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COSMIC DUST CATALOG

(PARTICLES FROM COLLECTION FLAG W7017)

COMPILED BY

COSMIC DUST PRELIMINARY EXAMINATION TEAM (CDPET)

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COSMIC DUST CATALOG #1

(Particles from Collection Flag W7017)

Compiled By

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CONTENTS

		Page No.
	PREFACE TO CATALOG #1	iii
1.	INTRODUCTION	iv
2.	PROCESSING OF PARTICLES	v
3.	PRELIMINARY EXAMINATION OF PARTICLES	vi
4.	CATALOG FORMAT	vii
5.	ANALYSES OF REFERENCE MATERIALS	x
6.	SAMPLE REQUEST PROCEDURE	xx
7.	ACKNOWLEDGEMENTS	xxi
	PARTICLE DESCRIPTIONS	1

Note: Pages iii-vii missing from original document.

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 mineralogical and aerospace 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 proper 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 which we hope our program 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 cosmic dust sampling. Categories used in this catalog are defined as follows:

AOS: aluminum oxide sphere

(Based on work by D.E. Brownlee and collaborators, AOS particles are thought to be products of solid-fuel rocket exhausts. Less spherical or irregular particles of similar composition are of enigmatic origin and have been provisionally called Al' particles by Brownlee and R.M. Walker. In this catalog, we have noted possible Al' candidates in the "Comments" section of the appropriate particle descriptions.)

C: cosmic dust (variety unspecified) or other extraterrestrial material

TCA: terrestrial contamination (artificial or man-made)
(This category includes particles produced by or derived from aircraft operation or collector hardware, or possibly spacecraft debris.)

TCN: terrestrial contamination (natural)
(This category includes mineral, rock, or soil material from Earth or various biological contaminants such as spores, insect parts, etc.)

?: 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.)

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

**IMPORTANT NOTES: (1) With regard to EDS spectra, some copper x-radiation is emitted from some of the SEM internal parts as a consequence of bombardment by stray electrons. The peaks labelled "CU" may, therefore, represent a contribution from both sample and instrument. The instrument is being modified to remove the machine artifact.

(2) Particles labelled W7017B... or W7017E... have already been allocated for research and are gold-palladium coated.

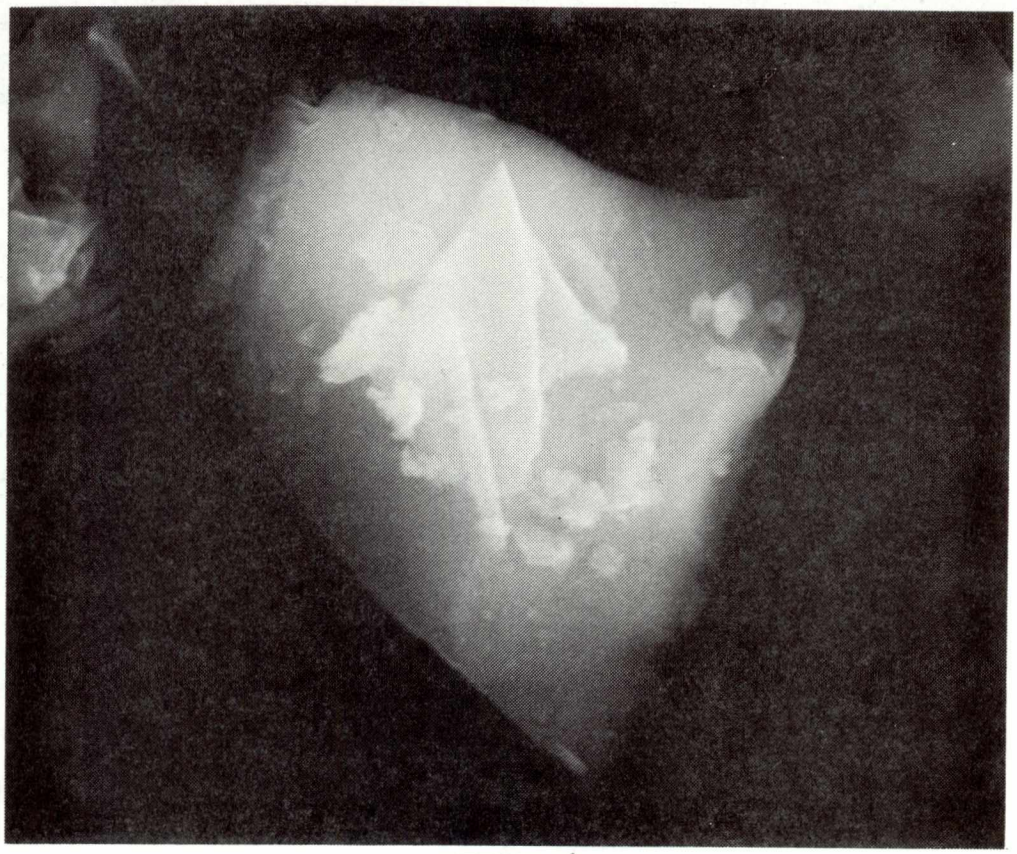
5. ANALYSES OF REFERENCE MATERIALS

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 comparably sized particles of known composition. Accordingly, the next several pages summarize data acquired by SEM examination of reference particles under the same conditions used in the preliminary examination of particles from the stratospheric dust collections. Each reference particle represents material which has proven useful as a reference (which may be distinct from an analytical standard) in SEM and/or electron microprobe work at JSC or elsewhere. Included in this group are several members of the excellent series of microprobe standards prepared by Eugene Jarosewich (Smithsonian Institution). Other materials will be added to our reference suite in future catalogs. However, those included here provide a sampling of minerals common in meteorites (olivine, pyroxene, sodic plagioclase, ilmenite) or their ablation products (magnetite). In addition, a reasonable analog of stratospheric volcanic ash (rhyolite glass) is included.

For completeness, the currently accepted bulk composition (expressed as oxide weight percent) of each reference particle (which was taken from a demonstrably homogeneous stock) is also provided. The EDS spectra included in this catalog are of quality equal to that which is routinely obtained in other state-of-the-art SEM laboratories. However, well-known geometrical and differential matrix effects prevent these raw spectra from being interpreted as quantitative analyses. Hence, we have avoided the use of peak-height ratios as diagnostic compositional indicators. Further work on comparison of reference particle spectra with sample particle spectra may later permit semi-quantitative compositional information to be inferred for the sample particles.

Future catalogs will extend our presentation of SEM reference material images and EDS spectra and their applicability in problems related to identification of particles in the cosmic dust collections.

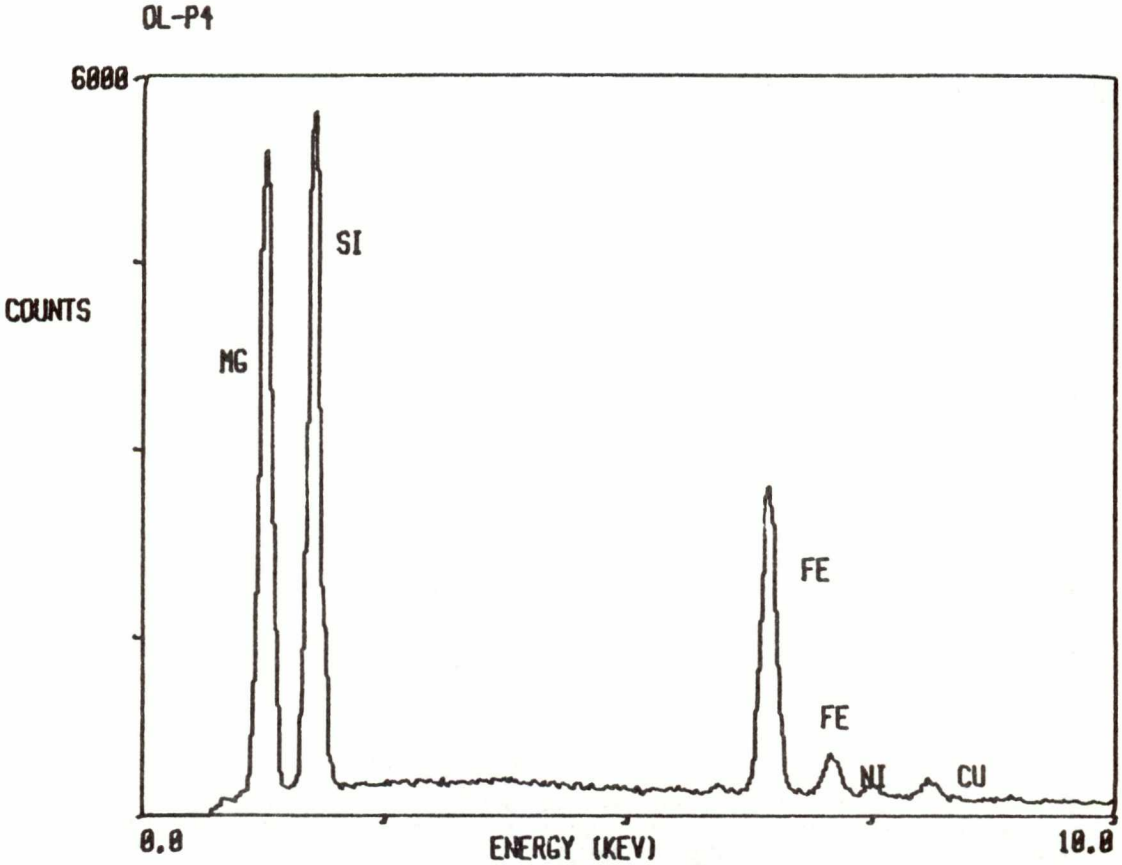
OLIVINE
JLC-129-63



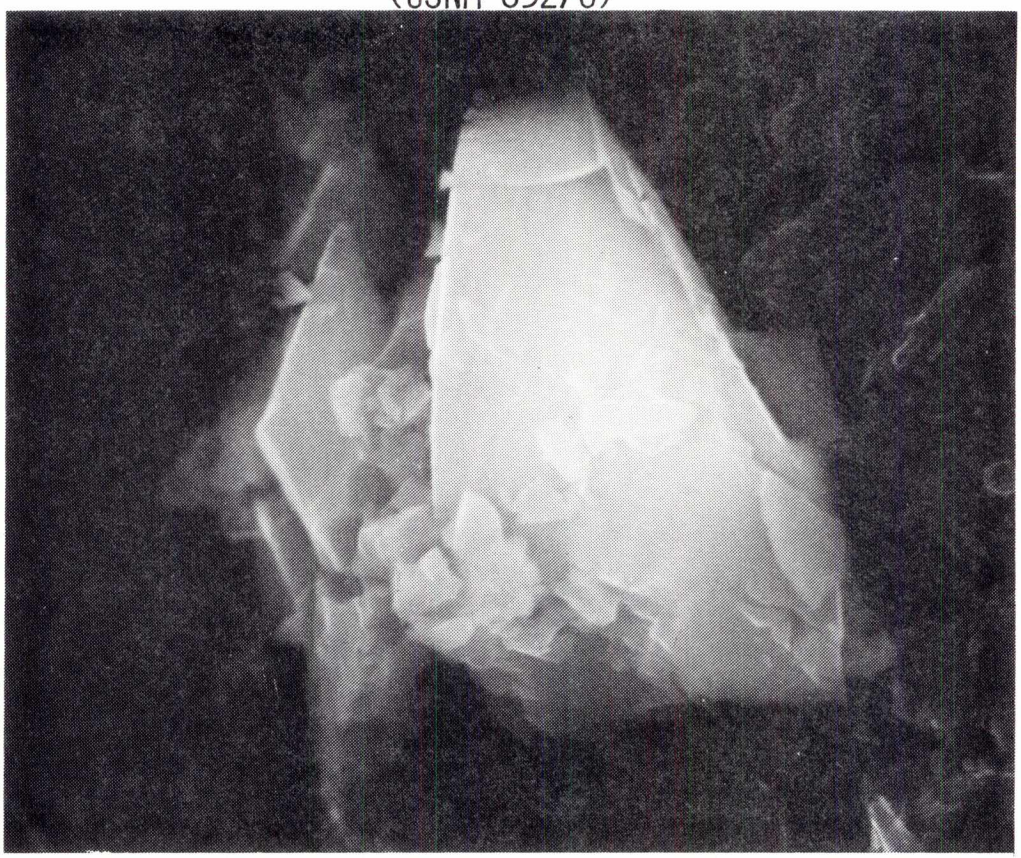
S-82-25746

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
40.94	0.01	0.07	0.01	-	8.74	0.35	0.12	49.64	0.10	-	-	99.98



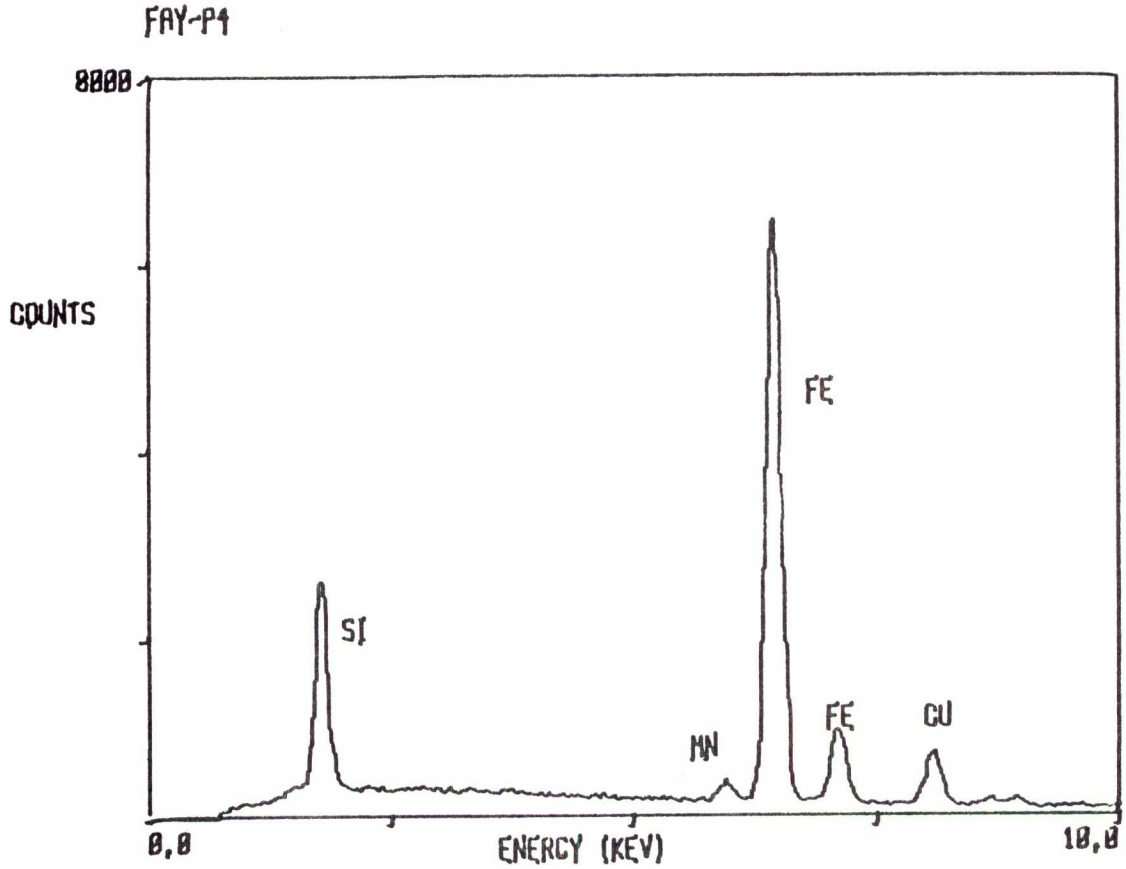
ROCKPORT FAYALITE
(USNM 85276)



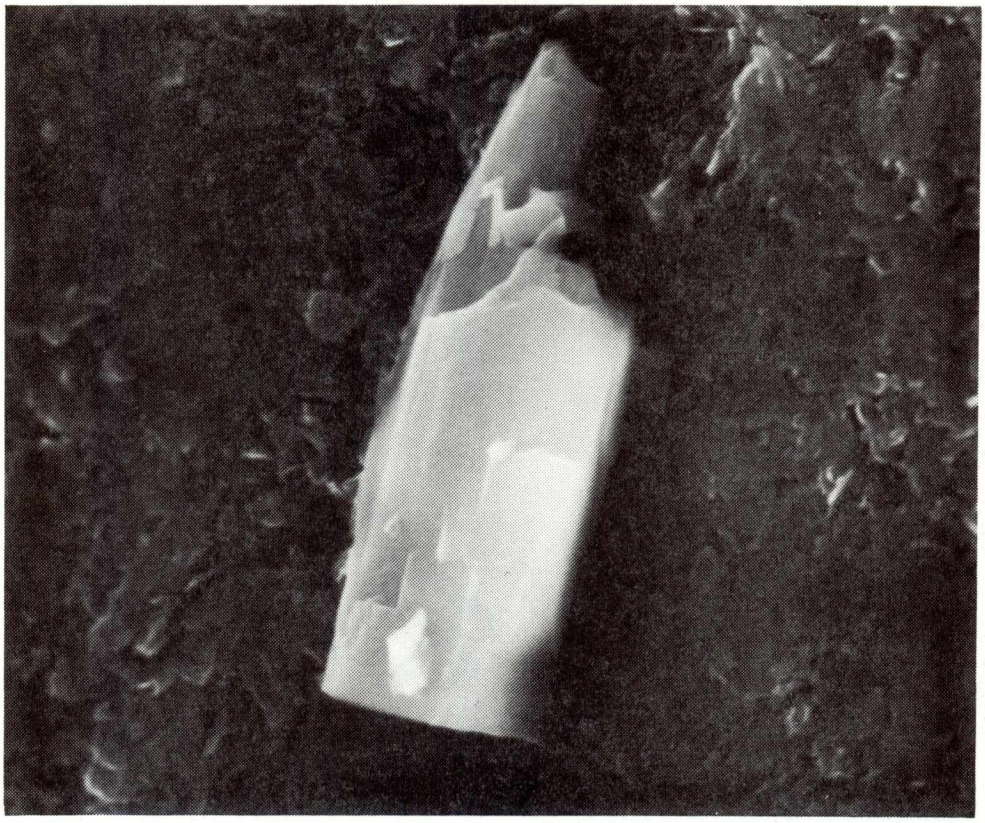
S-82-25741

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
29.22	0.04	-	-	1.32	66.36	-	2.14	-	-	-	-	99.08



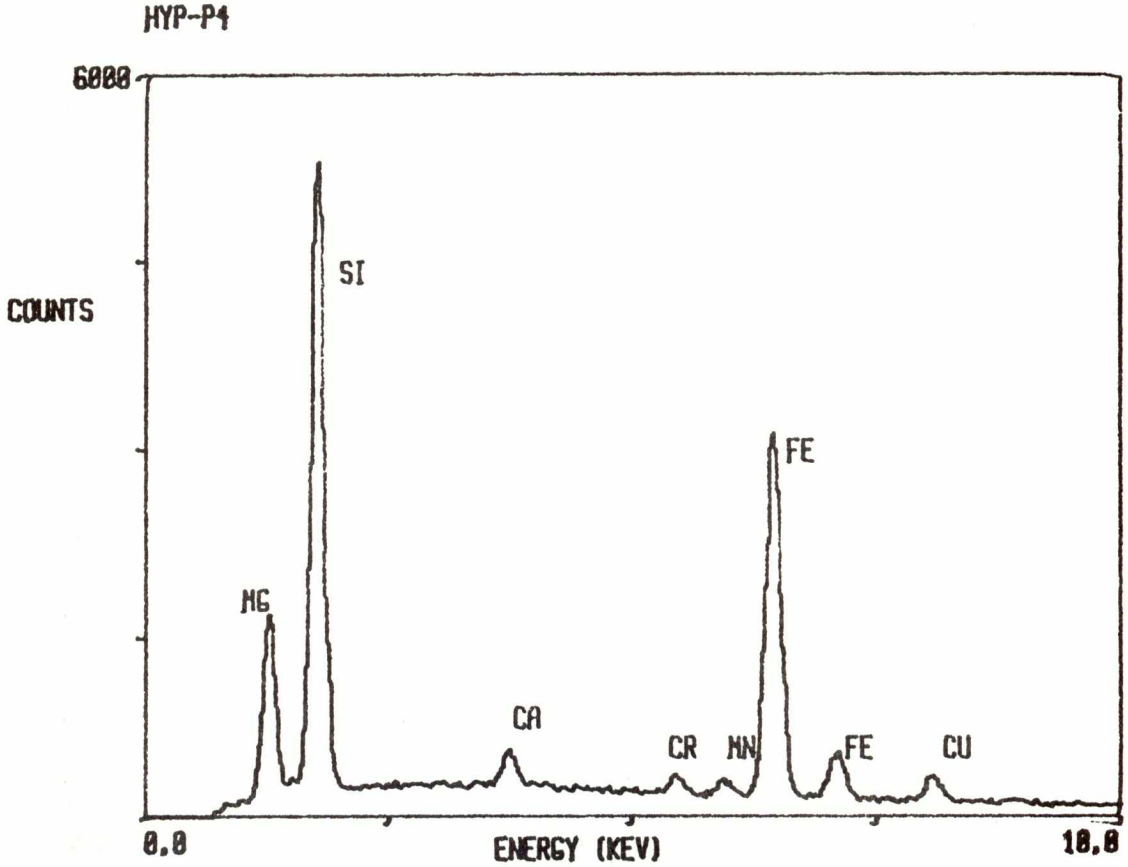
JOHNSTOWN HYPERSTHENE
(USNM 746)



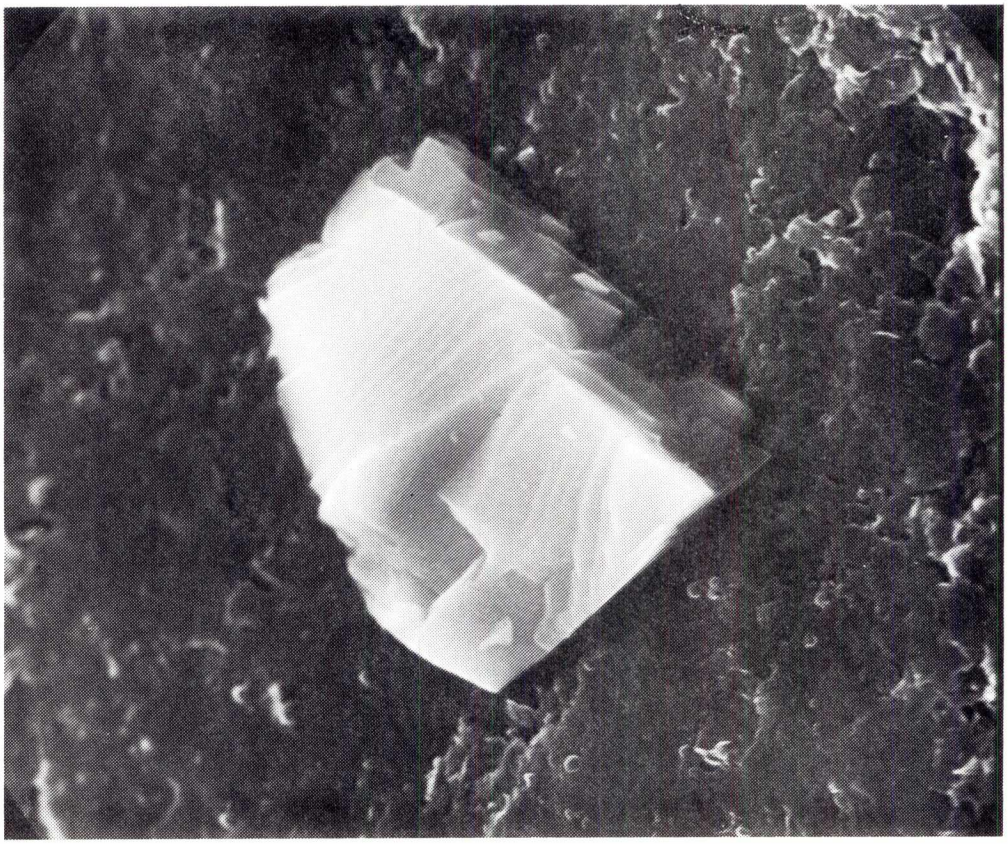
S-82-25742

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
54.09	0.16	1.23	0.75	-	15.22	-	0.49	26.79	1.52	<0.05	<0.05	100.25



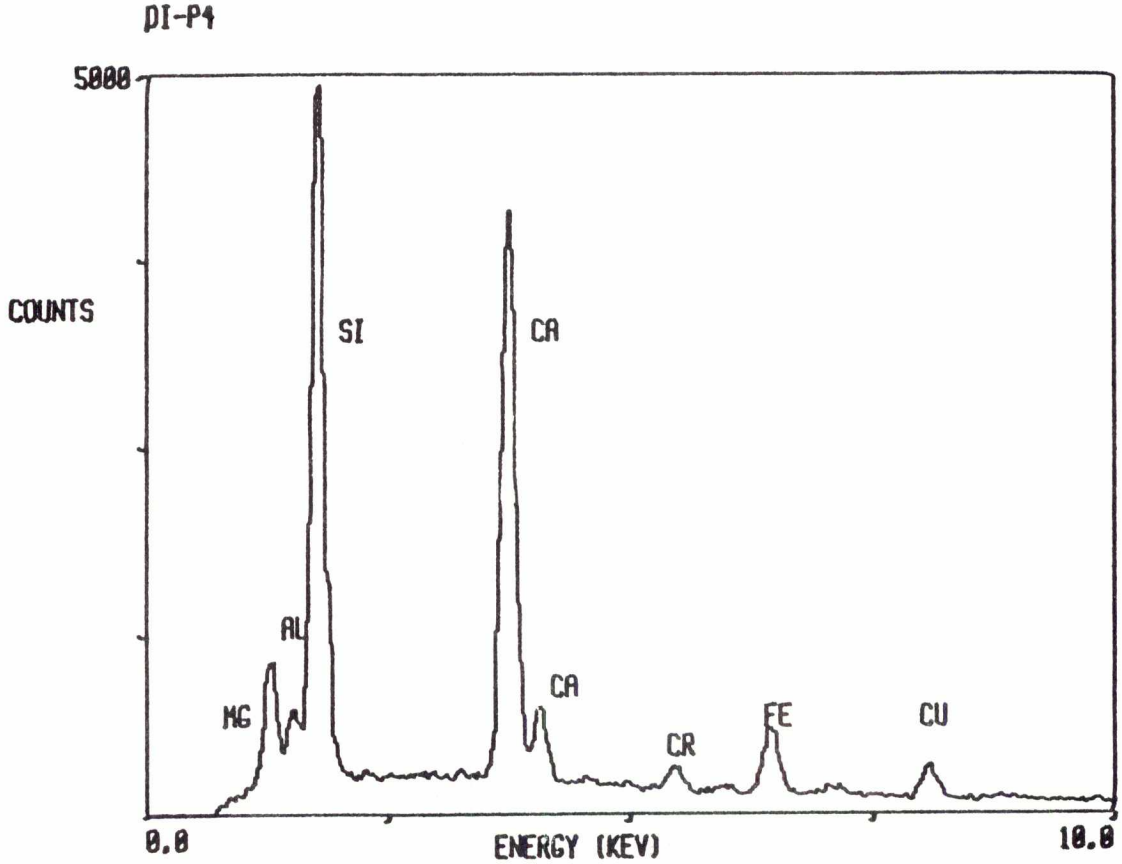
DIOPSIDE
JLC-99-63



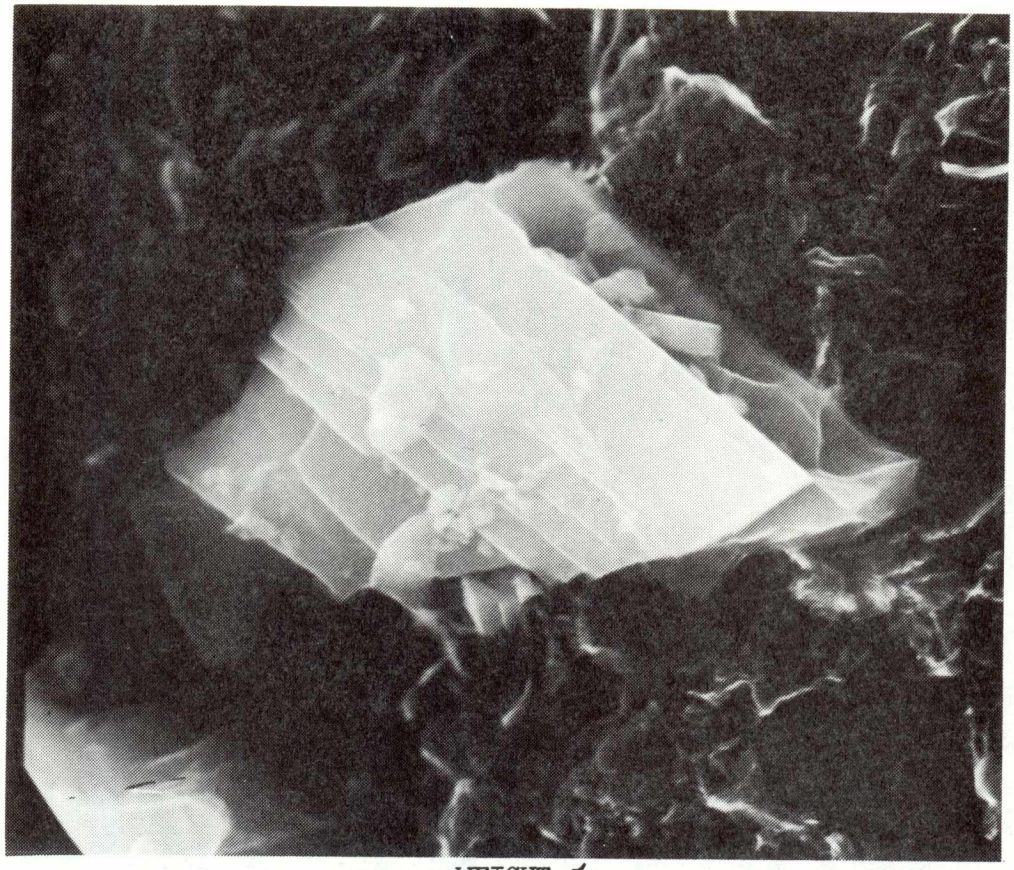
S-82-25744

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
51.93	0.46	6.31	0.96	1.80	2.34	0.04	0.07	16.05	18.64	1.39	-	99.99



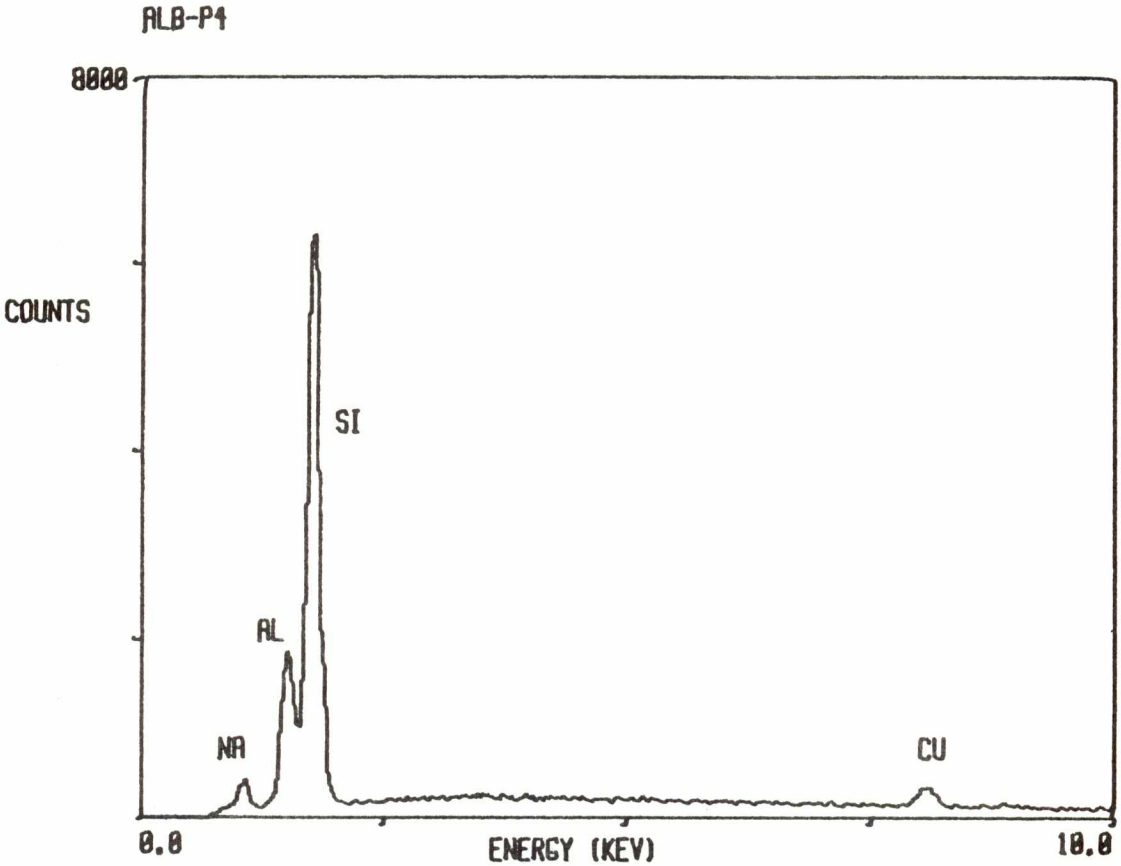
TIBURON ALBITE



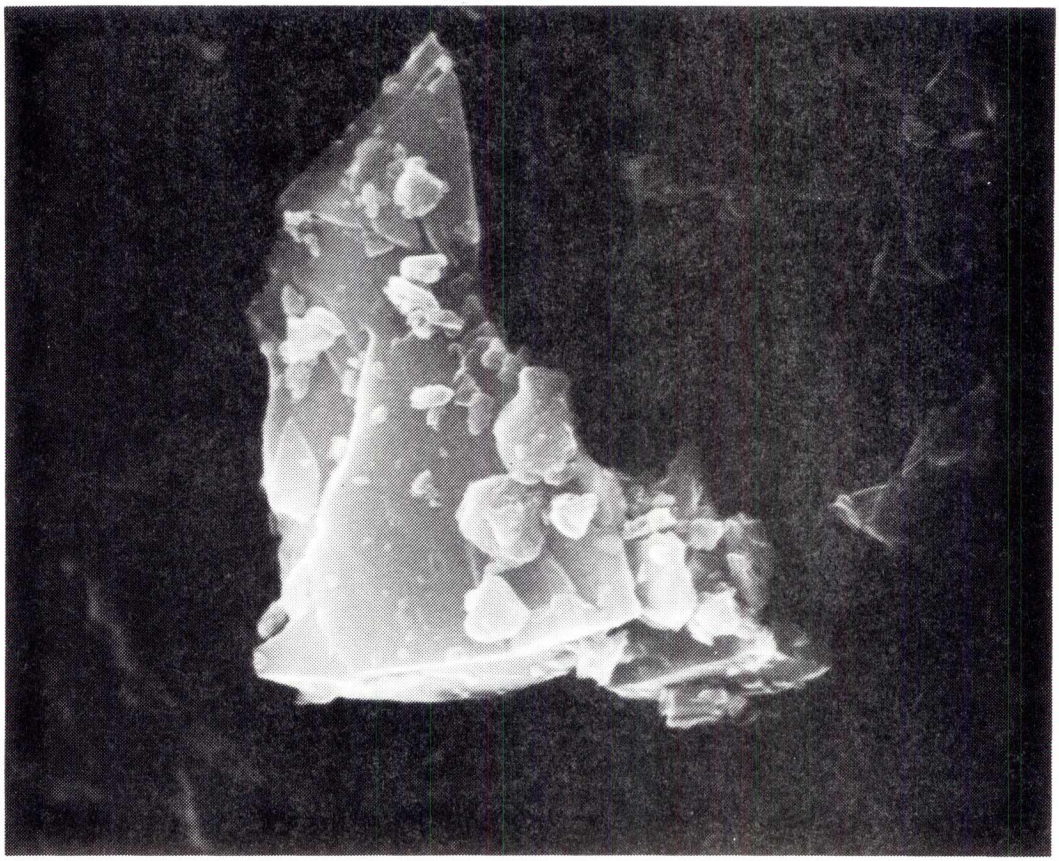
S-82-25750

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
68.22	-	19.90	-	0.06	-	-	-	-	0.00	11.65	0.03	99.86



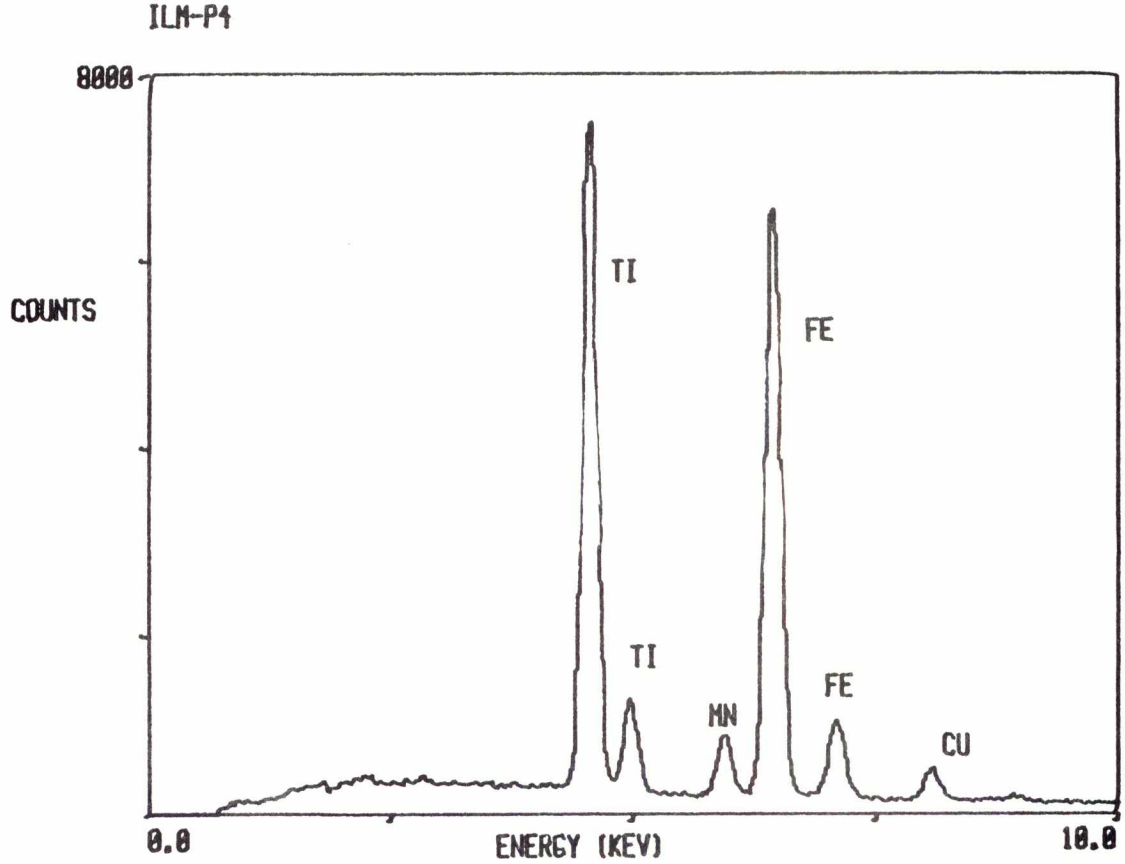
ILMENITE
(USNM 96189)



S-82-25749

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
-	45.70	-	-	11.60	36.10	-	4.77	0.31	-	-	-	98.48

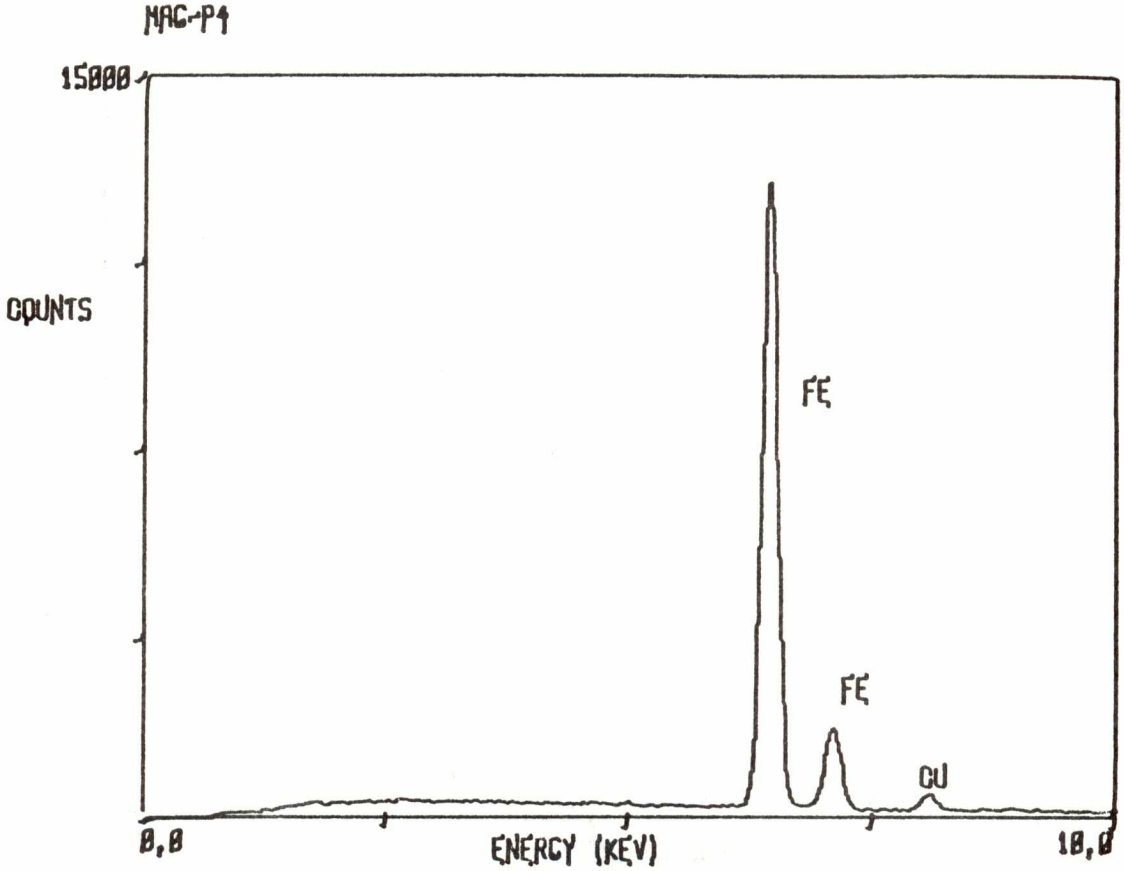


MINAS GERAIS MAGNETITE
(USNM 114887)

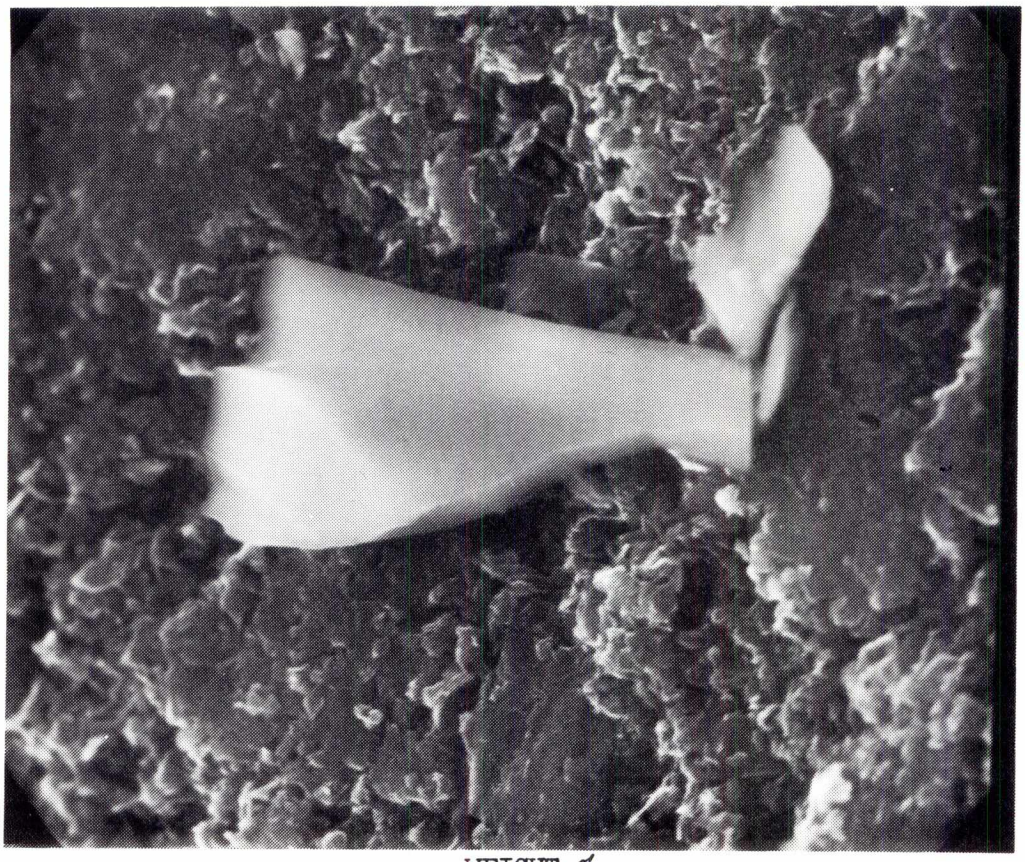
S-82-25743

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
-	-	-	-	67.50	30.20	-	-	-	-	-	-	97.70



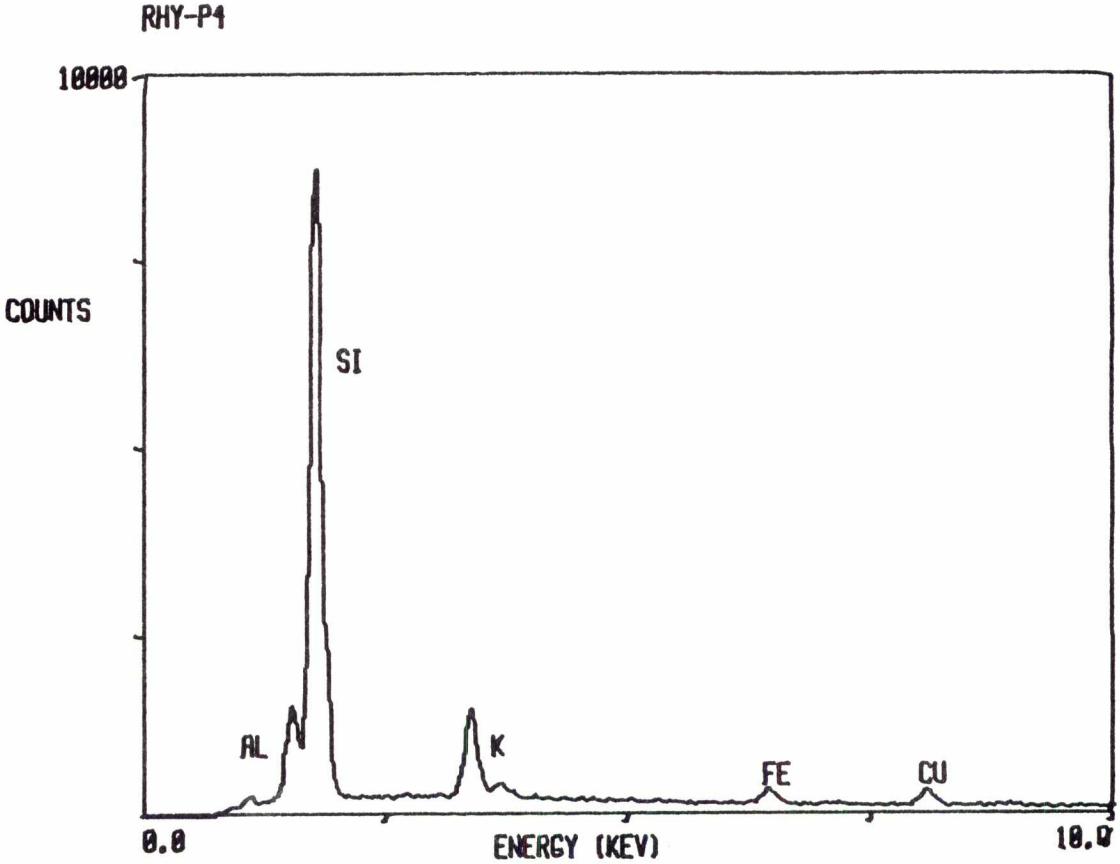
RHYOLITE GLASS
(USNM 72854 VG-568)



S-82-25748

WEIGHT %

SiO2	TiO2	Al2O3	Cr2O3	Fe2O3	FeO	NiO	MnO	MgO	CaO	Na2O	K2O	TOTAL
76.71	0.12	12.06	-	0.48	0.80	-	0.03	<0.10	0.50	3.75	4.89	99.34



6. SAMPLE REQUESTS

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

Curator/CDL
Code SN2
NASA/Johnson Space Center
Houston, Texas 77058
U.S.A.

Telephone: (713) 483-3274

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 requestor 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.

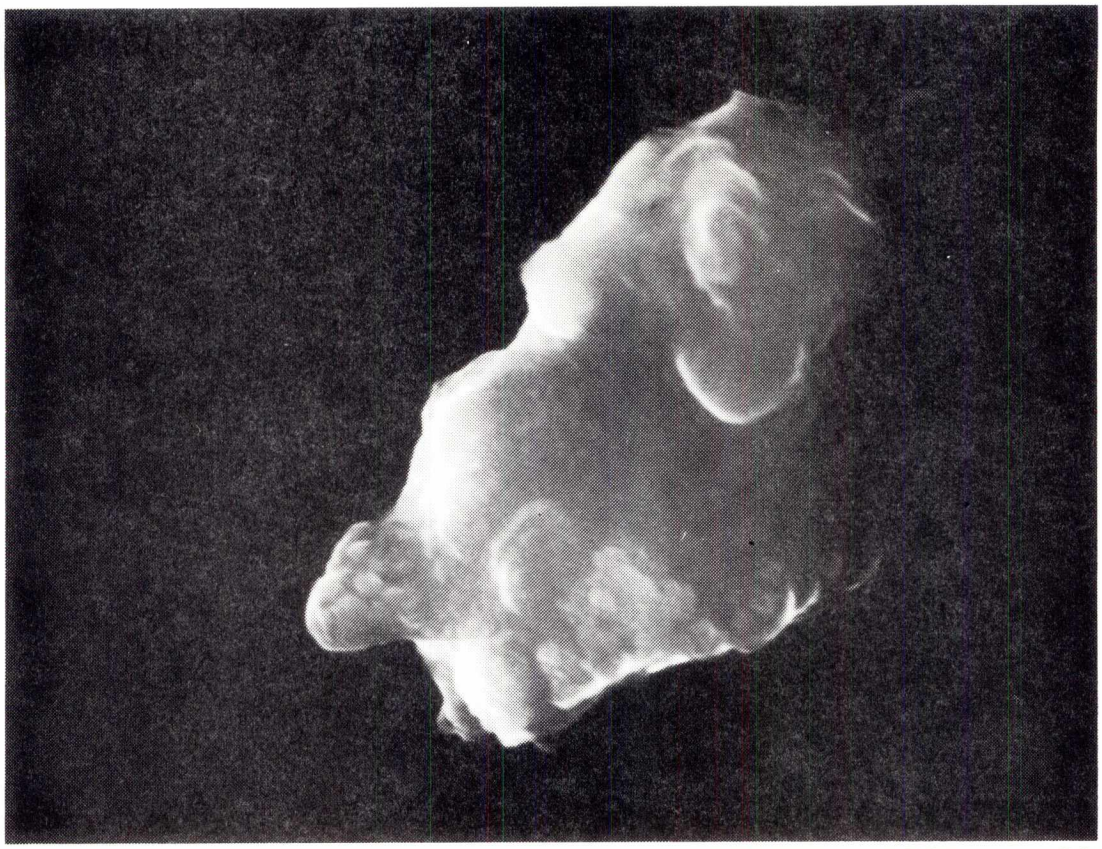
It should be noted that particles labelled W7017B... or W7017E... have already been allocated for research and, thus, are not available from the inventory summarized in this catalog. Again, preliminary examination data for these allocated mounts are included for completeness.

7. ACKNOWLEDGEMENTS

Dr. Donald E. Brownlee (University of Washington, Seattle) generously provided information, advice, and material cooperation which contributed greatly to the successful start of the JSC Cosmic Dust Program. Dr. Robert M. Walker and Dr. Philip B. Fraundorf (Washington University, St. Louis) provided informative discussions on particle identification problems. Dr. Eugene Jarosewich (Smithsonian Institution, Washington, D.C.) kindly provided several mineral standards.

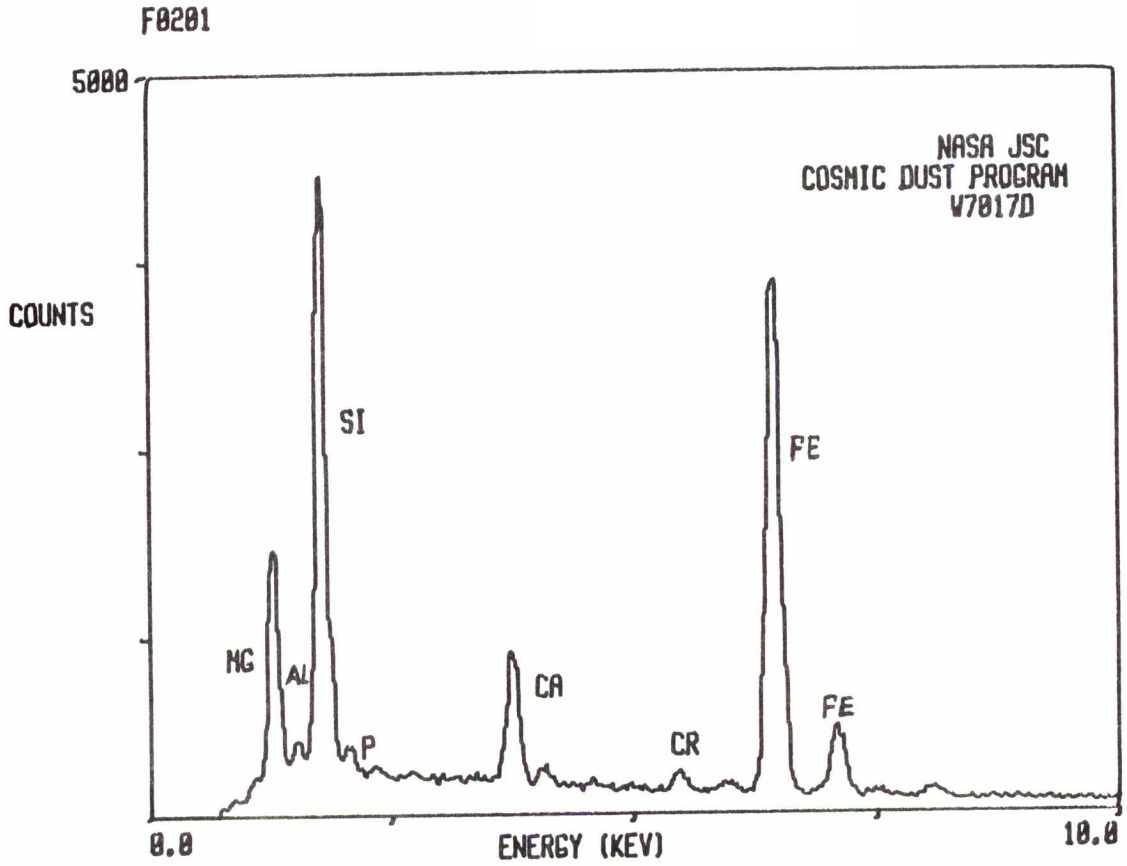
MOUNT W7017D

W7017D2

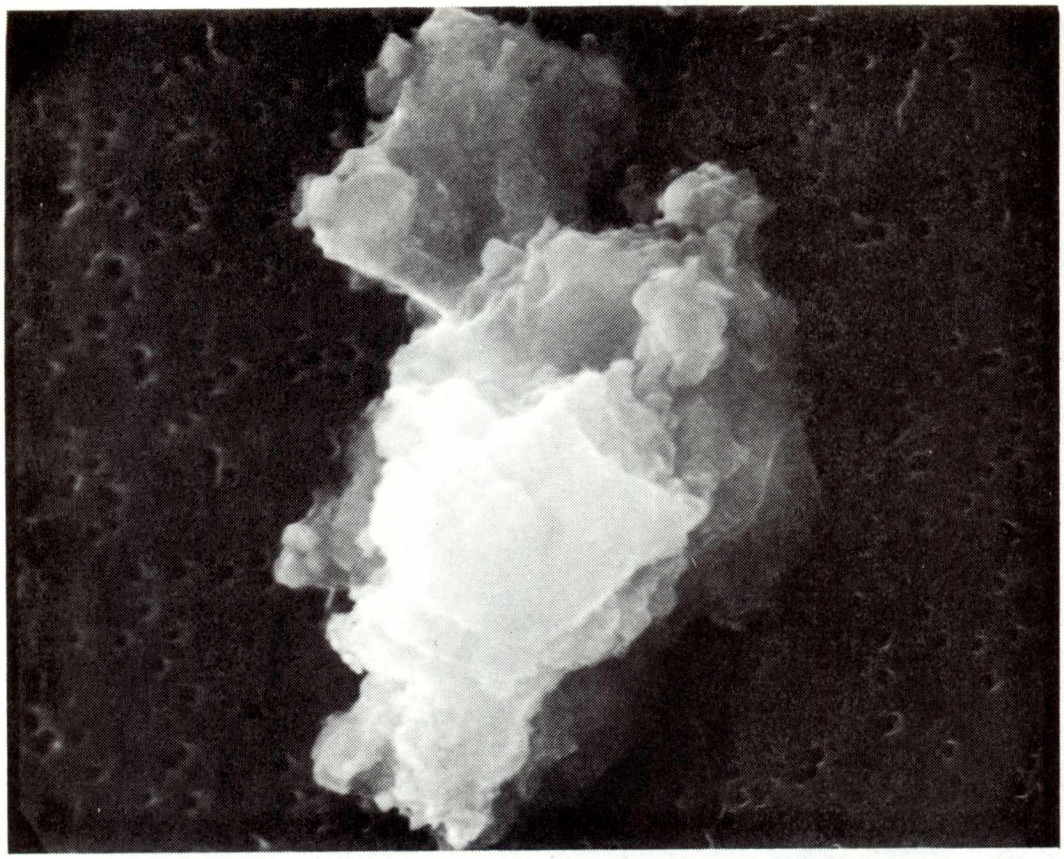


S-82-25177

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7x11~~ 6x7	I	TL	Reddish Brown	SV	C?	

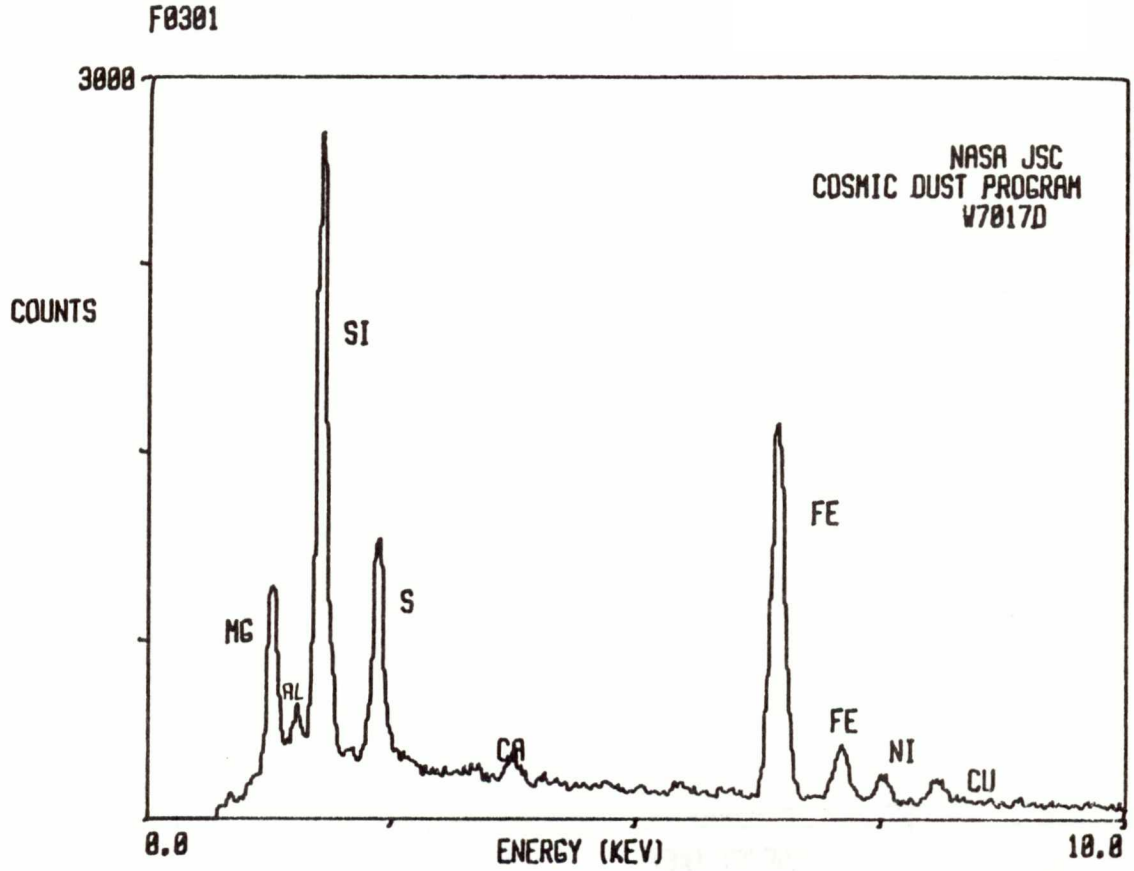


W7017D3

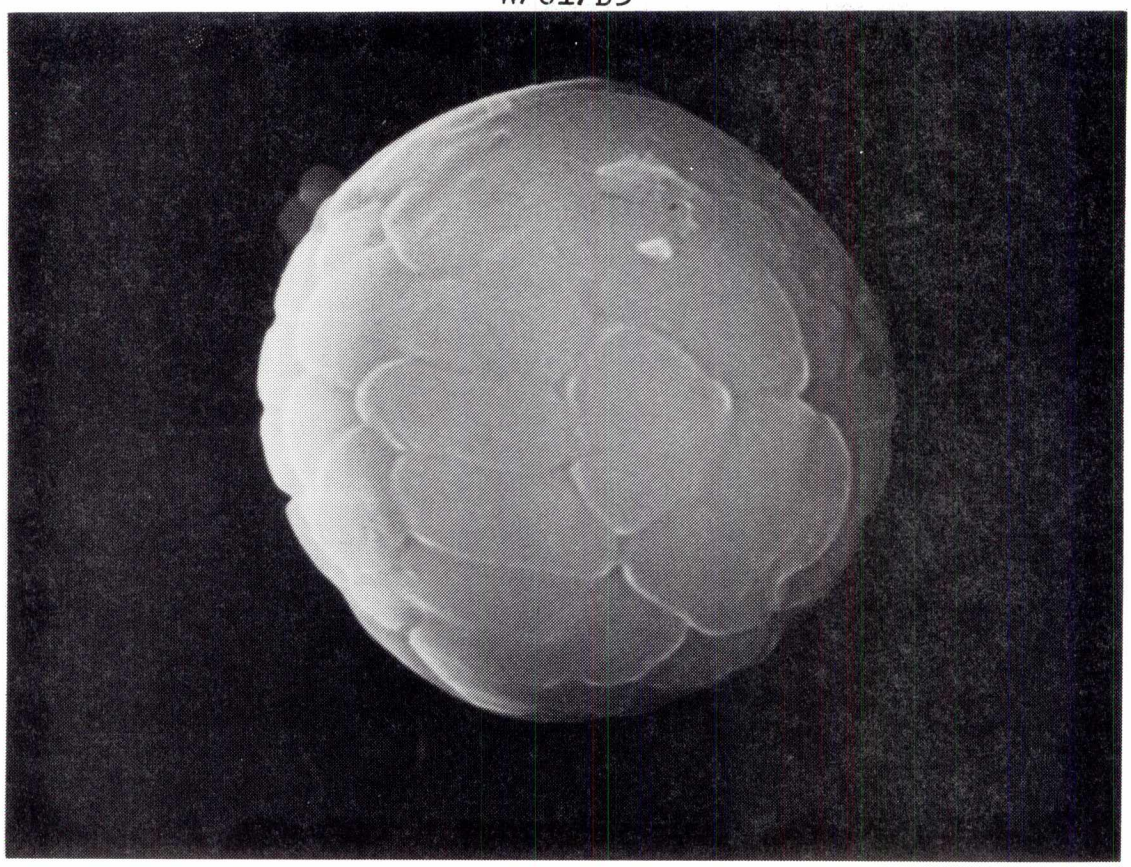


S-82-25176

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~10x16~~ 8x12	I	O	Brown/Black	D/SV	C?	

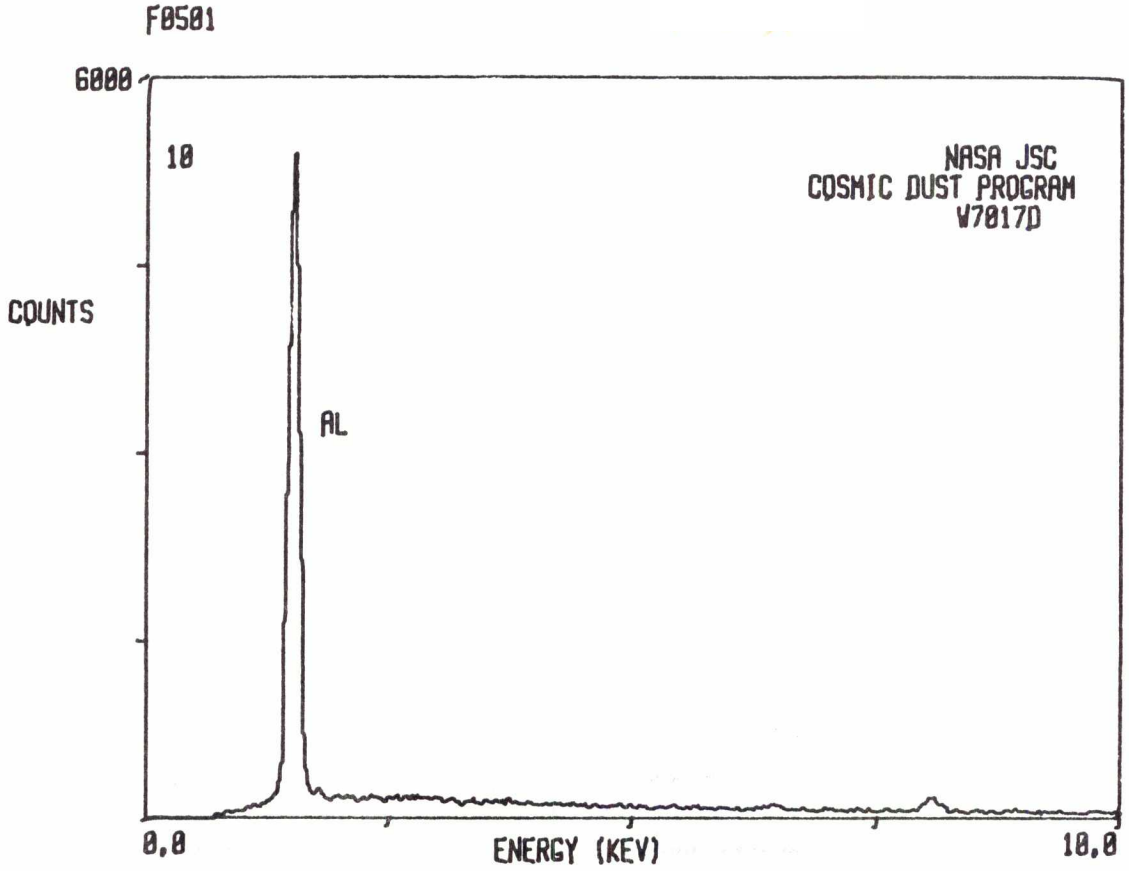


W7017D5

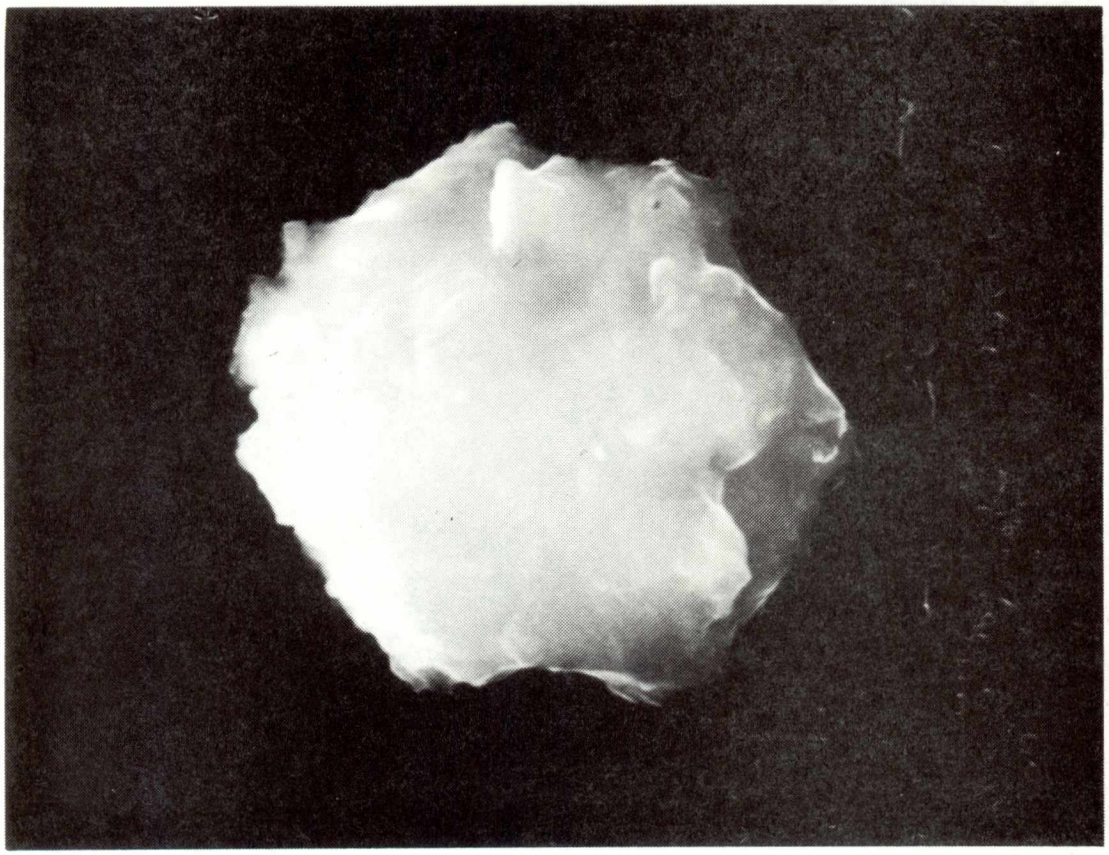


S-82-25175

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7~~ 6	S	TL	CL/Pale Yellow-Gray	V	AOS	Al x-ray emission may include artifacts from Al grid on SEM mount

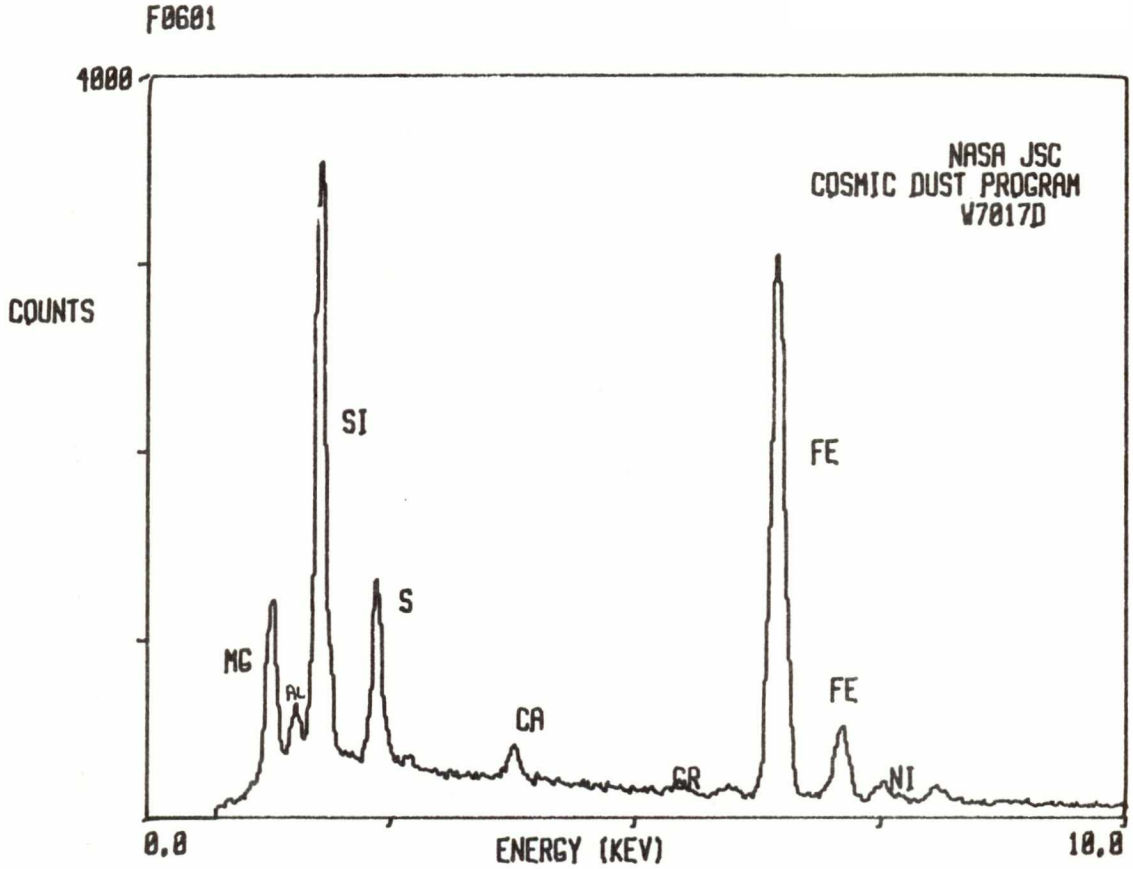


W7017D6

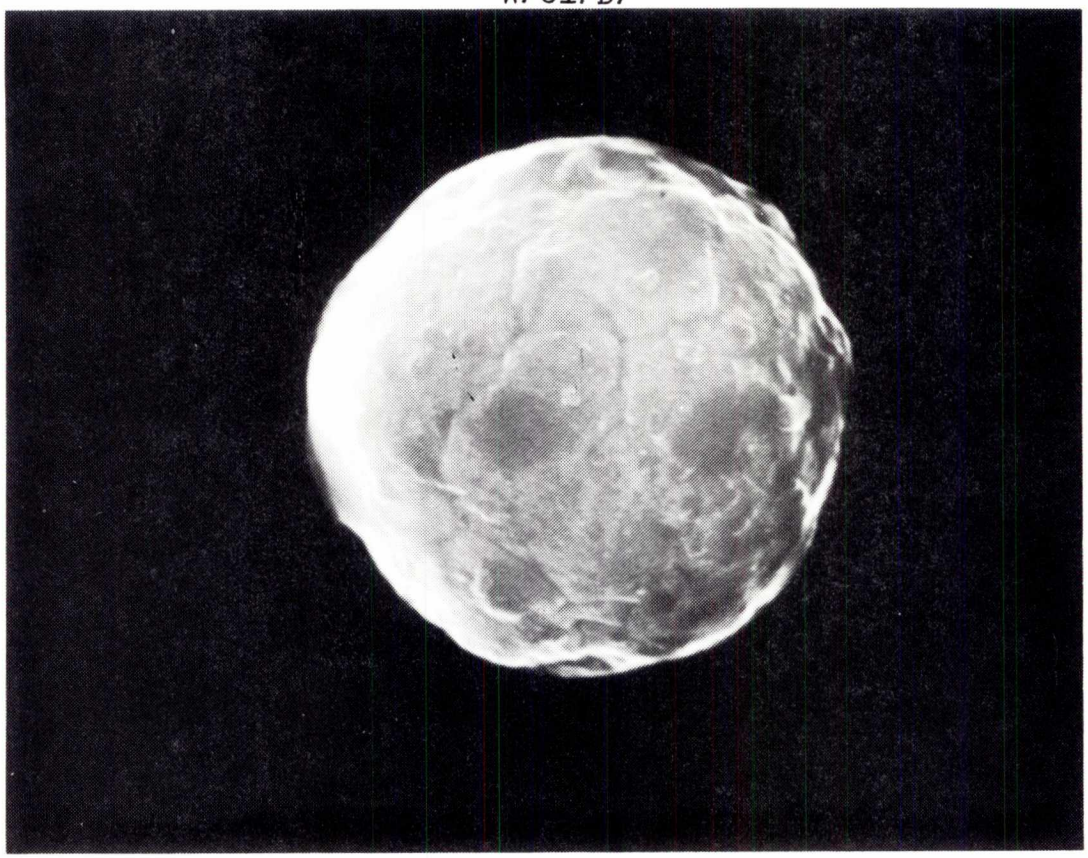


S-82-25174

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
8x9	E	O	Black	SV/V	C?	

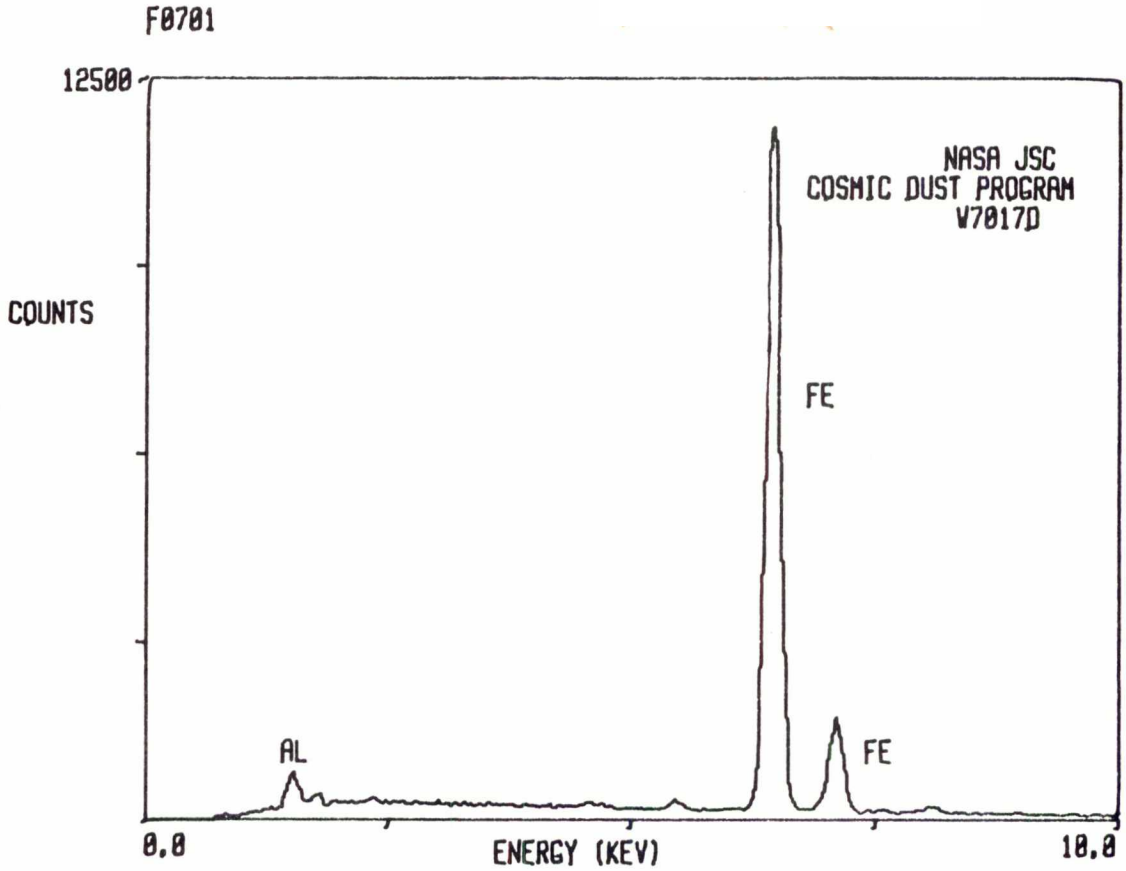


W7017D7

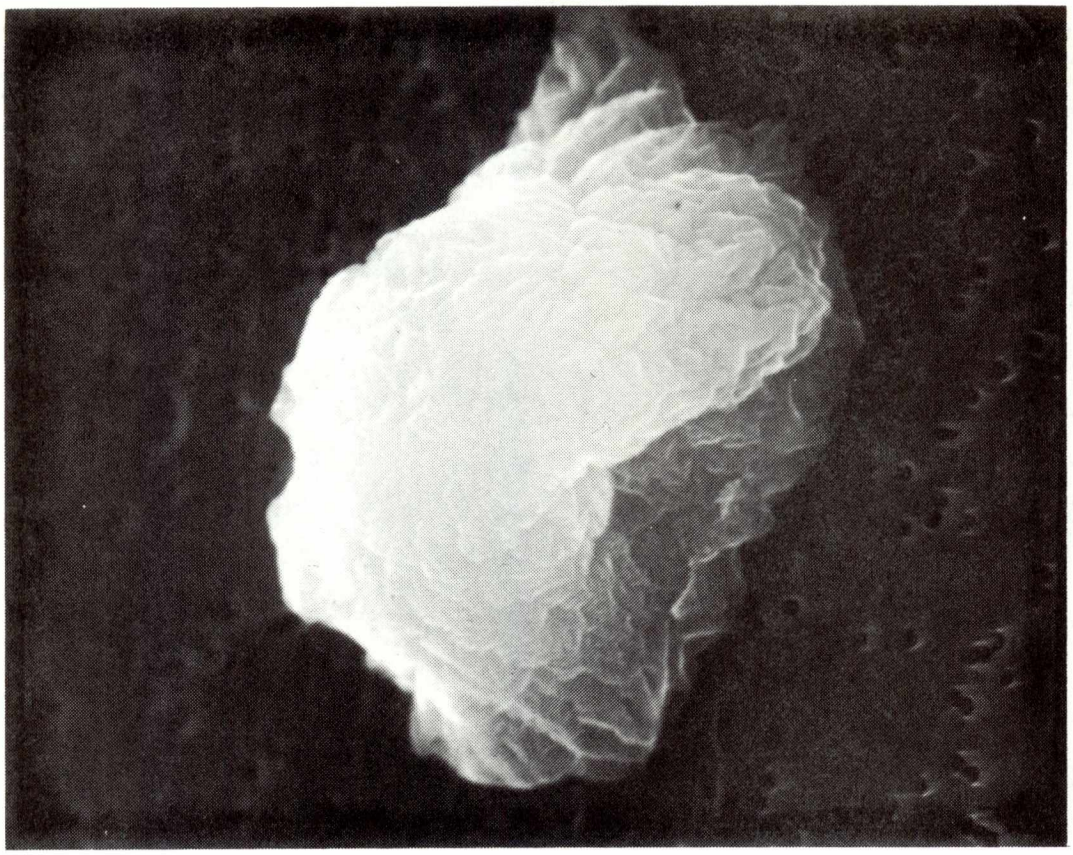


S-82-25173

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

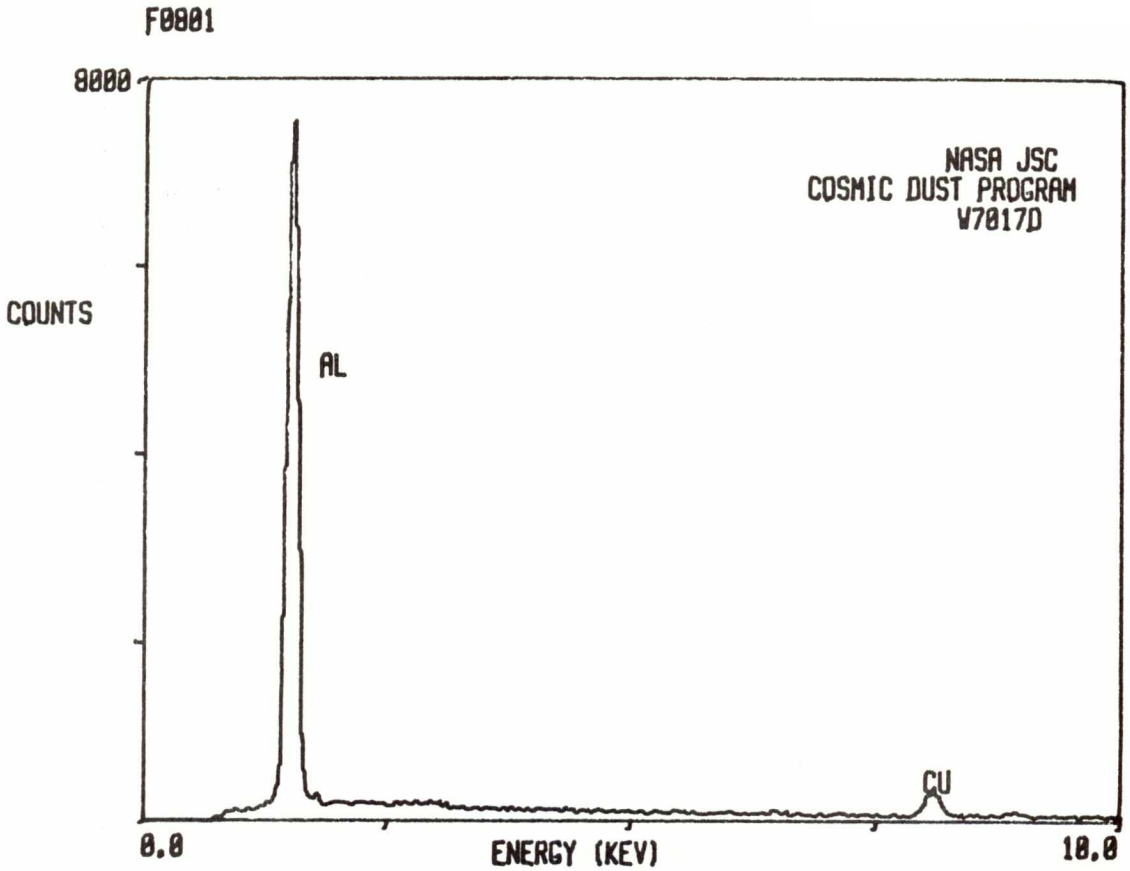


W7017D8



S-82-25172

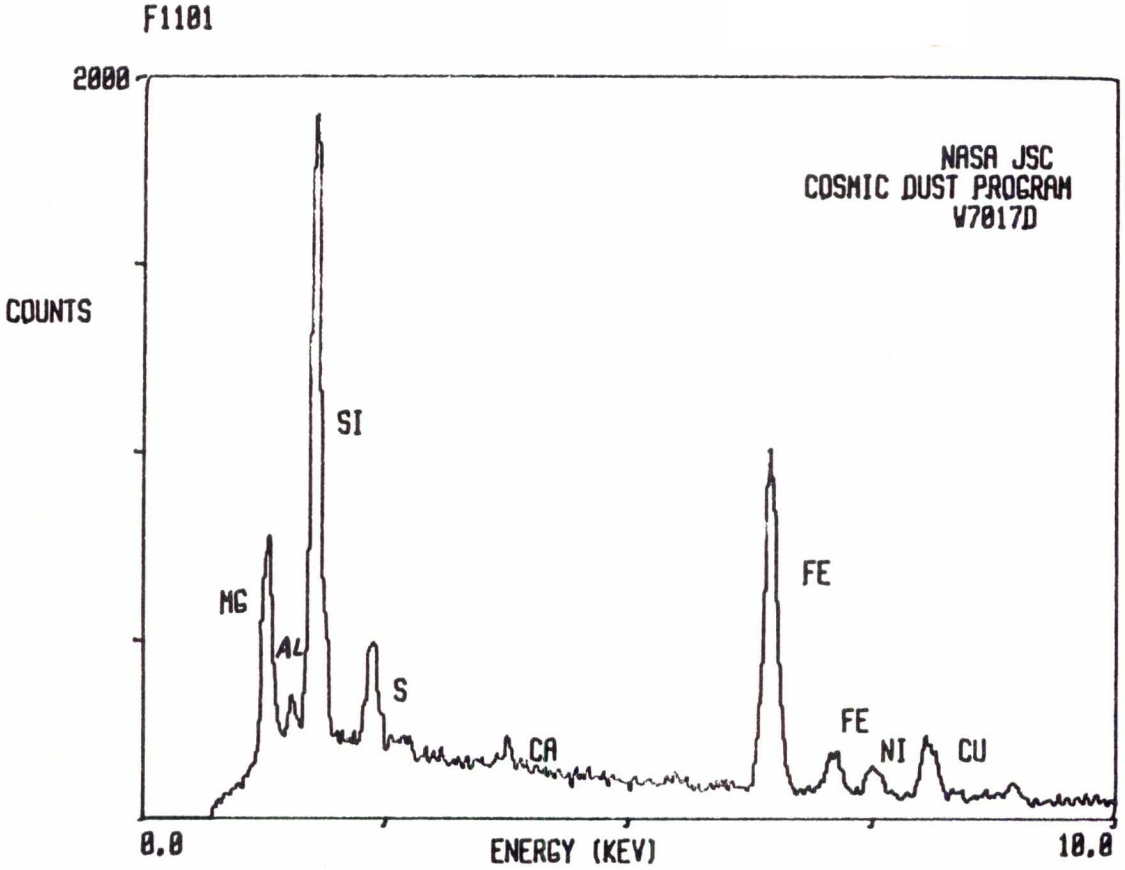
SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
7x~~12~~9	I	O	Black	SM/M	TCA?	



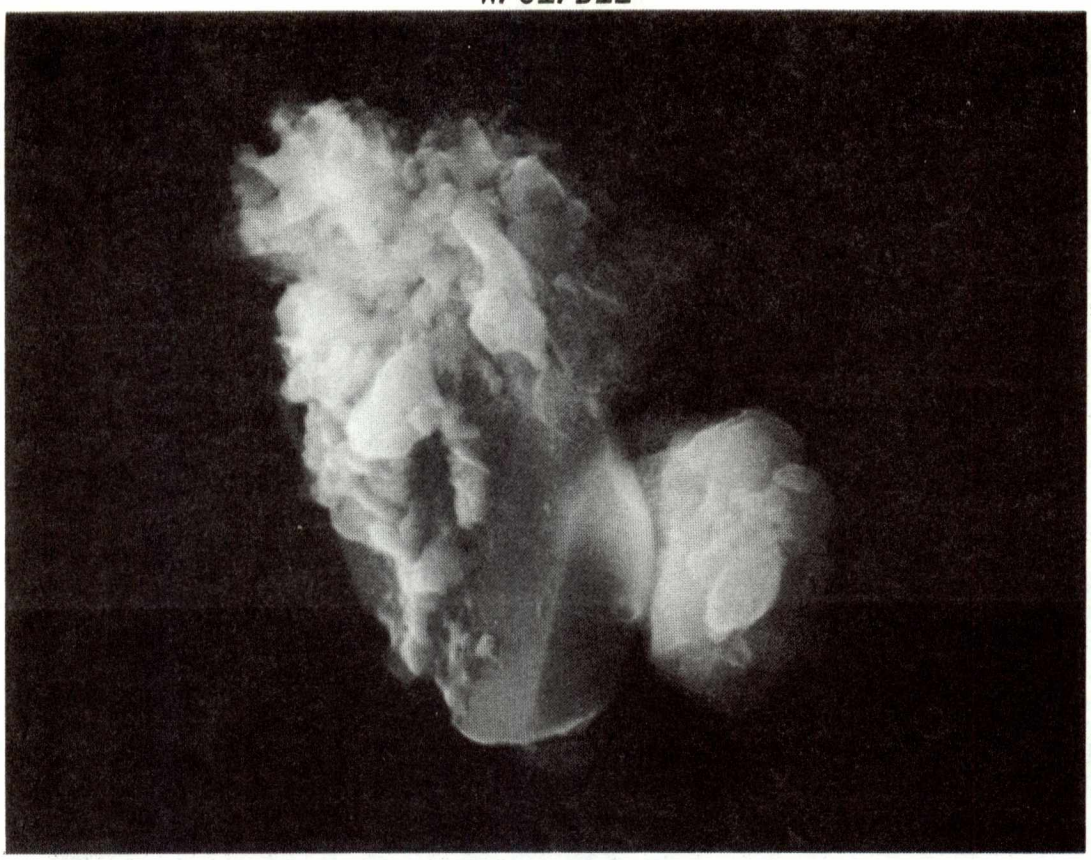
W7017D11

S-82-25171

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
4x~~10~~8	I	O	Brown/Black	SV	C?	

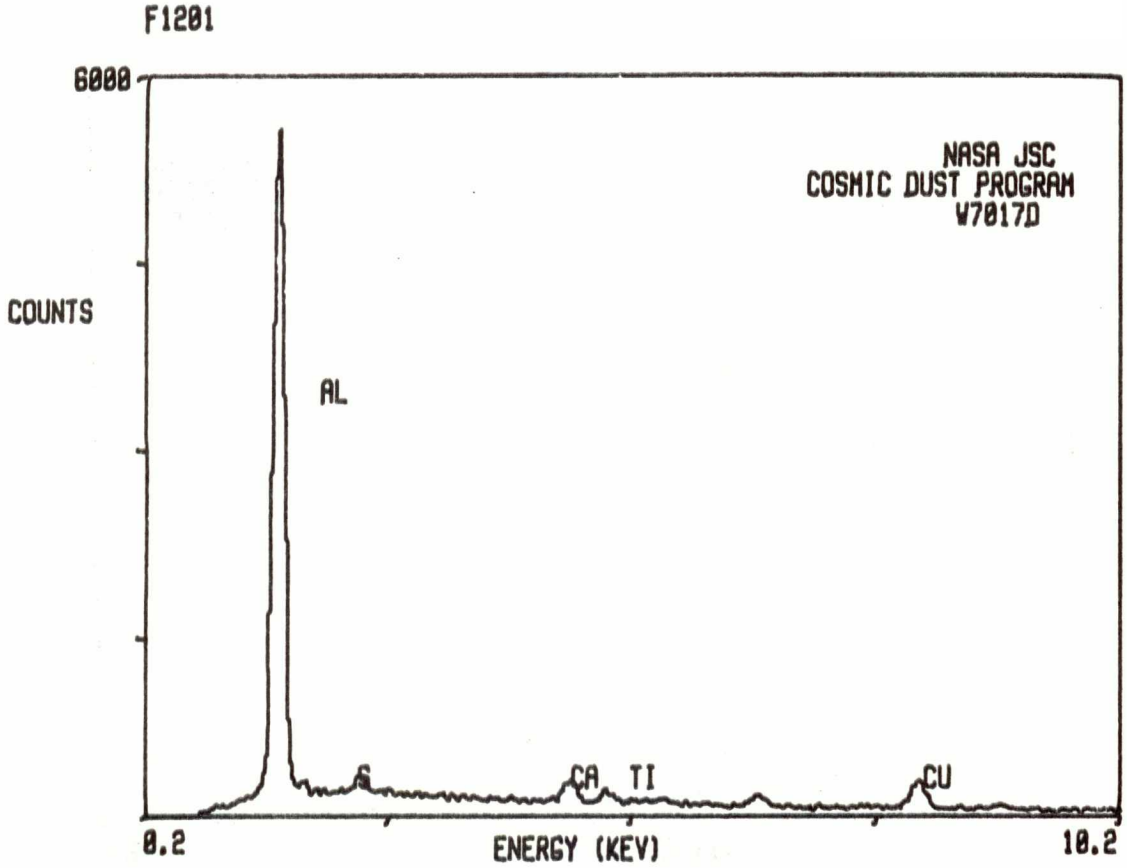


W7017D12

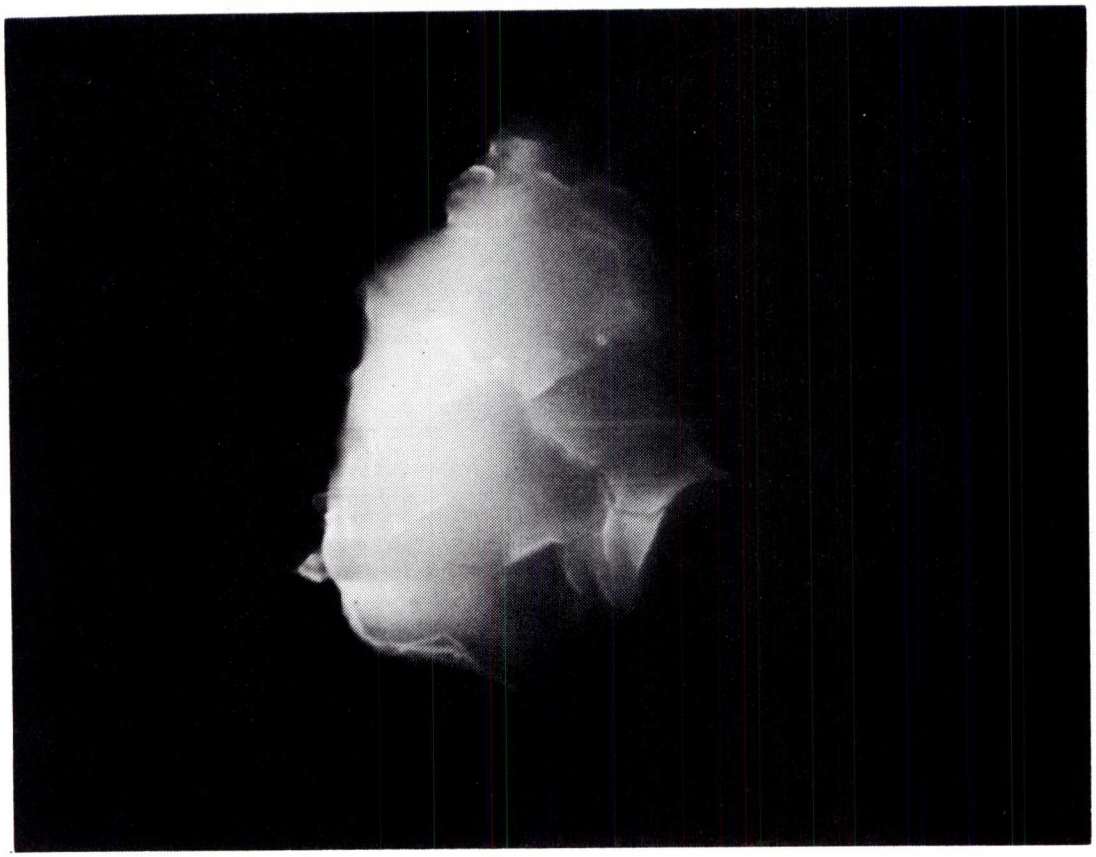


S-82-25170

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6x9~~ 4x6	I	TL	Pale Gray-Brown	SV	?	Al'?

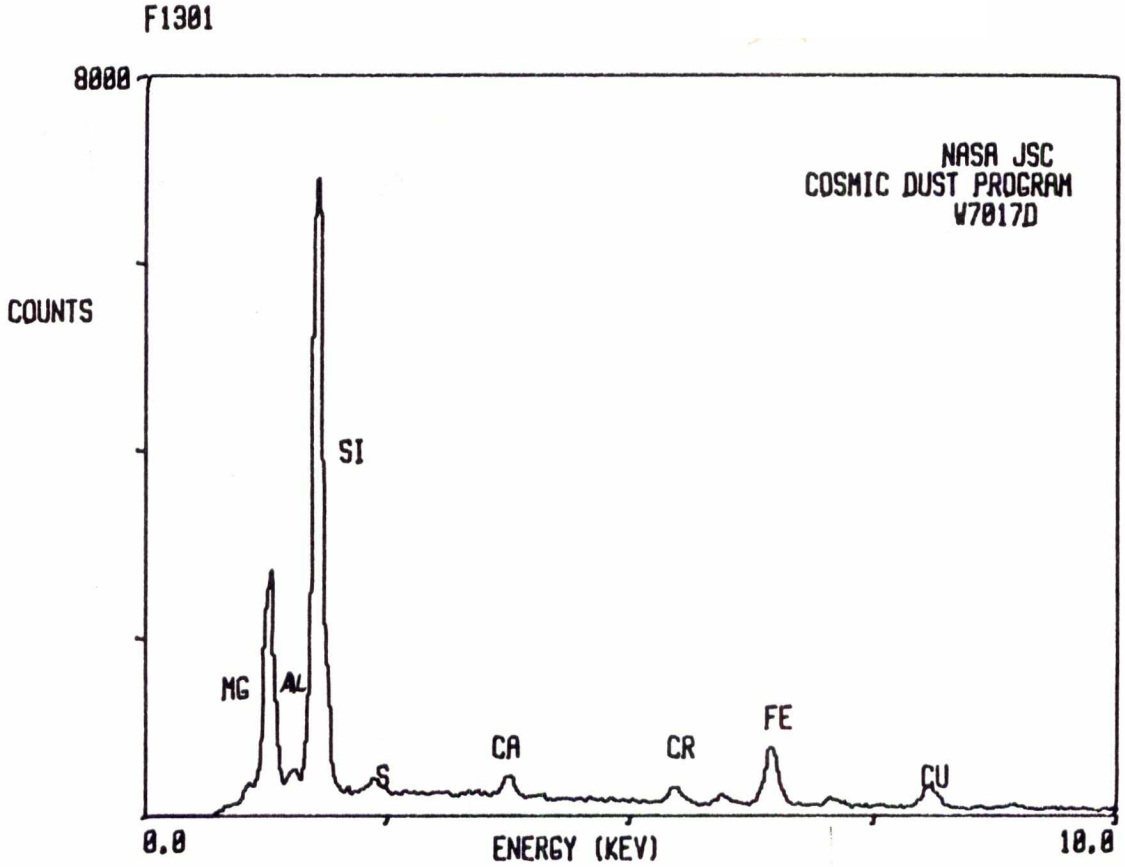


W7017D13

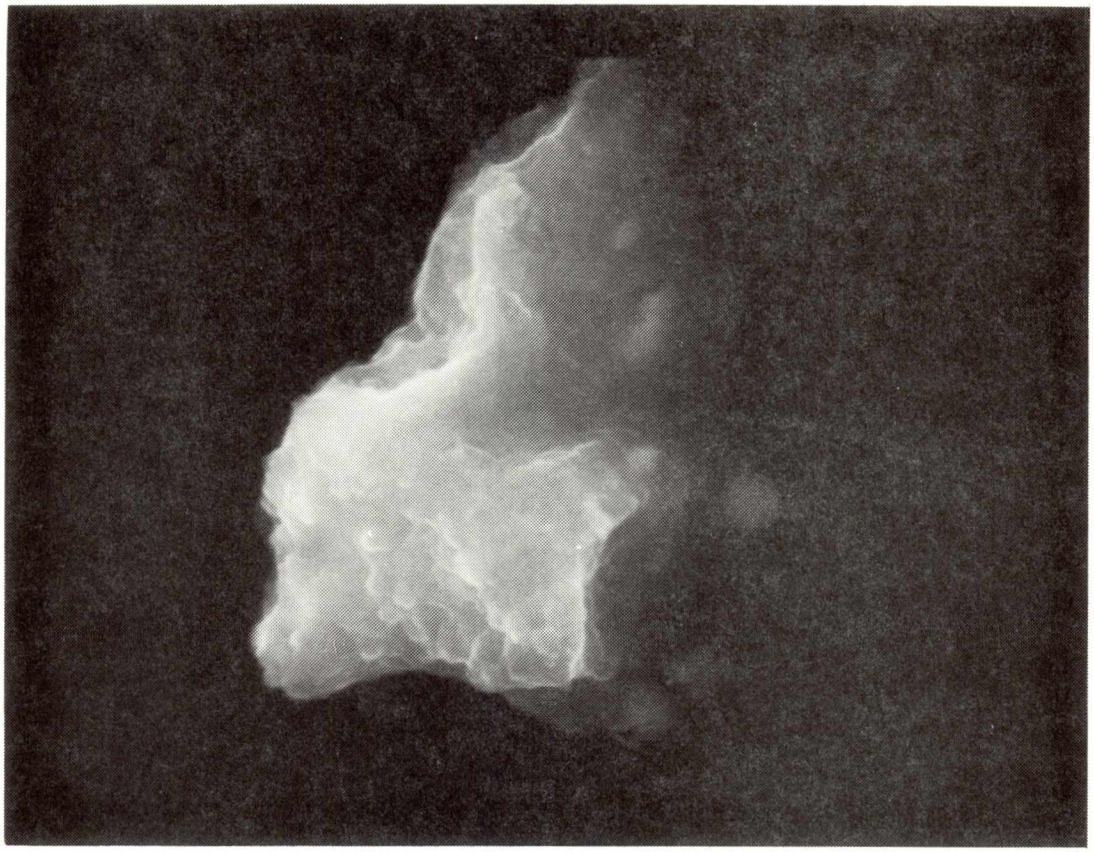


S-82-25169

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
12x~~16~~8	I	TL	Pale Gray-Brown	SV	C?	

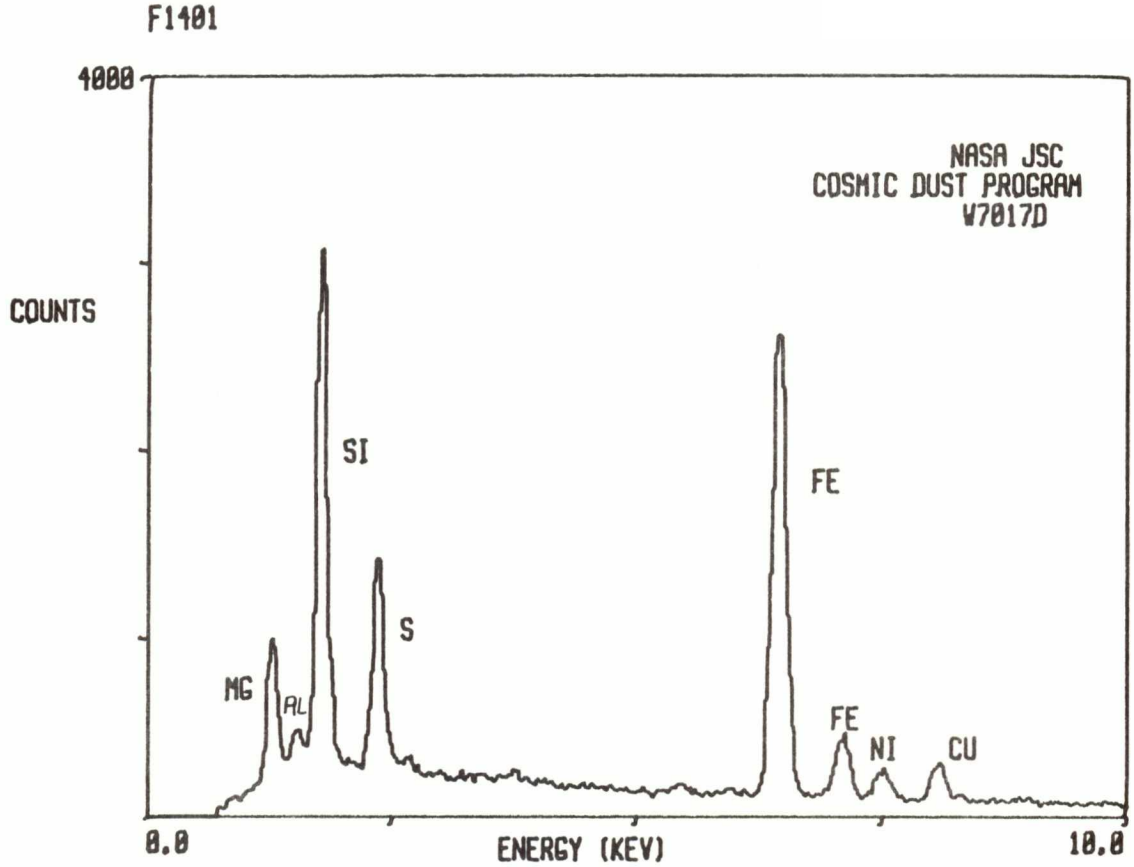


W7017D14



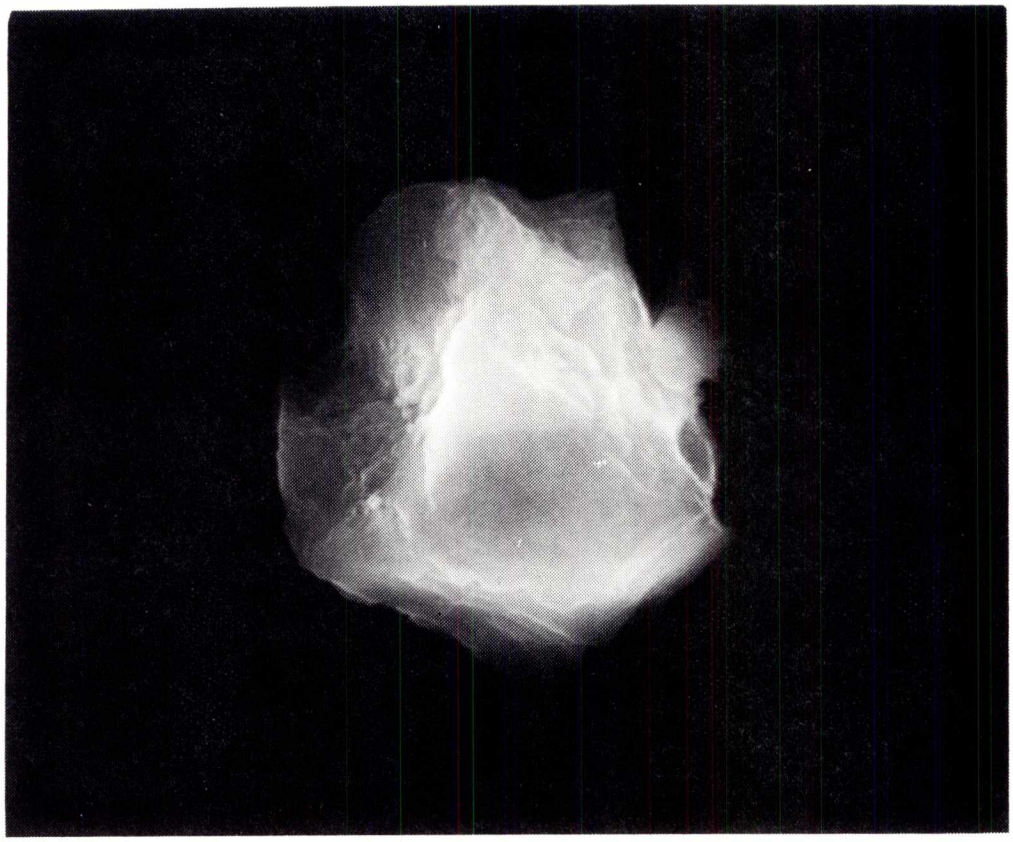
S-82-25168

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~12x22~~ 10x12	I	O	Black	SM	C?	



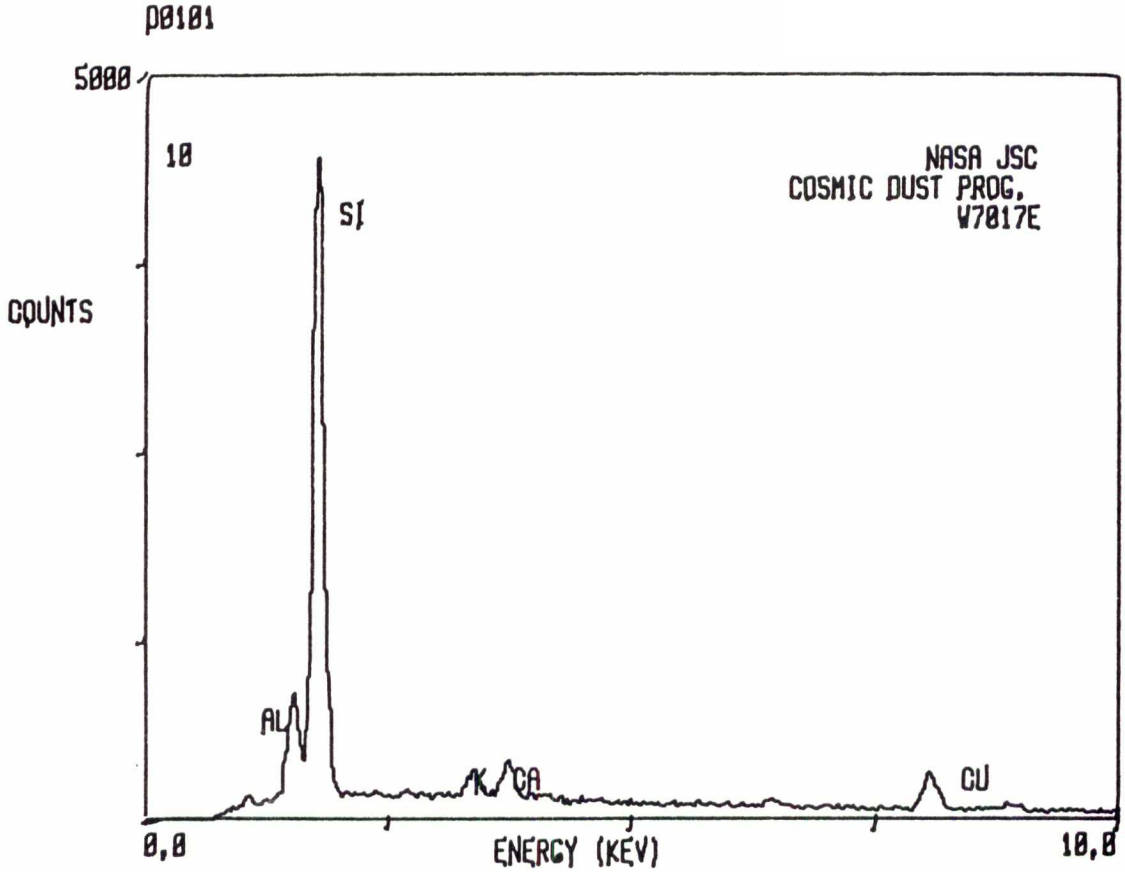
MOUNT W7017E

W7017E1

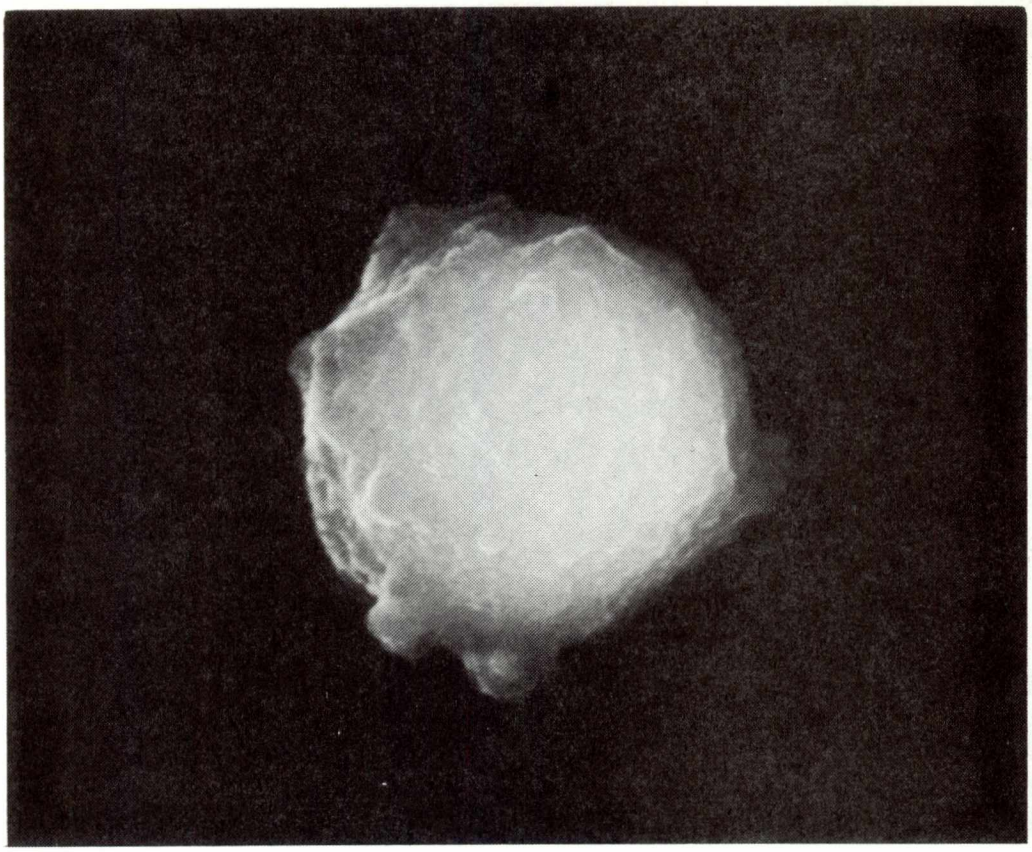


S-82-25150

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
14x~~16~~12	E	TL	Pale Yellow-Gray	SV	TCN?	

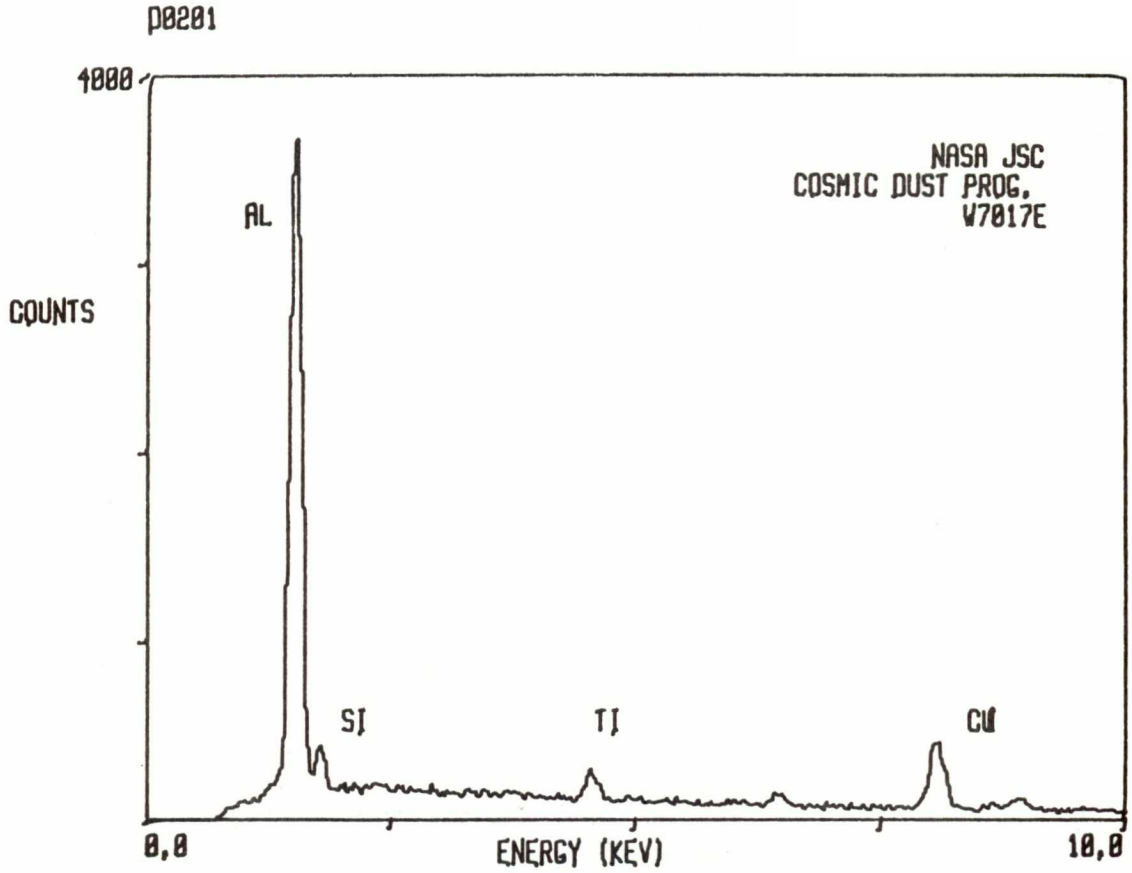


W7017E2

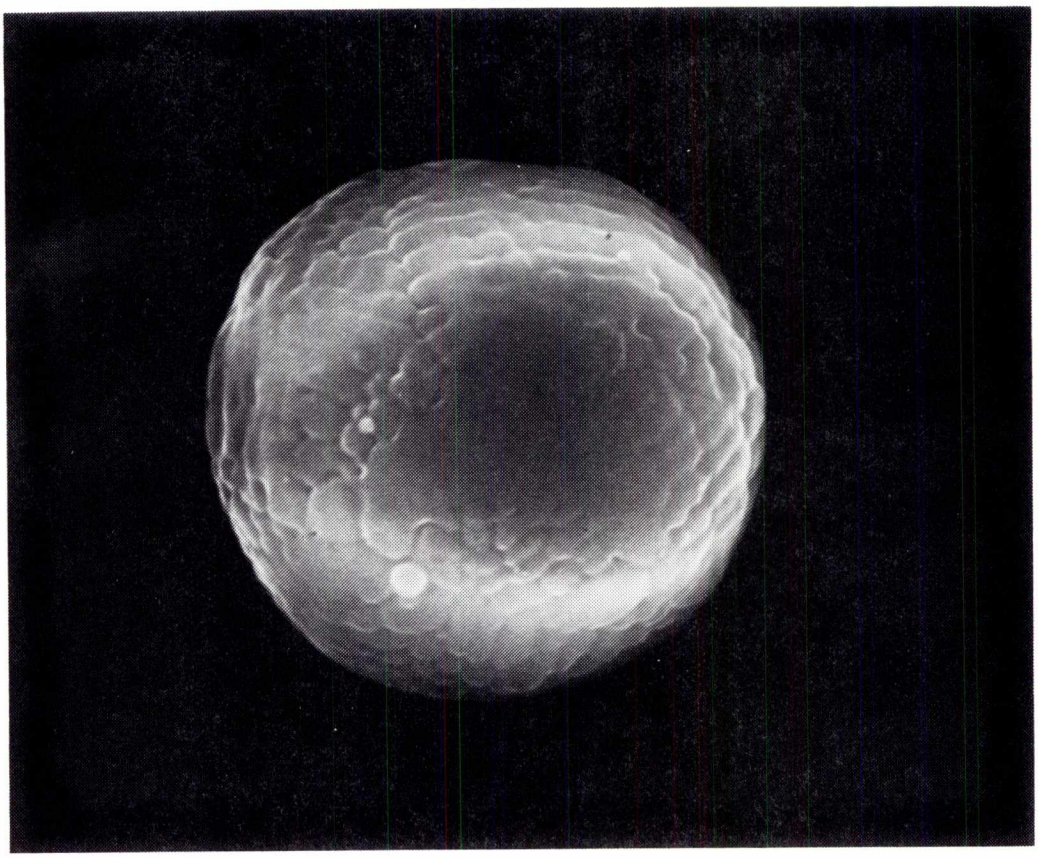


S-82-25151

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
7	E	TL	Pale Gray	SV	AOS?	Al'?

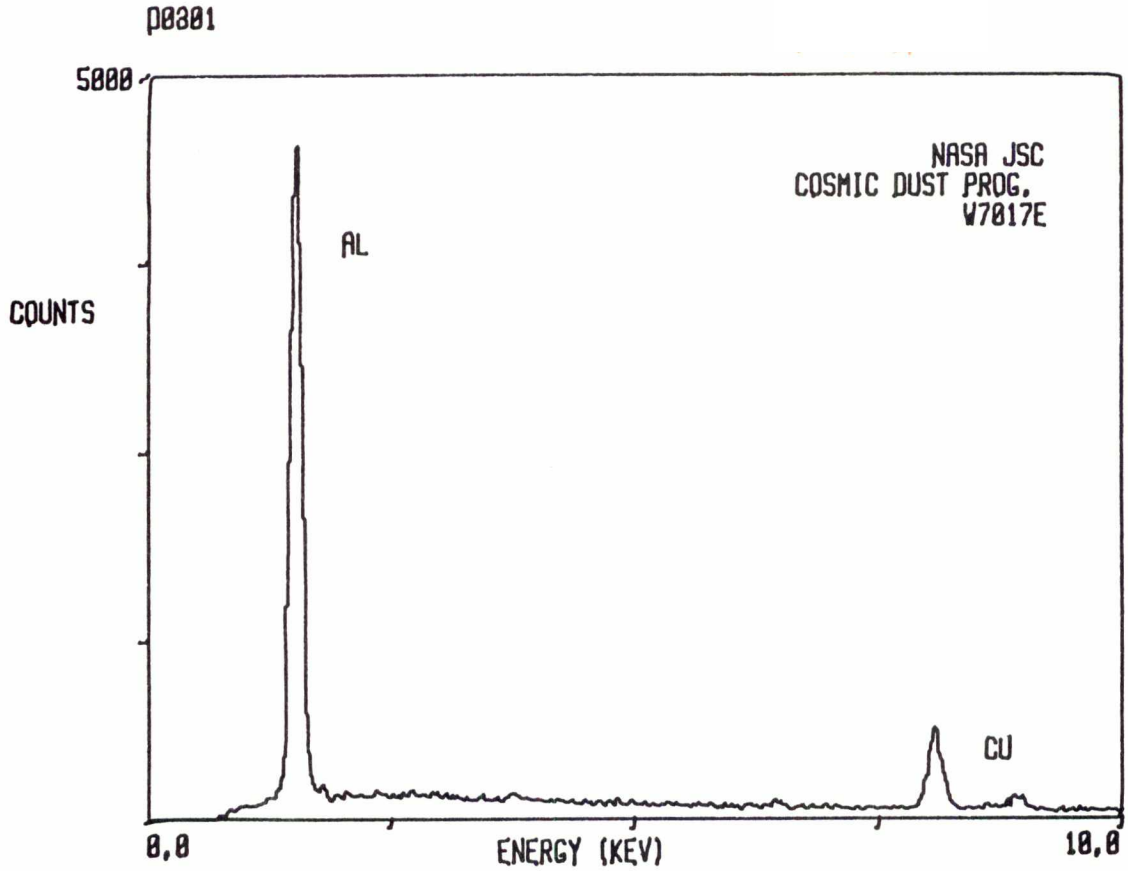


W7017E3

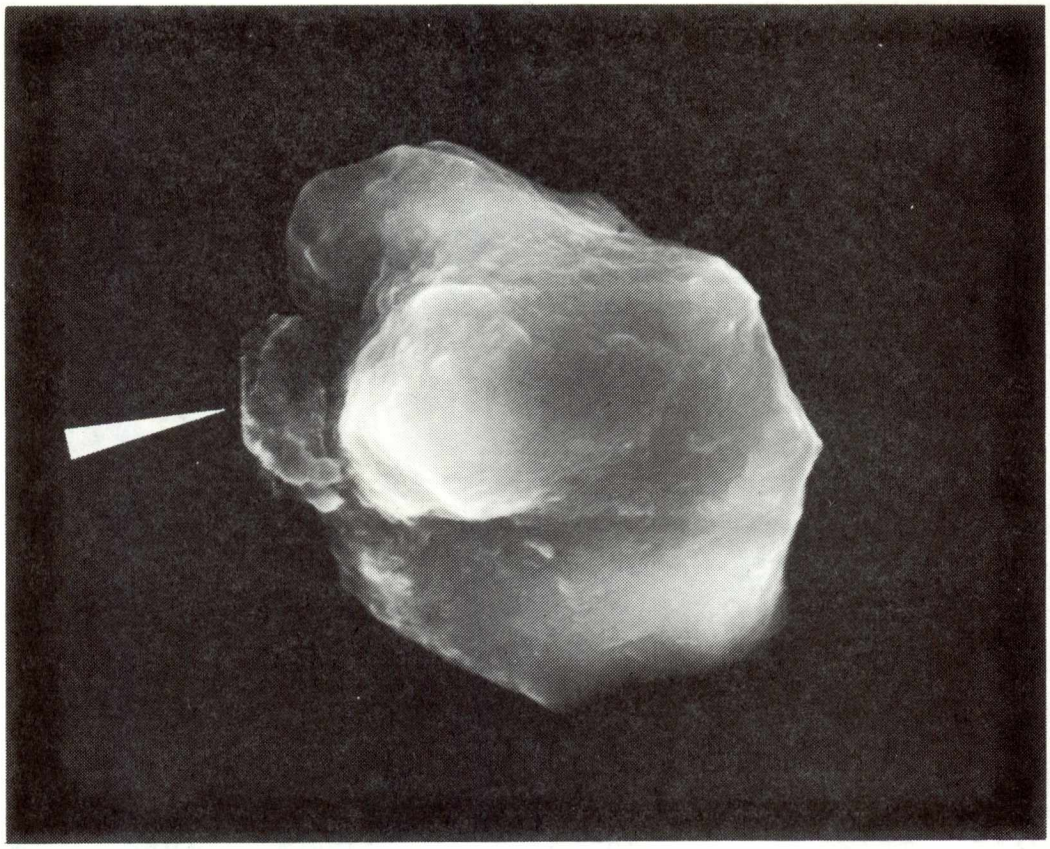


S-82-25152

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~9~~ 7	S	TL	Pale Gray	V	AOS	

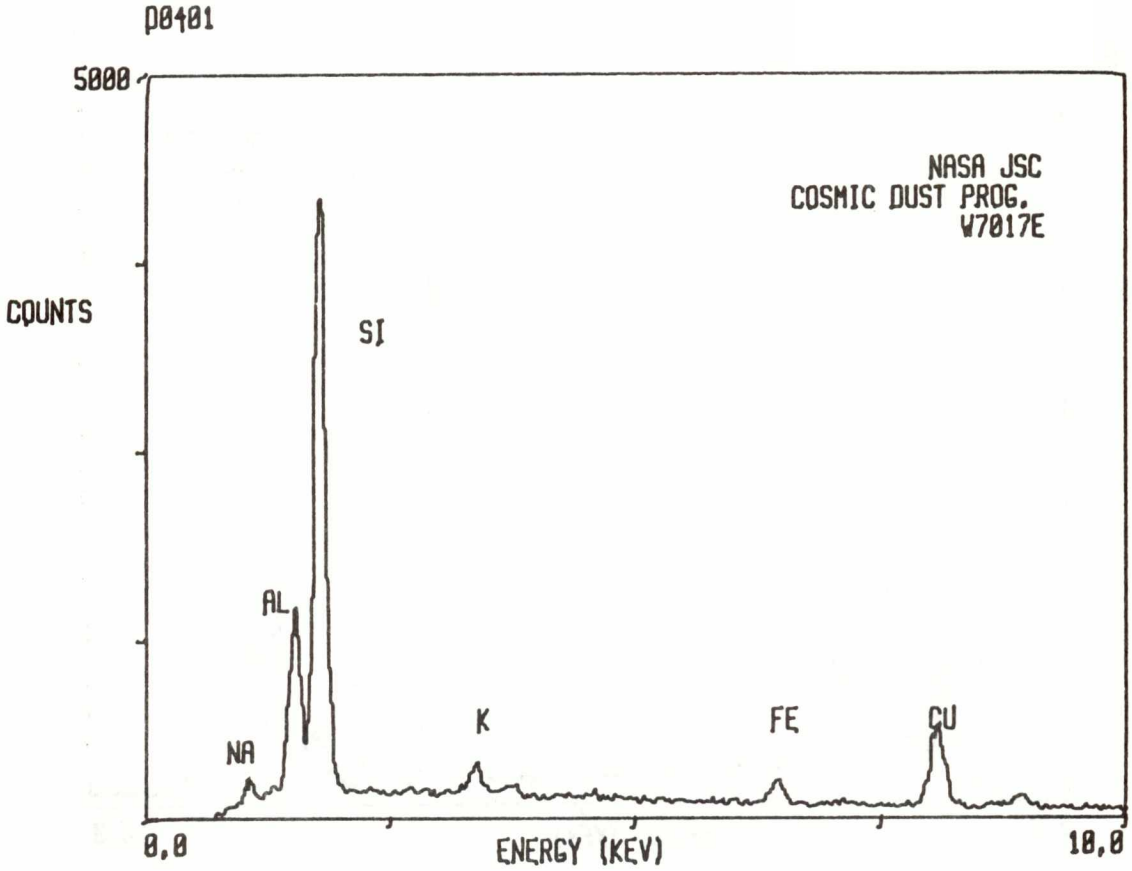


W7017E4

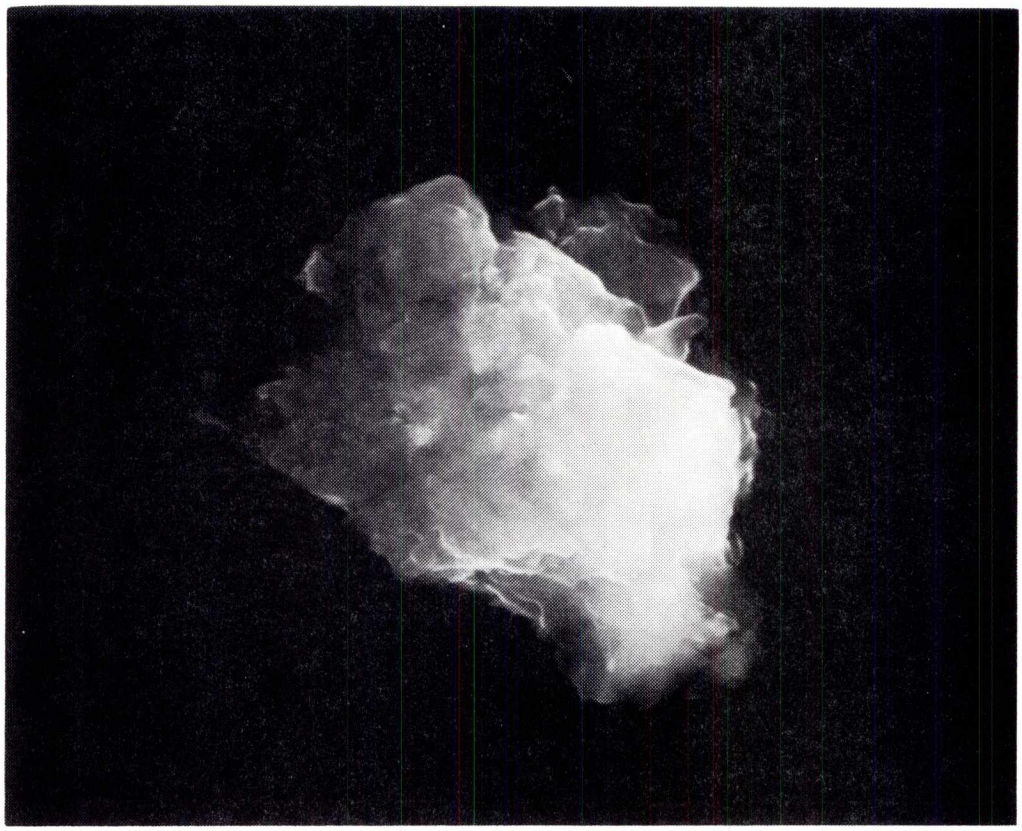


S-82-25153

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
16x~~21~~14	I	TL	Pale Yellow-Gray	SV	TCN?	Opaque grain marked with arrow

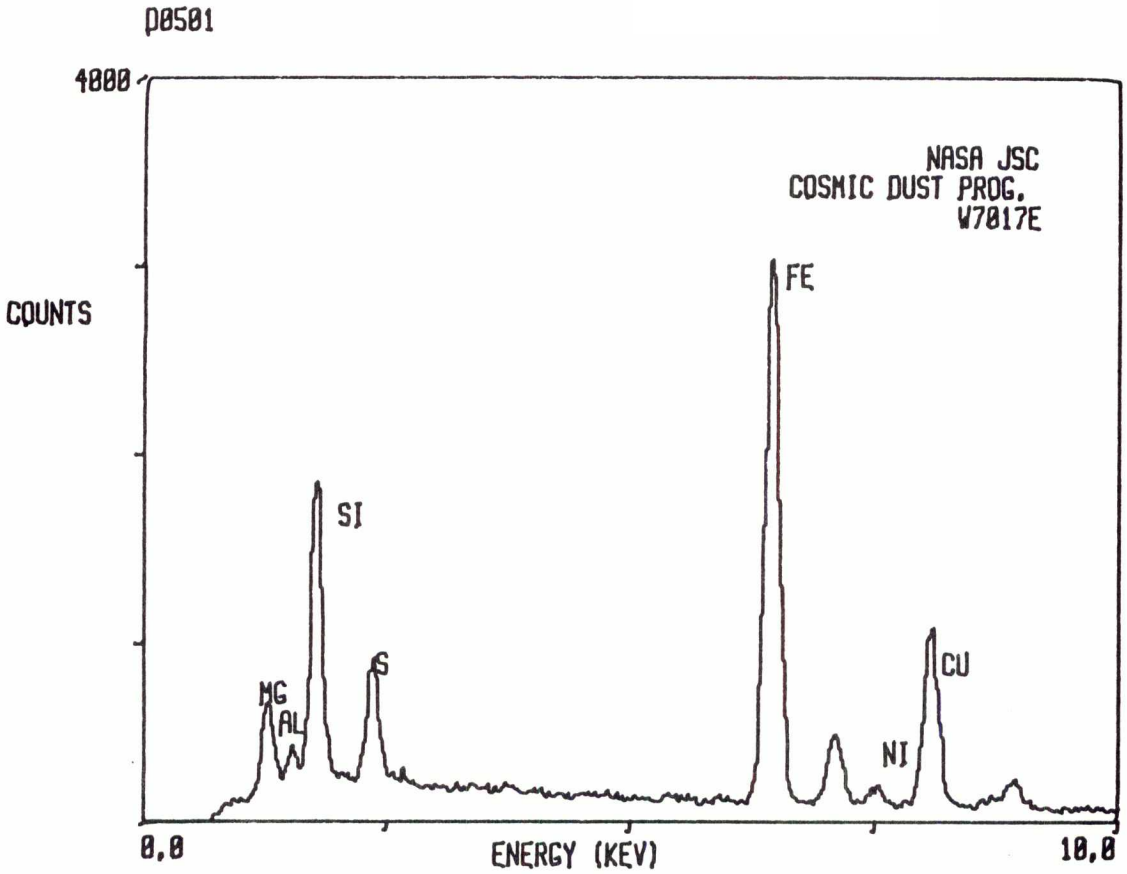


W7017E5

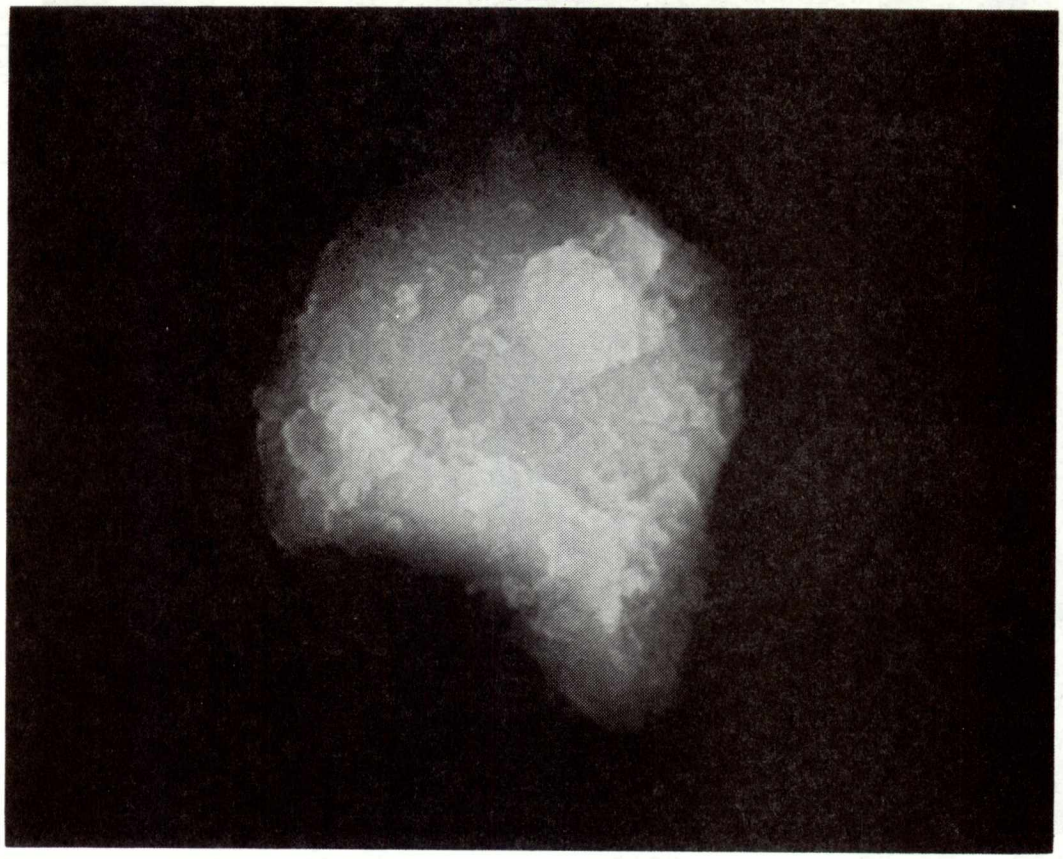


S-82-25154

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~11x15~~ 12x8	I	O	Black	SV	C?	

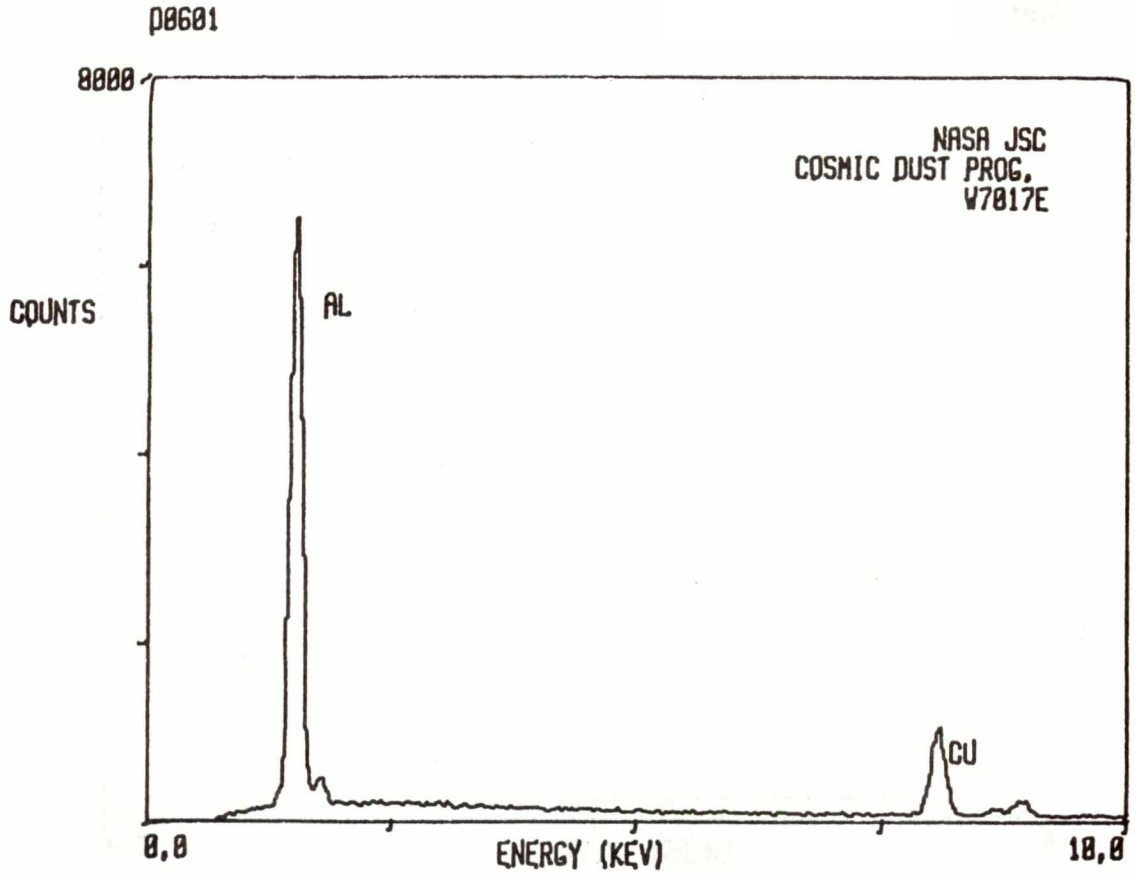


W7017E6

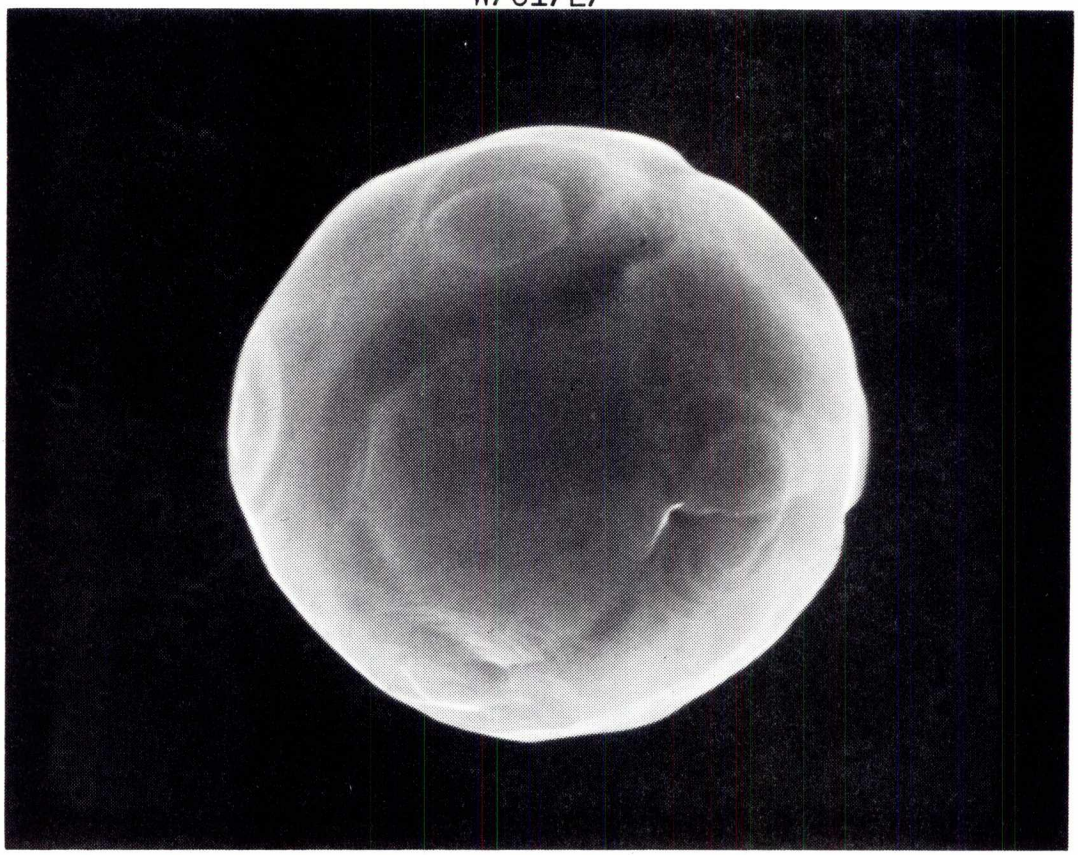


S-82-25155

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~9x11~~ 8x11	I	O	Dk. Gray	D	?	Al'?

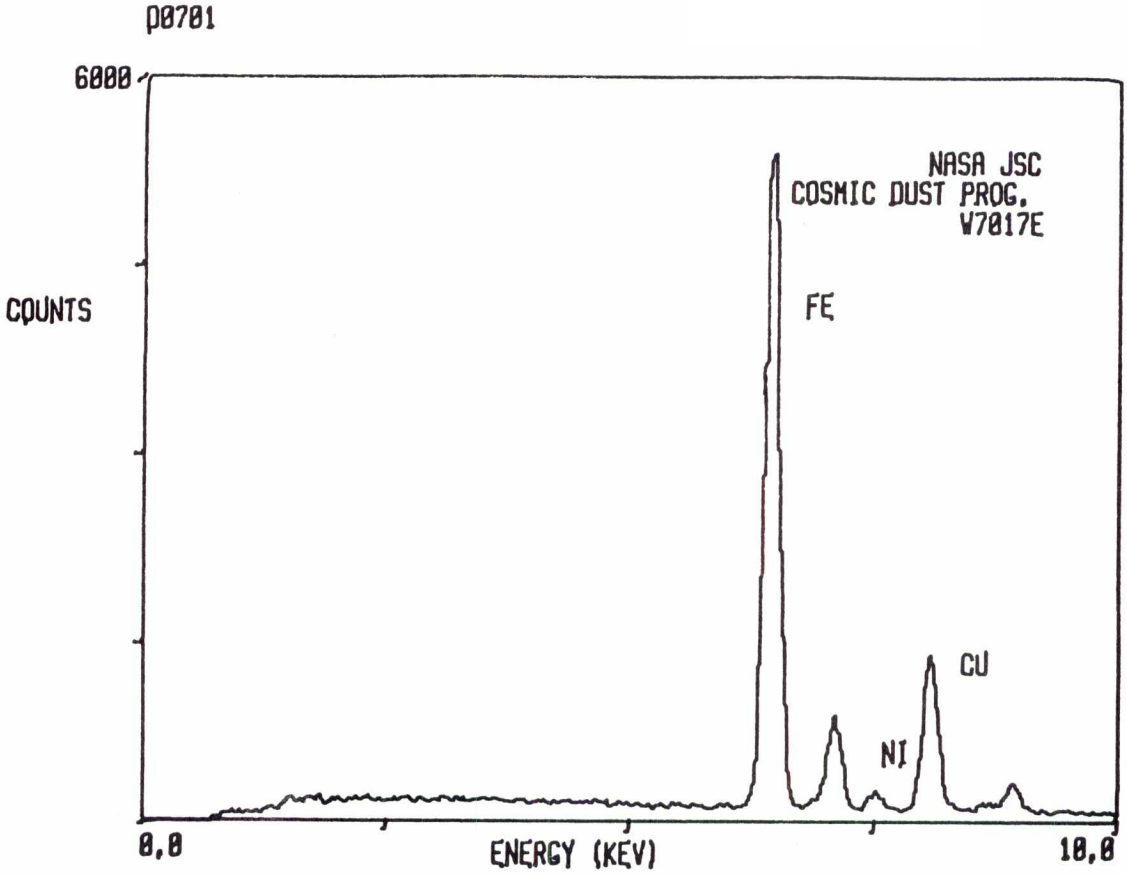


W7017E7

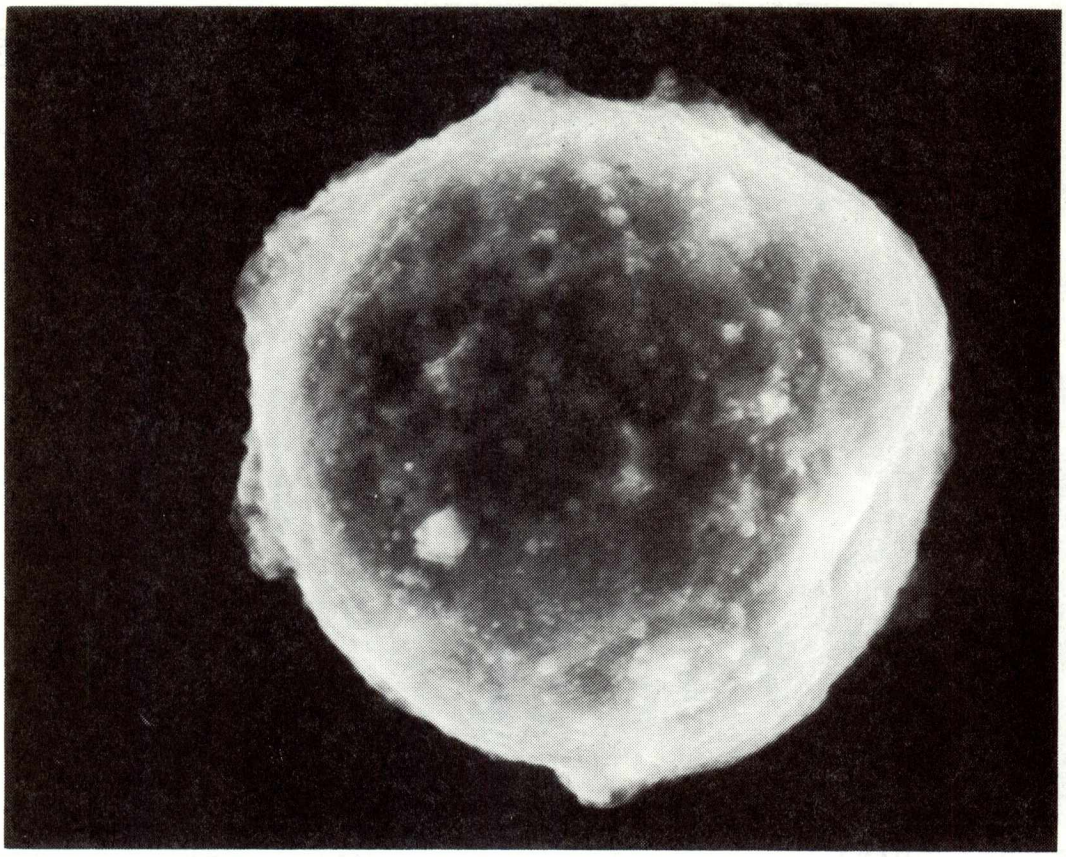


S-82-25156

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~12~~ 10	S	O	Dk. Brown/Black	SM	C?	

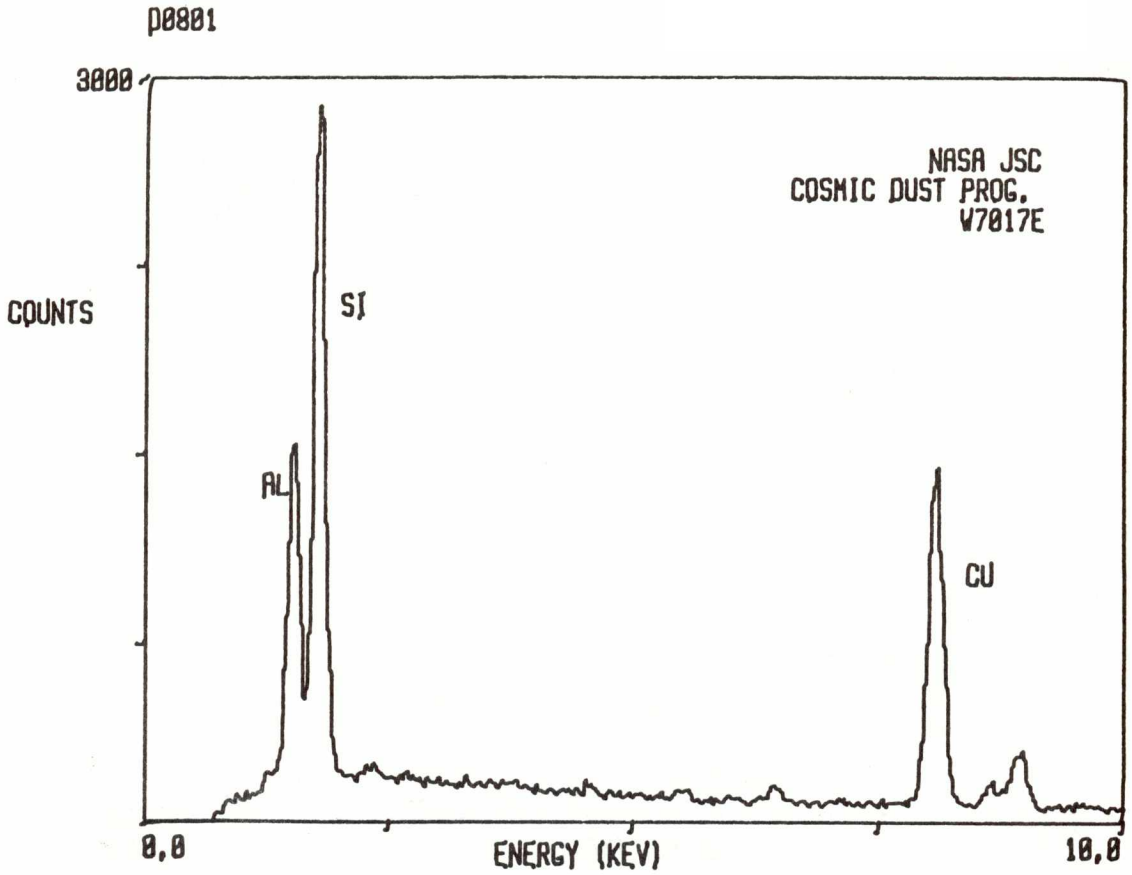


W7017E8

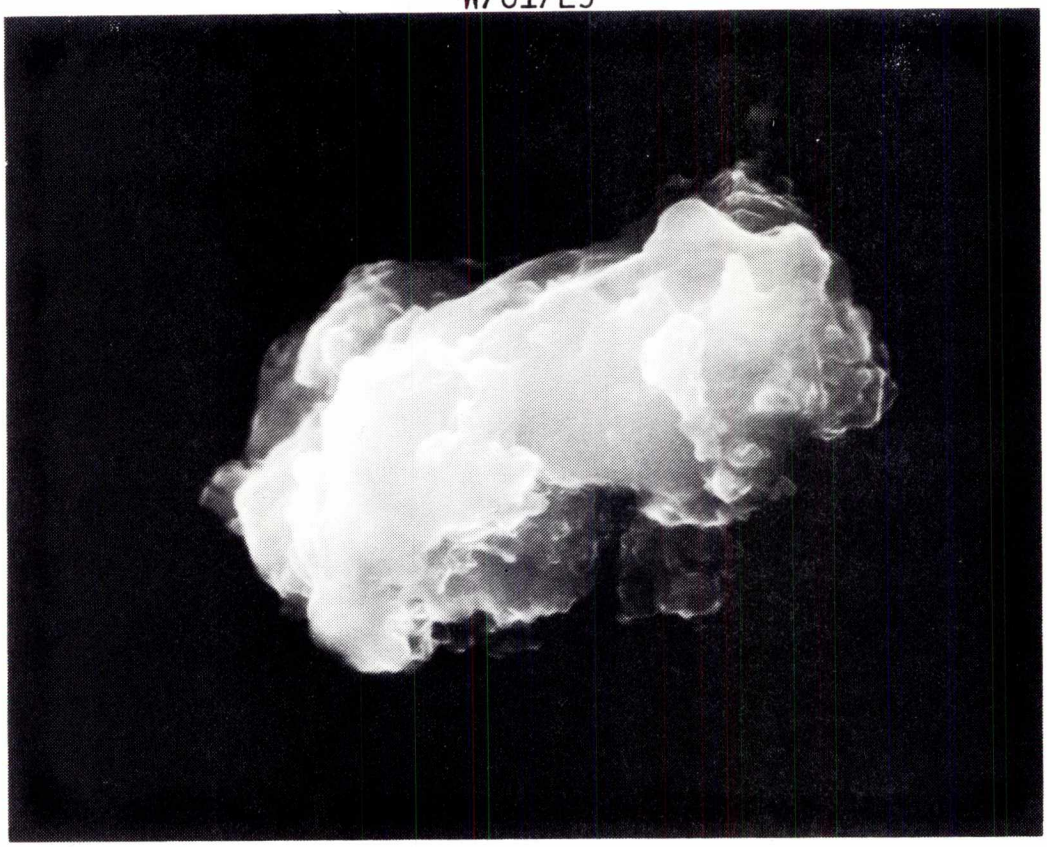


S-82-25157

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~11~~ 10	S/E	TL	Pale Gray	SV	TCN/TCA?	

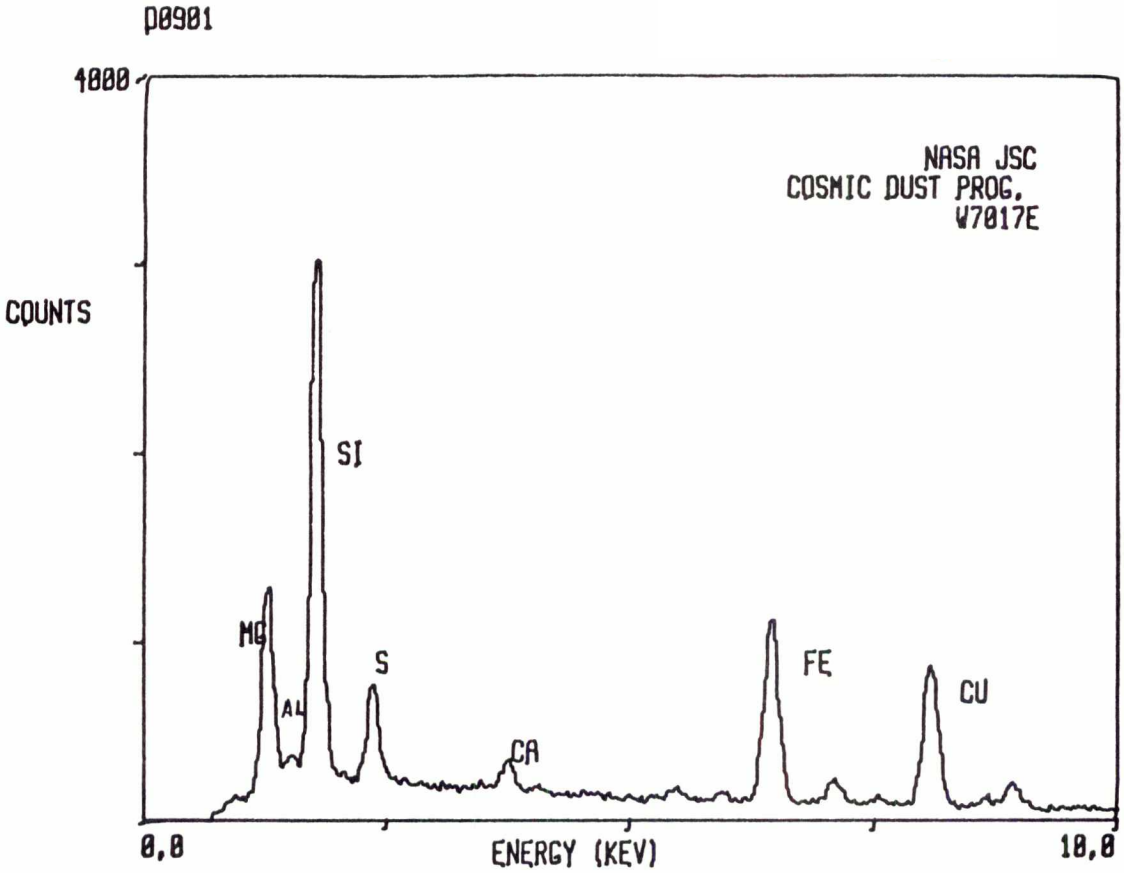


W7017E9

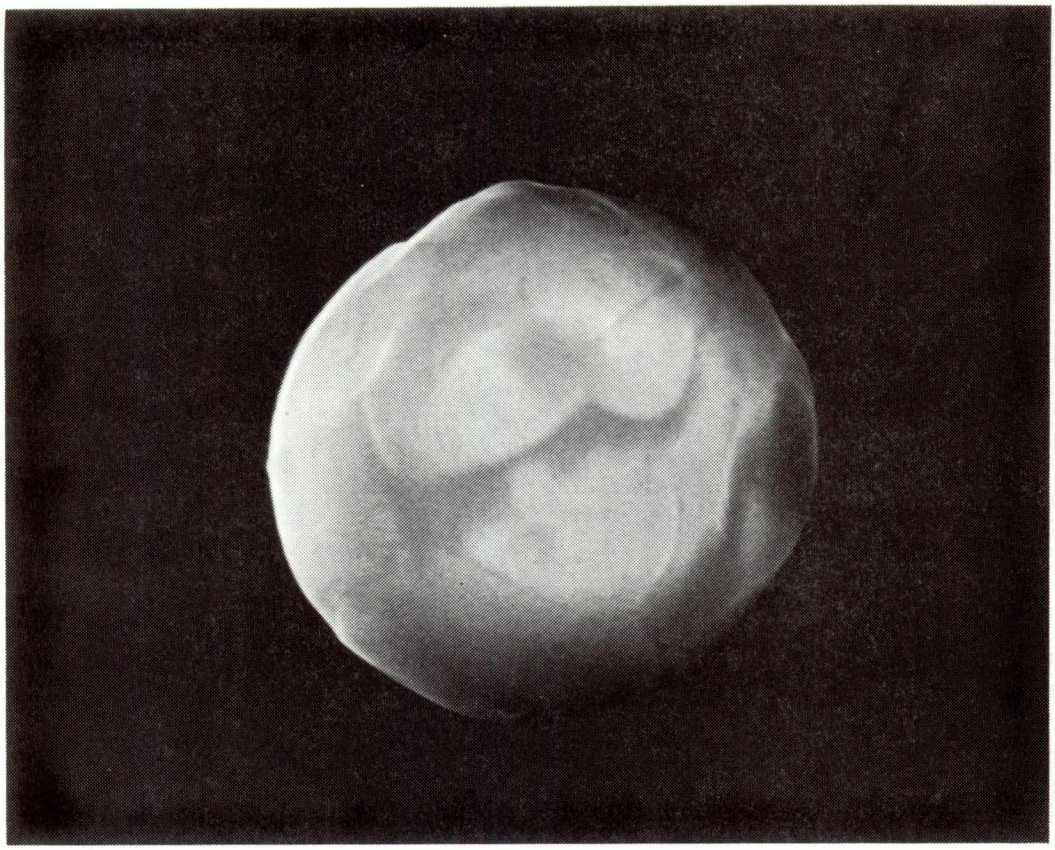


S-82-25158

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~9x13~~ 5x11	I	O	Black	SM	C?	

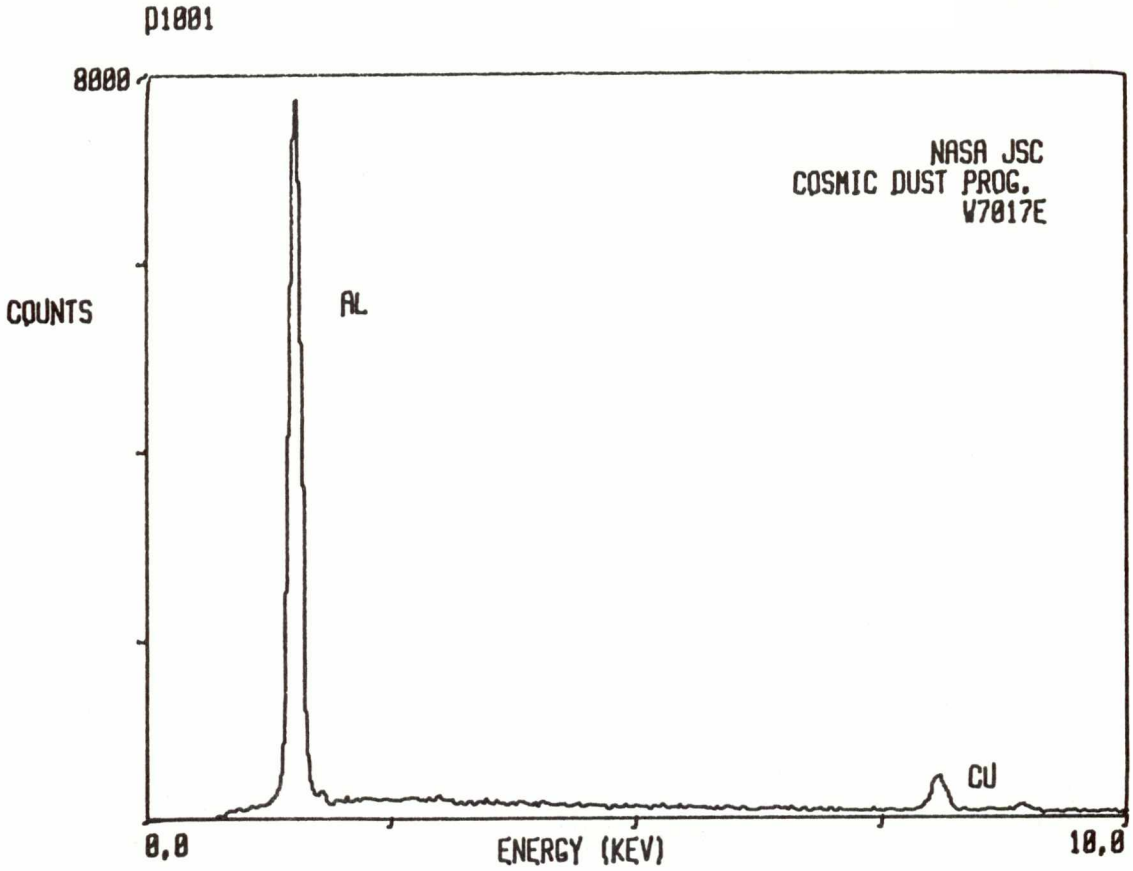


W7017E10

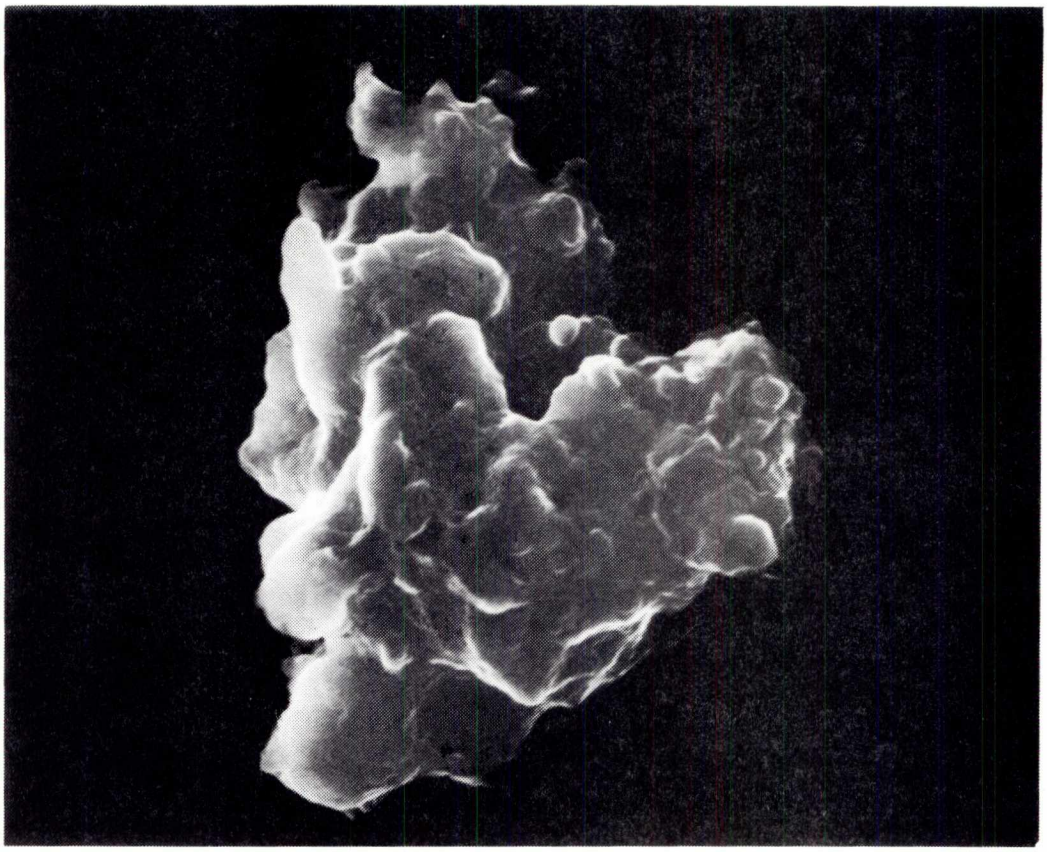


S-82-25159

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
8	S	T	Pale Gray-Brown	V	AOS	

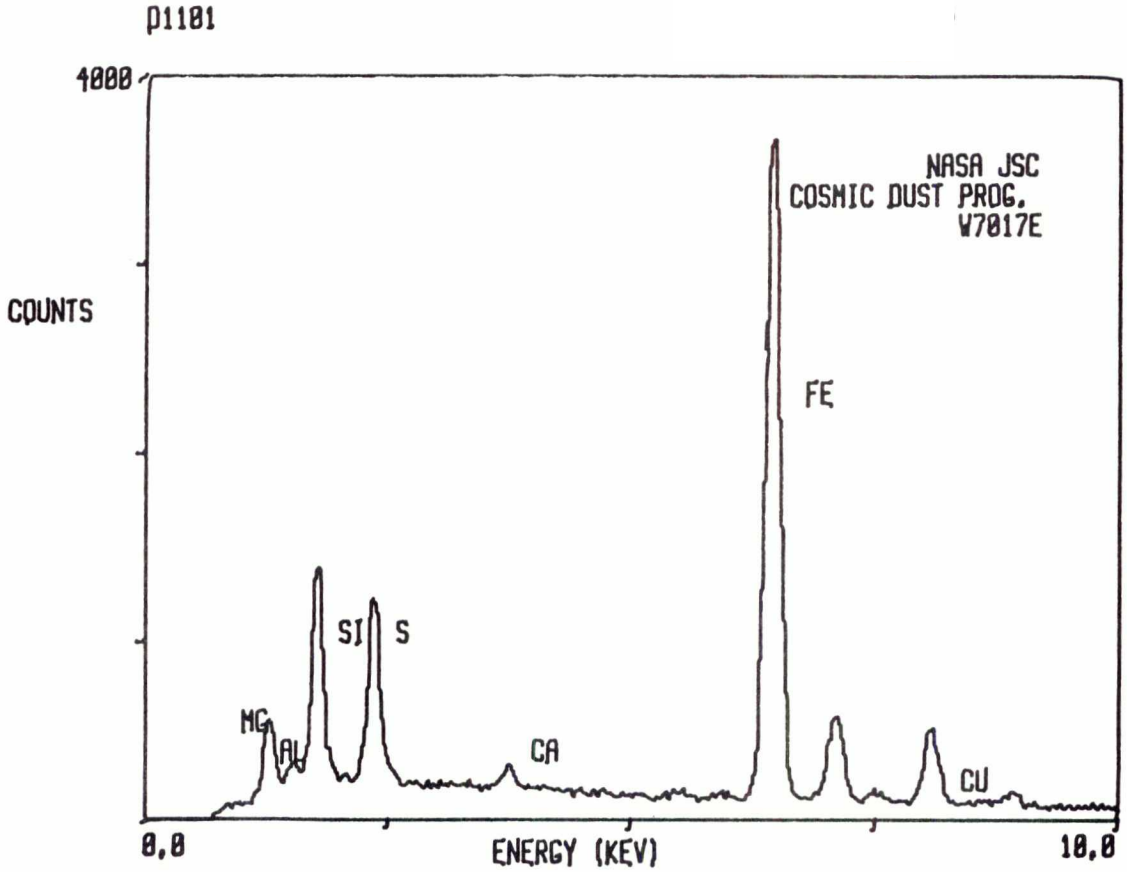


W7017E11

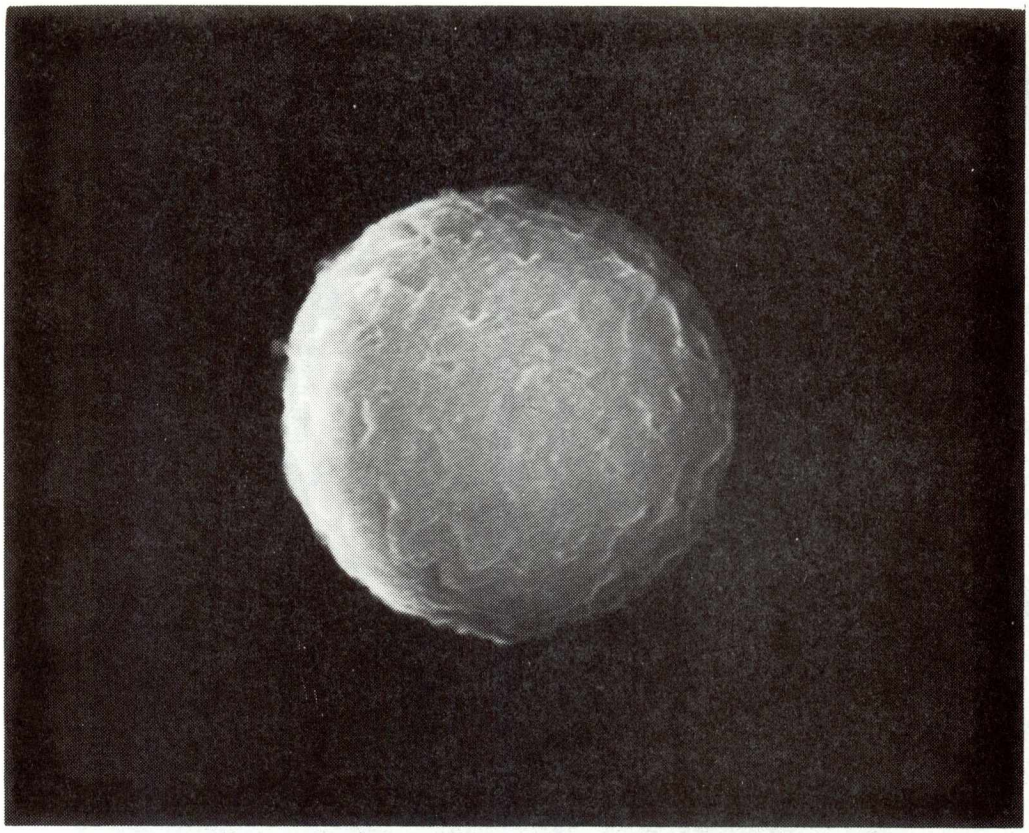


S-82-25160

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
14x~~18~~ 12	I	O	Black	SM	C?	

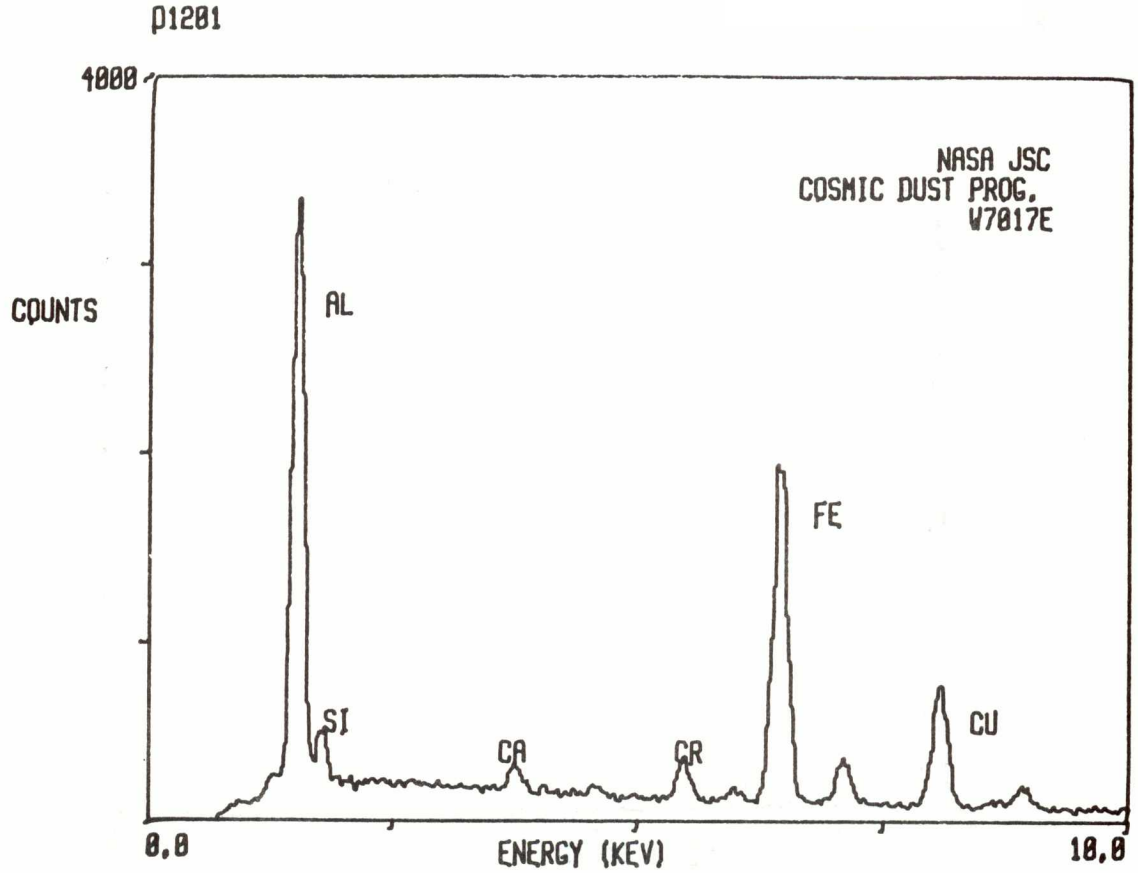


W7017E12



S-82-25161

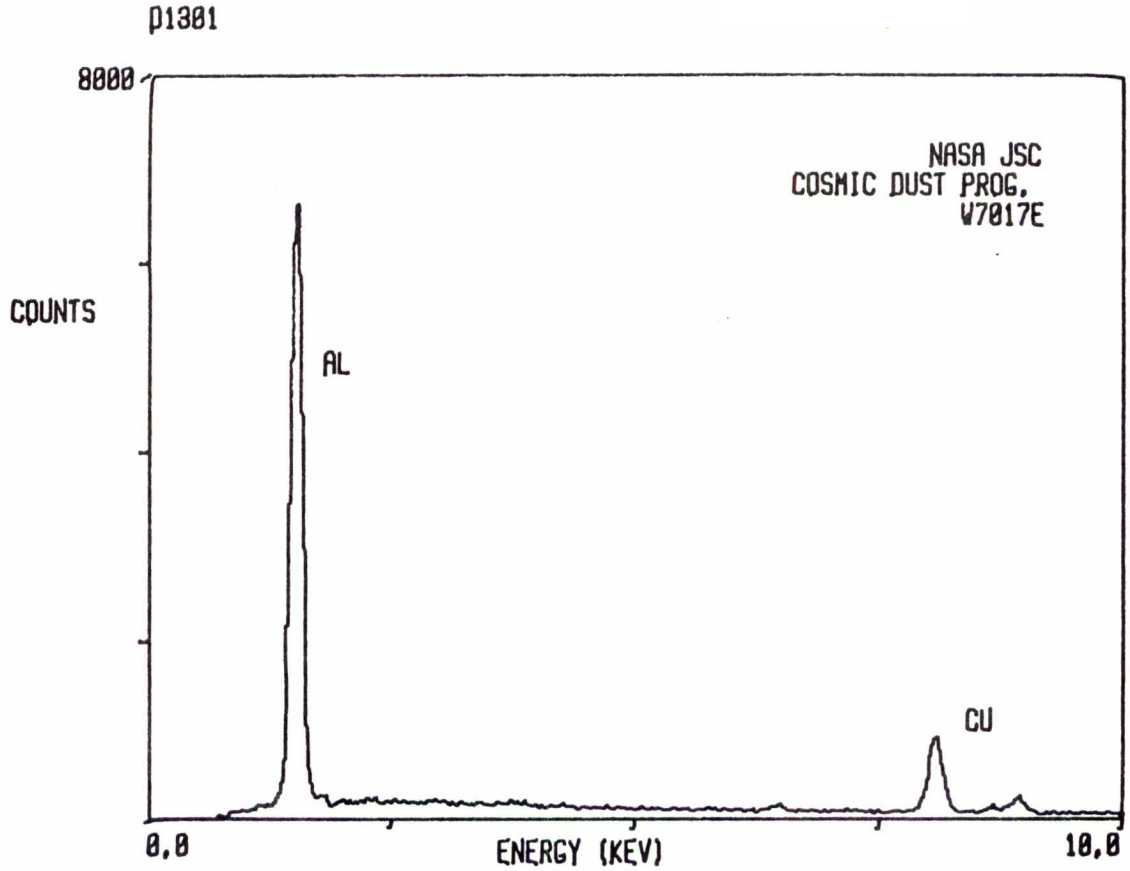
SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7~~ 6	S	TL	Gray-Brown	SV	TCA/TCN?	Al'?



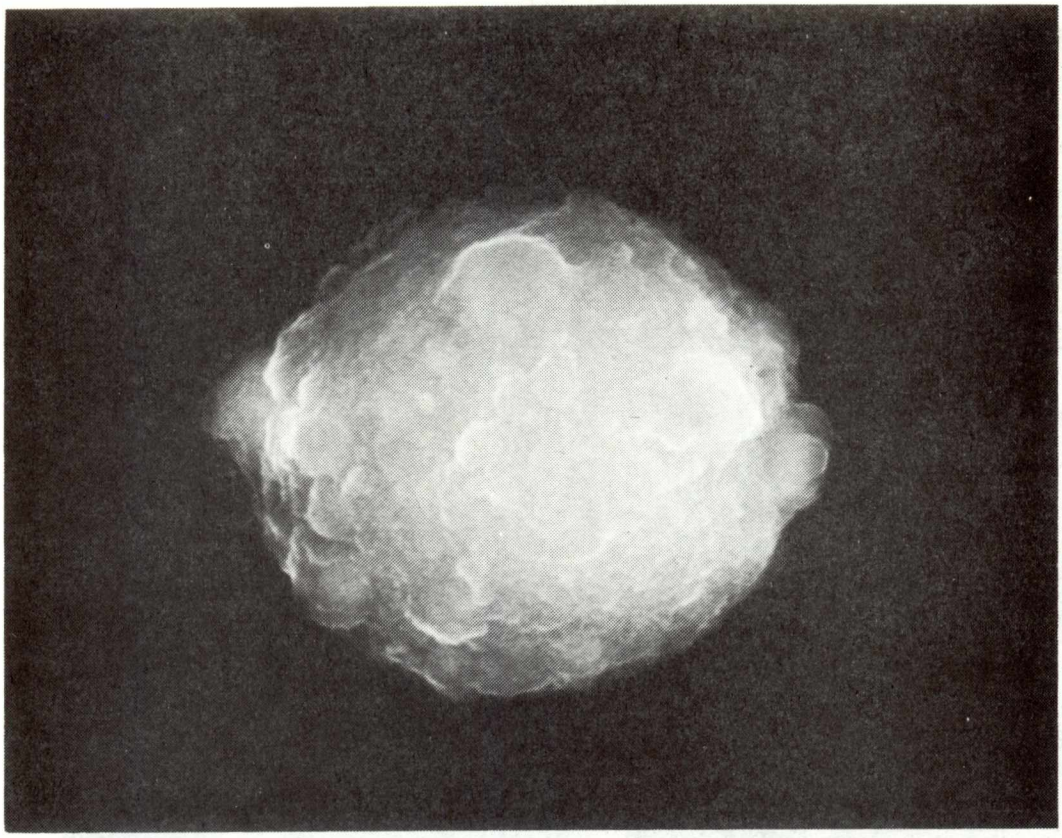
W7017E13

S-82-25162

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~10~~ 9-8	S	TL	Pale Gray	SV	AOS	

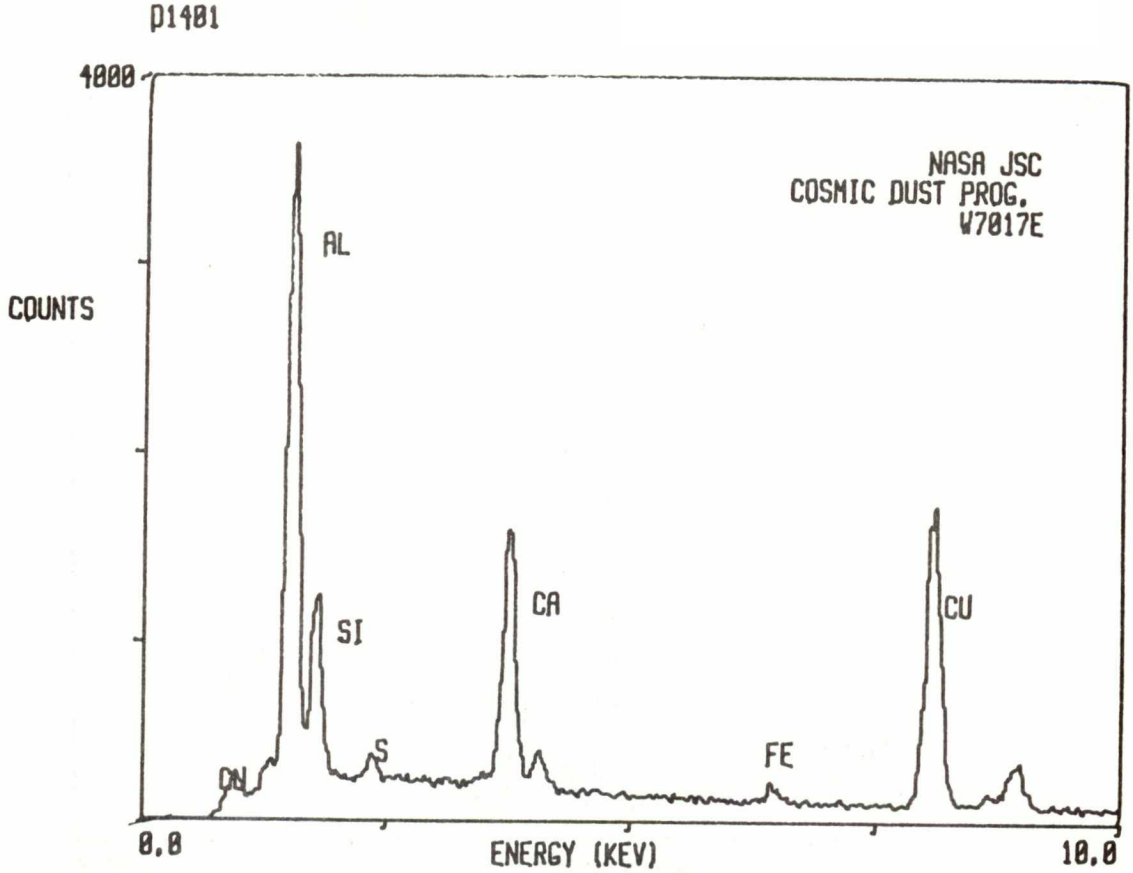


W7017E14

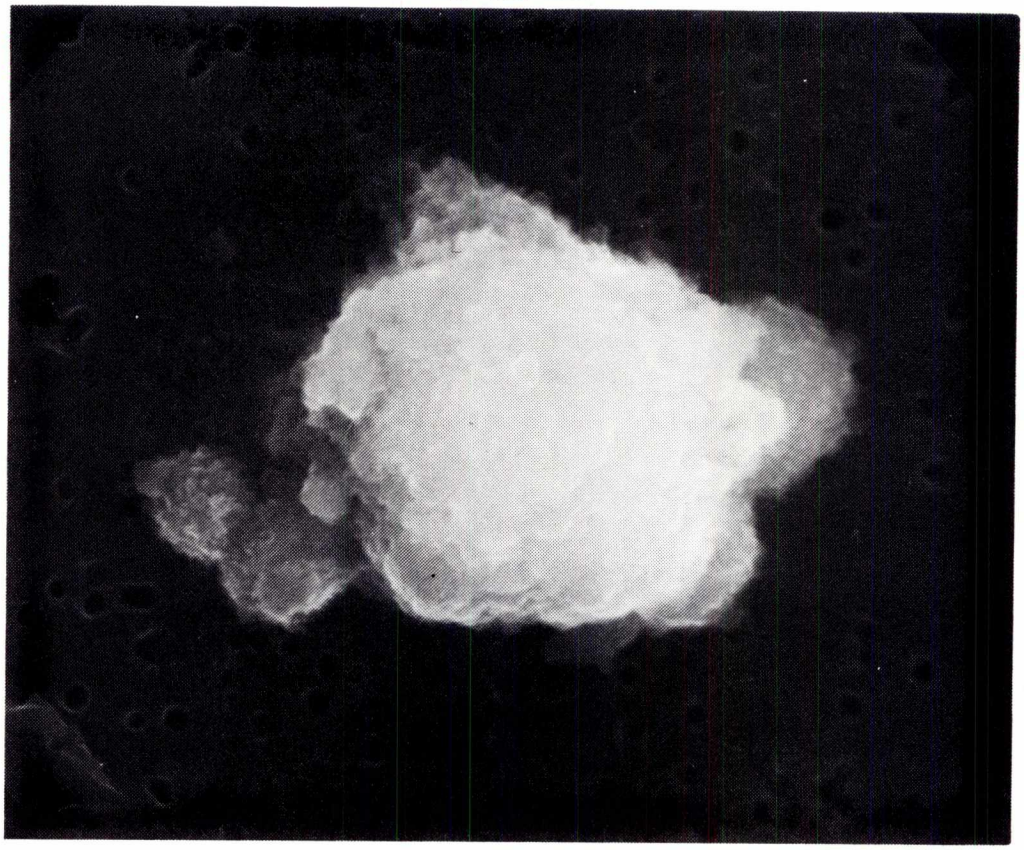


S-82-25163

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
8x97	E/S	TL/O	Dk. Brown	SV	?	

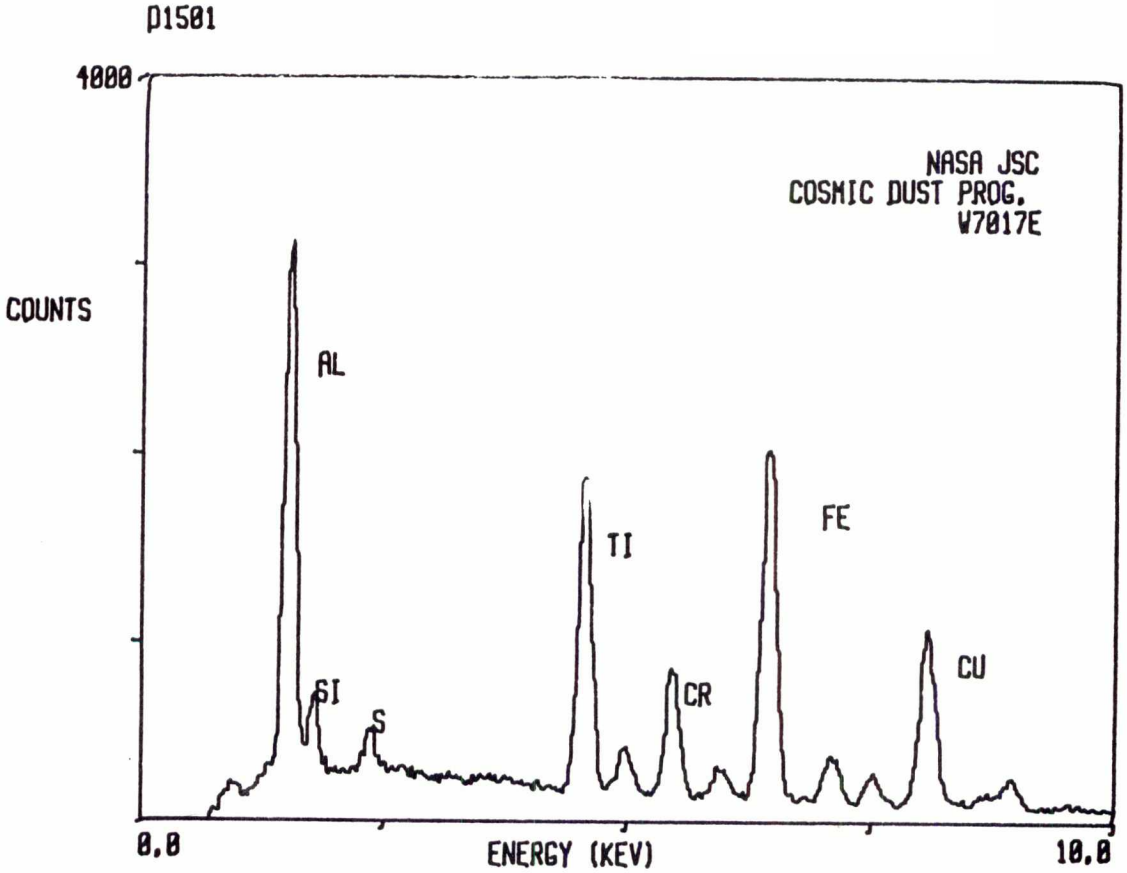


W7017E15

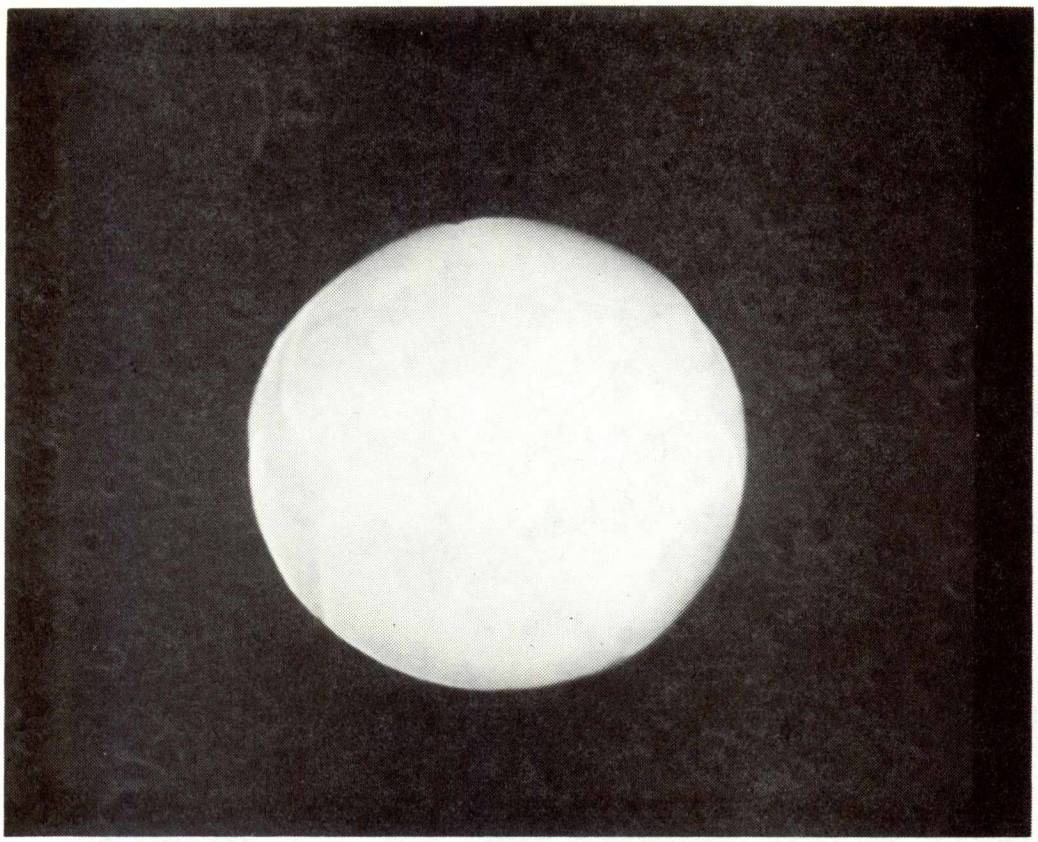


S-82-25164

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6x9~~ 6x5	I	O	Black	SV	TCA?	

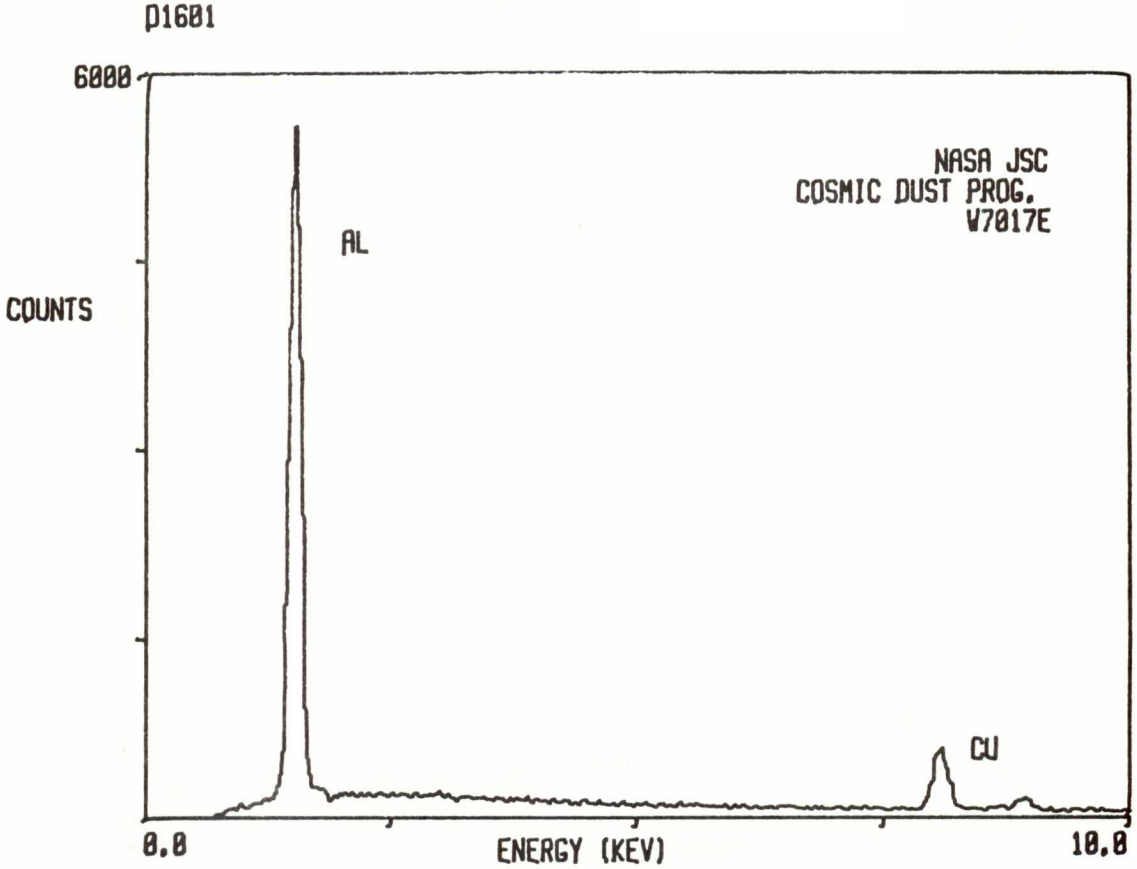


W7017E16

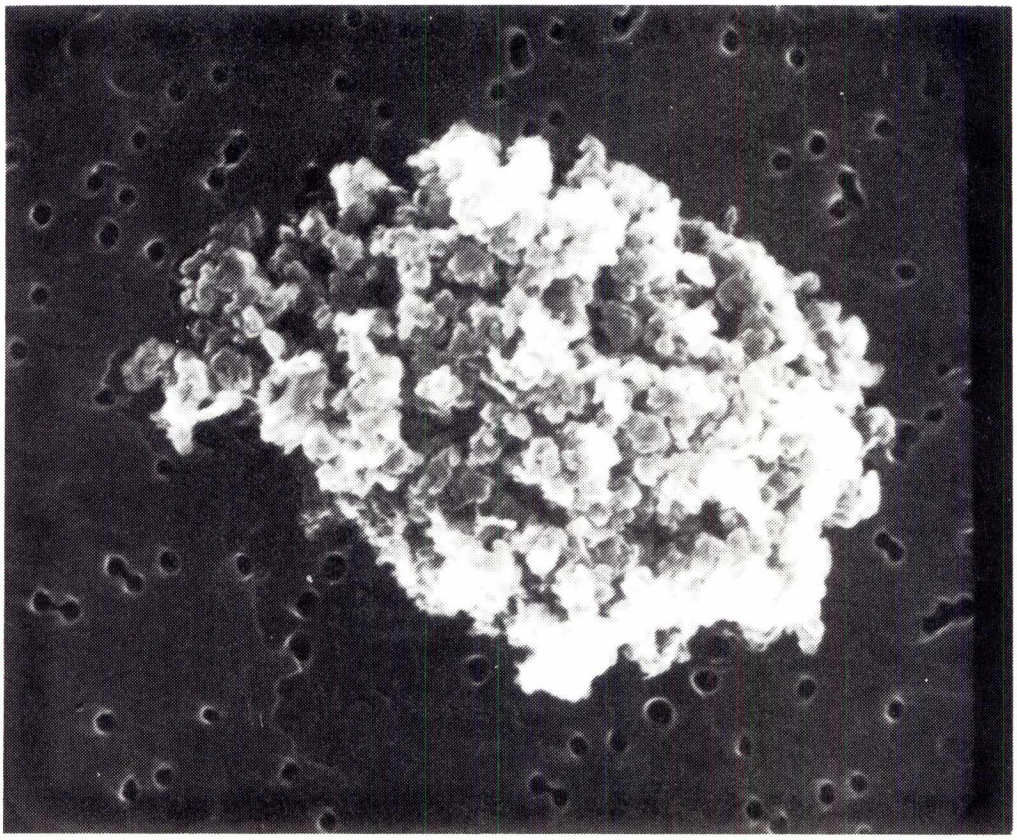


S-82-25165

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
87	S	T	Pale Yellow	V	AOS	

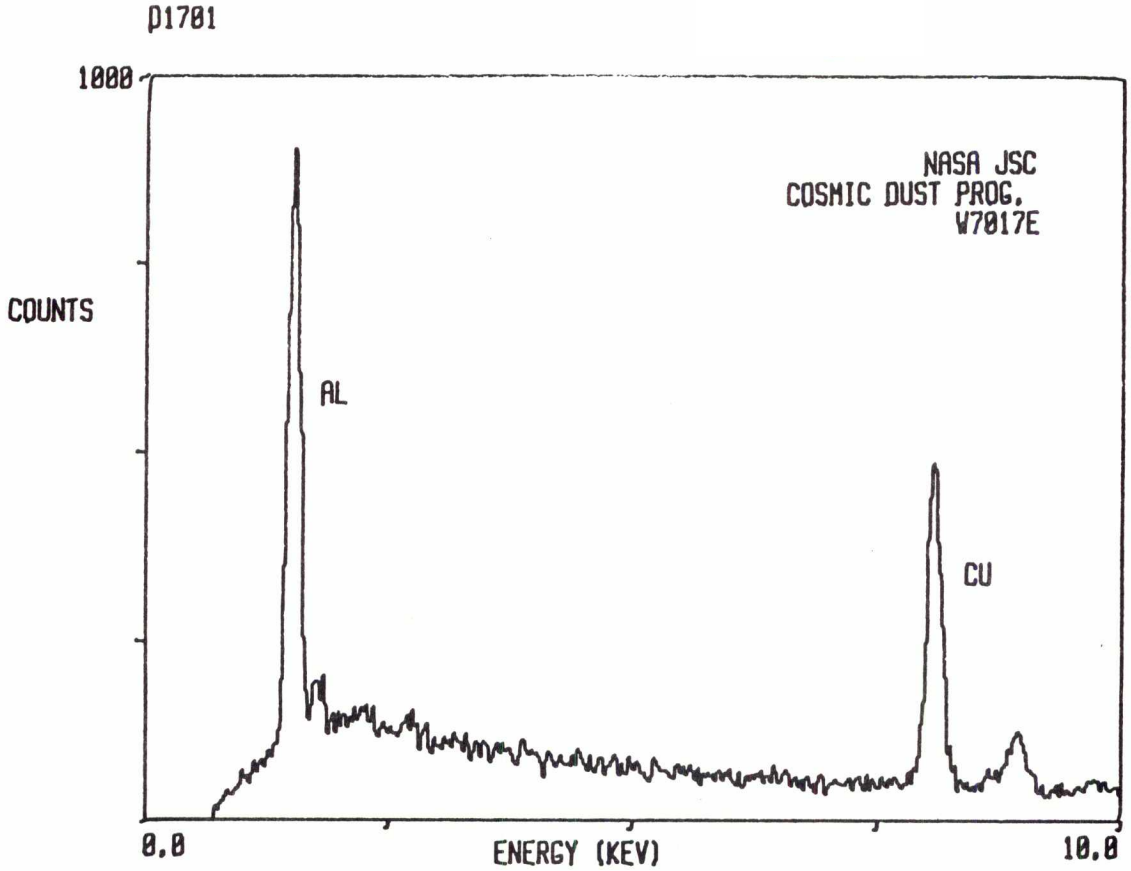


W7017E17

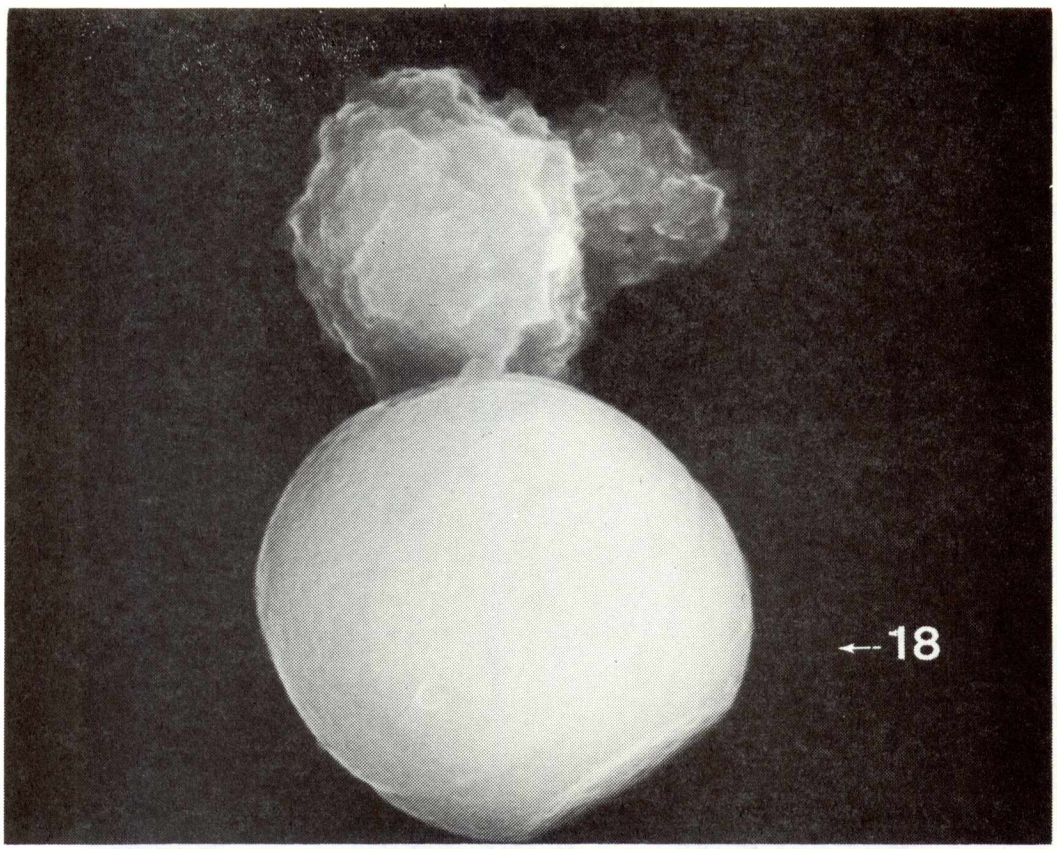


S-82-25166

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6x9~~ 5x8	I	O	Black	SV	TCA?	Al x-ray emission may be artifact from Al grid on SEM mount

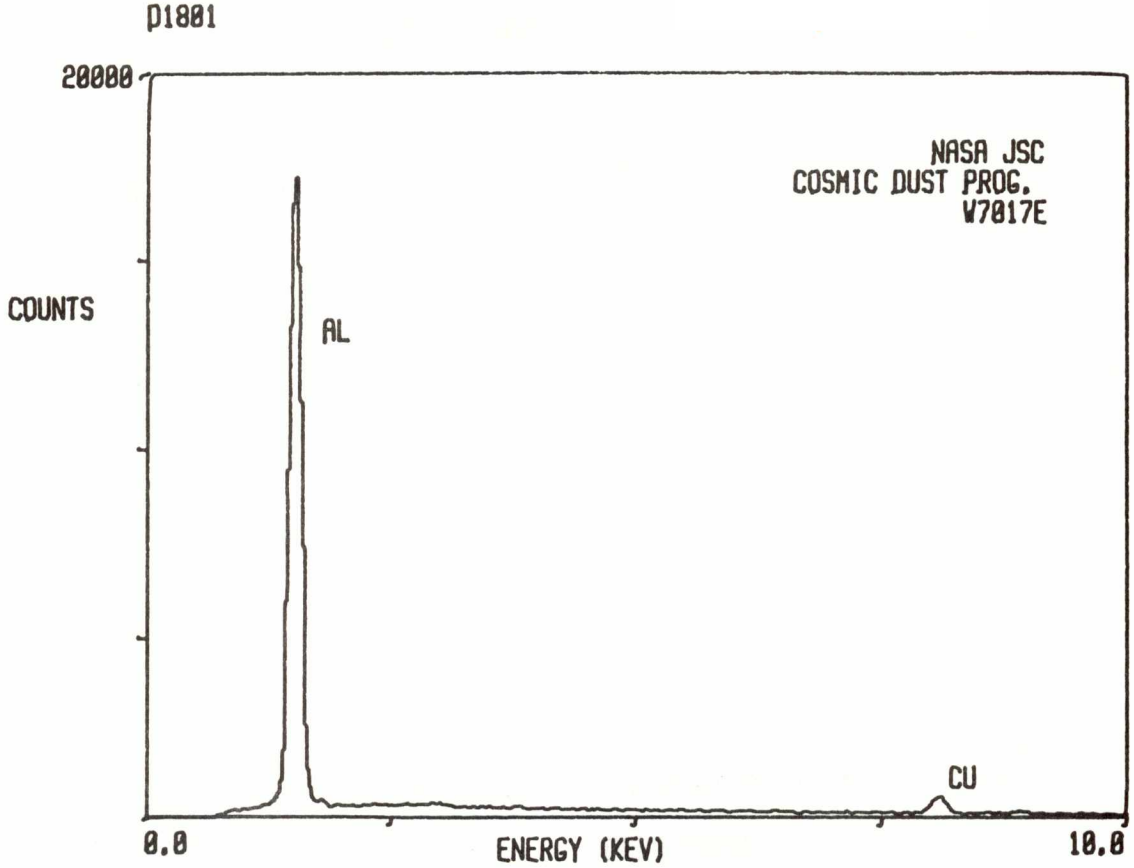


W7017E18

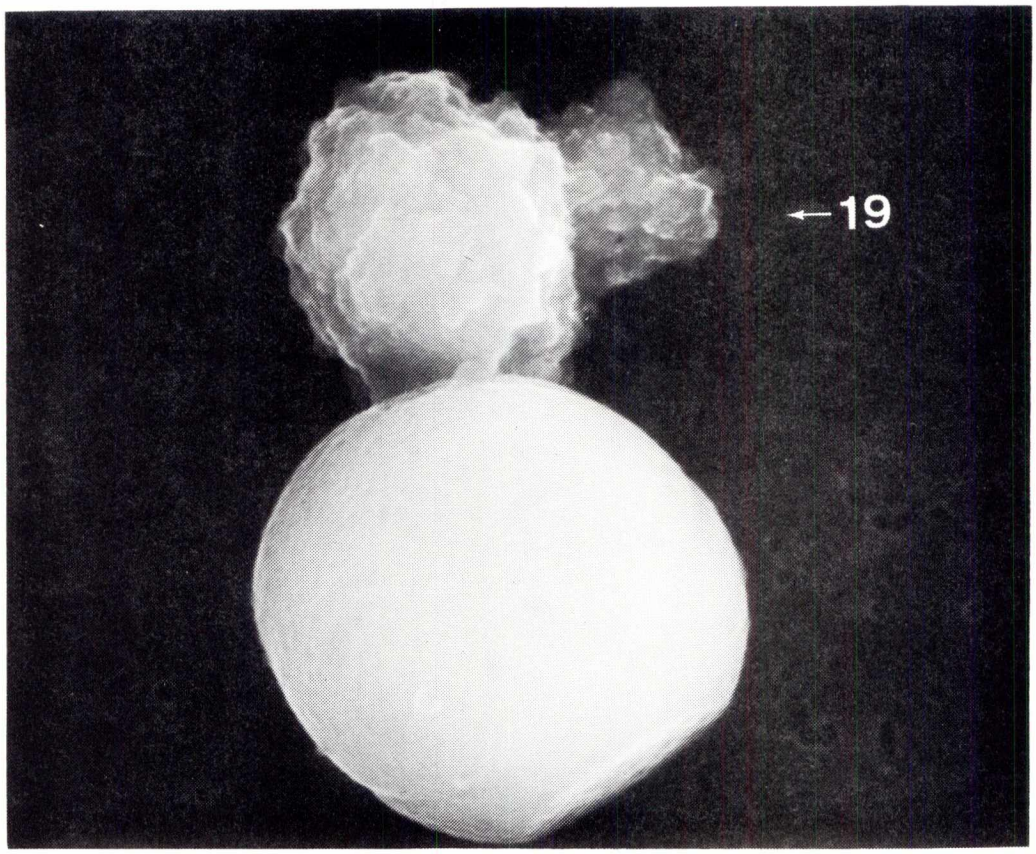


S-82-25167

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~8~~7	S	T	CL	V	AOS?	Attached to W7017E19

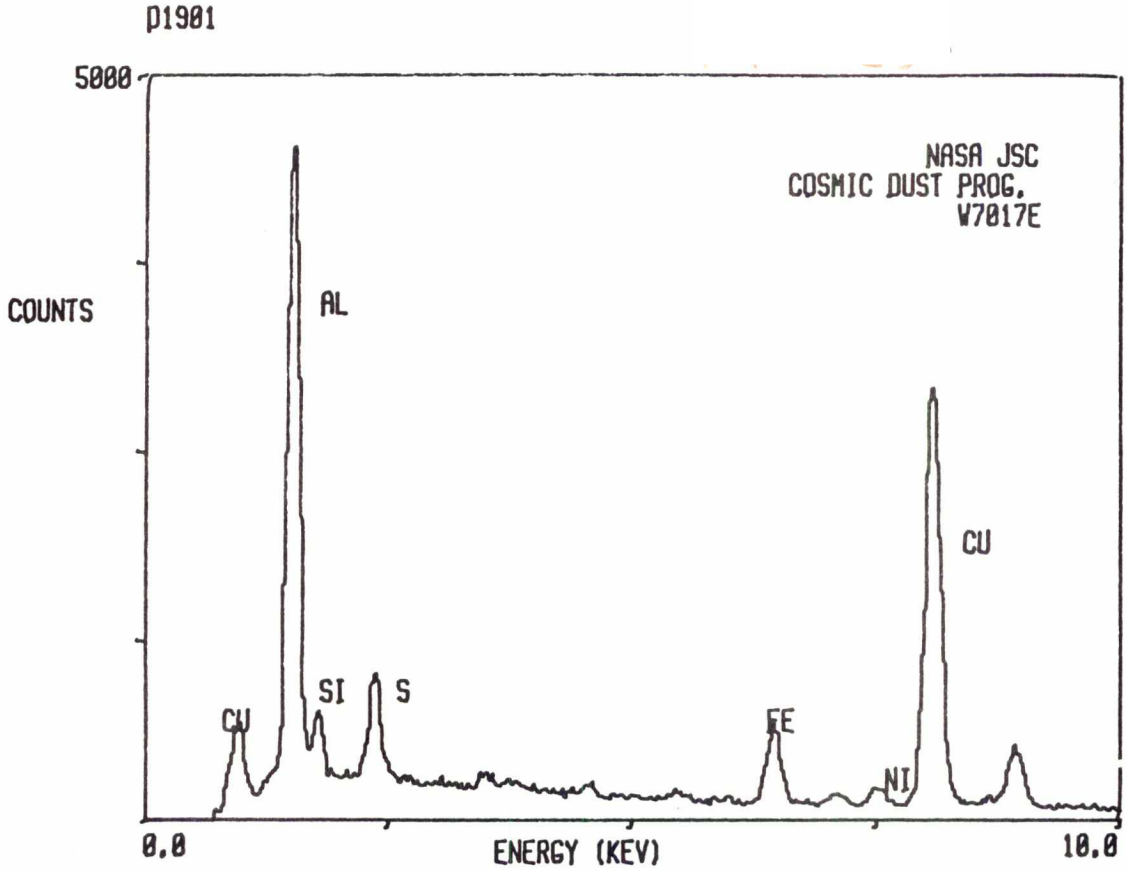


W7017E19



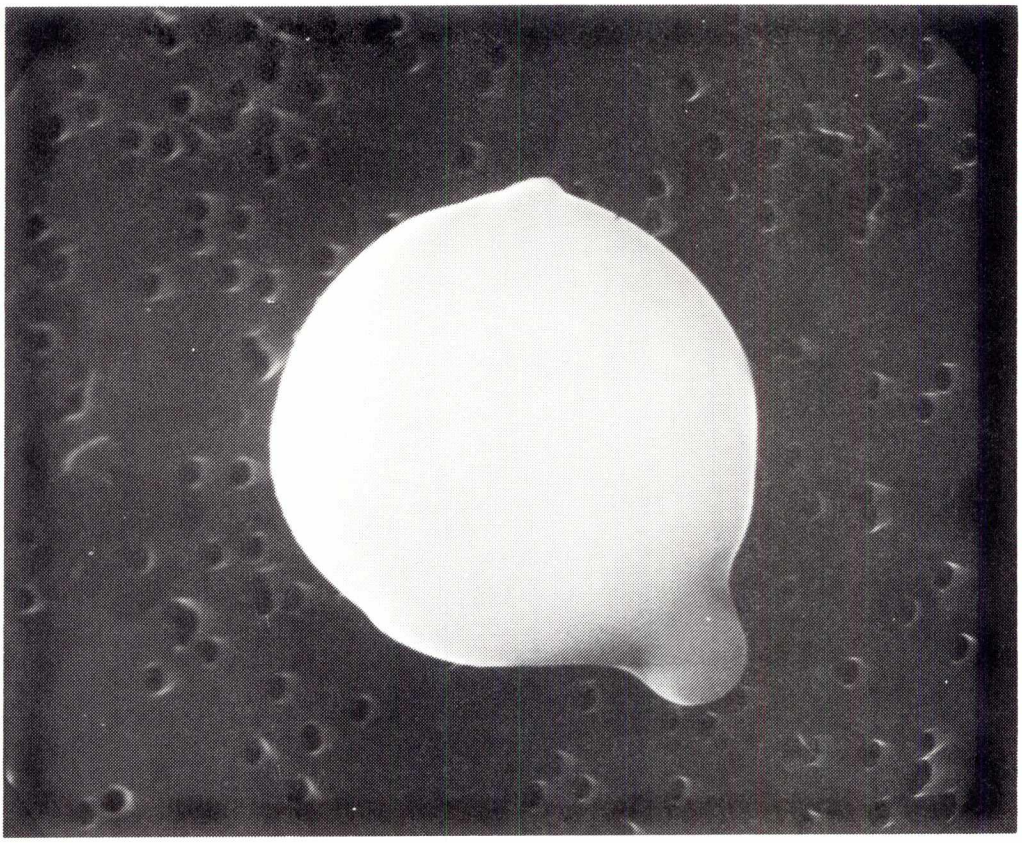
S-82-25167

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~5x7~~ 6x4	I	O	Black	SV	?	Attached to W7017E18; Al'?



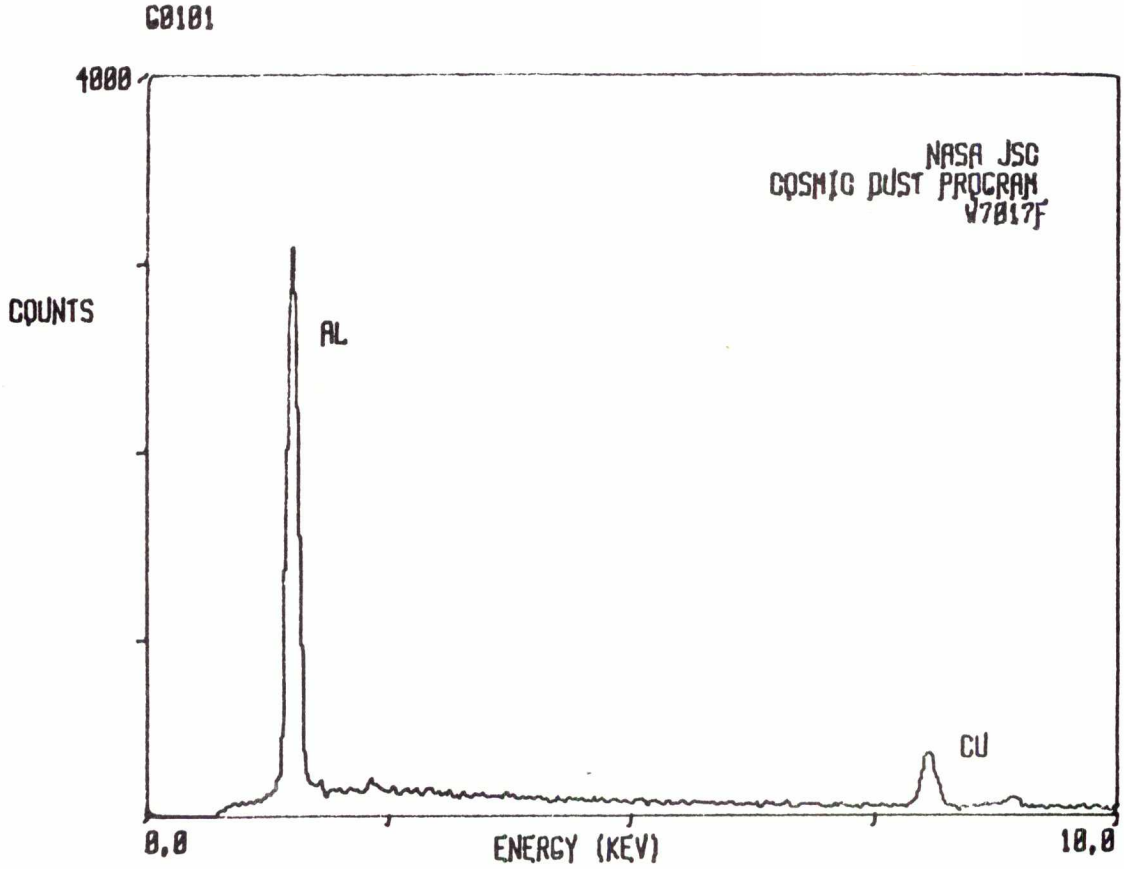
MOUNT W7017F

W7017F1

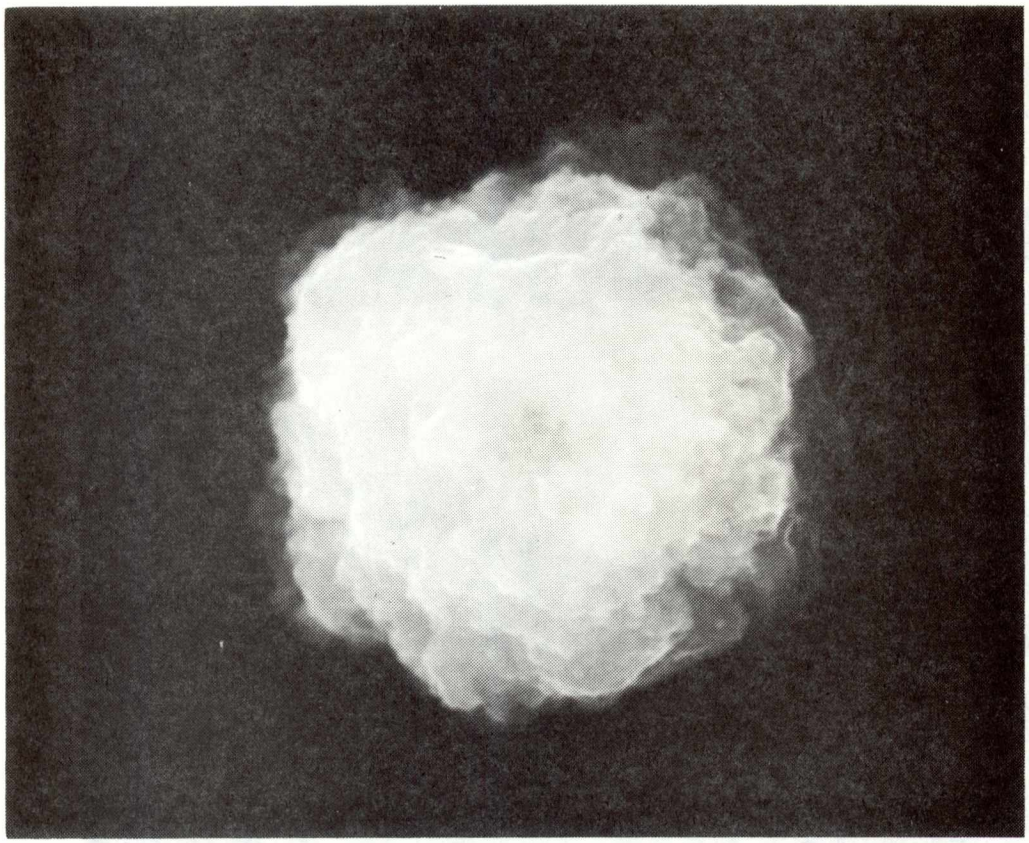


S-82-25731

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
65	S	T	CL/Pale Yellow	SV	AOS	Compound sphere

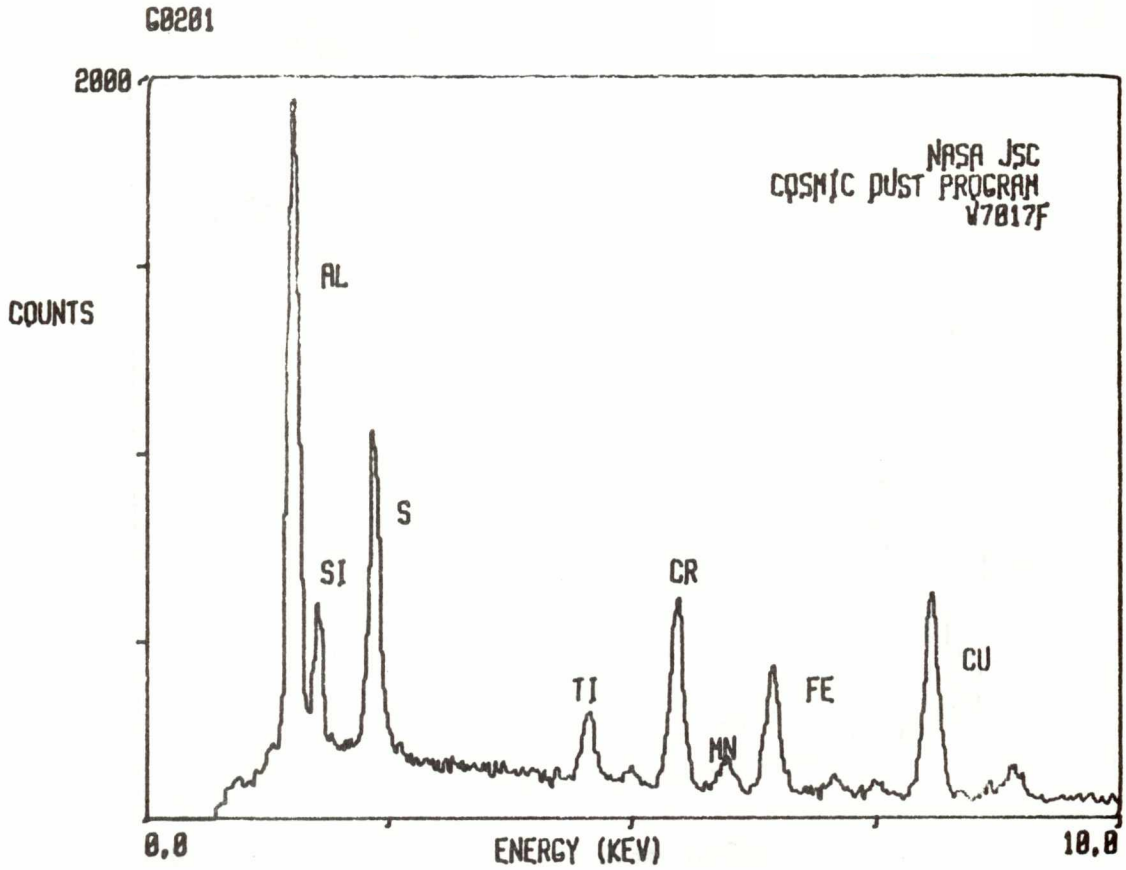


W7017F2

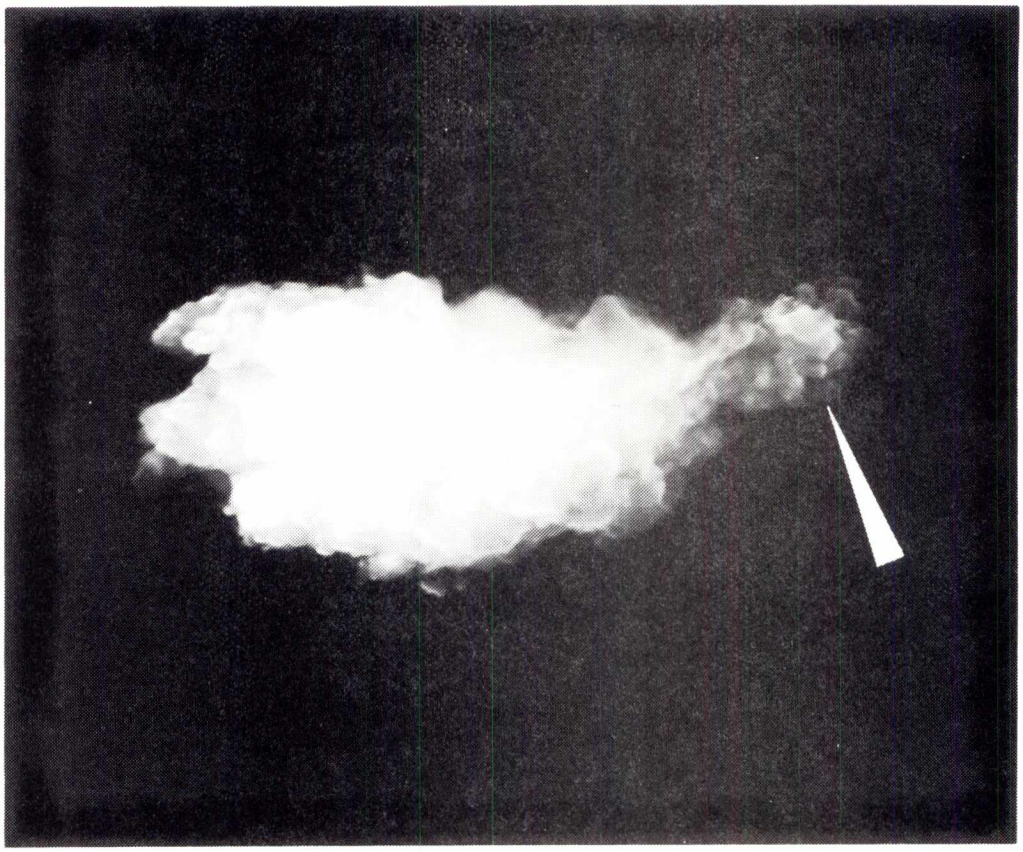


S-82-25732

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6~~ 5	E	TL	Very Dk. Gray	SV	TCA?	

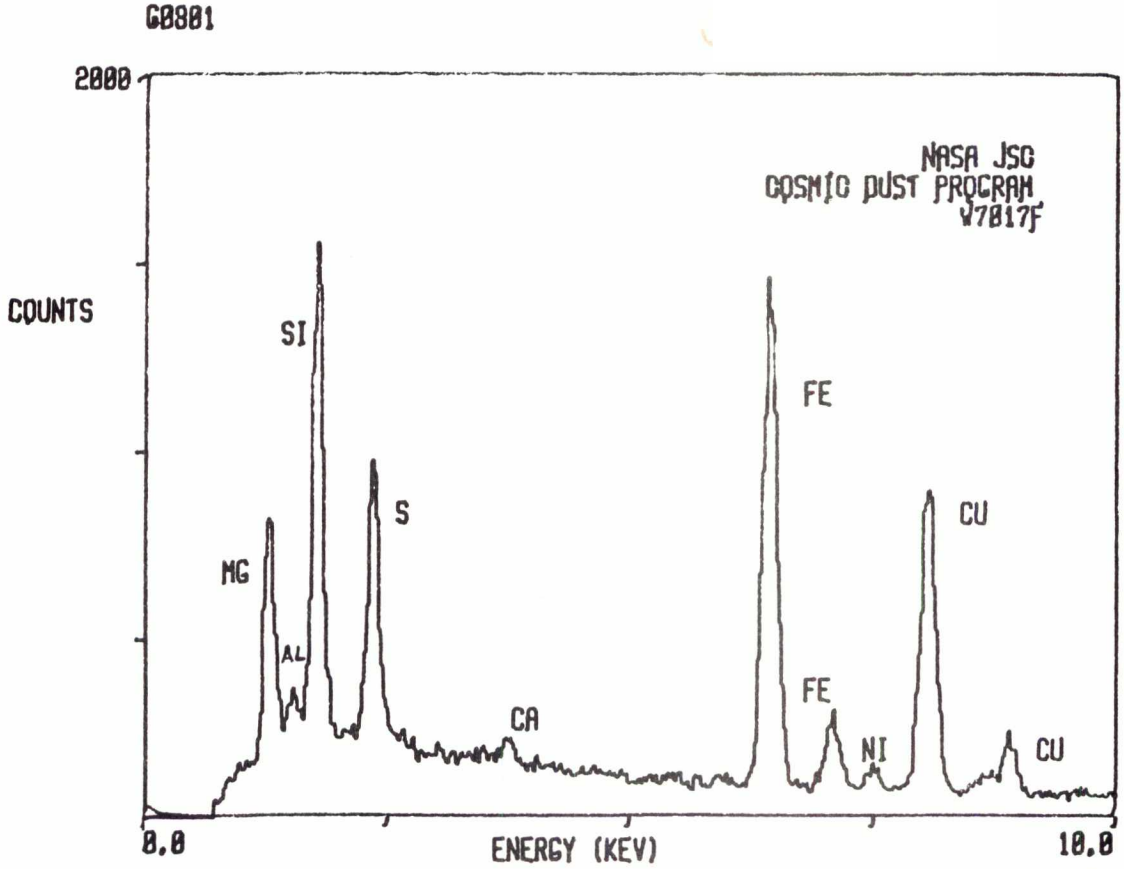


W7017F3

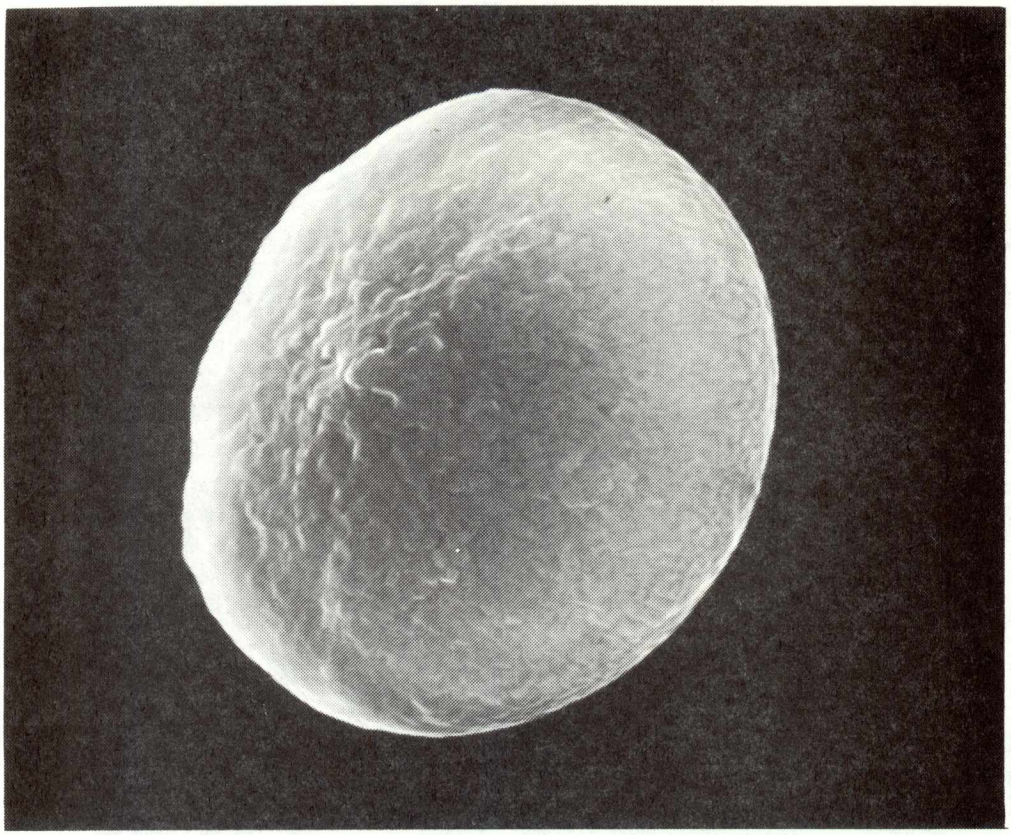


S-82-25733

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~5x11~~ 4+8	I	O/T	Mottled Gray-Black/Pale Yellow	SV	C?	Appendage (shown by arrow) is T and Pale Yellow

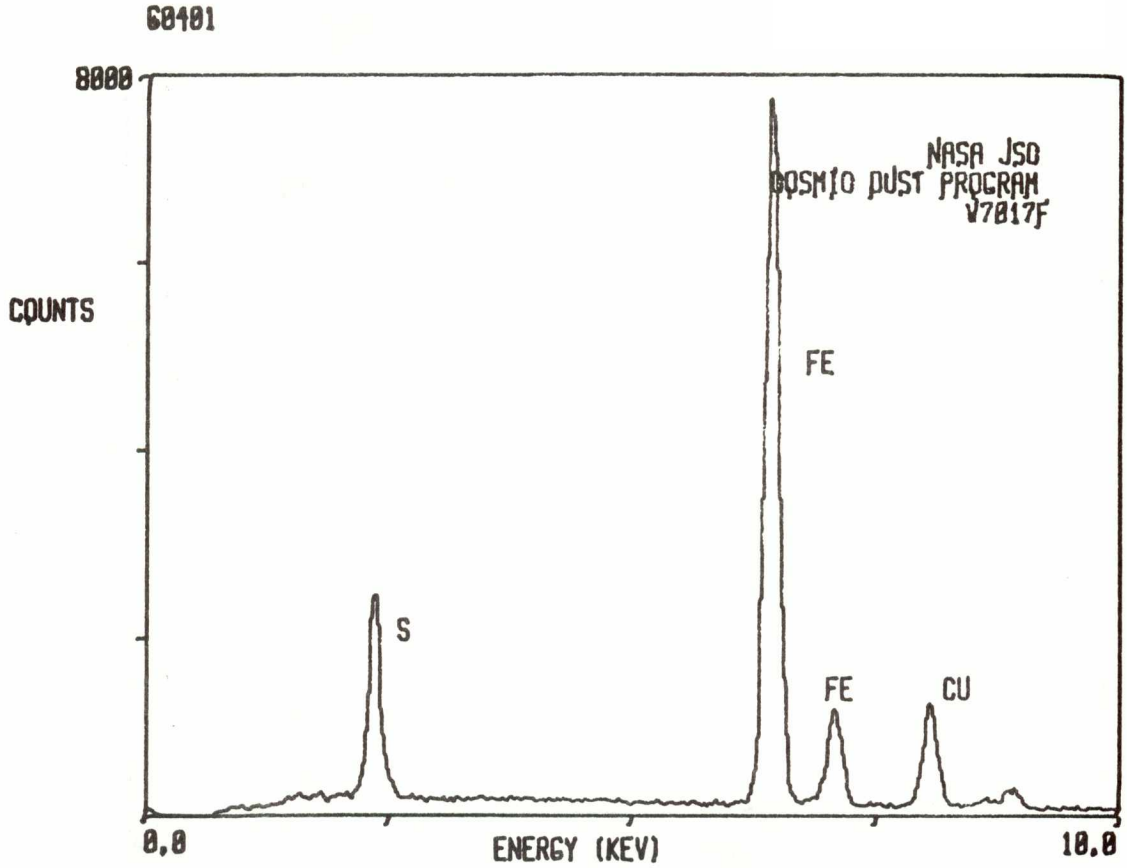


W7017F4

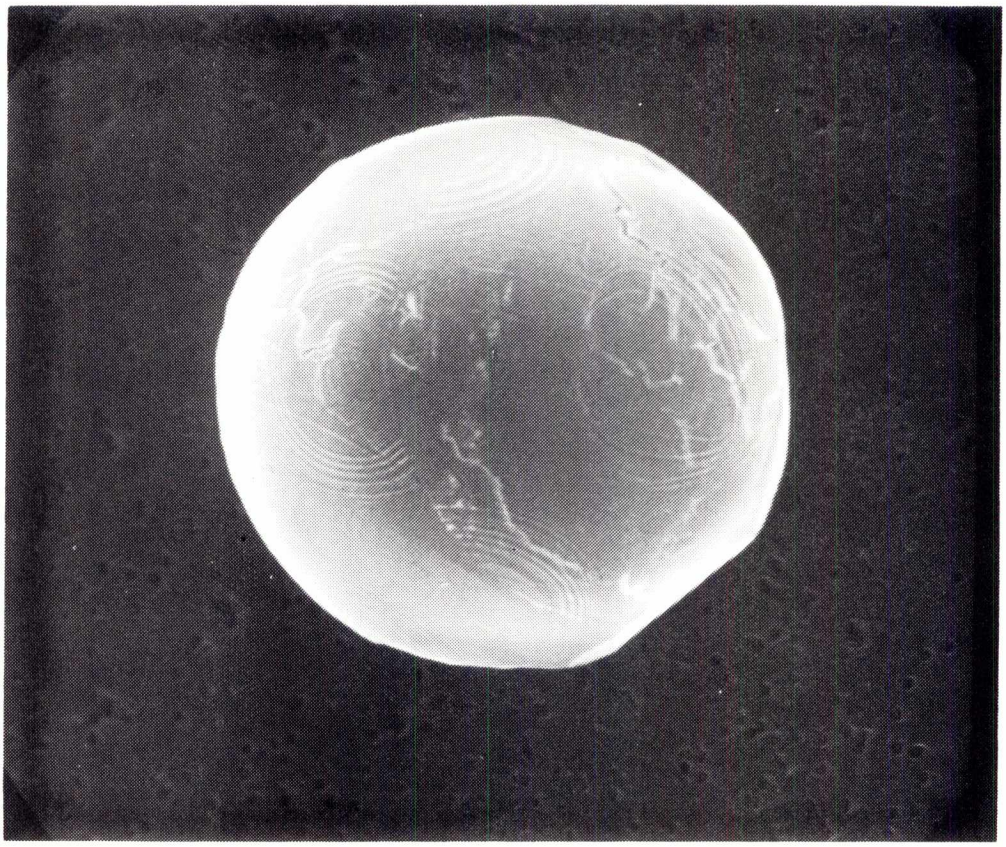


S-82-25734

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
9x~~10~~12	S	O	Black	SM	C?	Ellipsoid or broken sphere

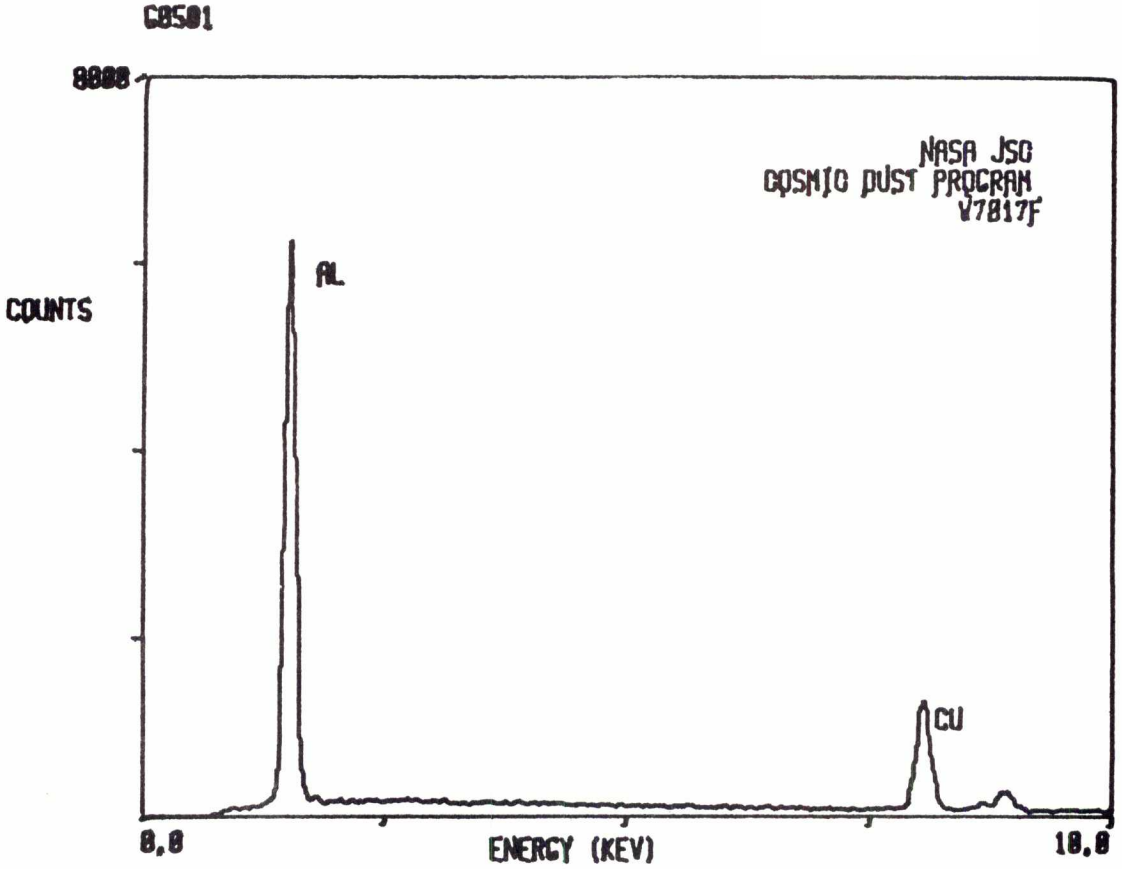


W7017F5

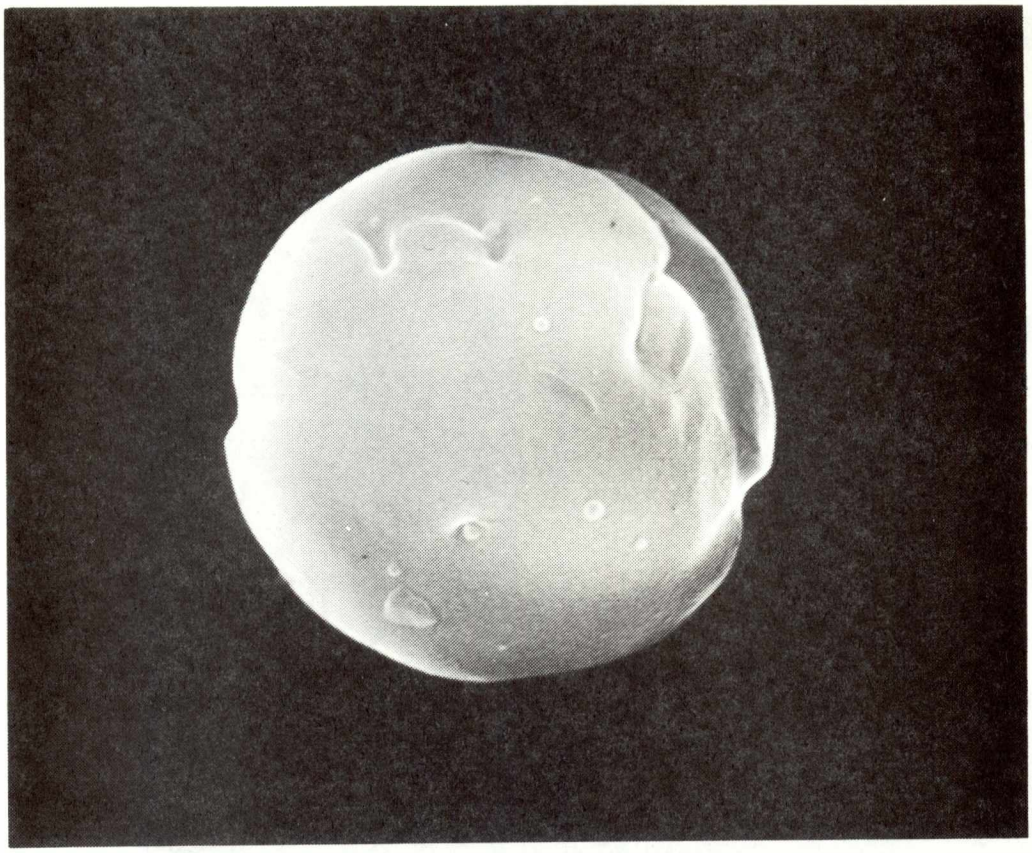


S-82-25735

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~14~~ 12×11	S	TL	CL/Pale Yellow	V	AOS	

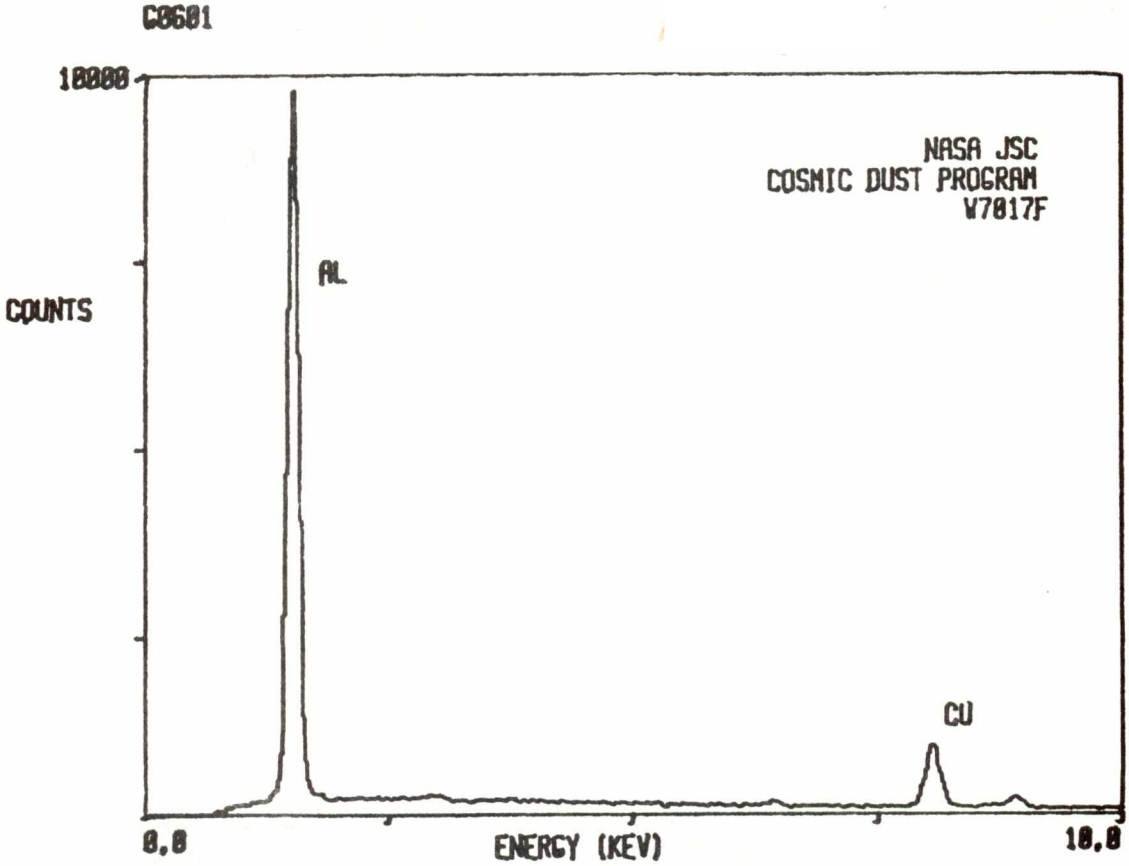


W7017F6

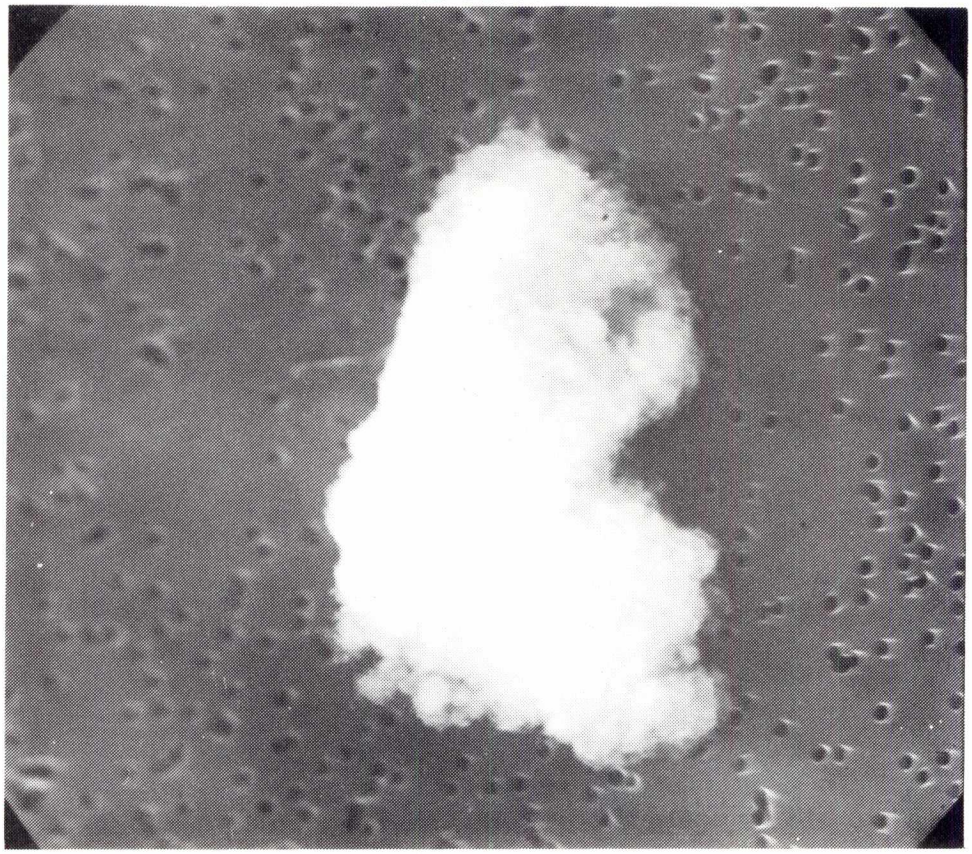


S-82-25736

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
87	S	TL	CL/Pale Yellow	V	AOS	

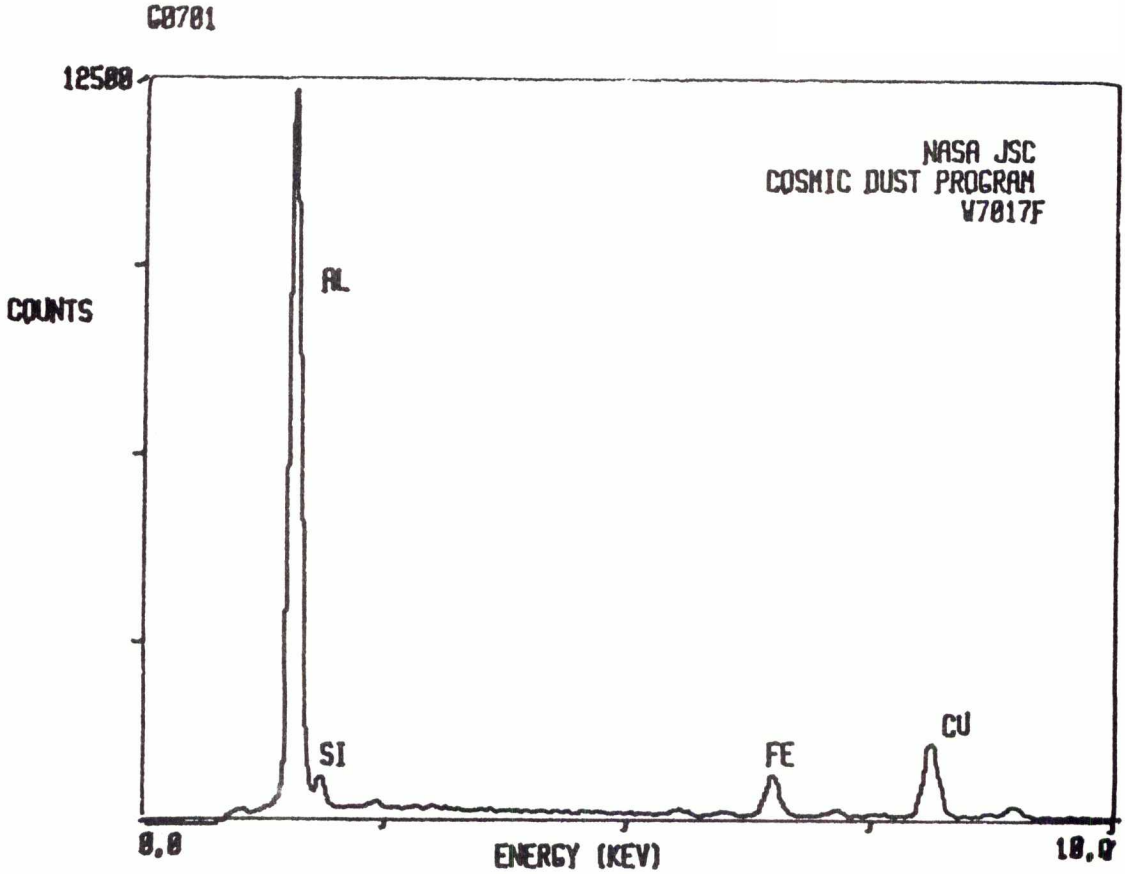


W7017F7

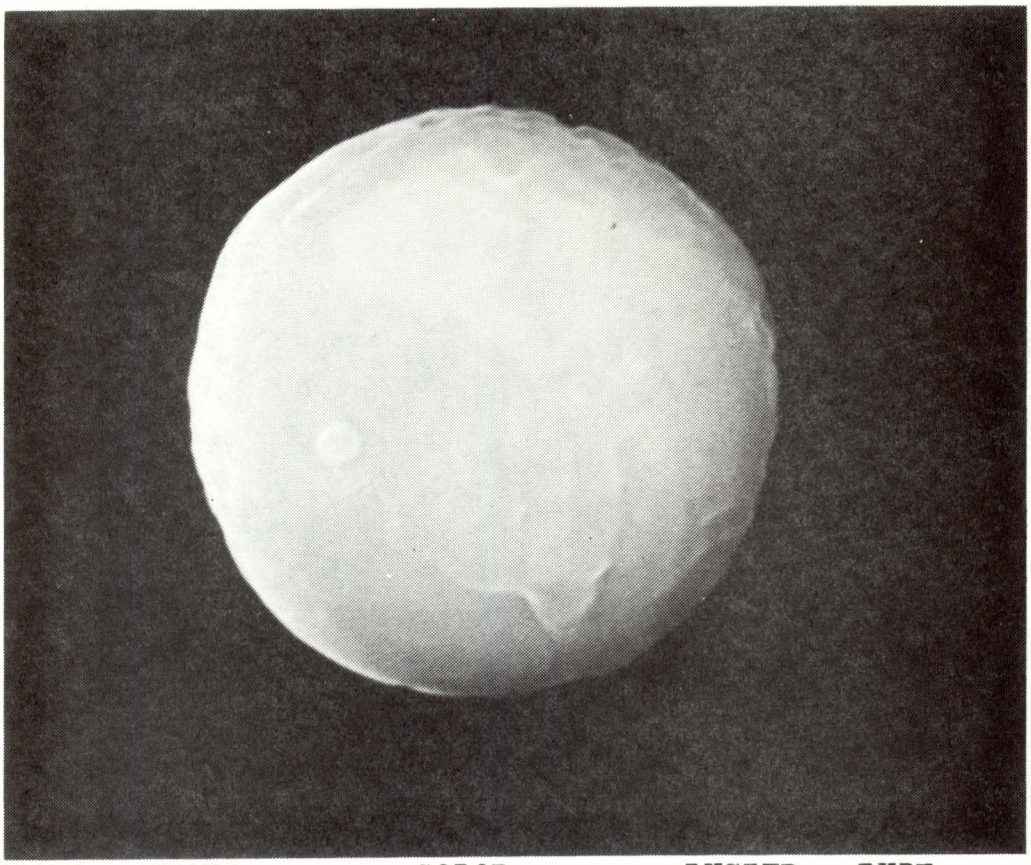


S-82-25737

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7x12~~ 6 x 10	I	O	Gray-Black	D/SM	?	"Salt-and-Pepper" coloration; Al'?

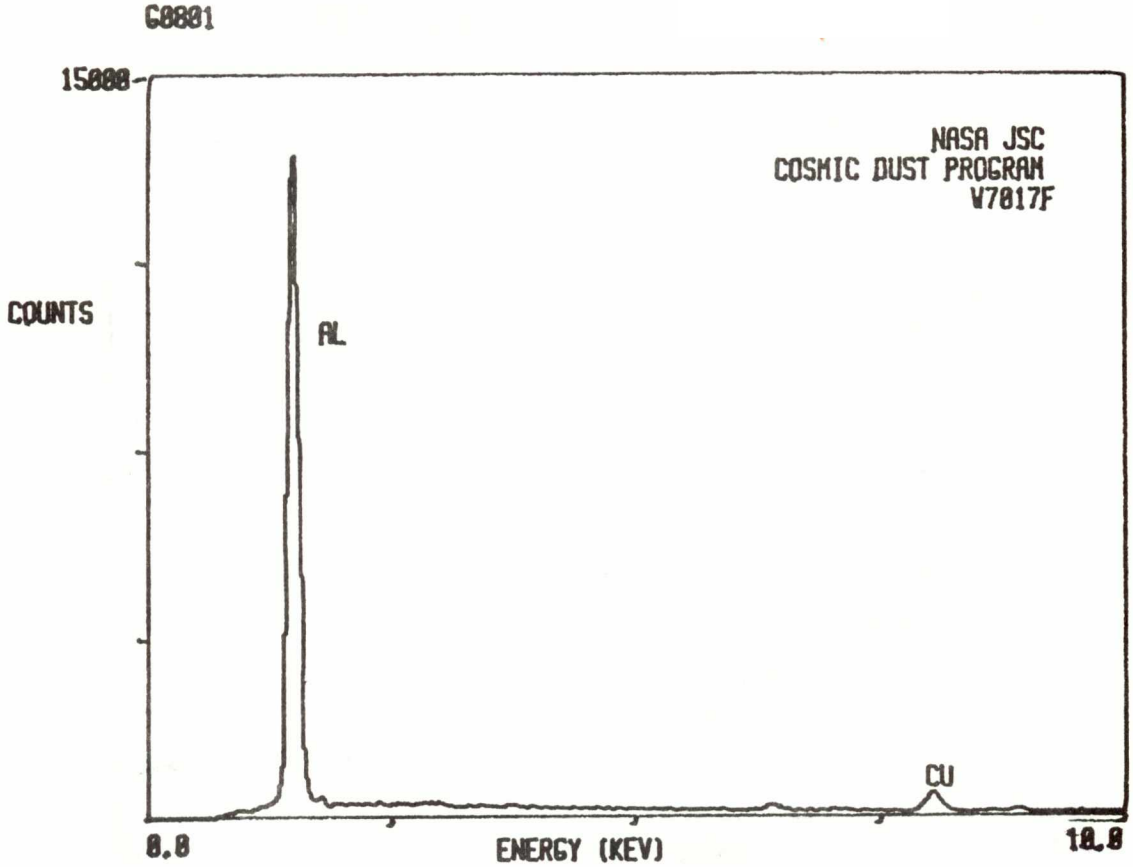


W7017F8

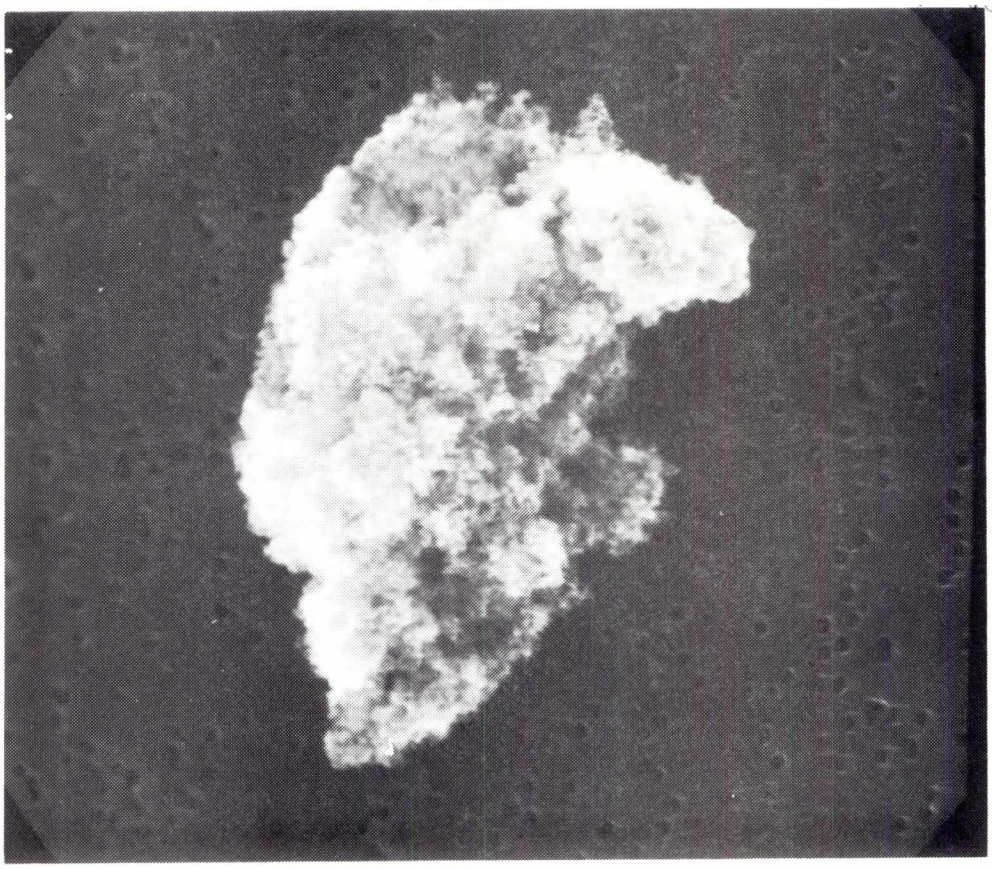


S-82-25738

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
7 8x6	S	TL	CL/Pale Yellow	V	AOS	

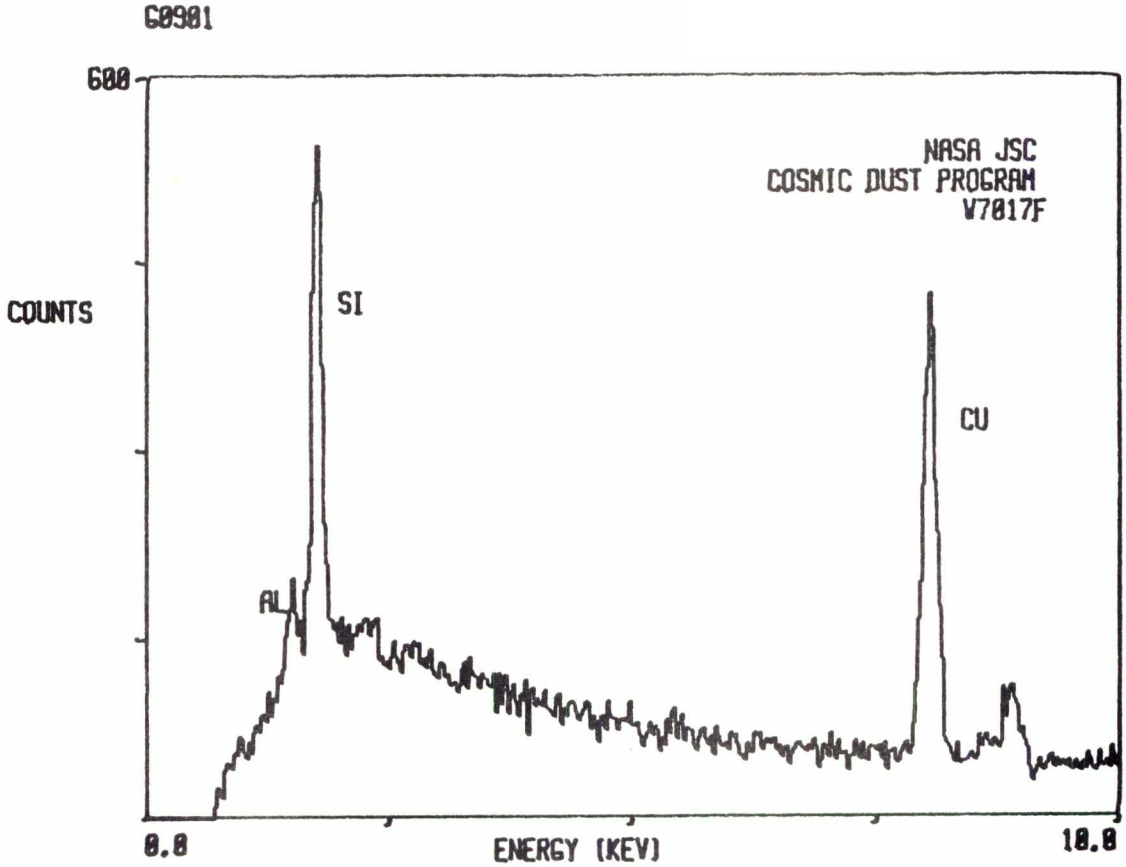


W7017F9

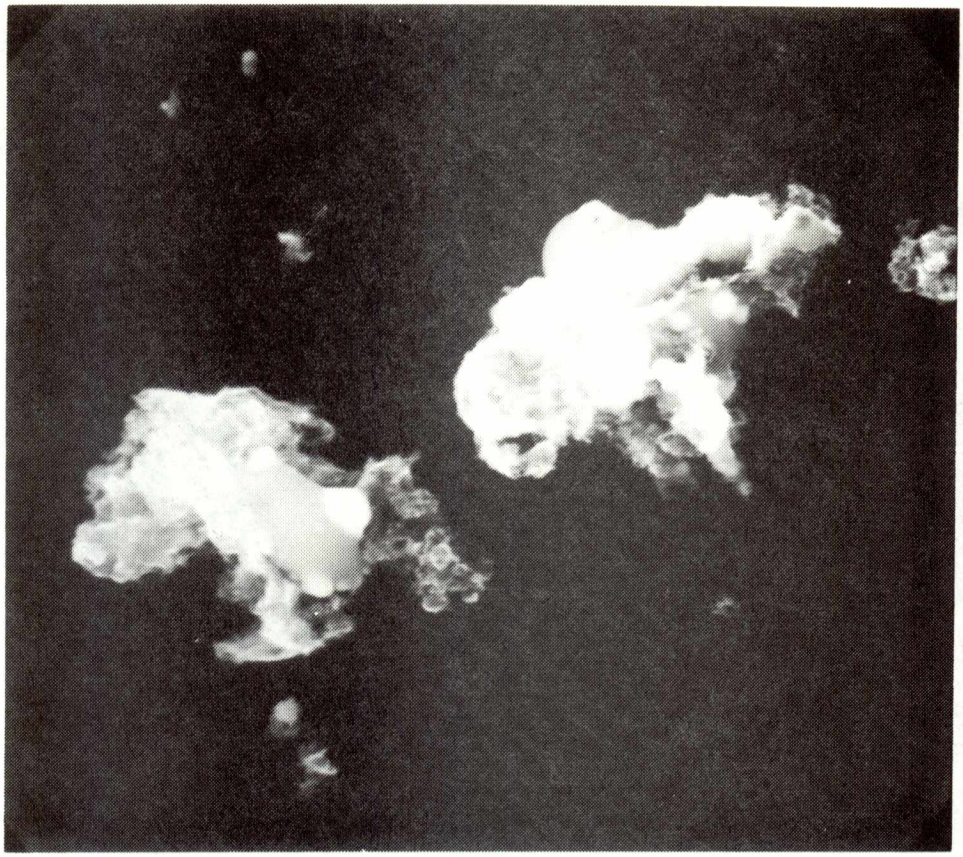


S-82-25739

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~9x13~~ 5x10	I	O	Dk. Gray/Black	D/SM	TCA?	

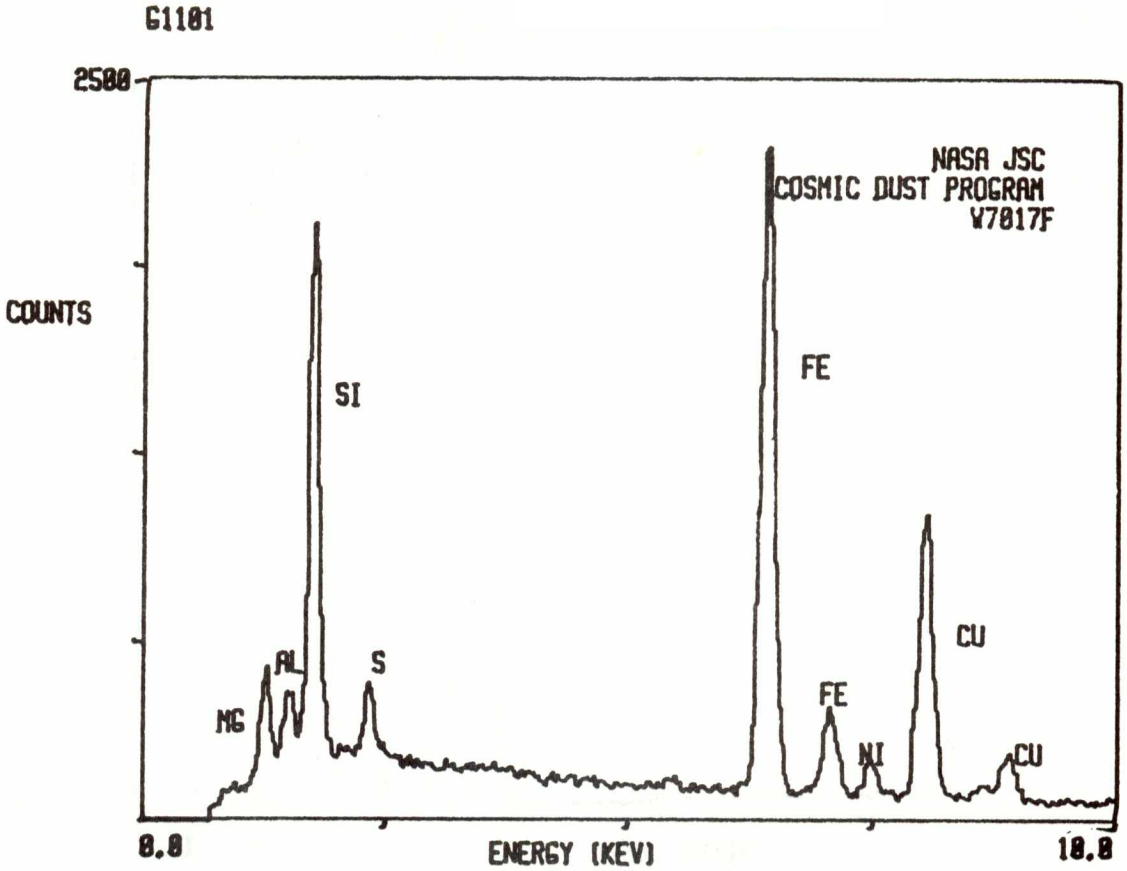


W7017F11

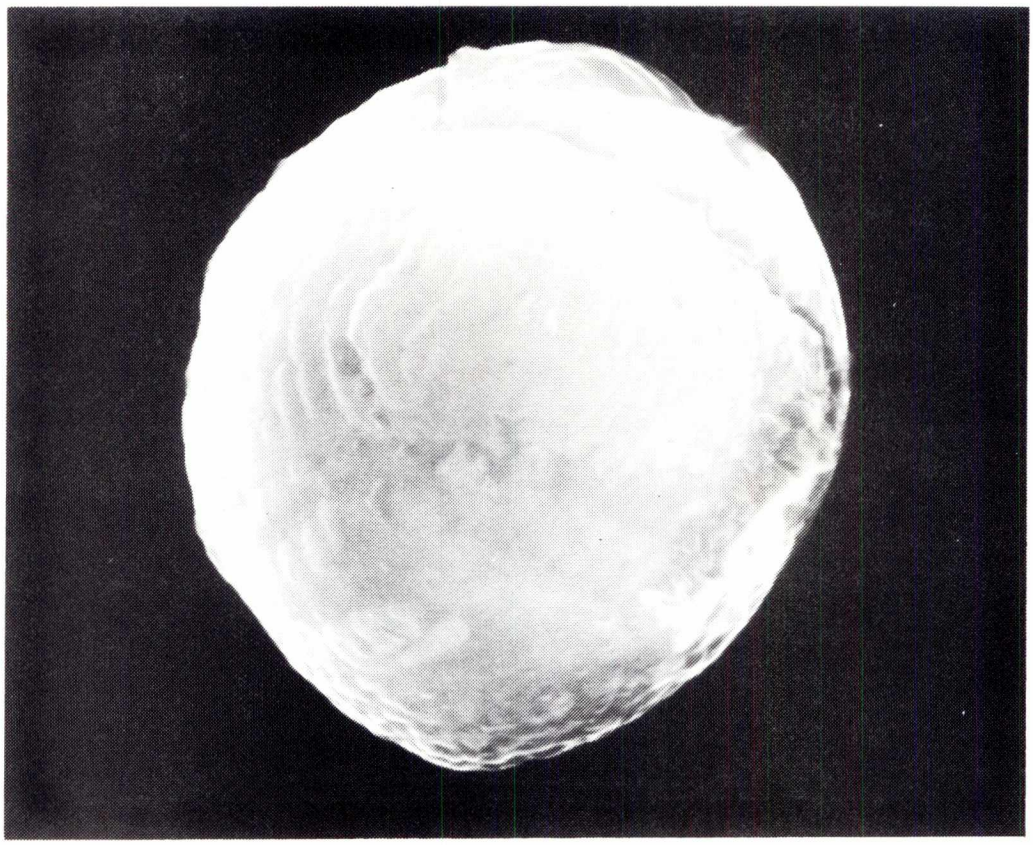


S-82-25740

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~12x16~~ 15x9, 15x20	I	O	Black	SV	C?	Two fragments

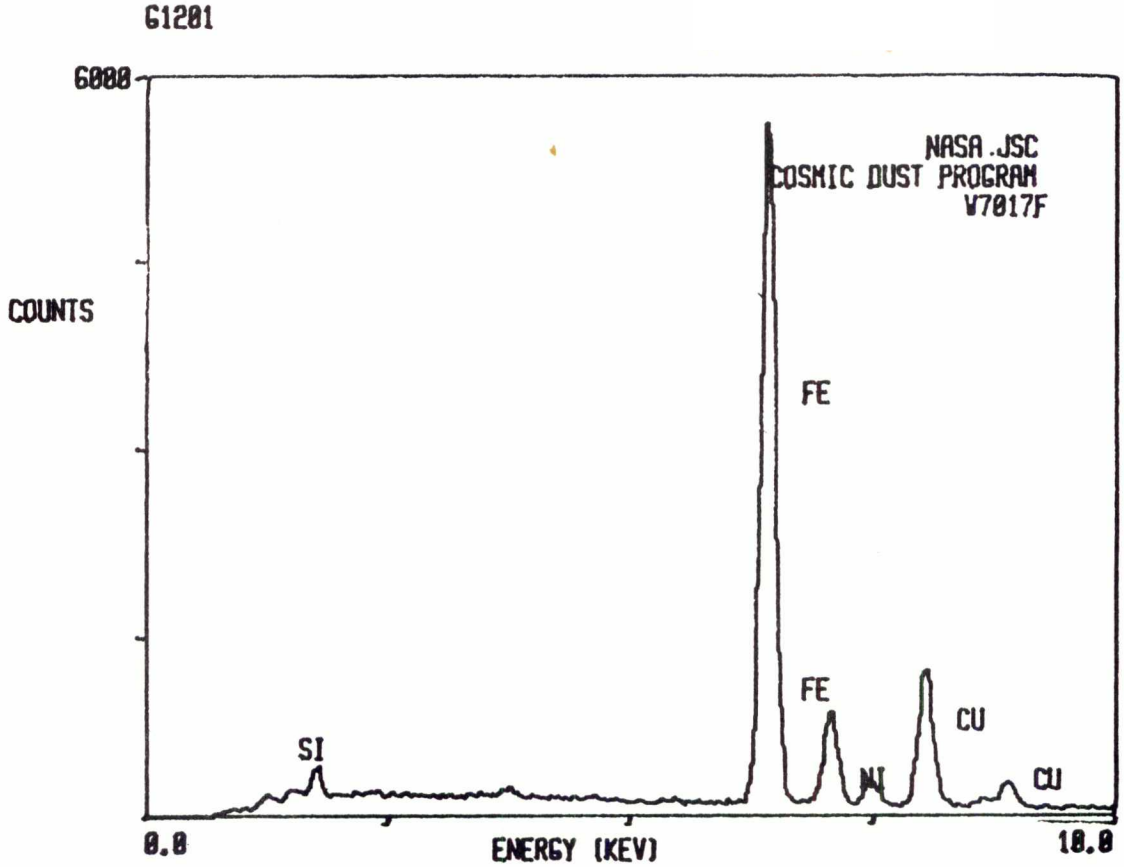


W7017F12

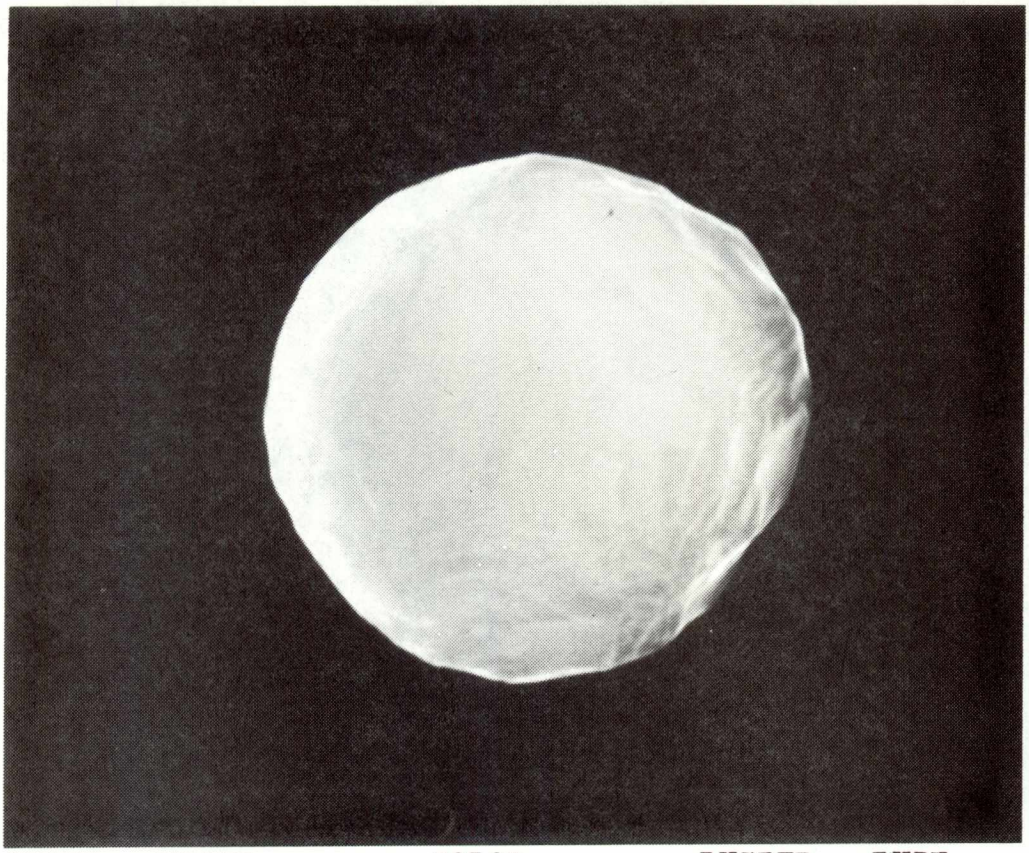


S-82-25730

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
76	S	O	Black	SM	C?	Fracture (?) on surface

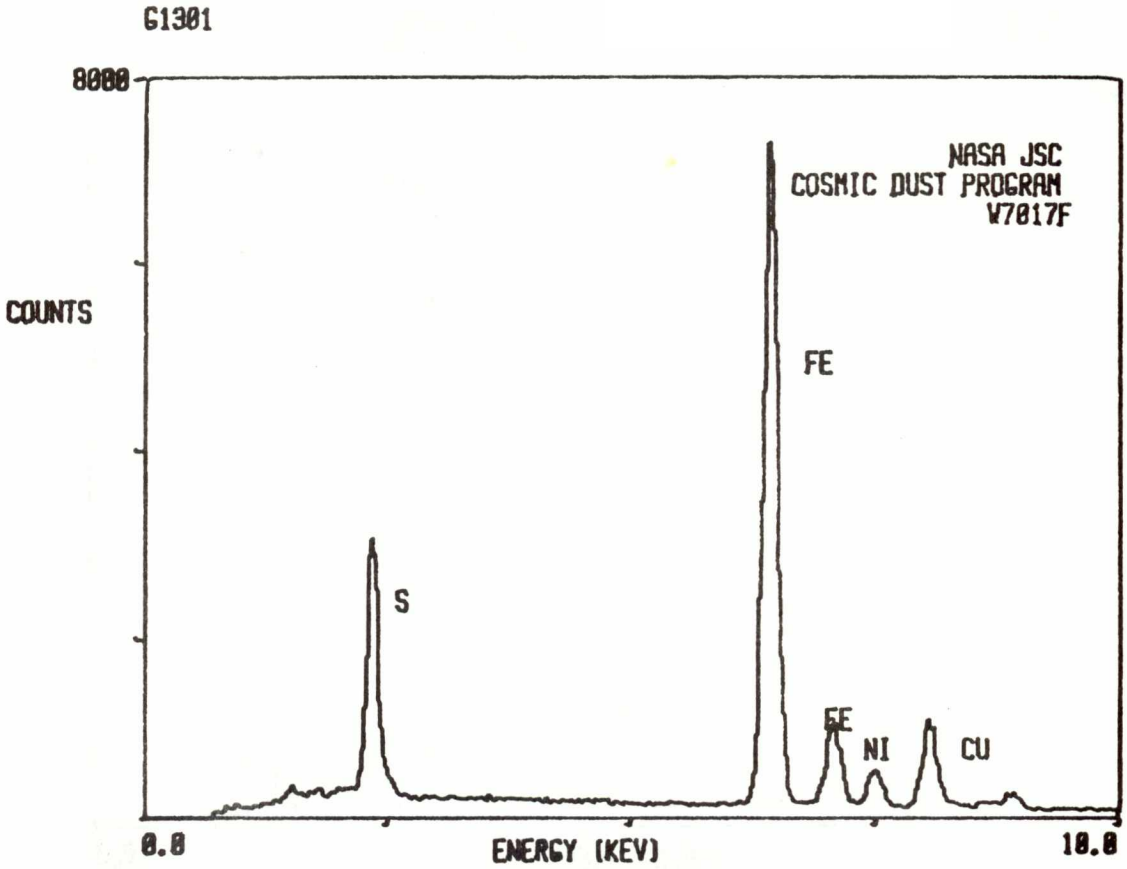


W7017F13



S-82-25729

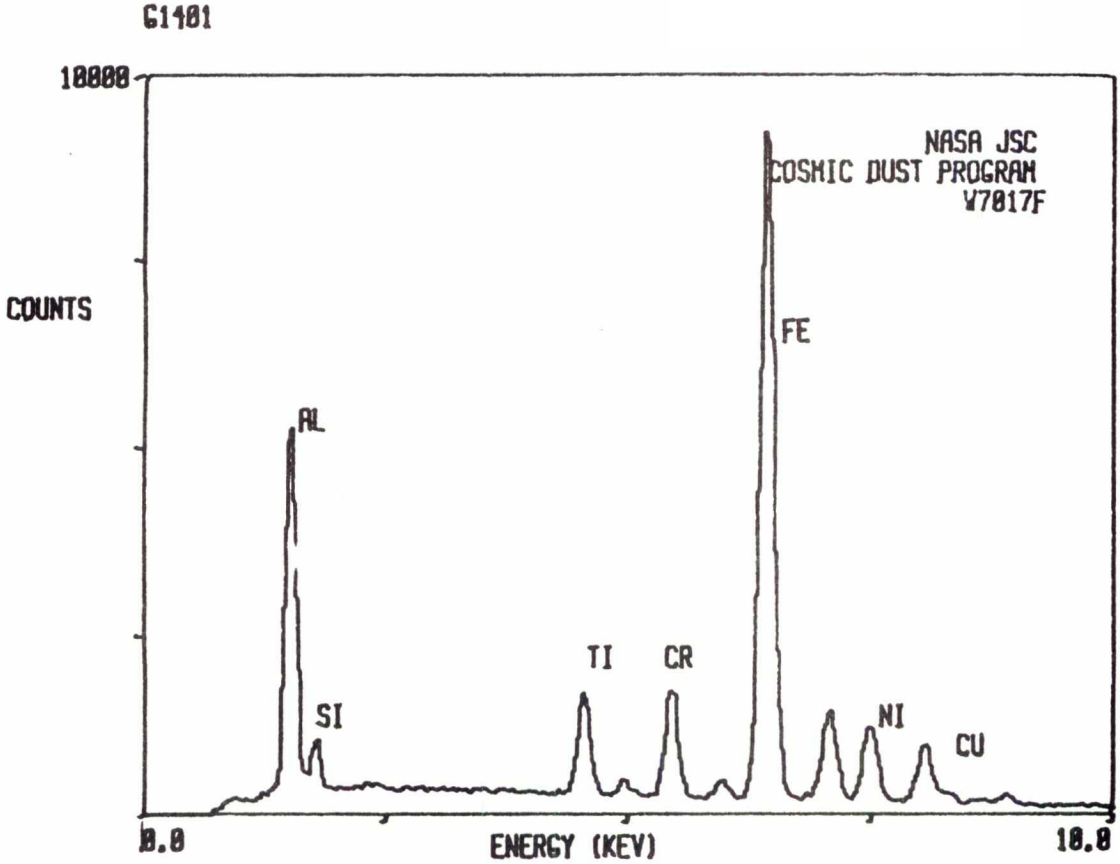
SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
5x4	S	O	Black	SM	C?	



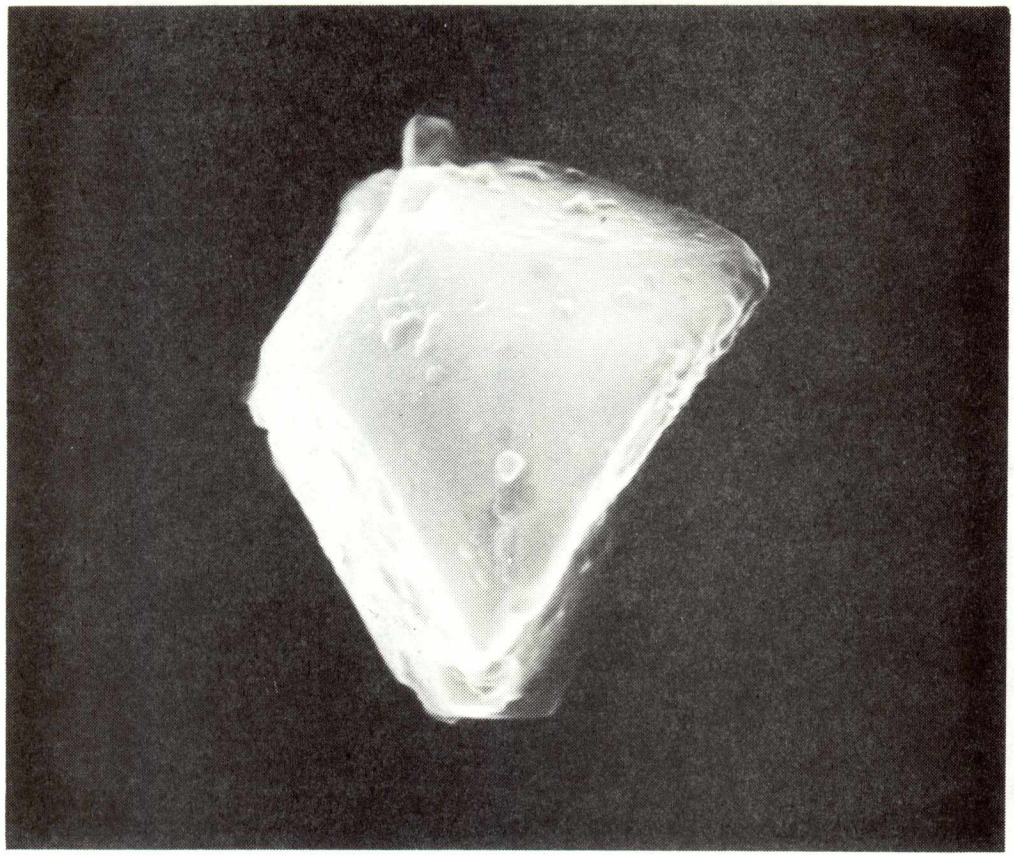
W7017F14

S-82-25728

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
5x?6	I	O	Dk. Brown/Black	D/SM	TCA?	

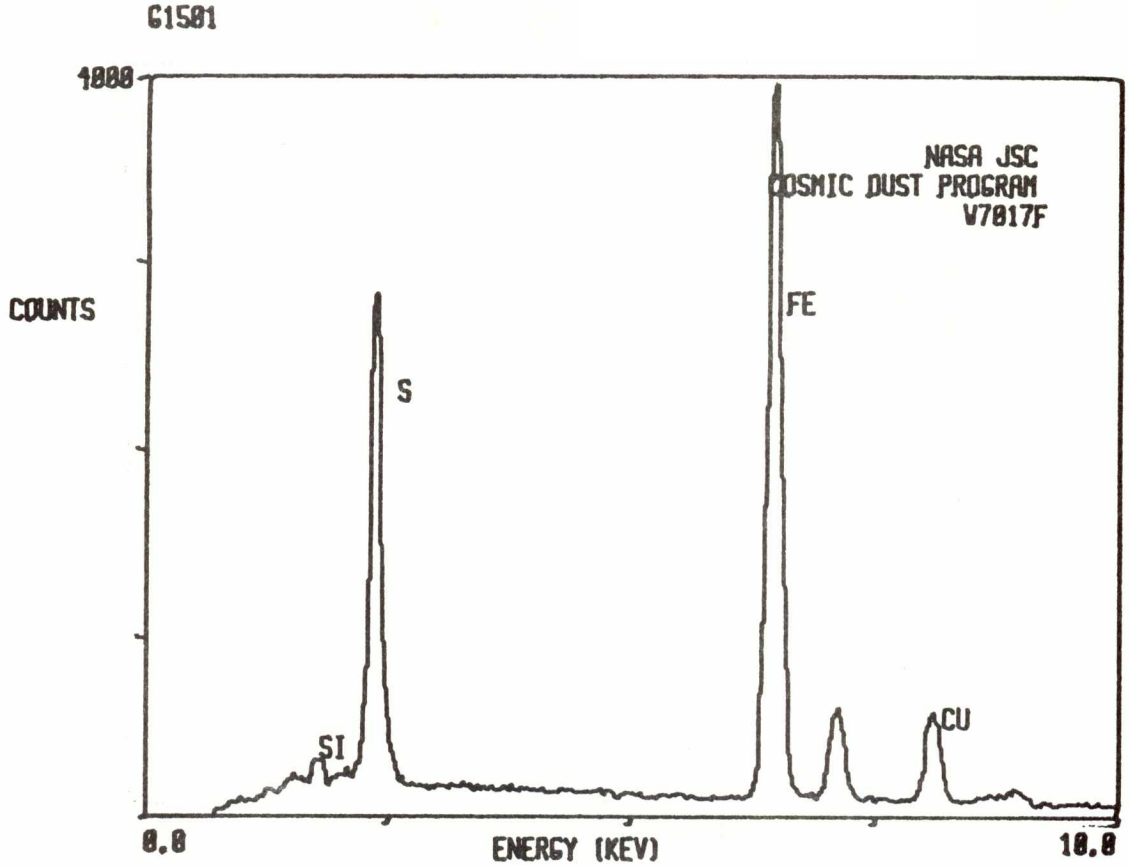


W7017F15

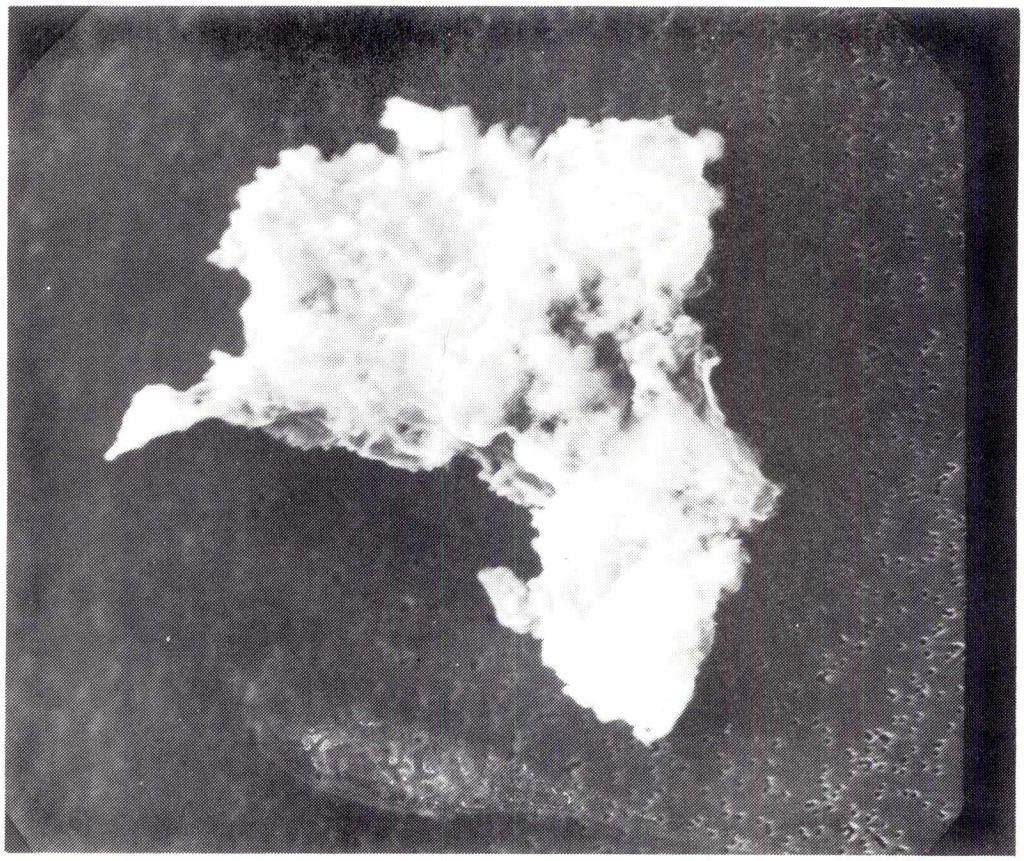


S-82-25727

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
6x8	I	O	Black	SV	C?	Euhedral crystal fragment (?)

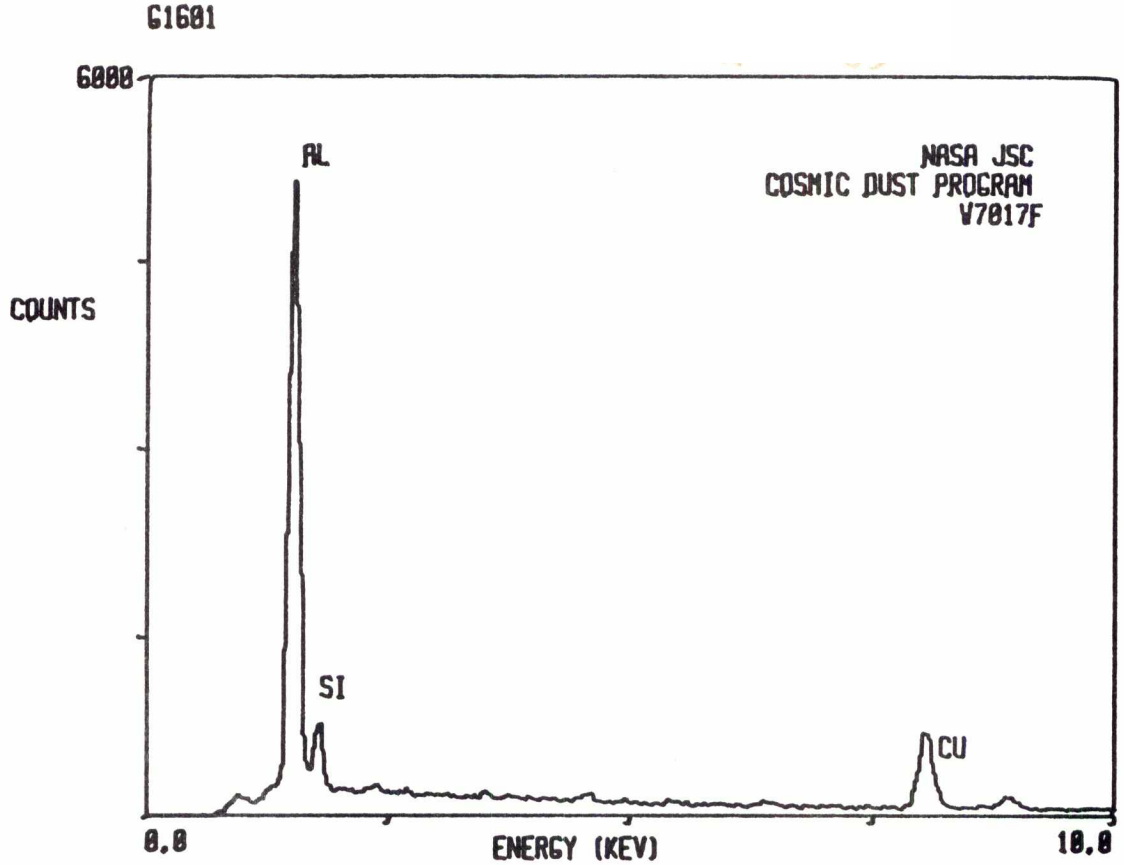


W7017F16



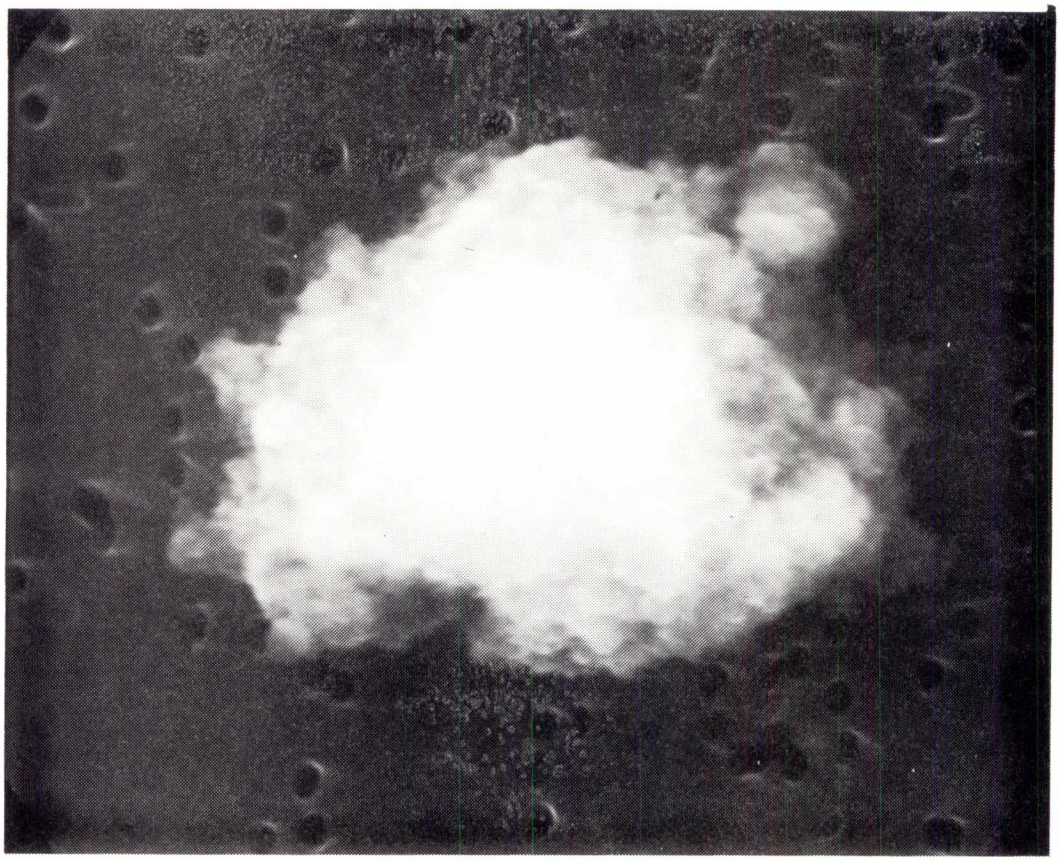
S-82-25726

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~25x35~~ 19x15	I	O	Dk. Gray/Black	D/SV	?	Al'?



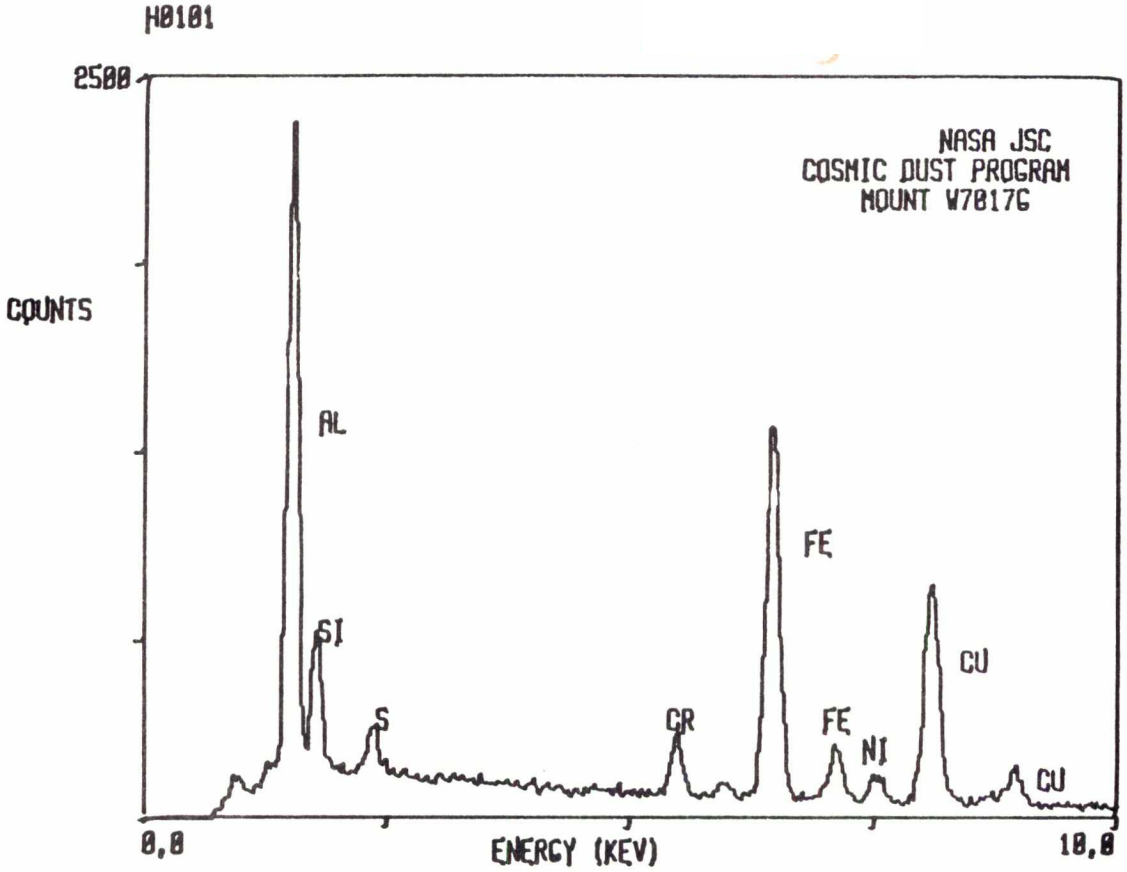
MOUNT W7017G

W7017G1

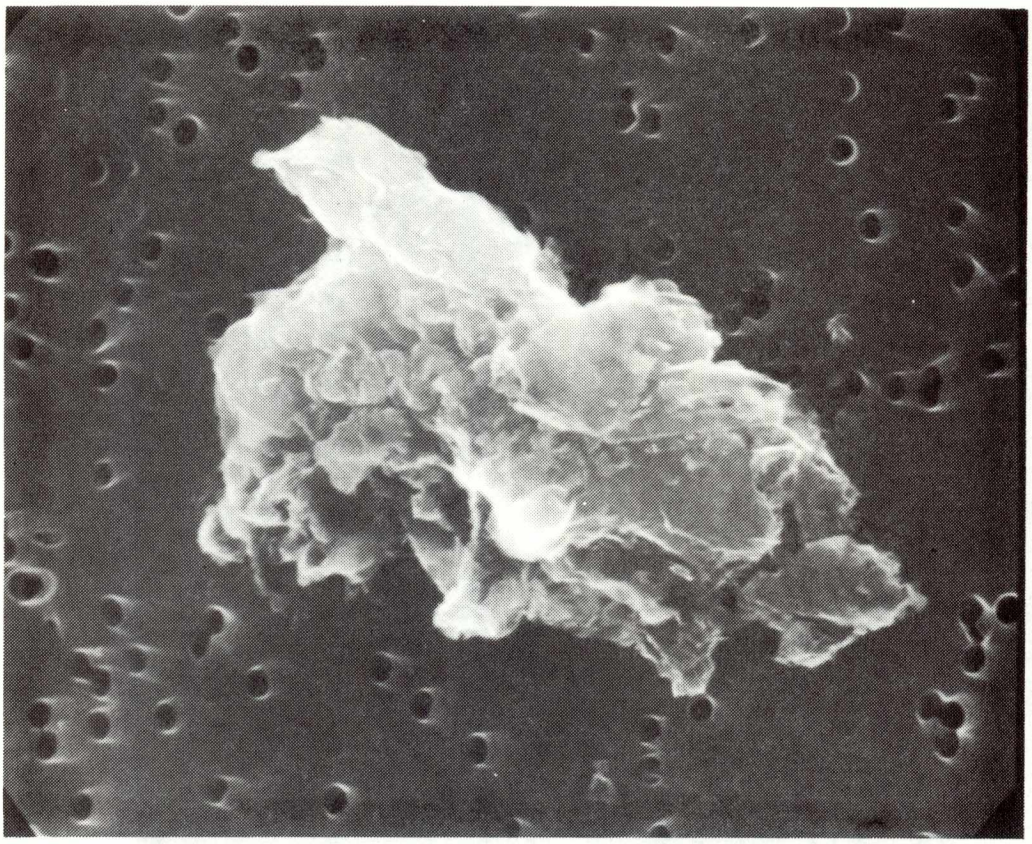


S-82-25725

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
5x6 4	I	O	Dk. Gray	D/SM	TCA?	"Salt-and-Pepper" coloration

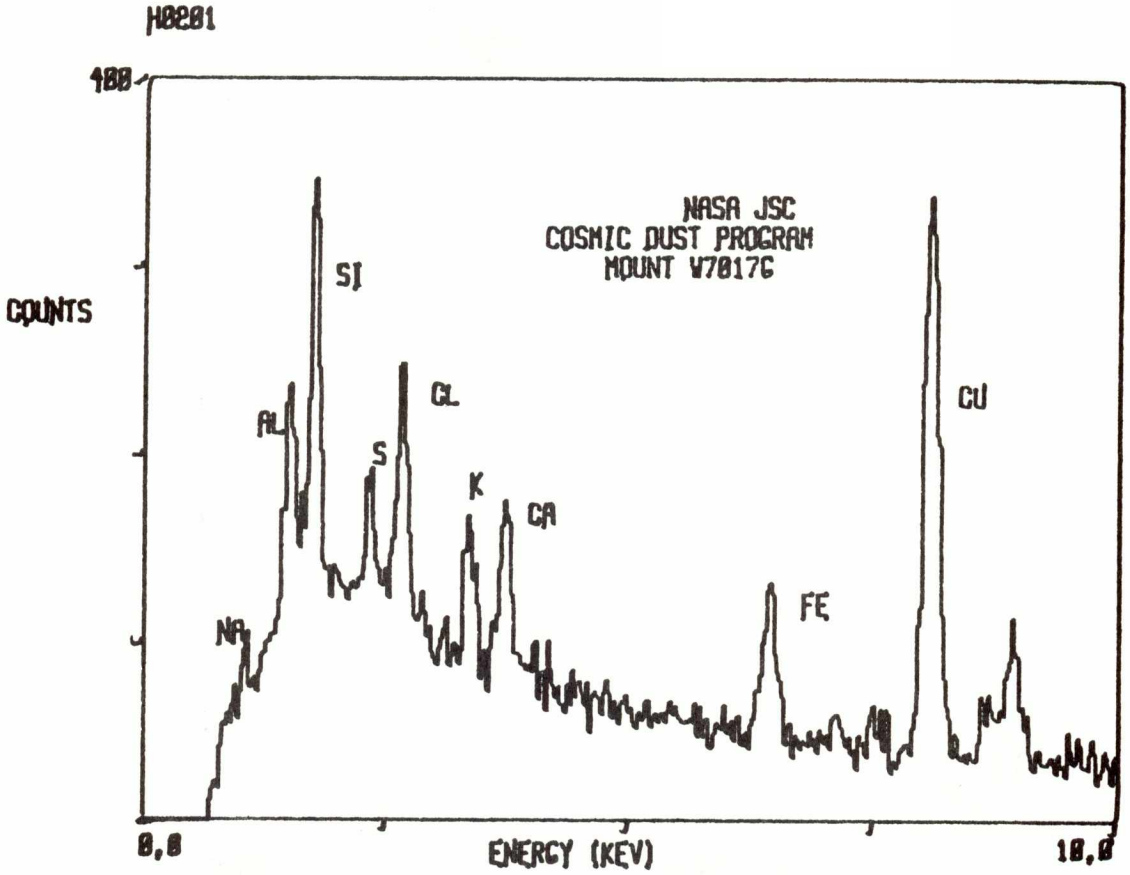


W7017G2

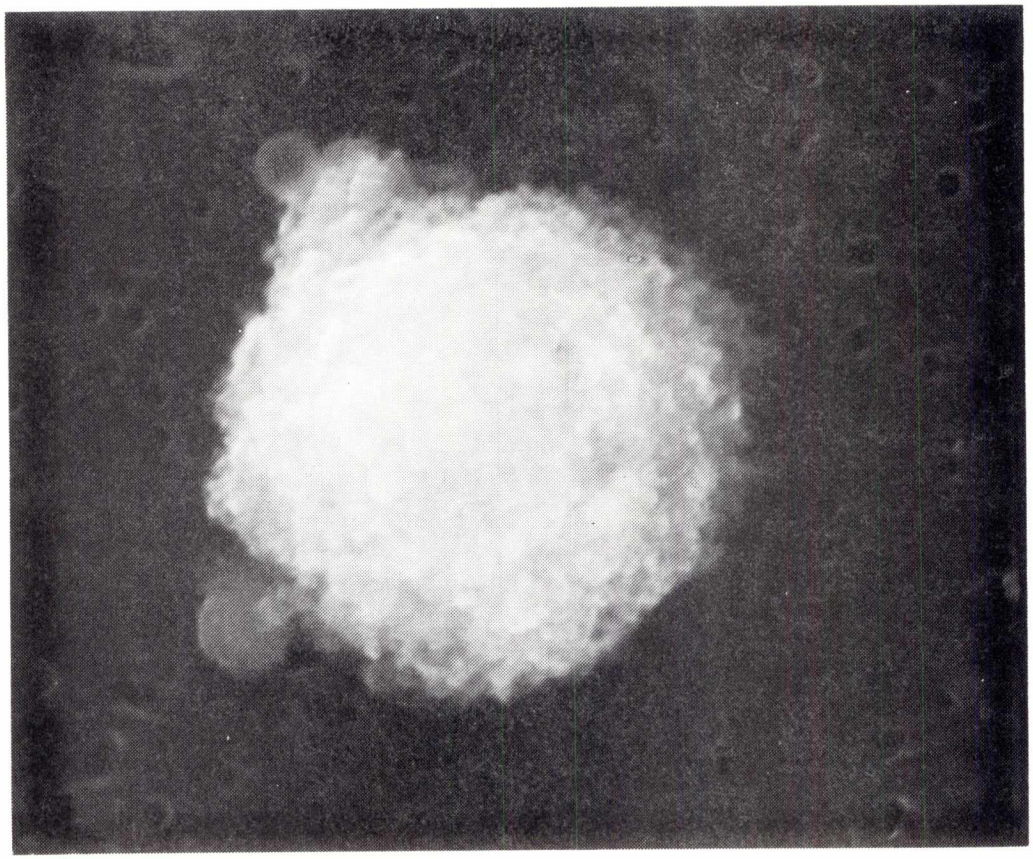


S-82-25720

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~5x9~~ 6x4	I	O	Dk. Gray/Black	D/SM	TCA?	

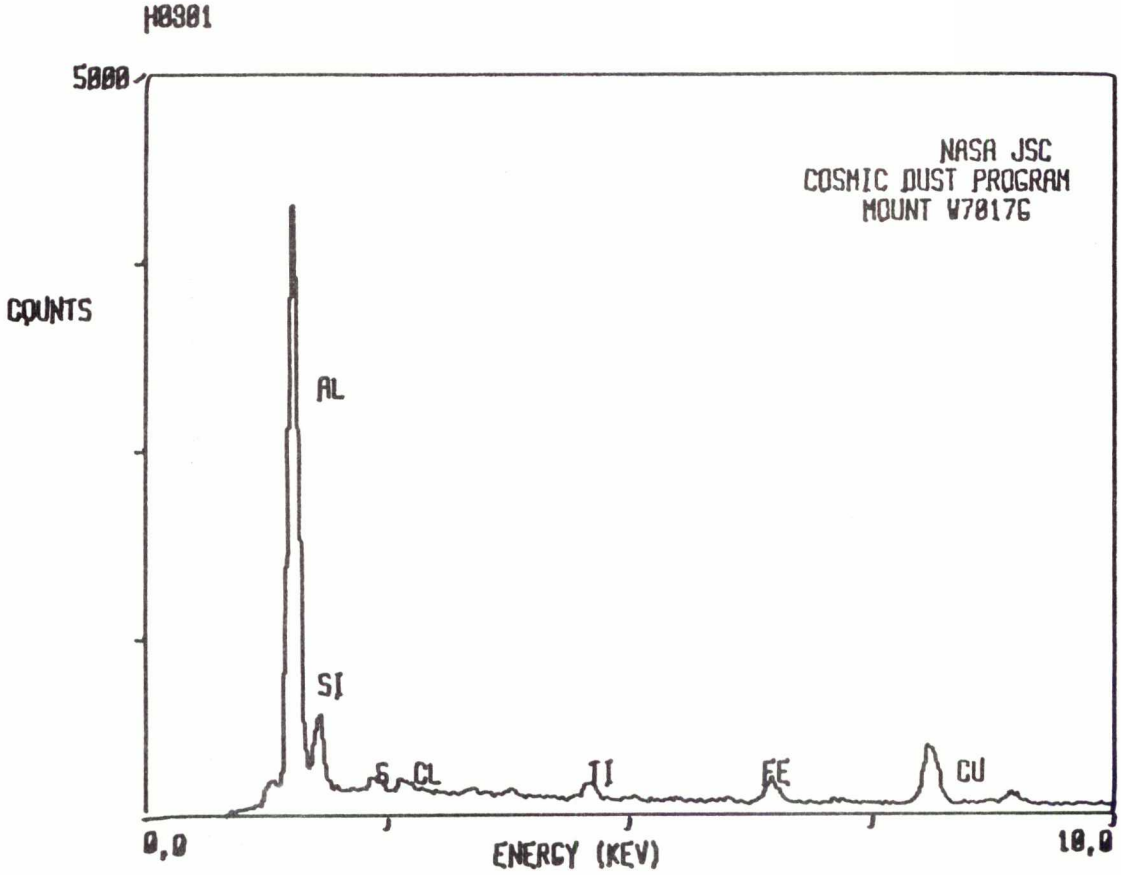


W7017G3

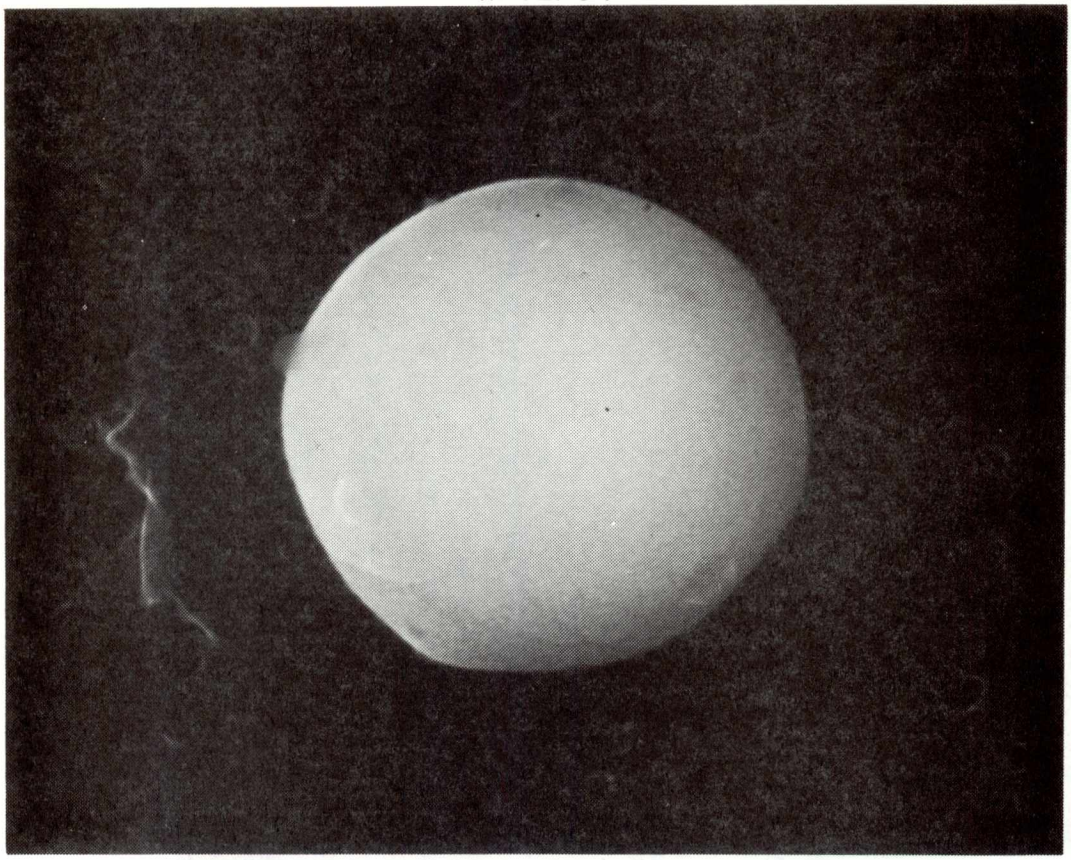


S-82-25717

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
75	E/S	O	Dk. Gray/Black	D/SM	?	Al'?

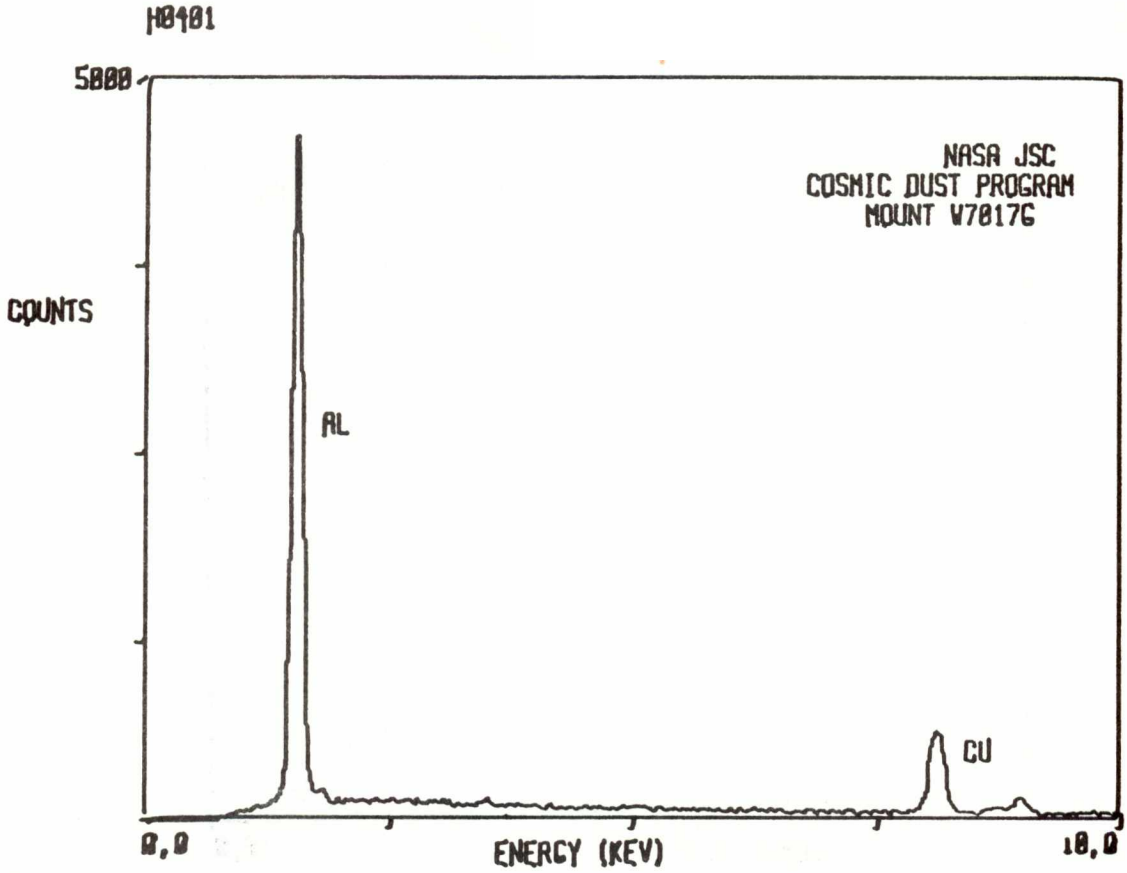


W7017G4

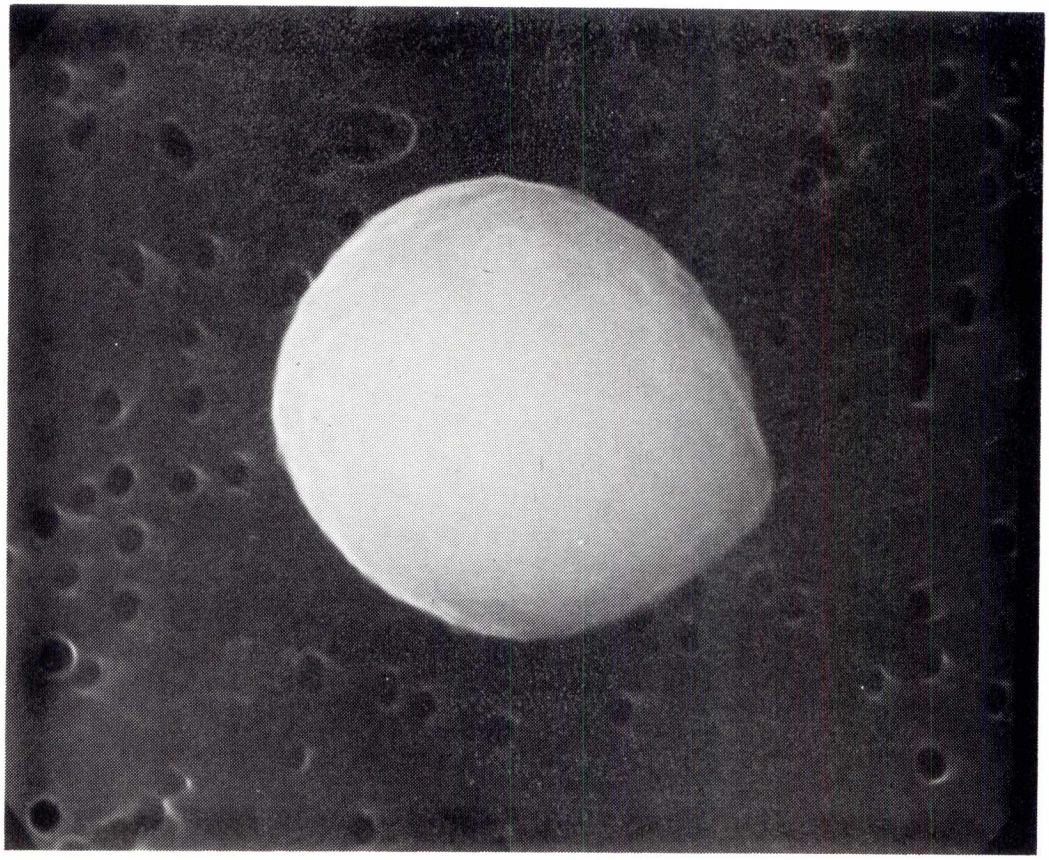


S-82-25718

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
65	S	T	CL	V	AOS	

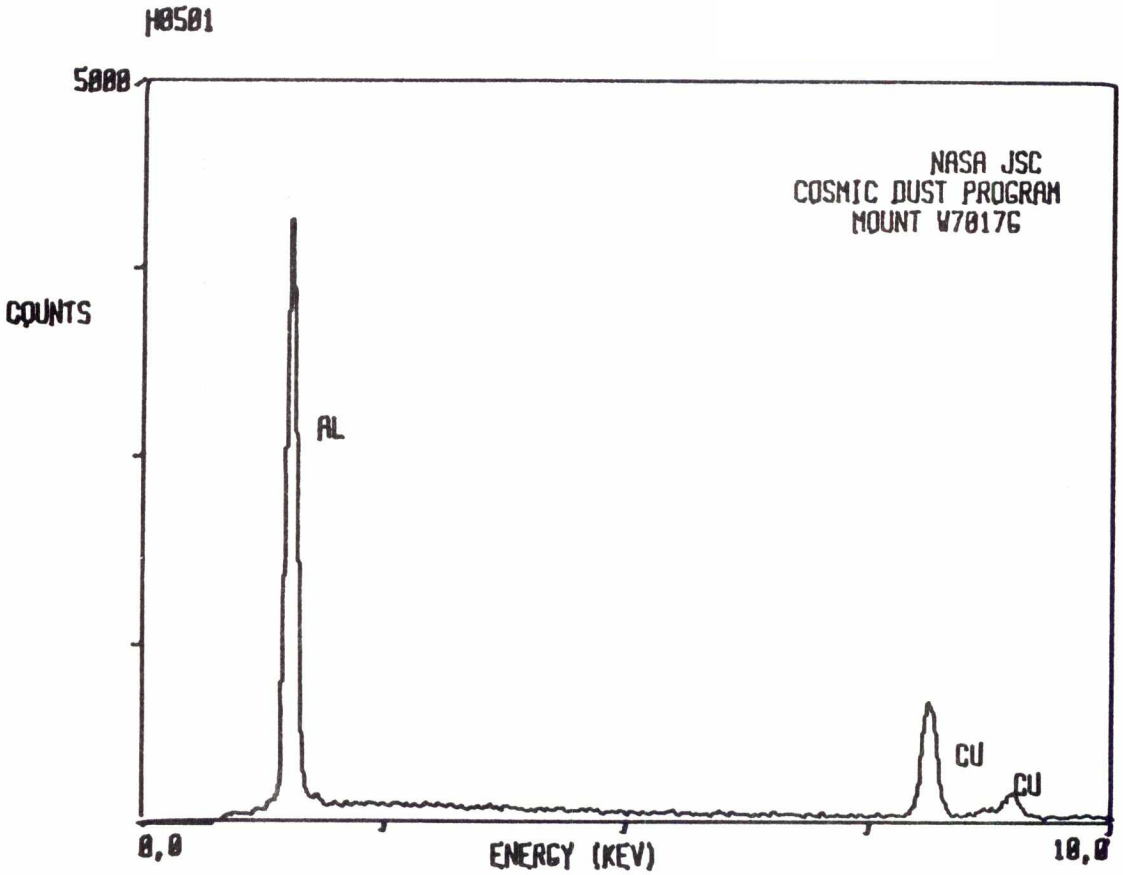


W7017G5

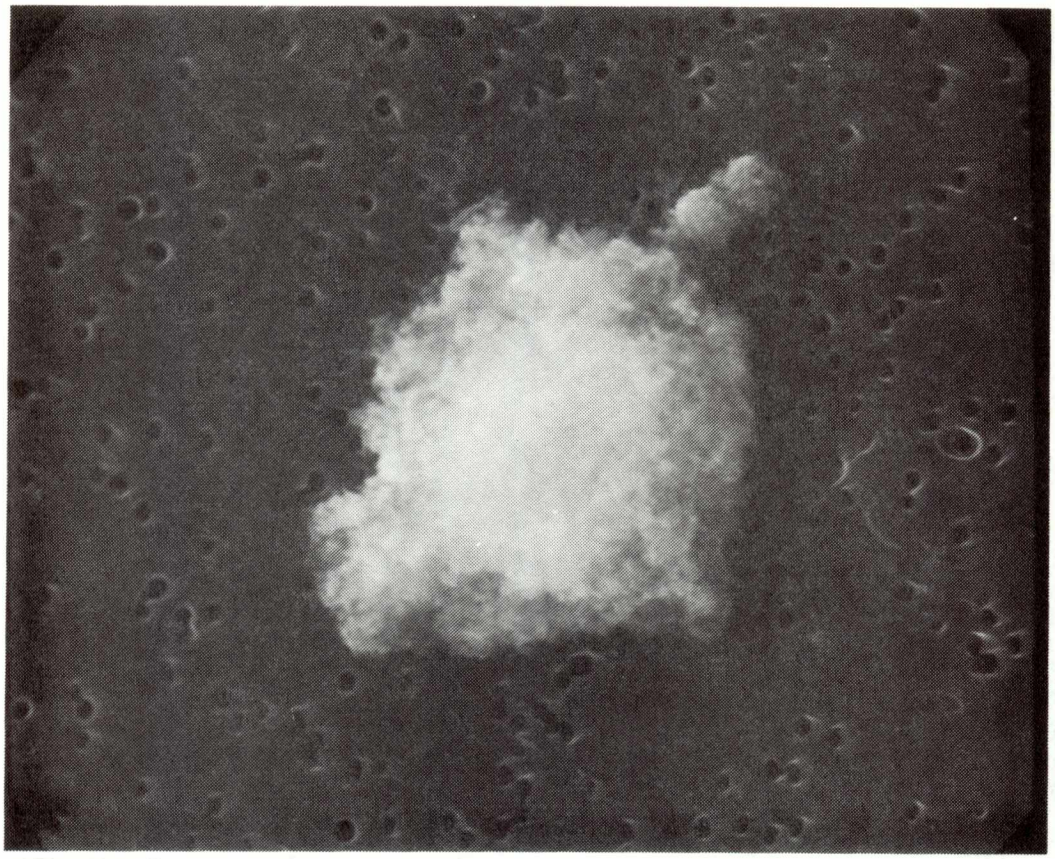


S-82-25716

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
4	S	T	CL	V	AOS	

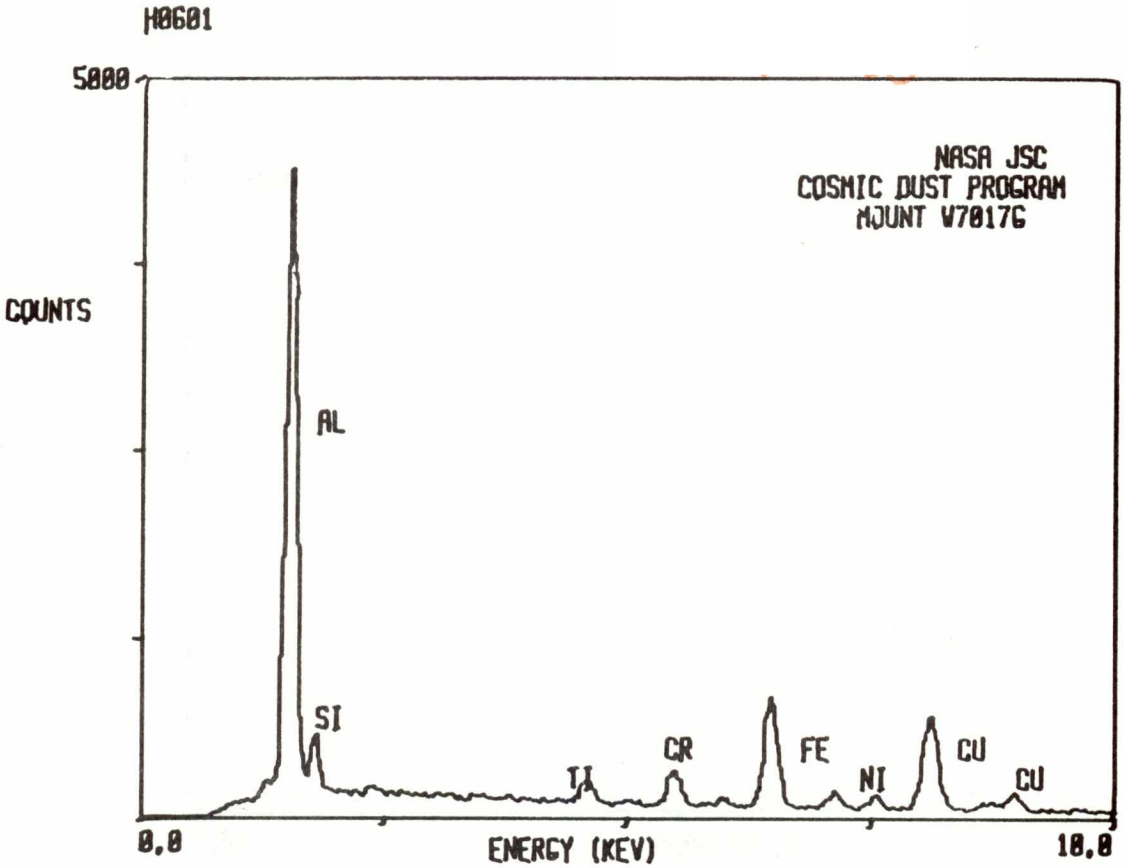


W7017G6

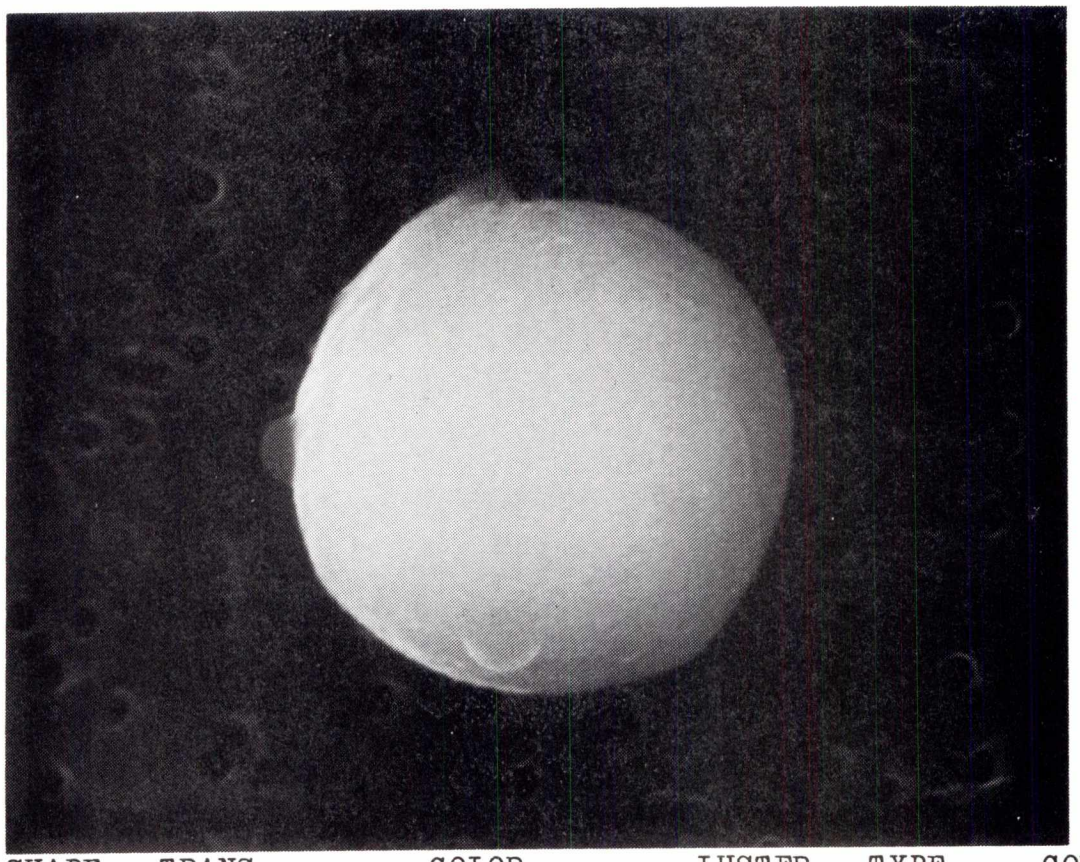


S-82-25715

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7x9~~ 5x6	I	O	Dk. Gray	D/SM	TCA?	"Salt-and-Pepper" coloration

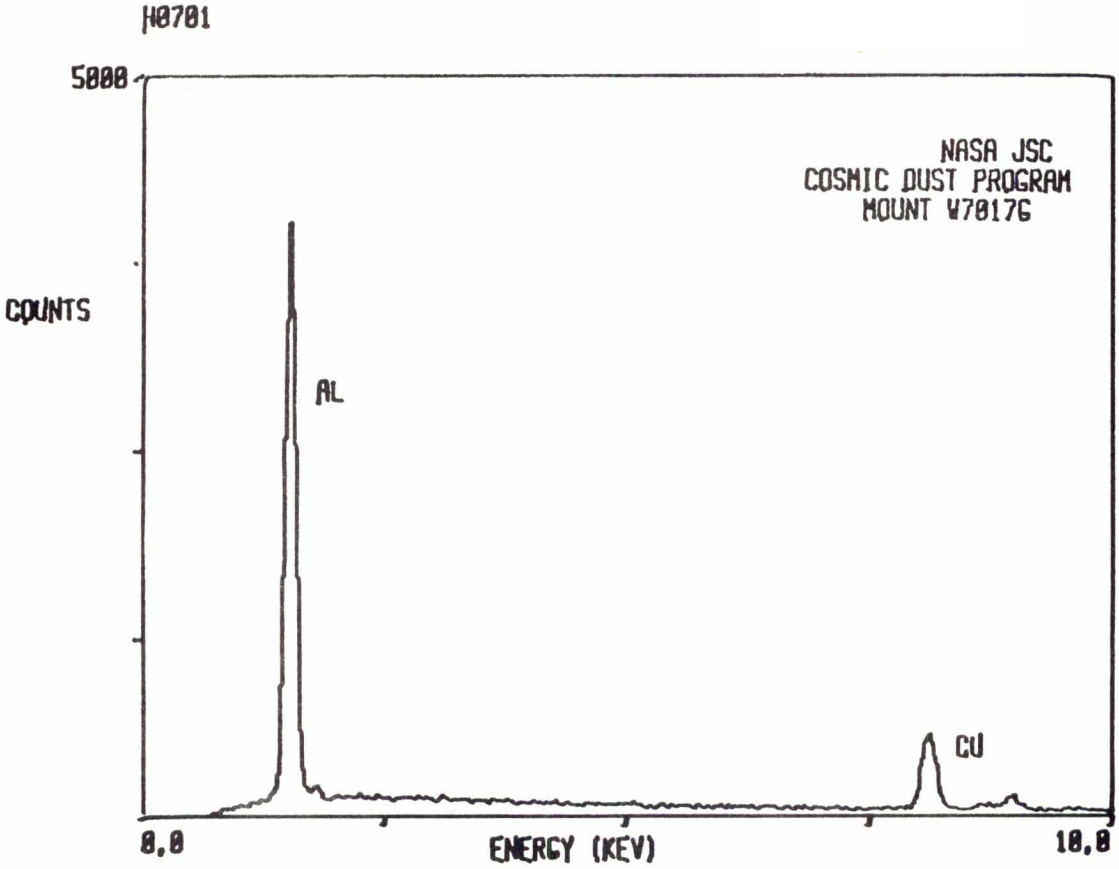


W7017G7

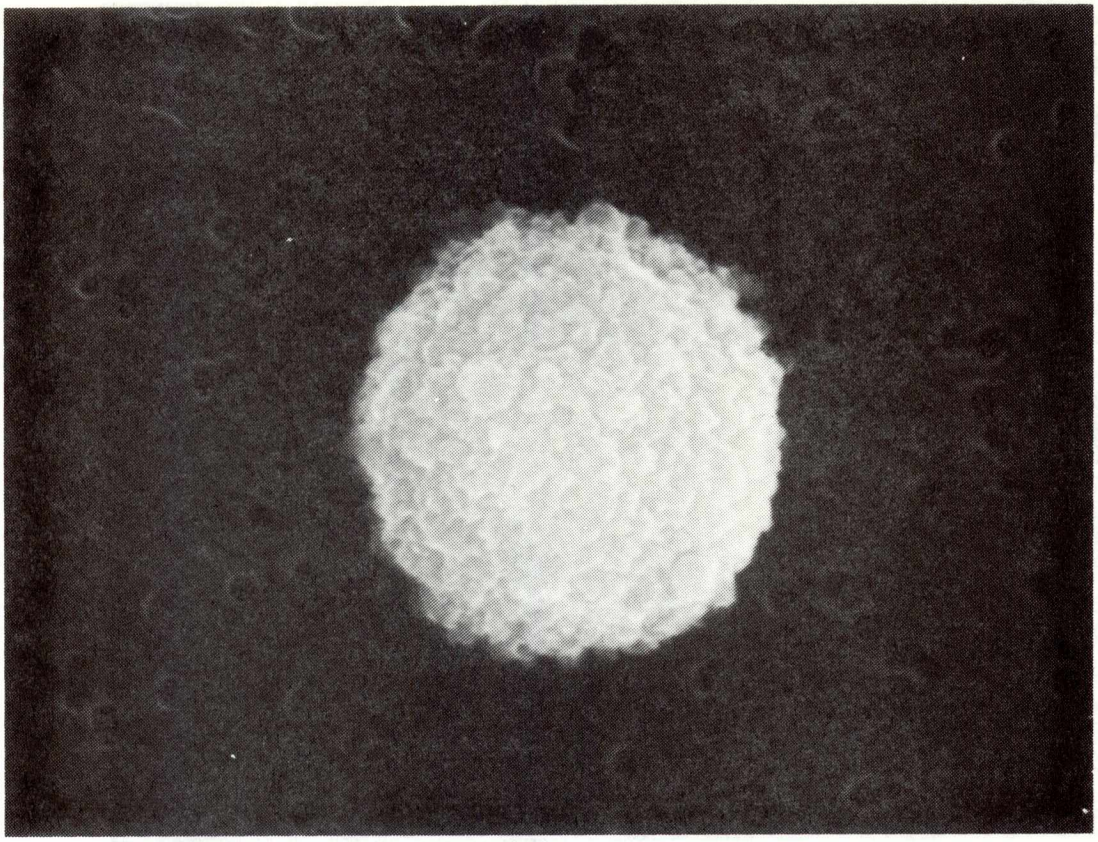


S-82-25721

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~5~~ 4	S	T	CL	V	AOS	

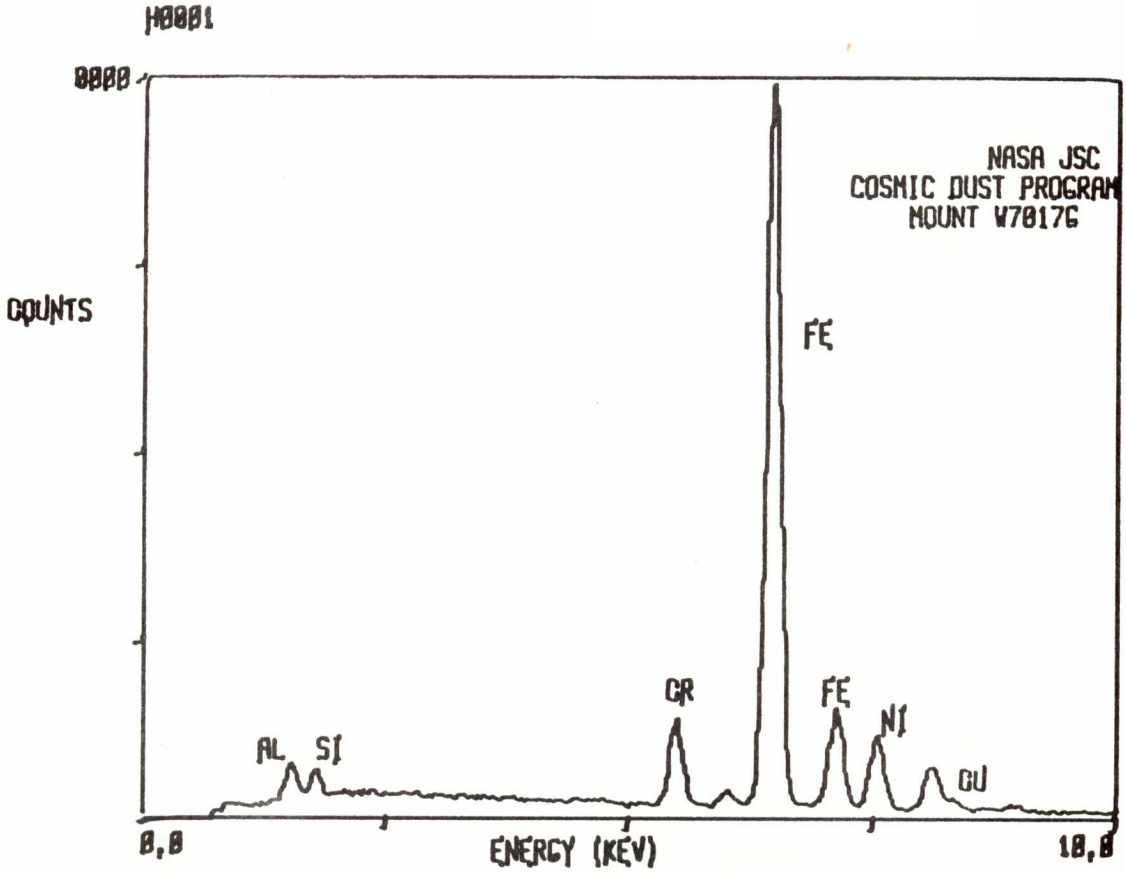


W7017G8

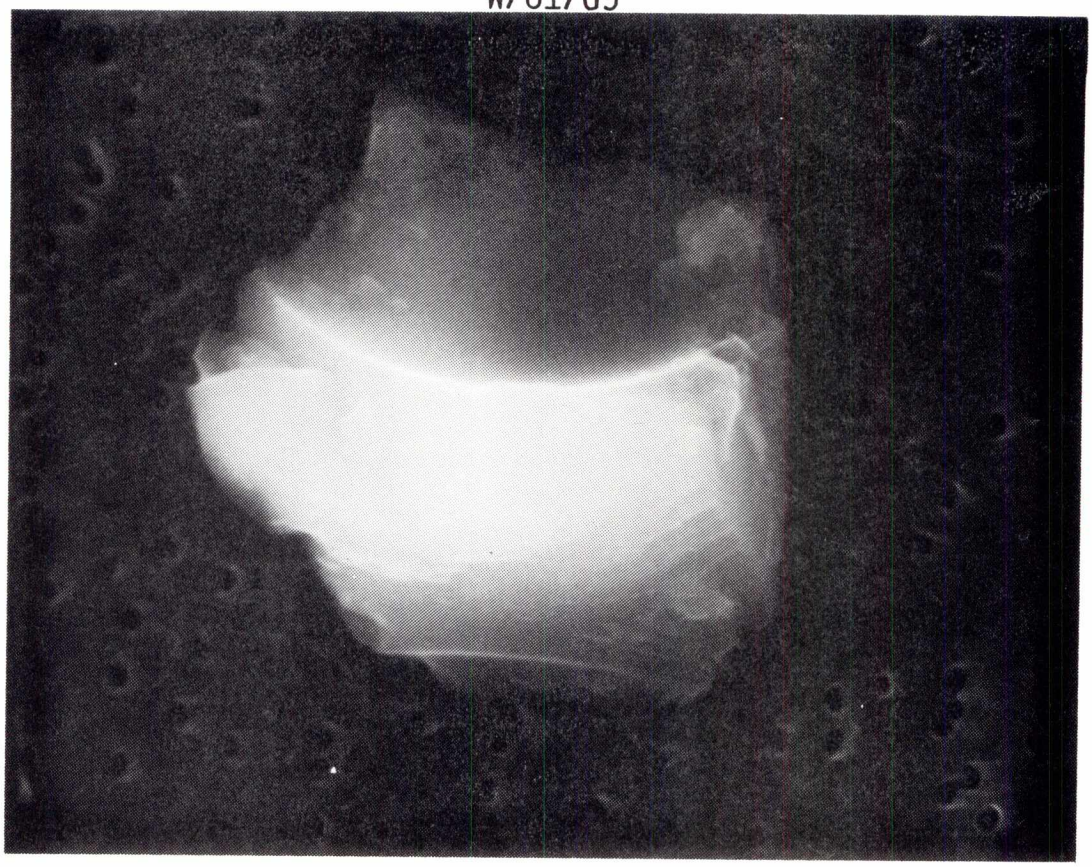


S-82-25719

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
4	S	O	Black	D/SM	?	Perhaps TCA, spherical?

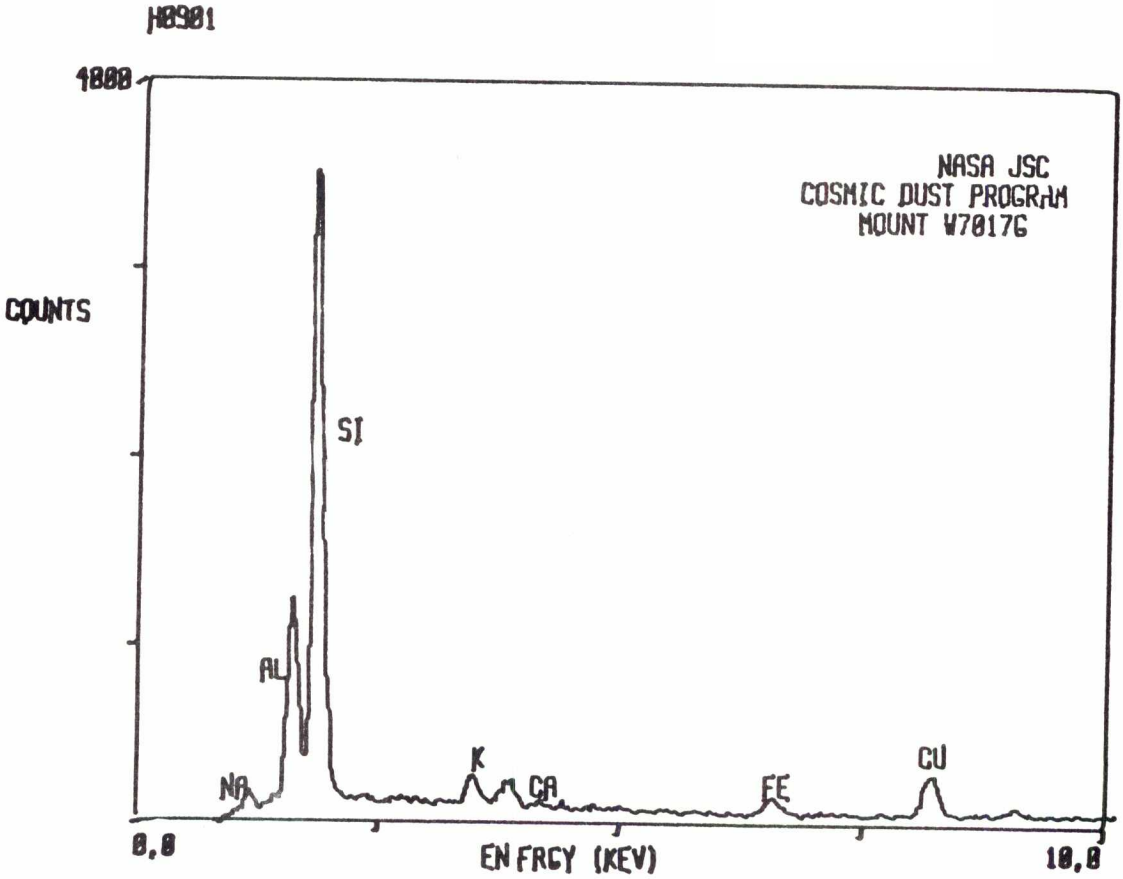


W7017G9

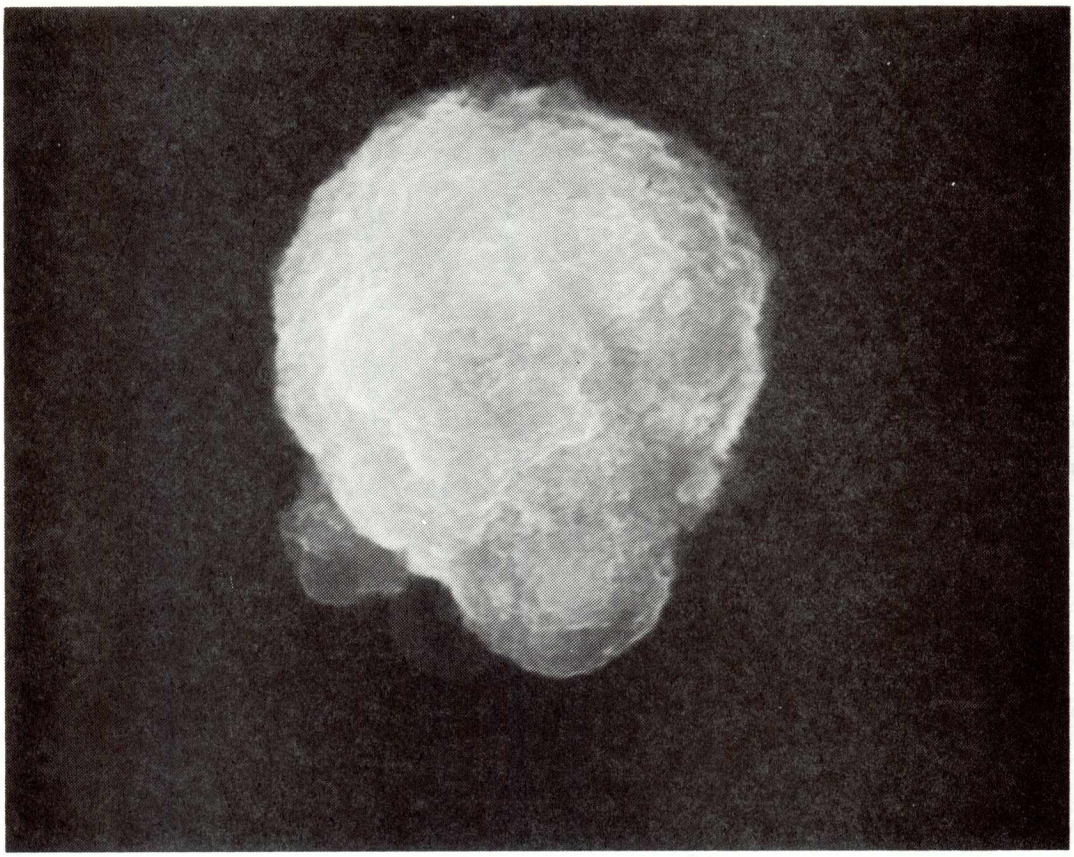


S-82-25722

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~7x8~~ 6x5	I	TL	CL	V	TCN?	Al x-ray emission may be artifact from Al grid on SEM mount

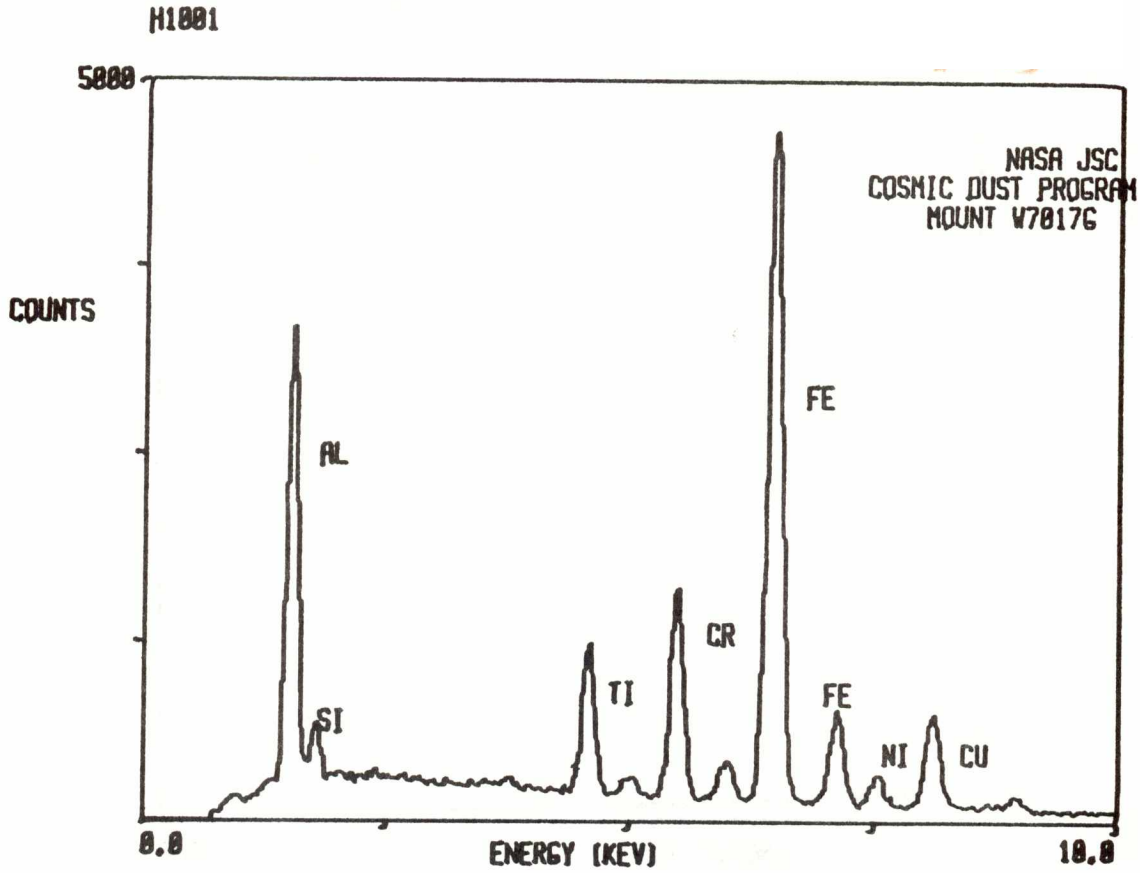


W7017G10

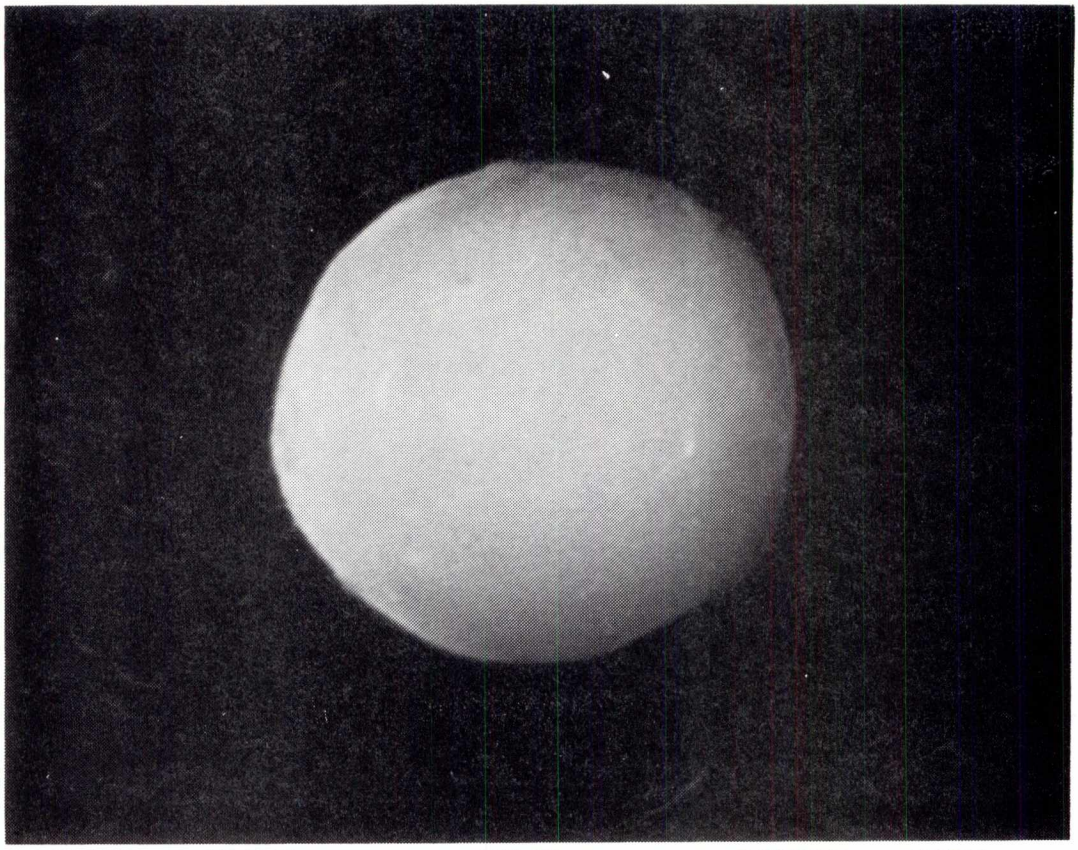


S-82-25724

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~5x6~~ 4x5	S/E	O	Black	SV/SM	TCA?	

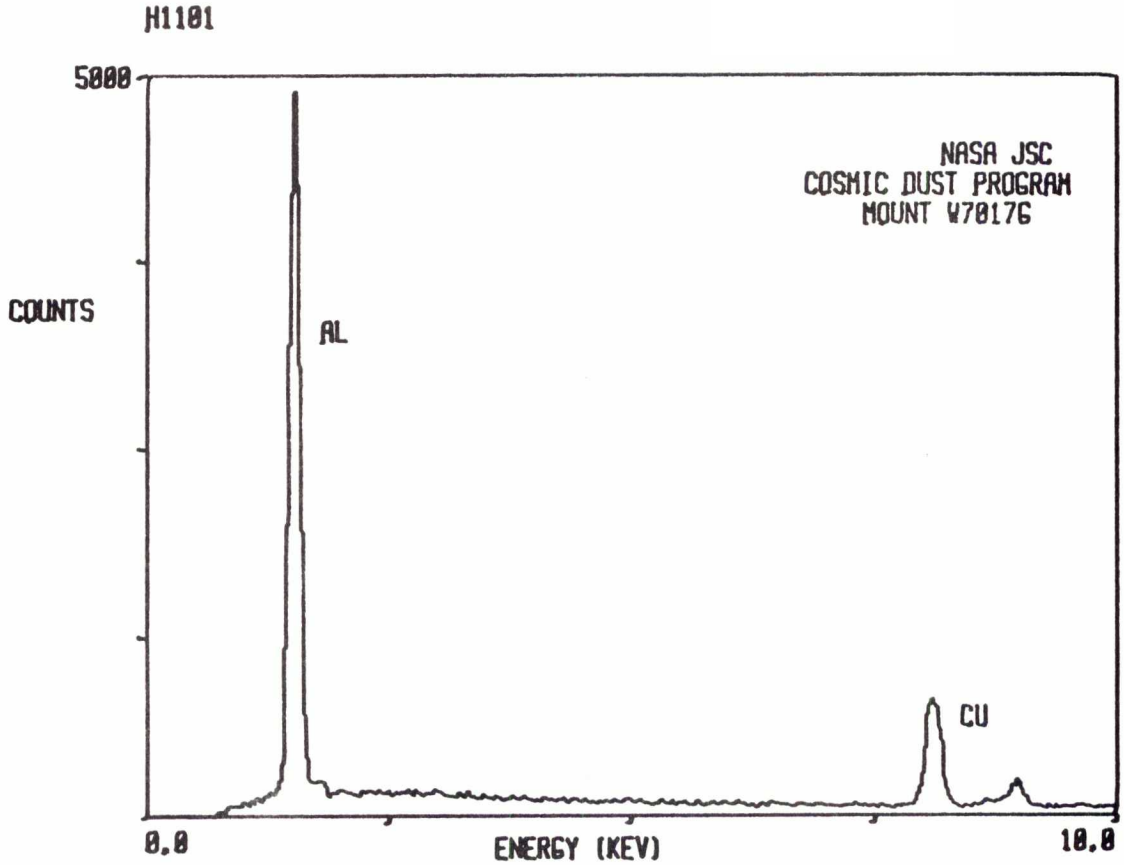


W7017G11

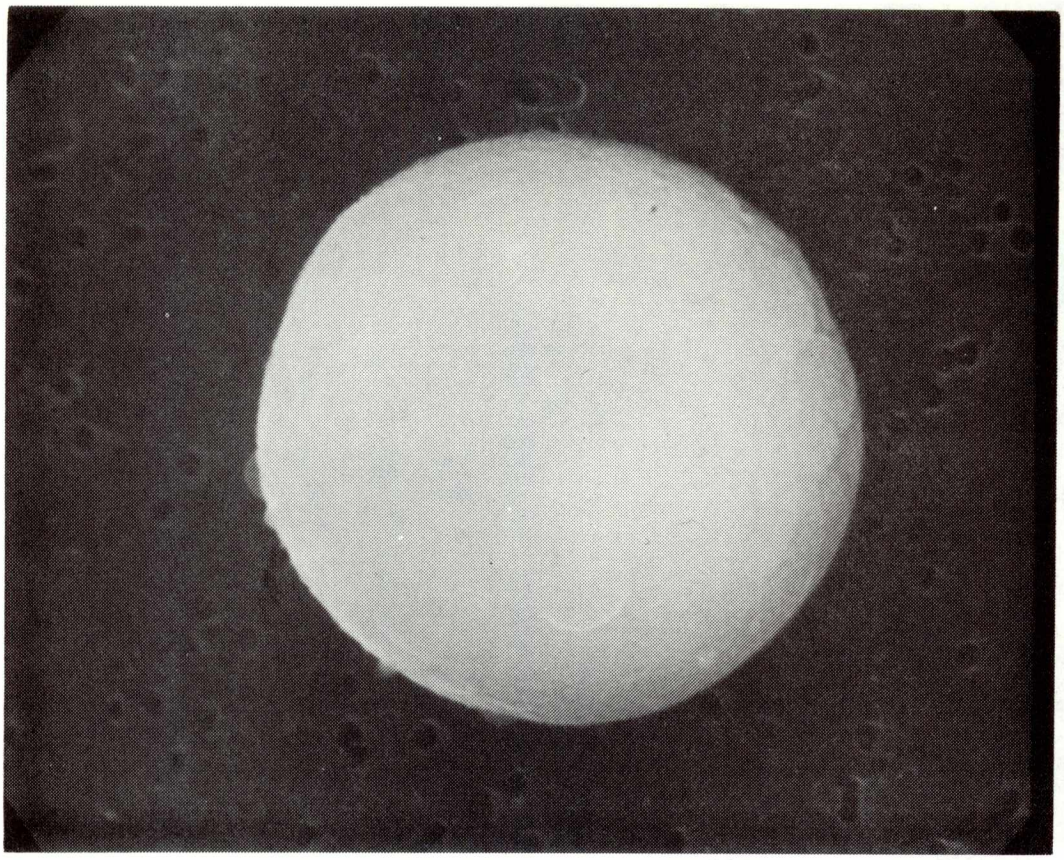


S-82-25723

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6~~ 5	S	T	CL	V	AOS	

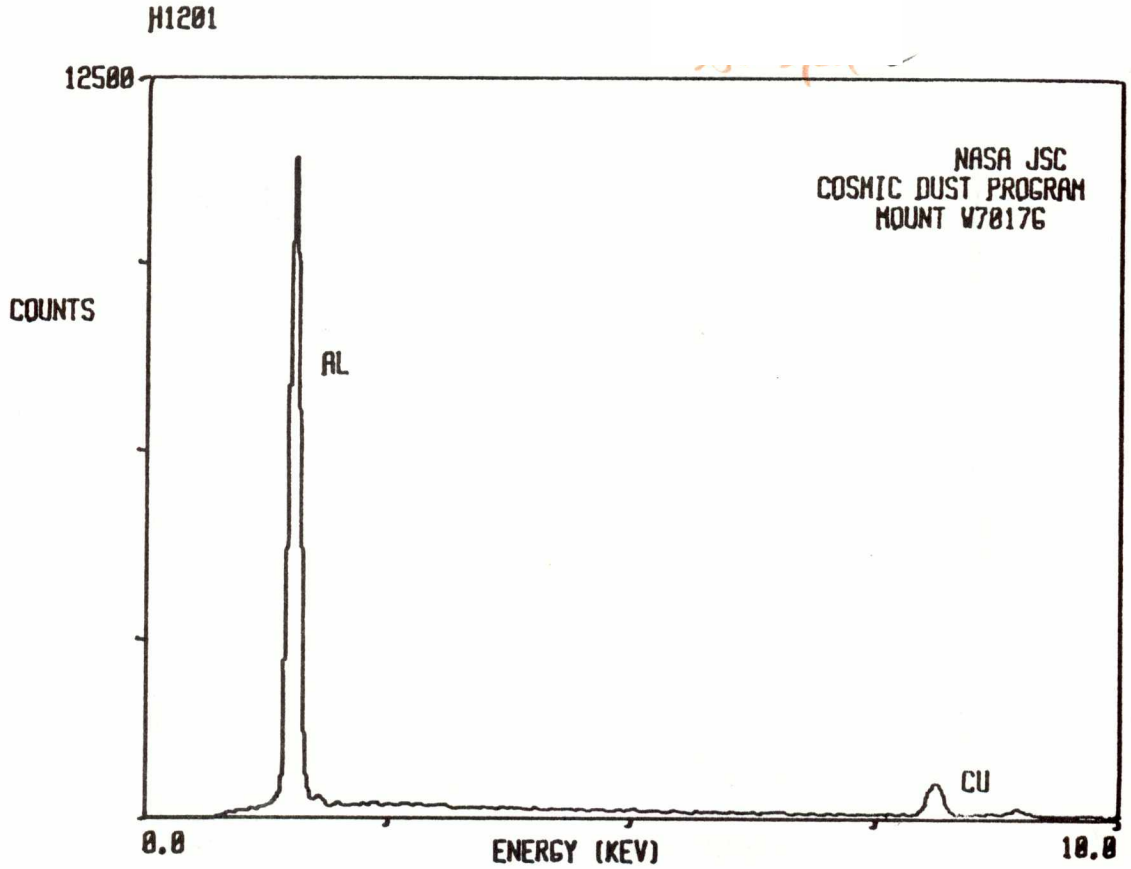


W7017G12

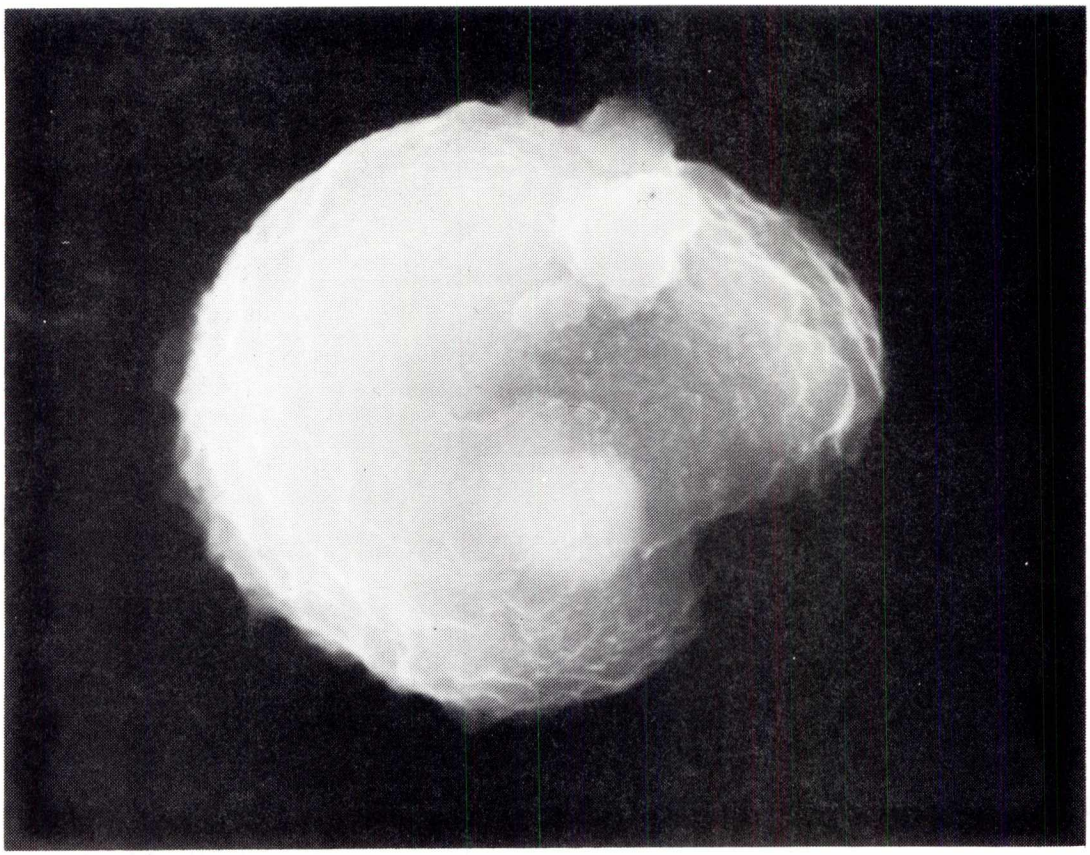


S-82-25714

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
76	S	T	CL	V	AOS	

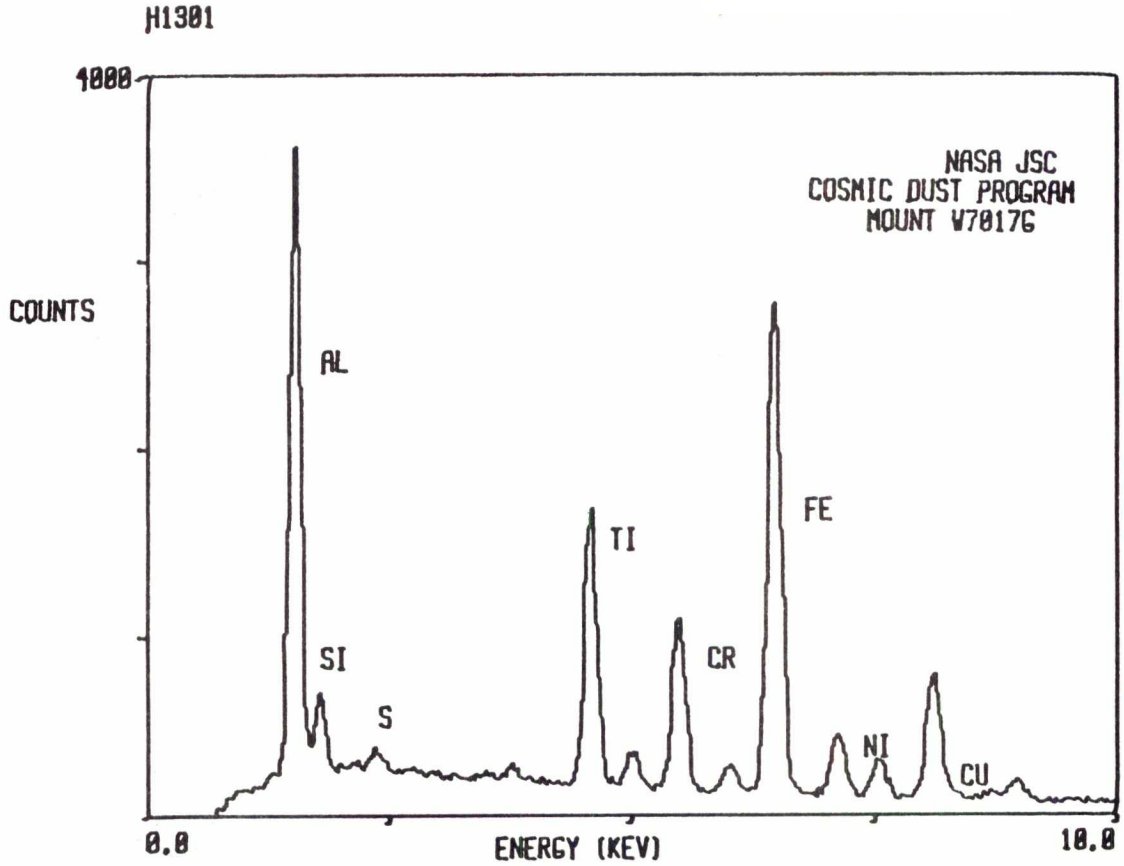


W7017G13

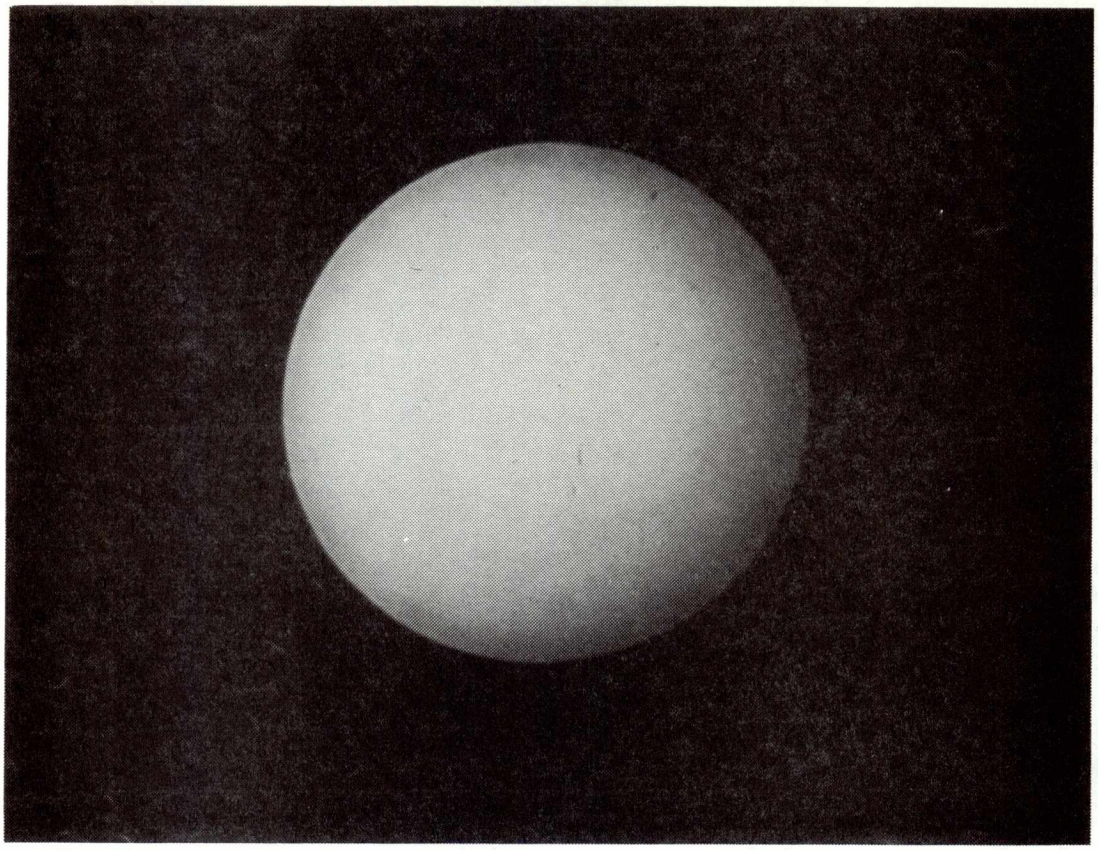


S-82-25713

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
6x5	S/E	O	Black	D/SM	TCA?	Broken sphere (?)

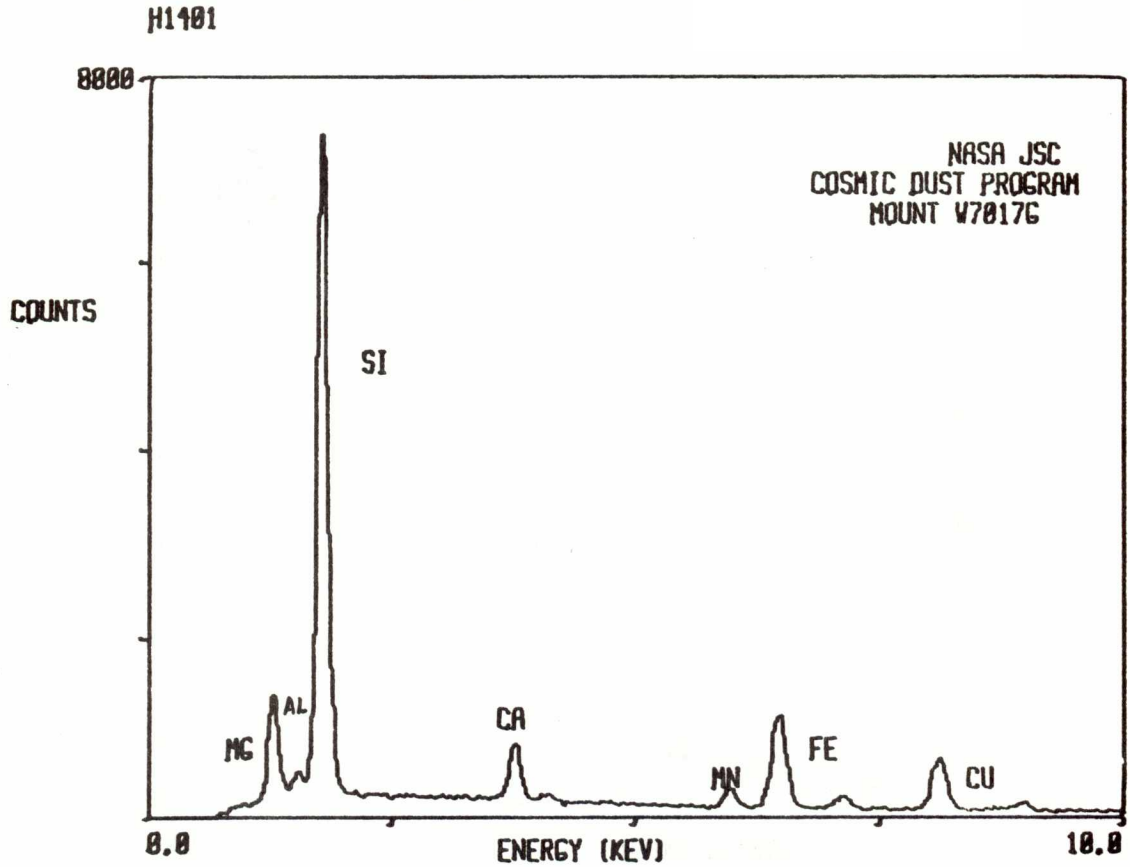


W7017G14

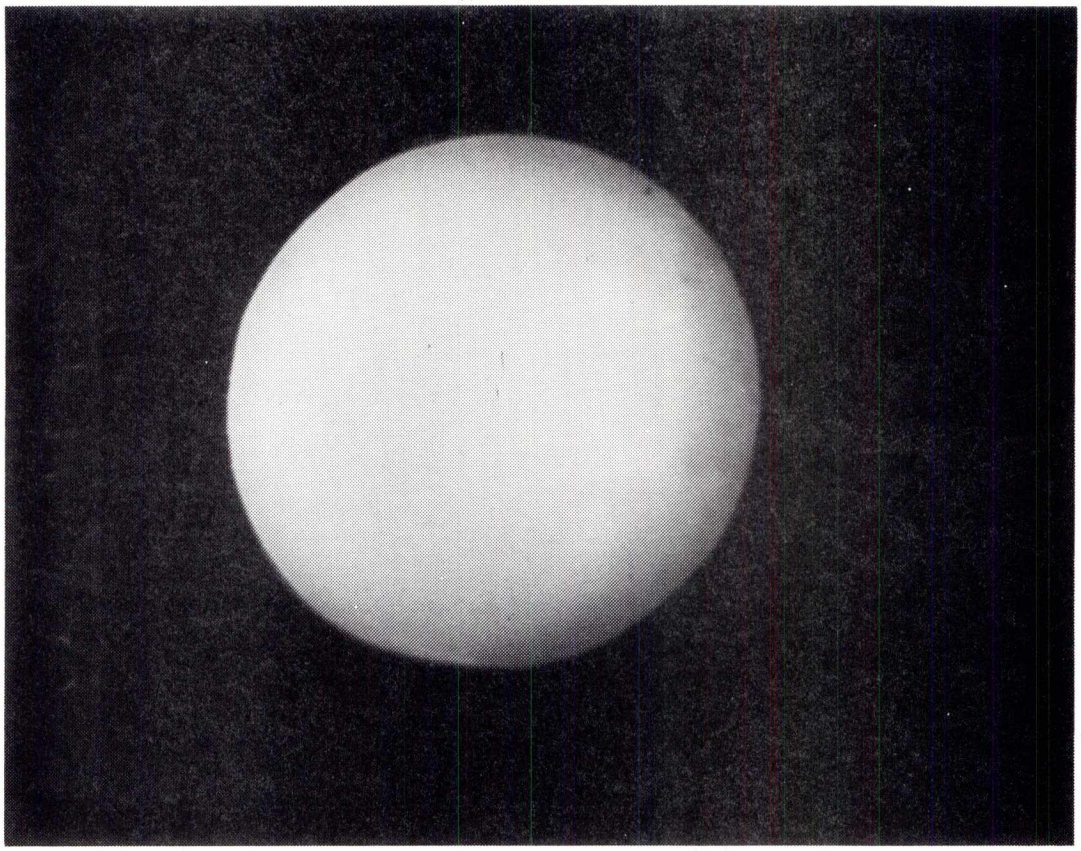


S-82-25712

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~6~~ 5	S	T	CL/Pale Yellow	V	?	

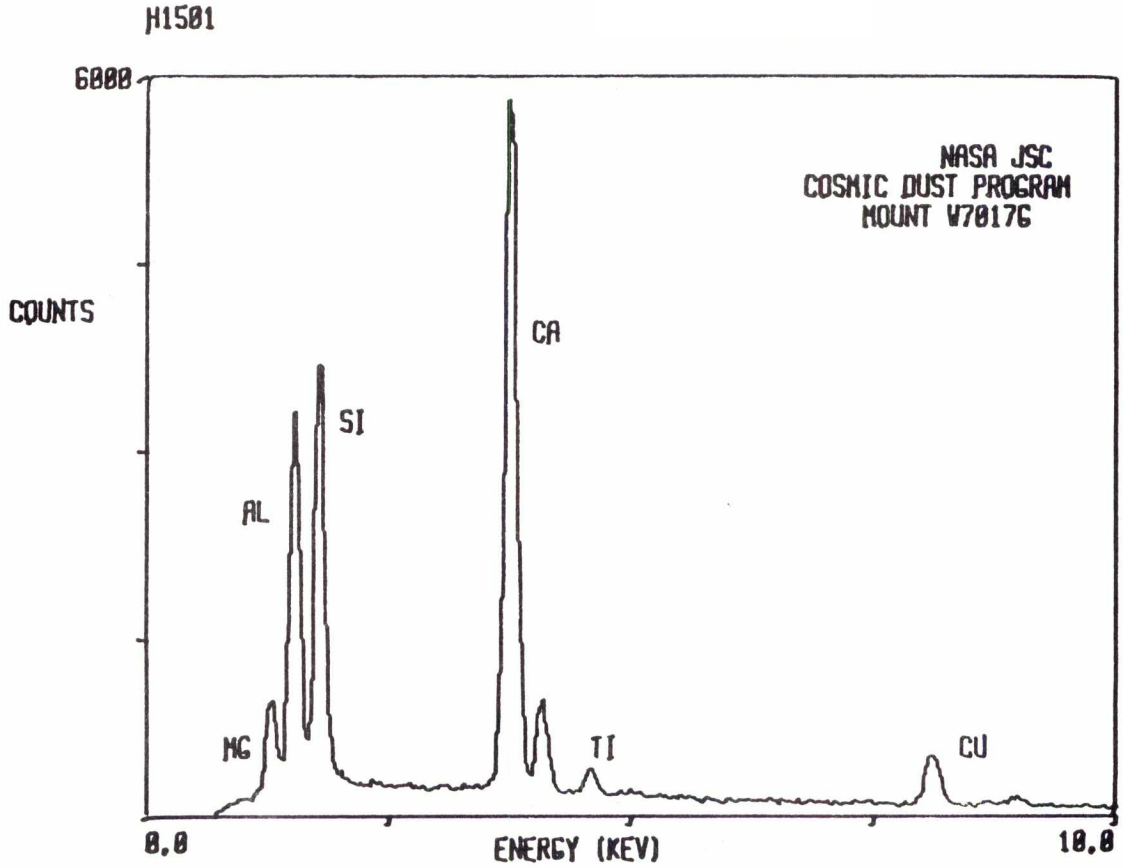


W7017G15

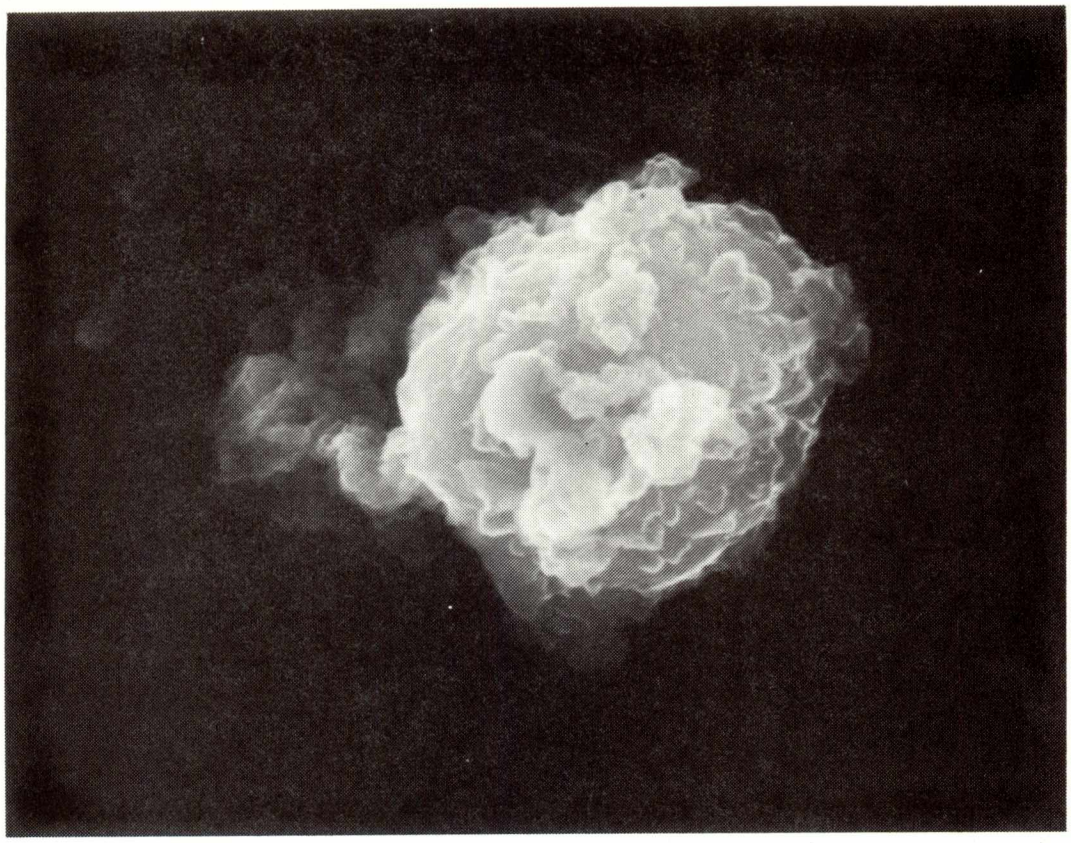


S-82-25711

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
7	S	T	CL	V	?	Perhaps C(?) with unusual elemental composition

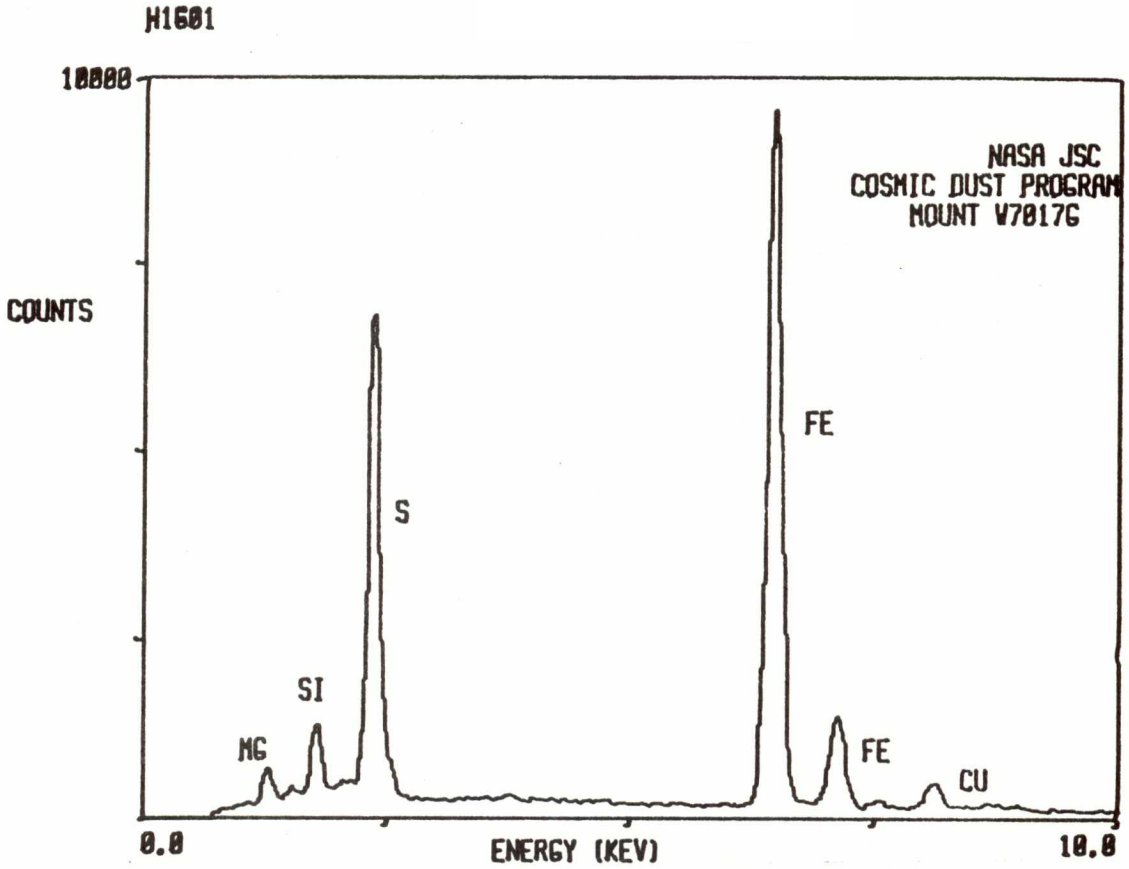


W7017G16



S-82-25710

SIZE	SHAPE	TRANS.	COLOR	LUSTER	TYPE	COMMENTS
~~9x12~~ 7x8	I	O	Reddish Black	SV/SM	C?	



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