 15

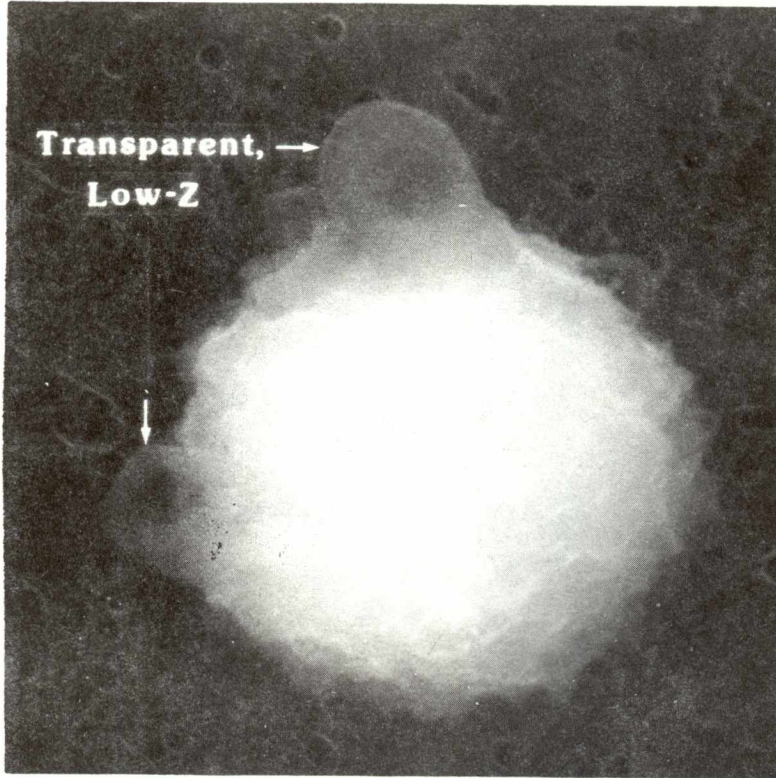


SIZE: 7x5  
SHAPE: I  
TRANS.: TL  
COLOR: Brown  
LUSTER: R  
TYPE: TCN  
COMMENTS:

S-86-40398



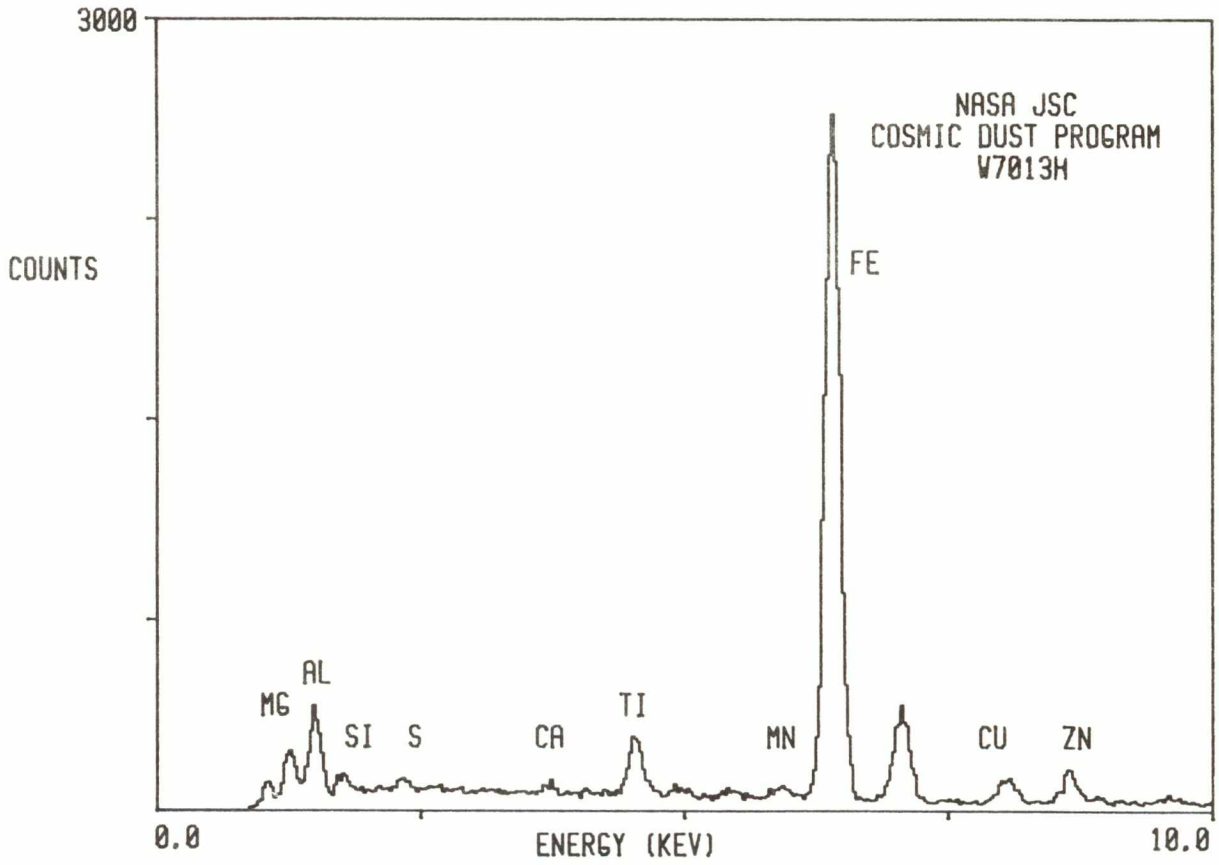
W7013 H 18



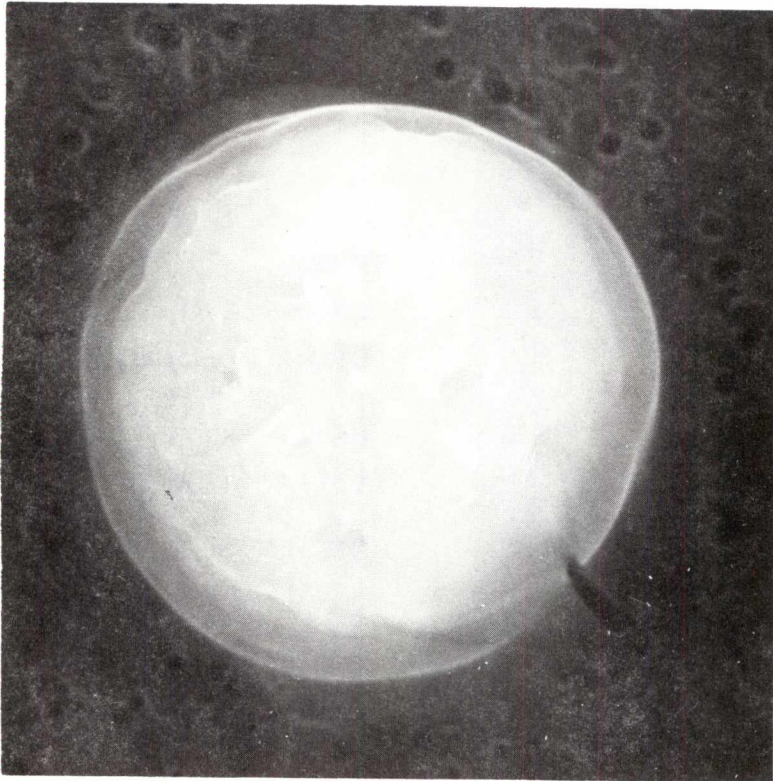
SIZE: 10x9  
SHAPE: S  
TRANS.: T/O  
COLOR: Colorless to black  
LUSTER: SM/V  
TYPE: TCA  
COMMENTS:

S-86-40400

WH18



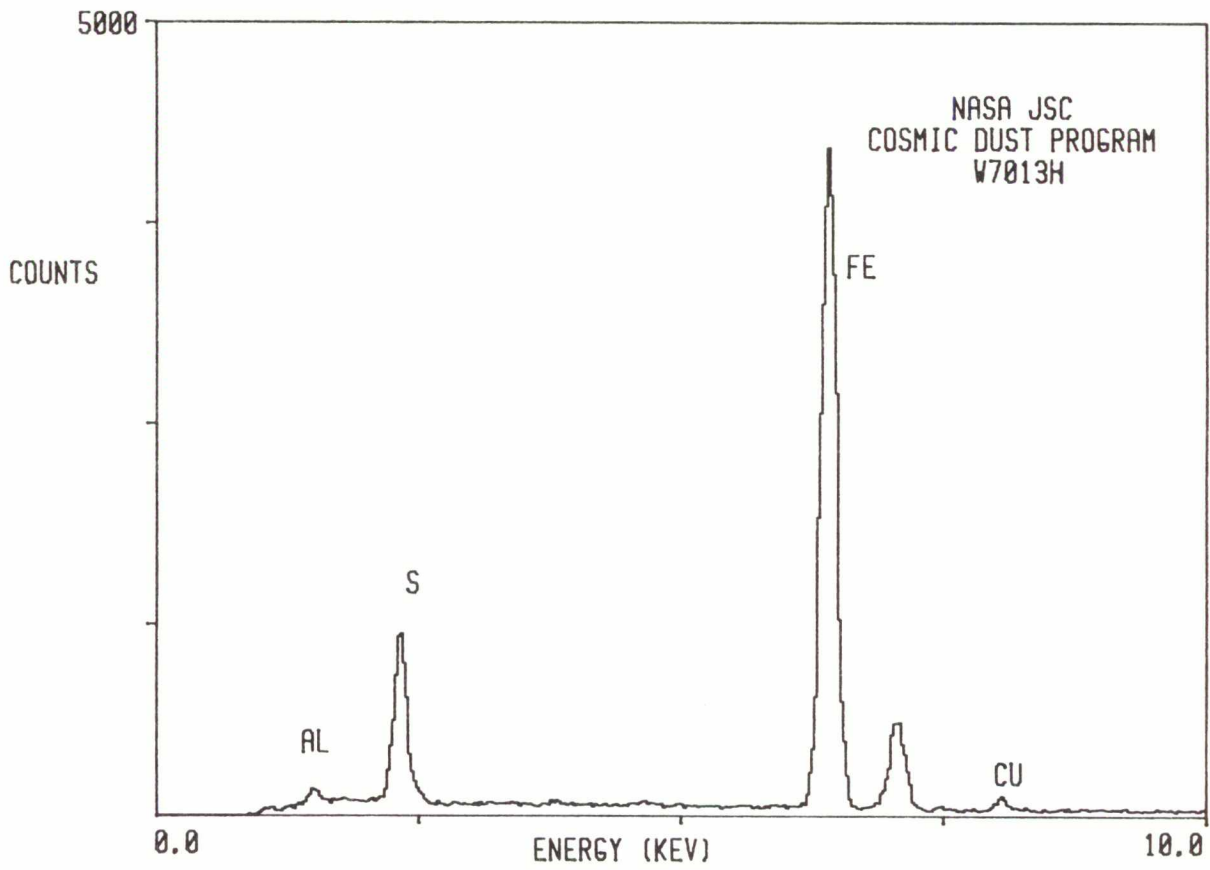
W7013 H 19



SIZE: 8  
SHAPE: S  
TRANS.: O  
COLOR: Brown  
LUSTER: SM  
TYPE: TCA?  
COMMENTS:

S-86-40401

WH13

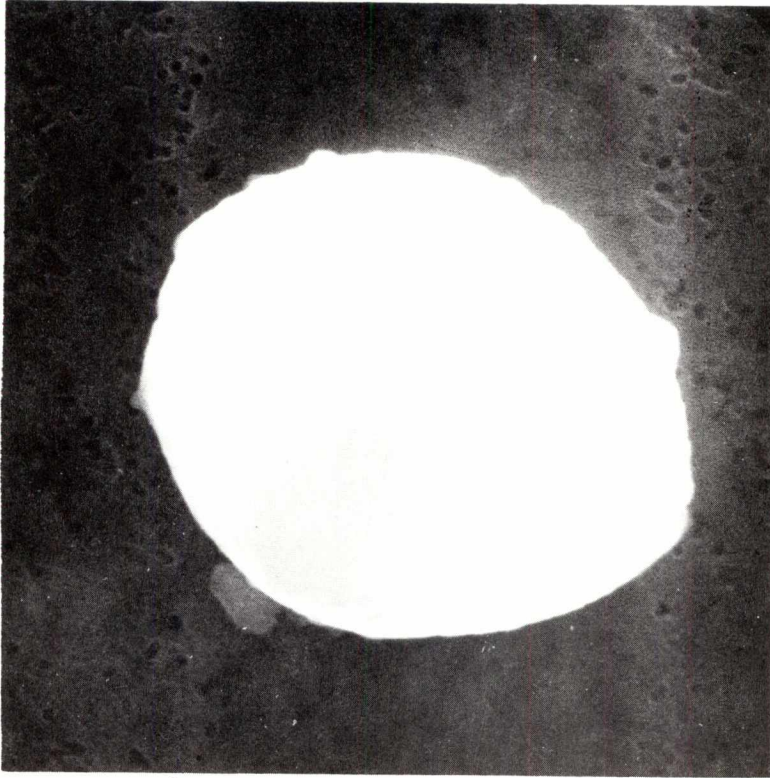






**ALUMINUM OXIDE SPHERES**

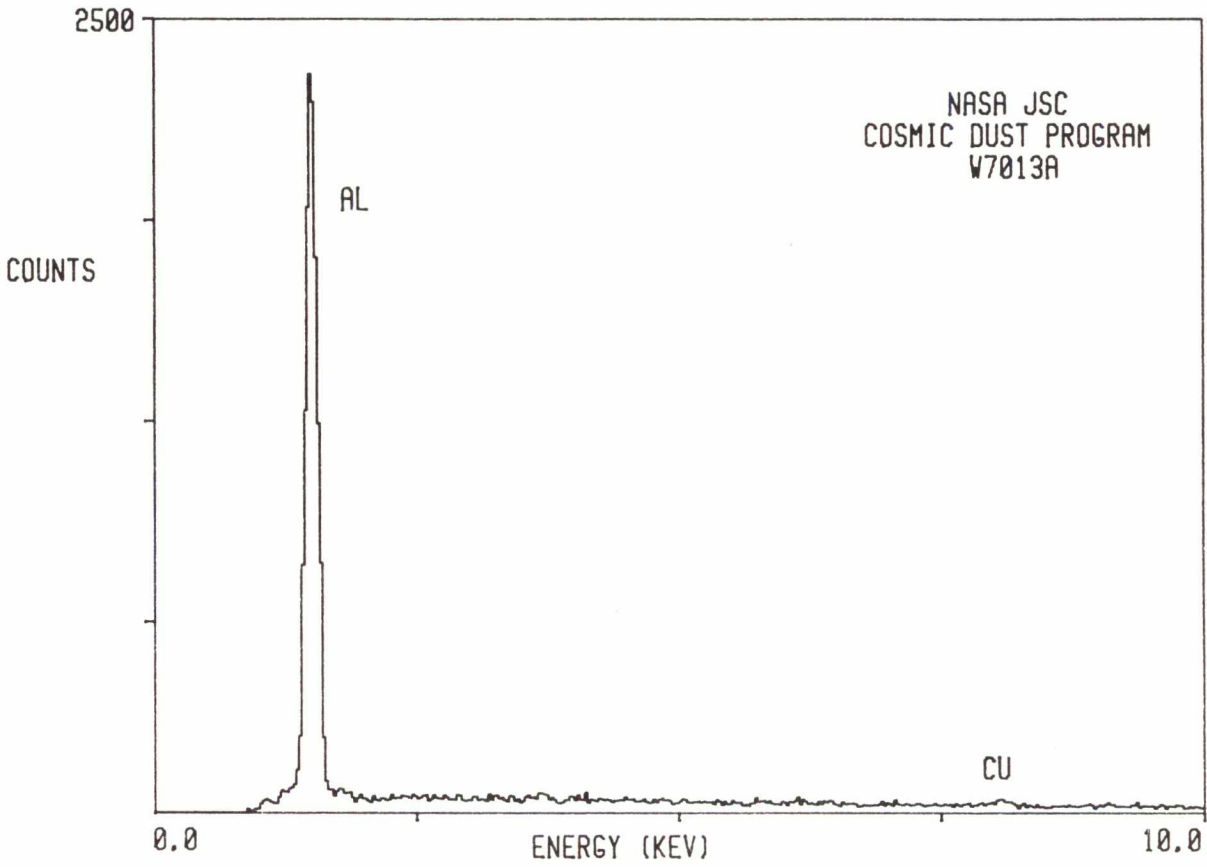
W7013 A 3



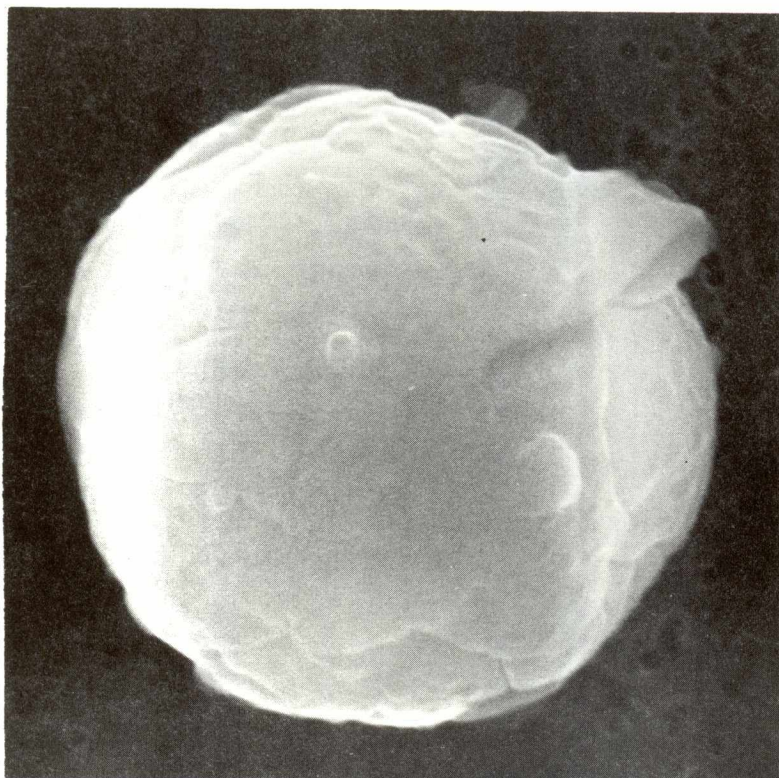
SIZE: 20  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40298

WR3

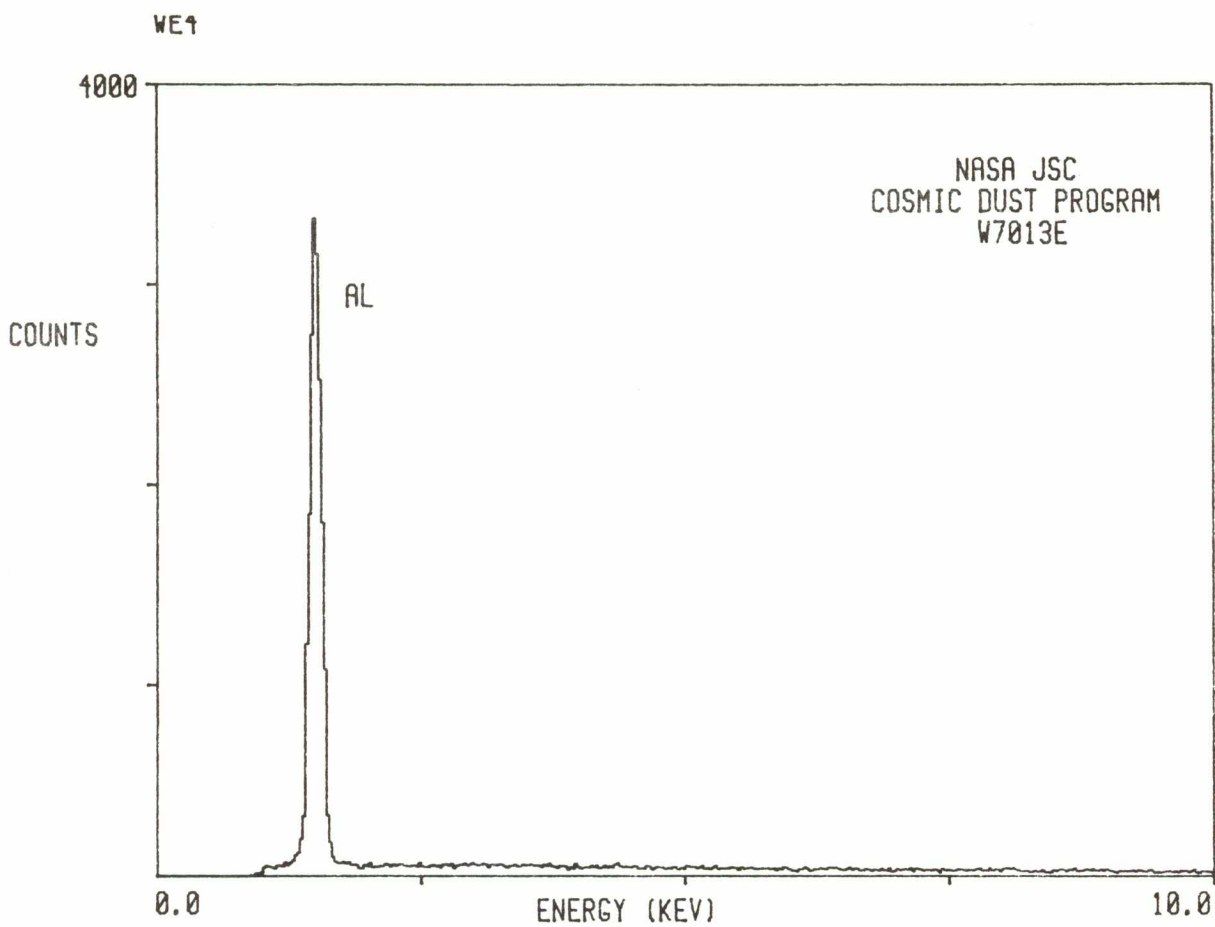


W7013 E 4

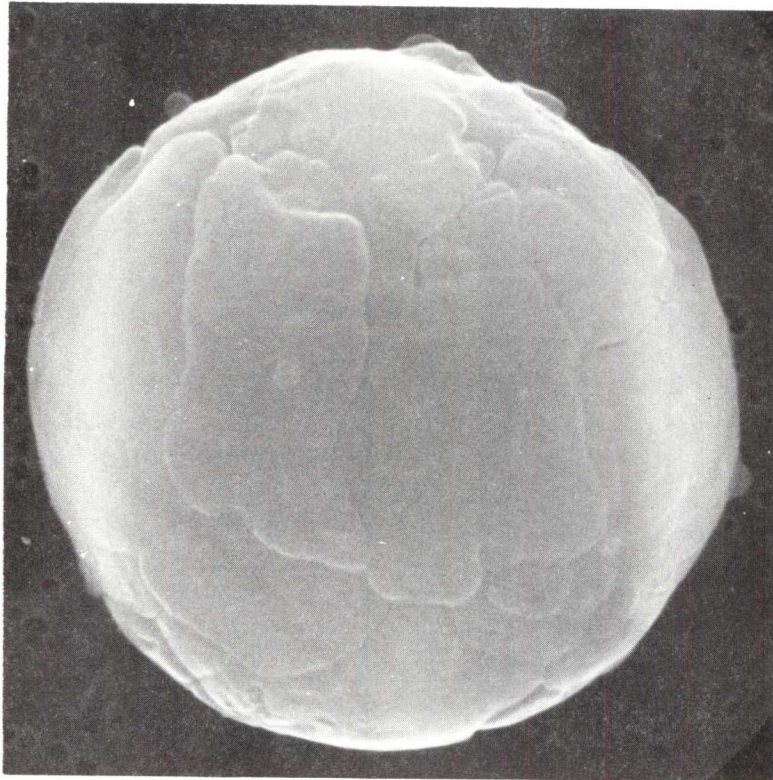


SIZE: 11  
SHAPE: S  
TRANS.: T  
COLOR: Yellow  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40357



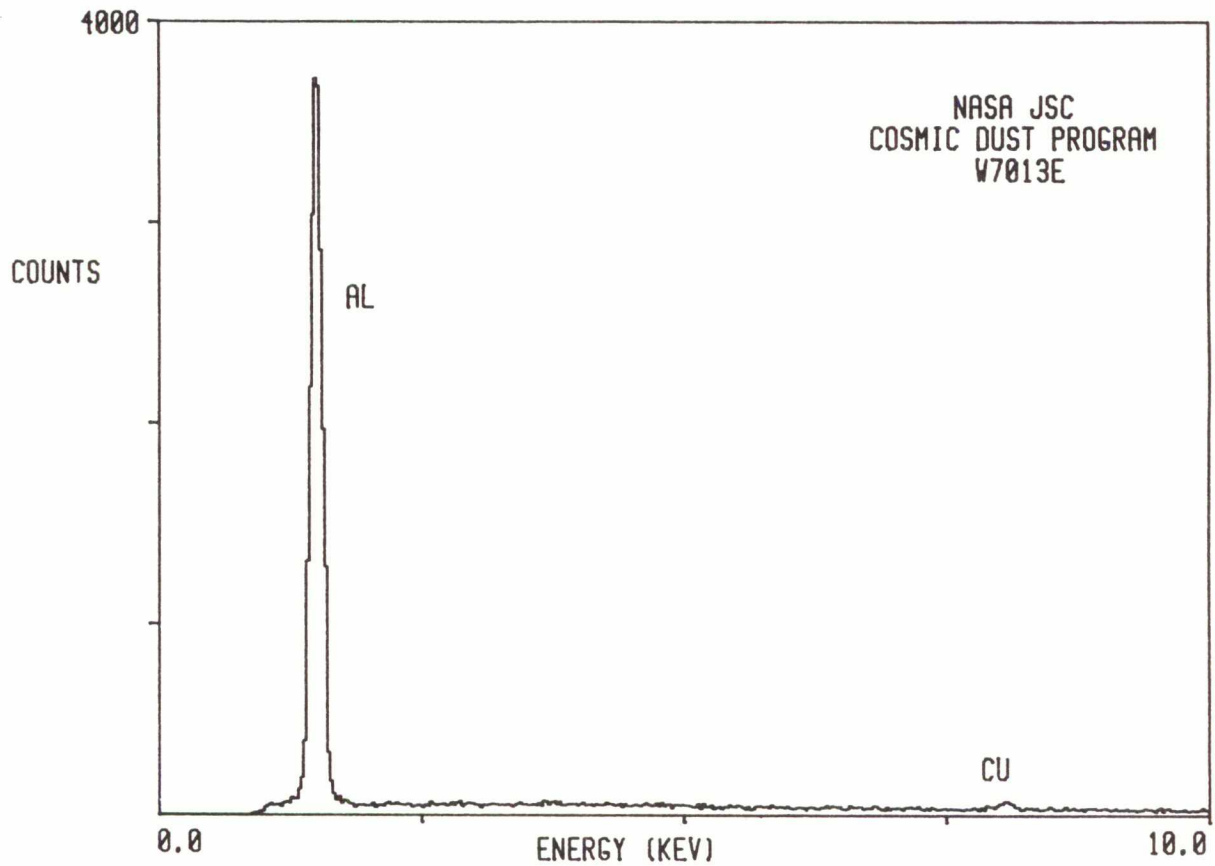
W7013 E 13



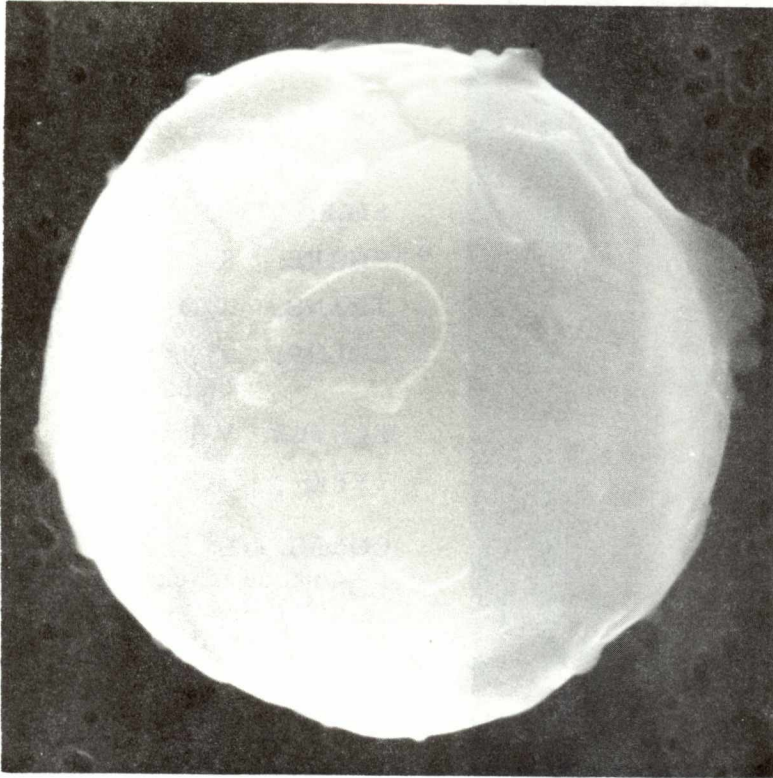
SIZE: 15  
SHAPE: S  
TRANS.: TL  
COLOR: Yellow to colorless  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40366

WE13

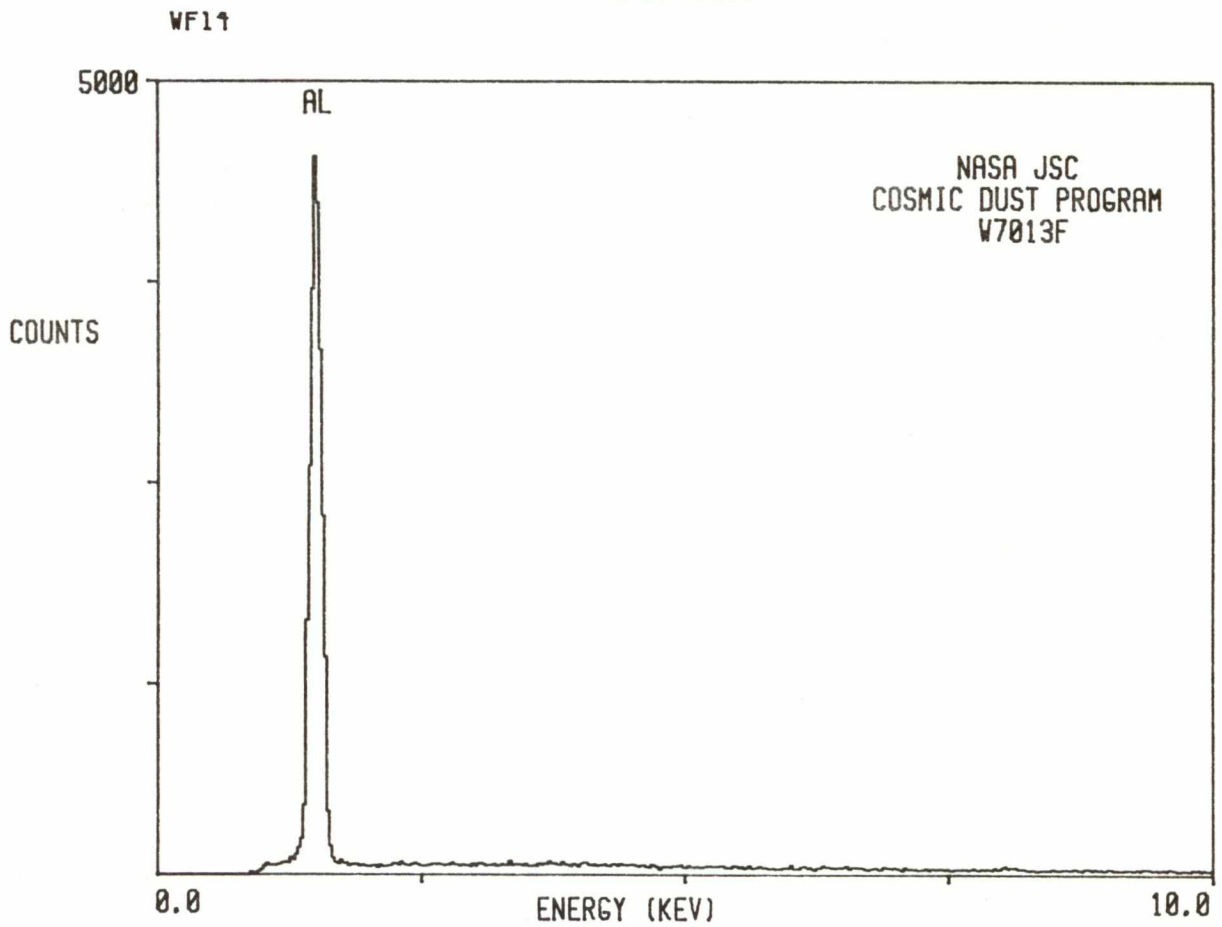


W7013 F 14

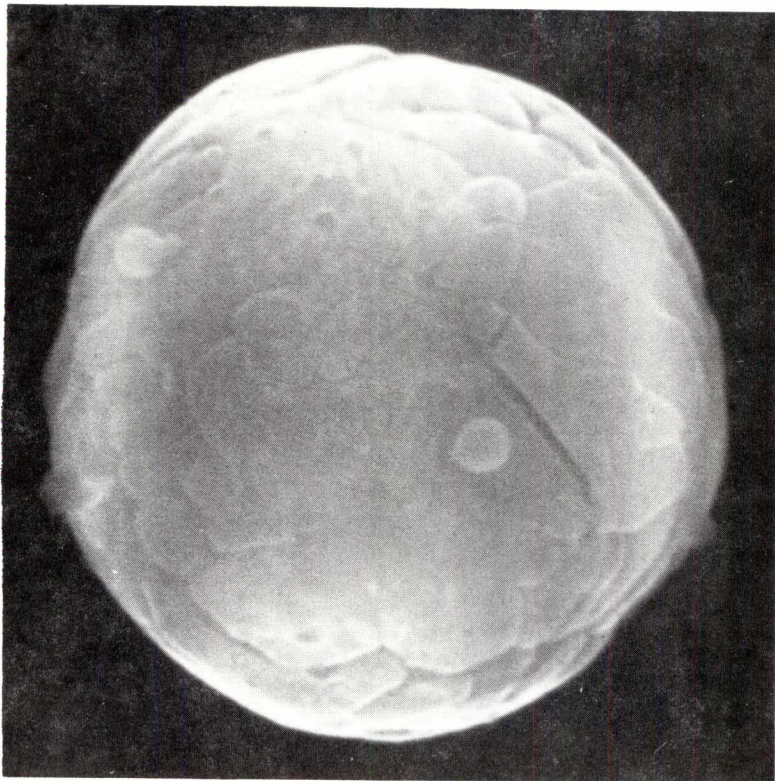


SIZE: 12  
SHAPE: S  
TRANS.: T/TL  
COLOR: Yellow  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40383



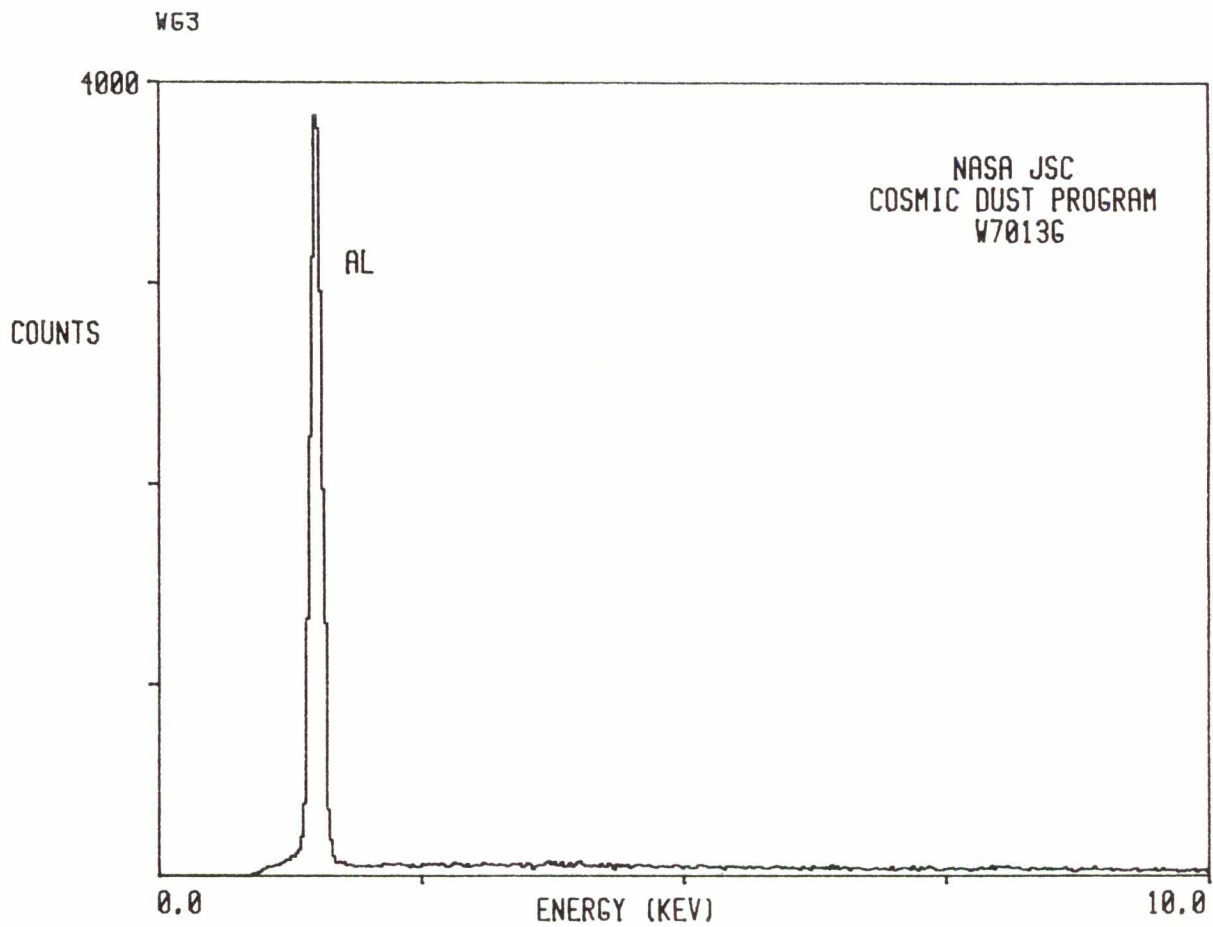
W7013 G 3



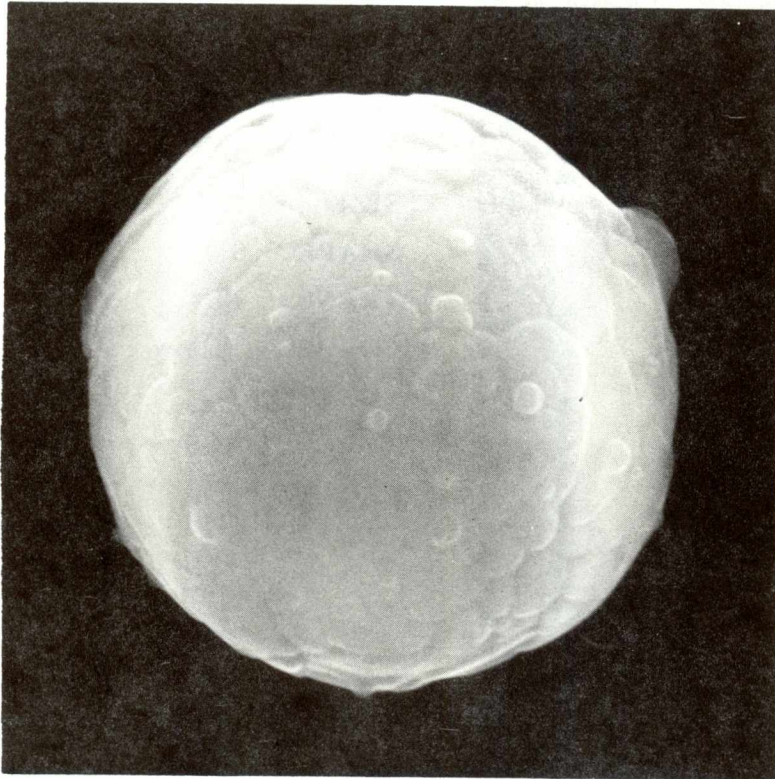
SIZE: 12  
SHAPE: S  
TRANS.: T/O  
COLOR: Yellow and black  
LUSTER: V/D  
TYPE: AOS

COMMENTS:  
Opaque patches on otherwise transparent sphere

S-86-40419



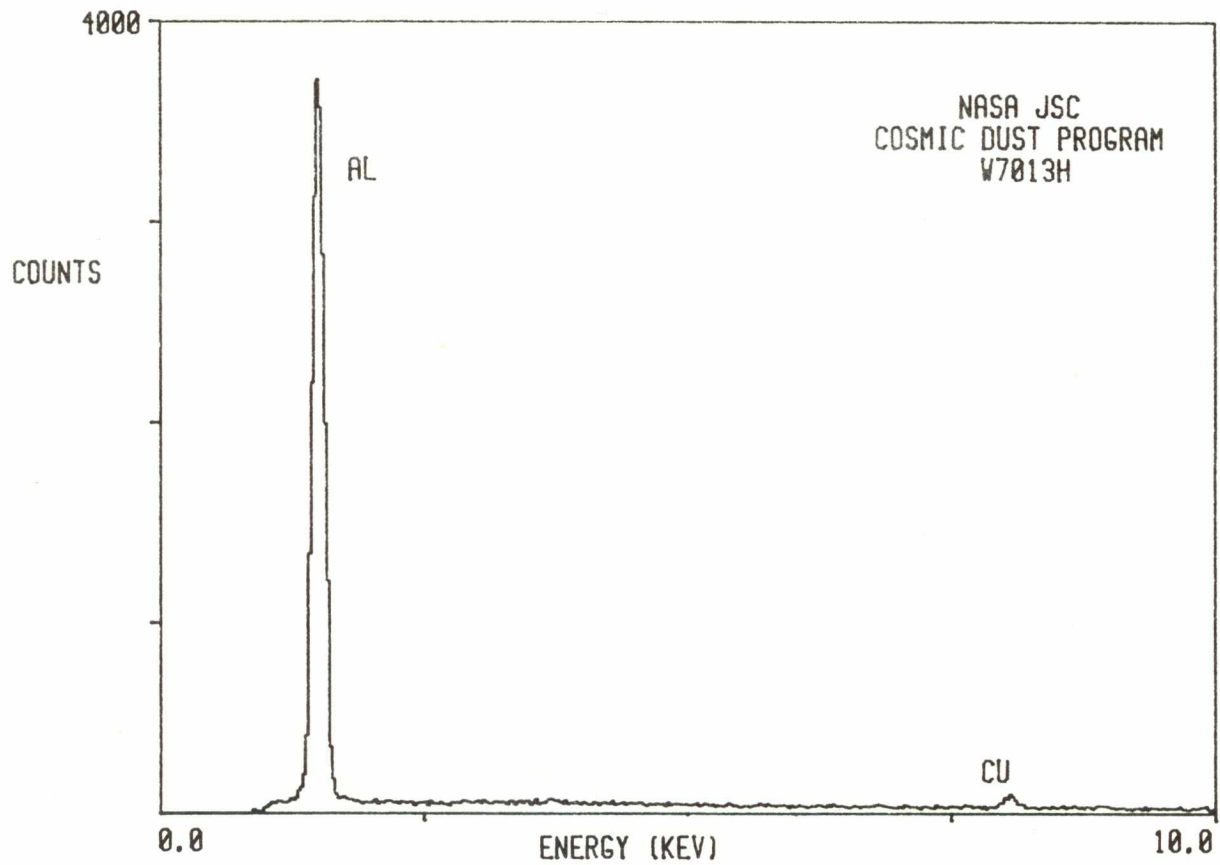
W7013 H 11



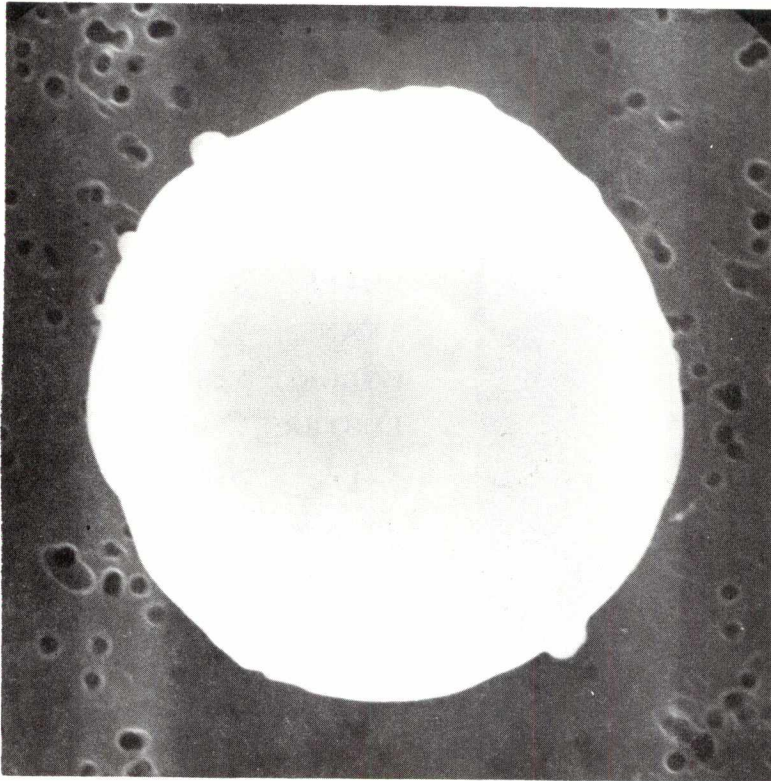
SIZE: 12  
SHAPE: S  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40394

WH11

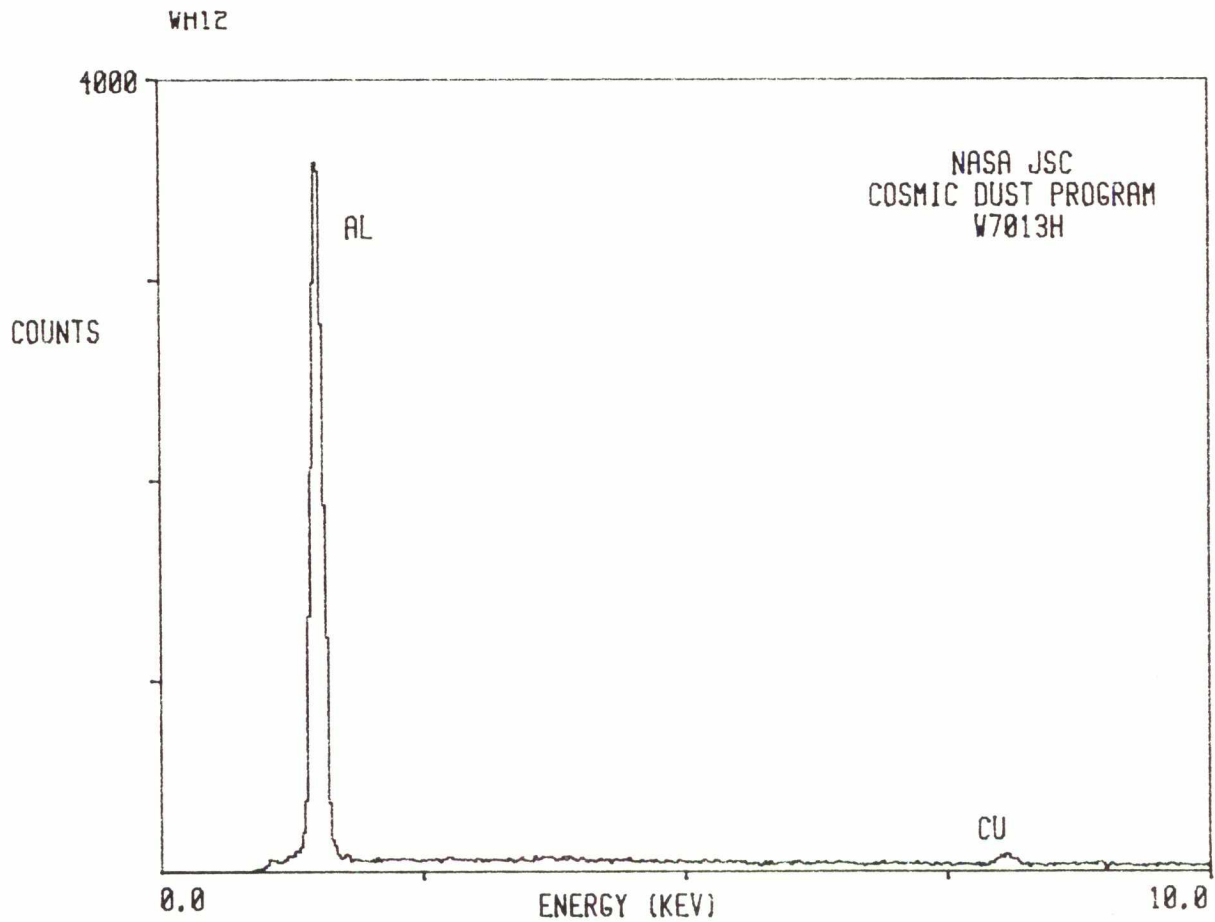


W7013 H 12



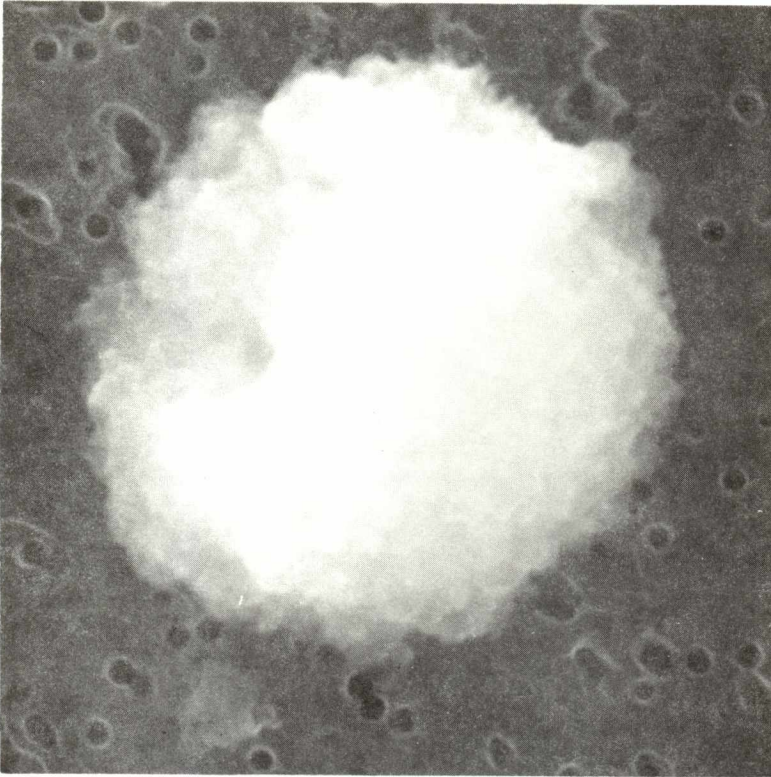
SIZE: 12  
SHAPE: S  
TRANS.: TL  
COLOR: Yellow  
LUSTER: V  
TYPE: AOS  
COMMENTS:

S-86-40395





W7013 H 13



SIZE: 8  
SHAPE: S  
TRANS.: O  
COLOR: Black  
LUSTER: SM  
TYPE: AOS  
COMMENTS:

S-86-40396

