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Cosmic Dust Catalog

Volume 11, Number 1

Particles from Collection Flag L2005

Space and Life Sciences Directorate
Solar System Exploration Division
Planetary Materials Branch Publication #83

Compiled by:

Cosmic Dust Preliminary Examination Team (CDPET)

June 1990

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

COSMIC DUST CATALOG

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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 ultra-clean (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 166 particles retrieved from collection surface L2005. This surface was a flat plate Large Area Collector (with a 300 cm^2 surface area) which was coated with silicone oil (dimethyl siloxane) and then flown aboard a NASA ER-2 aircraft during a series of flights that were made within west-central North America during the fall of 1989. 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 40 hours of stratospheric exposure was accumulated for flag L2005.

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 filter (0.4 μm 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 stereo-microscope. Each particle is positioned on an aluminum-free area of a Freon-cleaned (Freon 113), 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.

This catalog is the first to be produced from the new Large Area Cosmic Dust Collectors (LACs). These collectors have approximately one order of magnitude more collection surface area than the conventional collectors used for Cosmic Dust Catalogs 1-10. Accordingly, we wished to determine the particle type distri-

bution being collected on these new large plates. We therefore embarked upon a survey of LAC L2005, with the following results. There were a total of 5560 particles larger than 12 microns on the entire collection surface. There were 45 large, black cluster particles. We picked a sample of all cluster particles, and a "random" sampling of the other large (>12 micron) particles for preliminary characterization.

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). Secondary-electron imaging of each particle is performed with a JEOL-35CF SEM at an accelerating voltage of 20 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 the same JEOL-35CF SEM equipped with a Si(Li) detector and PGT 4000T analyzer. Using an accelerating voltage of 20 kV, each particle is raster scanned and its X-ray spectrum recorded over the 0-10 keV range by counting for 100 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 1-3* and *8*. In these catalogs, EDS analysis was performed using the JEOL lOOCX STEM operated at 40 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.

To aid in our survey of this initial LAC collection, we analyzed more particles that could reasonably be included in this catalog. This catalog therefore describes <u>all</u> particles we found to resemble previously described interplanetary dust, and a selection of all other particle types encountered. The only exception to this rule concerns aluminum oxide spheres, of which none are described in this catalog (although many were encountered during the preliminary characterization study). Although this catalog does not present data on all of the particles from L2005 that

were characterized, all of this data, as well as the particles, are available for allocation. Contact the Curator for further information.

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

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 (μm) 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 (0). 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). Lusters 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. 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:

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 extraterrestrial 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 S and/or Ni.

(b) irregular to spherical, translucent to opaque, dark-colored particles containing various proportions of Mg, Si, and Fe with traces of S and/or Ni.

(c) irregular to faceted or blocky, transparent to translucent particles containing mostly Mg, Si, and Fe but with traces S and/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 al-

loys. 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.

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.) This particular catalog contains, by fiat, no AOS type particles. Such particles were encountered during the preliminary characterization study, and are available from the Curator.

?: 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. All of the larger, cluster particles have related material residing still on the LAC plate, and the comments reflect this. Users are free to request this material as well as the grains actually pictured in the catalog.

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; Allende Meteorite Bulk Powder, NMNH 3529). 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 20 kV whereas spectra in *Catalogs 1-3 and 8* were obtained with a different instrument operated at 40 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 20 kV and the other at

40 kV, as presented in *Cosmic Dust Catalogs 1-3 and 8* (only spectra collected at 20kV 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 20 kV spectra in this catalog will show peaks of light elements enhanced relative to peaks of heavy elements when compared with 40 kV spectra published in *Catalogs 1-3 and 8*. The explanation is based both on geometrical differences between X-ray paths in the two EDS systems (the JEOL35CF 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 with 20 kV spectra. 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.

SAMPLE REQUESTS

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

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

Telephone:
(713) 483-5128
FTS: 525-5128

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 SN21
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.

ACKNOWLEDGEMENTS

Norm La Fleur and coworkers (NASA/Ames Research Center, Moffett Field, California) performed the loading and unloading of the cosmic dust collectors on the ER-2 aircraft and provided flight log data.

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

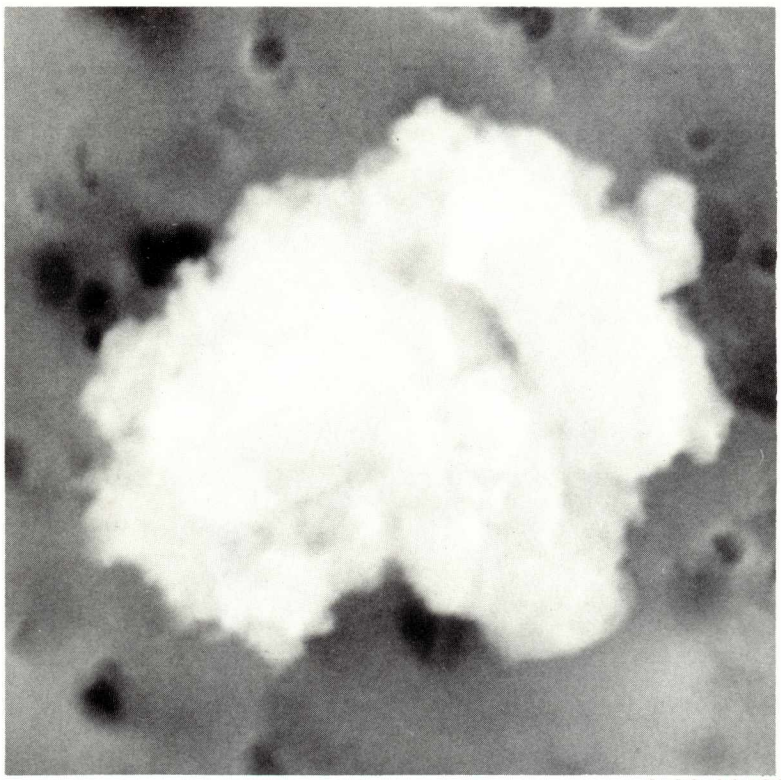
PARTICLE TABLE OF CONTENTS

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.

Particle Descriptions

C and C? Type

L2005 A 5



S-90-38129

SIZE: 4x5

SHAPE: I

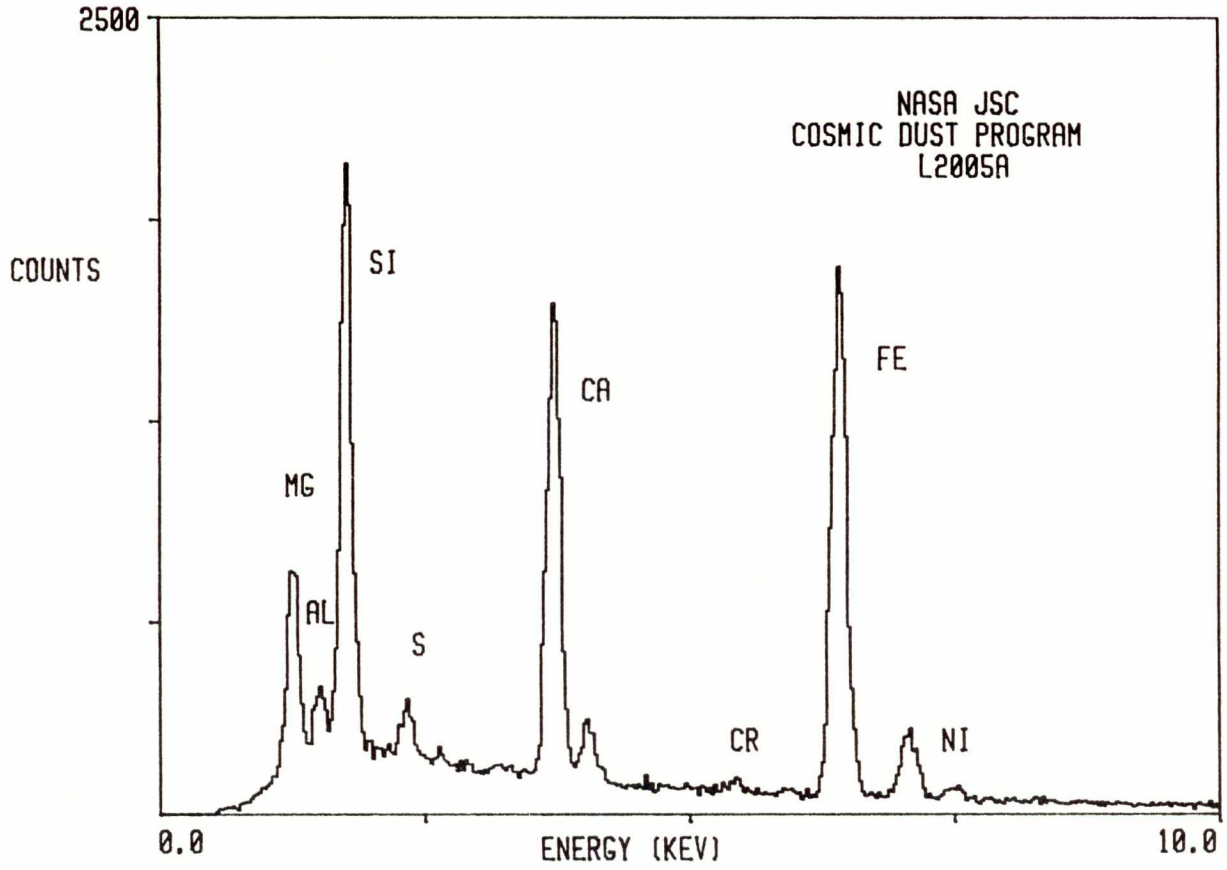
TRANS.: O/TL

COLOR: Black

LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 14 microns remain on collector



L2005 A 6

S-90-38130

SIZE: 4x6

SHAPE: I

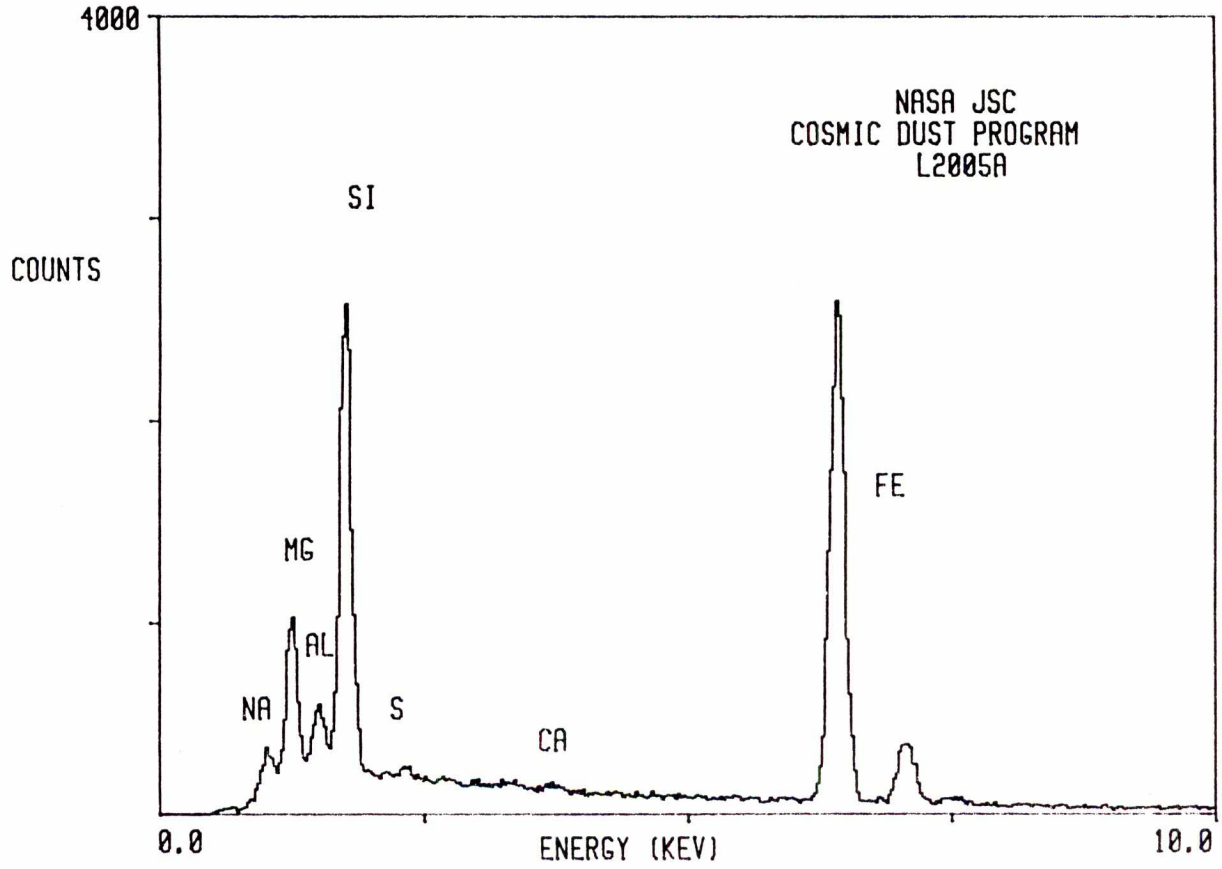
TRANS.: O/TL

COLOR: Black

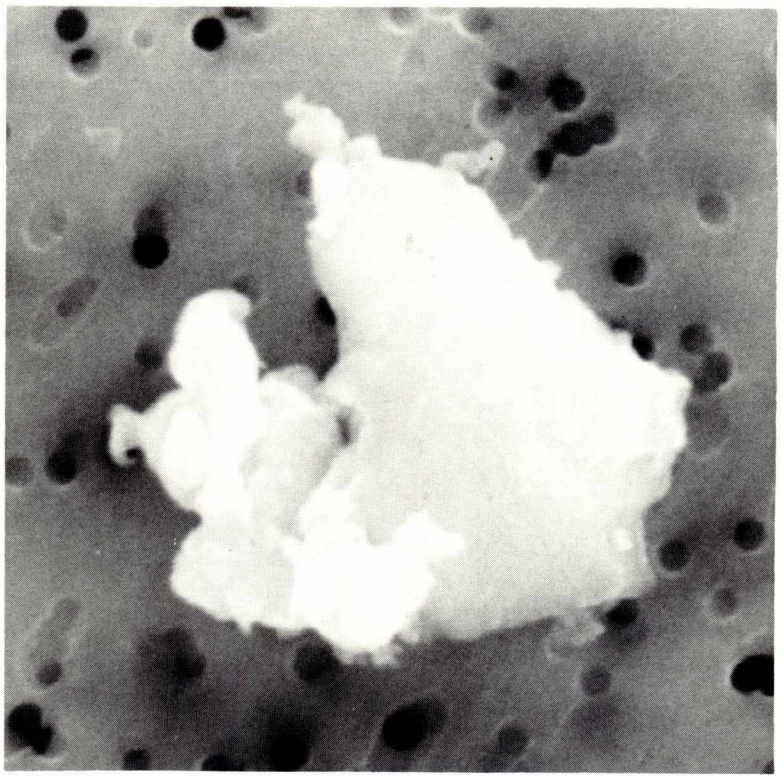
LUSTER: D

TYPE: C?

COMMENTS:
Related grains up to 10 microns remain on collector



L2005 B 9



S-90-38132

SIZE: 5

SHAPE: I

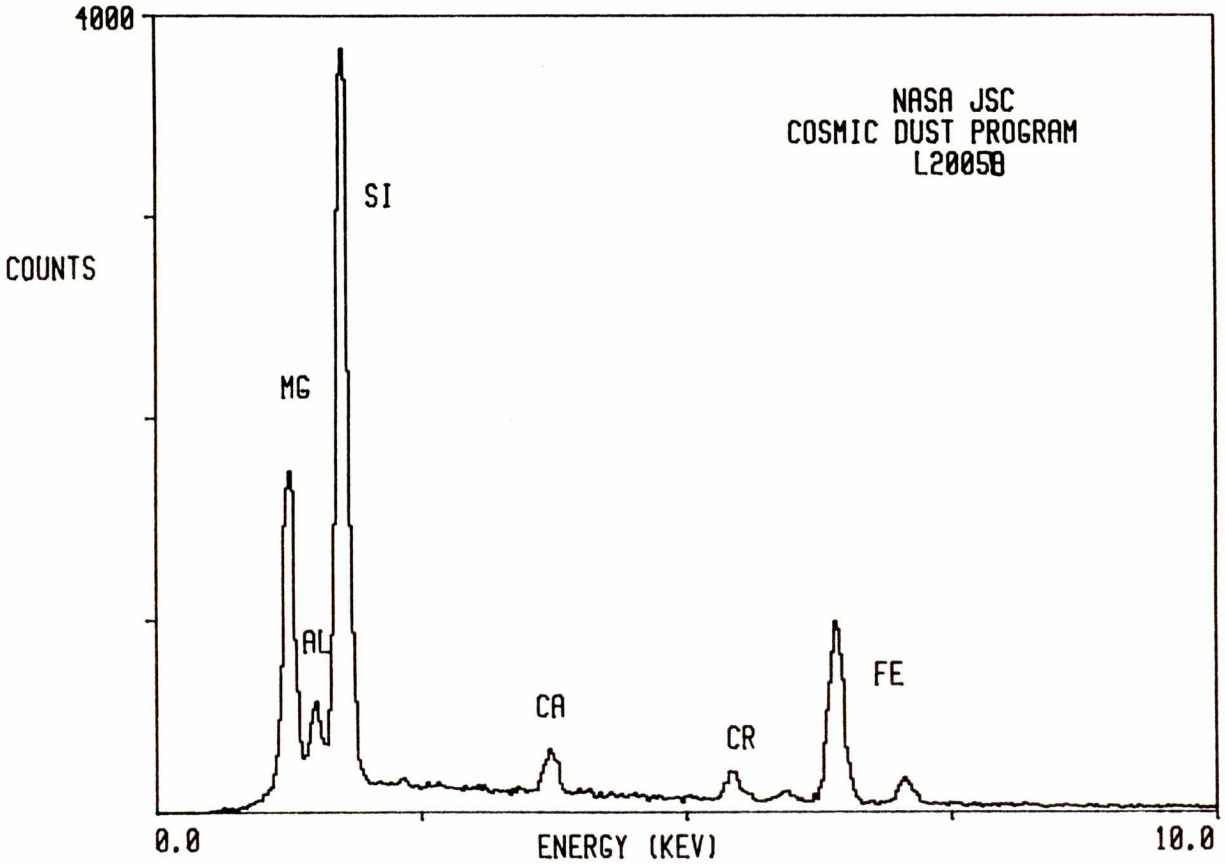
TRANS.: O

COLOR: Black

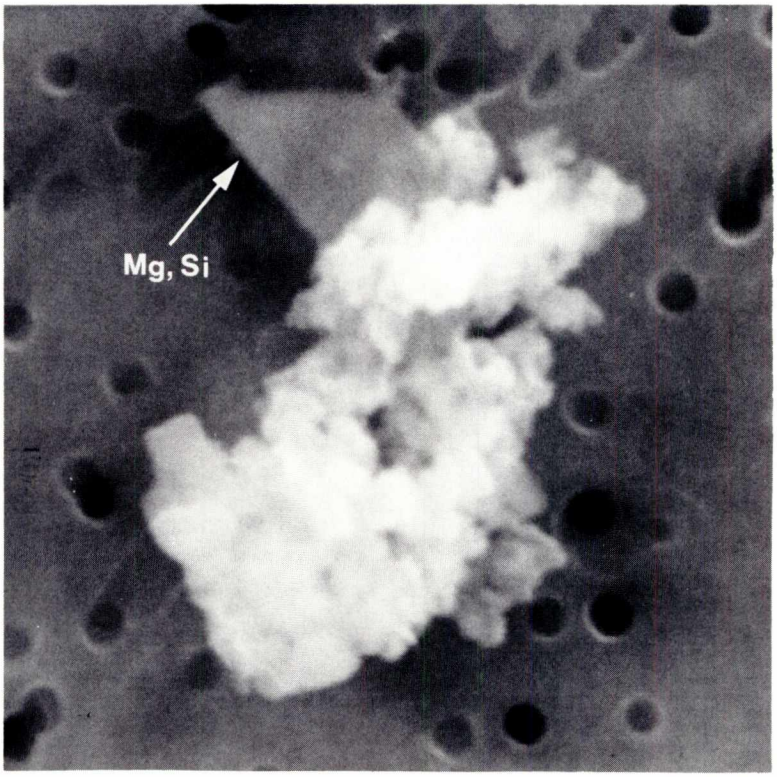
LUSTER: D

TYPE: C?

COMMENTS:
Related grains up to 6 microns remain on collector



L2005 B 10



S-90-38133

SIZE: 6x3

SHAPE: I

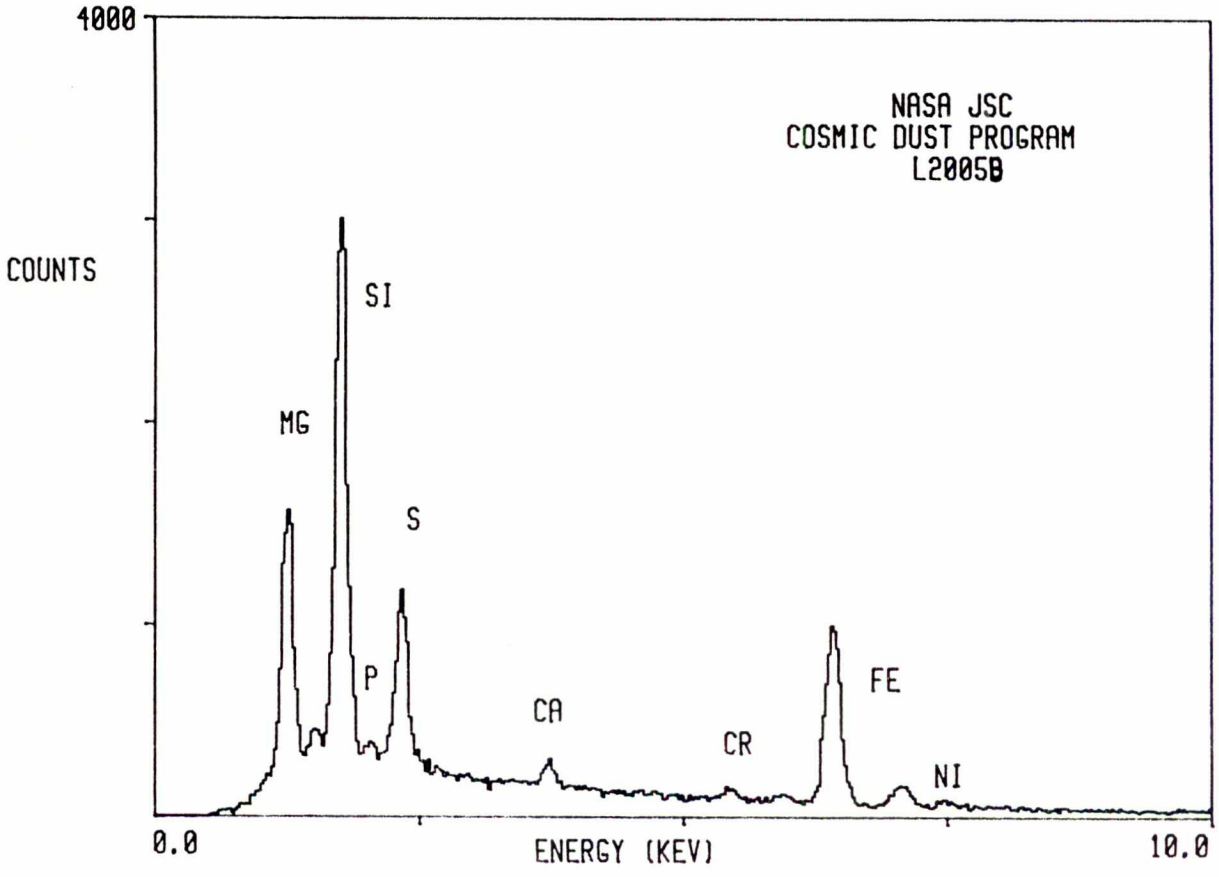
TRANS.: O/TL

COLOR: Black

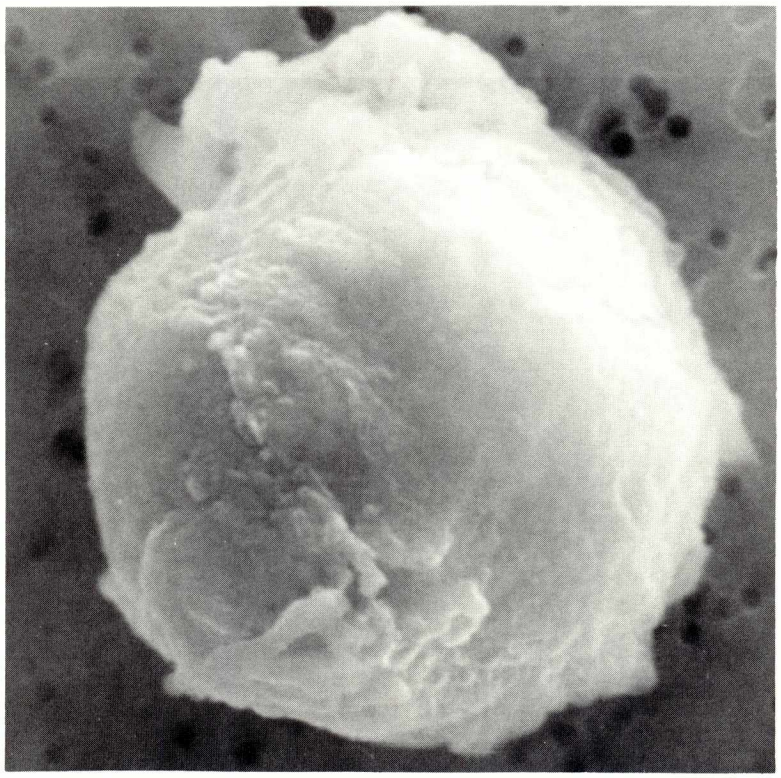
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 10 microns remain on collector



L2005 B 11



S-90-38134

SIZE: 10

SHAPE: S

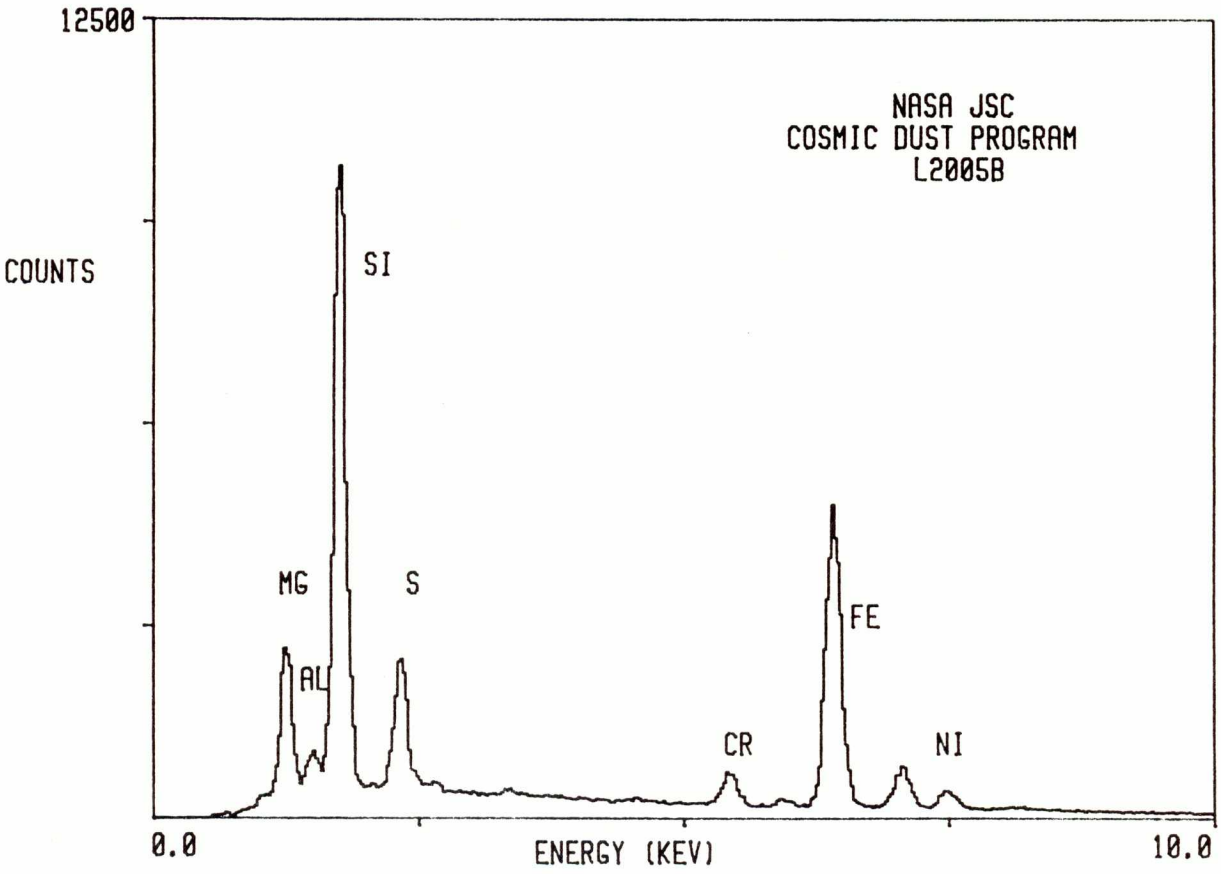
TRANS.: TL

COLOR: Brown

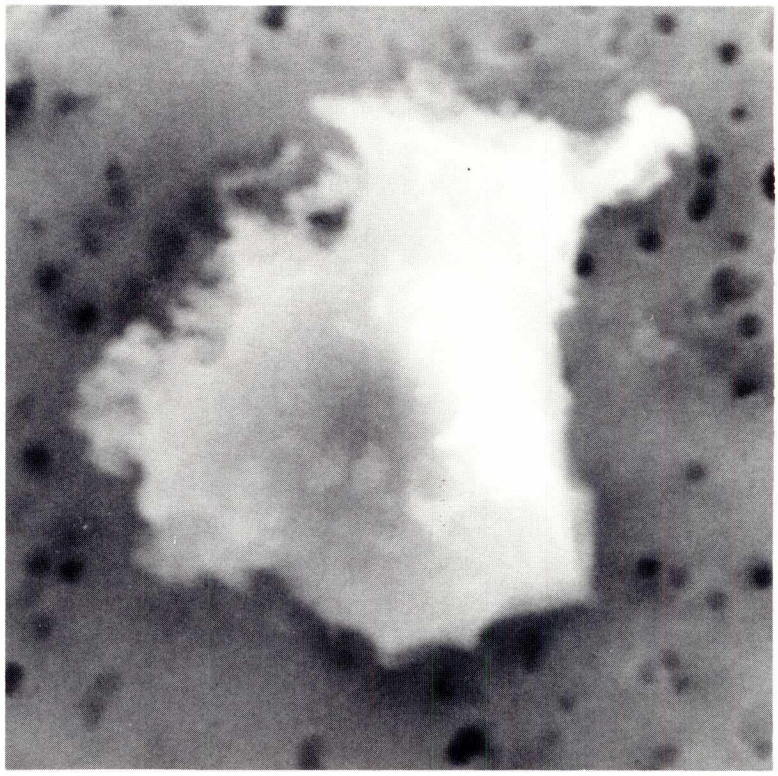
LUSTER: V

TYPE: C

COMMENTS:
Related grains up to 12 microns remain on collector



L2005 B 12



S-90-38135

SIZE: 10

SHAPE: I

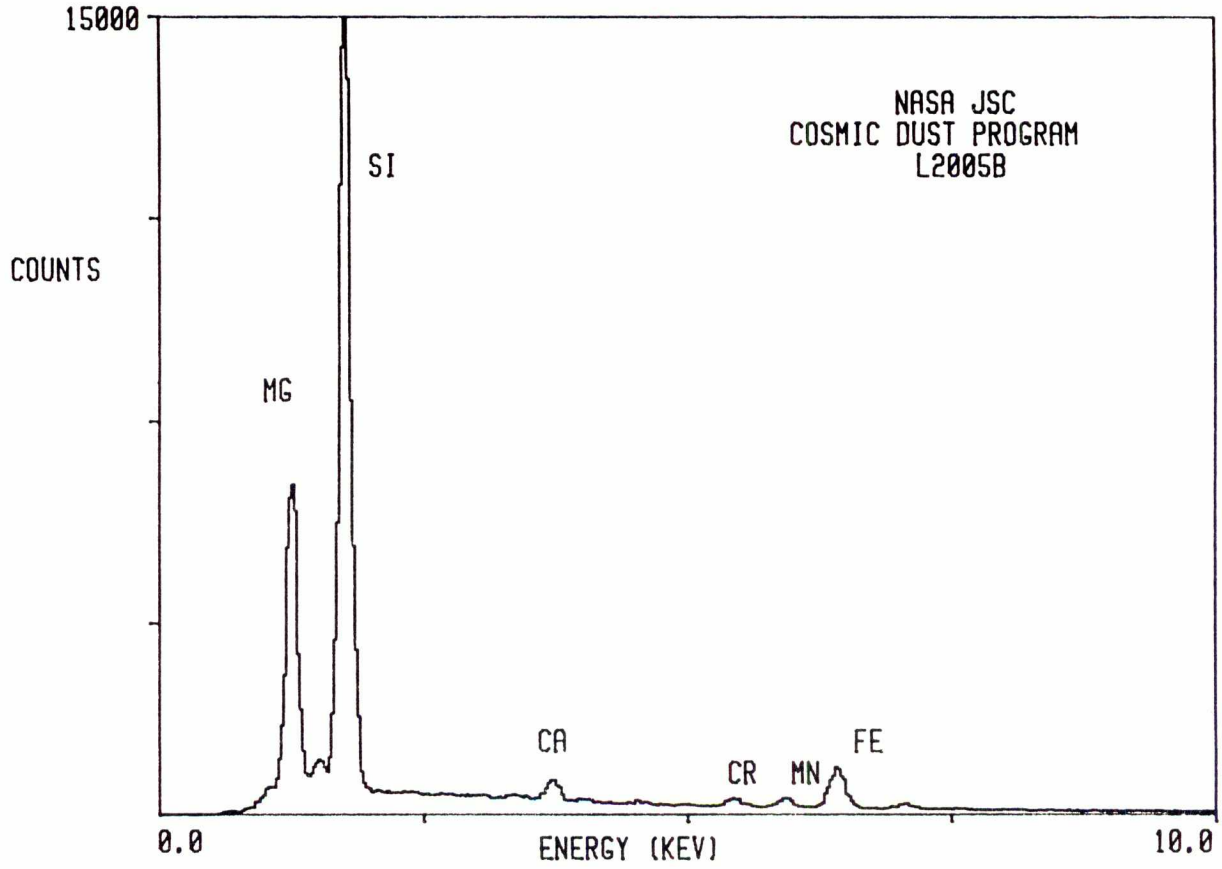
TRANS.: O

COLOR: Black

LUSTER: D

TYPE: C?

COMMENTS:
Related to L2005B13, B14, B15 and B16. Related grains up to 20 microns remain on collector



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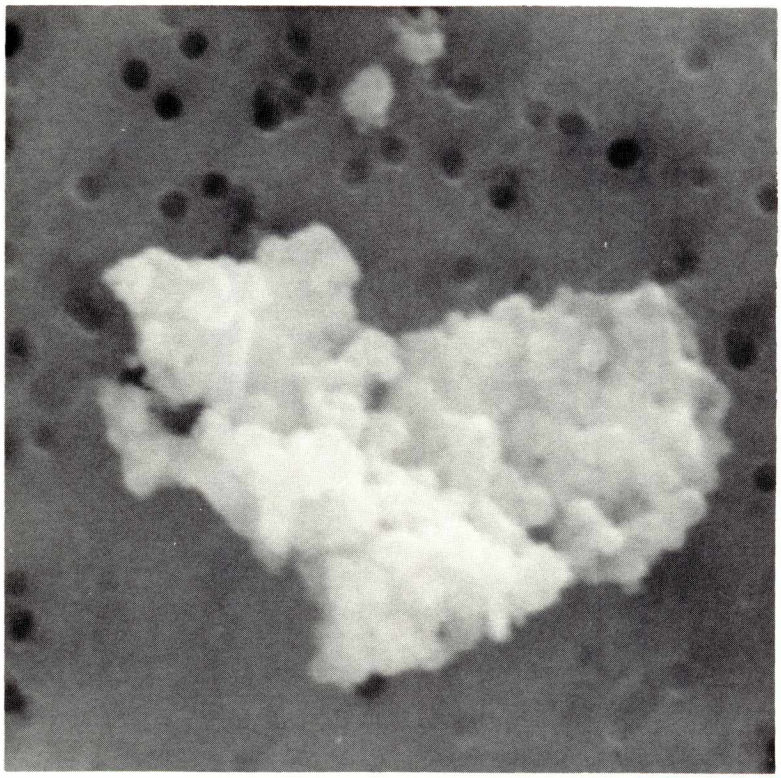


S-90-38123

SIZE: 7

SHAPE: I

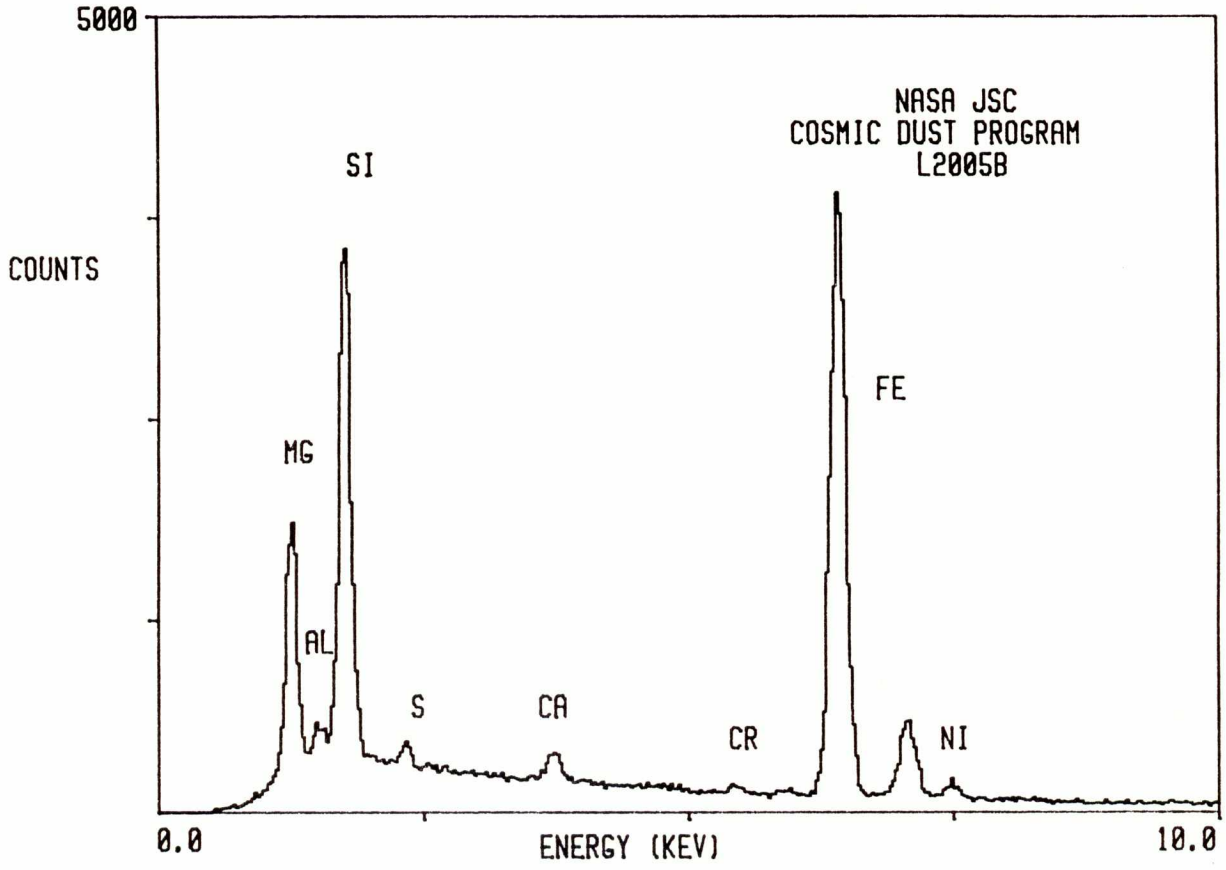
TRANS.: O

COLOR: Black

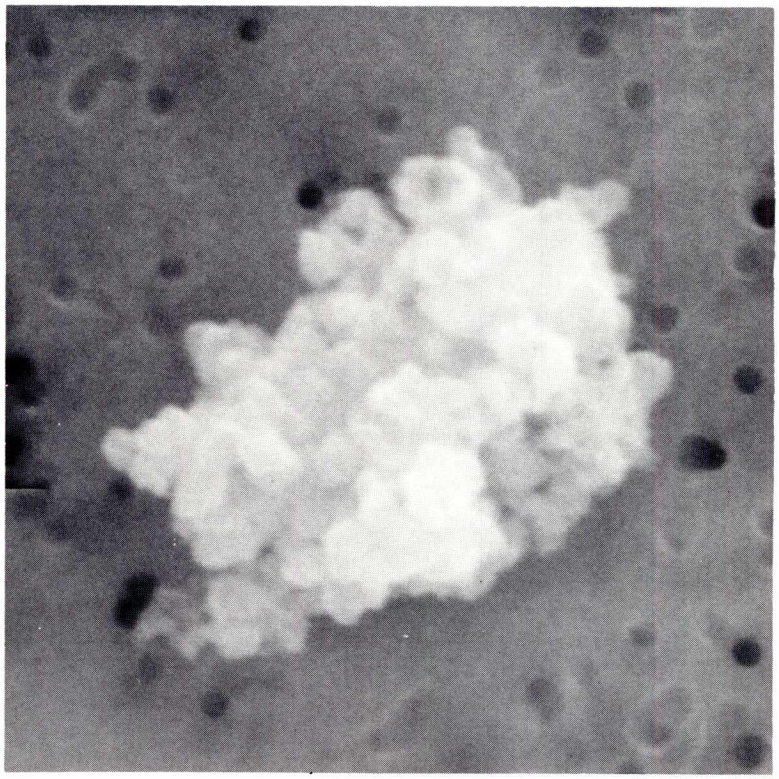
LUSTER: D

TYPE: C?

COMMENTS:
Related to L2005B12, B14, B15 and B16



L2005 B 14



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SHAPE: I

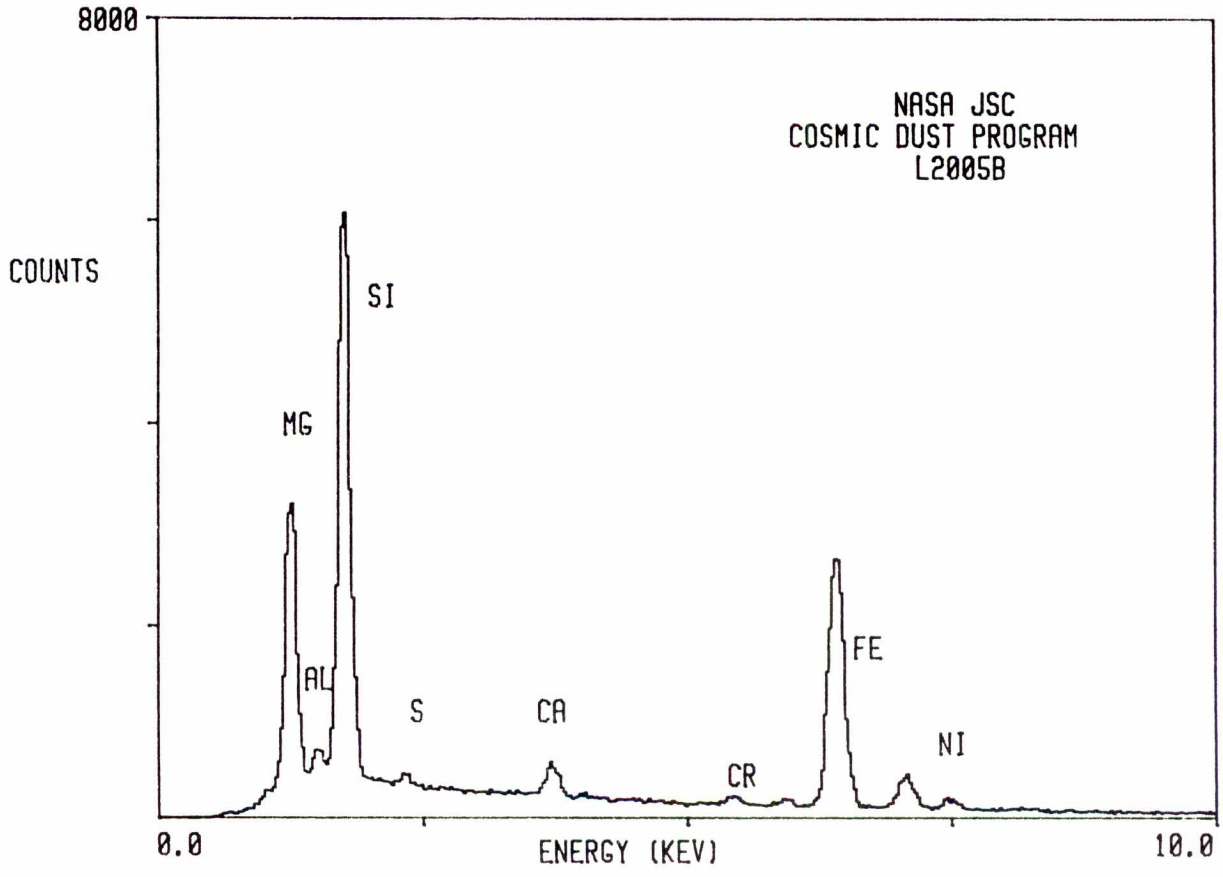
TRANS.: O

COLOR: Black

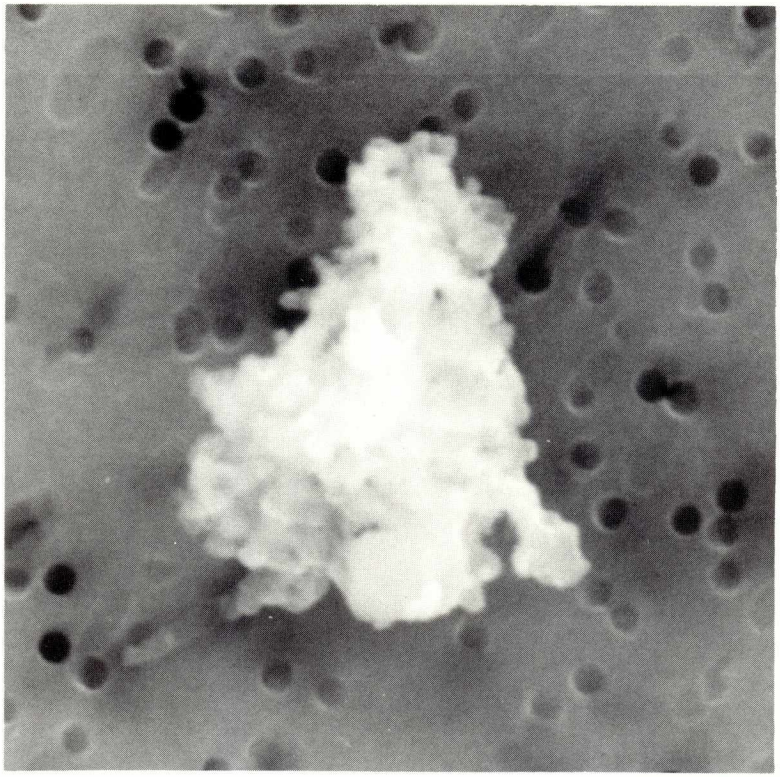
LUSTER: D

TYPE: C?

COMMENTS:
Related to L2005B12, B13, B15 and B16



L2005 B 15



S-90-38136

SIZE: 5

SHAPE: I

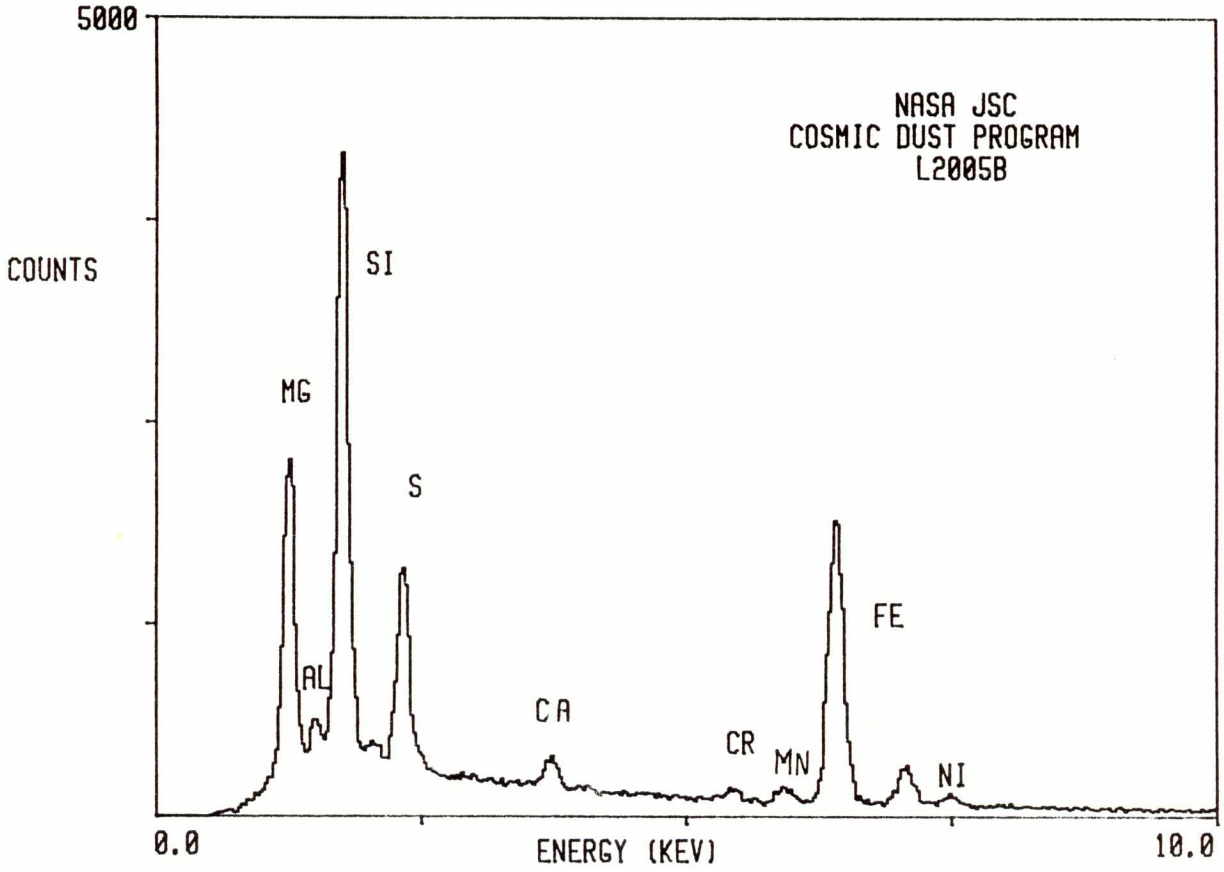
TRANS.: O

COLOR: Black

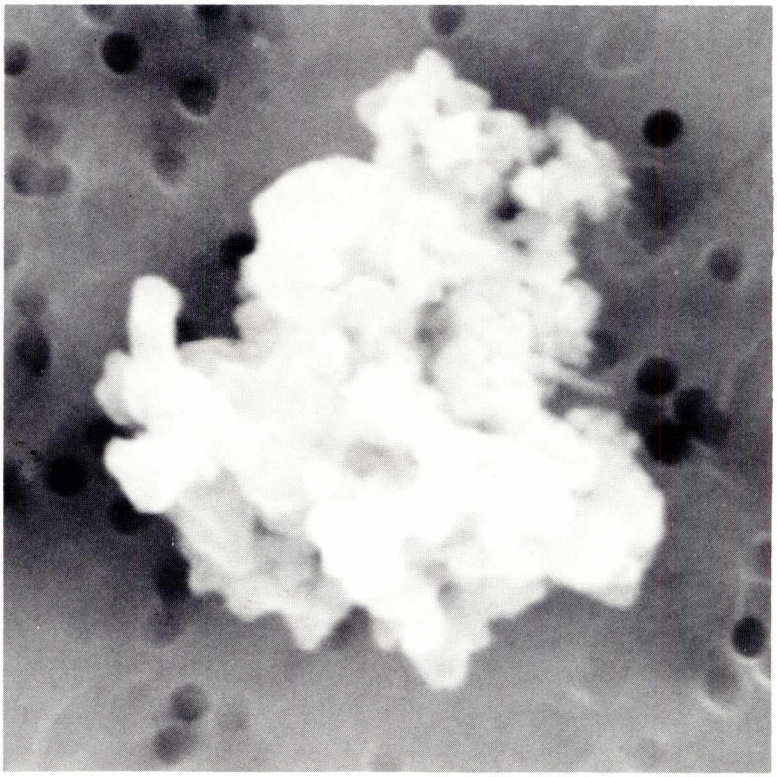
LUSTER: D

TYPE: C?

COMMENTS:
Related to
L2005B12, B13, B14
and B16



L2005 B 16



S-90-38137

SIZE: 5

SHAPE: I

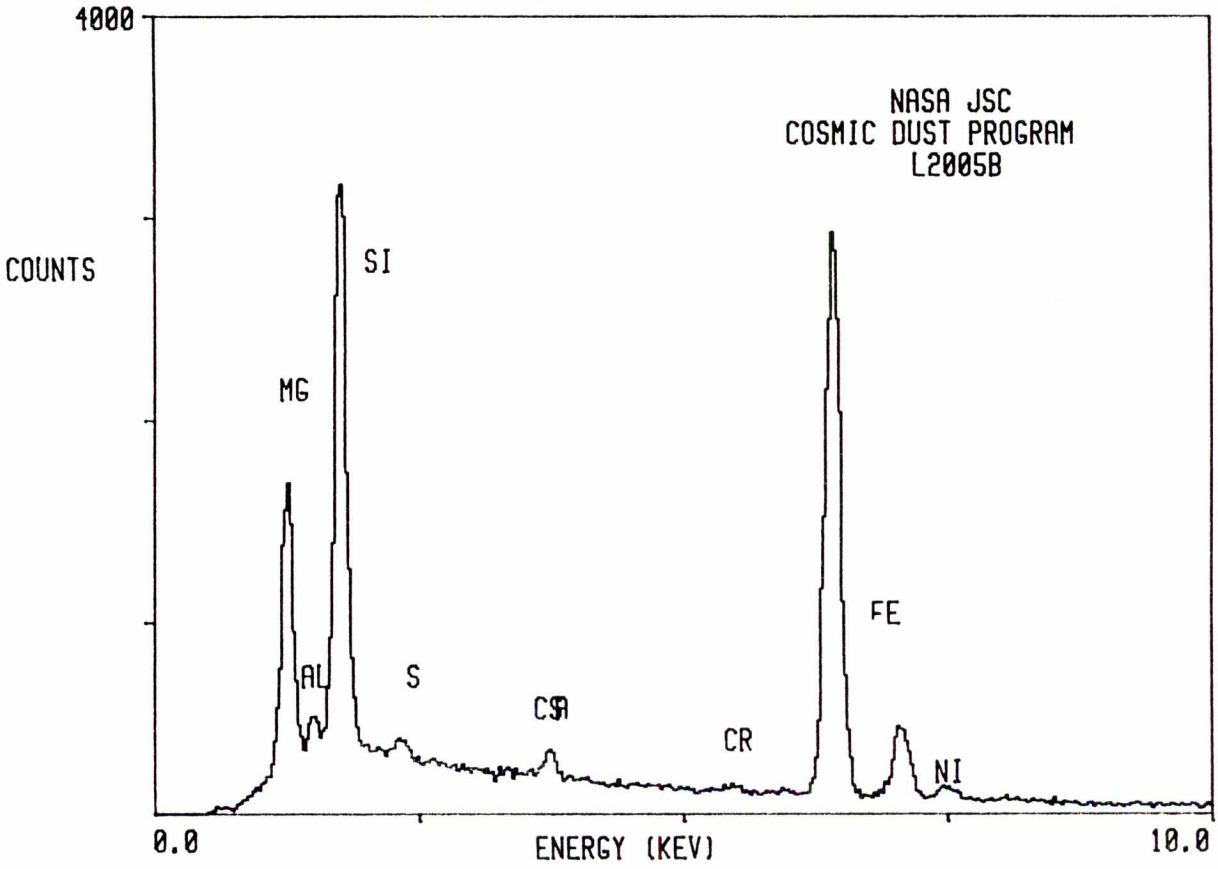
TRANS.: O

COLOR: Black

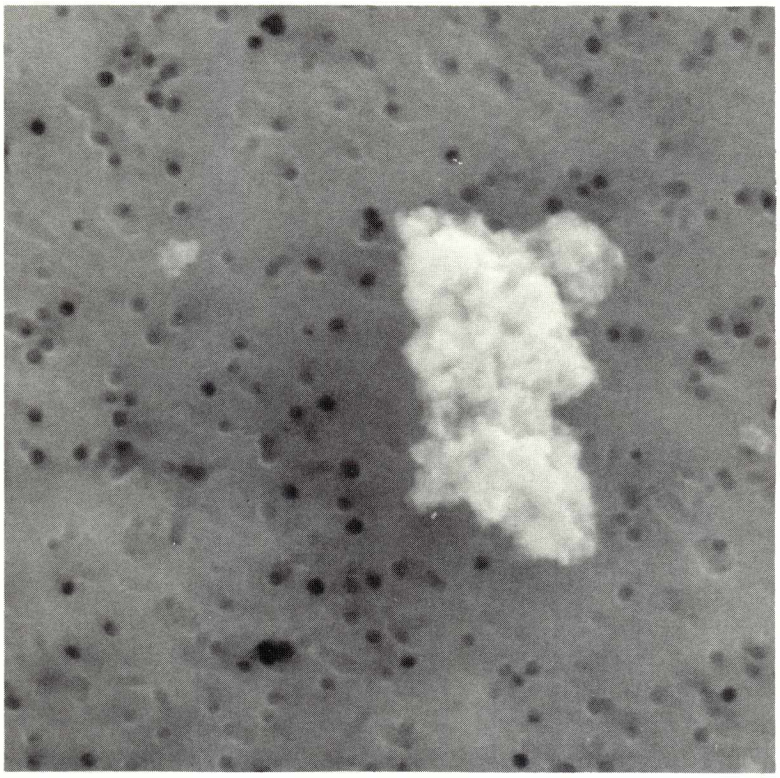
LUSTER: D

TYPE: C?

COMMENTS:
Related to L2005B12, B13, B14 and B15



L2005 C 1



S-90-38124

SIZE: 8

SHAPE: I

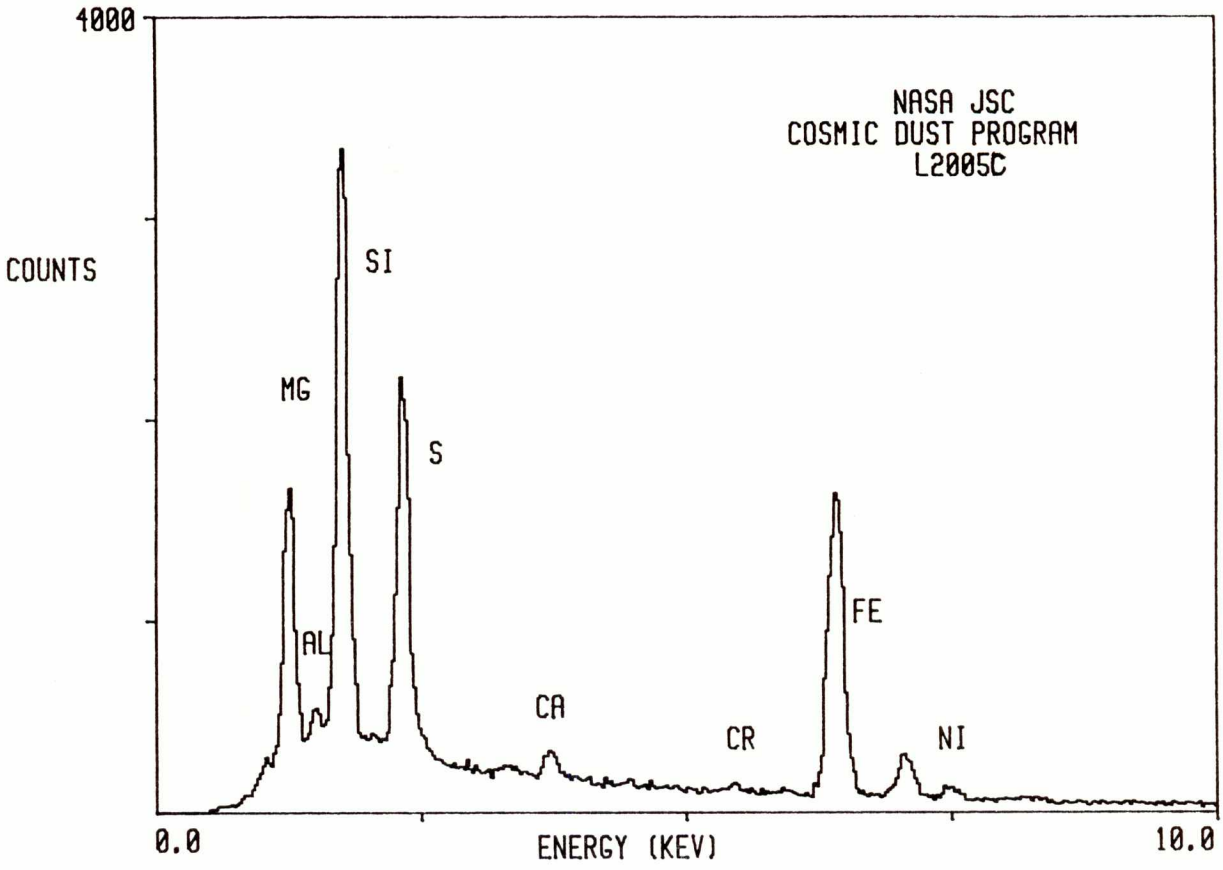
TRANS.: O/TL

COLOR: Black

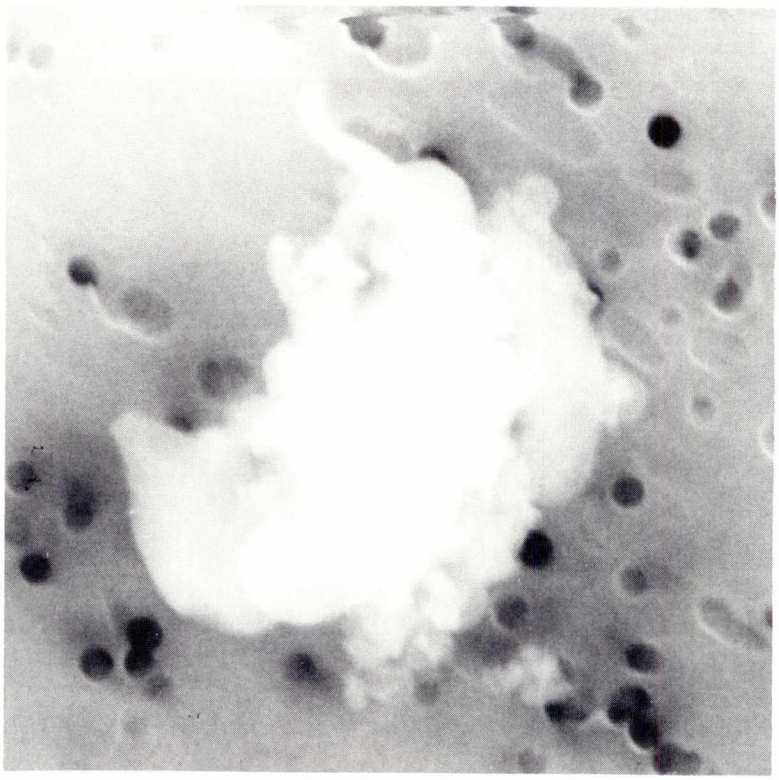
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C13. Related grains up to 40 microns remain on collector



L2005 C 2



S-90-38138

SIZE: 8

SHAPE: I

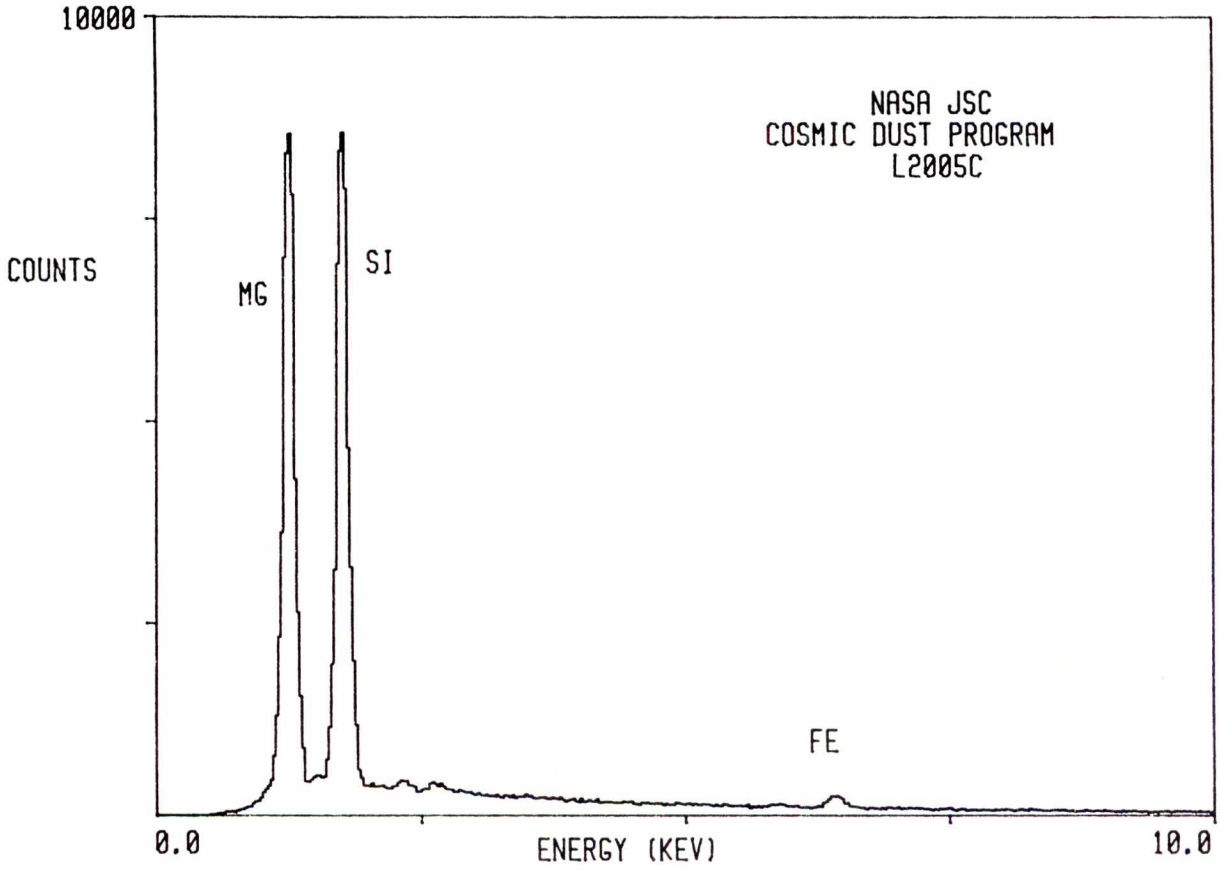
TRANS.: O/TL

COLOR: Black

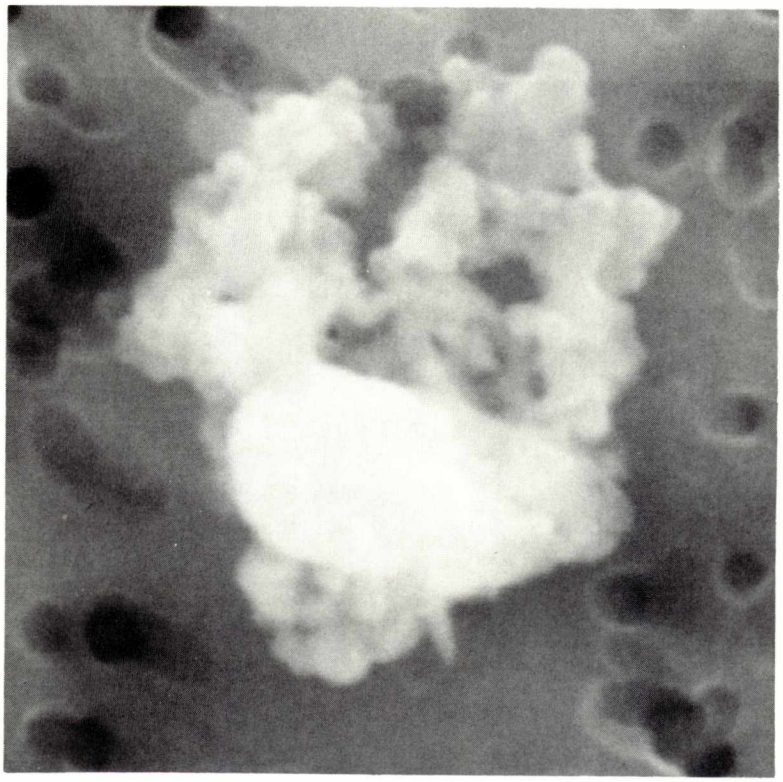
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C3 and C14



L2005 C 3



S-90-38139

SIZE: 3

SHAPE: I

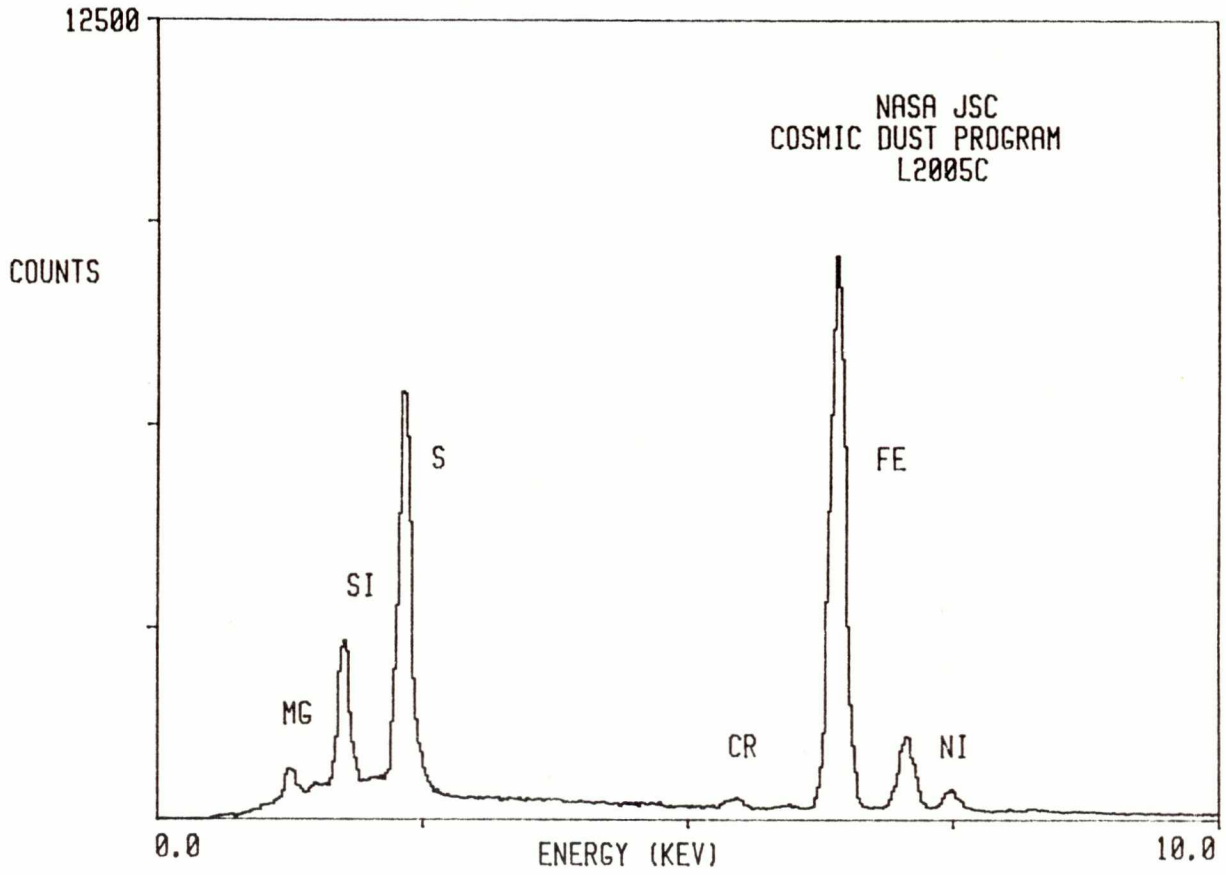
TRANS.: O/TL

COLOR: Black

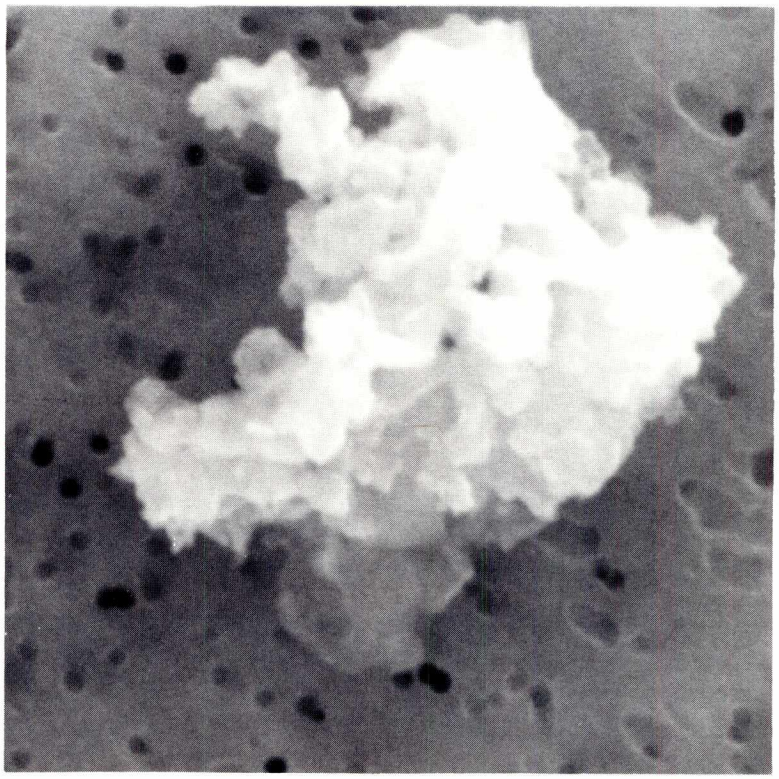
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C2 and C14



L2005 C 4



S-90-38125

SIZE: 6

SHAPE: I

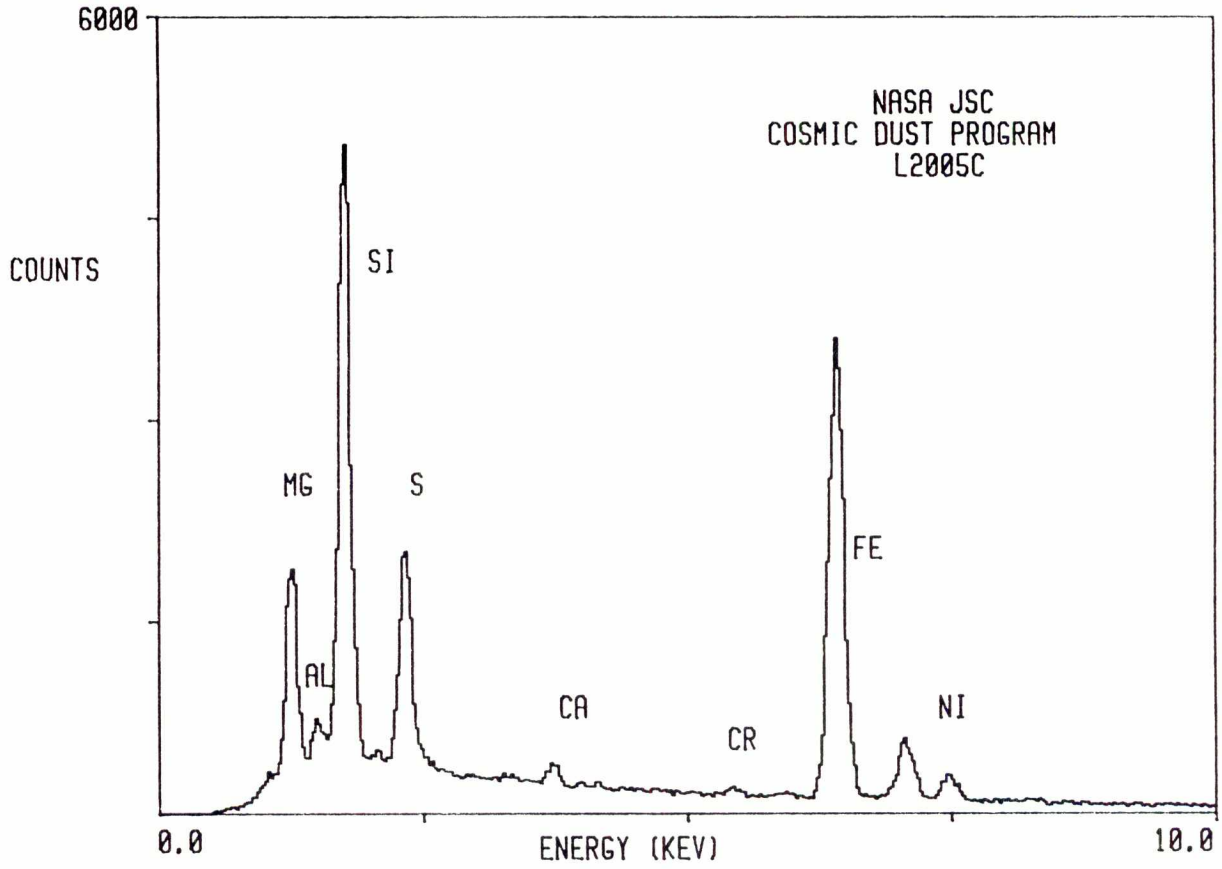
TRANS.: O/TL

COLOR: Black

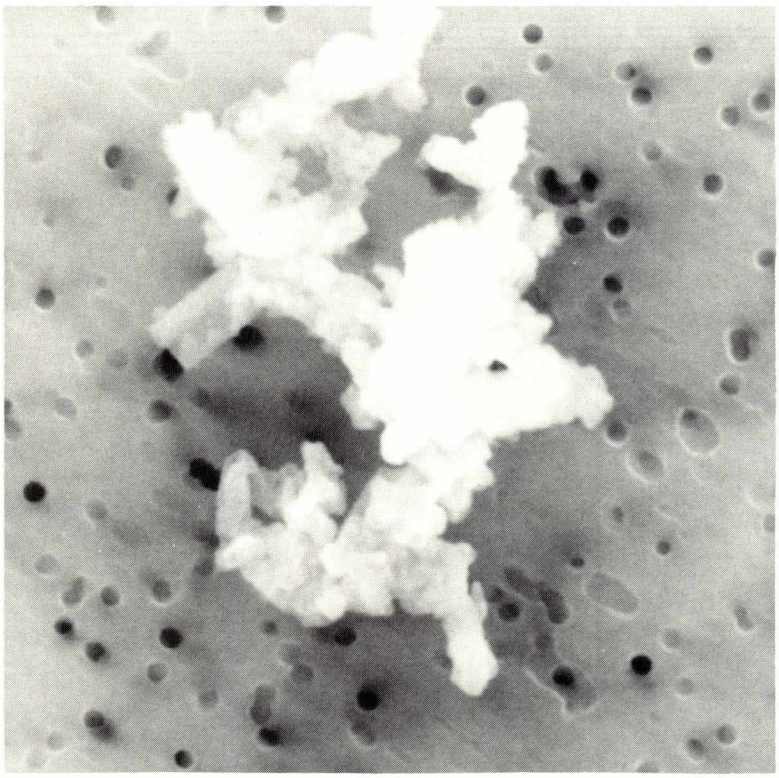
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C15. Related grains up to 30 microns remain on collector



L2005 C 5



S-90-38140

SIZE: 6

SHAPE: I

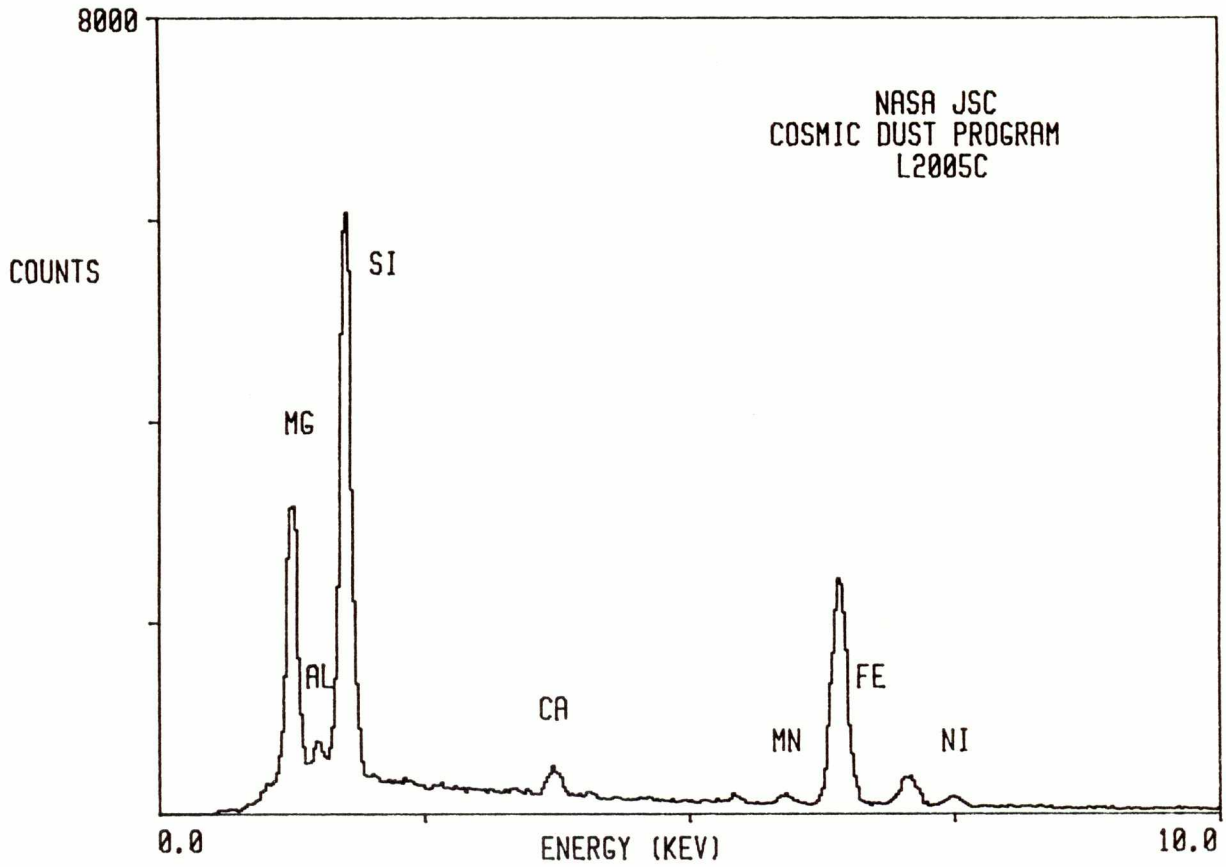
TRANS.: O/TL

COLOR: Black

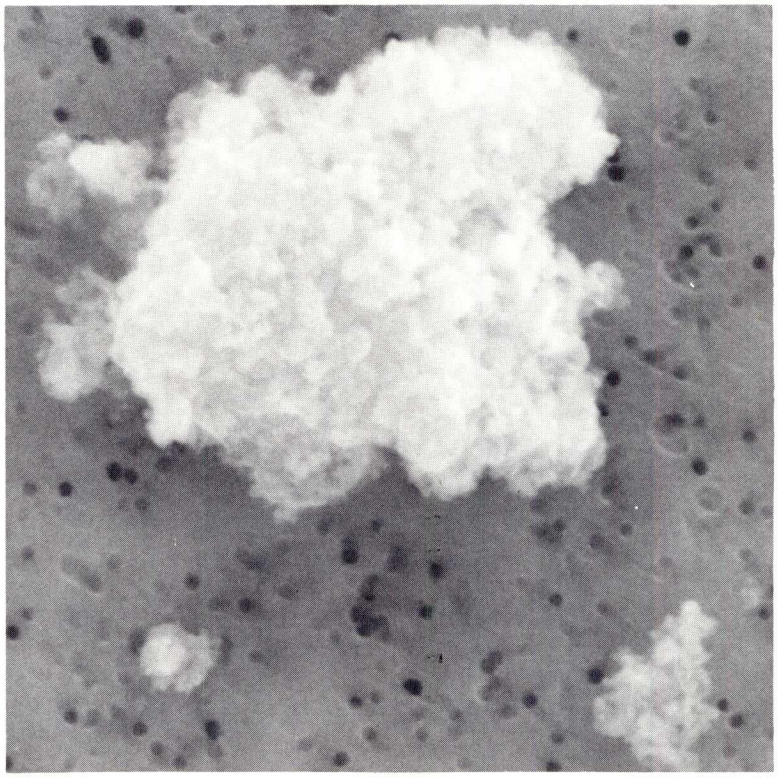
LUSTER: D

TYPE: C

COMMENTS:
Related to
L2005C18



L2005 C 13



S-90-38124

SIZE: 8

SHAPE: I

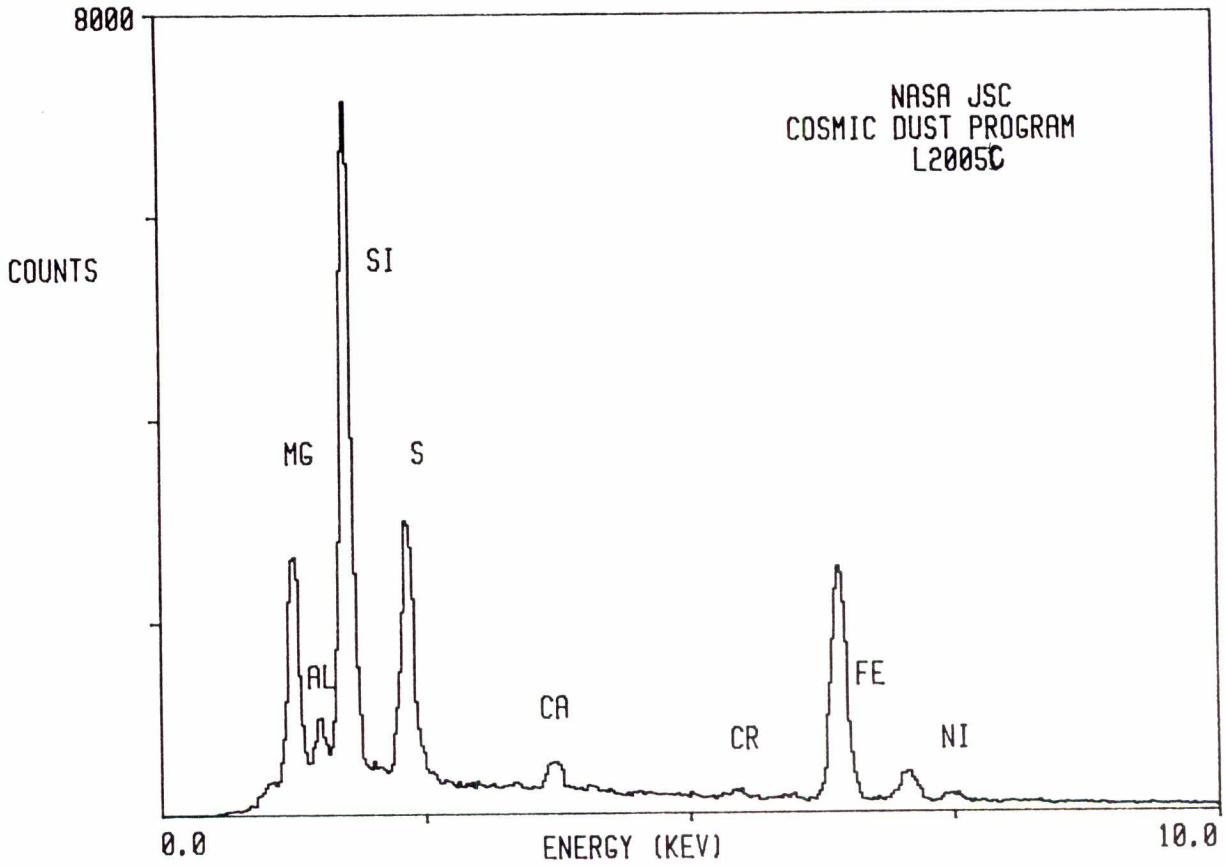
TRANS.: O/TL

COLOR: Black

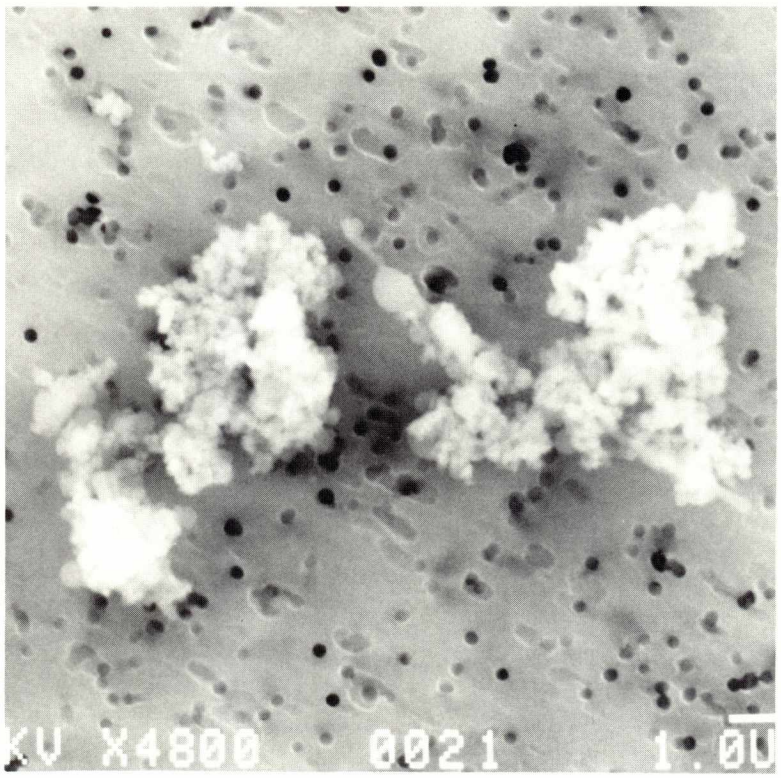
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C1



L2005 C 14



S-90-38141

SIZE: 10x6

SHAPE: I

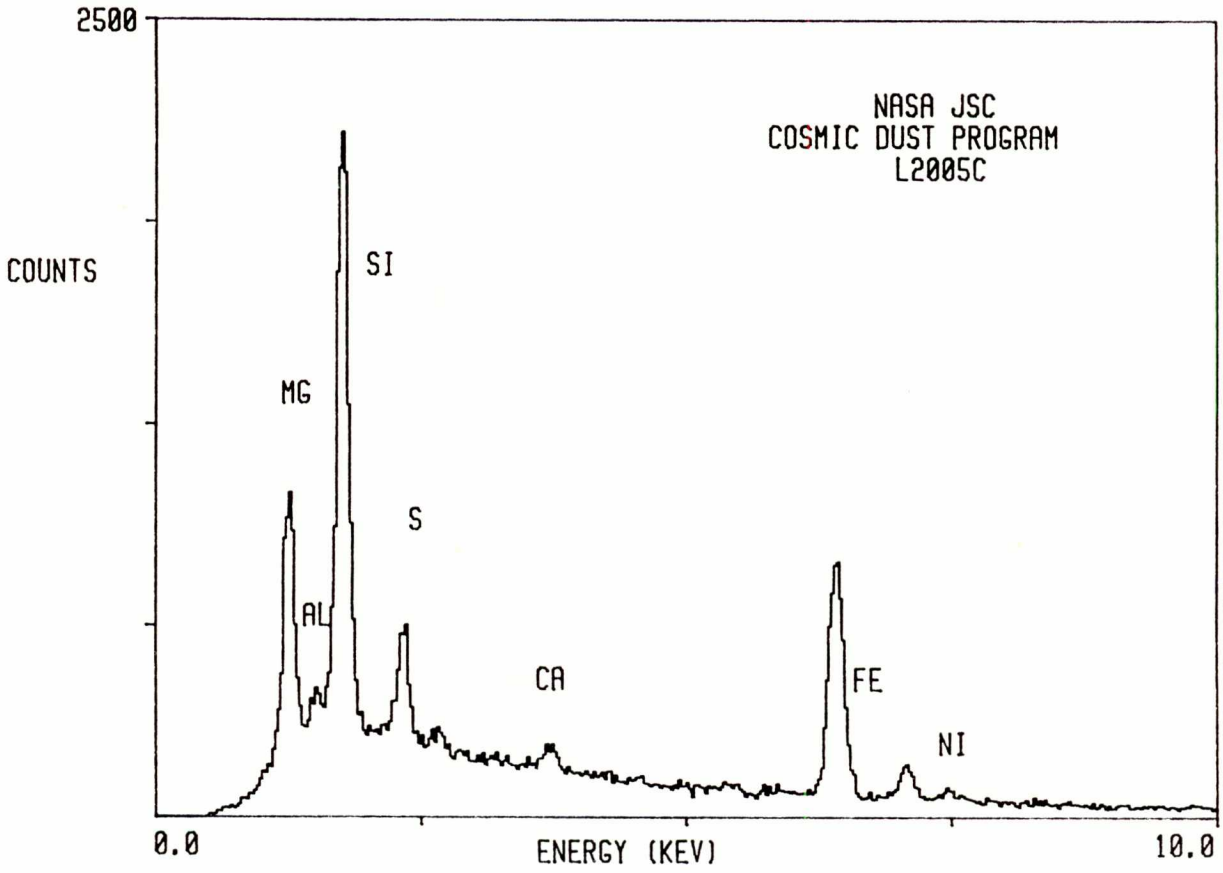
TRANS.: O/TL

COLOR: Black

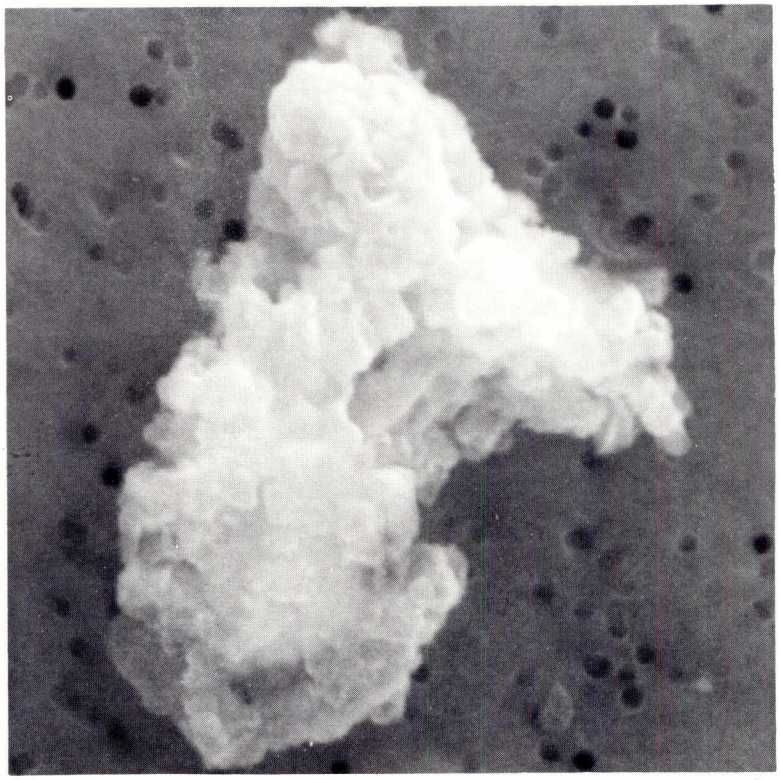
LUSTER: D

TYPE: C

COMMENTS:
Field of particles. Related to L2005C2 and C3. Related grains up to 15 microns remain on collector



L2005 C 15



S-90-38125

SIZE: 5x8

SHAPE: I

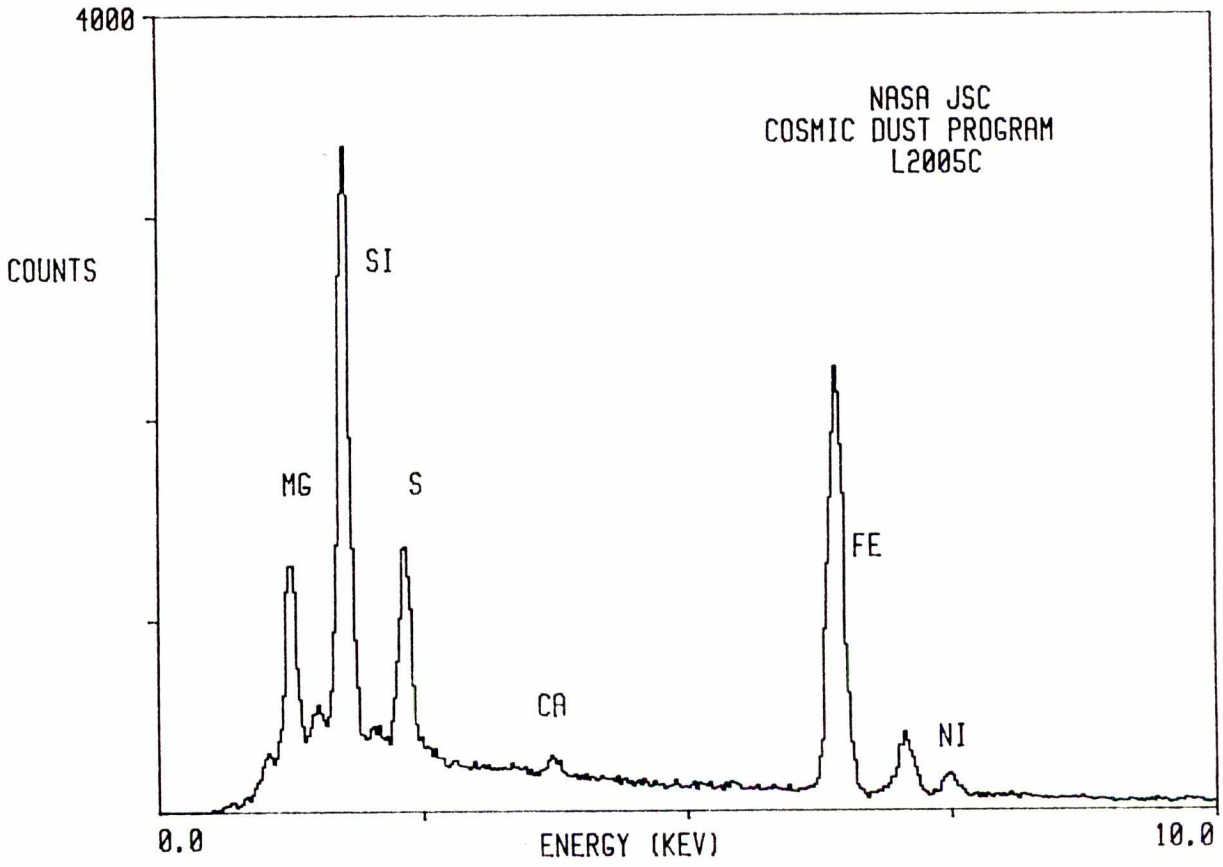
TRANS.: O/TL

COLOR: Black

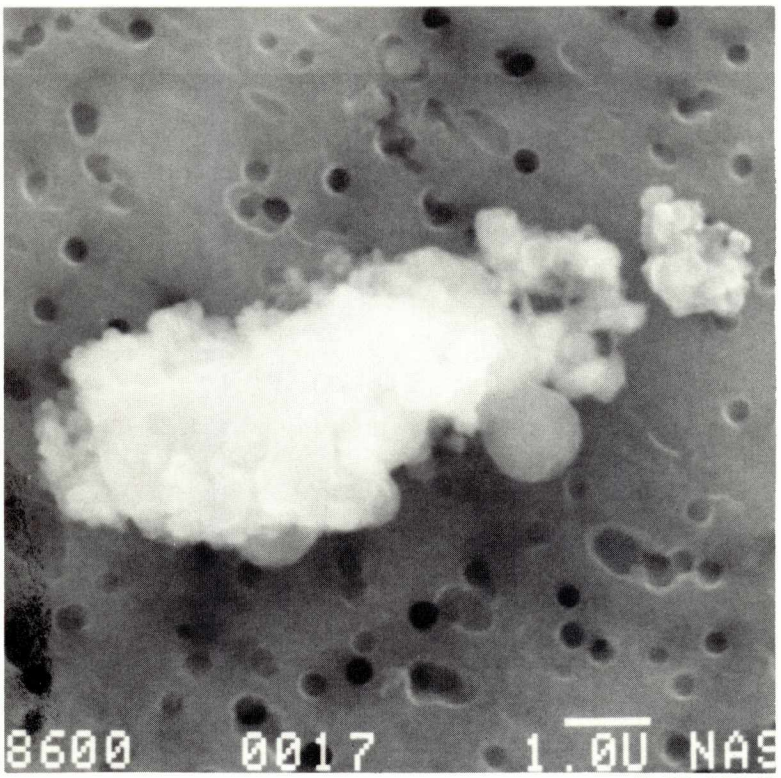
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005C4



L2005 C 16



S-90-38142

SIZE: 4x6

SHAPE: I

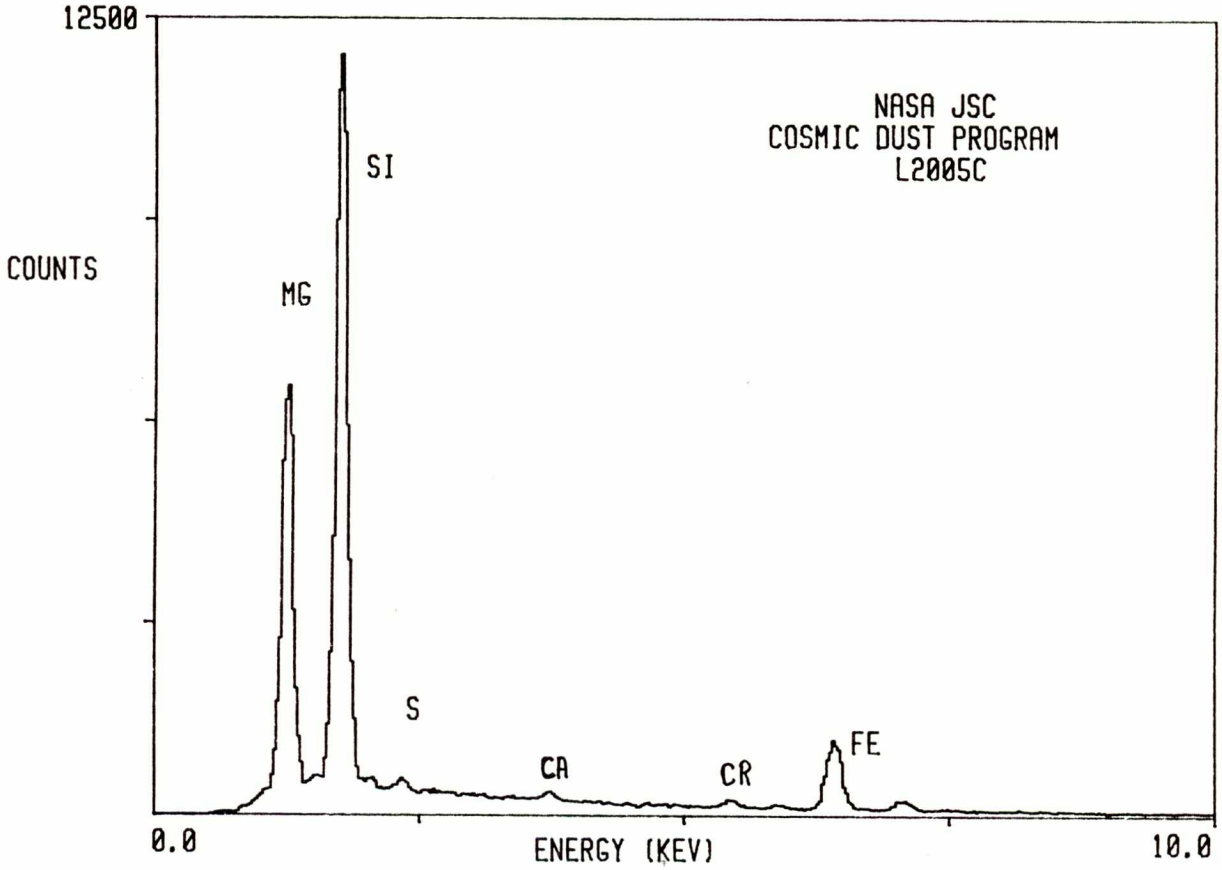
TRANS.: O/TL

COLOR: Black

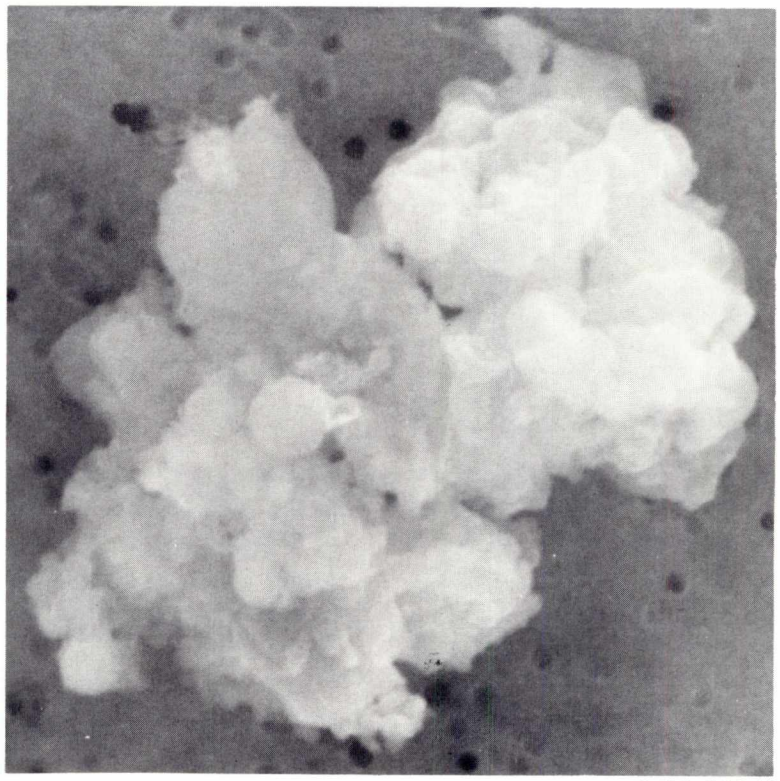
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 9 microns remain on collector



L2005 C 17



S-90-38143

SIZE: 6x9

SHAPE: I

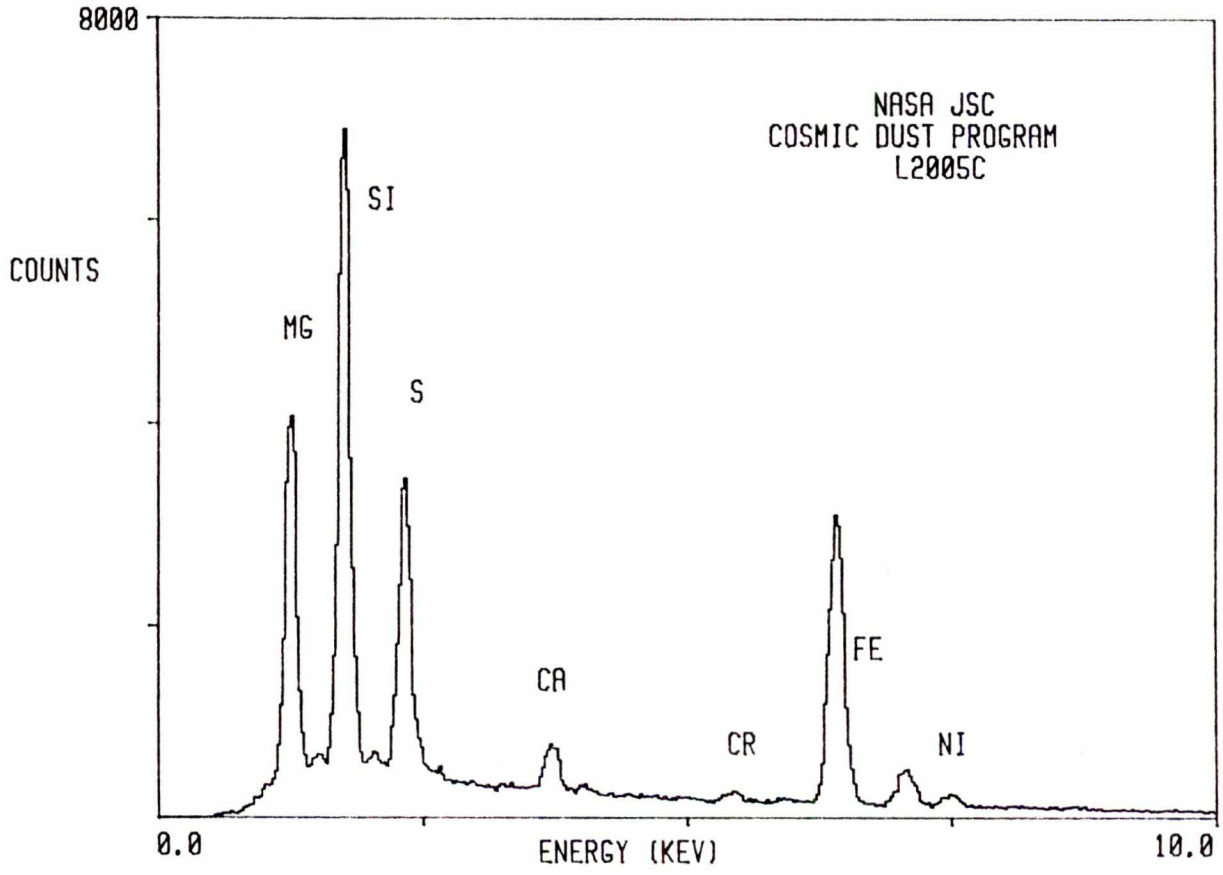
TRANS.: O/TL

COLOR: Black

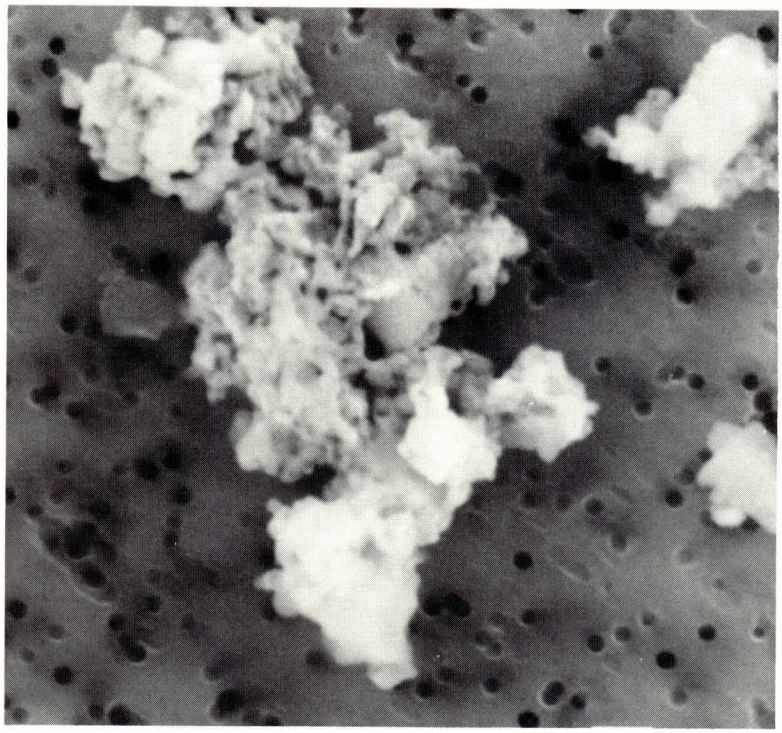
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 24 microns remain on collector



L2005 C 18



SIZE: 5x10

SHAPE: I

TRANS.: O/TL

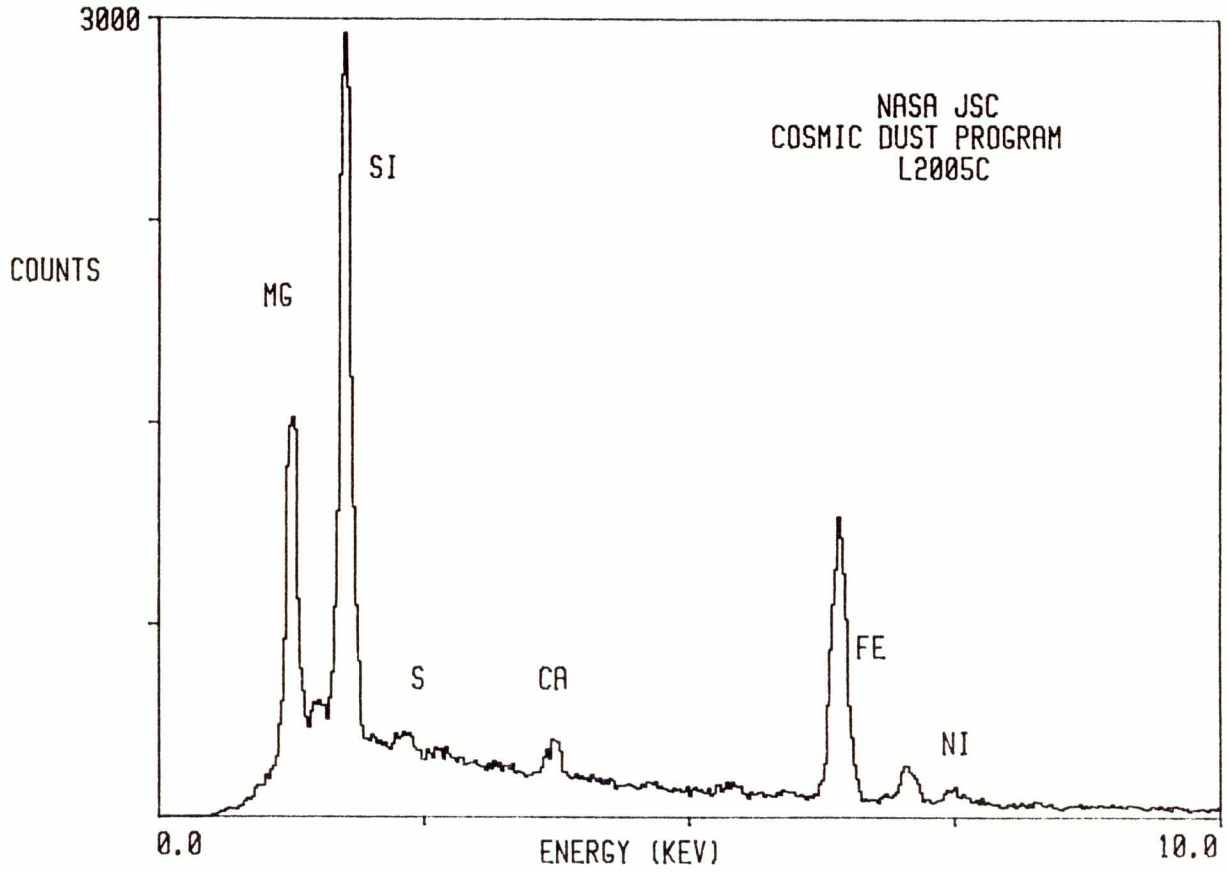
COLOR: Black

LUSTER: D

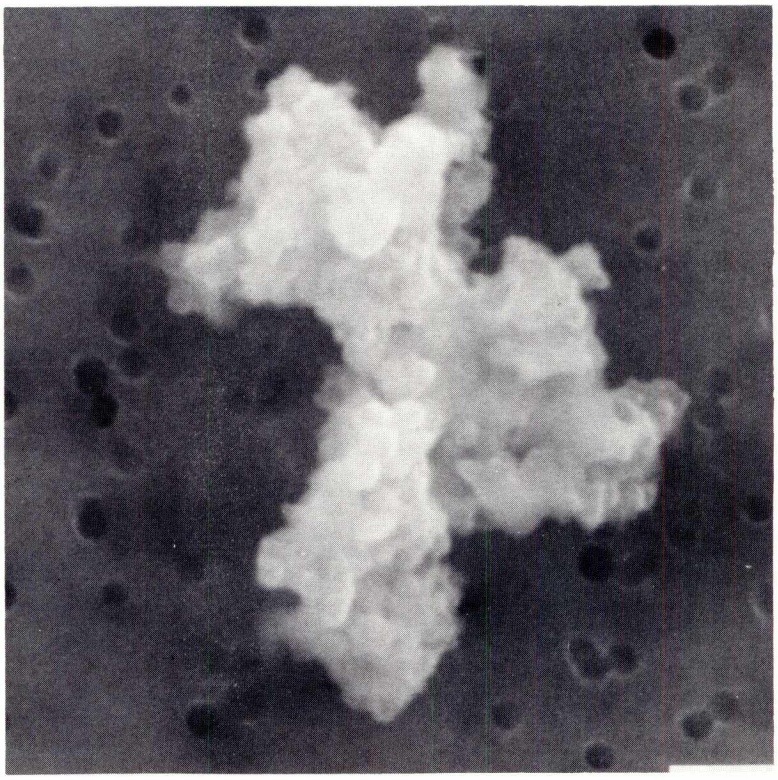
TYPE: C

COMMENTS:
Related grains up to 24 microns remain on collector.
Related to L2005C5

S-90-38144



L2005 D 1



S-90-38145

SIZE: 4x8

SHAPE: I

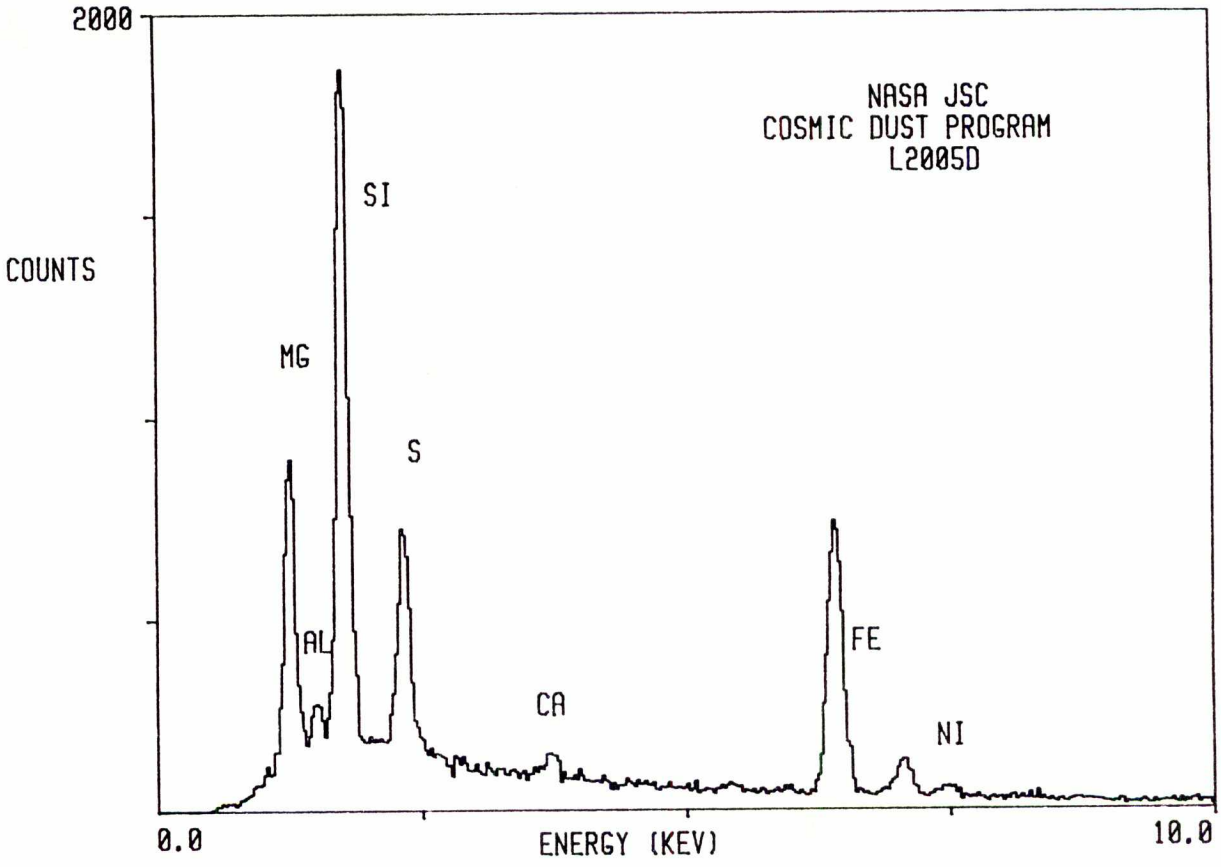
TRANS.: O

COLOR: Black

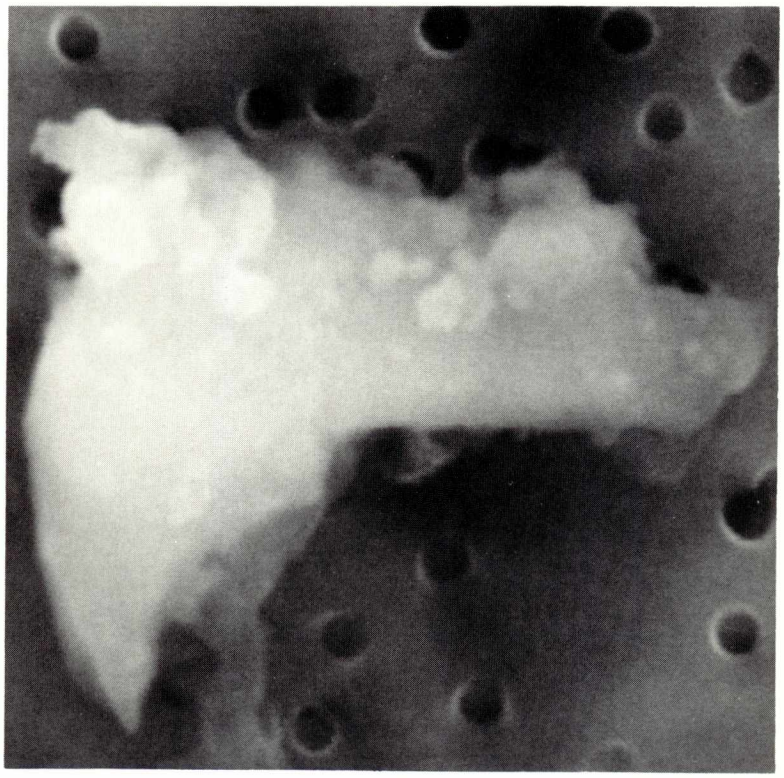
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 16 microns remain on collector. Related to L2005D19



L2005 D 2



S-90-38146

SIZE: 4

SHAPE: I

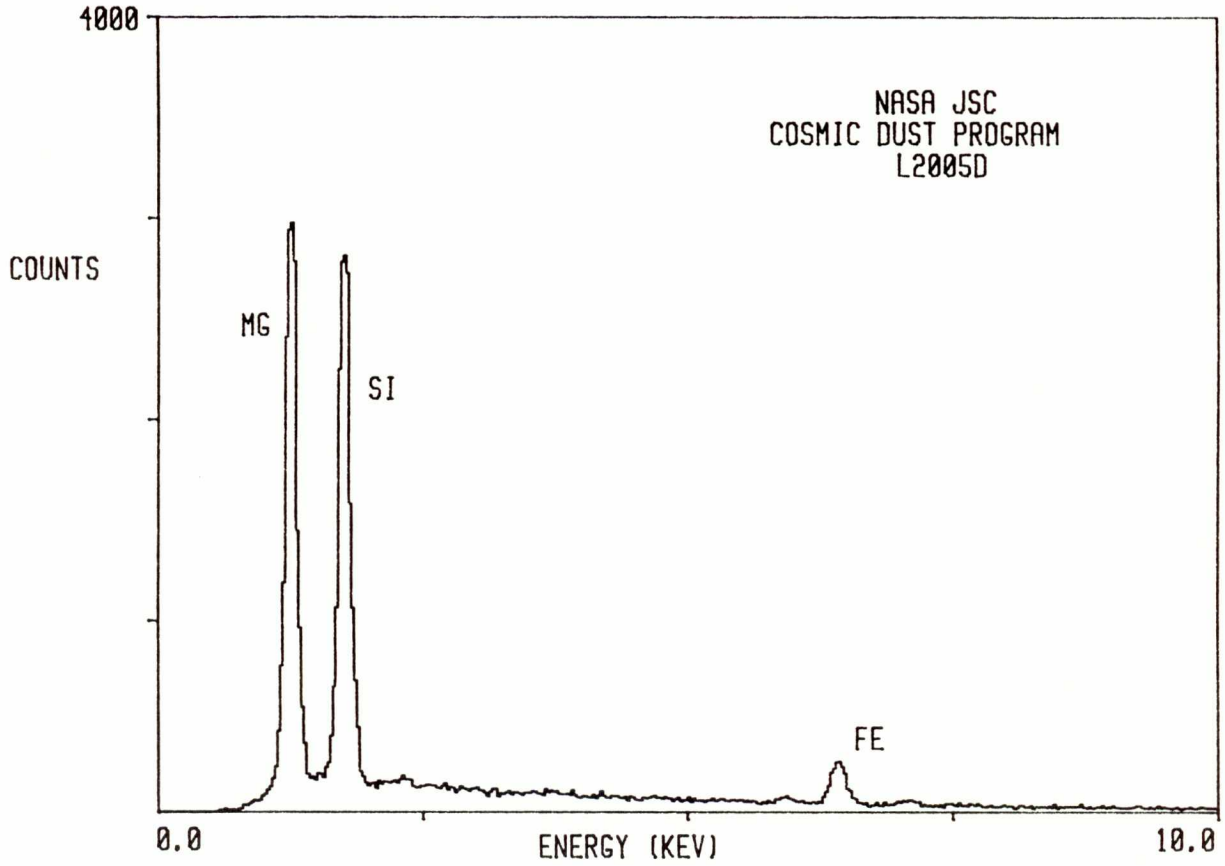
TRANS.: O/TL

COLOR: Black

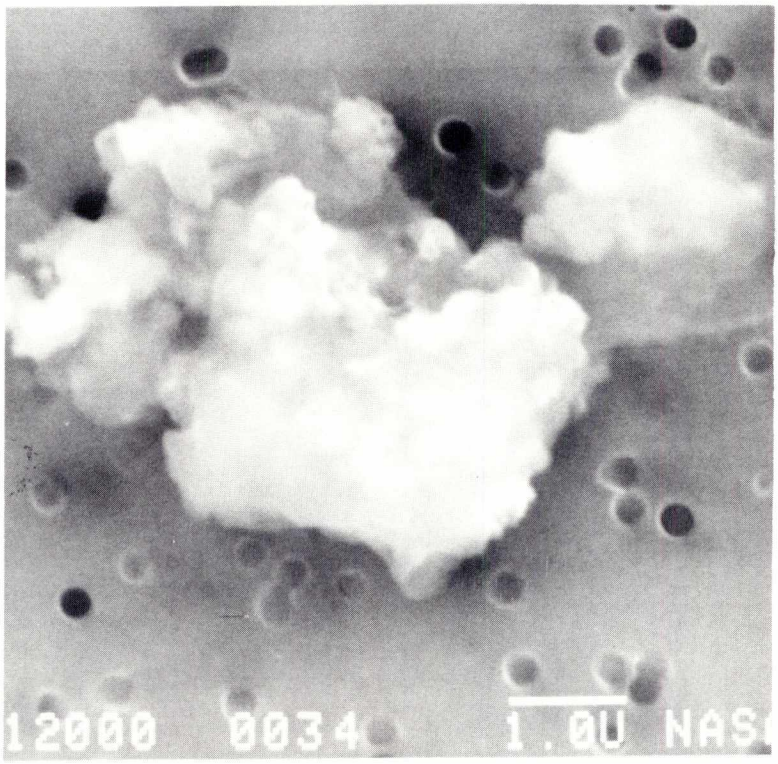
LUSTER: D

TYPE: C?

COMMENTS:
Related to L2005D3 and D20



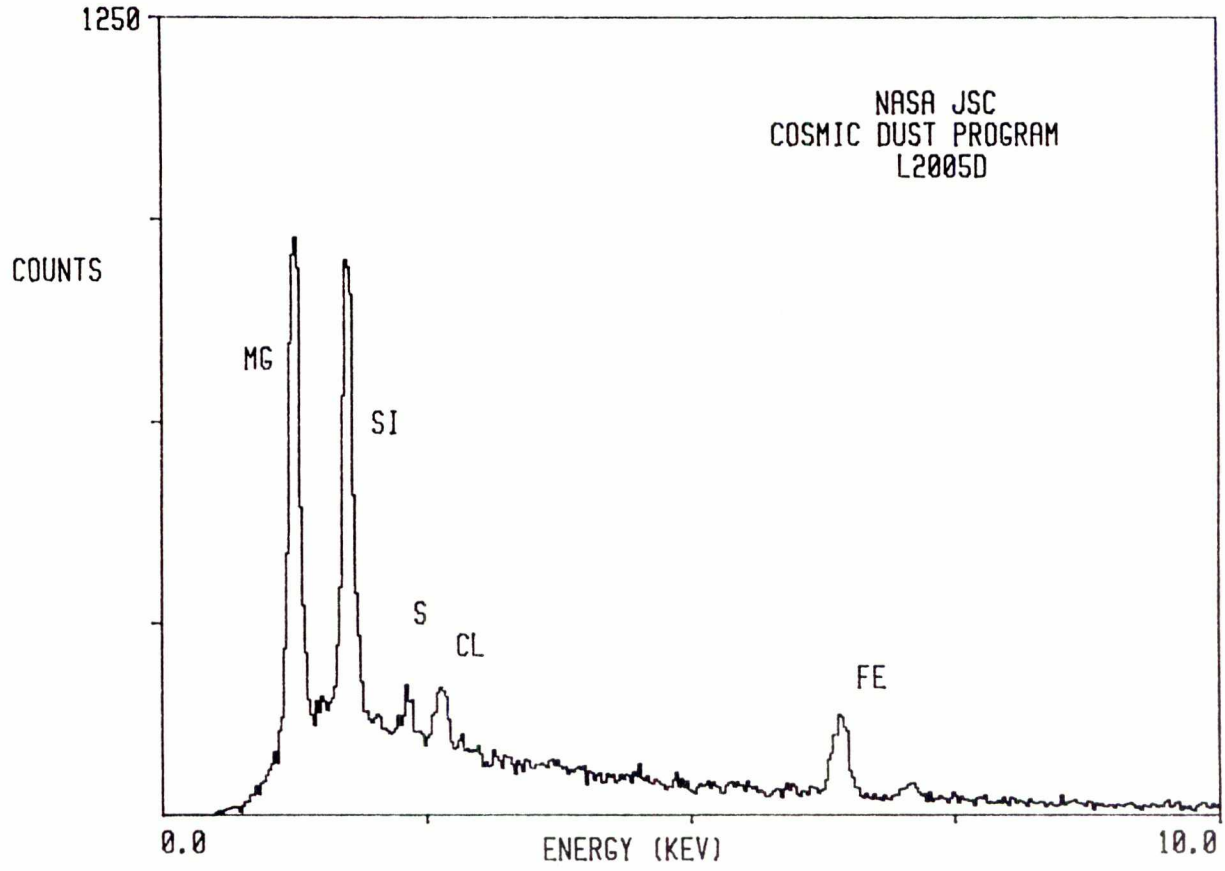
L2005 D 3



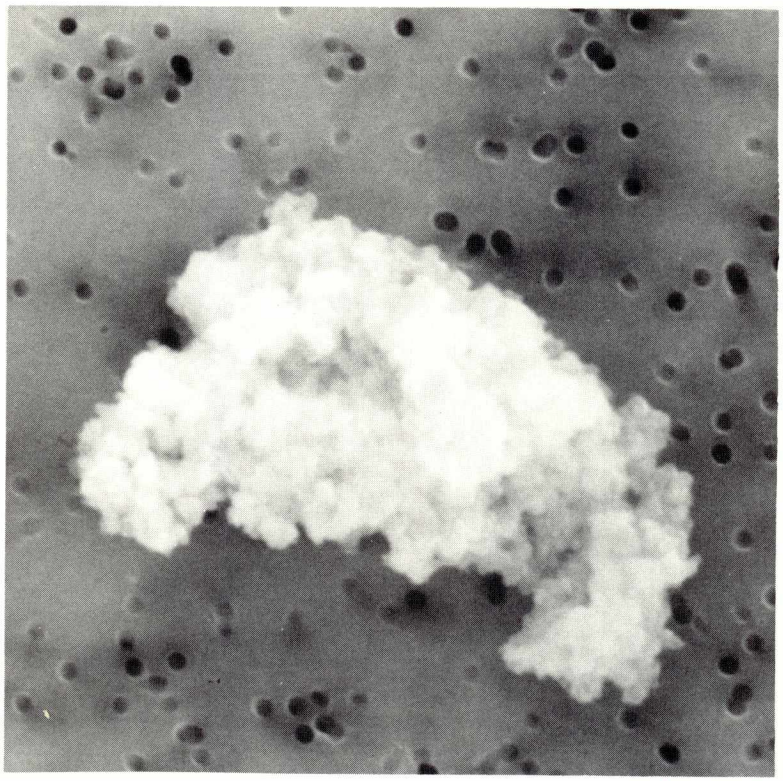
SIZE: 3x5
SHAPE: I
TRANS.: O/TL
COLOR: Black
LUSTER: D
TYPE: C?

COMMENTS:
Related to L2005D2 and D20

S-90-38147



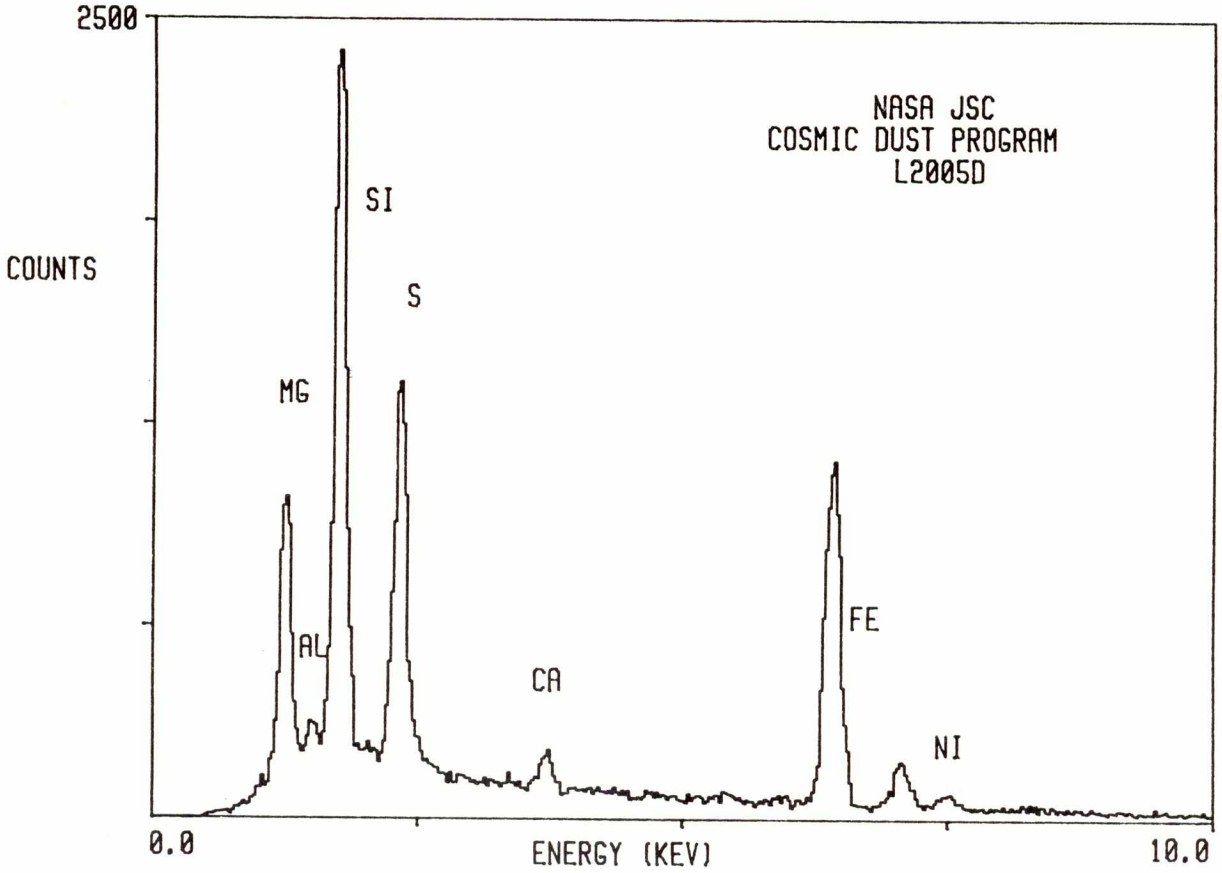
L2005 D 19



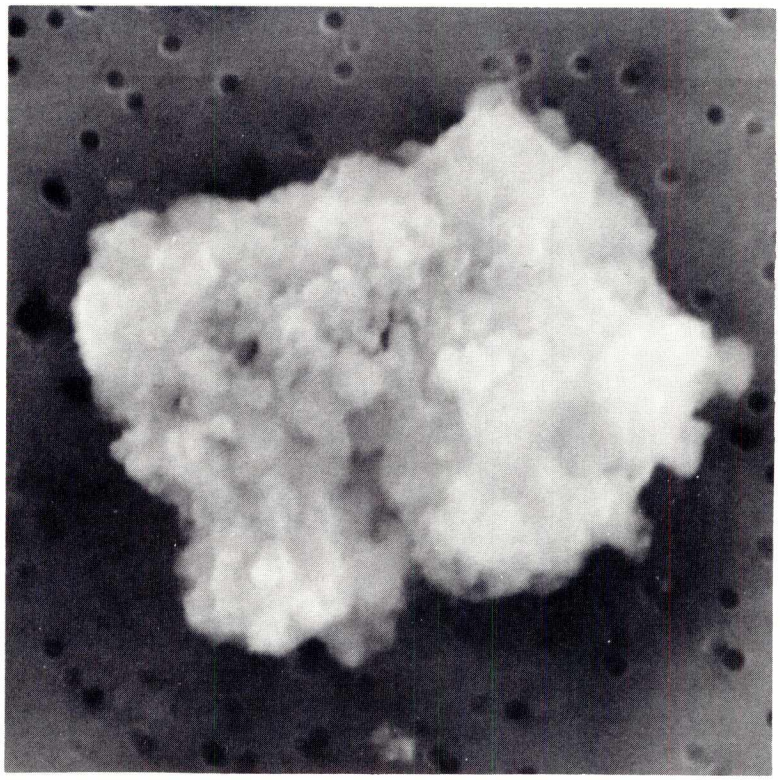
S-90-38148

SIZE: 5x10
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:
Related to L2005D1



L2005 D 20



S-90-38149

SIZE: 8x10

SHAPE: I

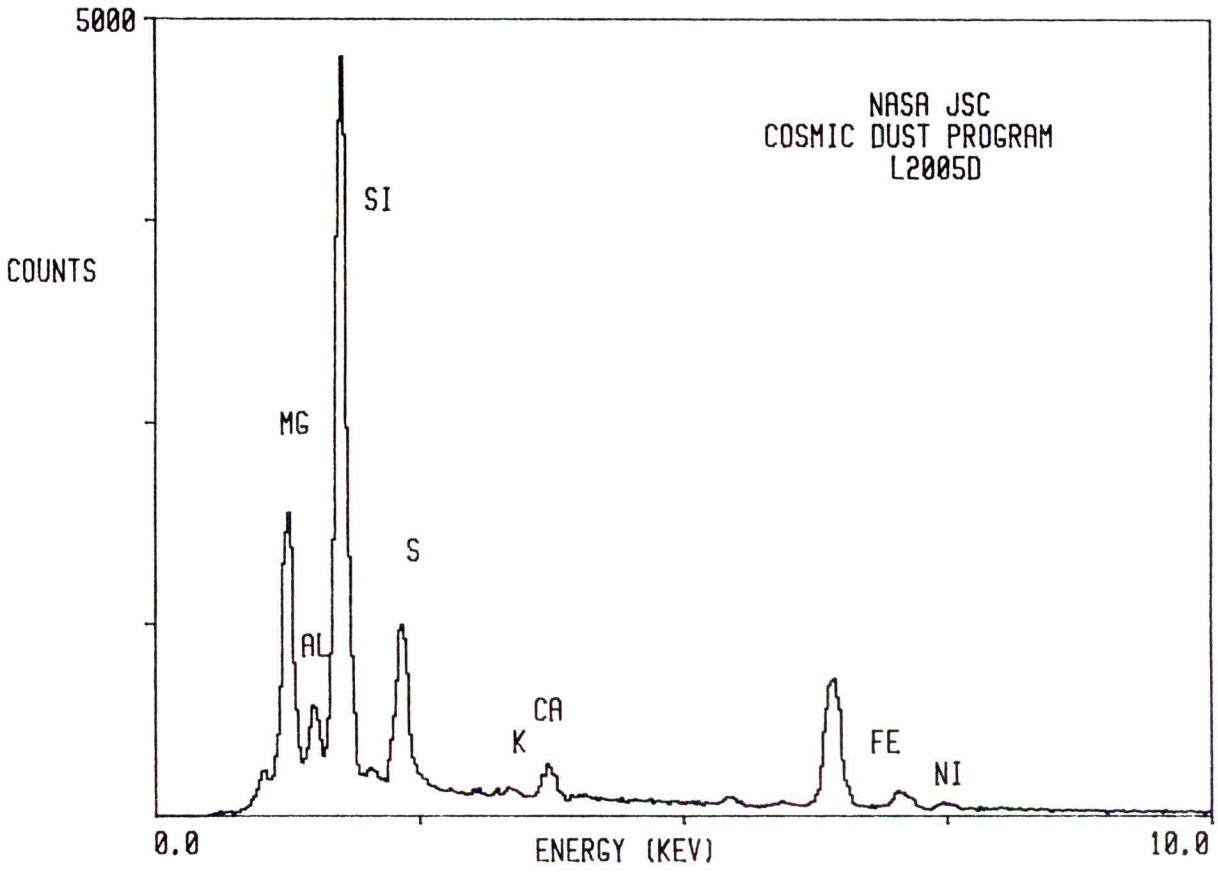
TRANS.: O/TL

COLOR: Black

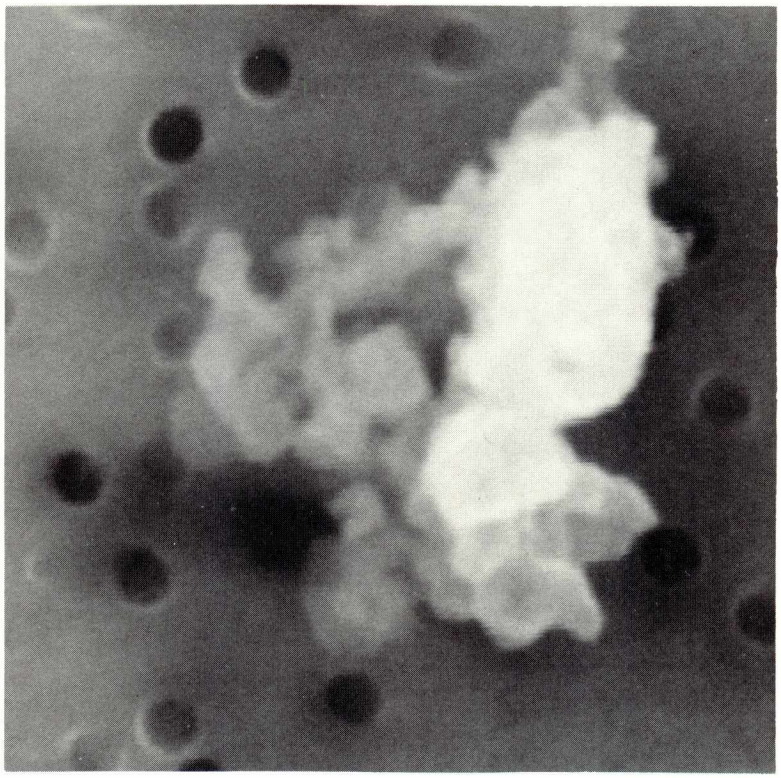
LUSTER: D

TYPE: C?

COMMENTS:
Related grains up to 24 microns remain on collector.
Related to L2005D2 and D3



L2005 D 24



S-90-38151

SIZE: 3

SHAPE: I

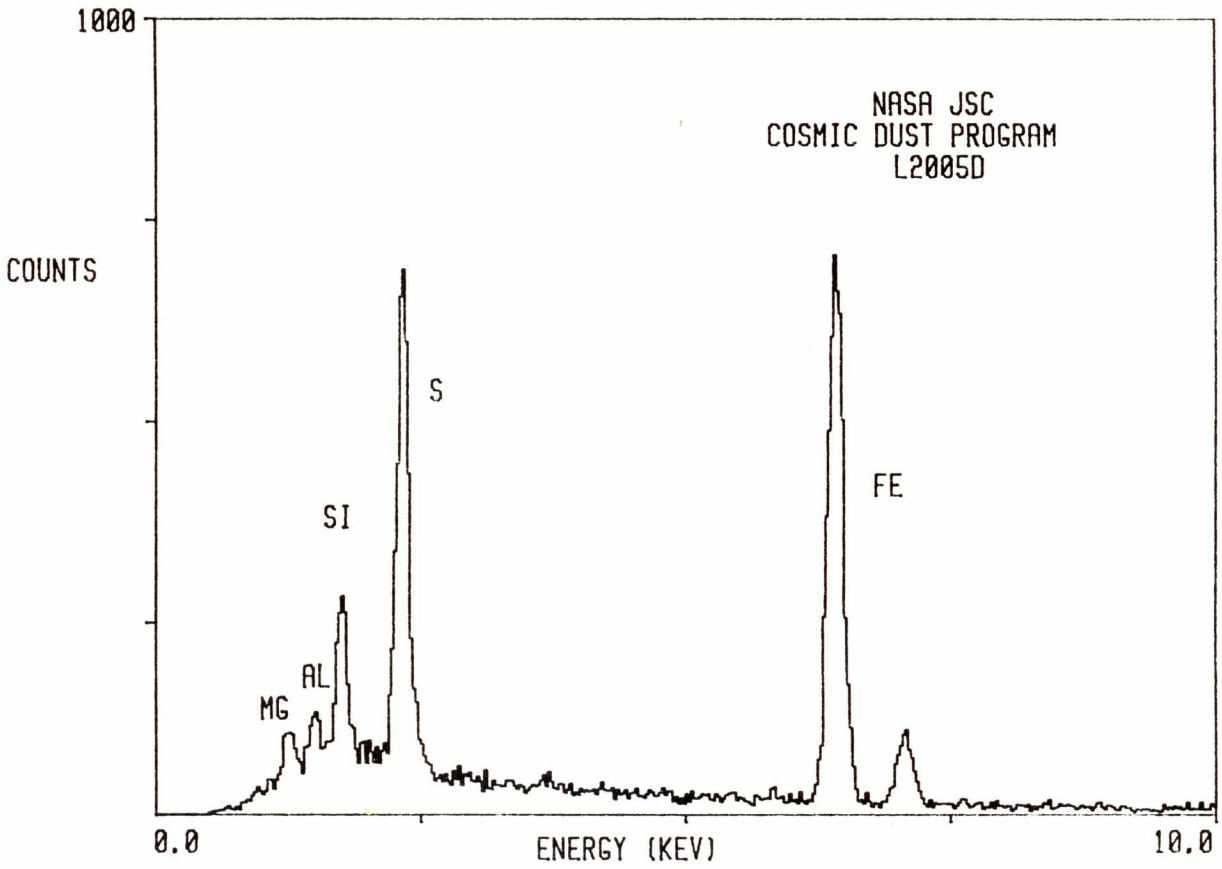
TRANS.: O

COLOR: Brown

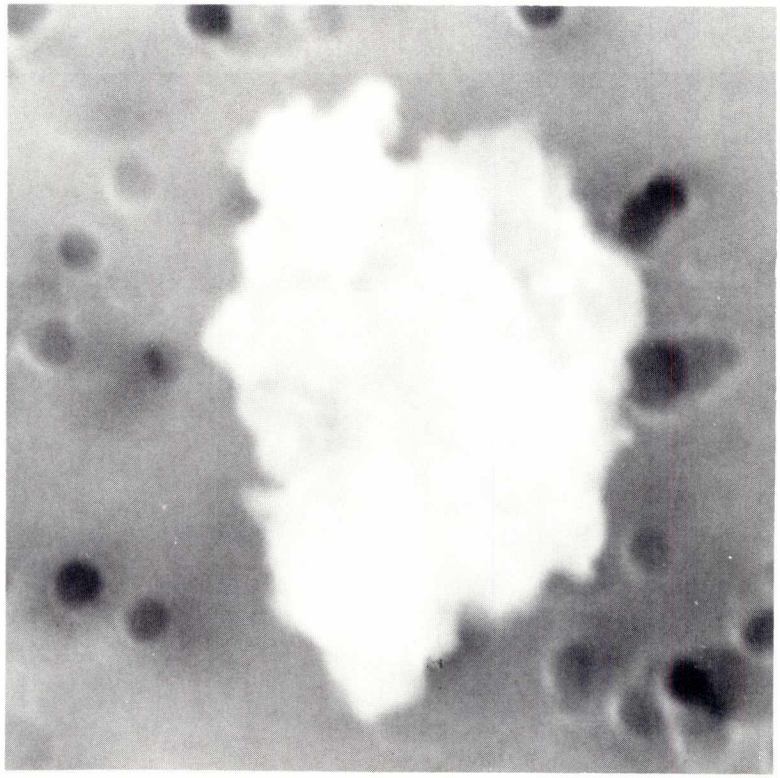
LUSTER: D/SM

TYPE: C?

COMMENTS:
Related grains up to 25 microns remain on collector



L2005 E 1



S-90-38162

SIZE: 3x4

SHAPE: I

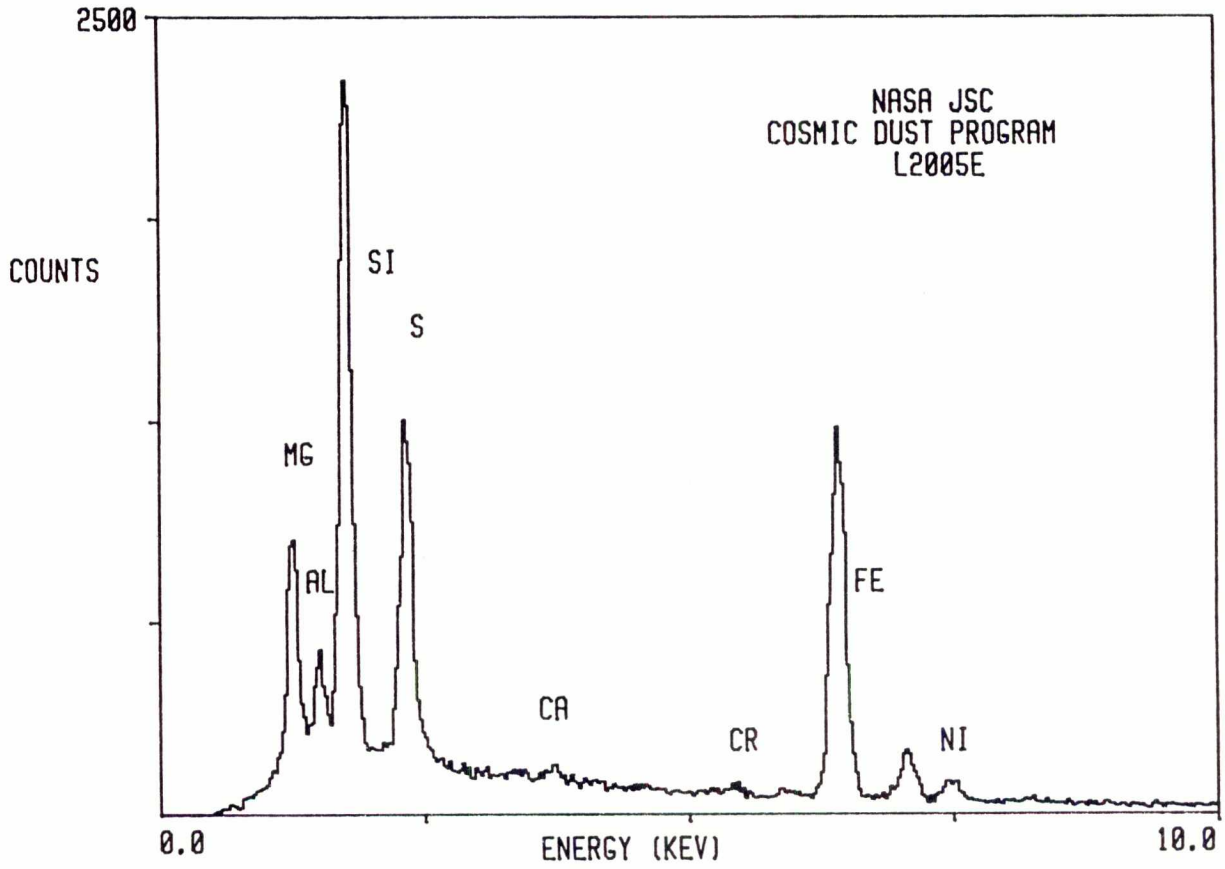
TRANS.: O/TL

COLOR: Black

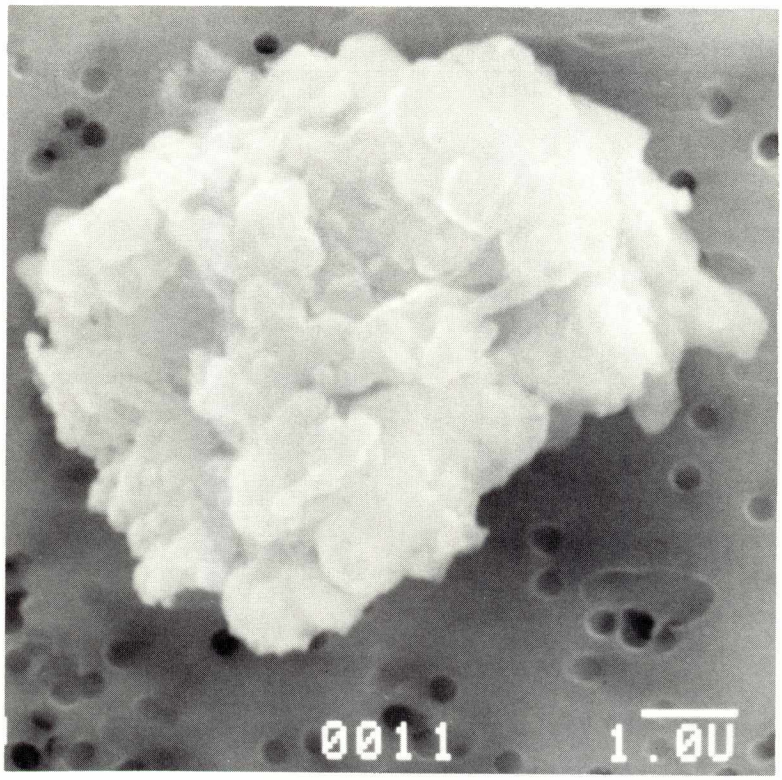
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005E25, E2 and E3



L2005 E 2



S-90-38163

SIZE: 8

SHAPE: I

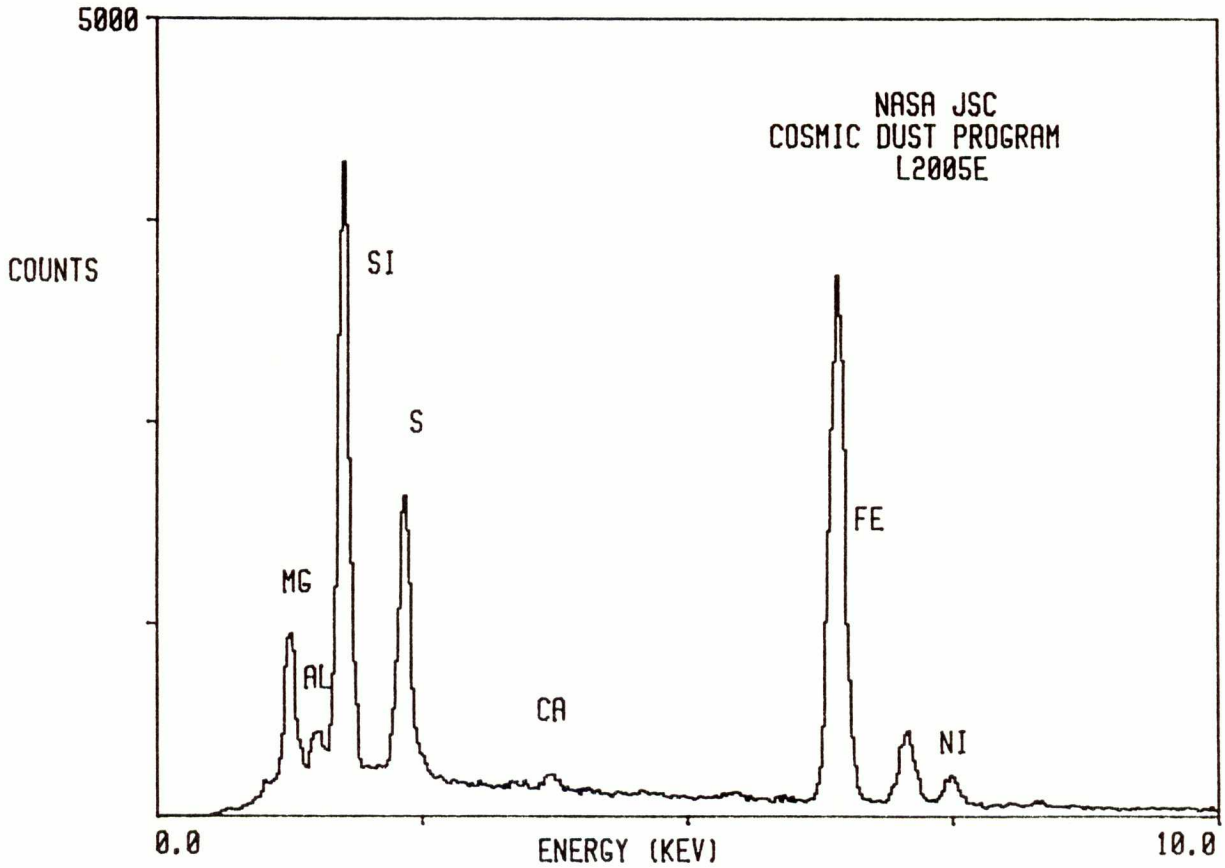
TRANS.: O/TL

COLOR: Black

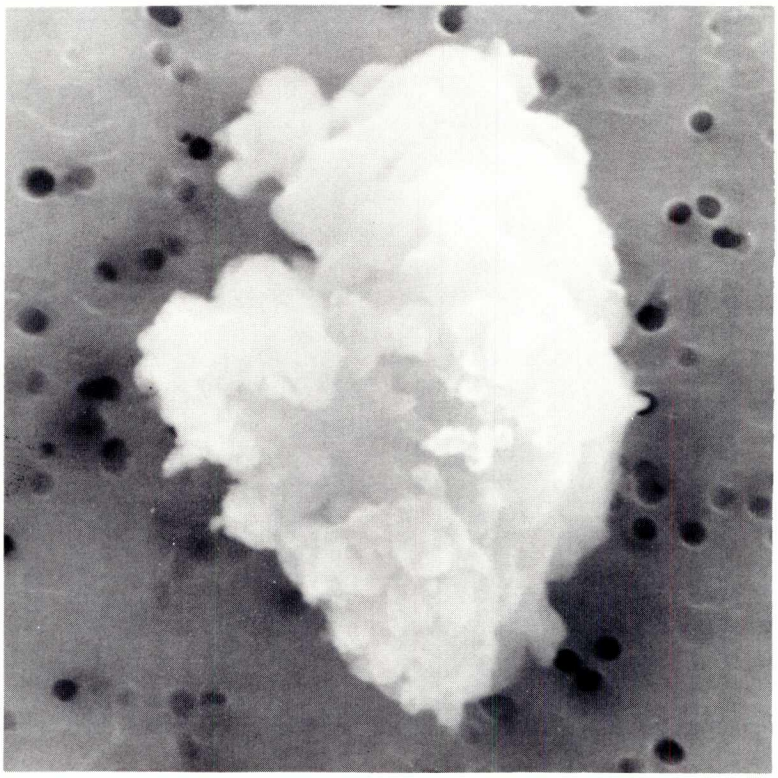
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005E25, E1 and E3



L2005 E 3



S-90-38164

SIZE: 7x9

SHAPE: I

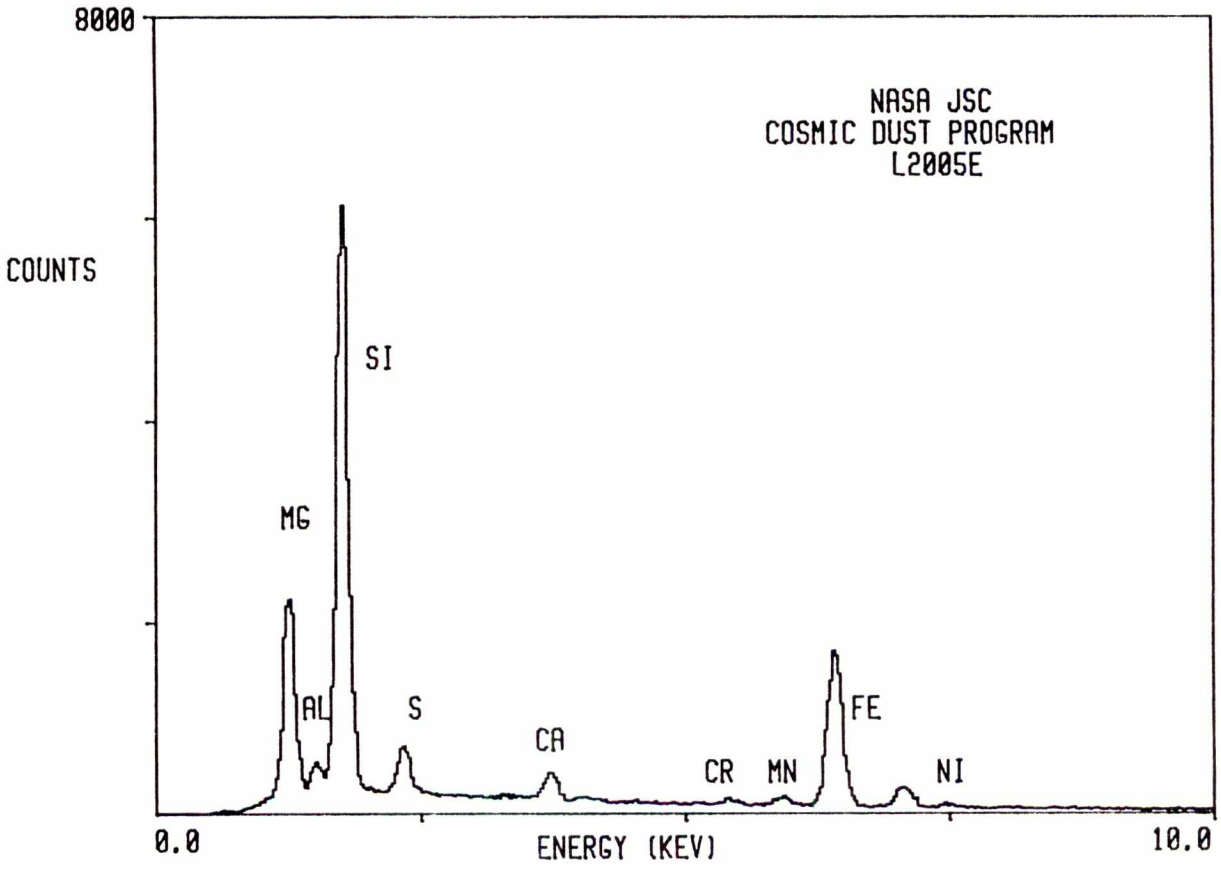
TRANS.: O/TL

COLOR: Black

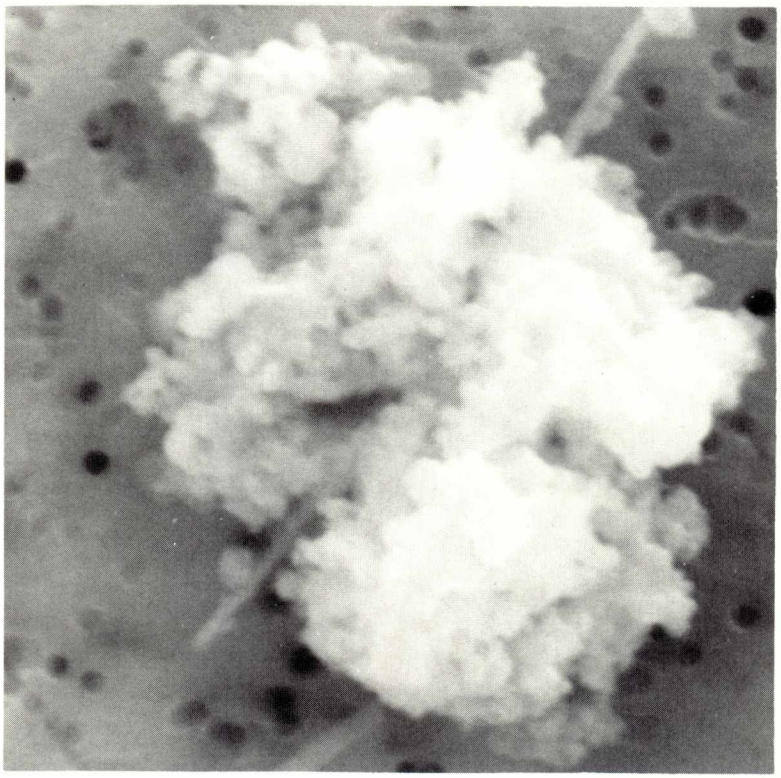
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005E25, E1 and E2



L2005 E 4



S-90-38165

SIZE: 7x10

SHAPE: I

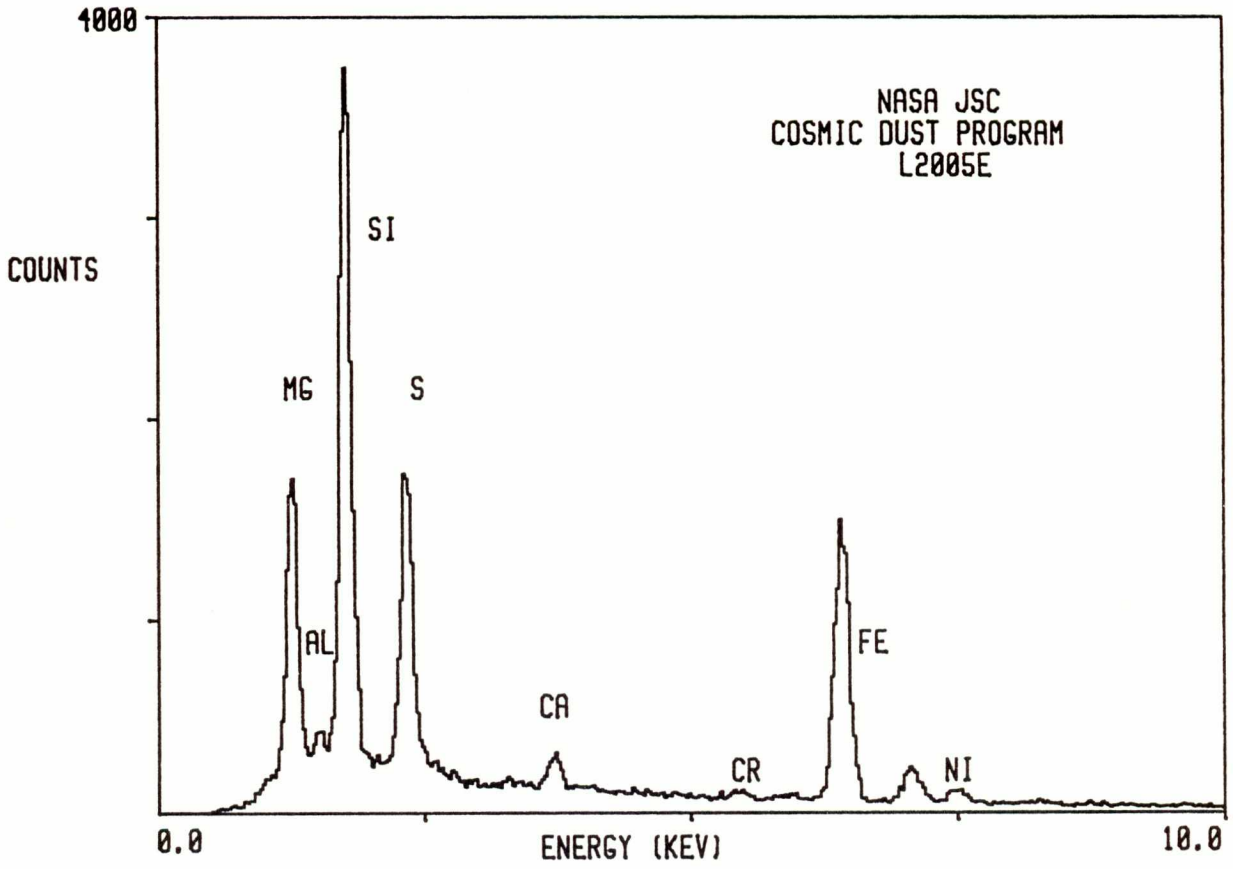
TRANS.: O/TL

COLOR: Black

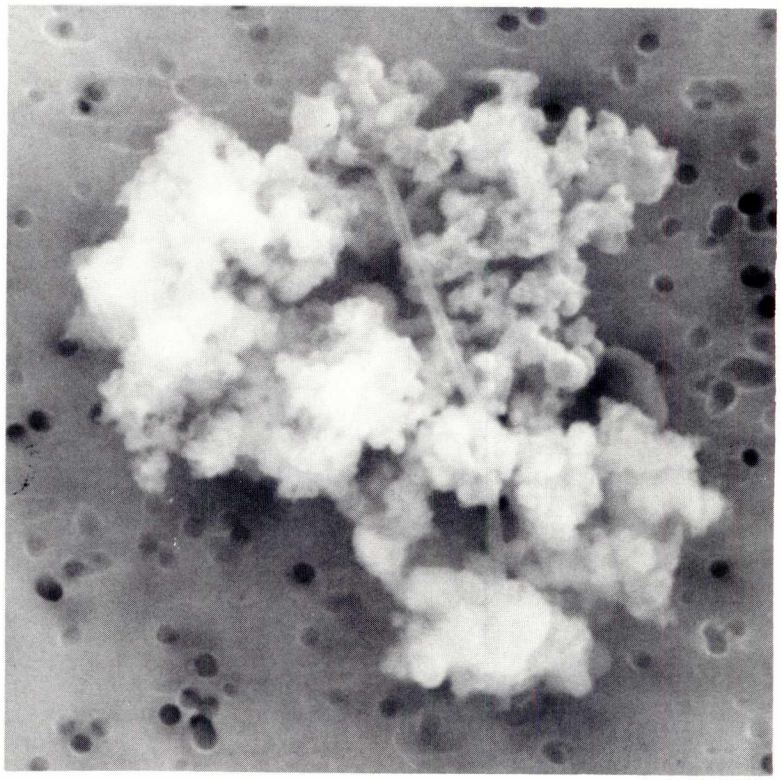
LUSTER: D

TYPE: C

COMMENTS:
Related to
L2005E26 and E5



L2005 E 5



S-90-38166

SIZE: 8x10

SHAPE: I

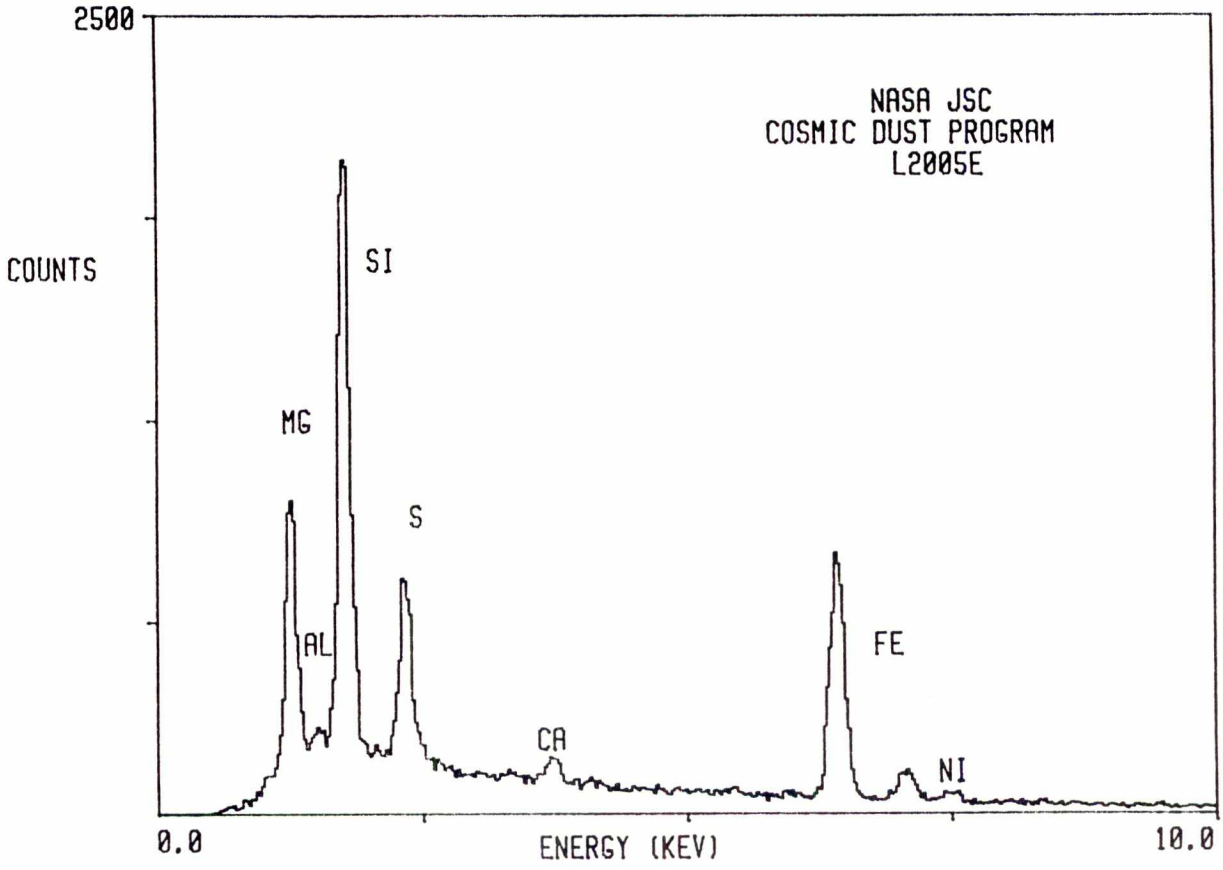
TRANS.: O/TL

COLOR: Black

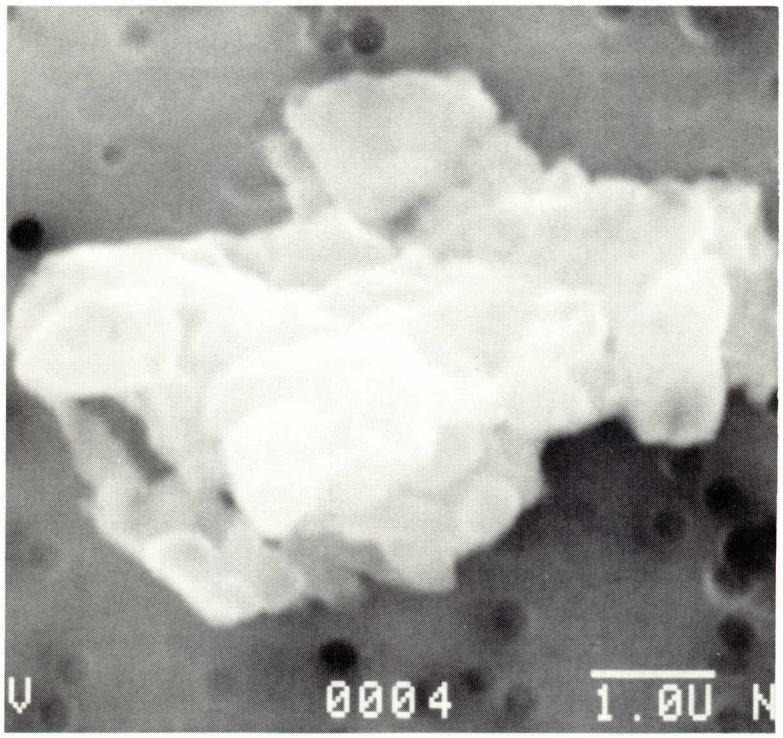
LUSTER: D

TYPE: C

COMMENTS:
Related to
L2005E26 and E4



L2005 E 25



SIZE: 8

SHAPE: I

TRANS.: O/TL

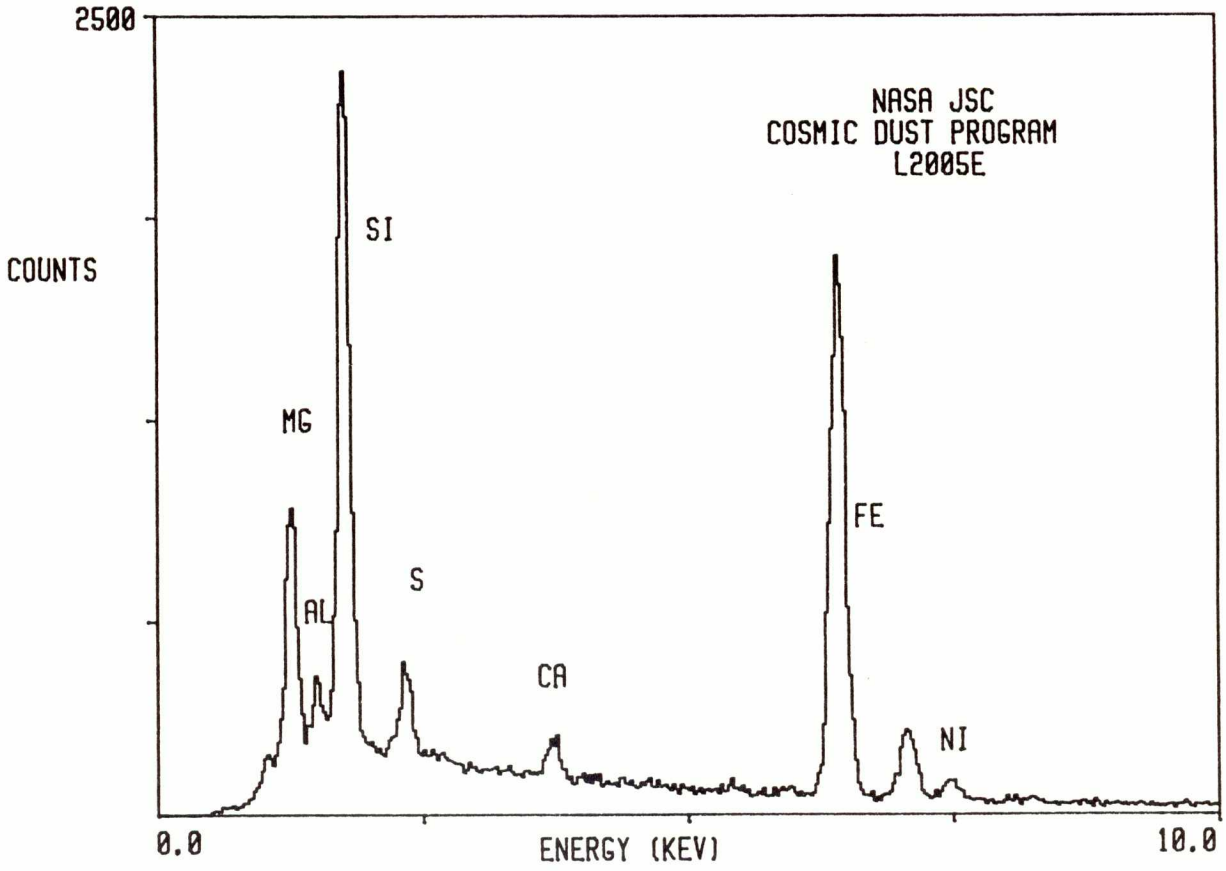
COLOR: Black

LUSTER: D

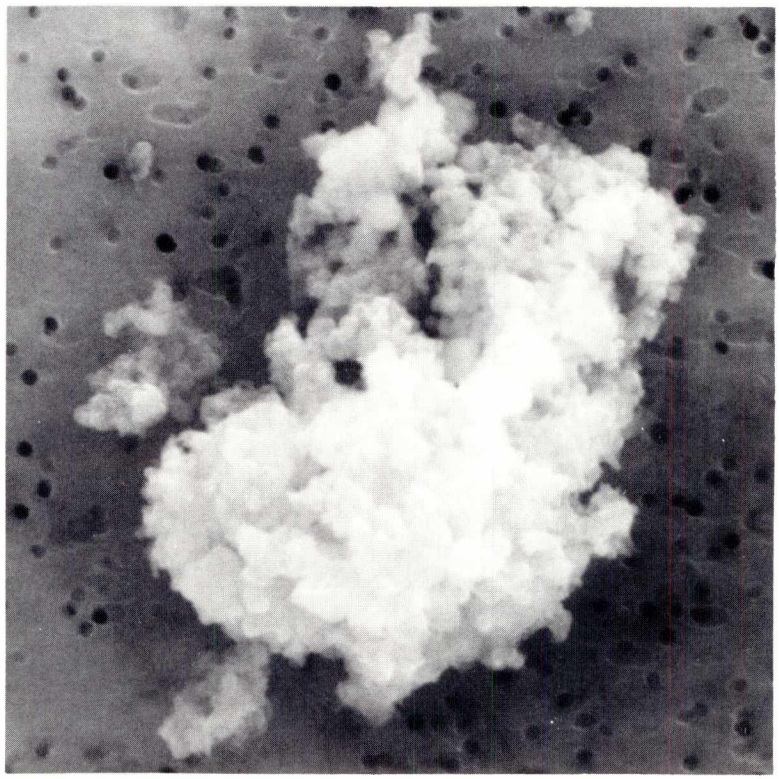
TYPE: C

COMMENTS:
Related grains up to 28 microns remain on collector. Related to L2005E1, E2 and E3

S-90-38167



L2005 E 26



S-90-38168

SIZE: 9x12

SHAPE: I

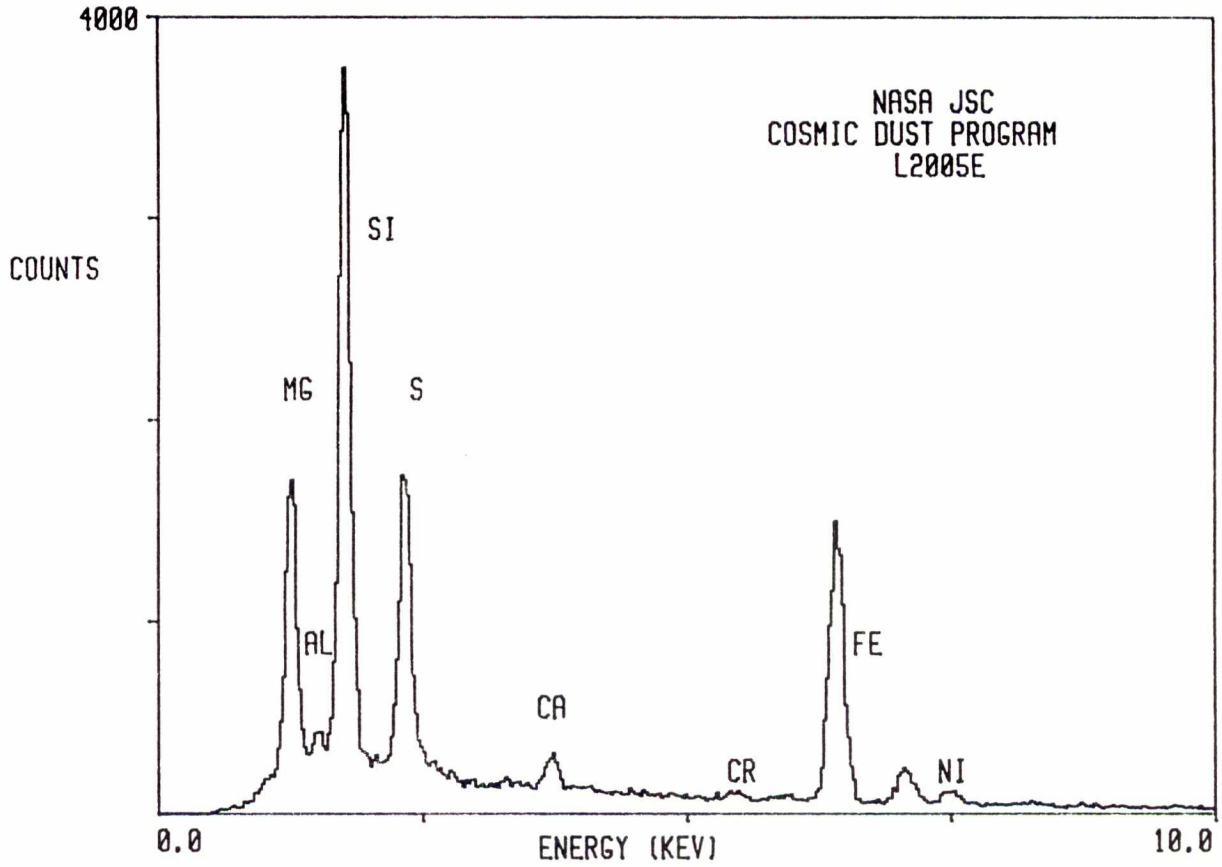
TRANS.: O/TL

COLOR: Black

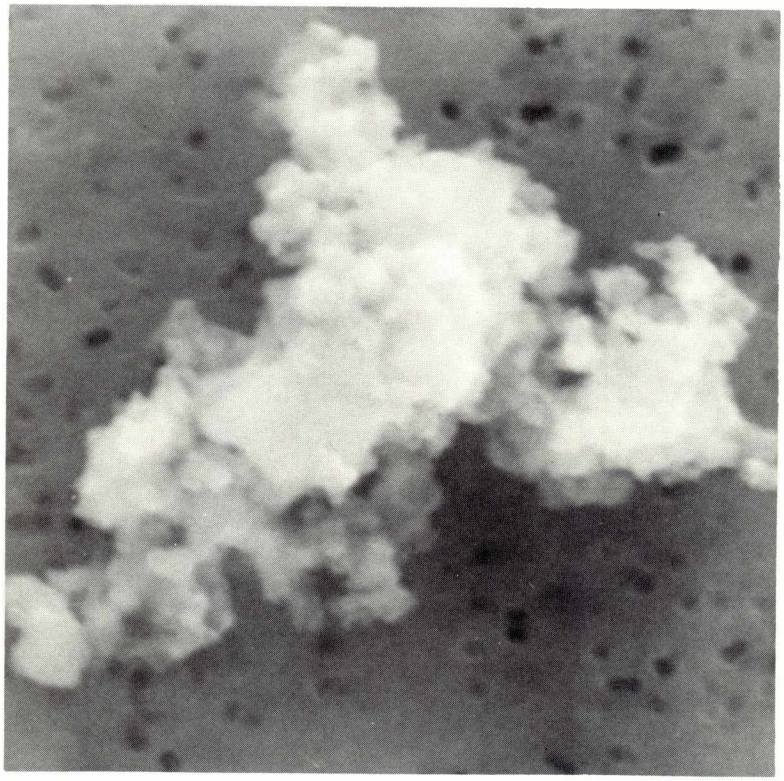
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 15 microns remain on collector.
Related to L2005E4 and E5



L2005 E 28



S-90-38169

SIZE: 11

SHAPE: I

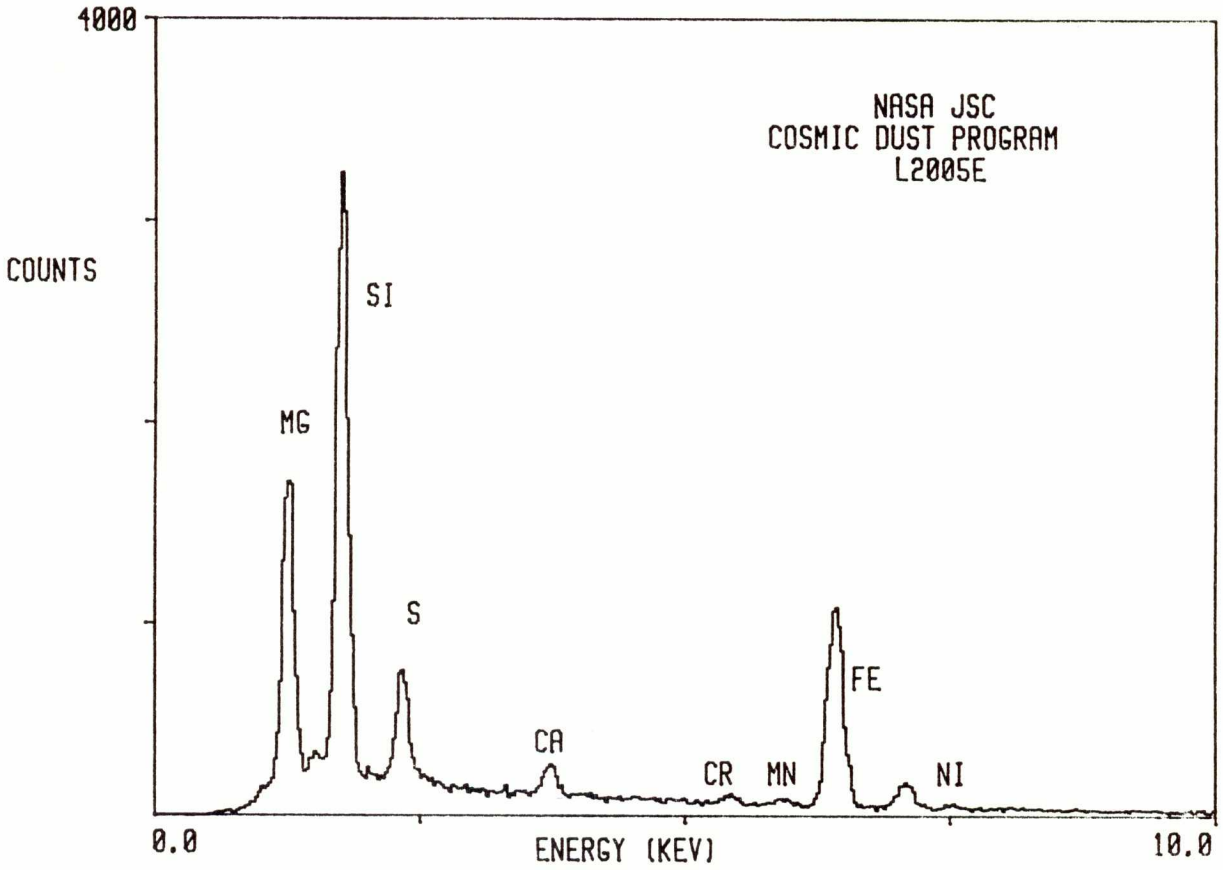
TRANS.: O

COLOR: Black

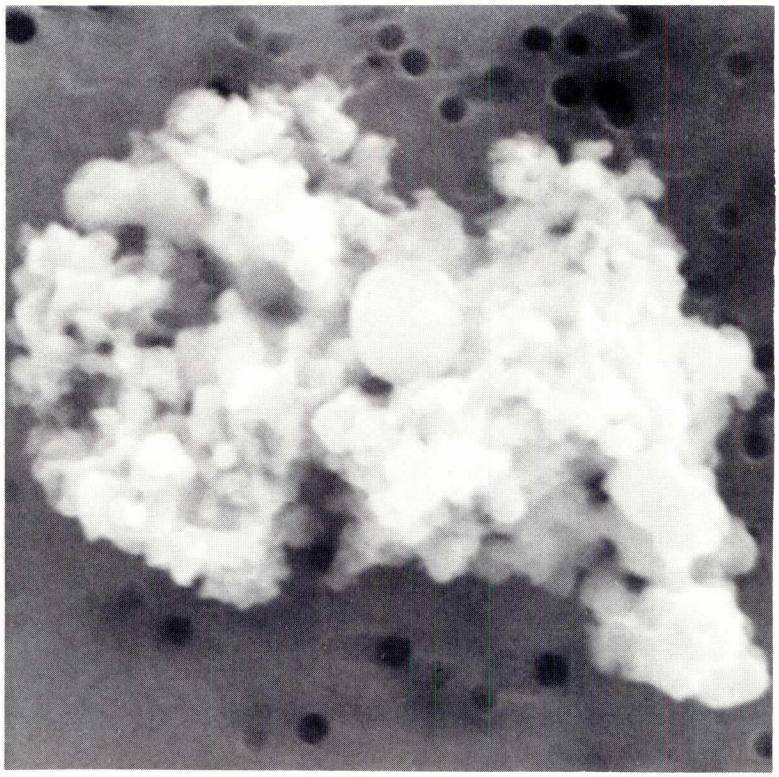
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 12 microns remain on collector



L2005 E 30



S-90-38170

SIZE: 5x9

SHAPE: I

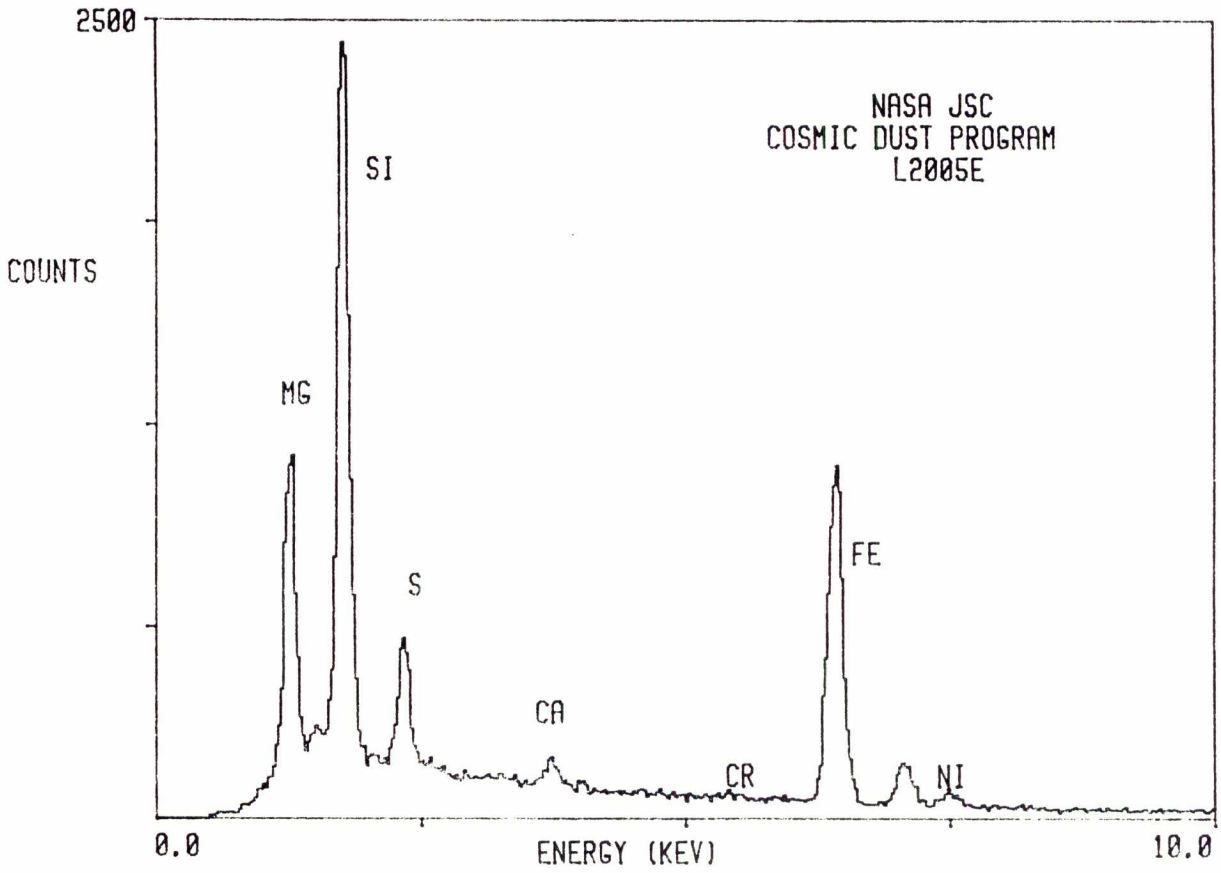
TRANS.: O

COLOR: Black

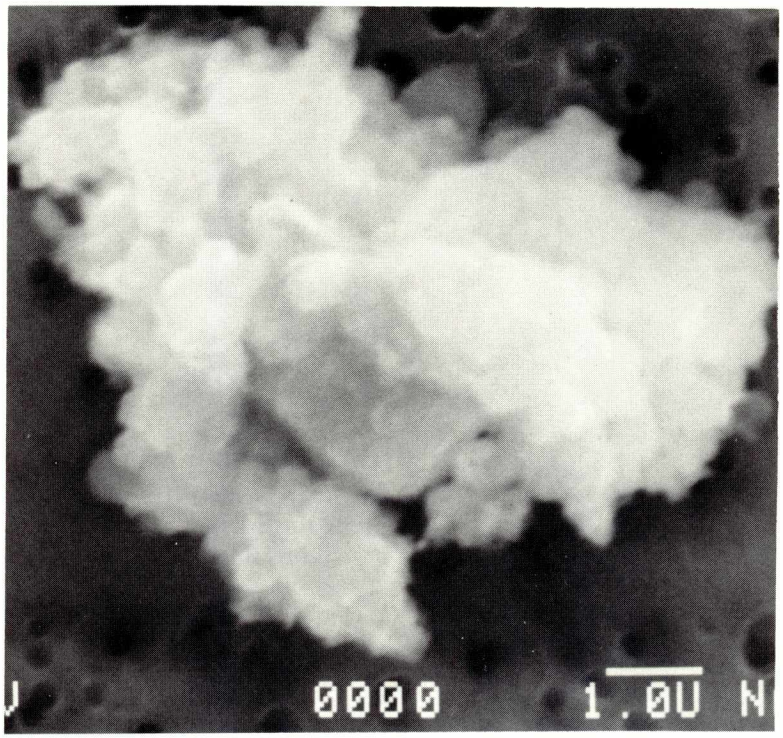
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 4 microns have been removed from collector



L2005 F 1



SIZE: 8x10

SHAPE: I

TRANS.: O

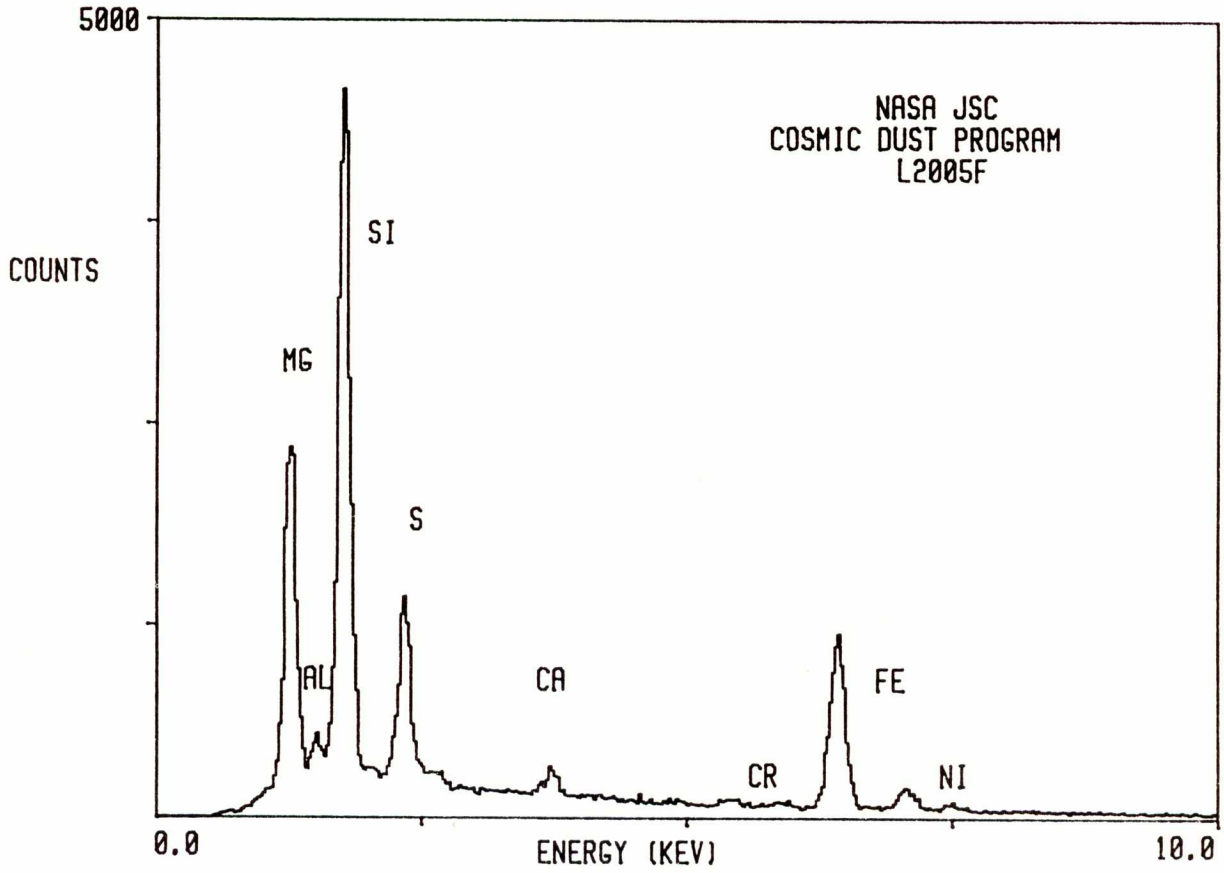
COLOR: Black

LUSTER: D/SM

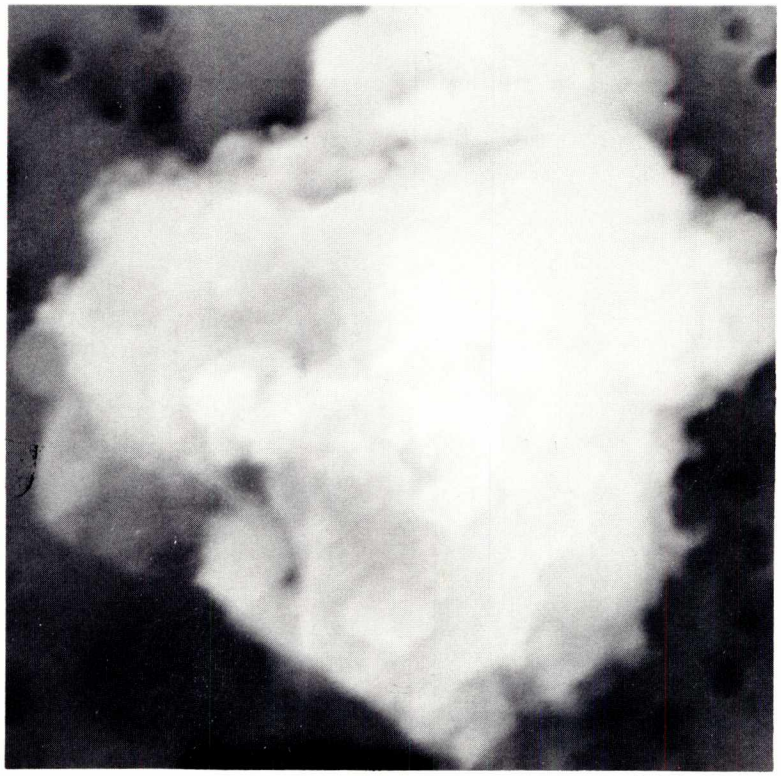
TYPE: C

COMMENTS:
Related to L2005F30, F2 and F3

S-90-38171



L2005 F 2



S-90-38172

SIZE: 8

SHAPE: I

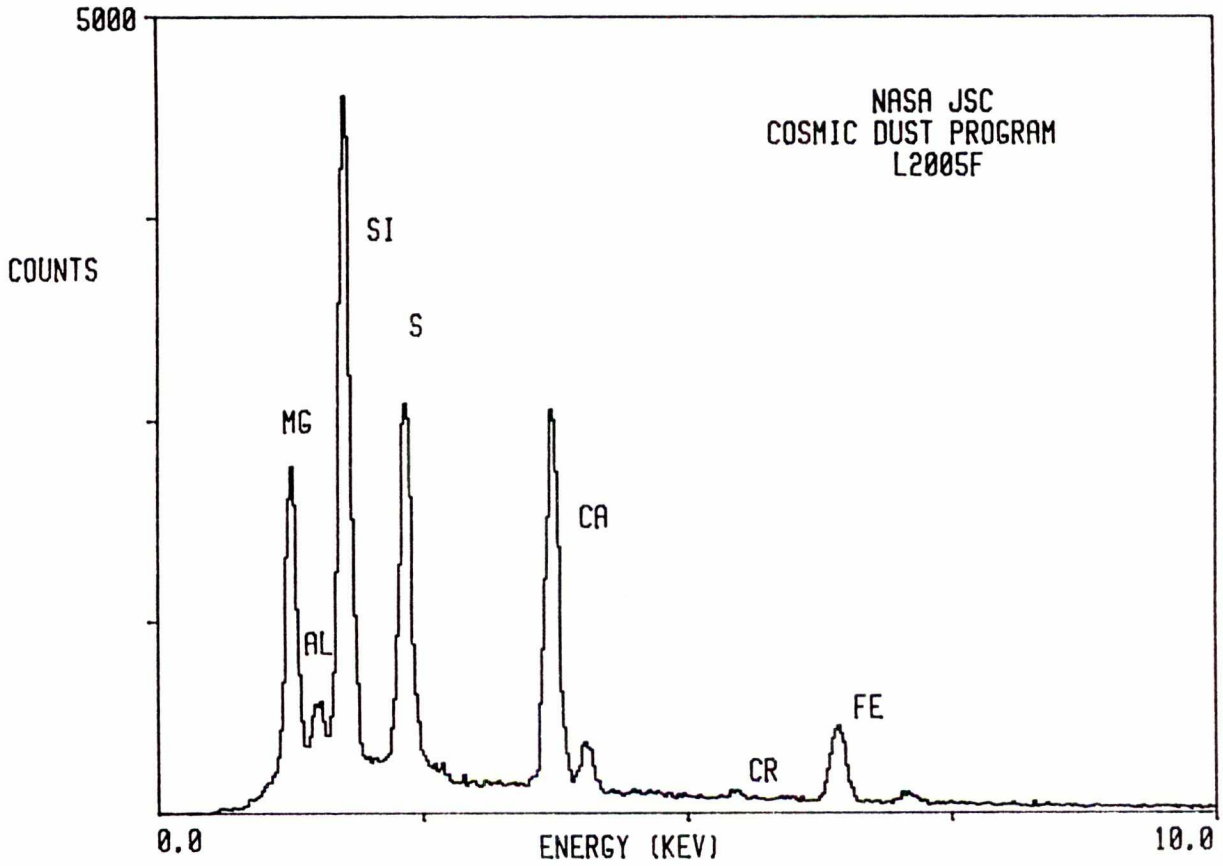
TRANS.: O

COLOR: Black

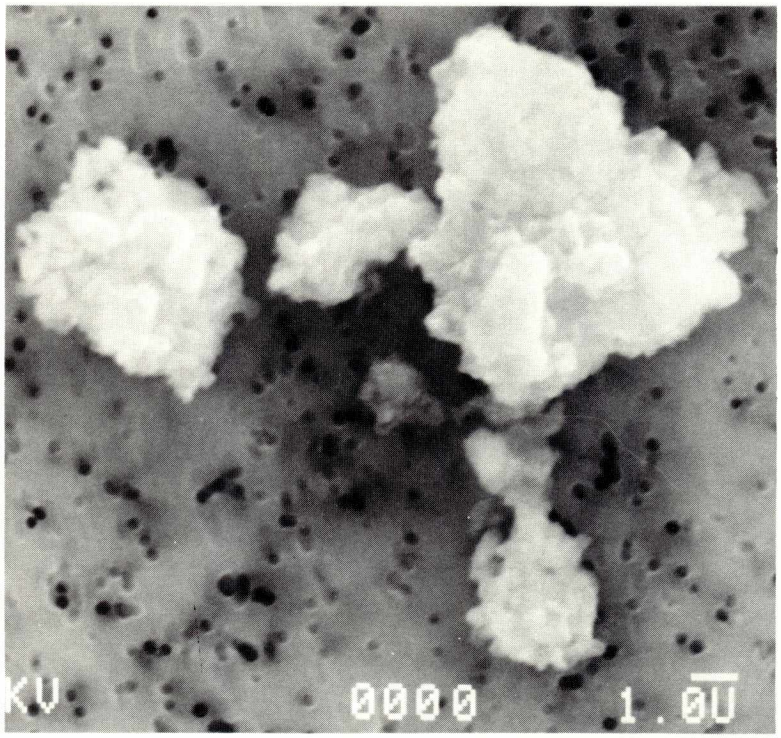
LUSTER: D/SM

TYPE: C

COMMENTS:
Related to L2005F30, F1 and F3



L2005 F 3



SIZE: 10

SHAPE: I

TRANS.: O

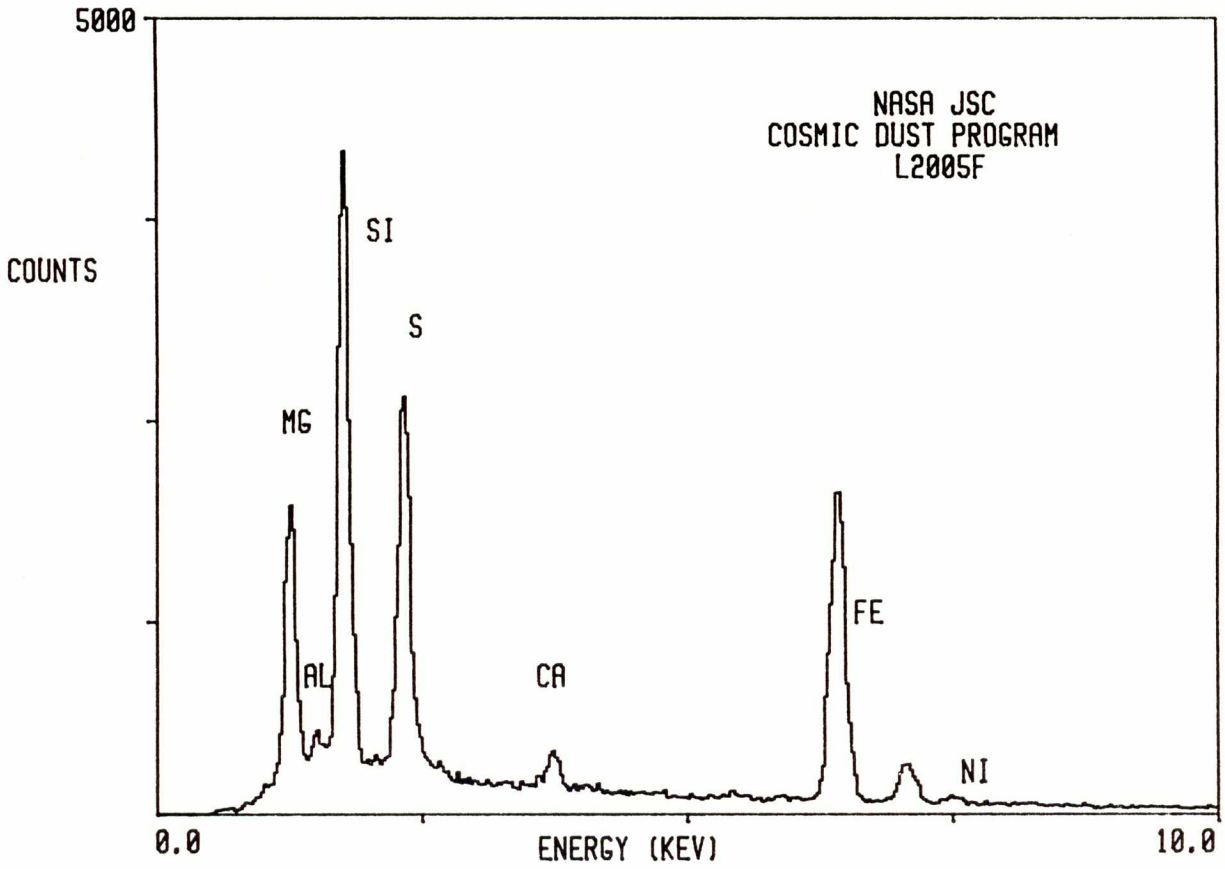
COLOR: Black

LUSTER: D/SM

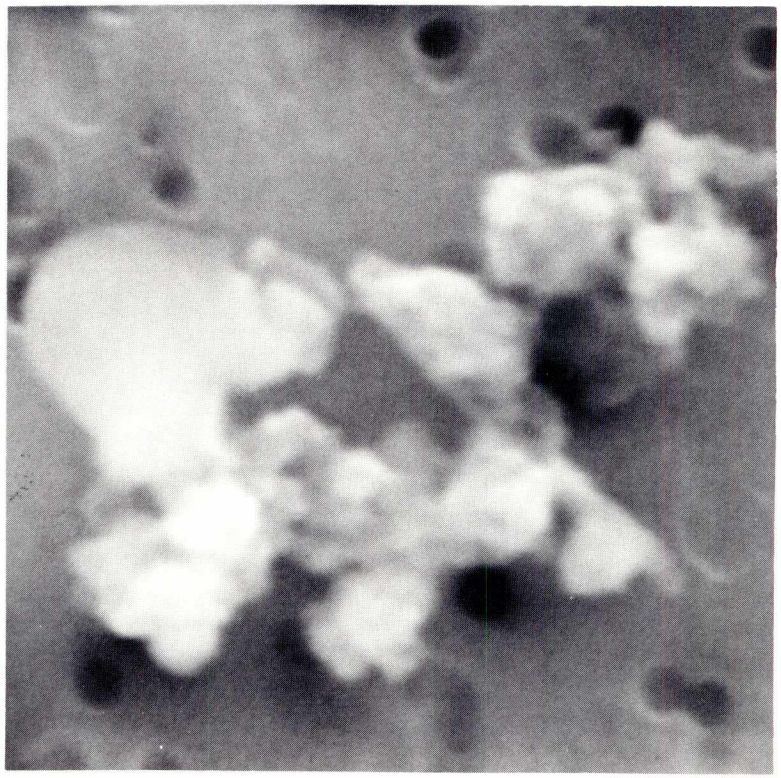
TYPE: C

COMMENTS:
Related to L2005F30, F1 and F2

S-90-38173



L2005 F 4



S-90-38174

SIZE: 4

SHAPE: I

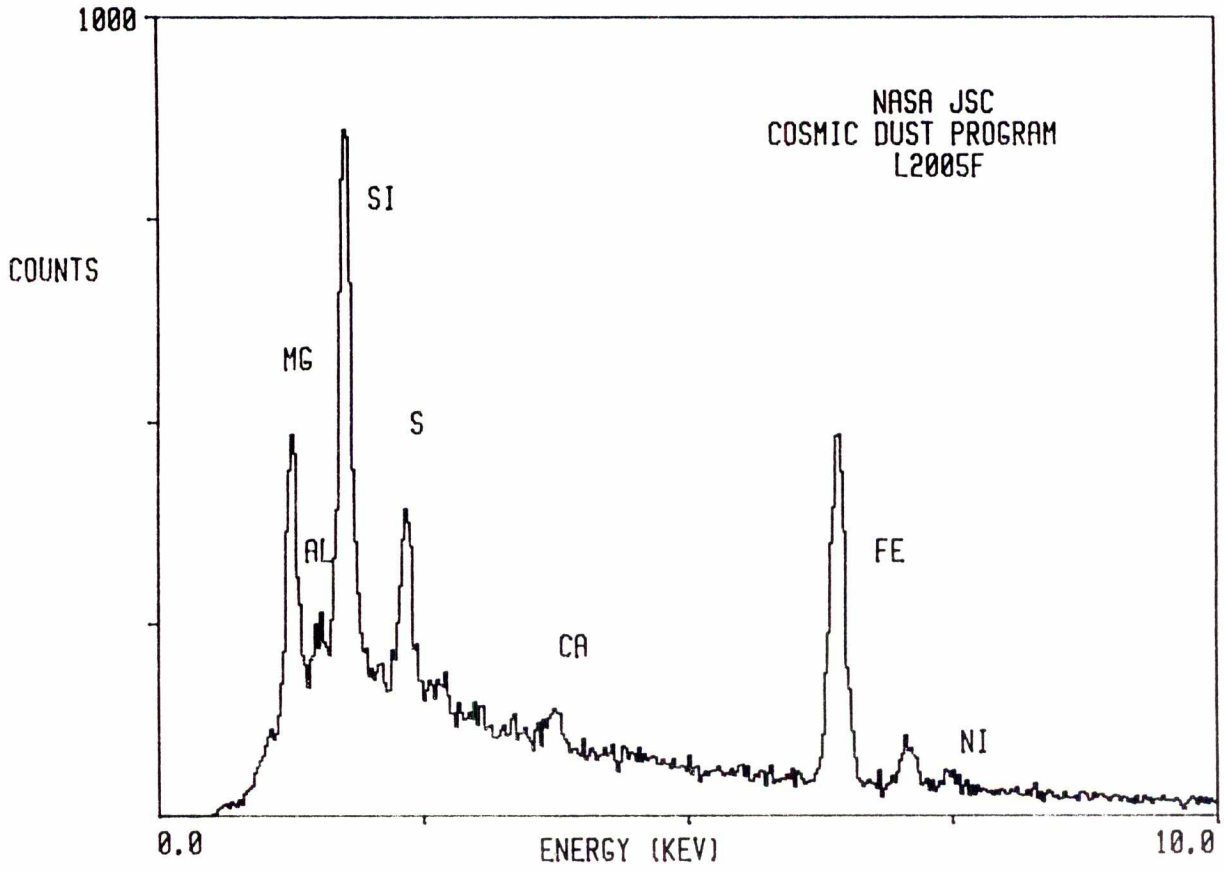
TRANS.: O

COLOR: Black

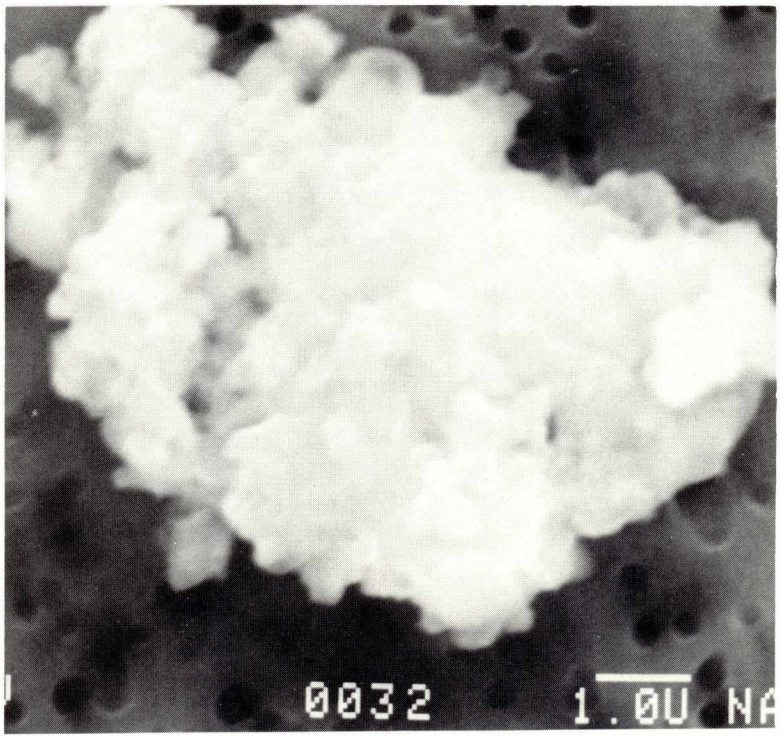
LUSTER: D

TYPE: C

COMMENTS:
Related to
L2005F33



L2005 F 31



SIZE: 8x10

SHAPE: I

TRANS.: O

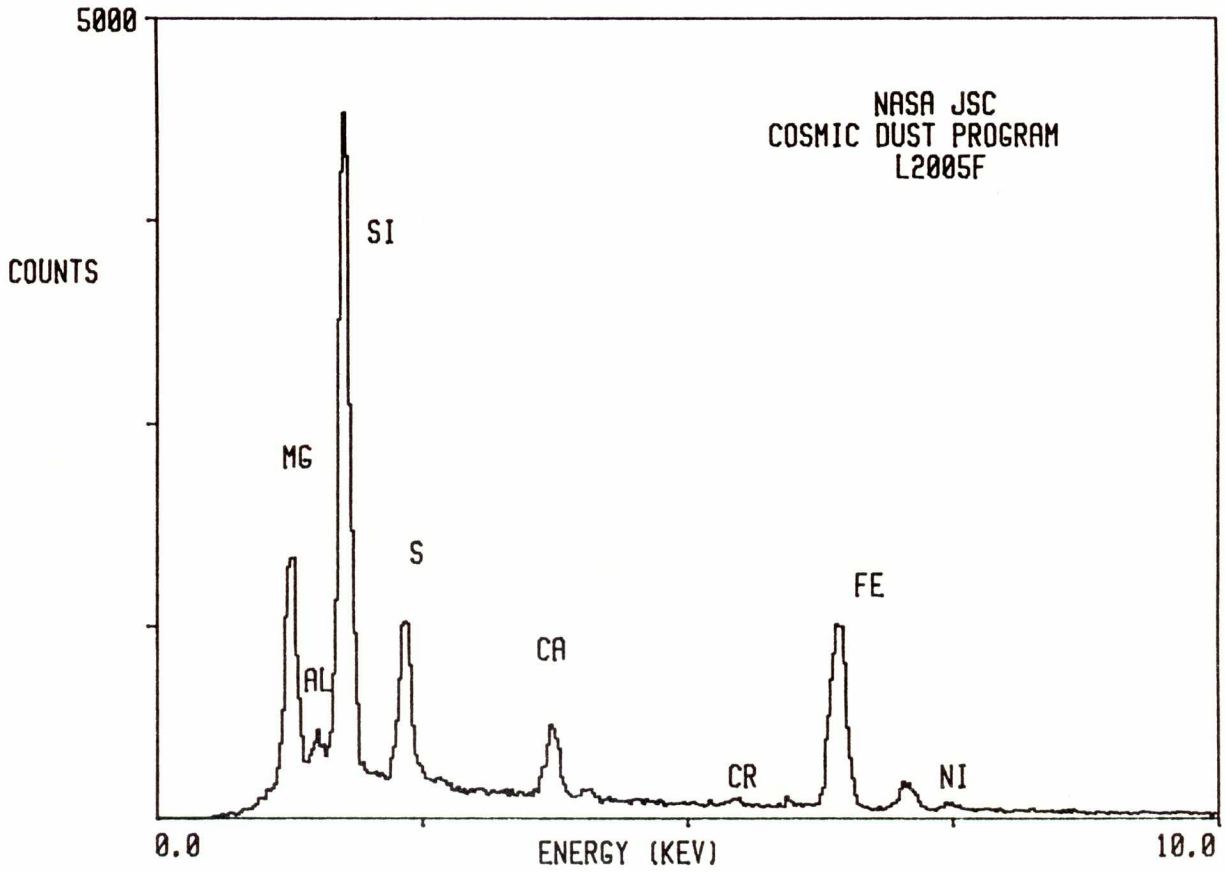
COLOR: Black

LUSTER: D/SM

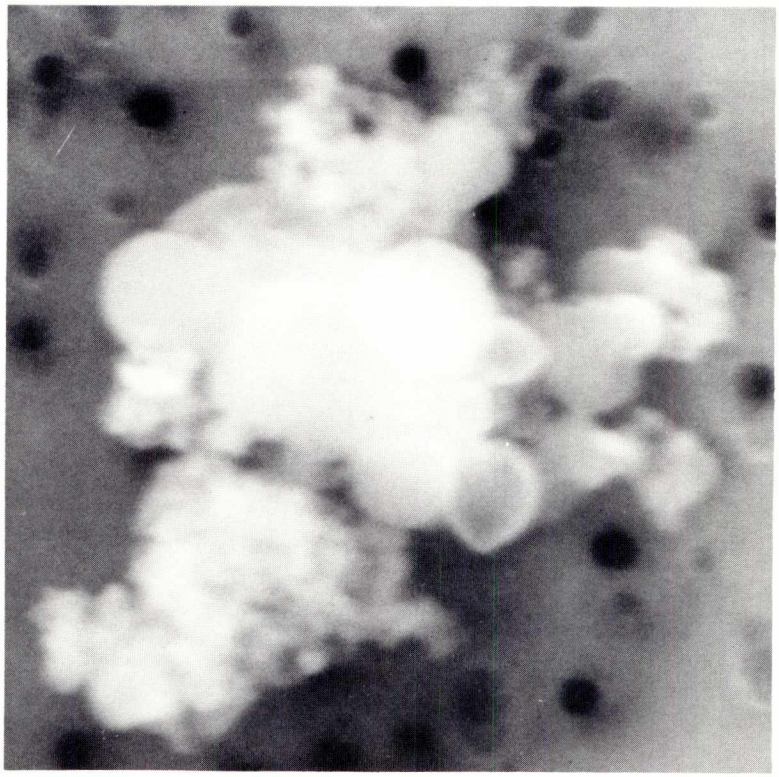
TYPE: C

COMMENTS:
Related grains up to 20 microns remain on collector. Related to L2005F1, F2 and F3

S-90-38175



L2005 F 33



S-90-38177

SIZE: 8

SHAPE: I

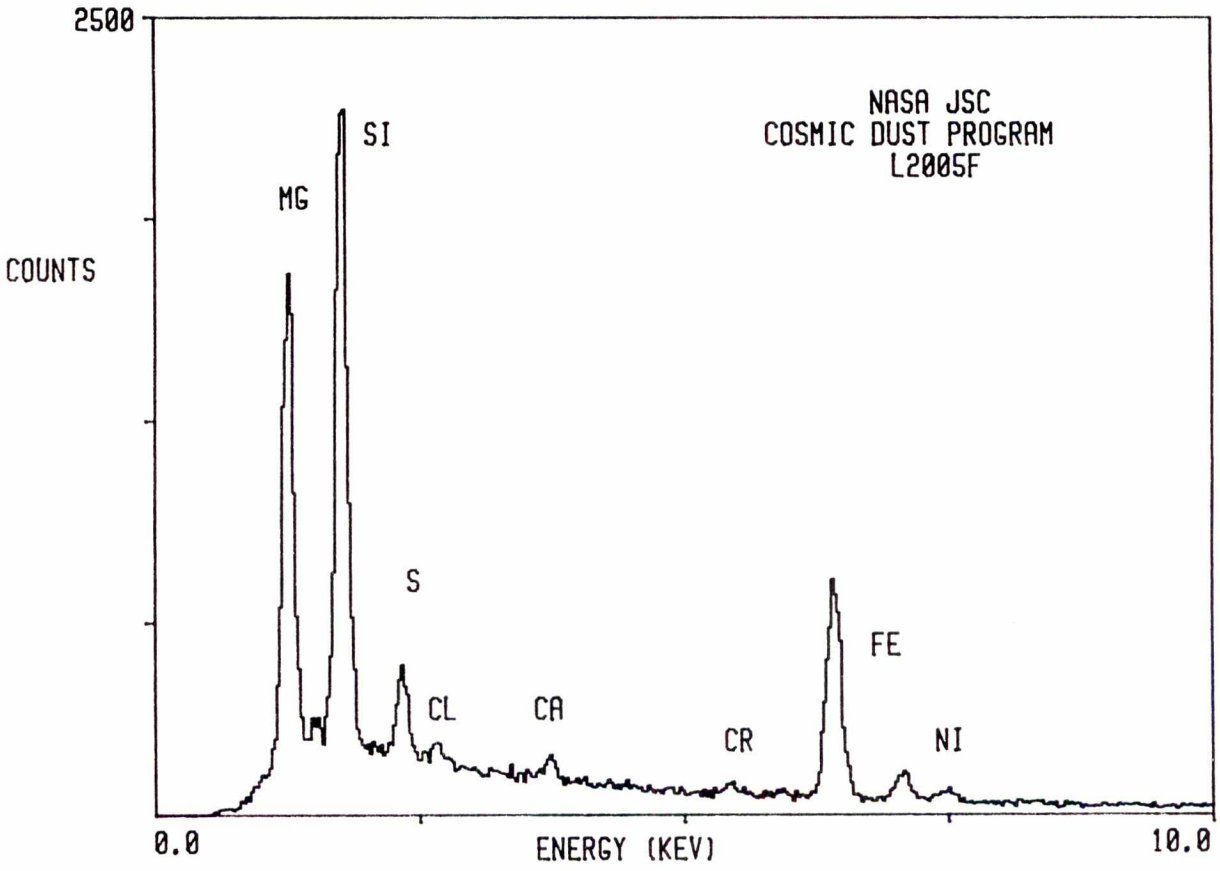
TRANS.: O

COLOR: Black

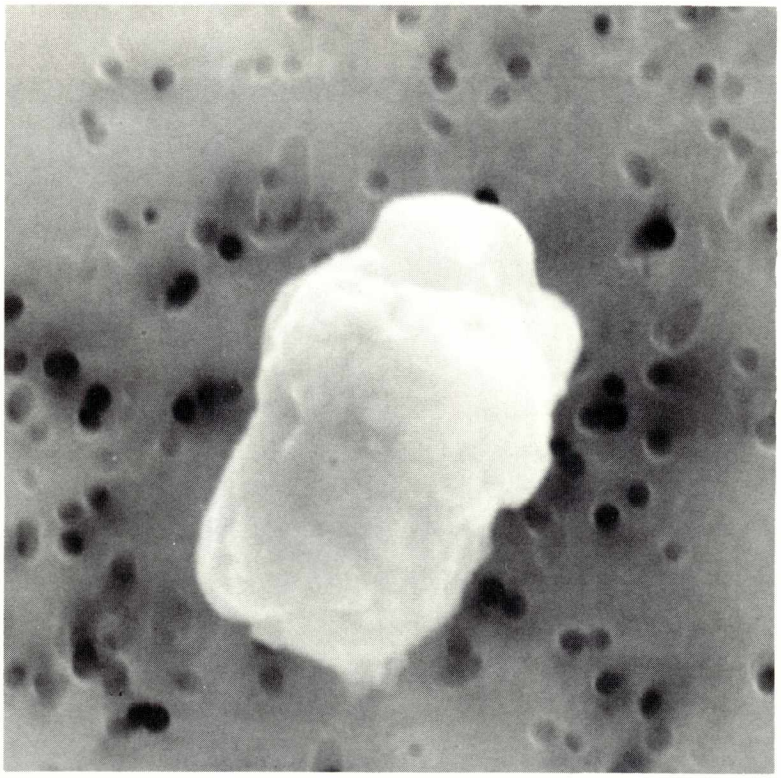
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005F4. Only fines remain on collector



L2005 G 1



S-90-38180

SIZE: 5

SHAPE: I

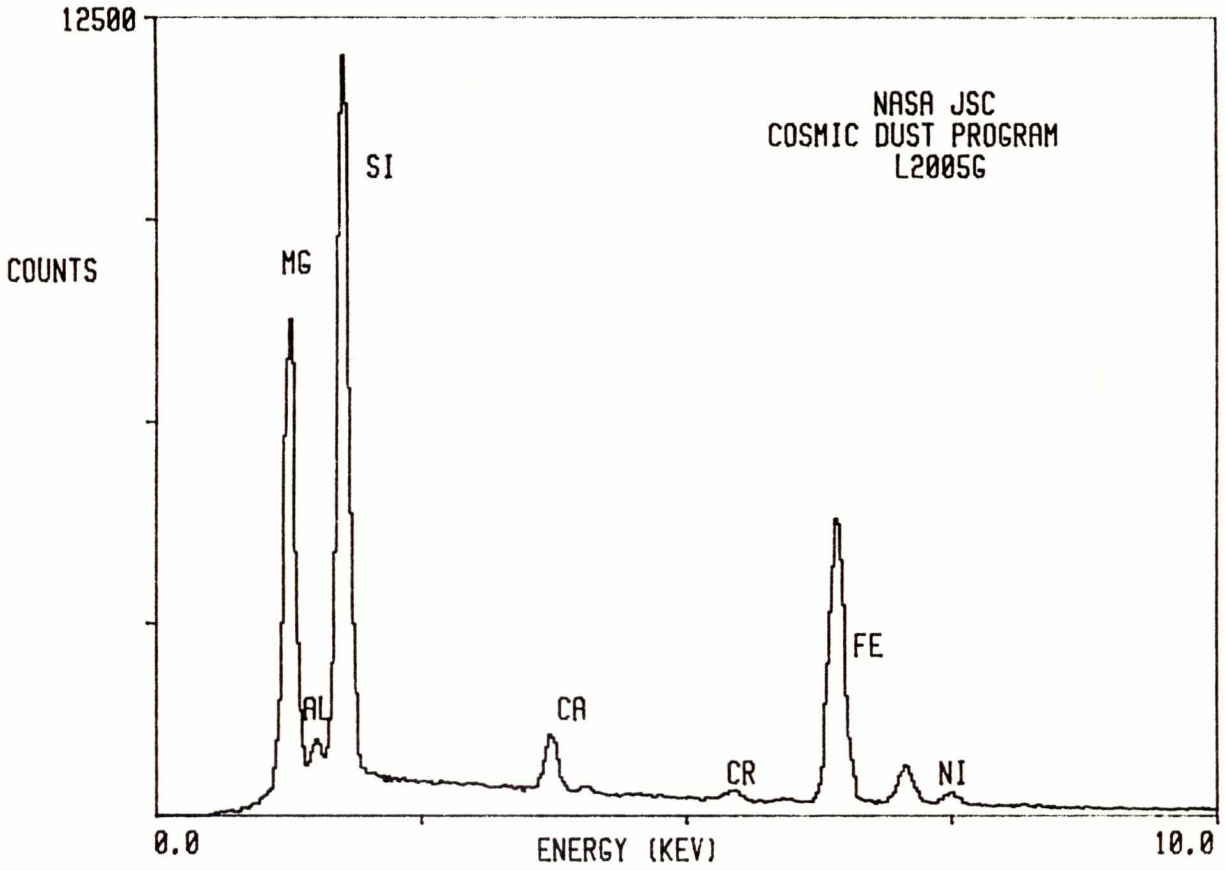
TRANS.: O

COLOR: Black to Brown

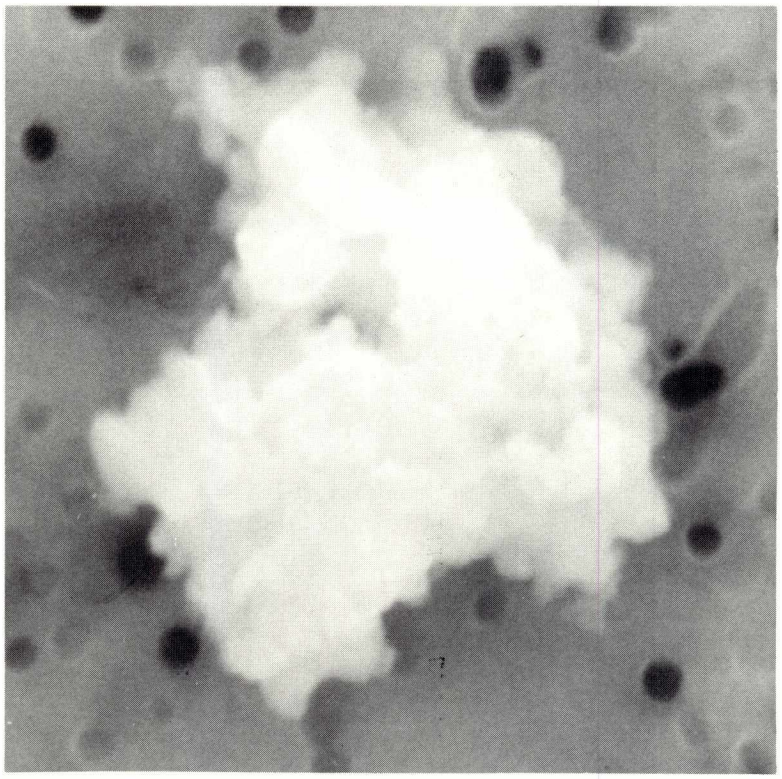
LUSTER: D/SM

TYPE: C

COMMENTS:
Related to
L2005G38



L2005 G 2



S-90-38181

SIZE: 4

SHAPE: I

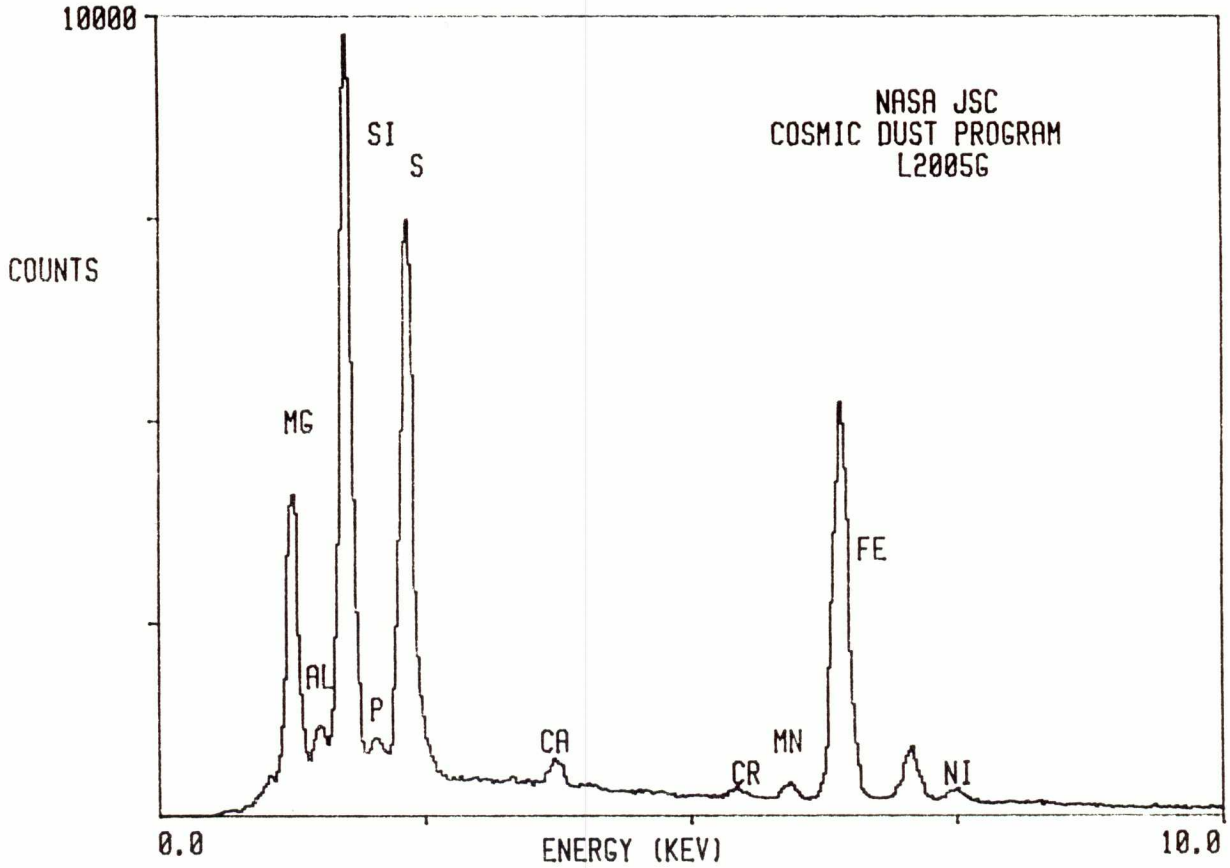
TRANS.: O

COLOR: Black

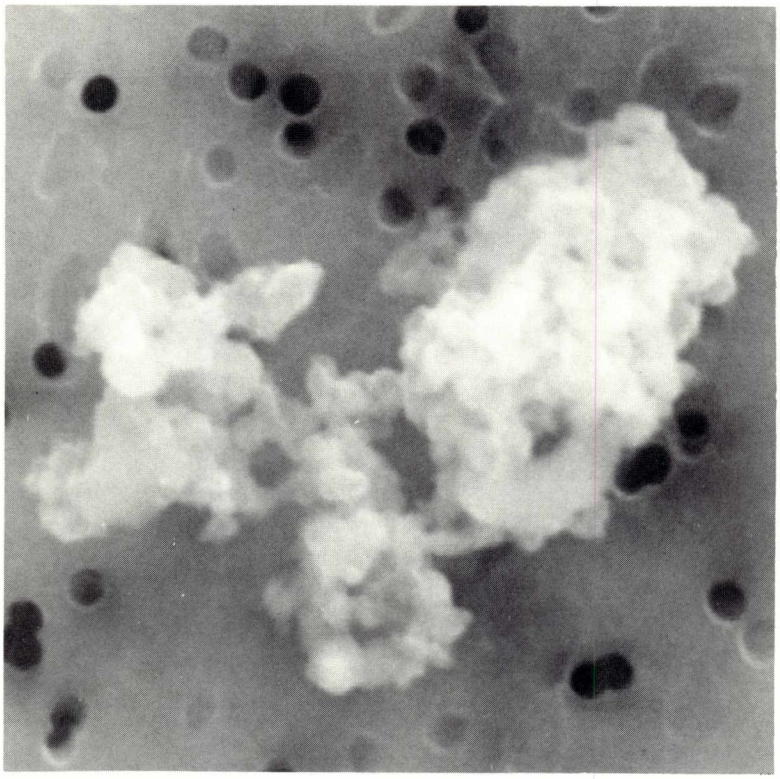
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005G3 and G42



L2005 G 3



S-90-38182

SIZE: 4

SHAPE: I

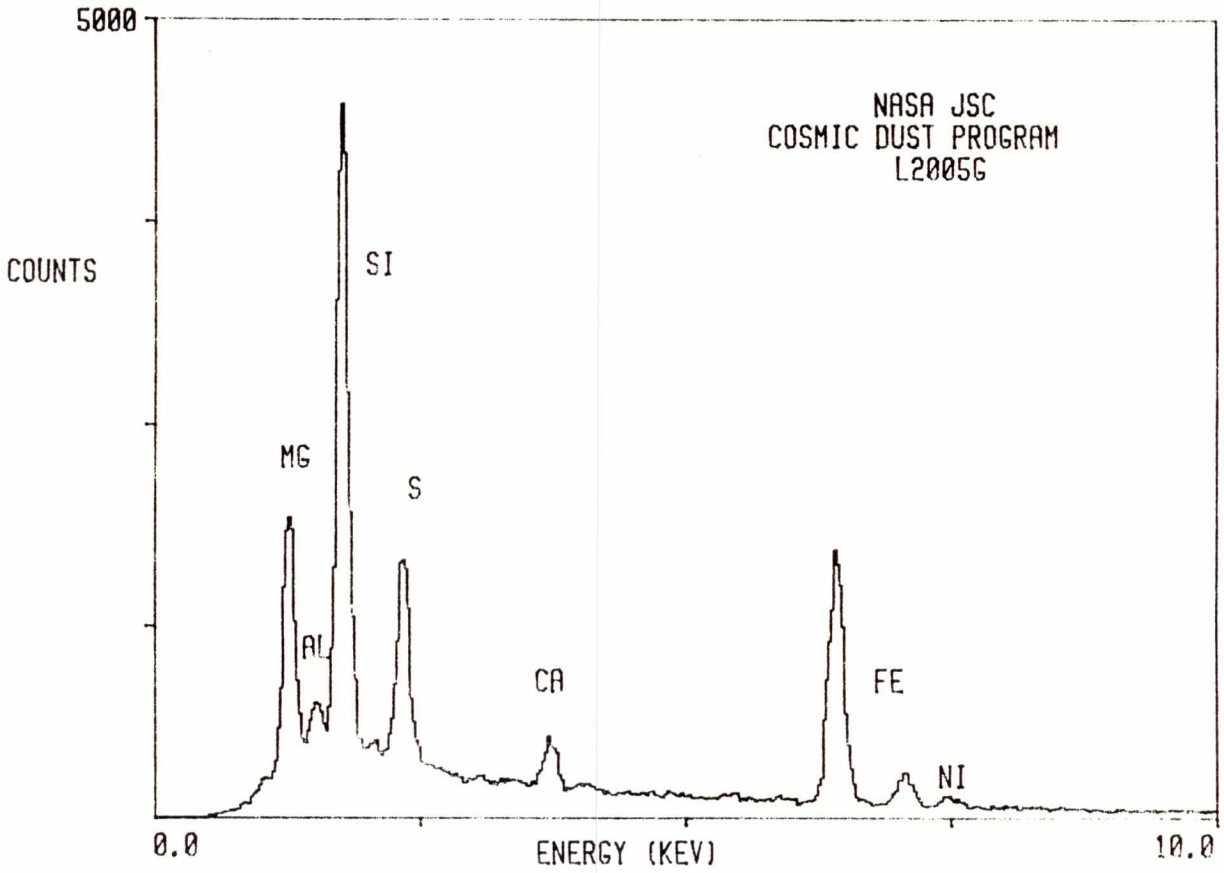
TRANS.: O

COLOR: Black

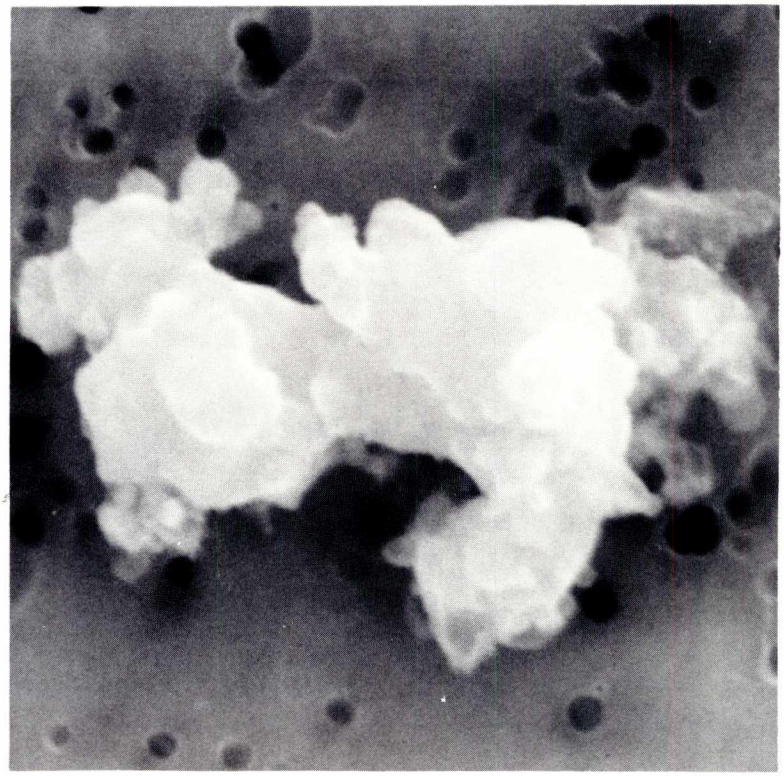
LUSTER: D

TYPE: C

COMMENTS:
Related to L2005G2 and G42



L2005 G 38



S-90-38183

SIZE: 8

SHAPE: I

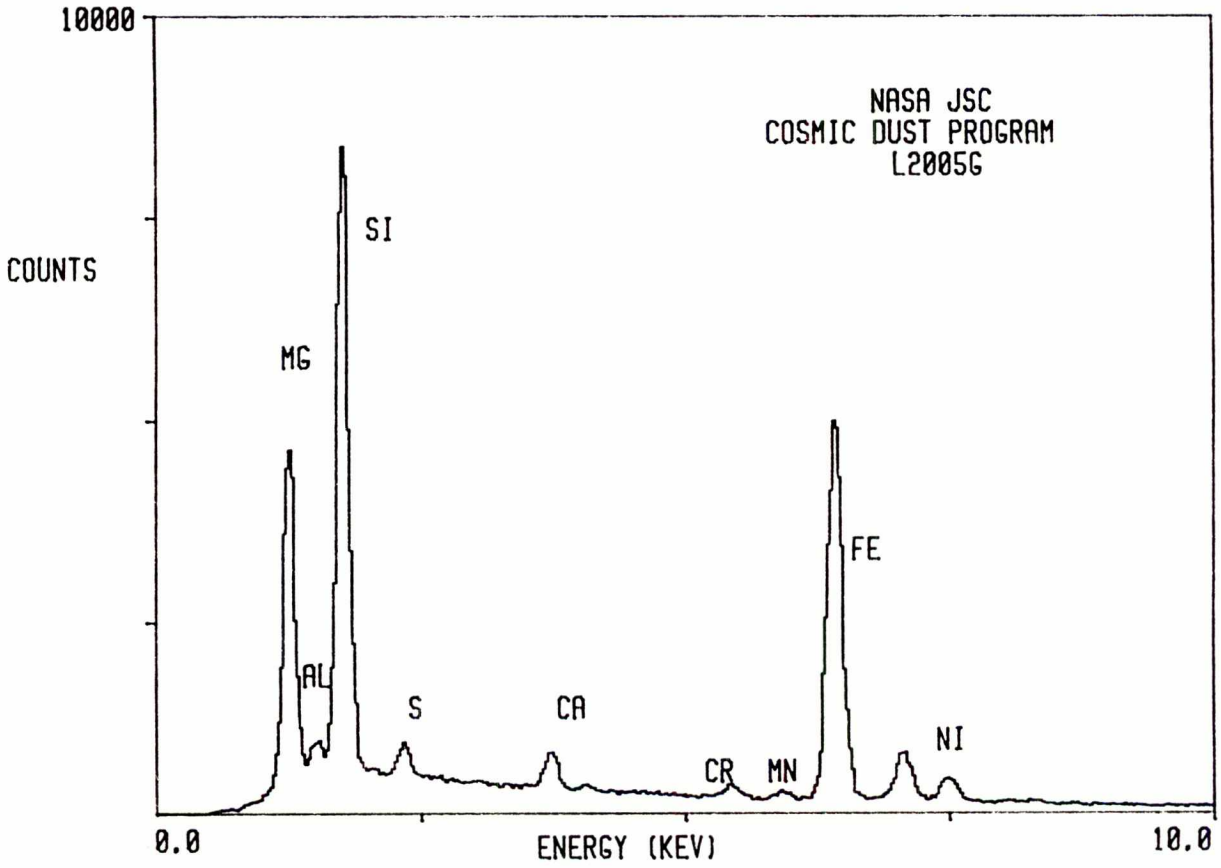
TRANS.: O

COLOR: Black to Brown

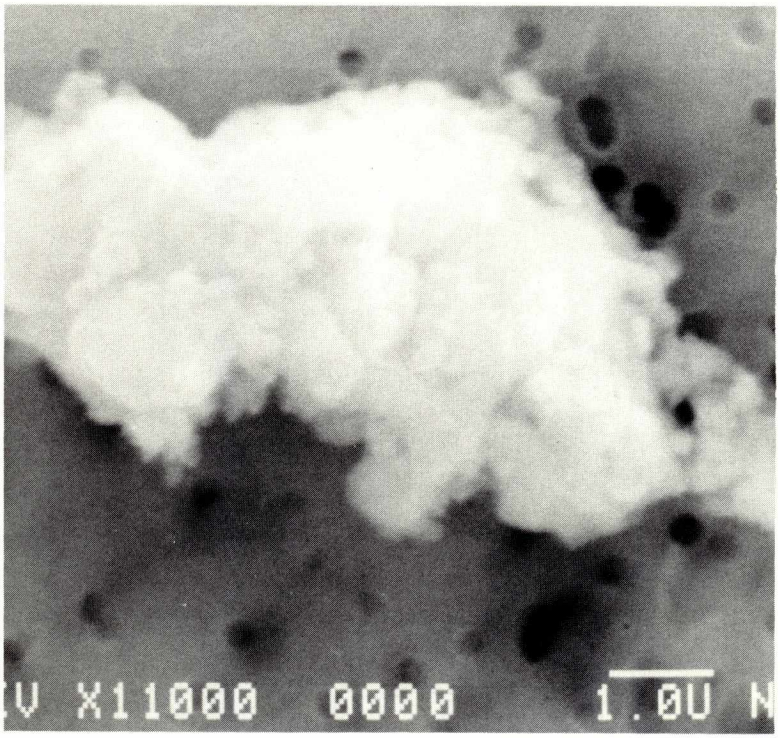
LUSTER: D/SM

TYPE: C

COMMENTS:
Related grains up to 20 microns remain on collector.
Related to L2005G1



L2005 G 42



SIZE: 8

SHAPE: I

TRANS.: O

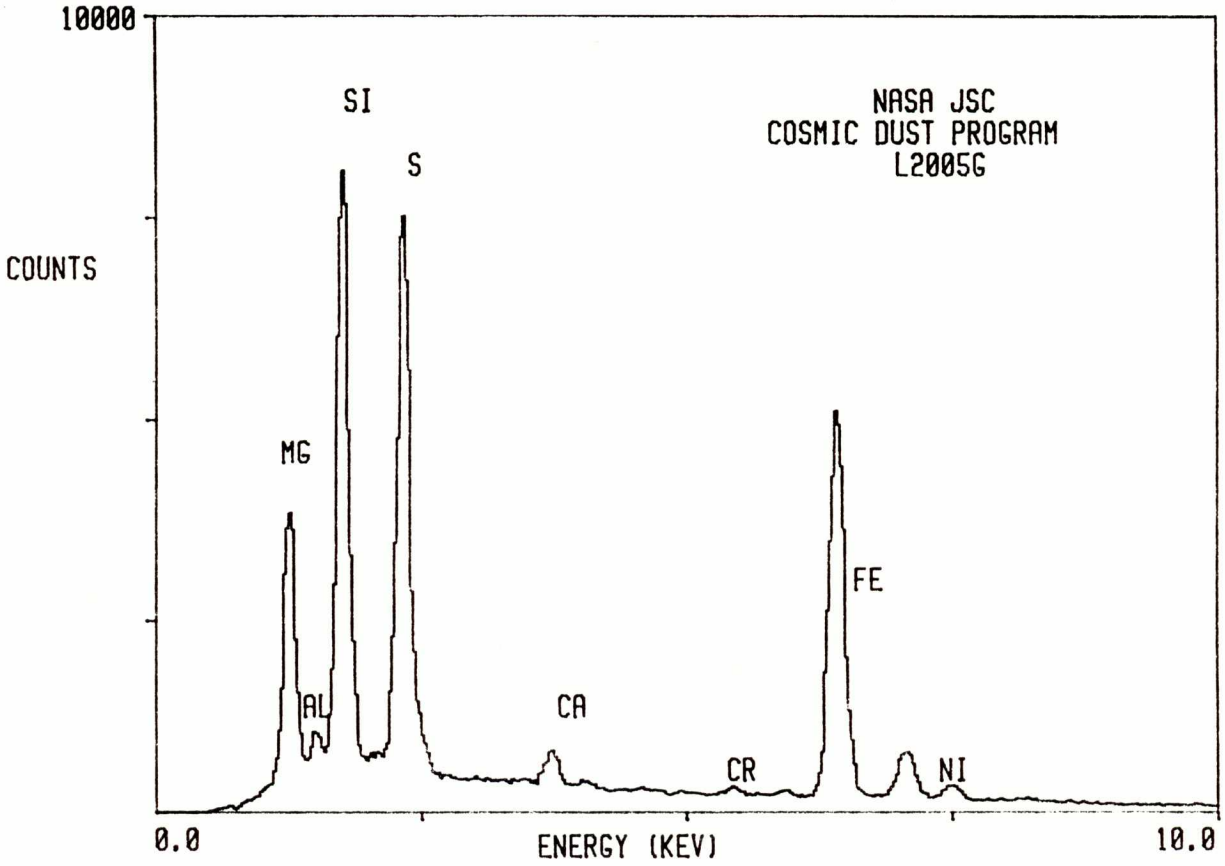
COLOR: Black

LUSTER: D

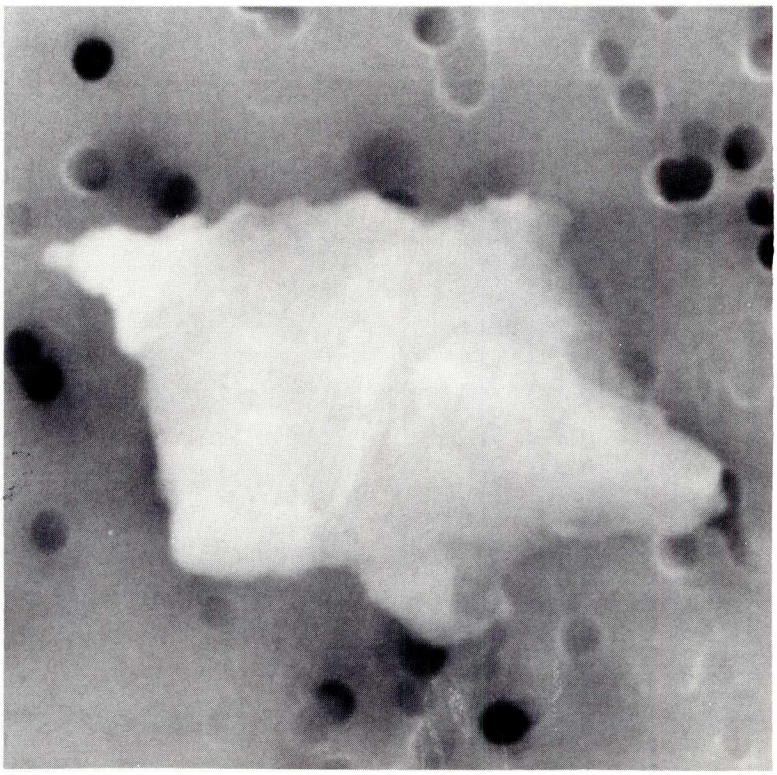
TYPE: C

COMMENTS:
Related to L2005G2 and G3. Only fines remain on collector

S-90-38184



L2005 H 1



S-90-38185

SIZE: 3x4

SHAPE: I

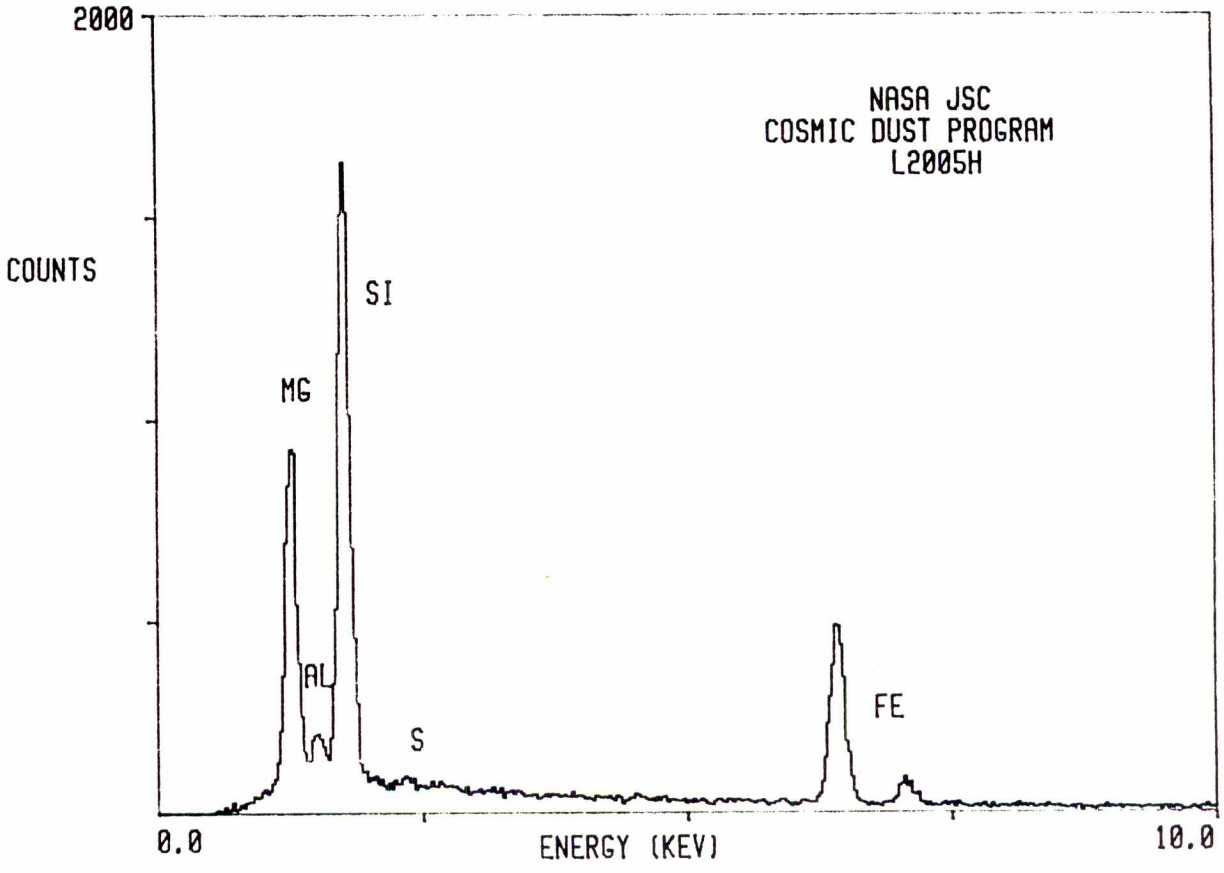
TRANS.: O

COLOR: Black

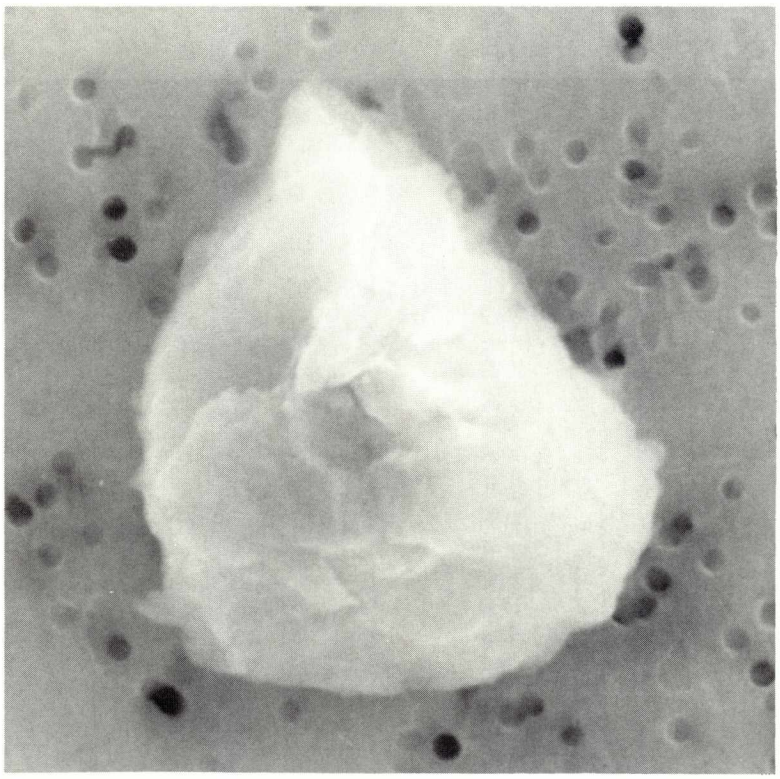
LUSTER: D

TYPE: C

COMMENTS:
Related to
L2005H44



L2005 H 43



S-90-38186

SIZE: 5x6

SHAPE: I

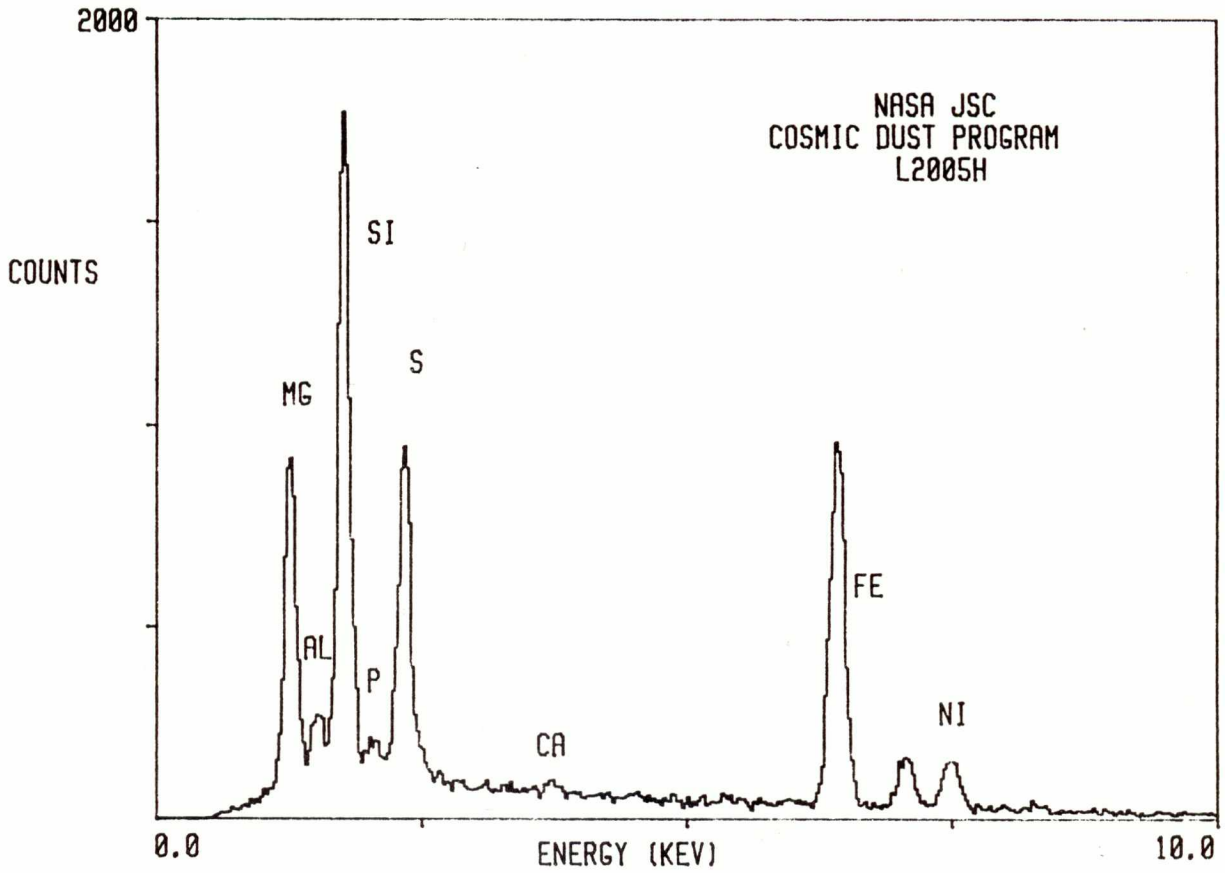
TRANS.: O

COLOR: Black

LUSTER: D/SV

TYPE: C

COMMENTS:
Related grains up to 12 microns remain on collector

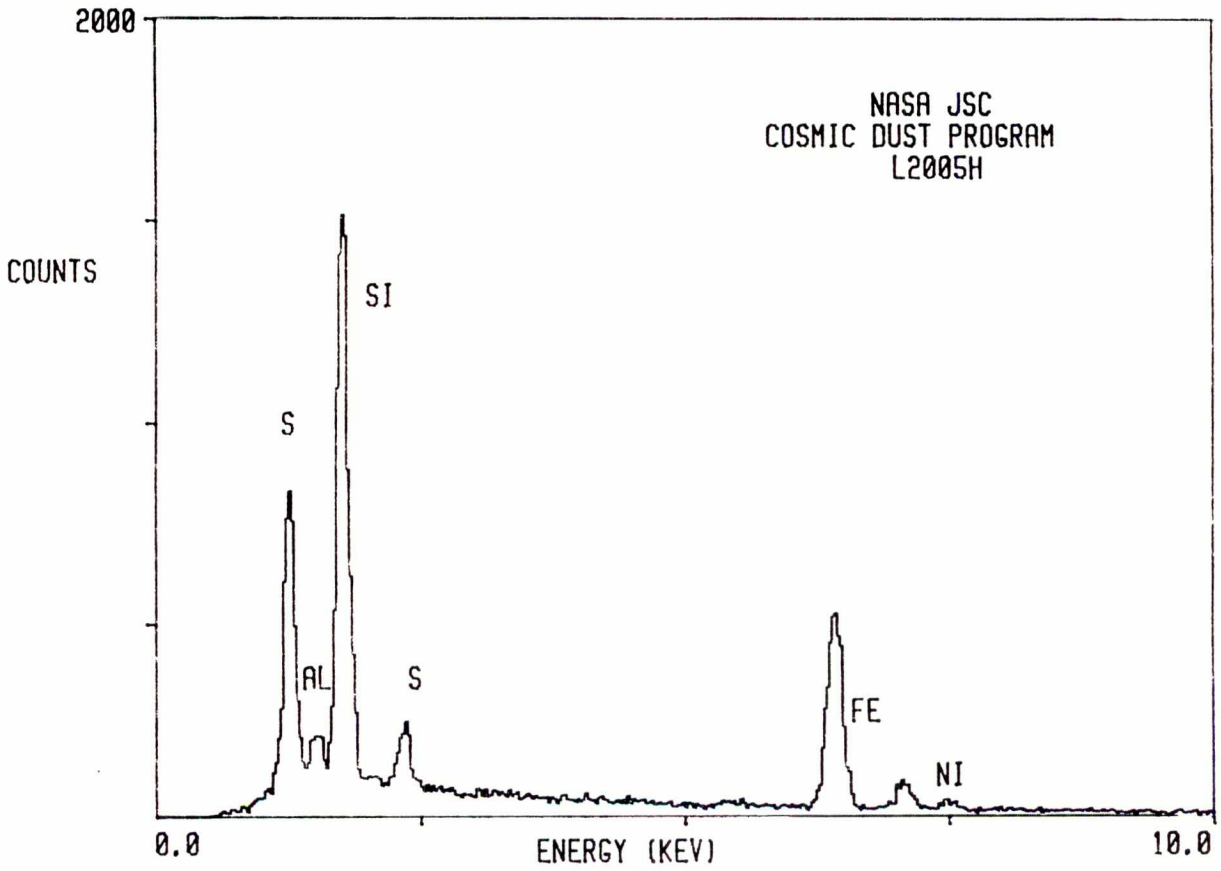


L2005 H 44

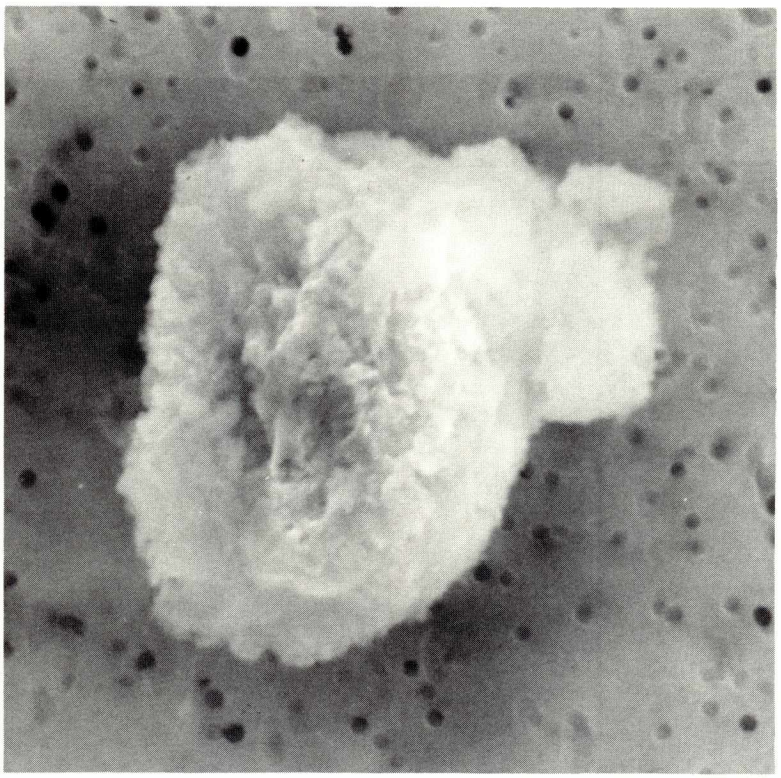
S-90-38187

SIZE: 3x4
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:
Related to L2005H1



L2005 H 45



S-90-38188

SIZE: 8

SHAPE: I

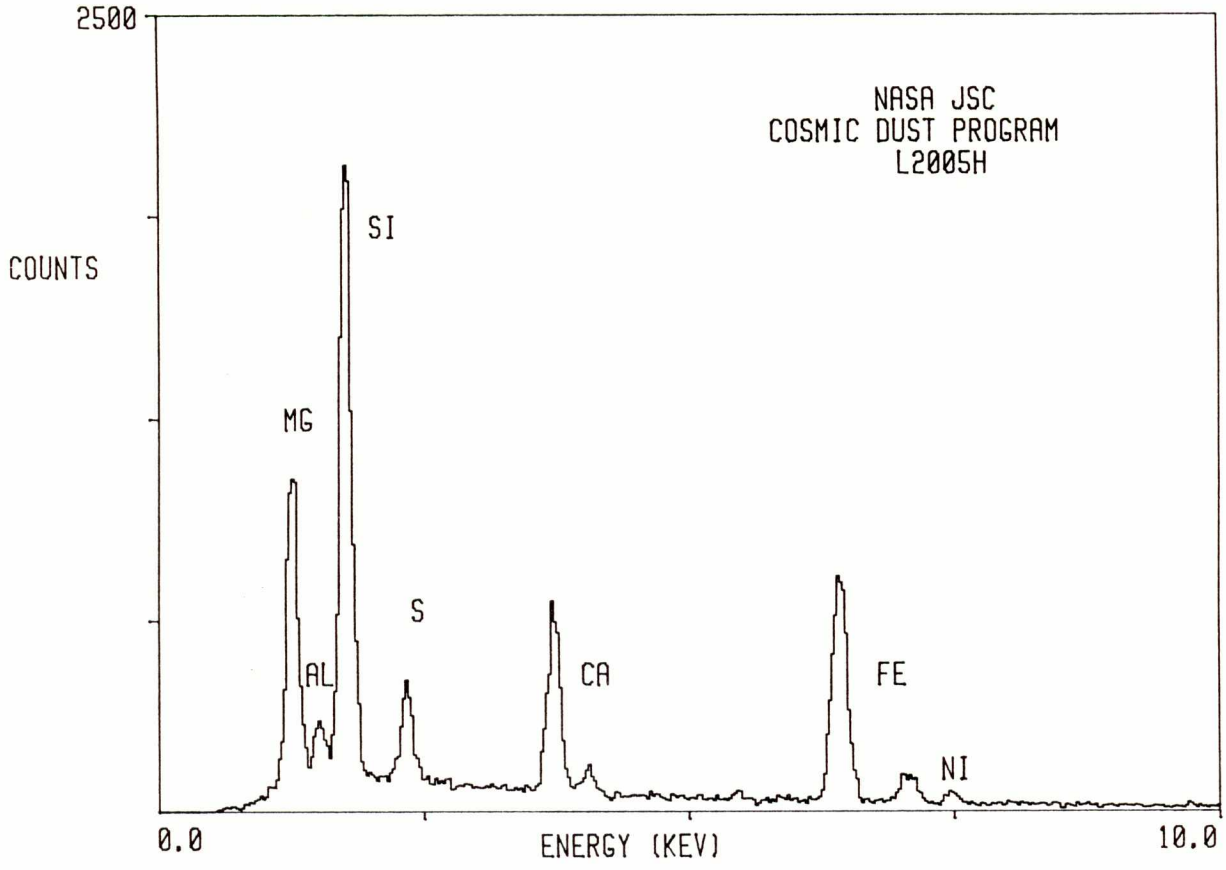
TRANS.: O

COLOR: Black

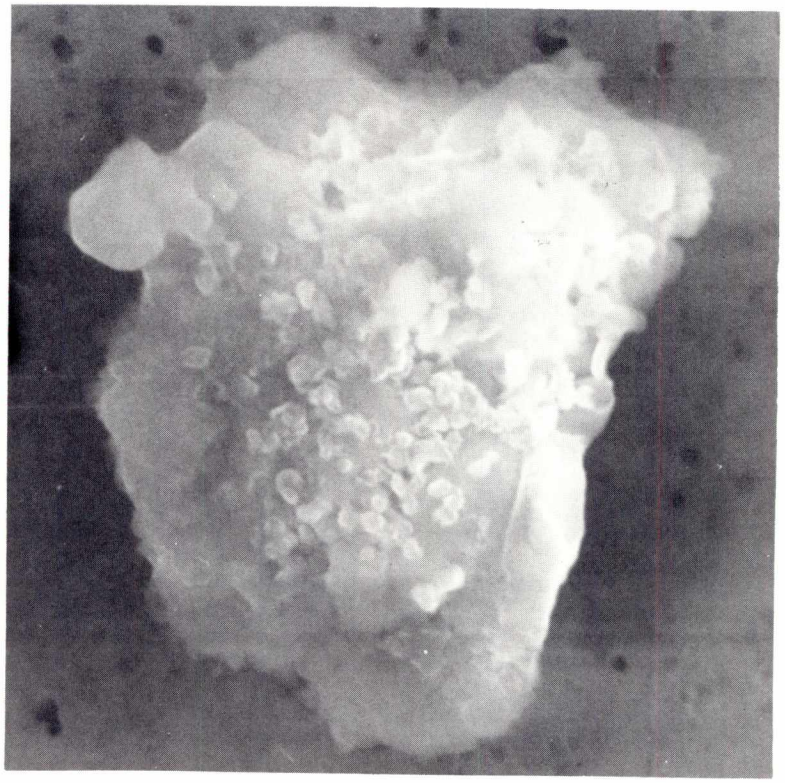
LUSTER: D

TYPE: C

COMMENTS:
Related grains up to 12 microns remain on collector



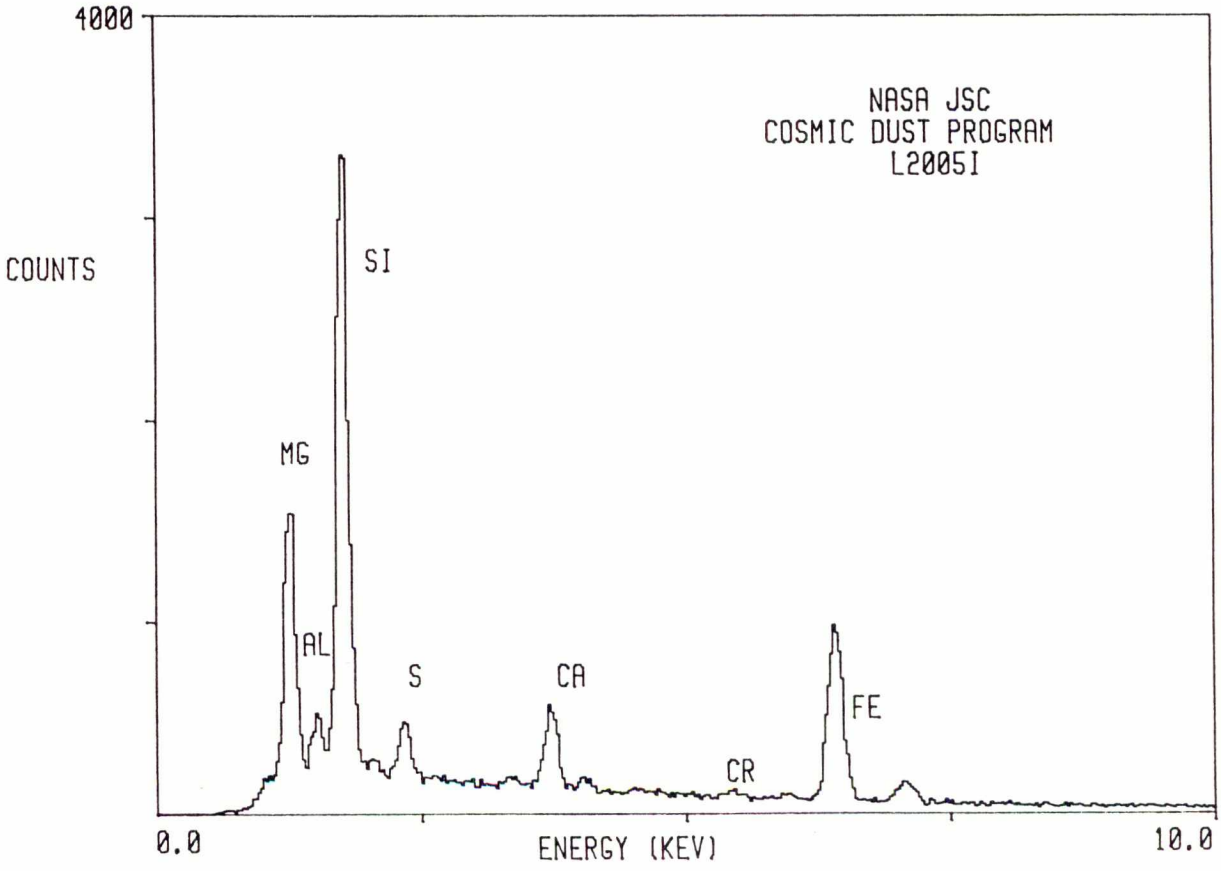
L2005 I 15



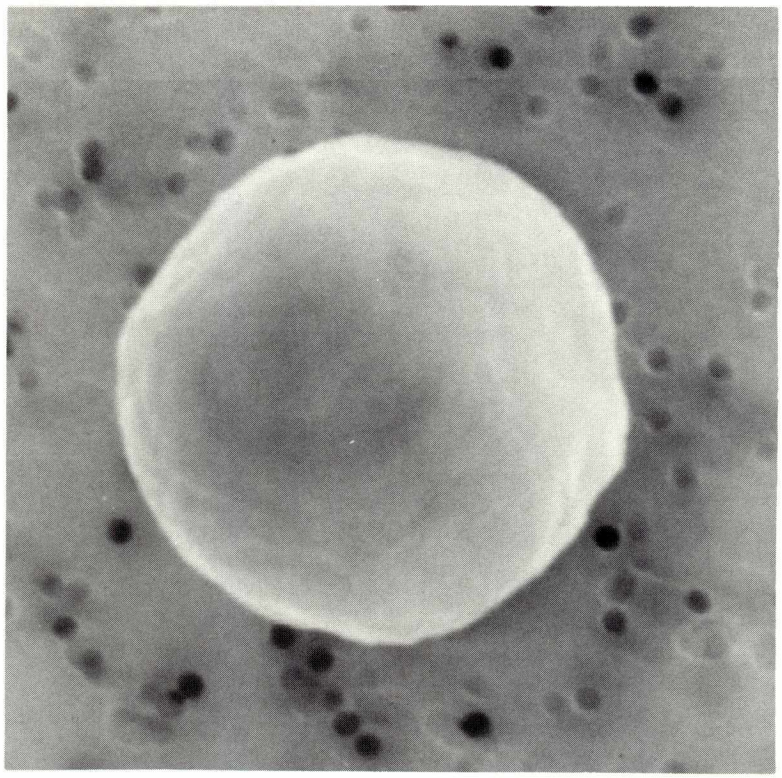
S-90-38192

SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



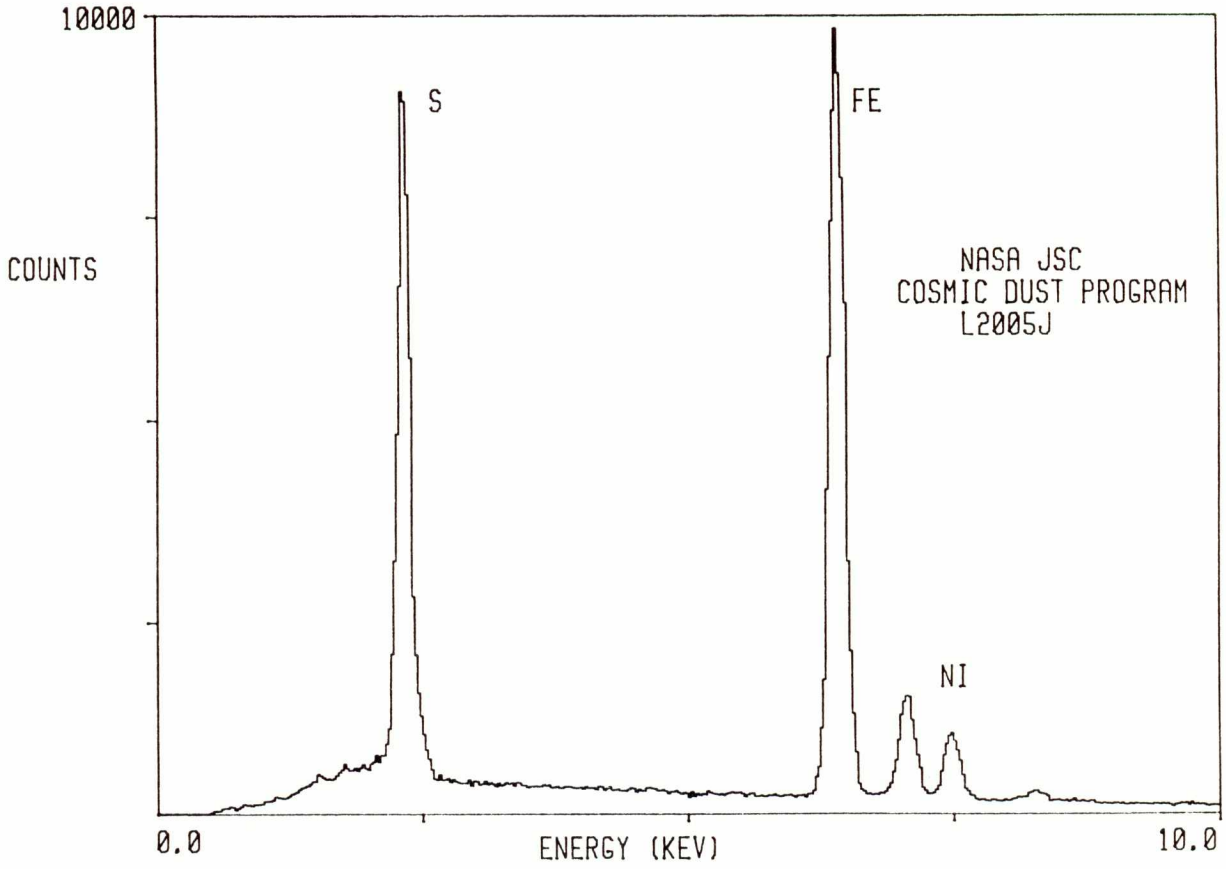
L2005 J 9



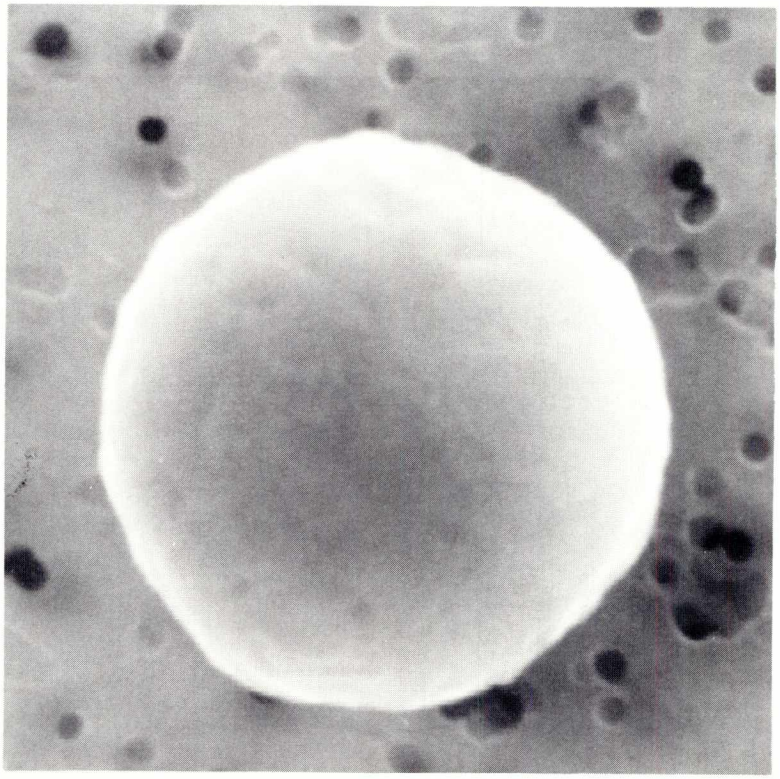
S-90-38202

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

COMMENTS:



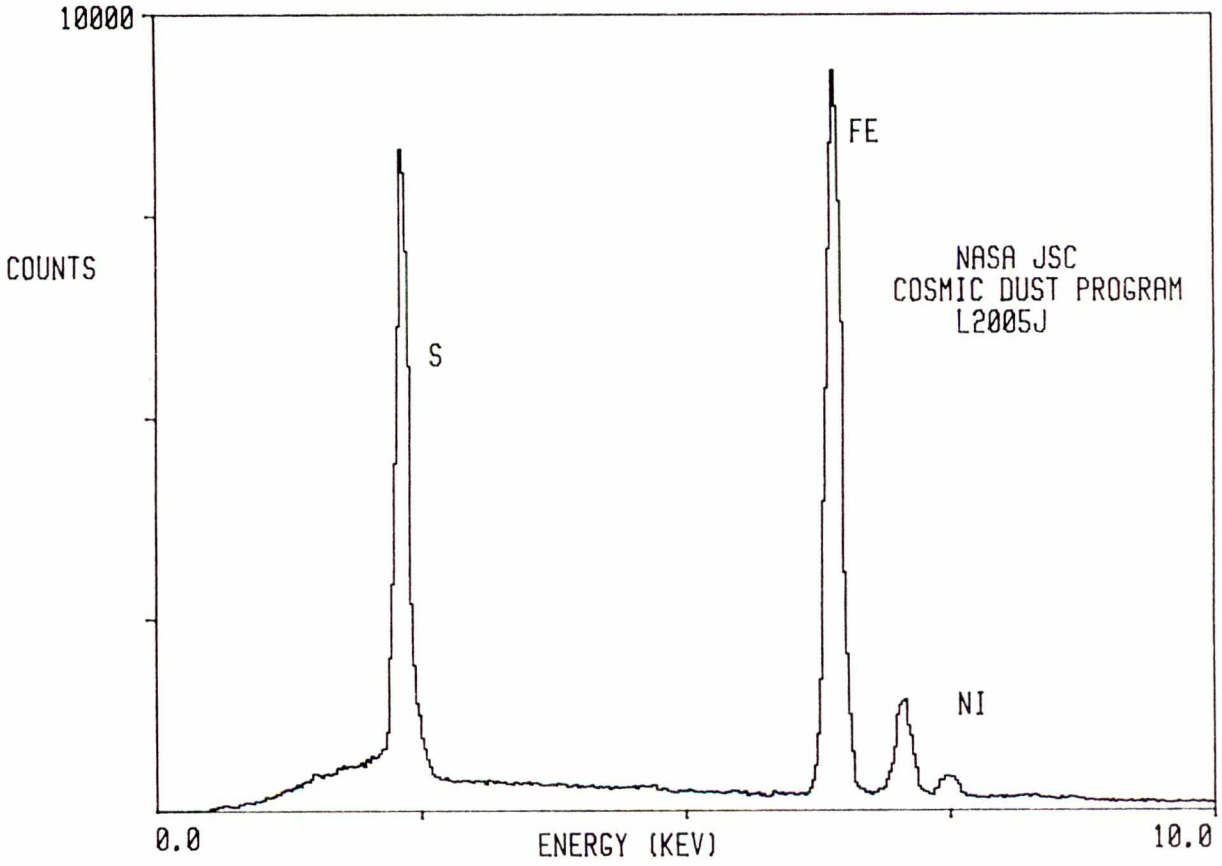
L2005 J 10



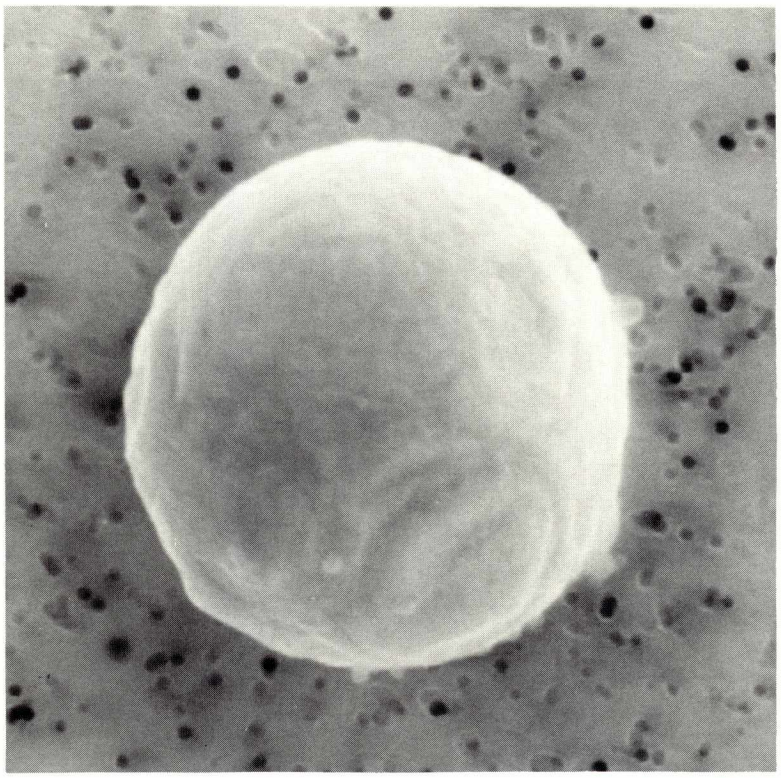
S-90-38203

SIZE: 5
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



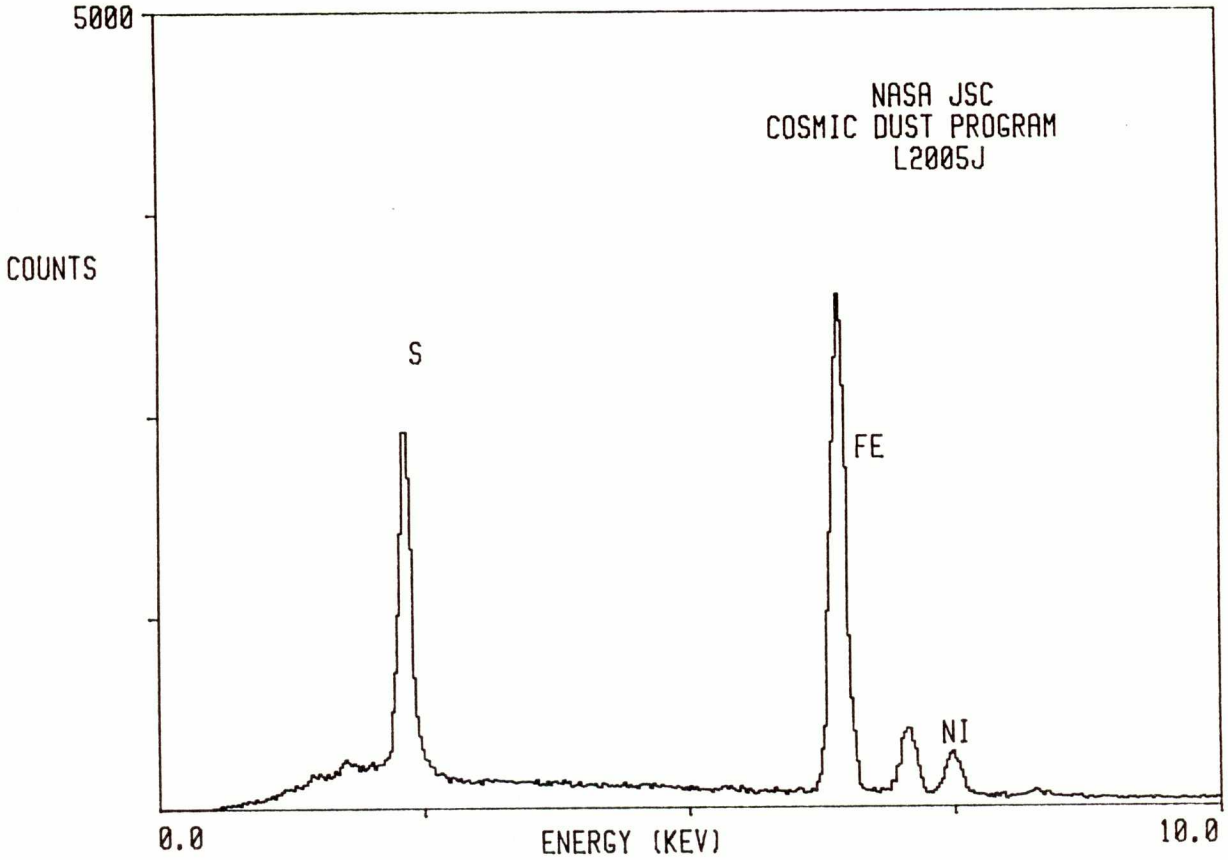
L2005 J 11



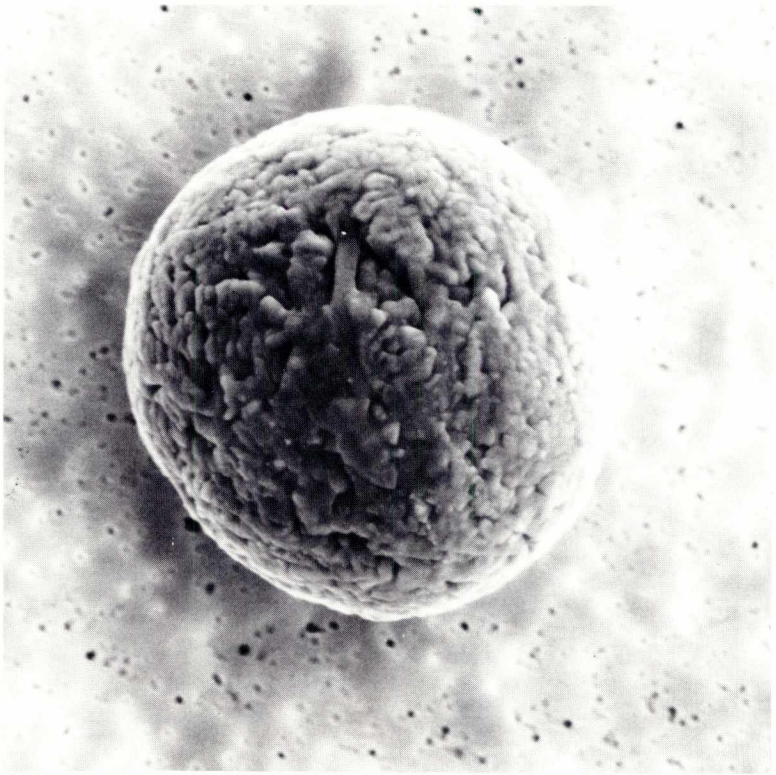
S-90-38204

SIZE: 10
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



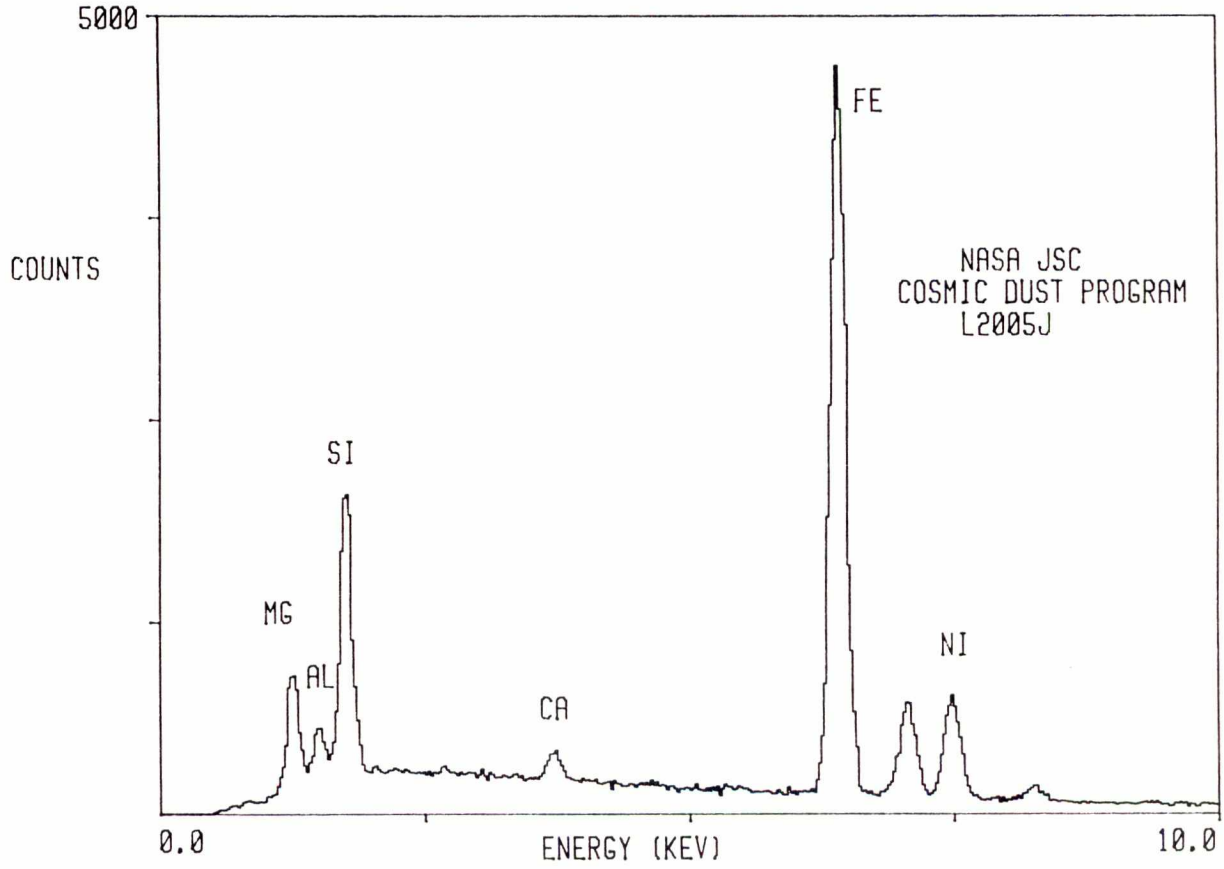
L2005 J 13



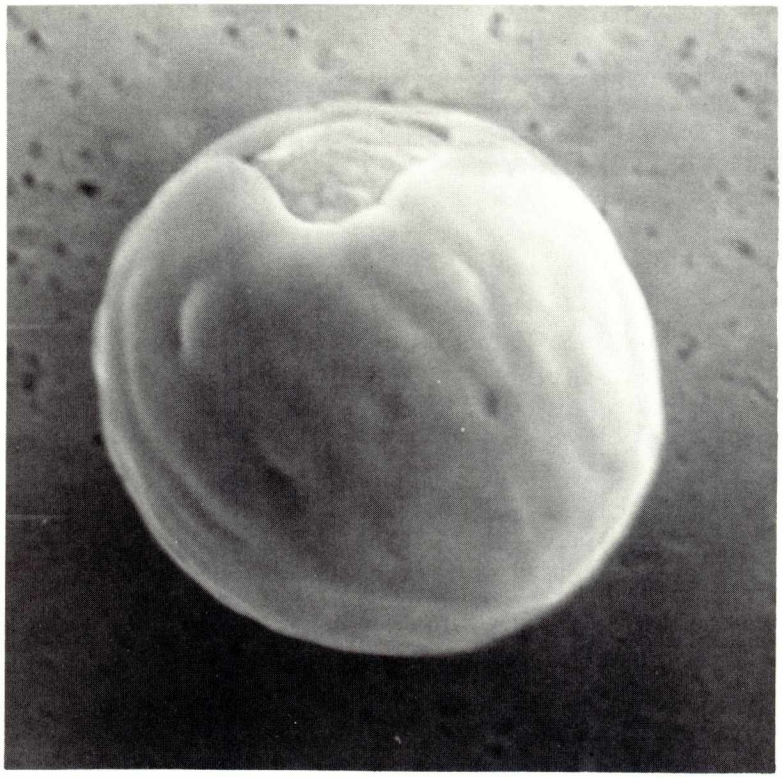
S-90-38206

SIZE: 10
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



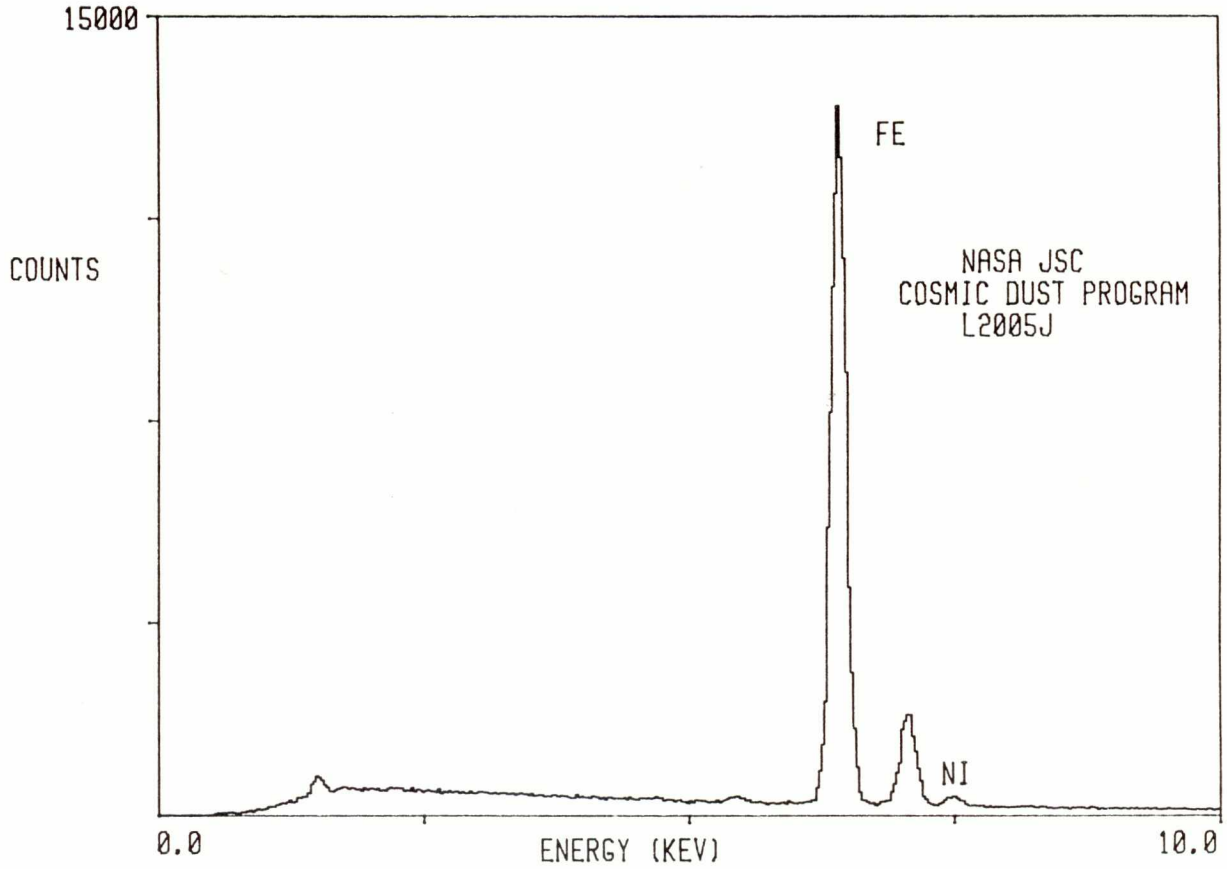
L2005 J 15



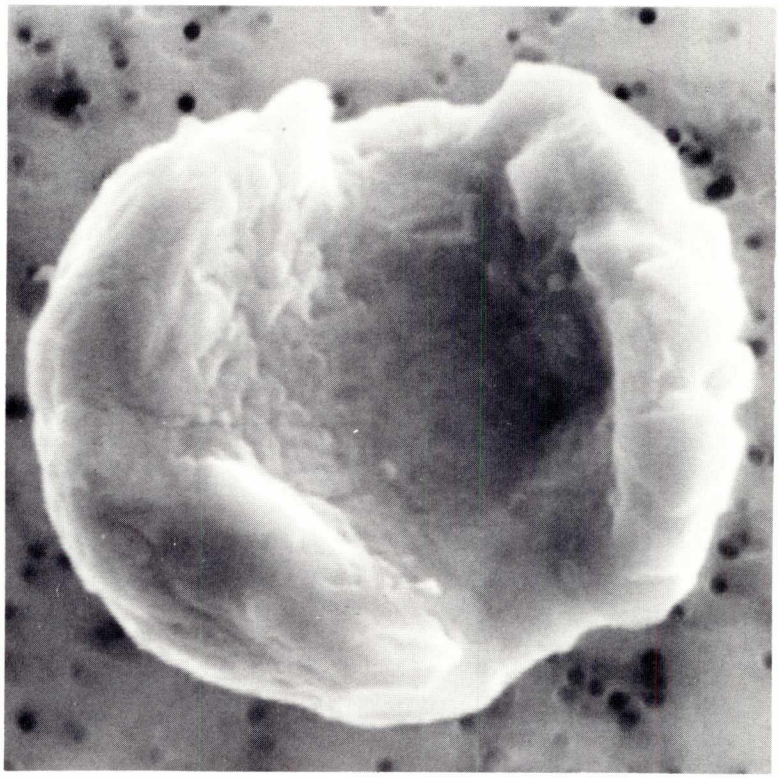
S-90-38207

SIZE: 9
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



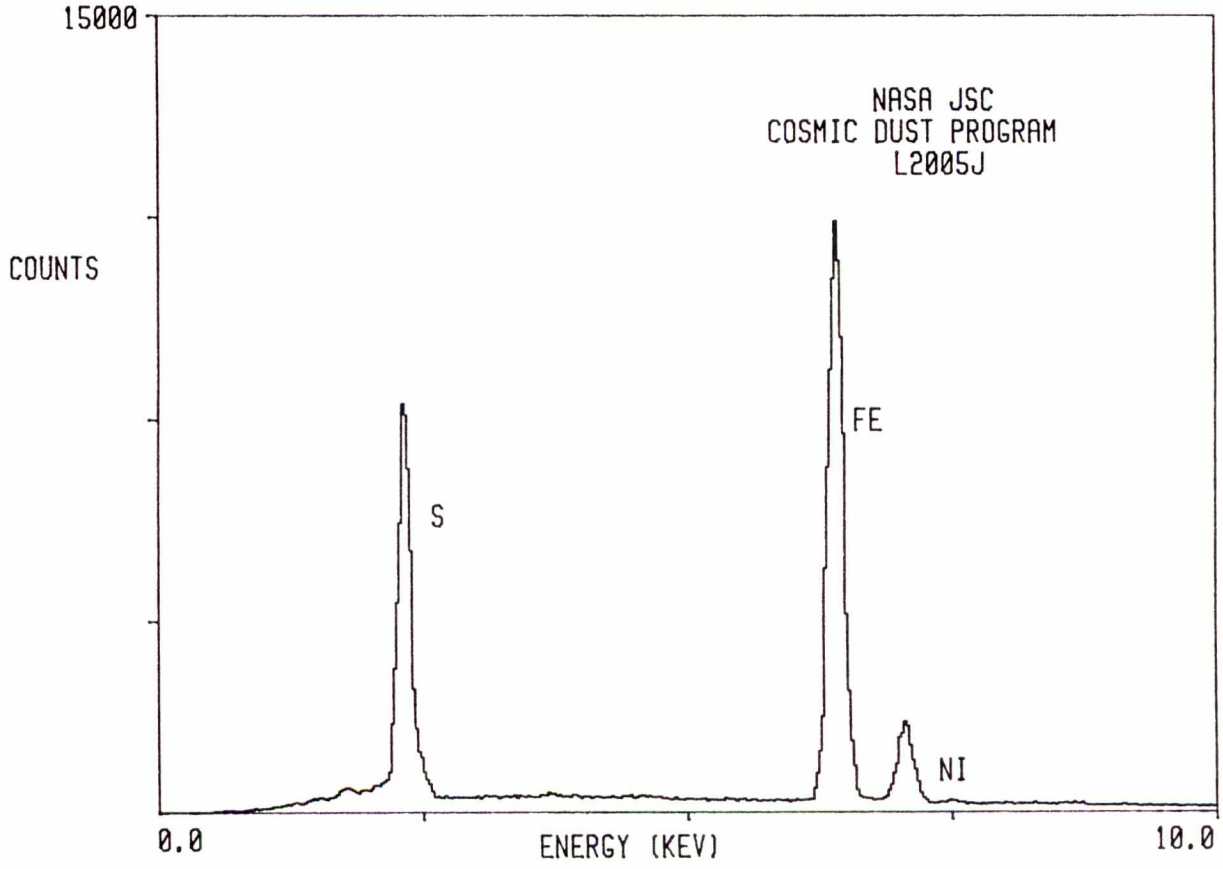
L2005 J 16



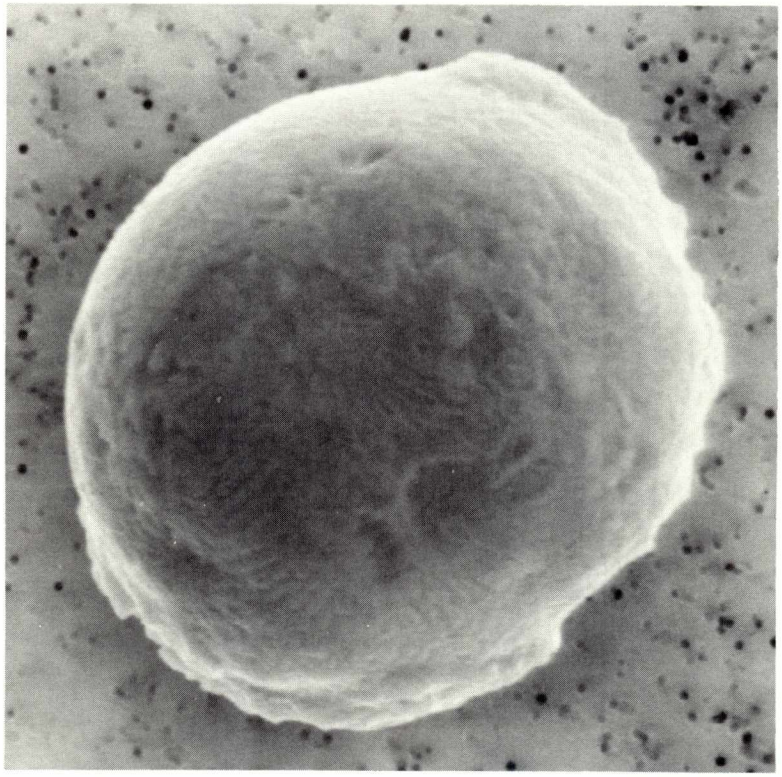
S-90-38208

SIZE: 10
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



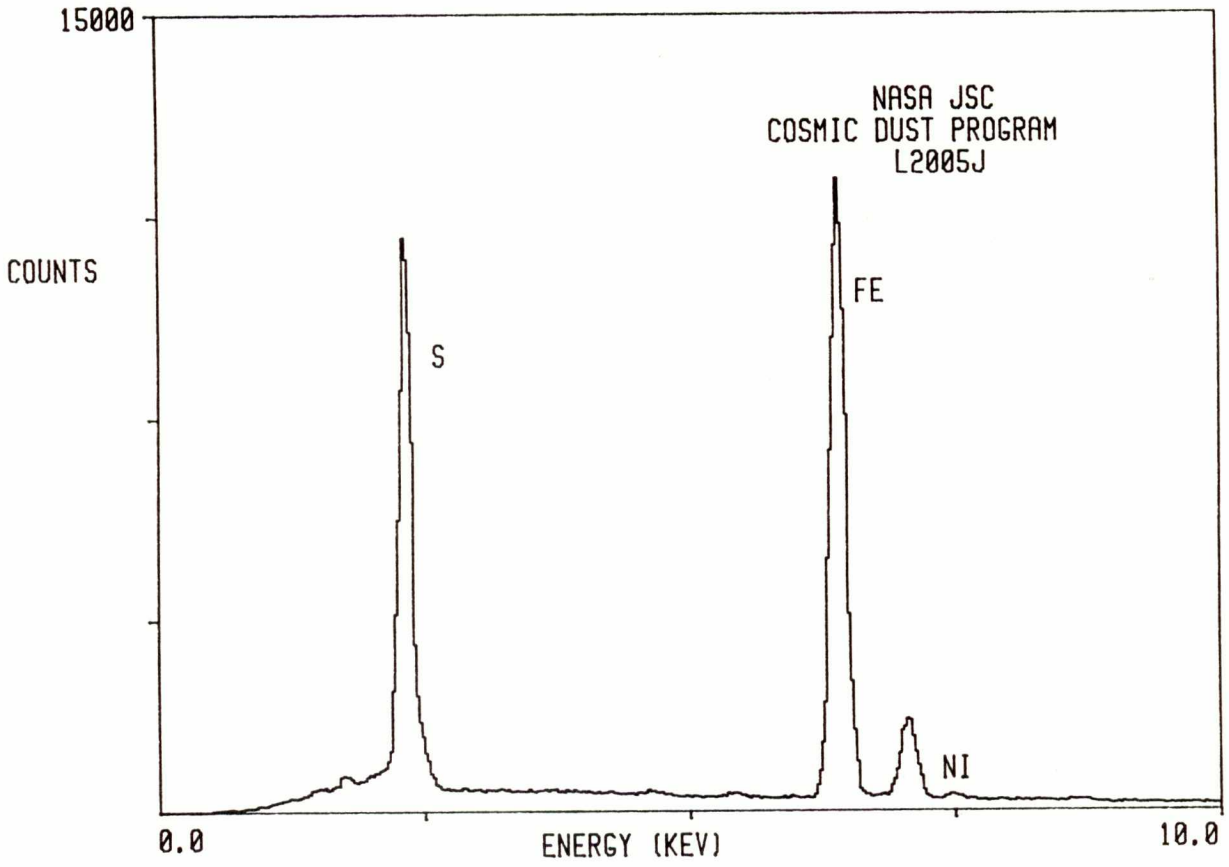
L2005 J 17



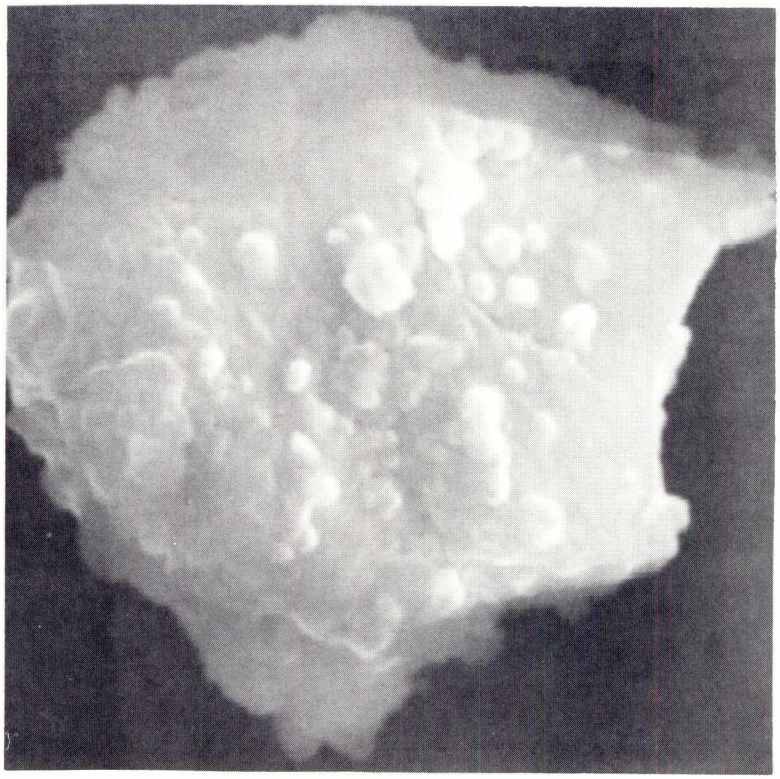
S-90-38209

SIZE: 12
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



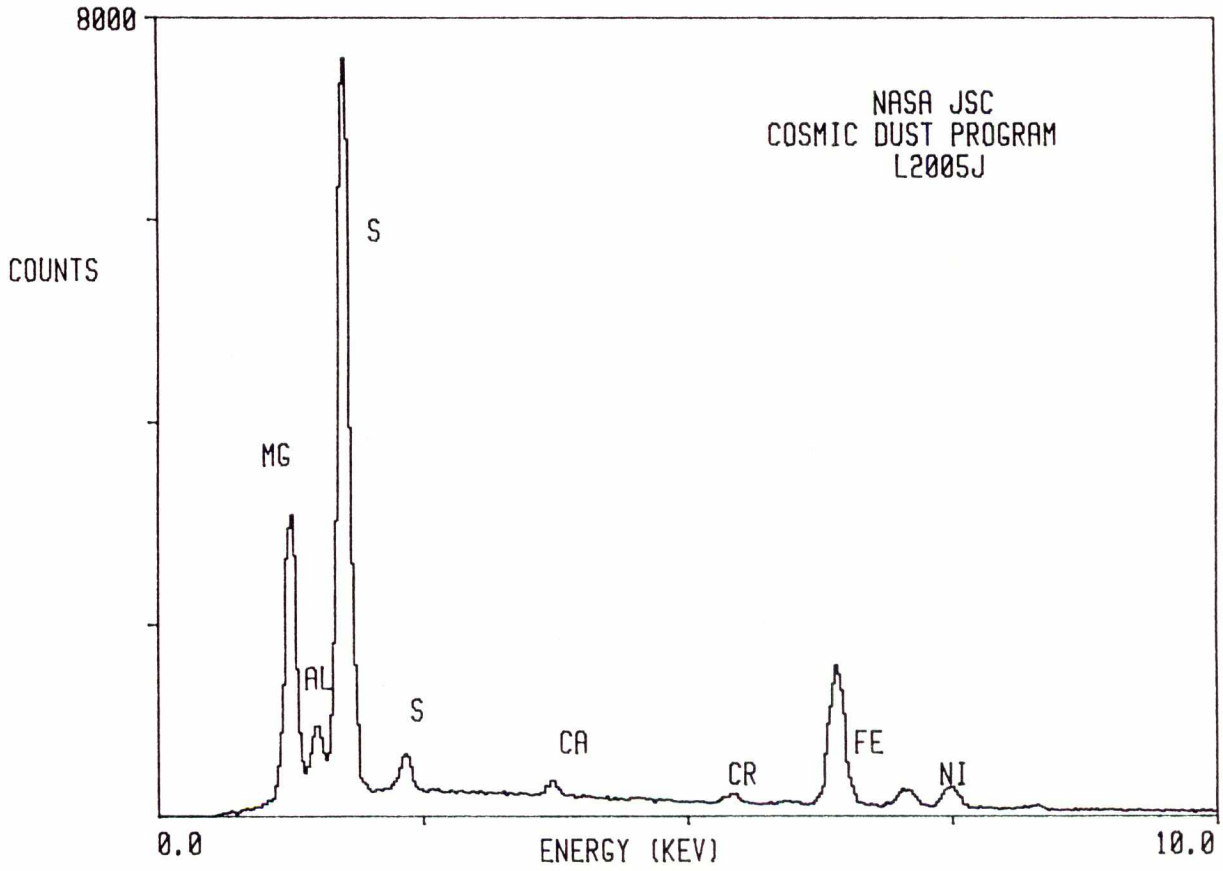
L2005 J 18



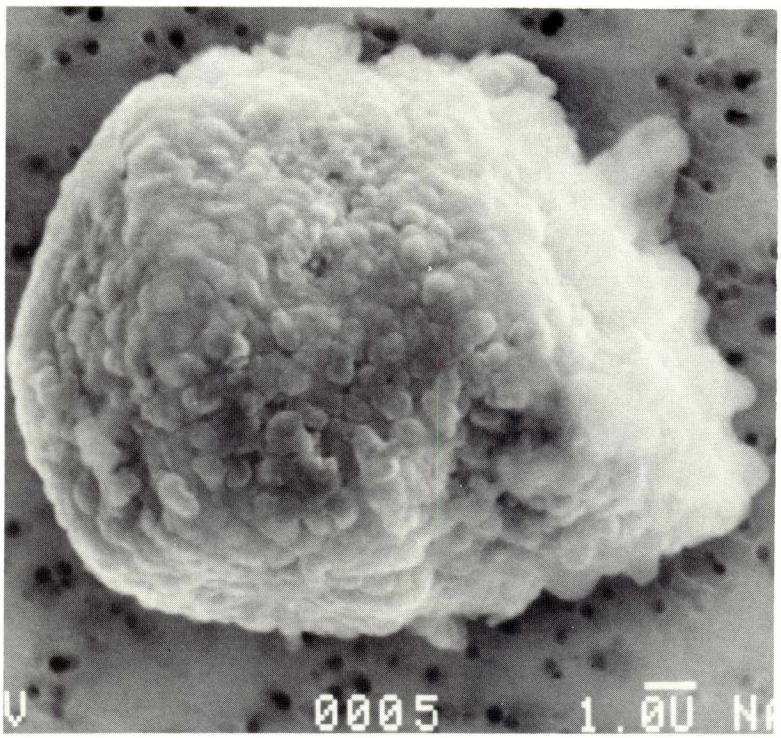
S-90-38210

SIZE: 8
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: D
TYPE: C?

COMMENTS:



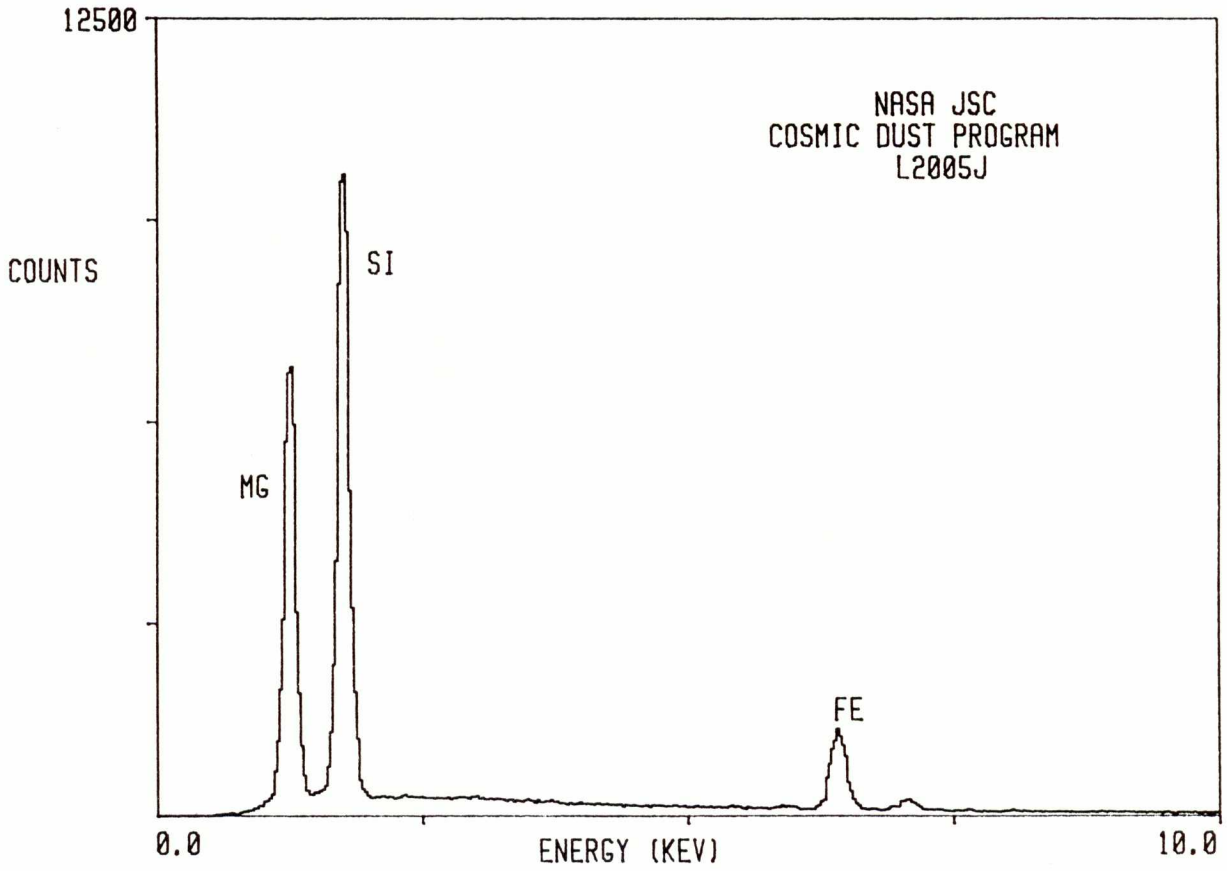
L2005 J 19



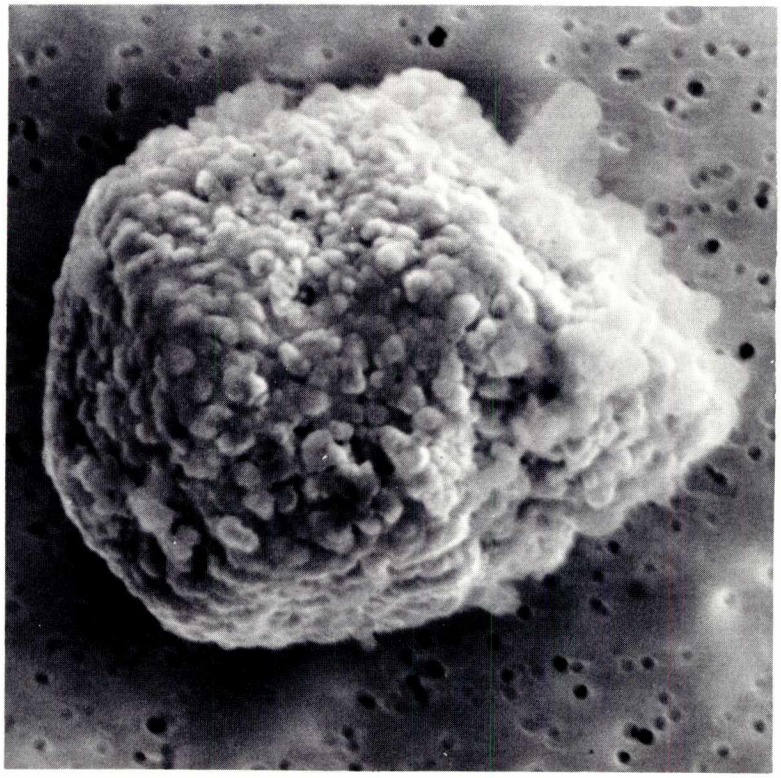
SIZE: 10
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN

COMMENTS:

S-90-38211



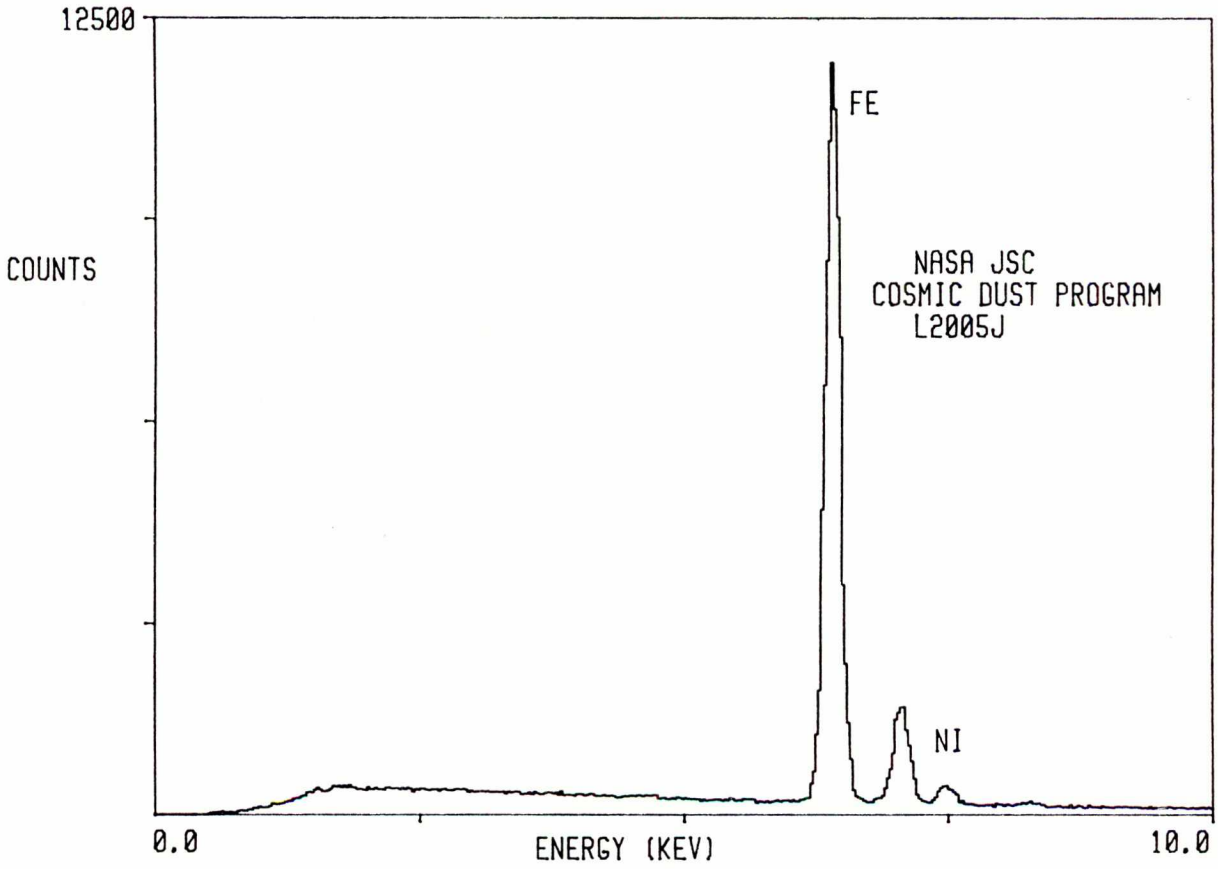
L2005 J 22



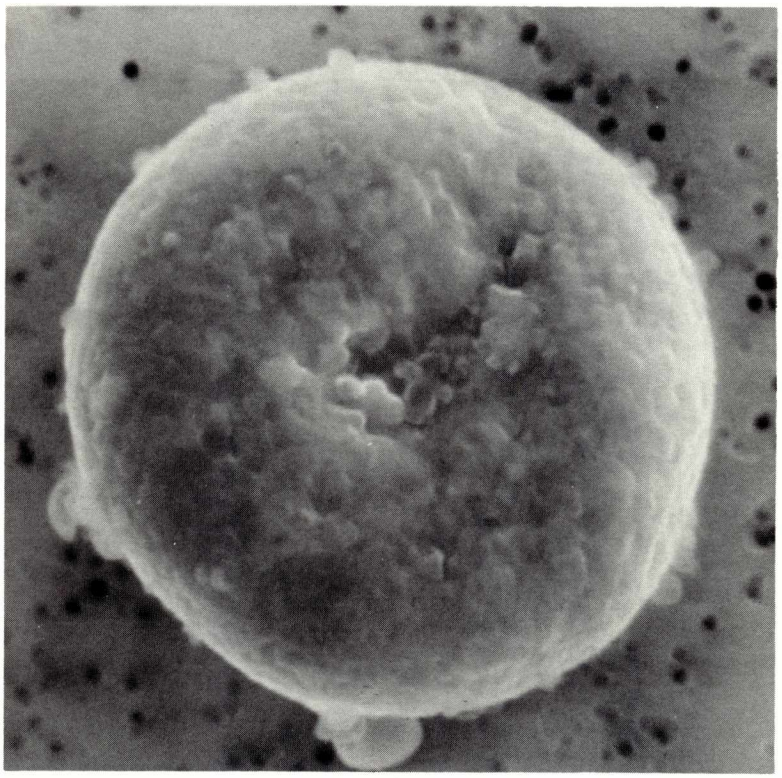
S-90-38214

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

COMMENTS:



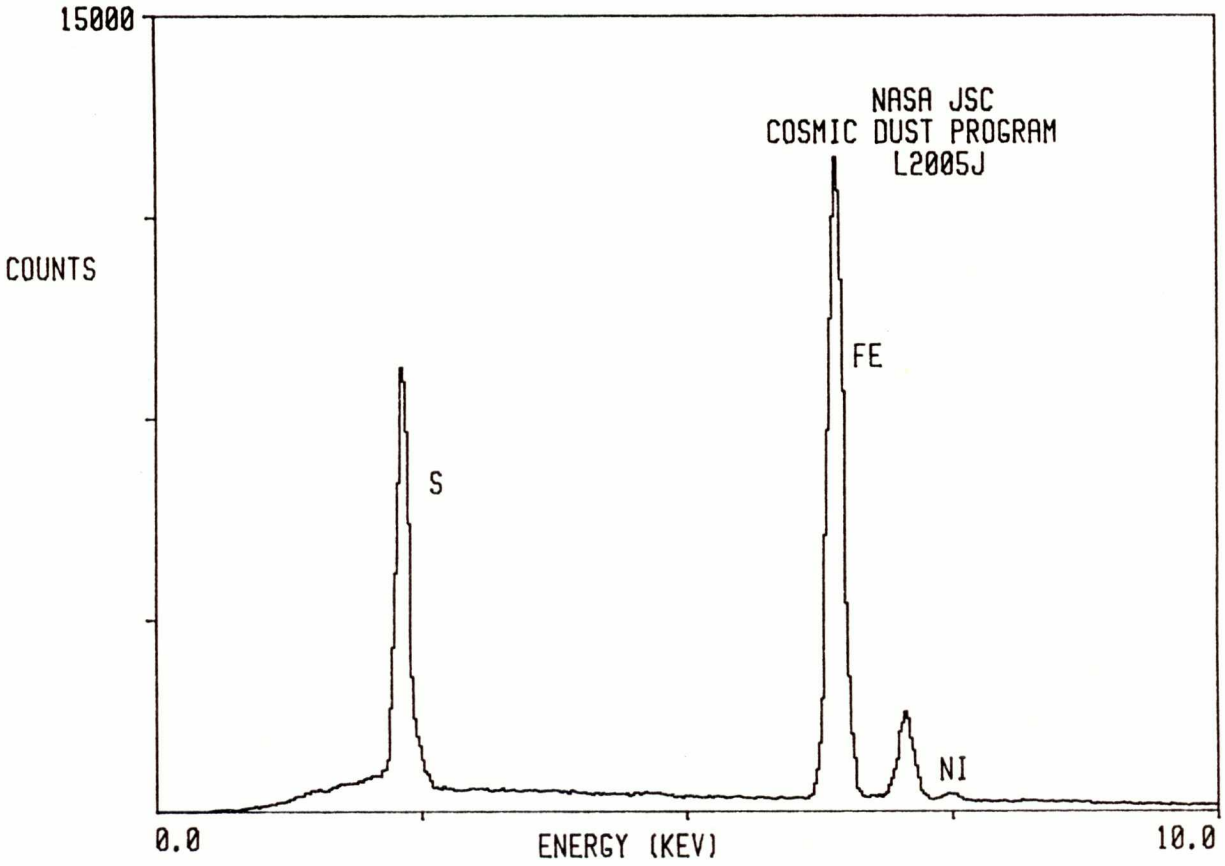
L2005 J 23



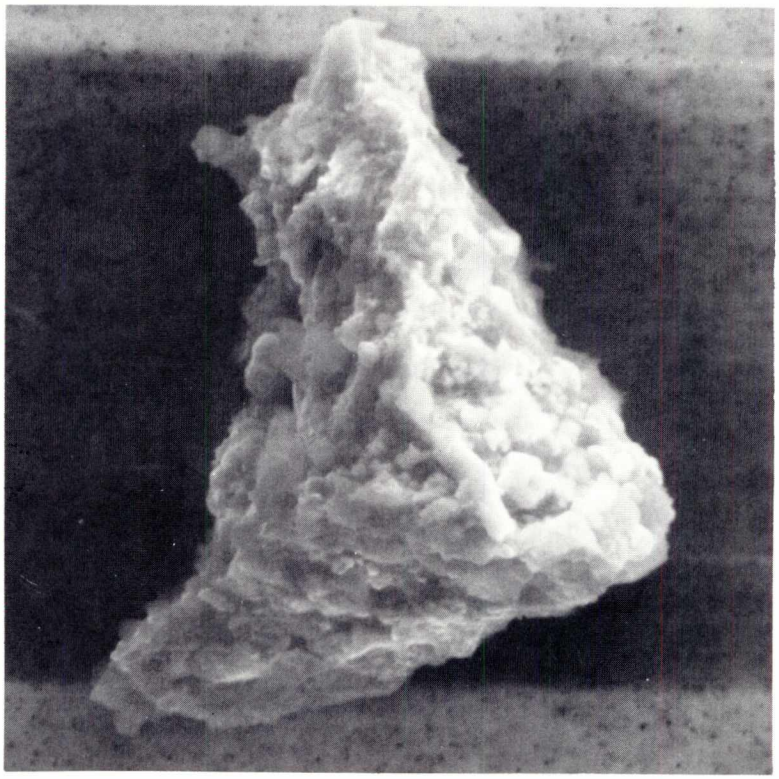
S-90-38215

SIZE: 10
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: C?

COMMENTS:



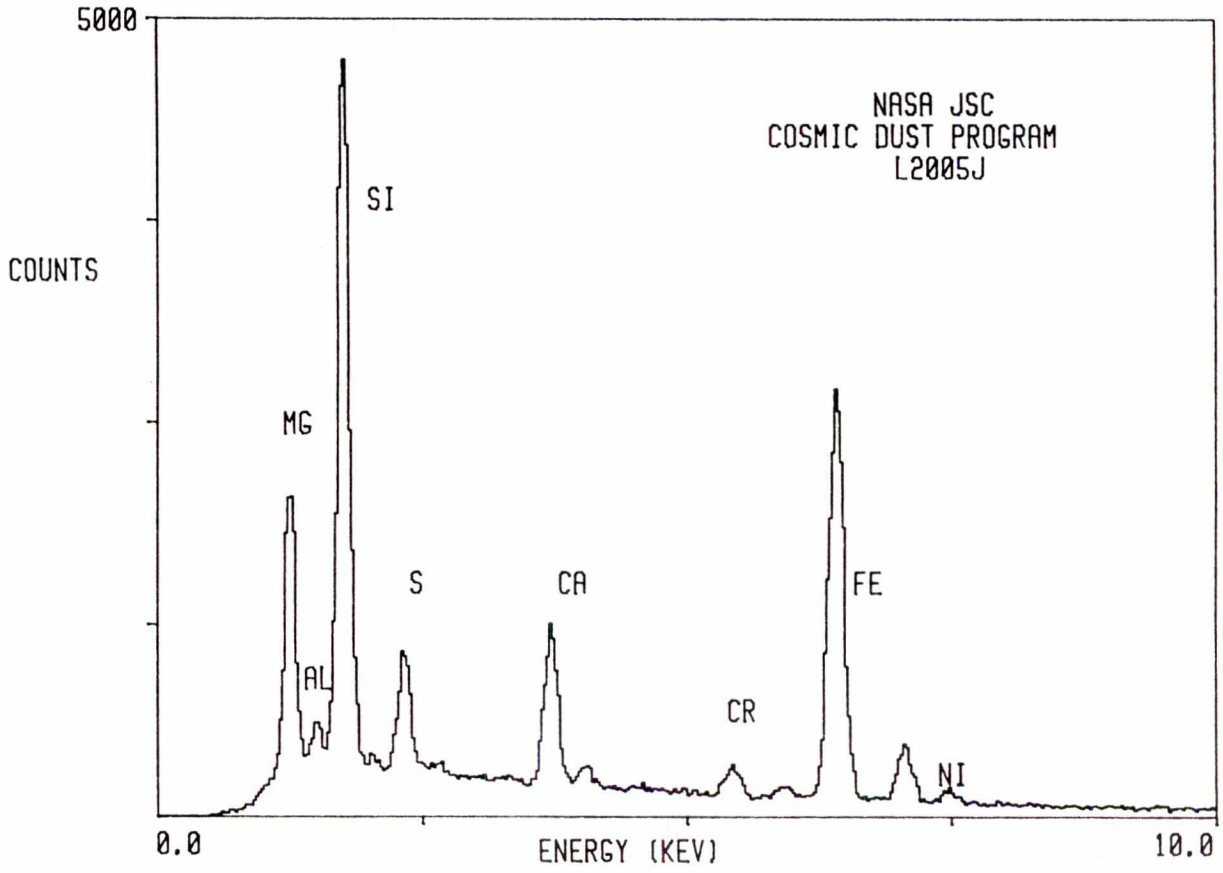
L2005 J 24



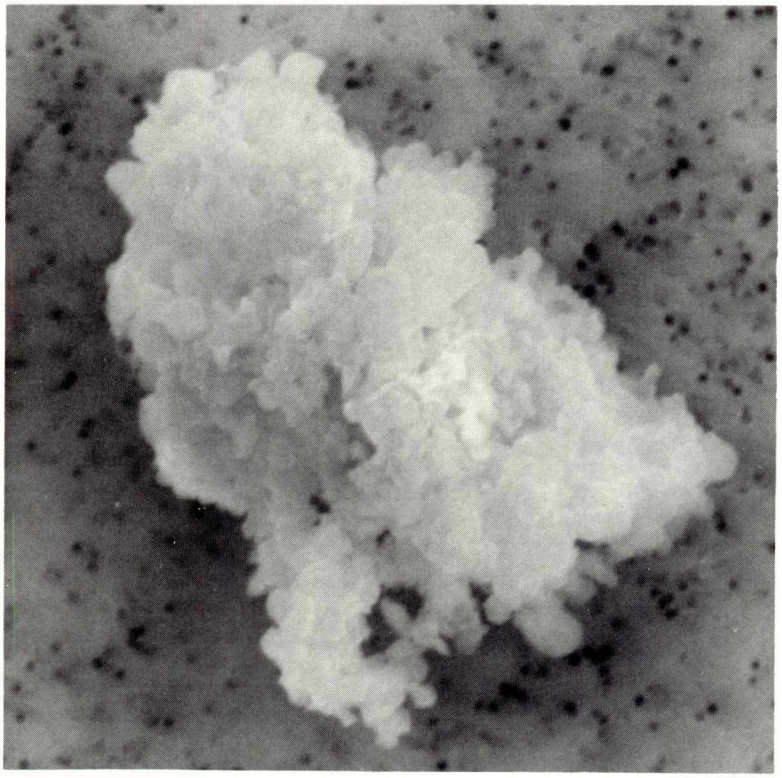
S-90-38216

SIZE: 40
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C?

COMMENTS:



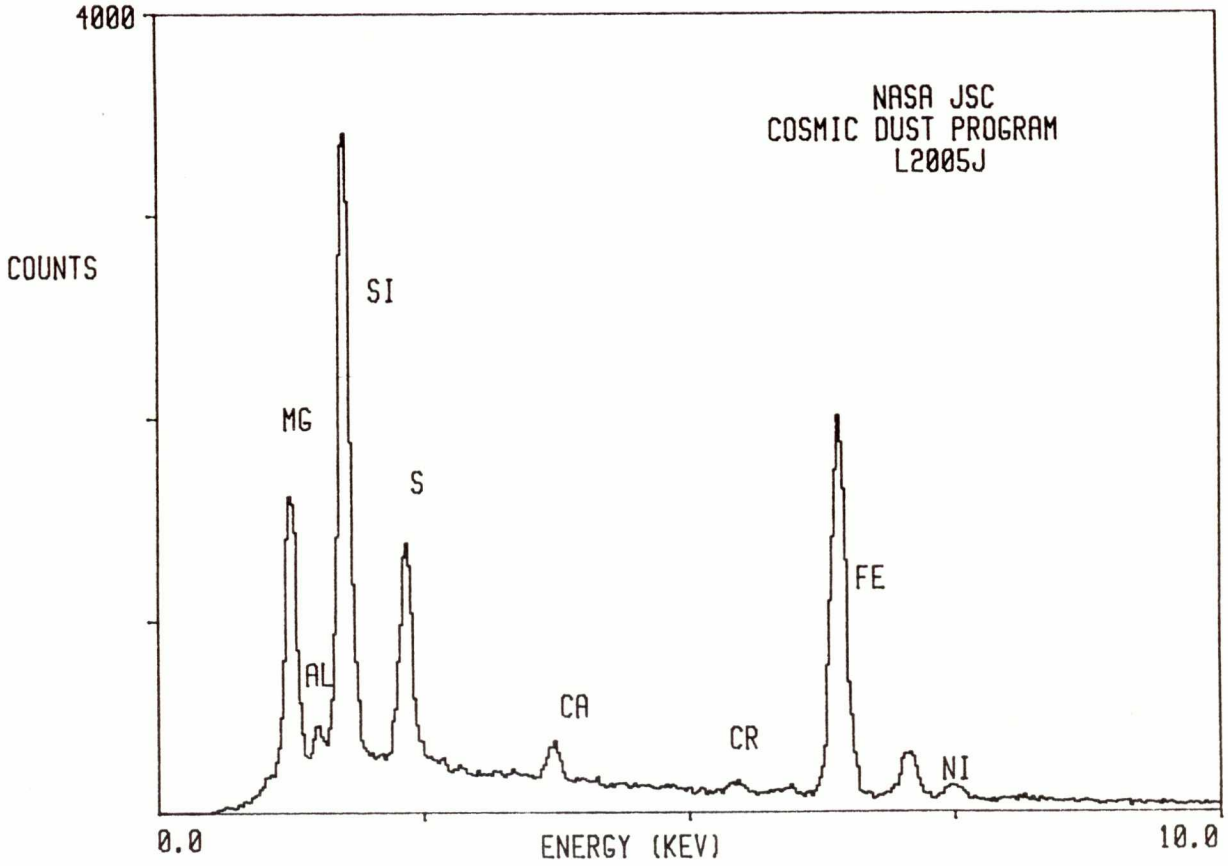
L2005 J 26



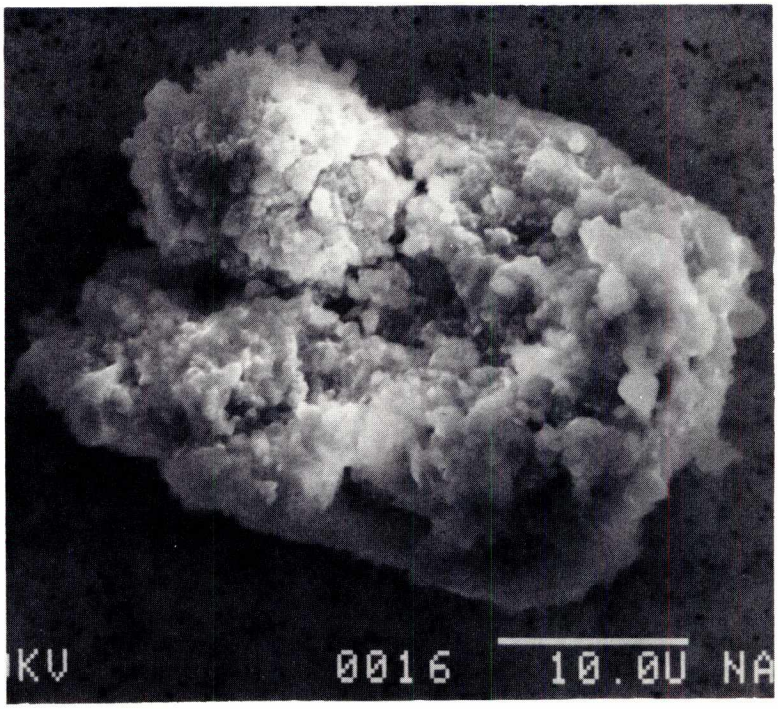
S-90-38218

SIZE: 19
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



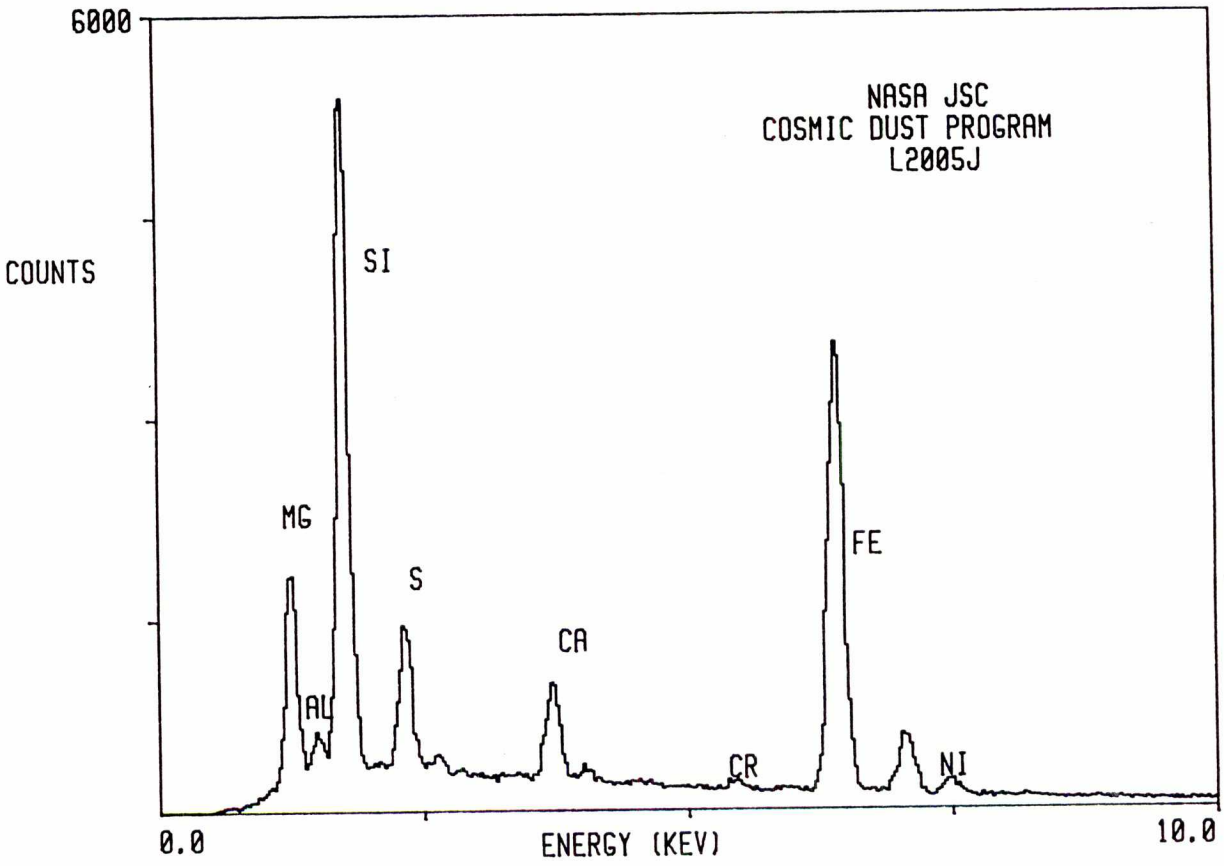
L2005 J 27



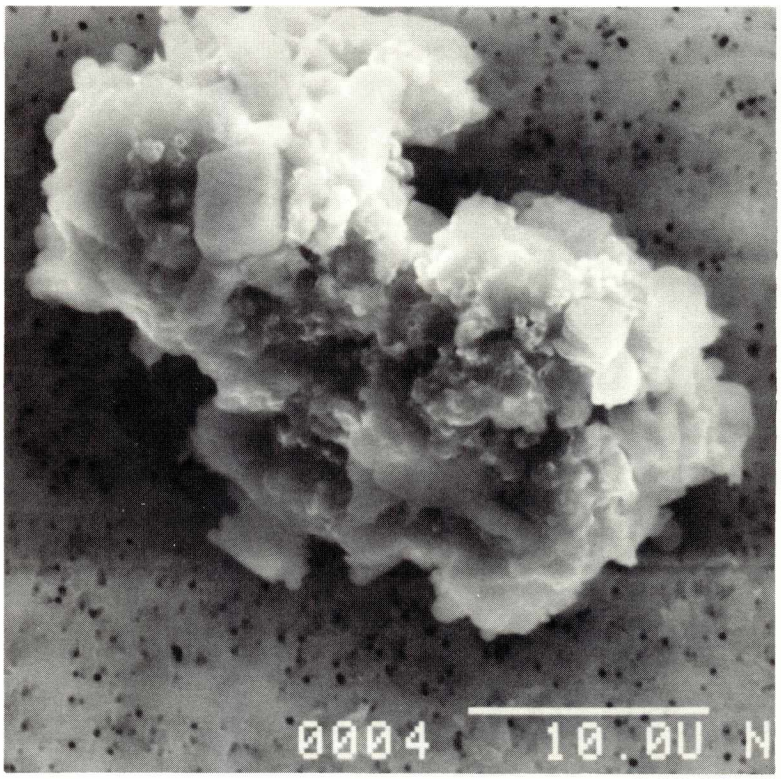
SIZE: 30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

S-90-38219



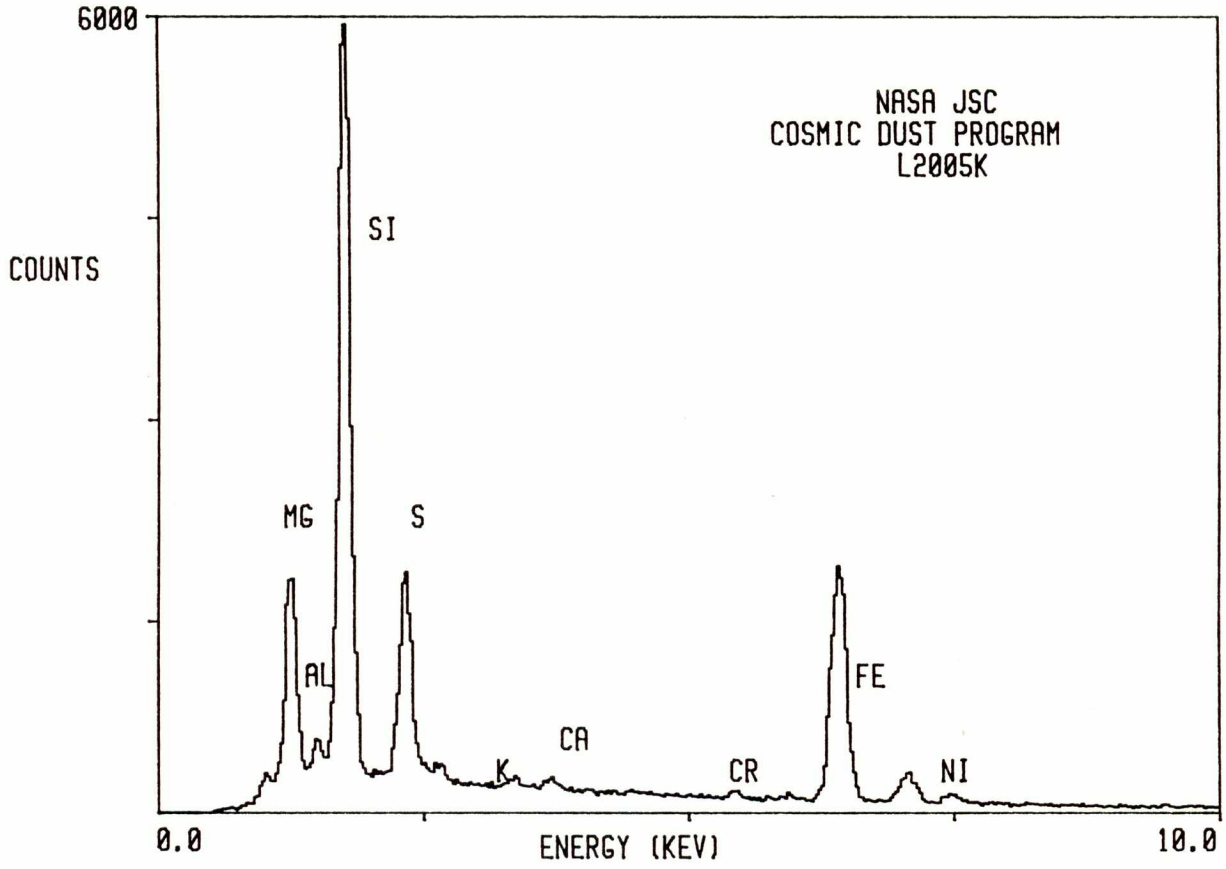
L2005 K 2



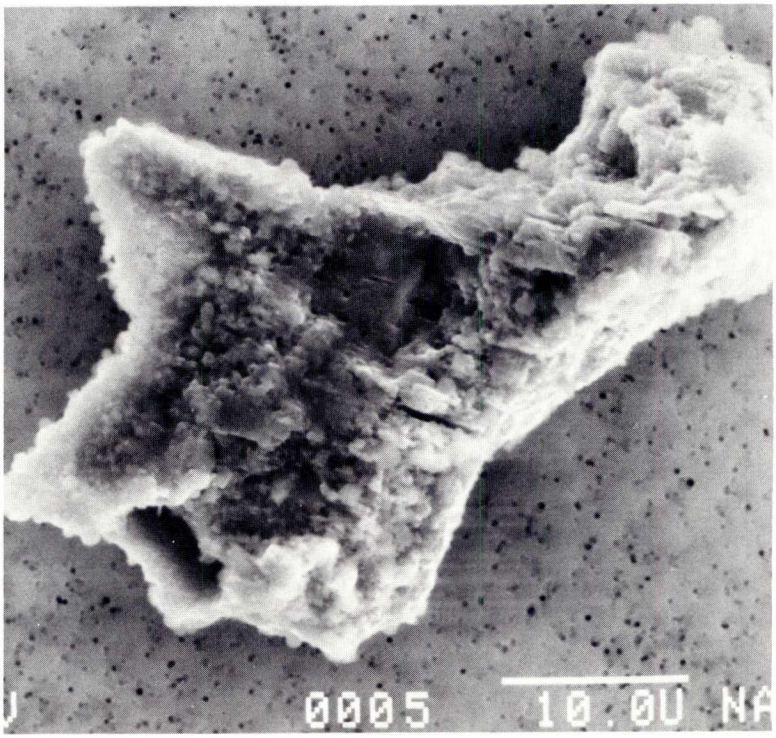
S-90-38153

SIZE: 21x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



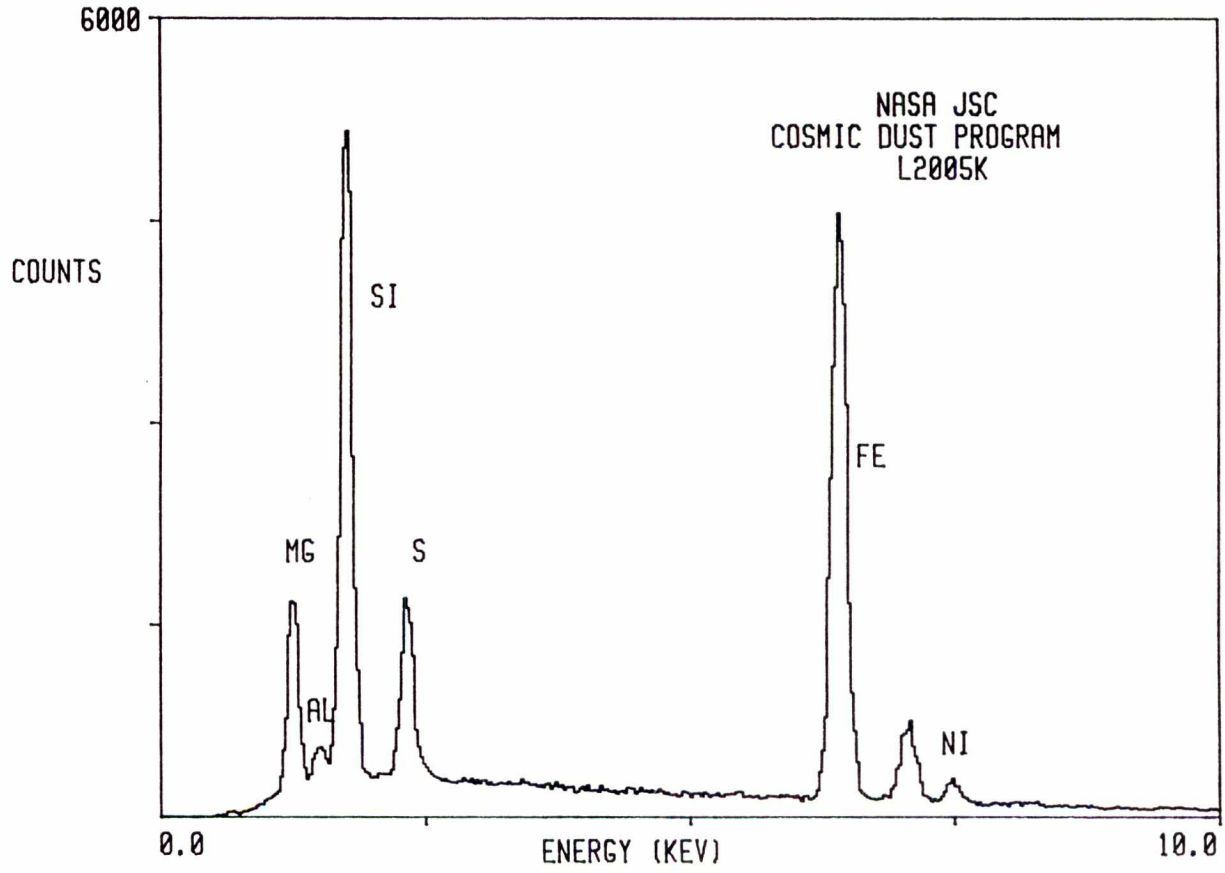
L2005 K 3



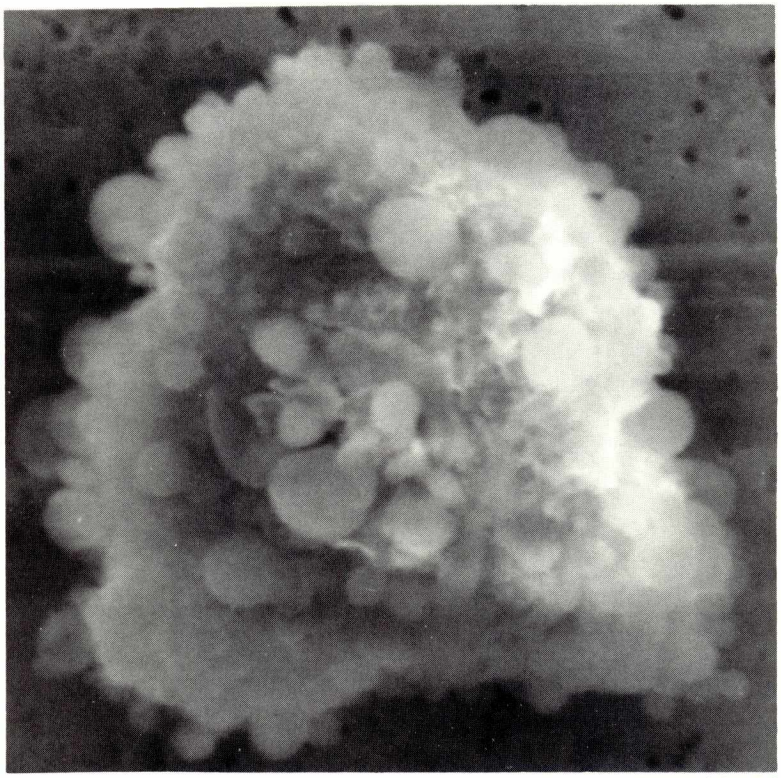
SIZE: 25x35
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

S-90-38154



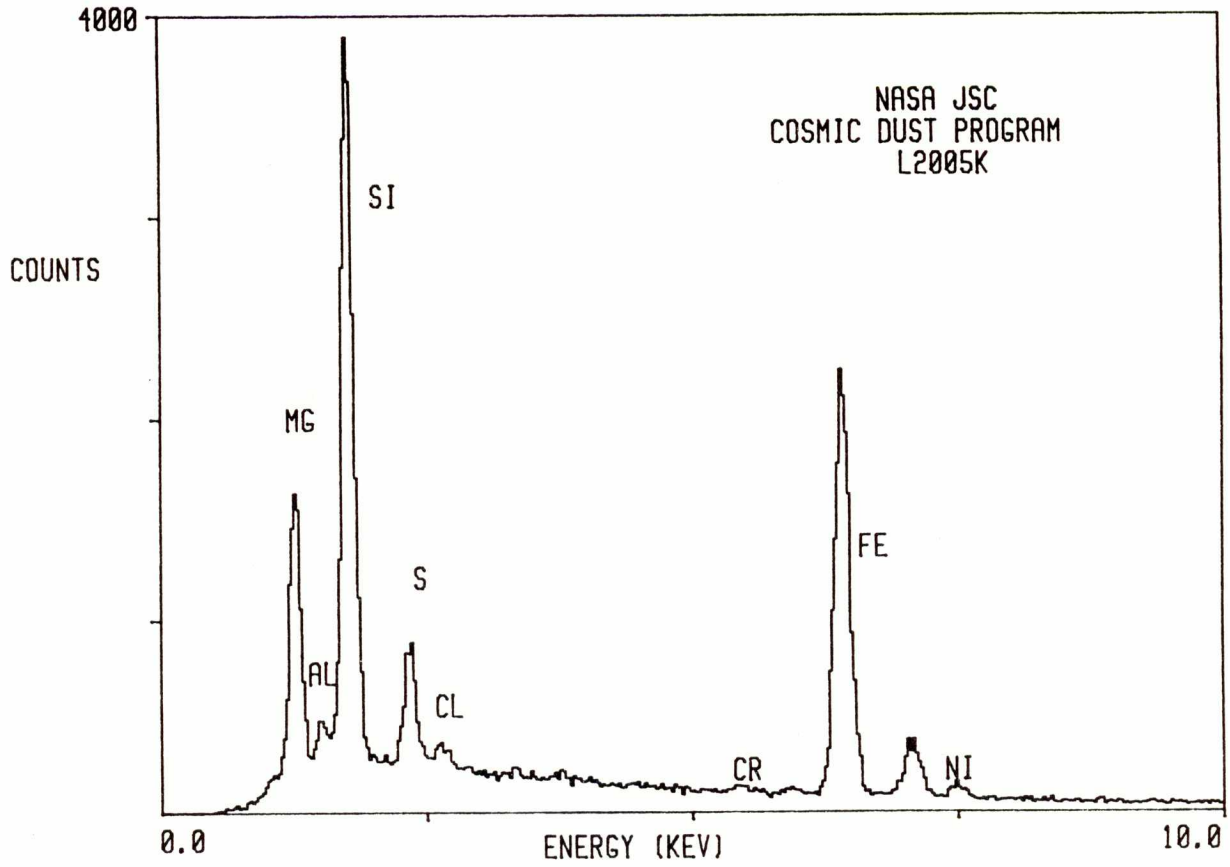
L2005 K 5



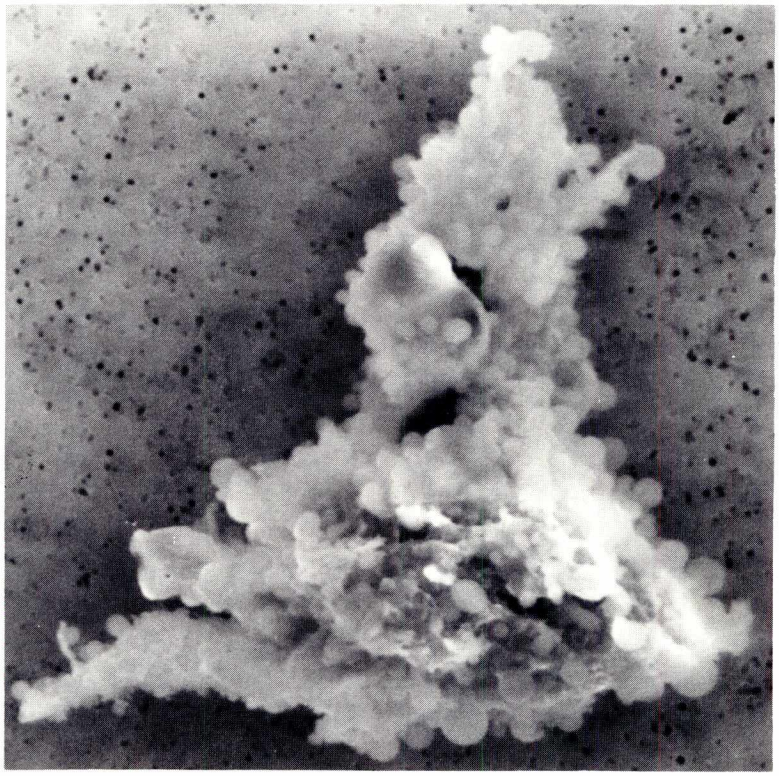
S-90-38156

SIZE: 17
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D/V
TYPE: C

COMMENTS:



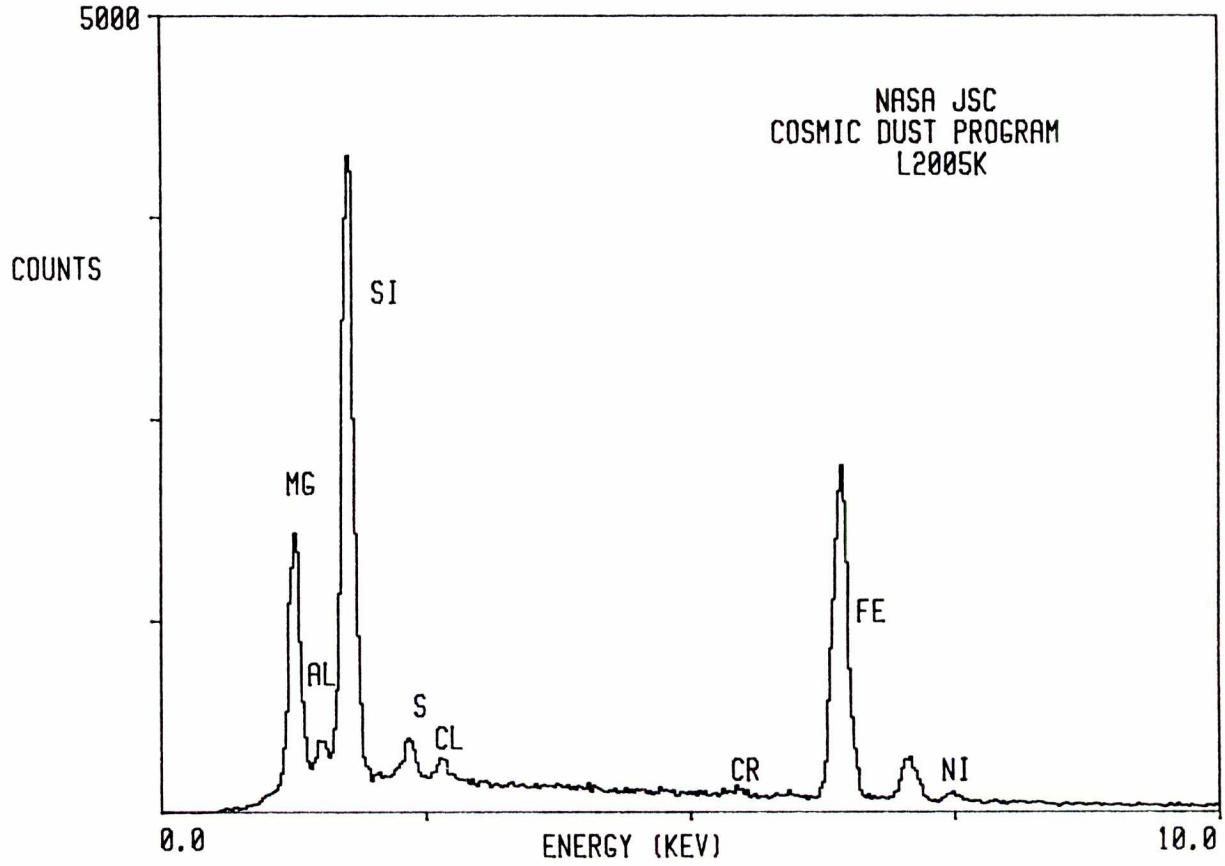
L2005 K 6



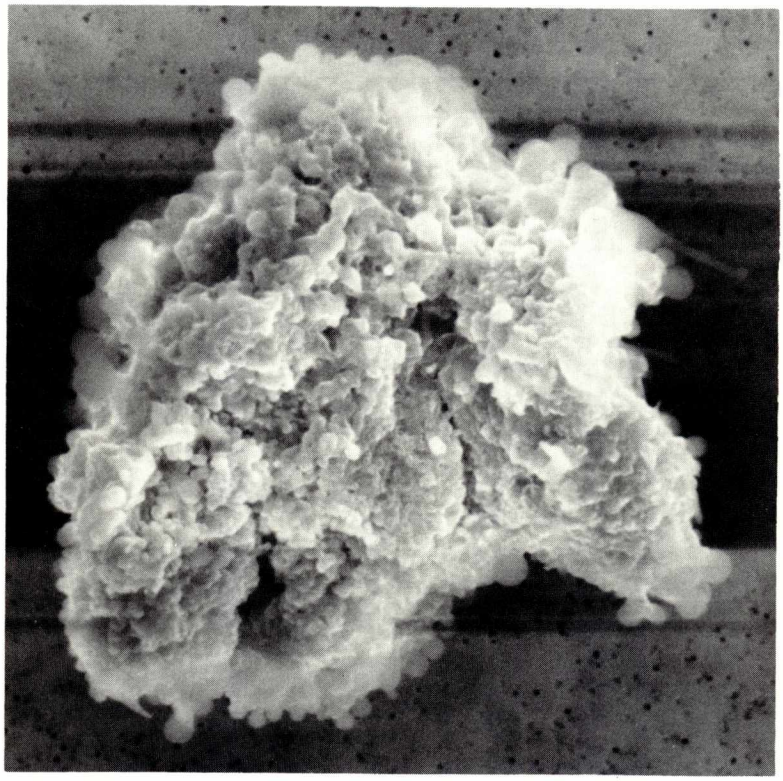
S-90-38157

SIZE: 25x32
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



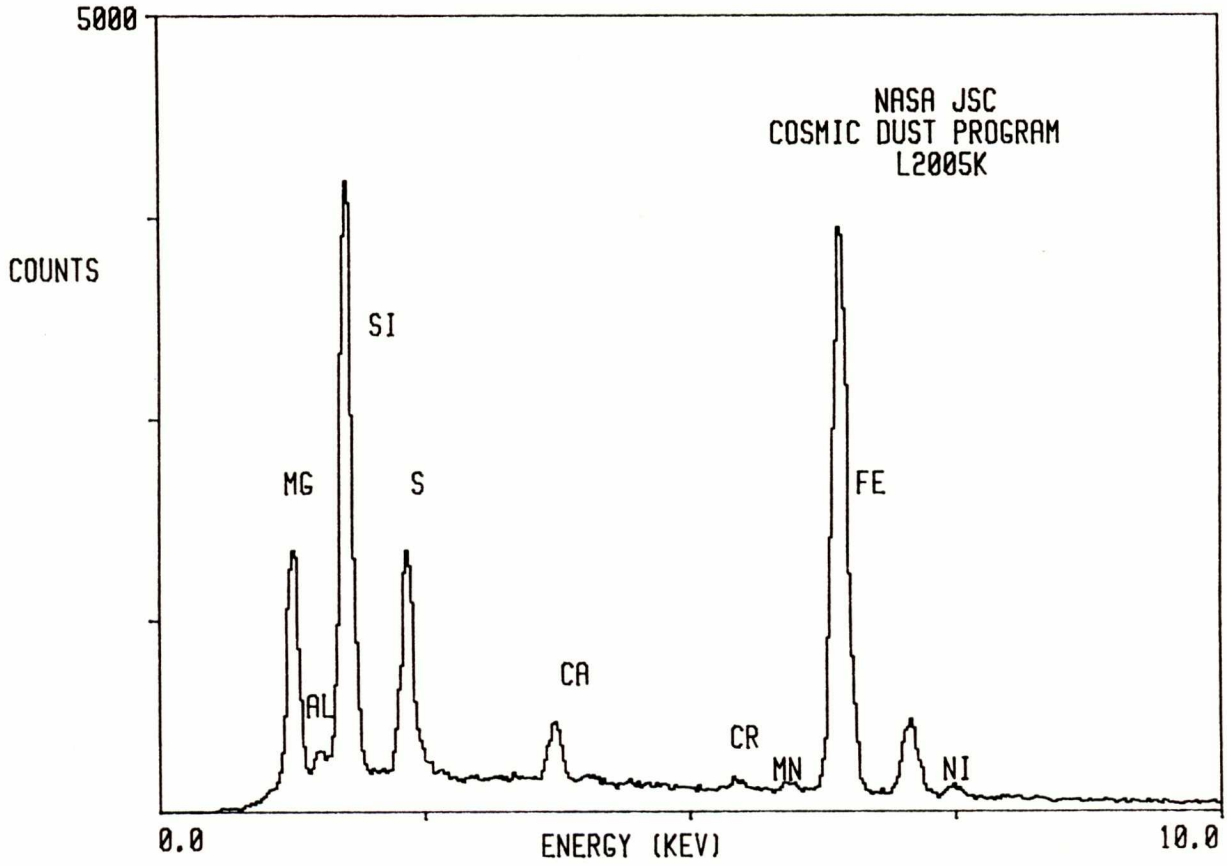
L2005 K 7



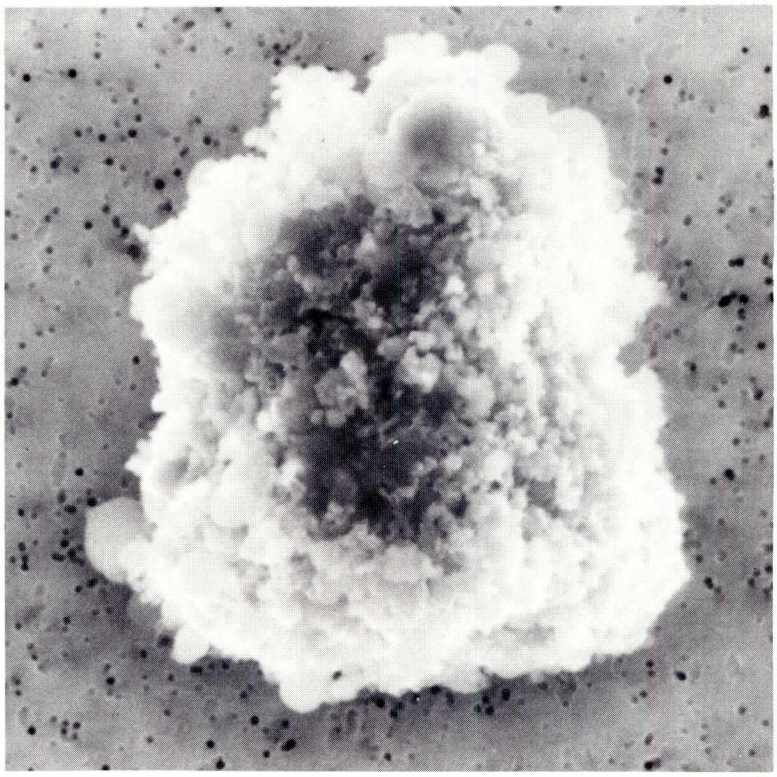
S-90-38158

SIZE: 32
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



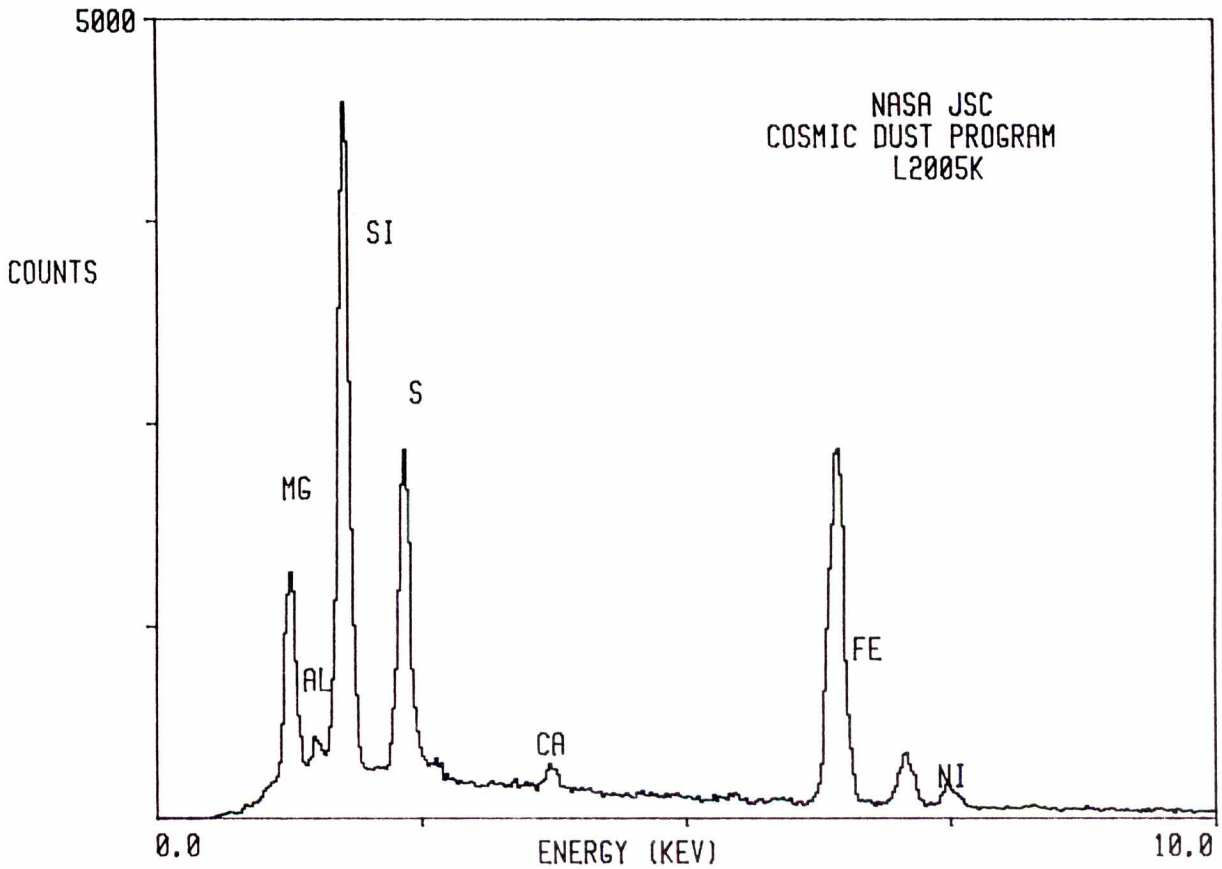
L2005 K 8



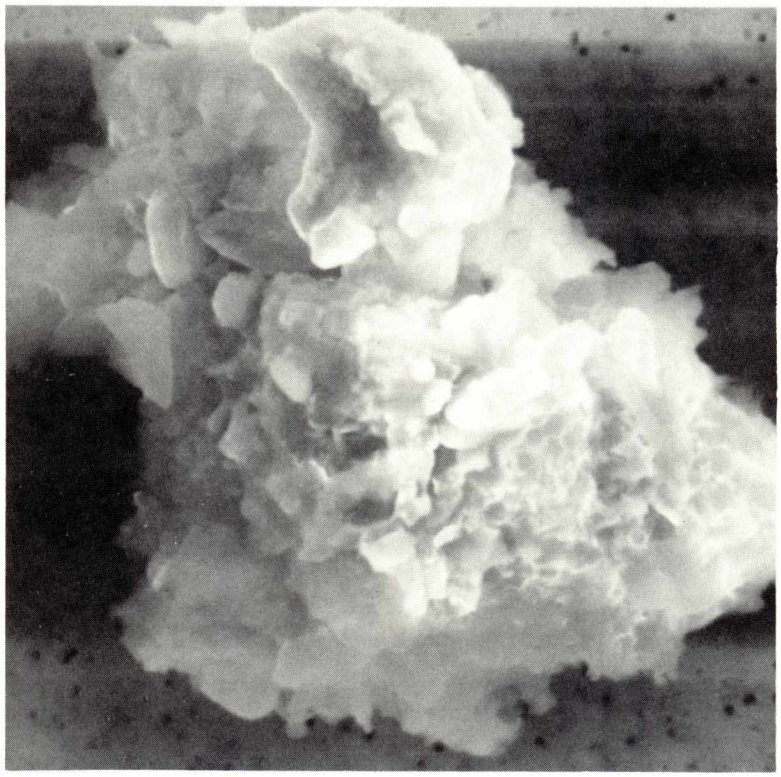
S-90-38159

SIZE: 21x25
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



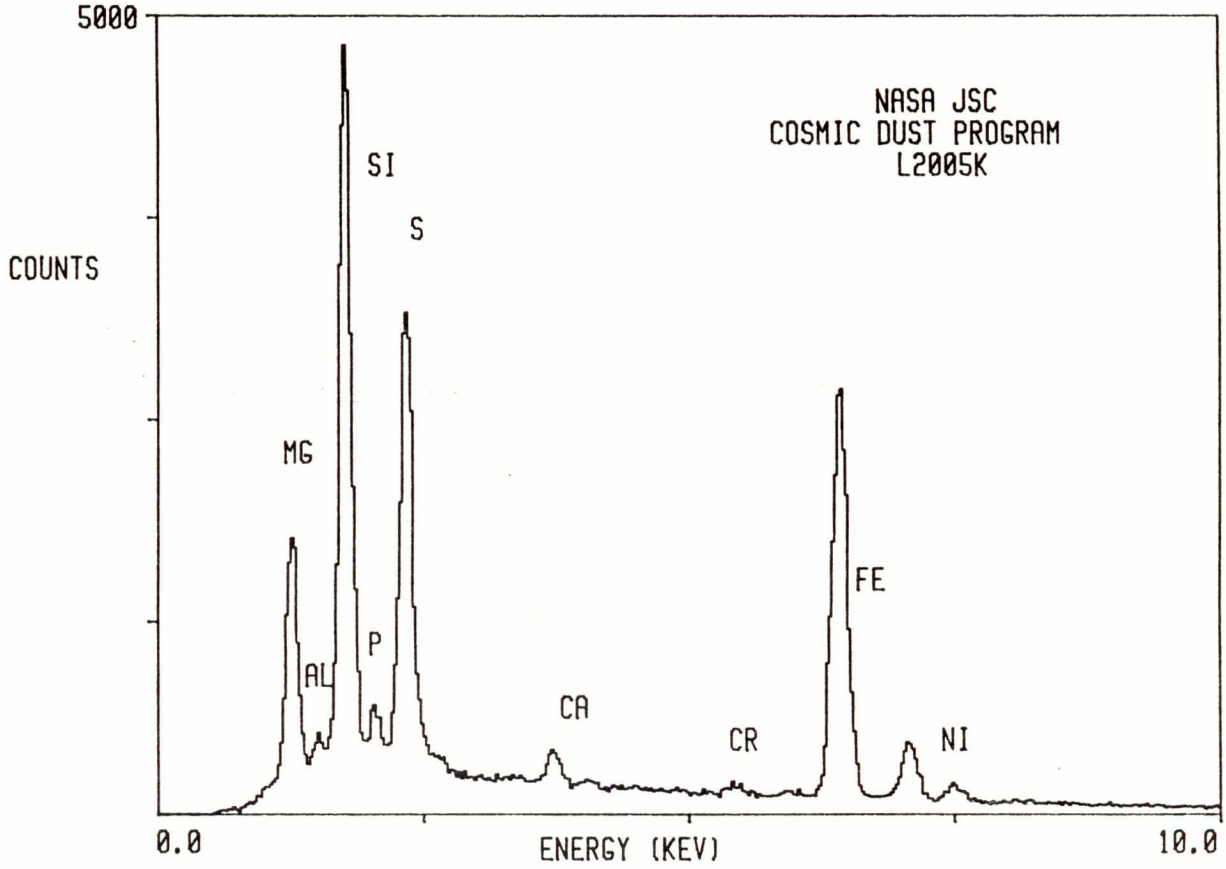
L2005 K 9



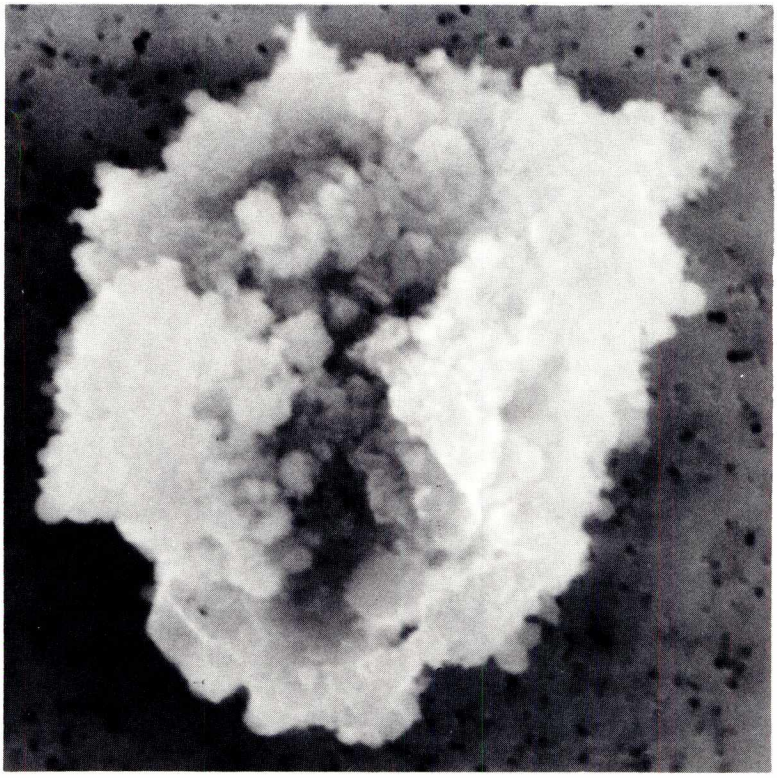
S-90-38160

SIZE: 21x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



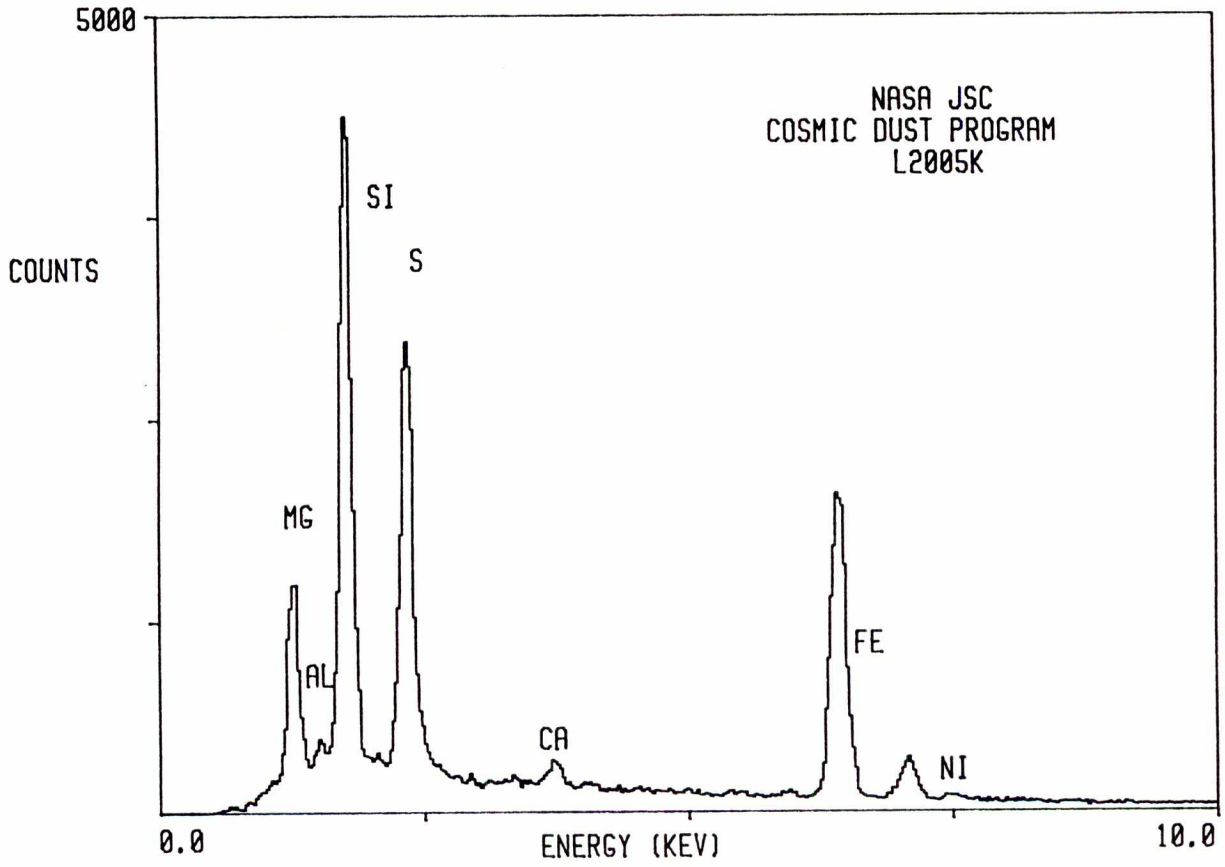
L2005 K 10



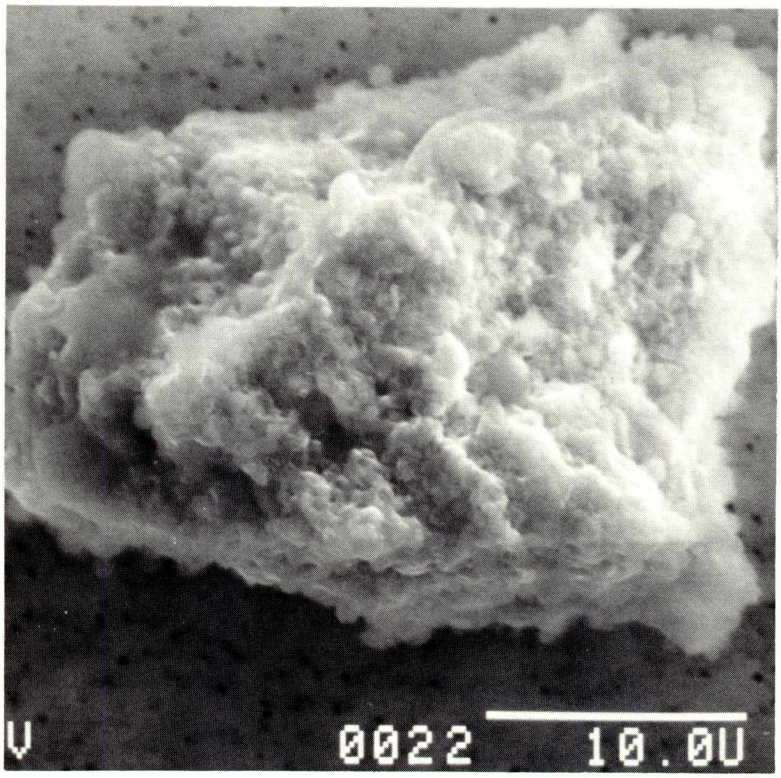
S-90-38161

SIZE: 18x20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



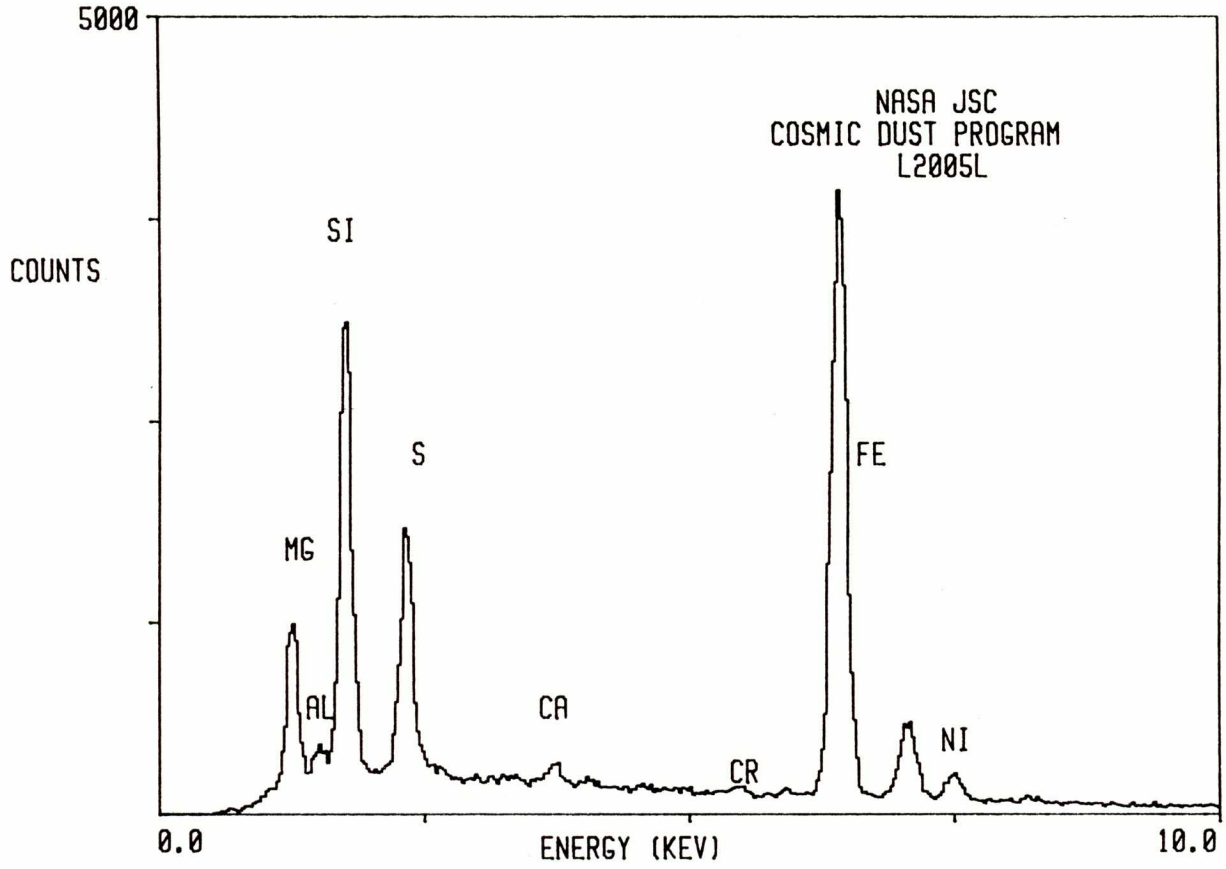
L2005 L 2



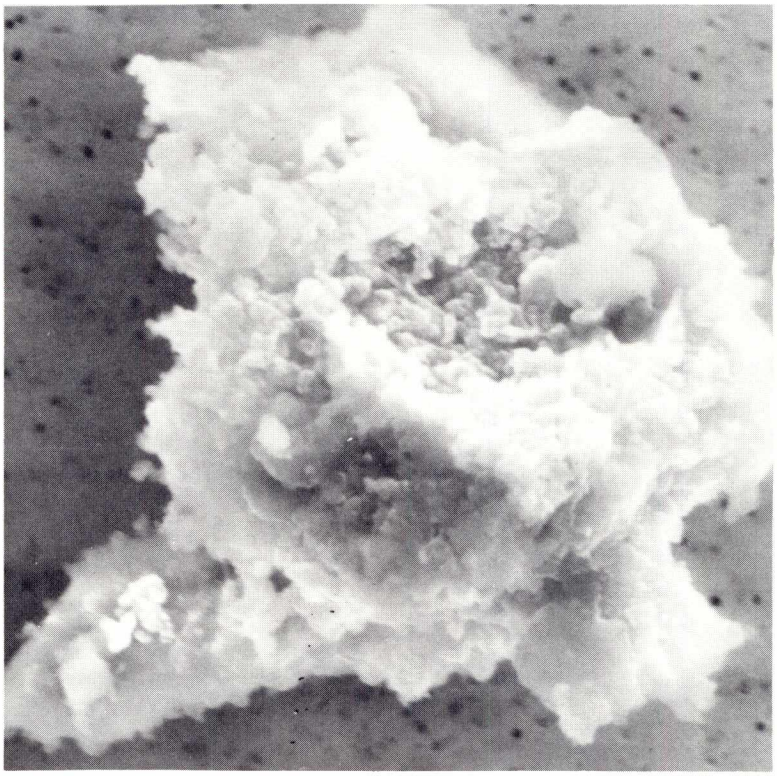
S-90-38221

SIZE: 22x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



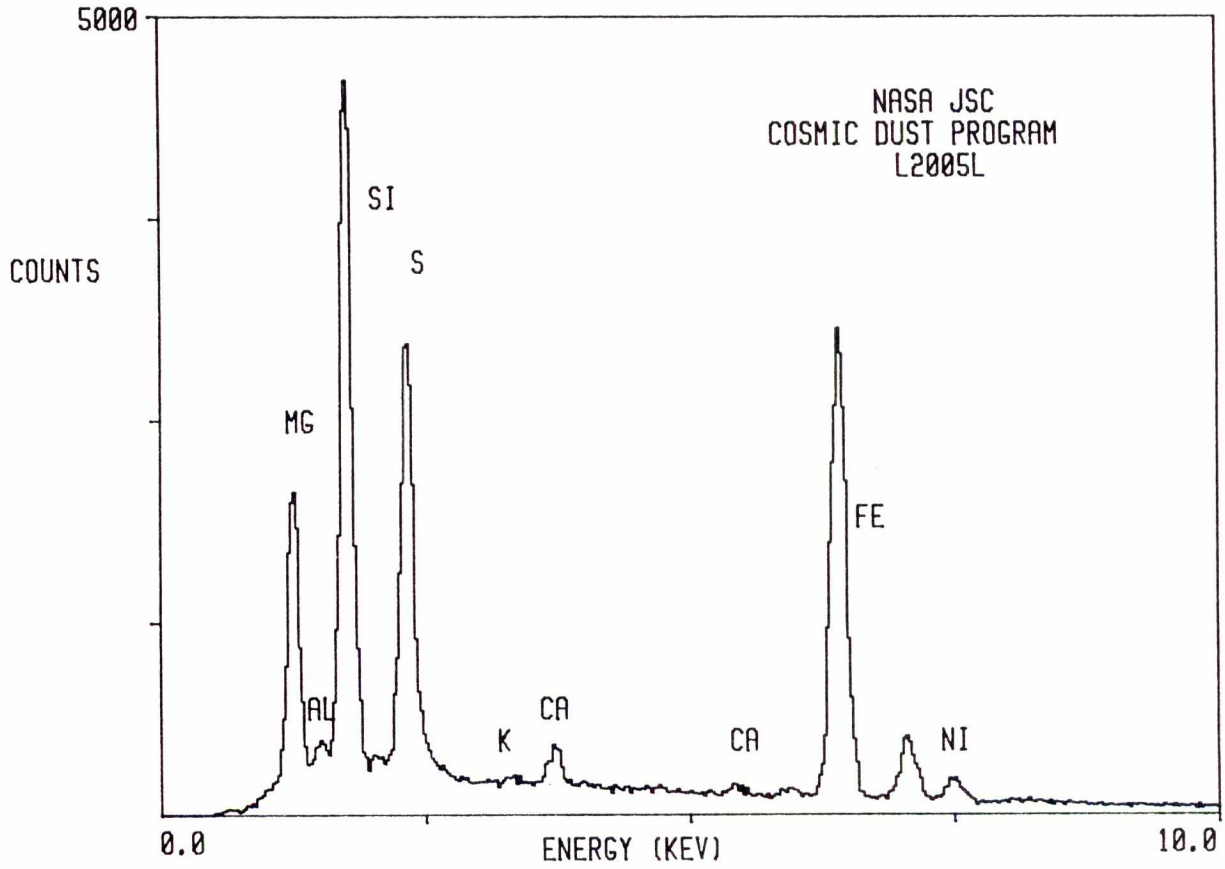
L2005 L 4



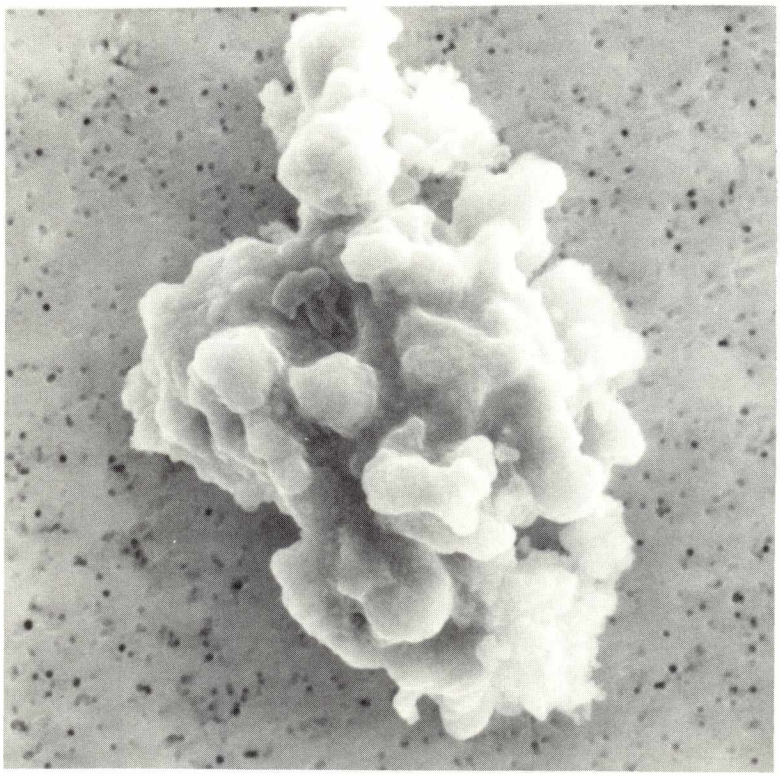
S-90-38223

SIZE: 27x28
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

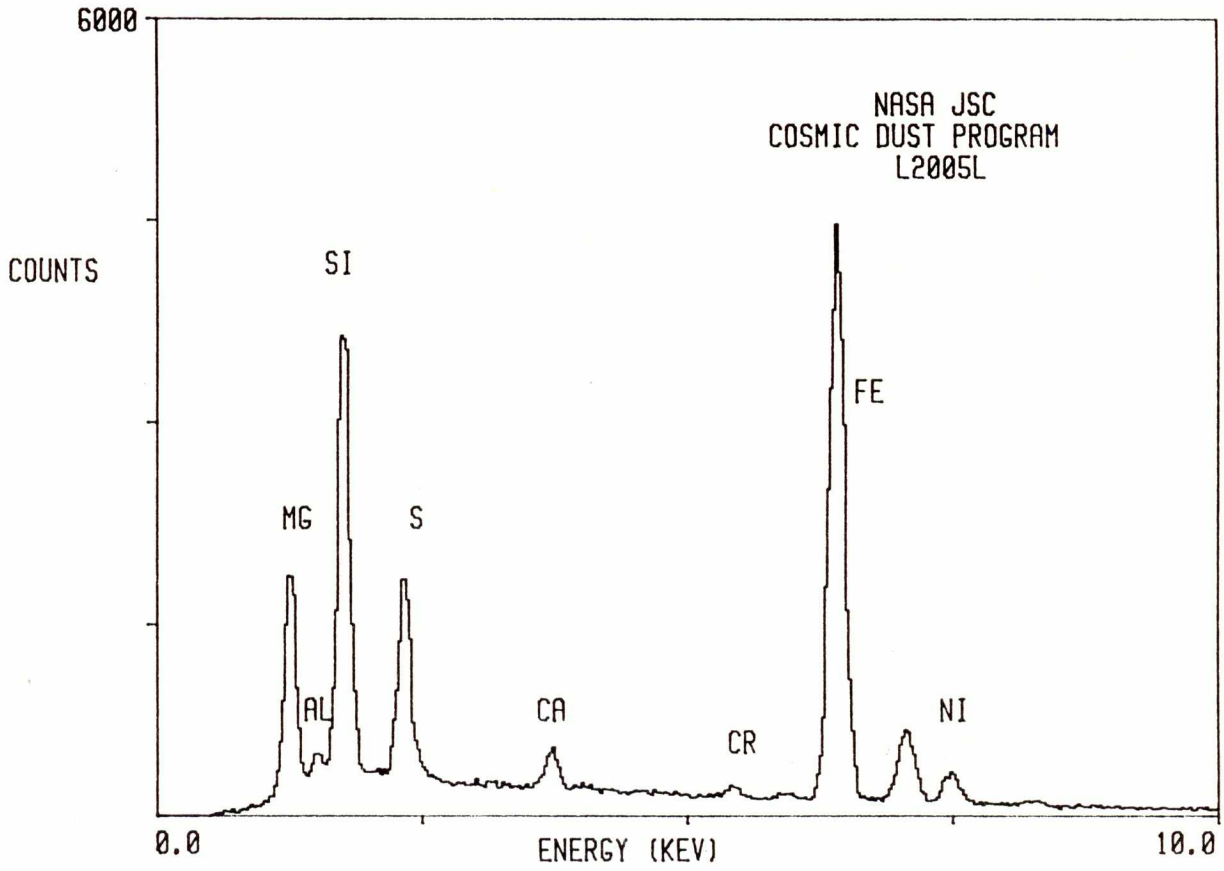


L2005 L 5

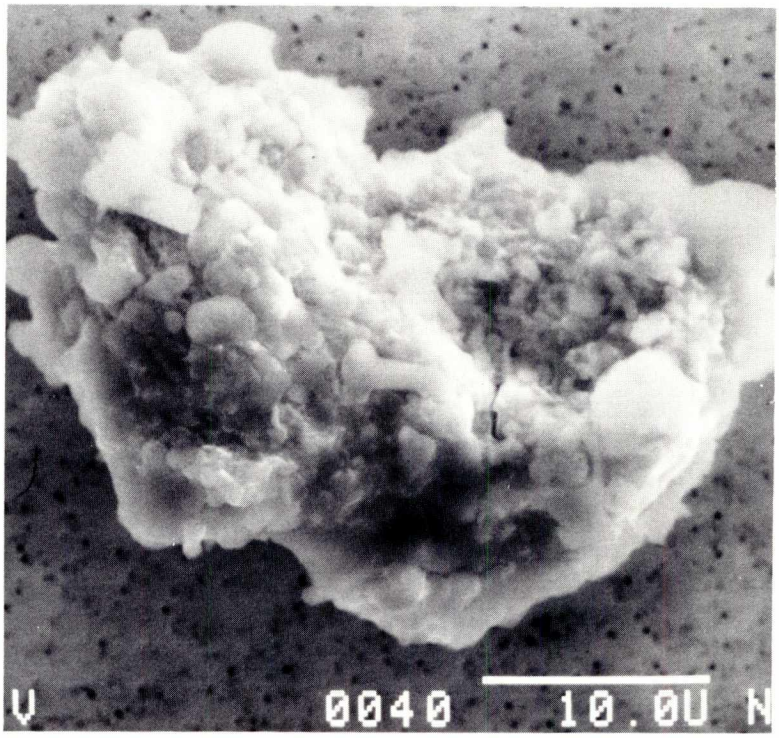


S-90-38224

SIZE: 20x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C
COMMENTS:



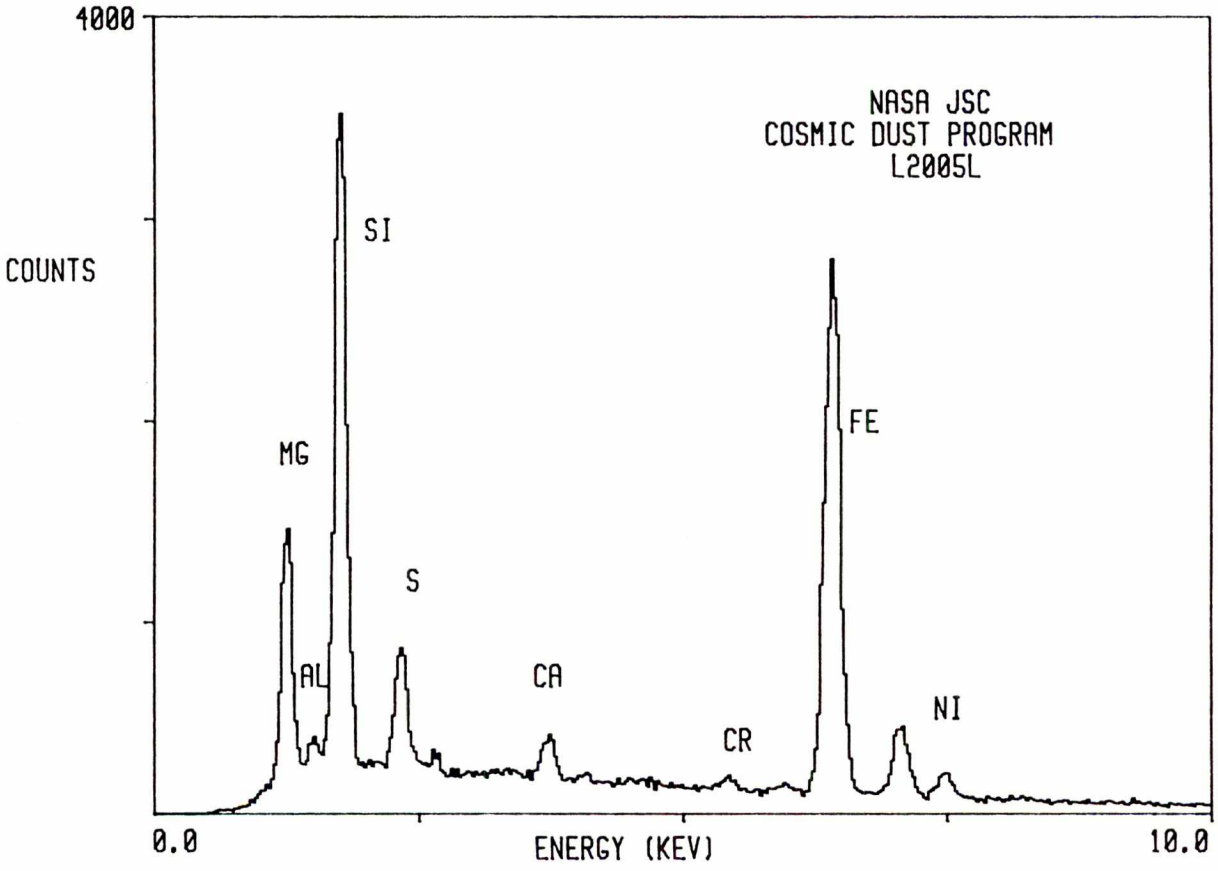
L2005 L 6



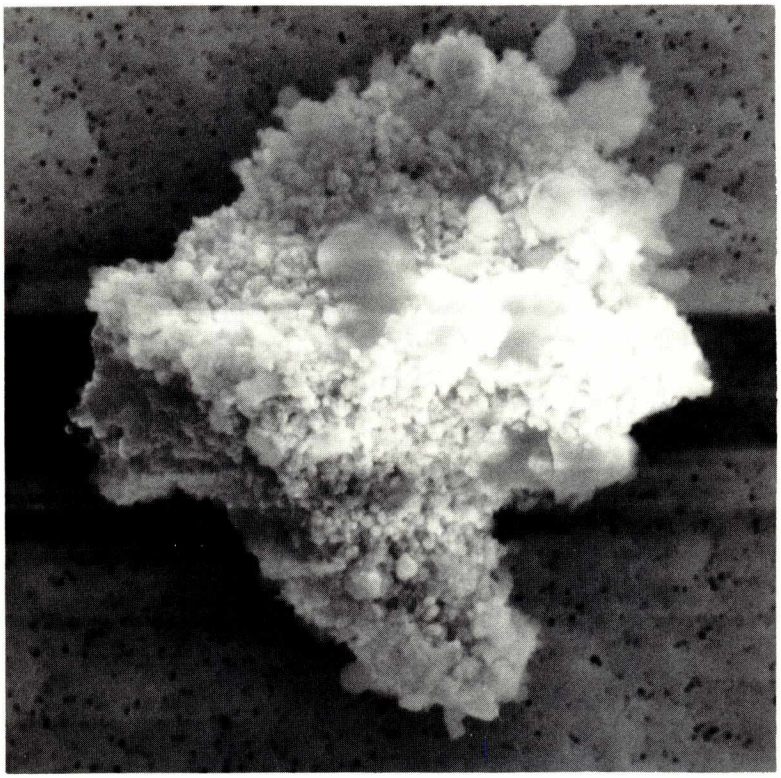
SIZE: 21x35
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

S-90-38225



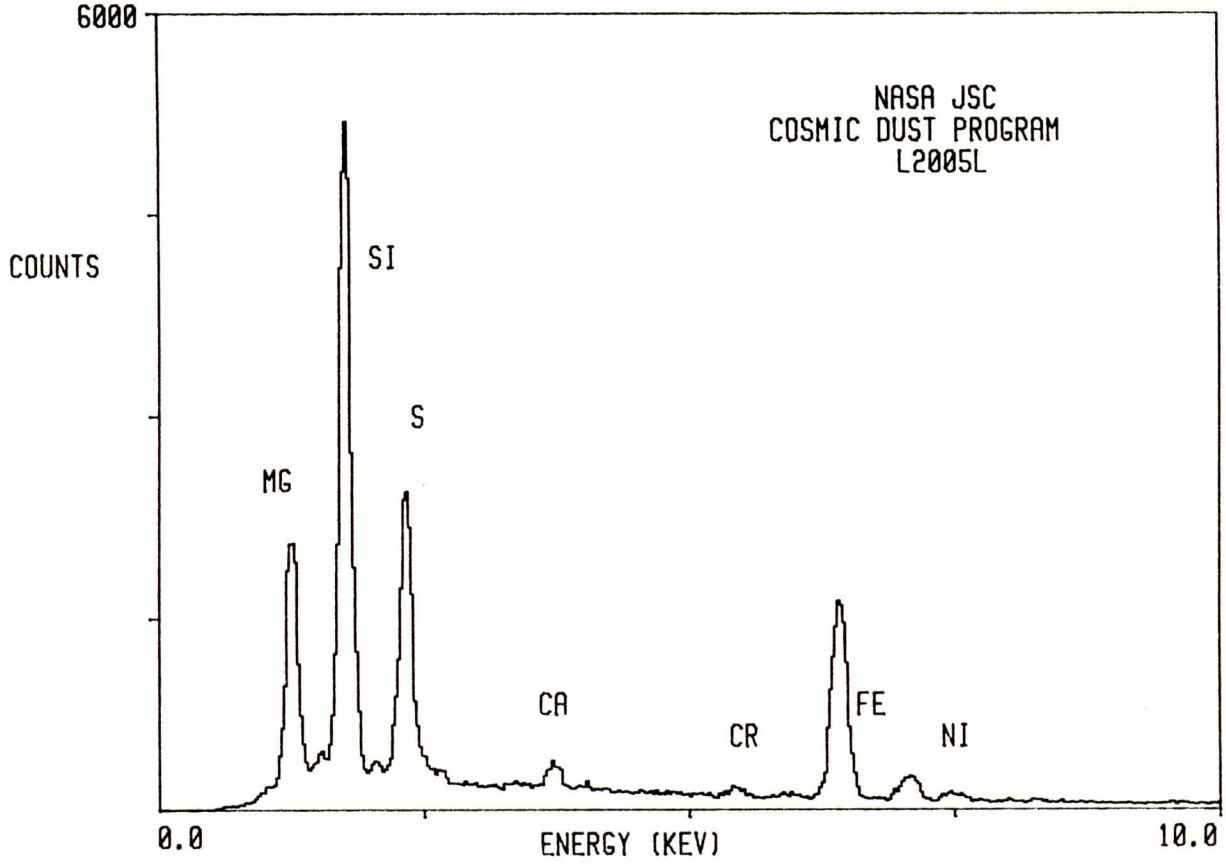
L2005 L 7



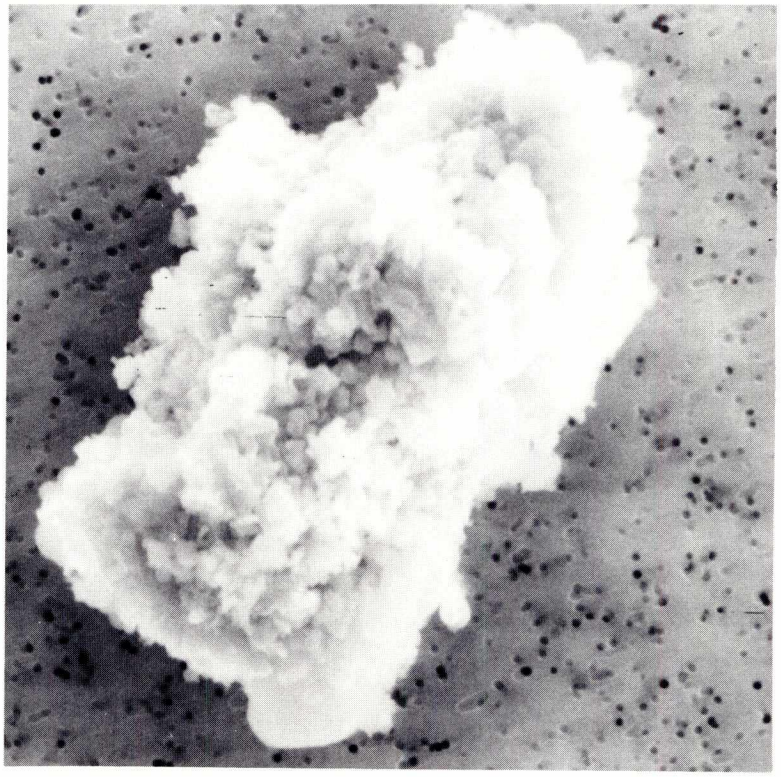
S-90-38226

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

COMMENTS:



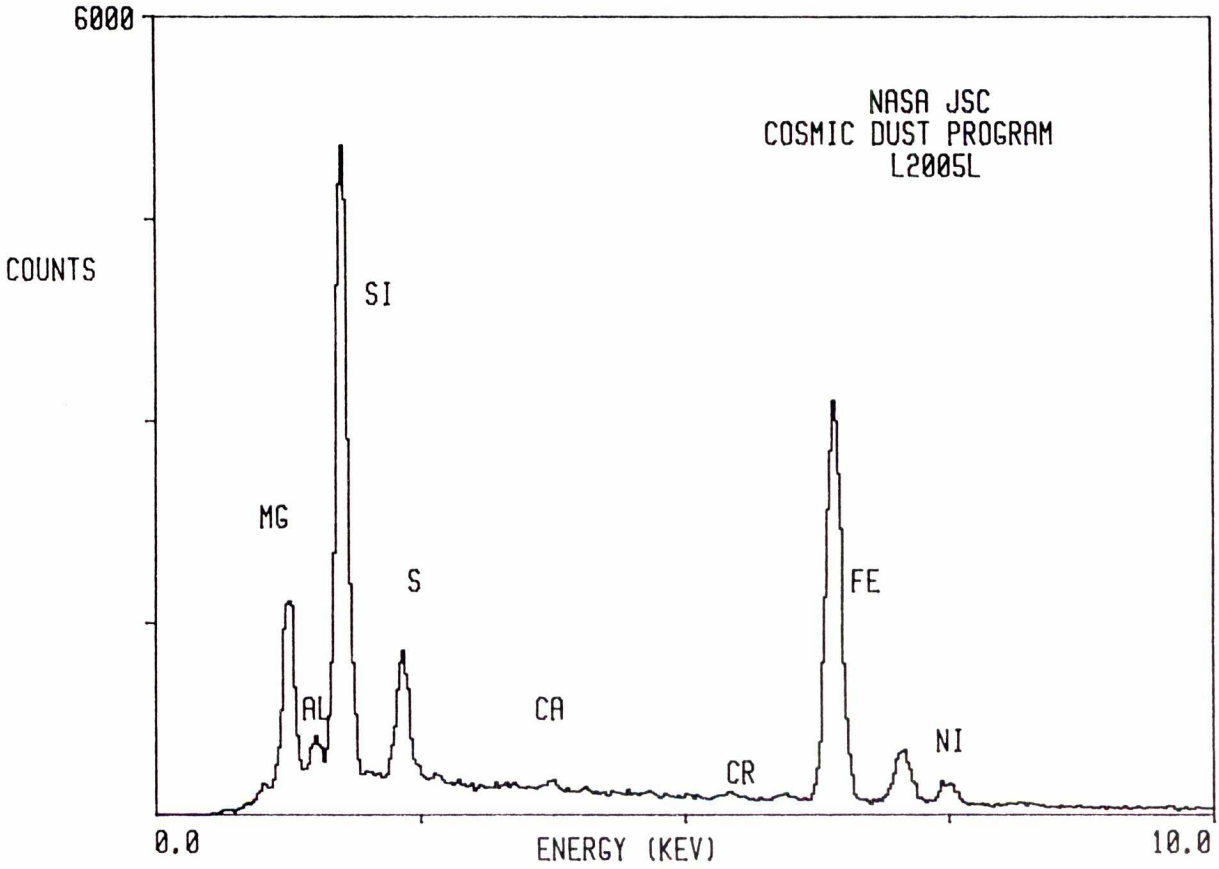
L2005 L 8



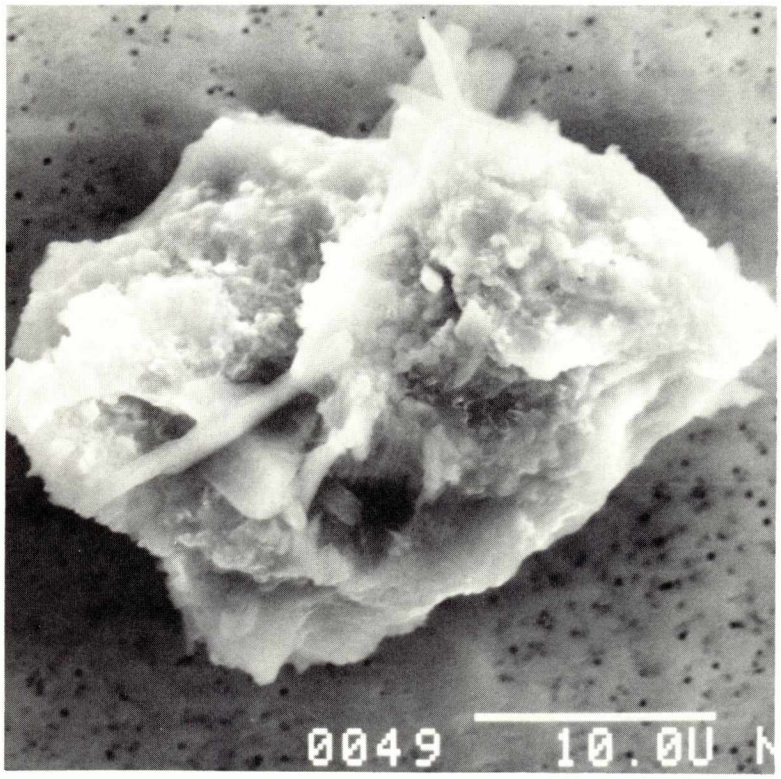
S-90-38227

SIZE: 18x27
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

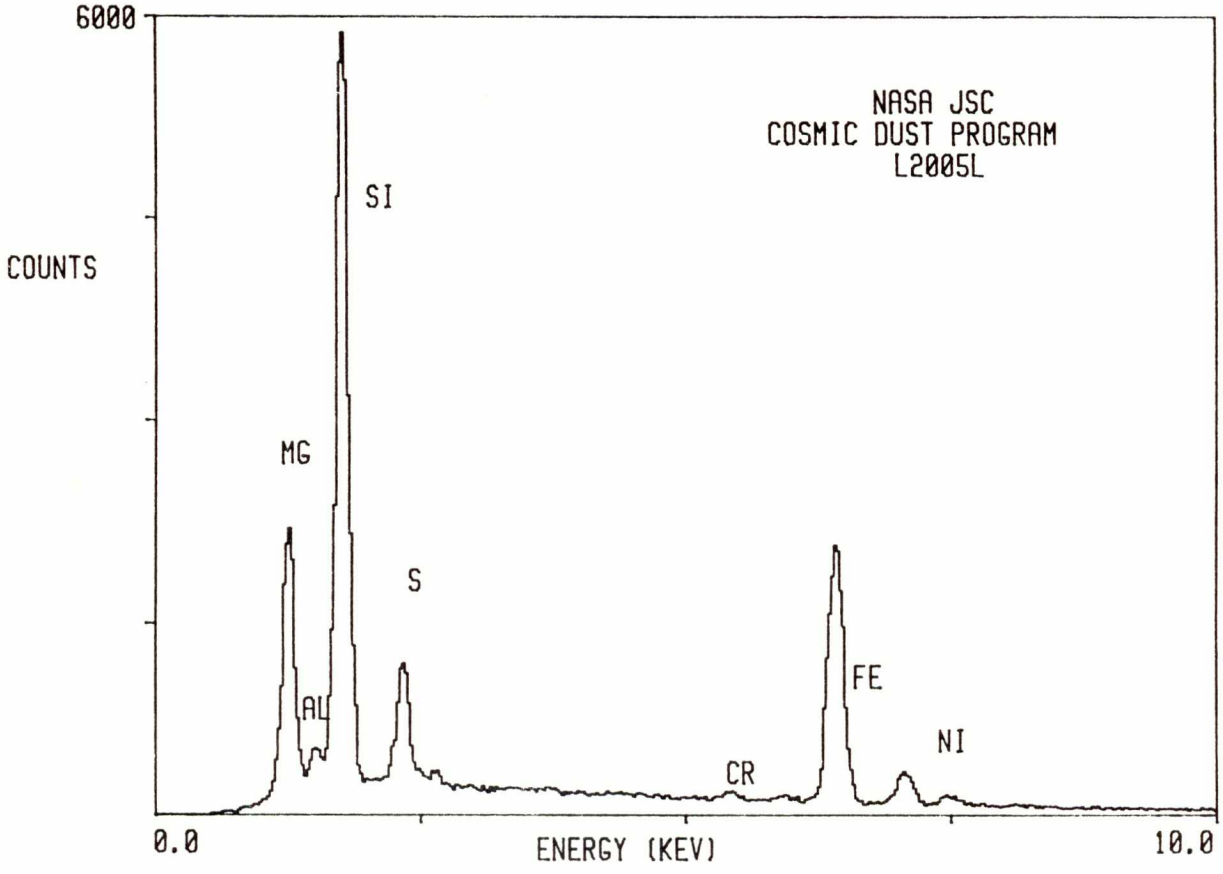


L2005 L 9

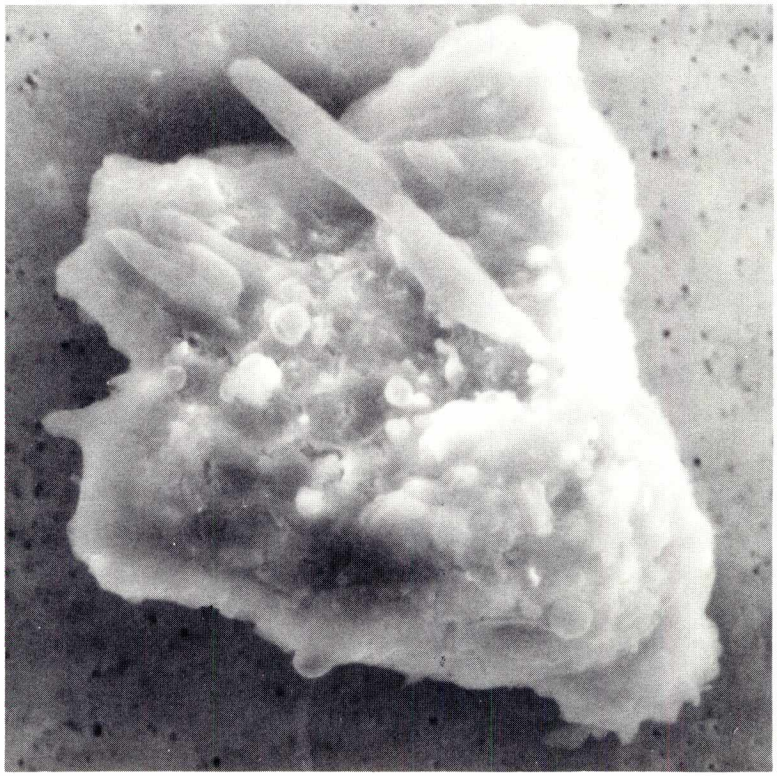


S-90-38228

SIZE: 25x34
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C
COMMENTS:



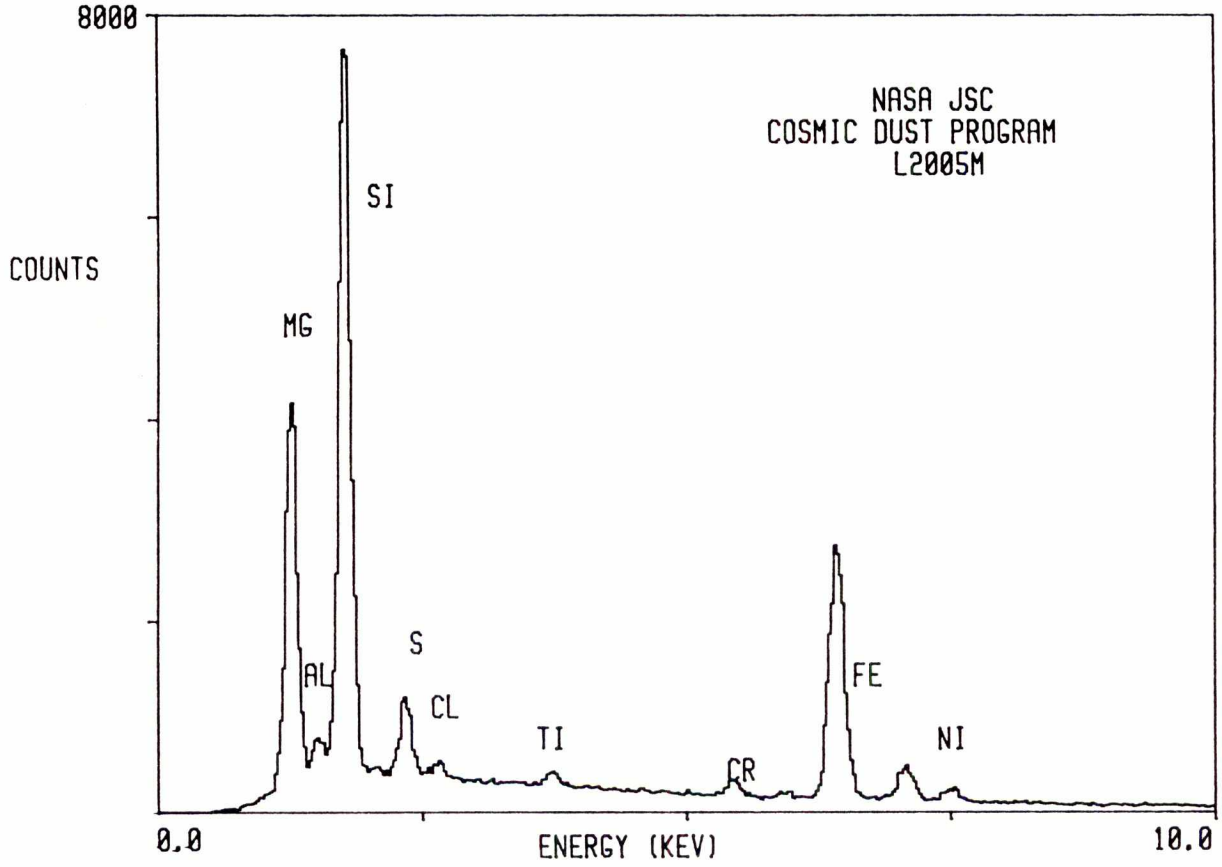
L2005 M 2



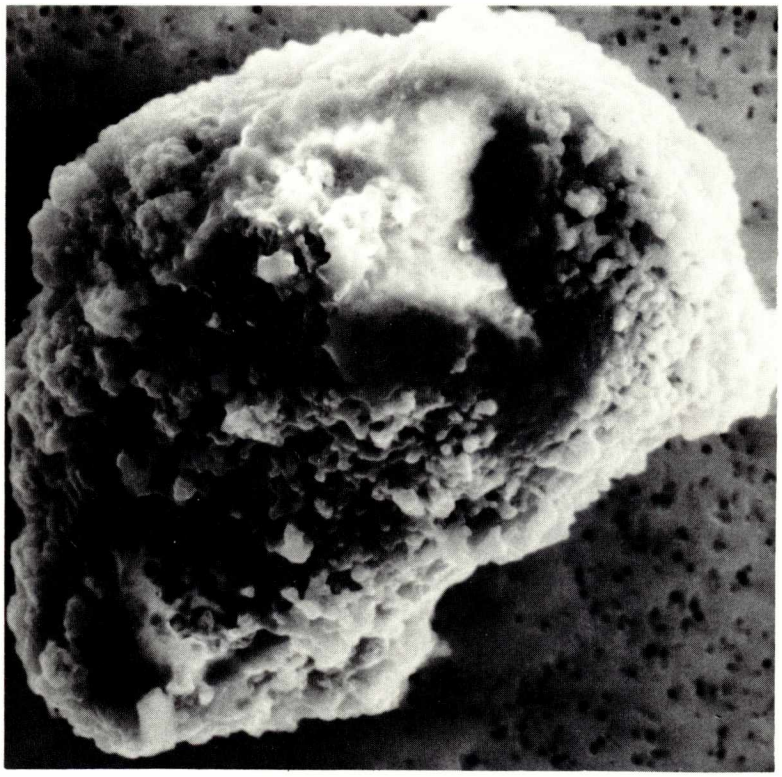
S-90-38230

SIZE: 26x32
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



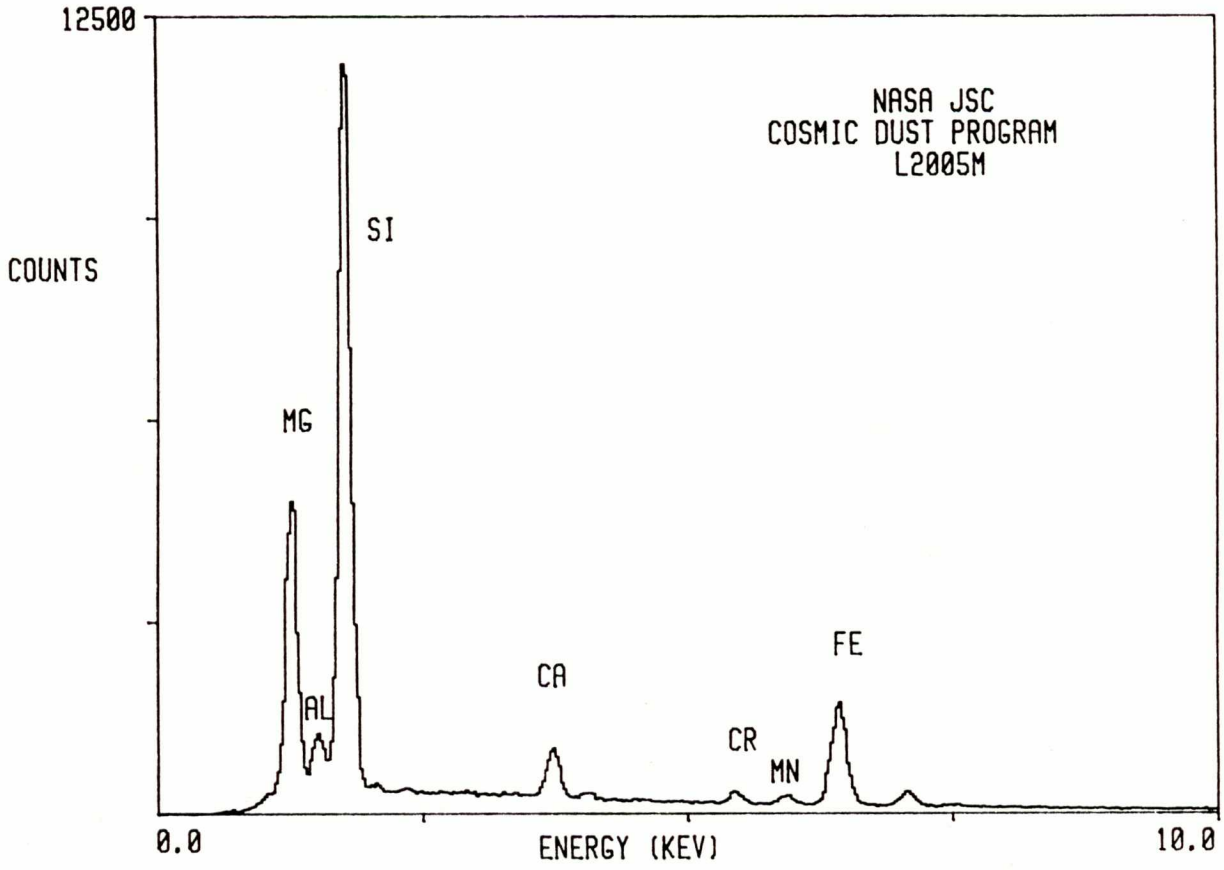
L2005 M 3



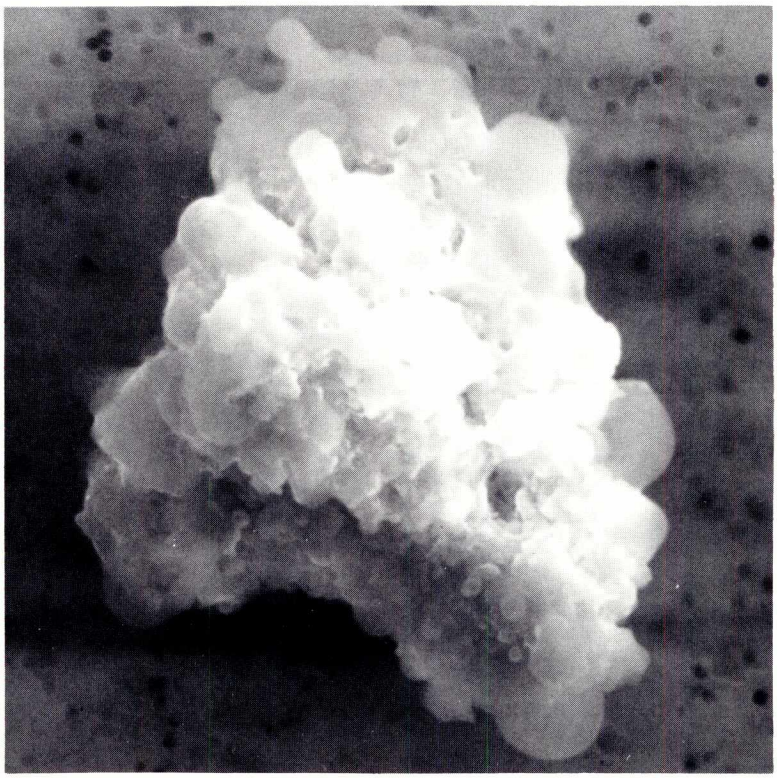
S-90-38231

SIZE: 23x32
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C?

COMMENTS:



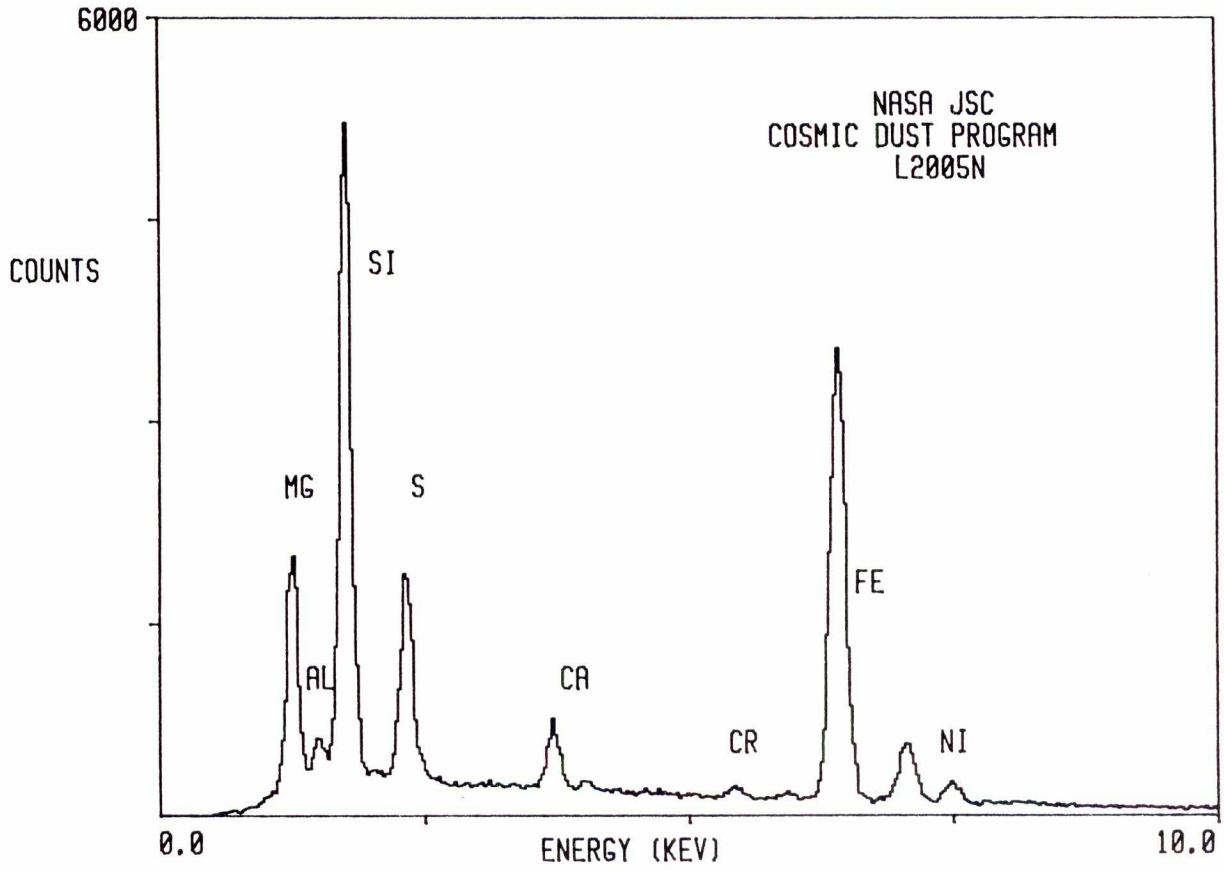
L2005 N 2



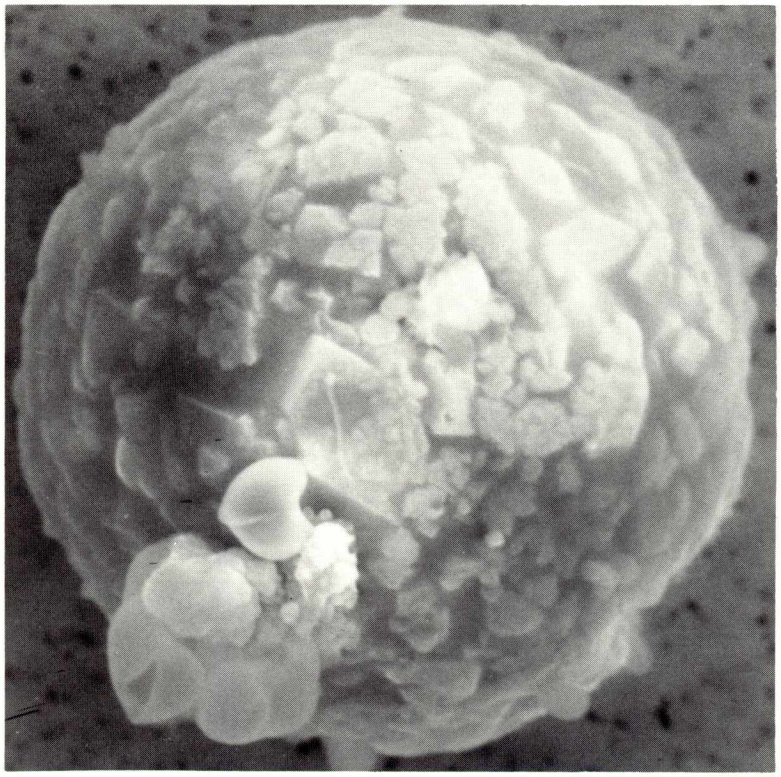
S-90-38234

SIZE: 13x18
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



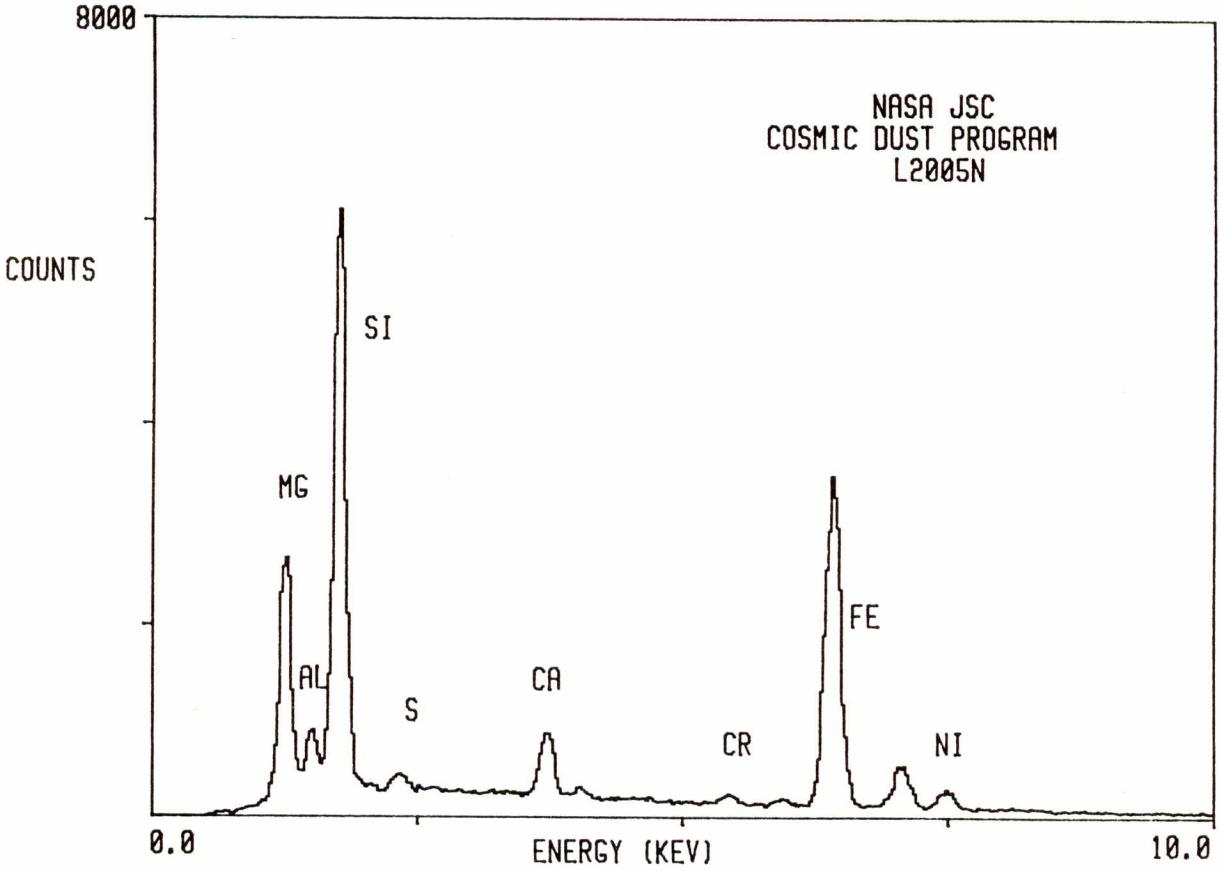
L2005 N 3



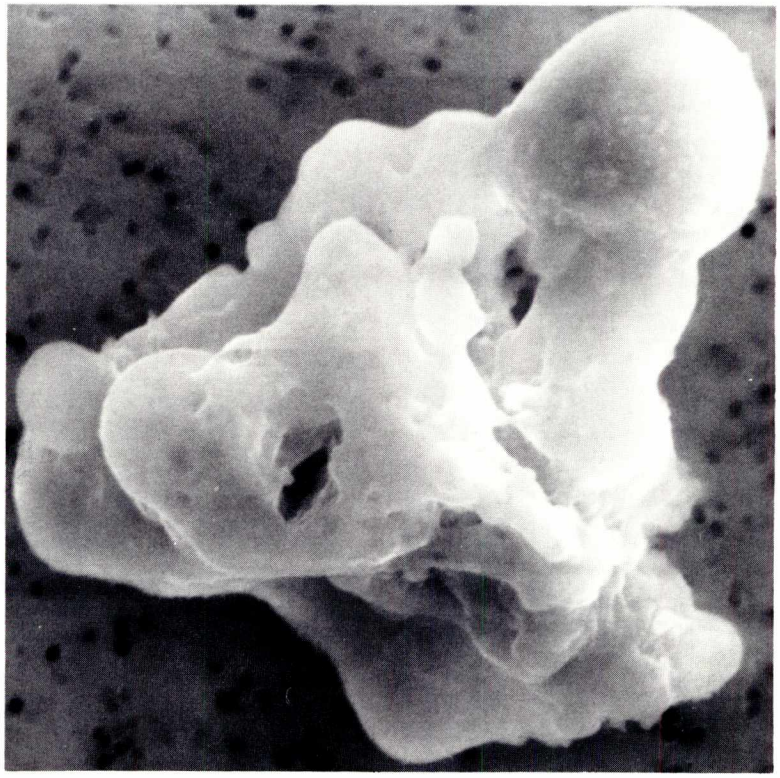
S-90-38235

SIZE: 18x20
SHAPE: S
TRANS.: O/TL
COLOR: Black
LUSTER: D/V
TYPE: C?

COMMENTS:



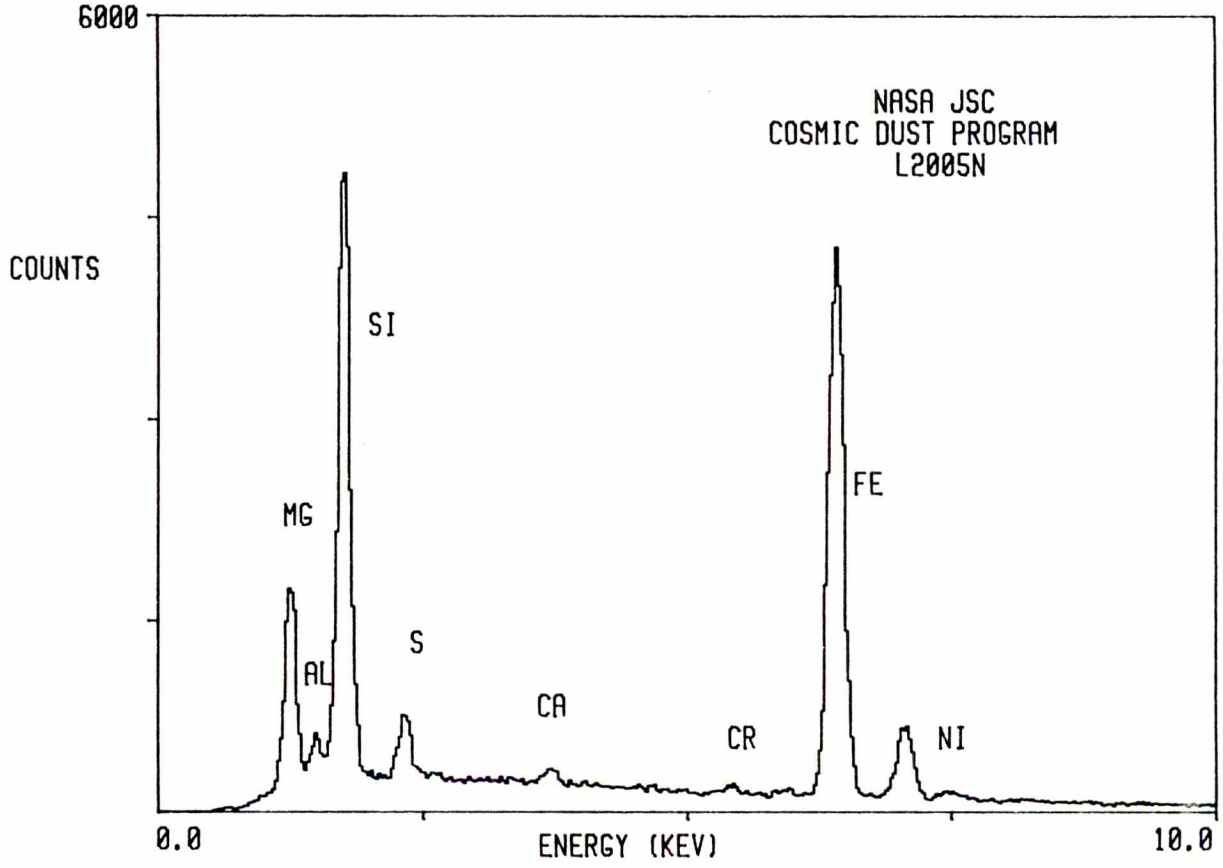
L2005 N 5



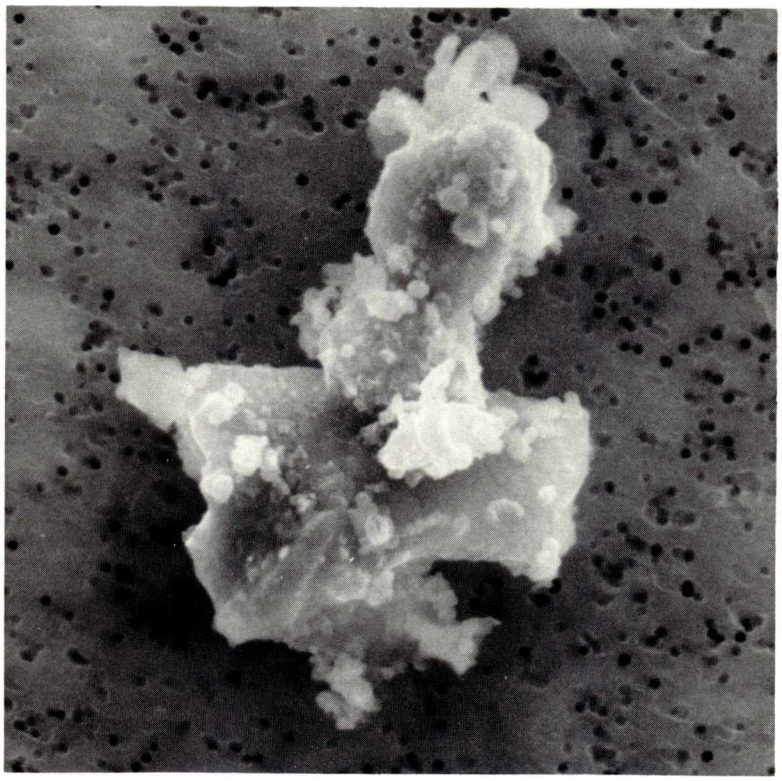
S-90-38237

SIZE: 16x18
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C?

COMMENTS:



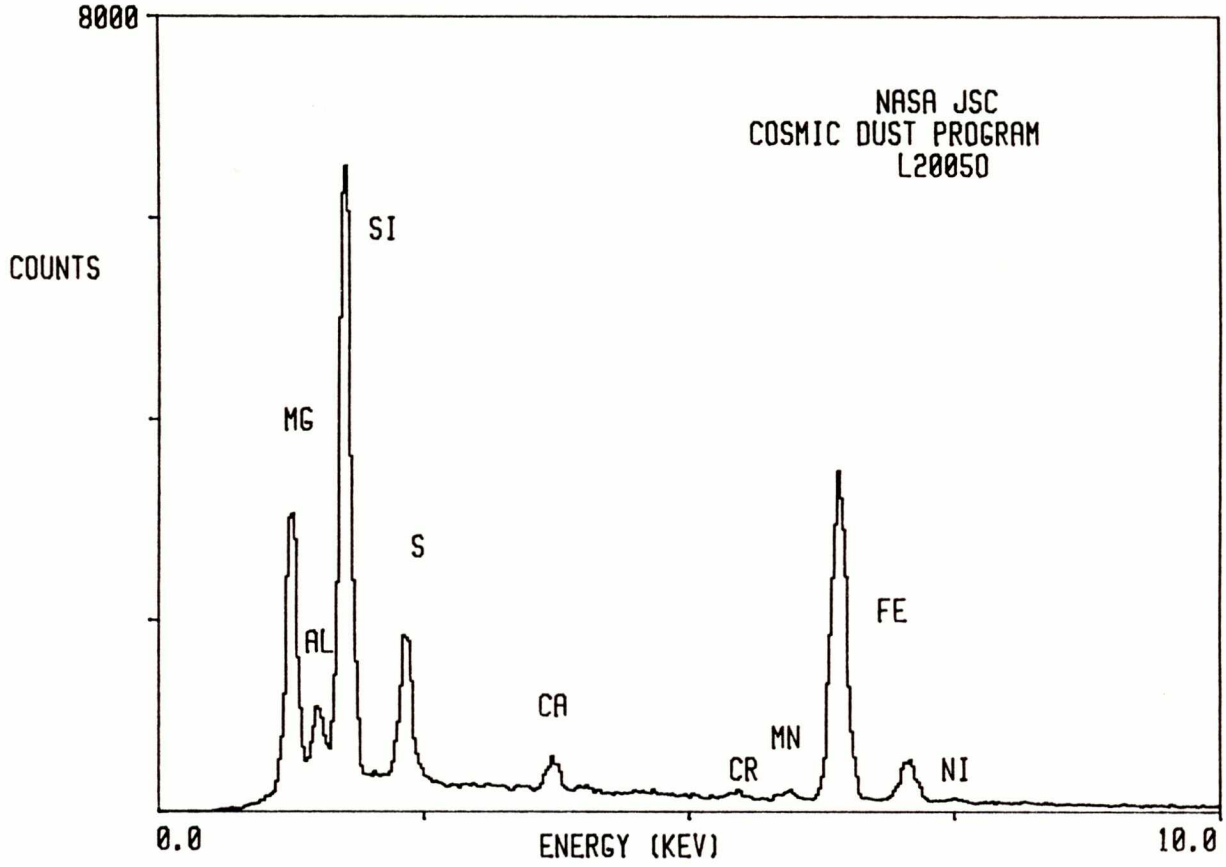
L2005 O 1



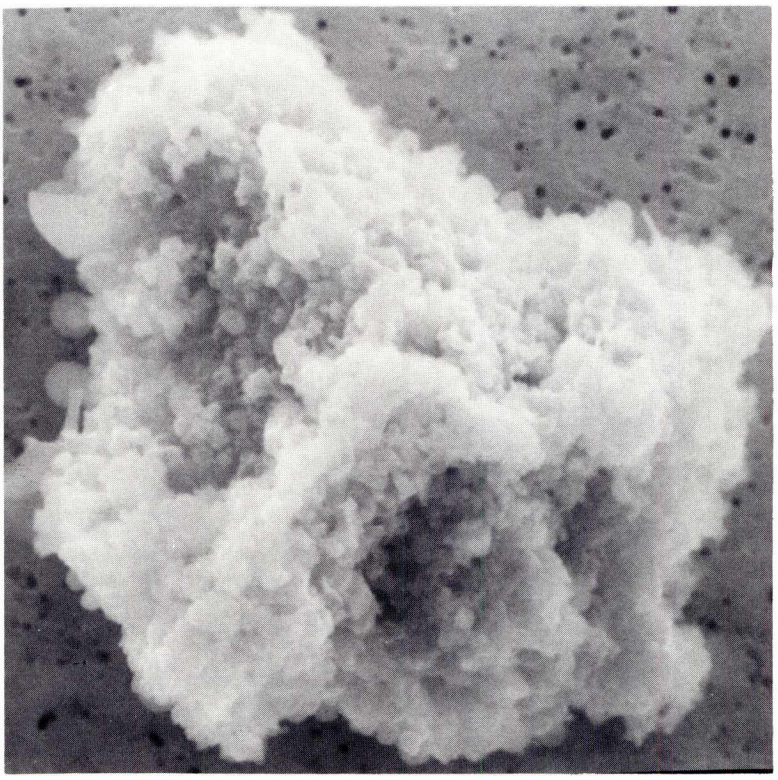
S-90-38240

SIZE: 15x19
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



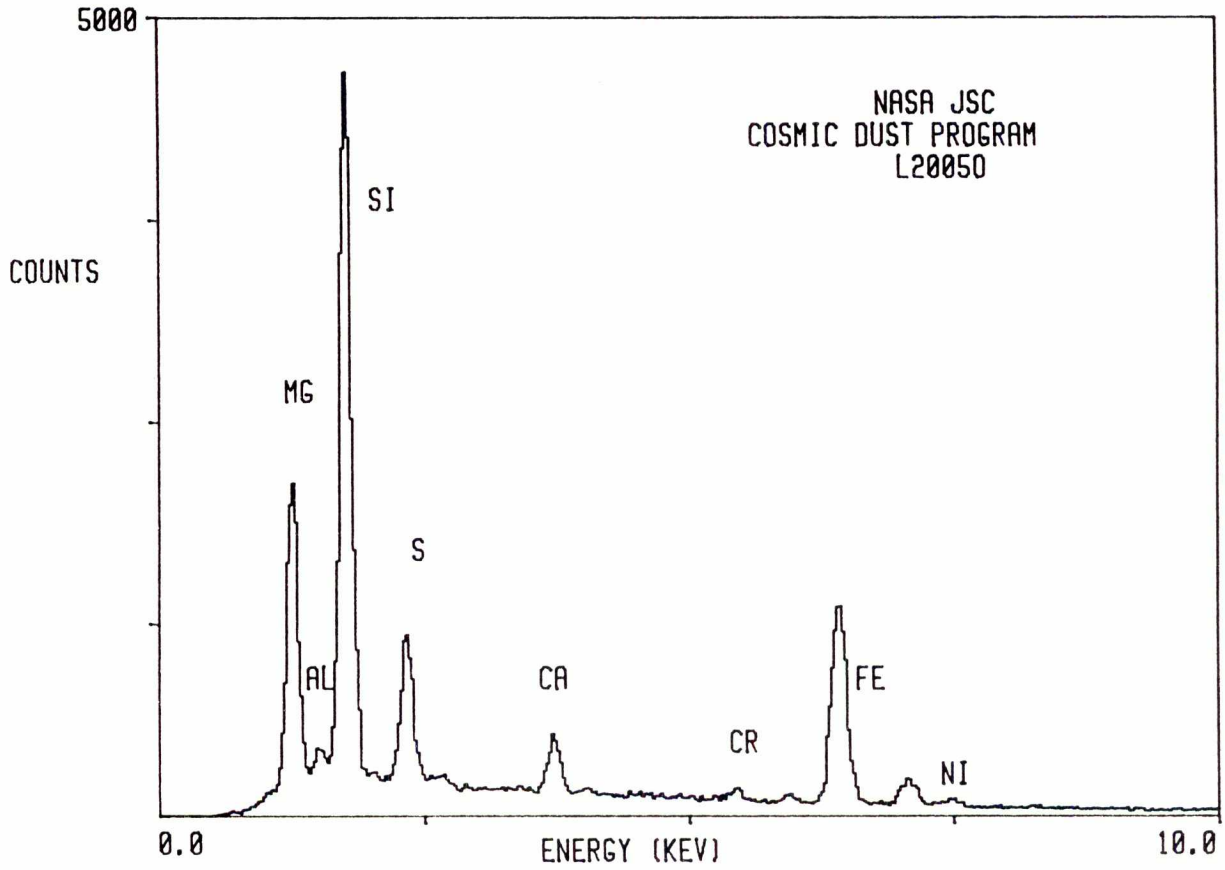
L2005 O 3



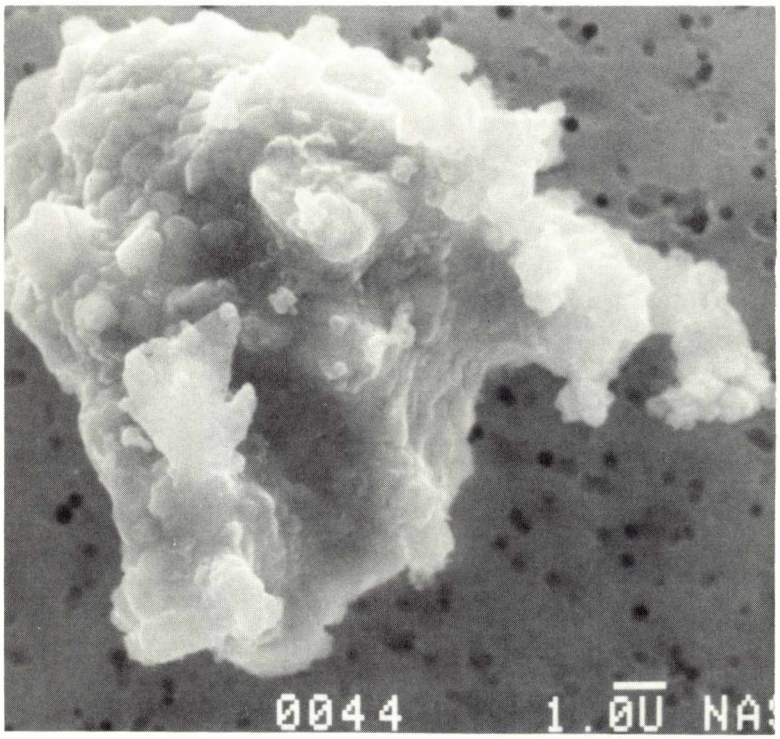
S-90-38242

SIZE: 20x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

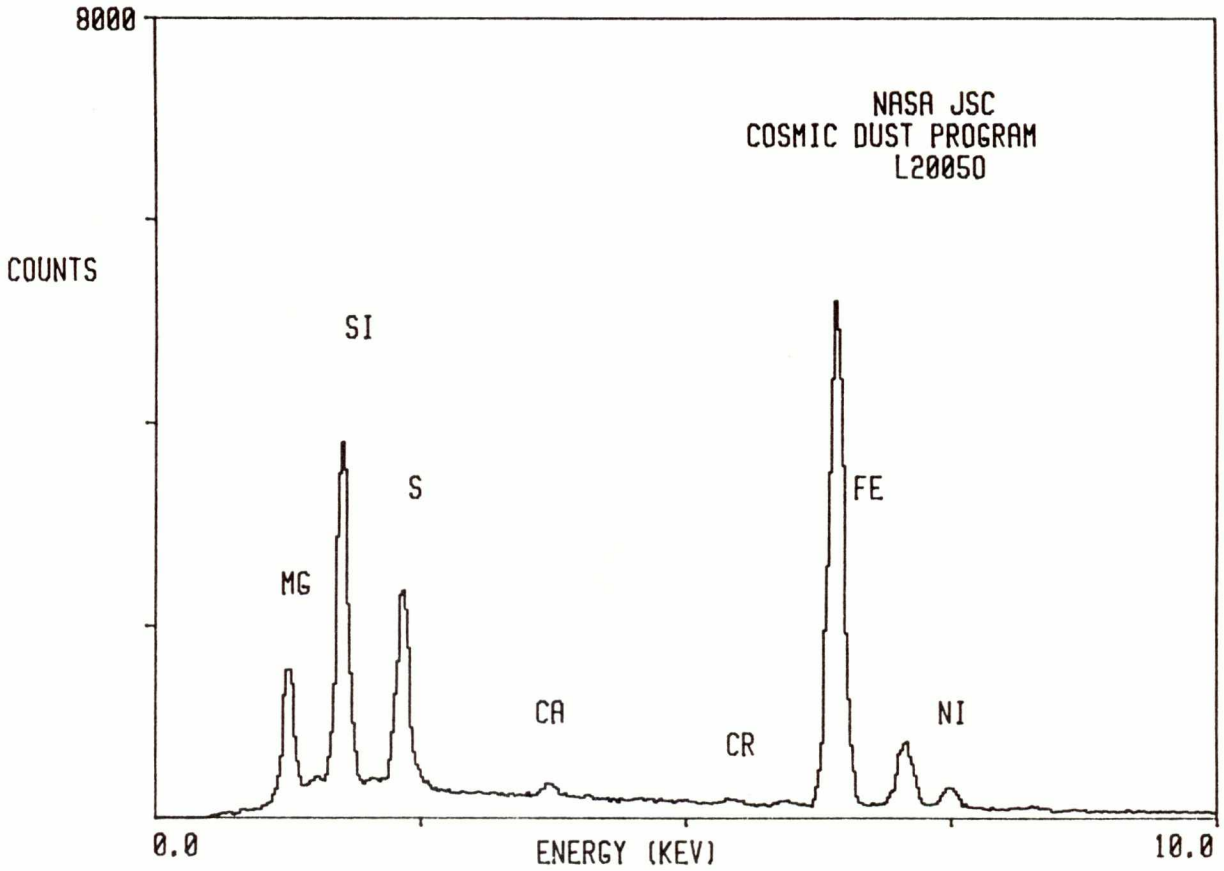


L2005 O 4

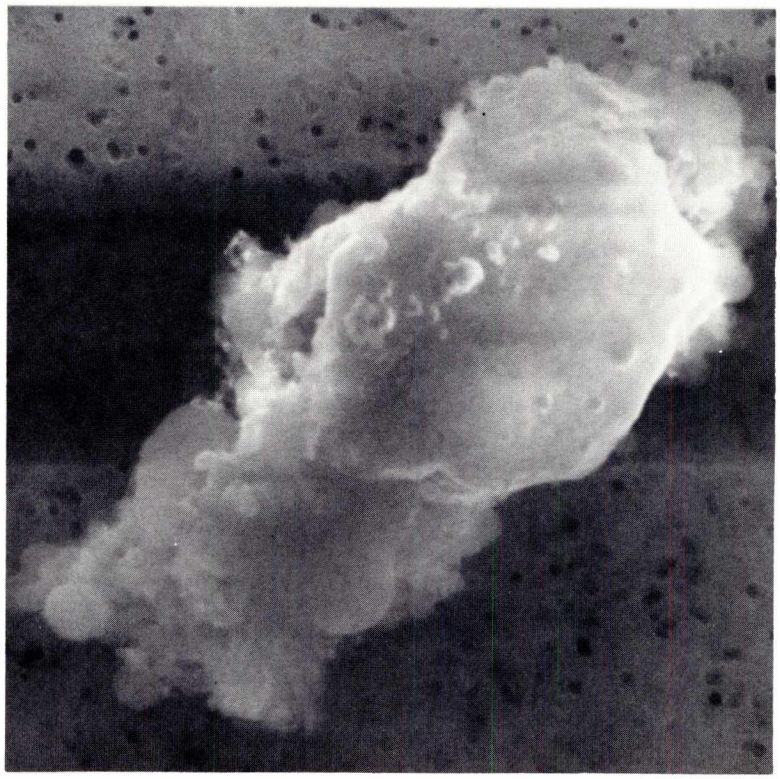


SIZE: 13x17
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C
COMMENTS:

S-90-38243



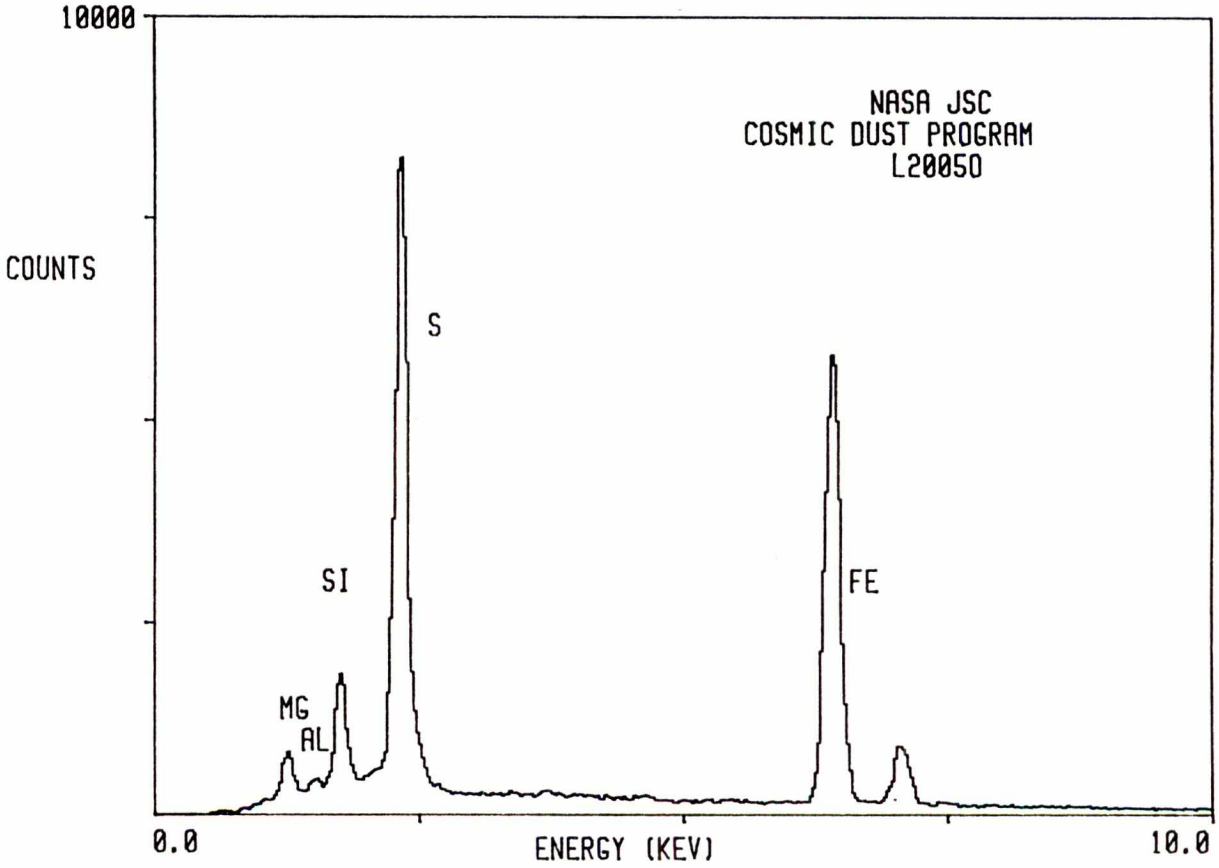
L2005 O 6



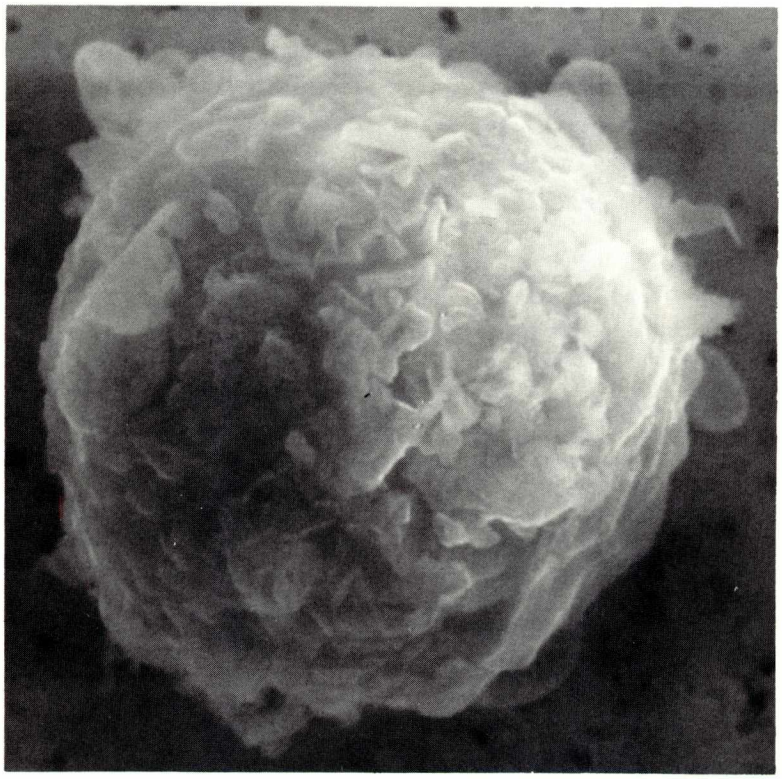
S-90-38245

SIZE: 11x22
SHAPE: I
TRANS.: O
COLOR: Black to Brown
LUSTER: D/SM
TYPE: C?

COMMENTS:



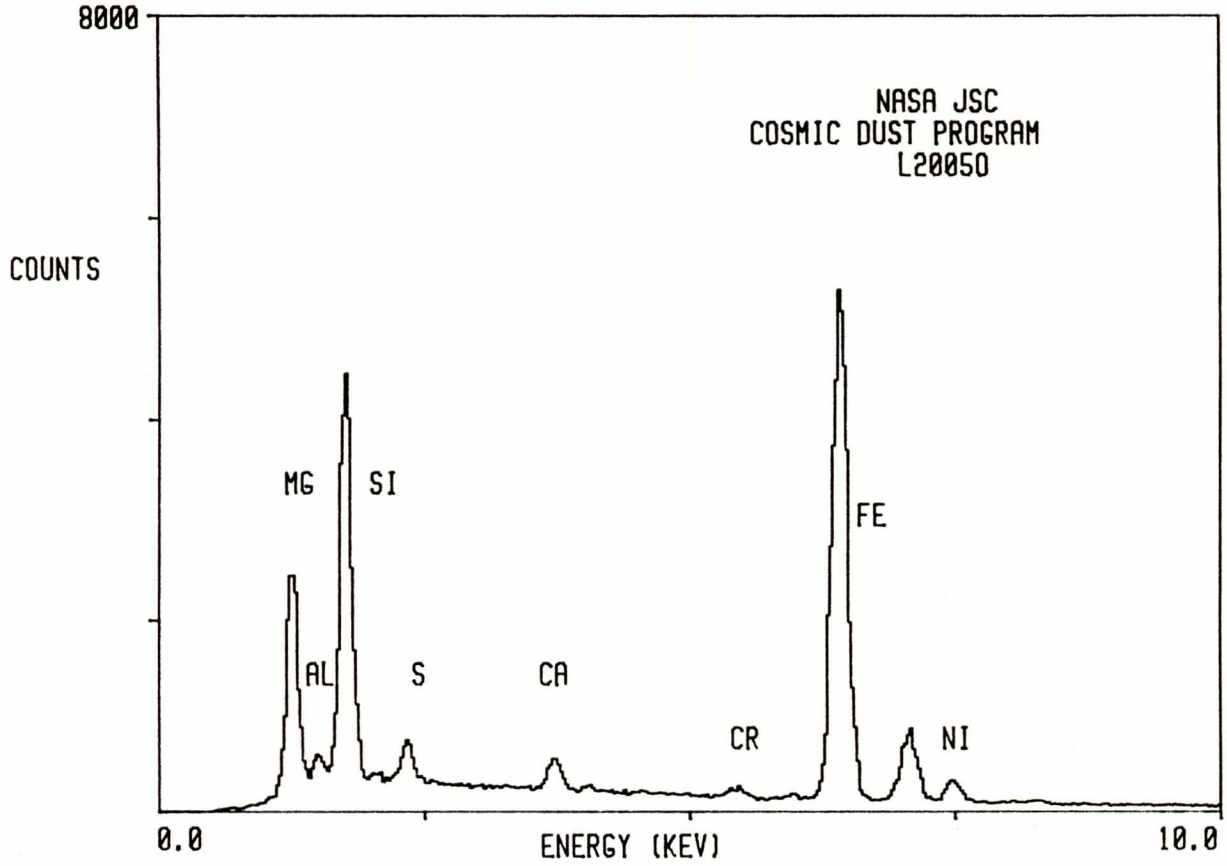
L2005 O 7



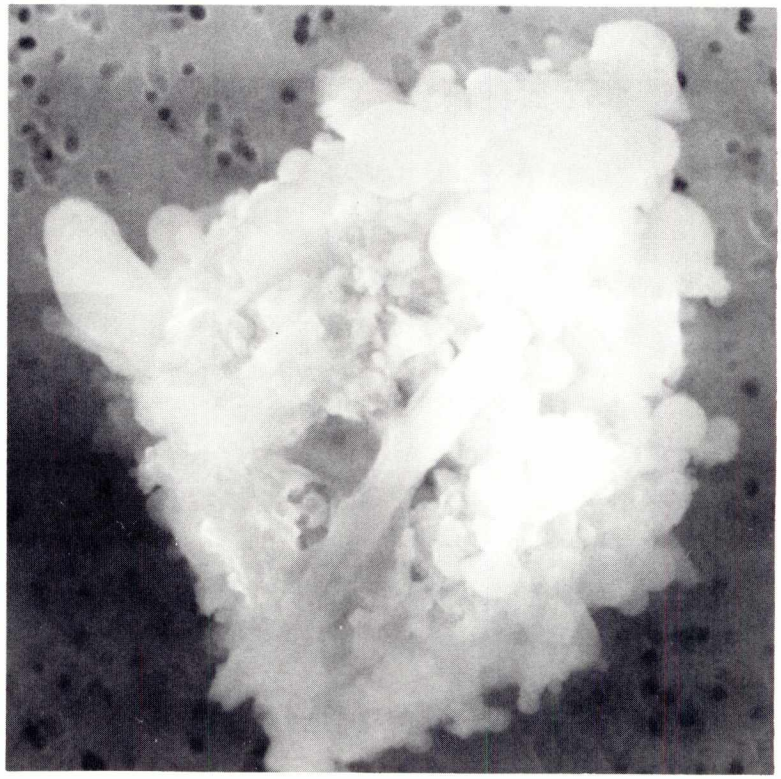
S-90-38246

SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



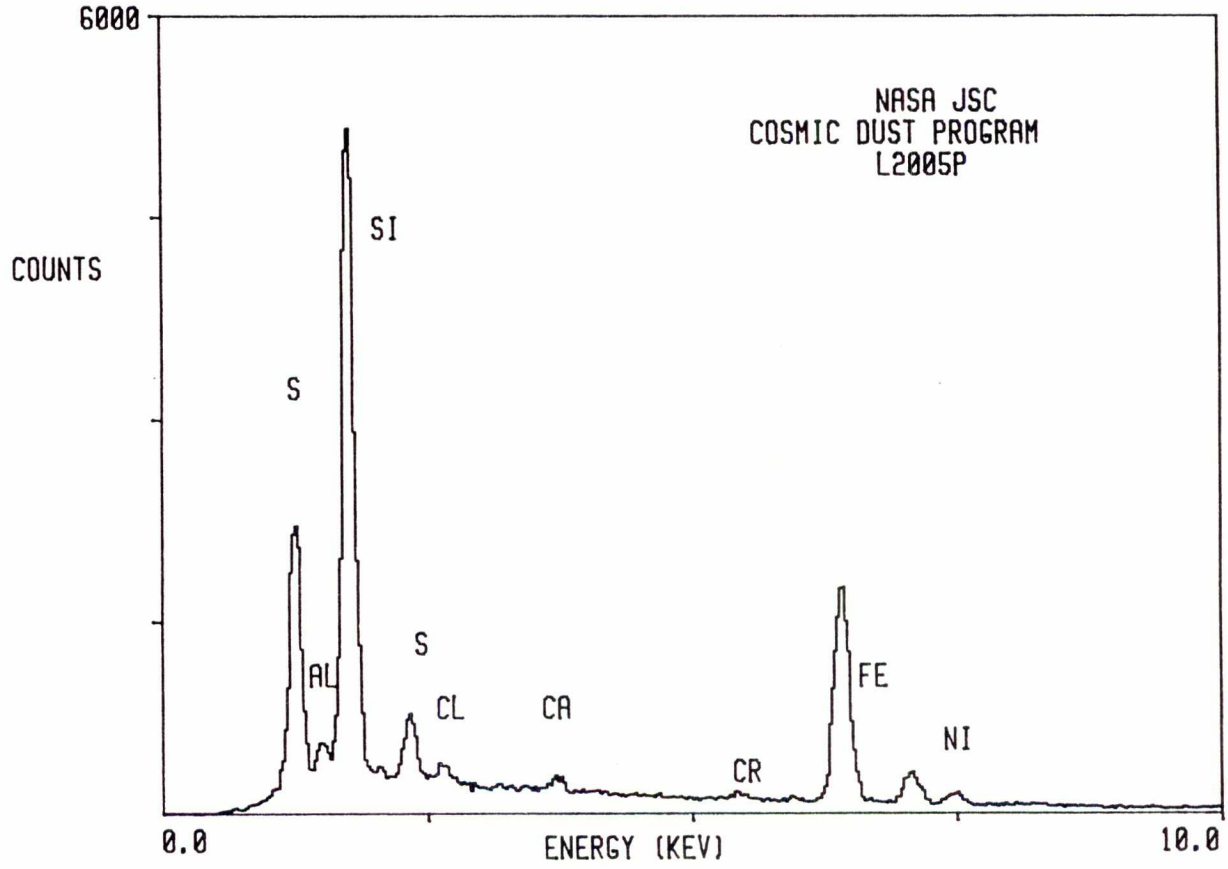
L2005 P 1



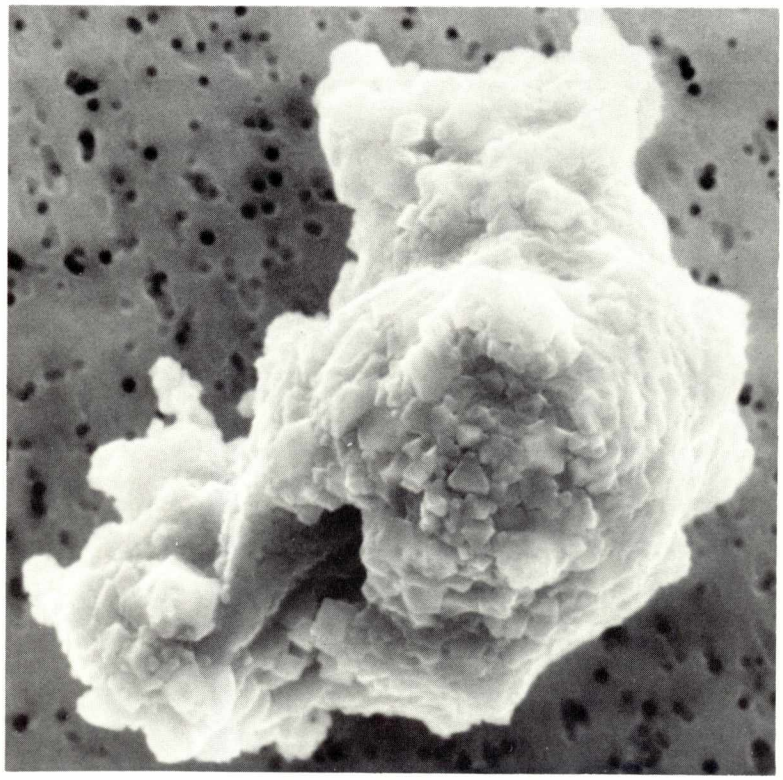
S-90-38250

SIZE: 15x17
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



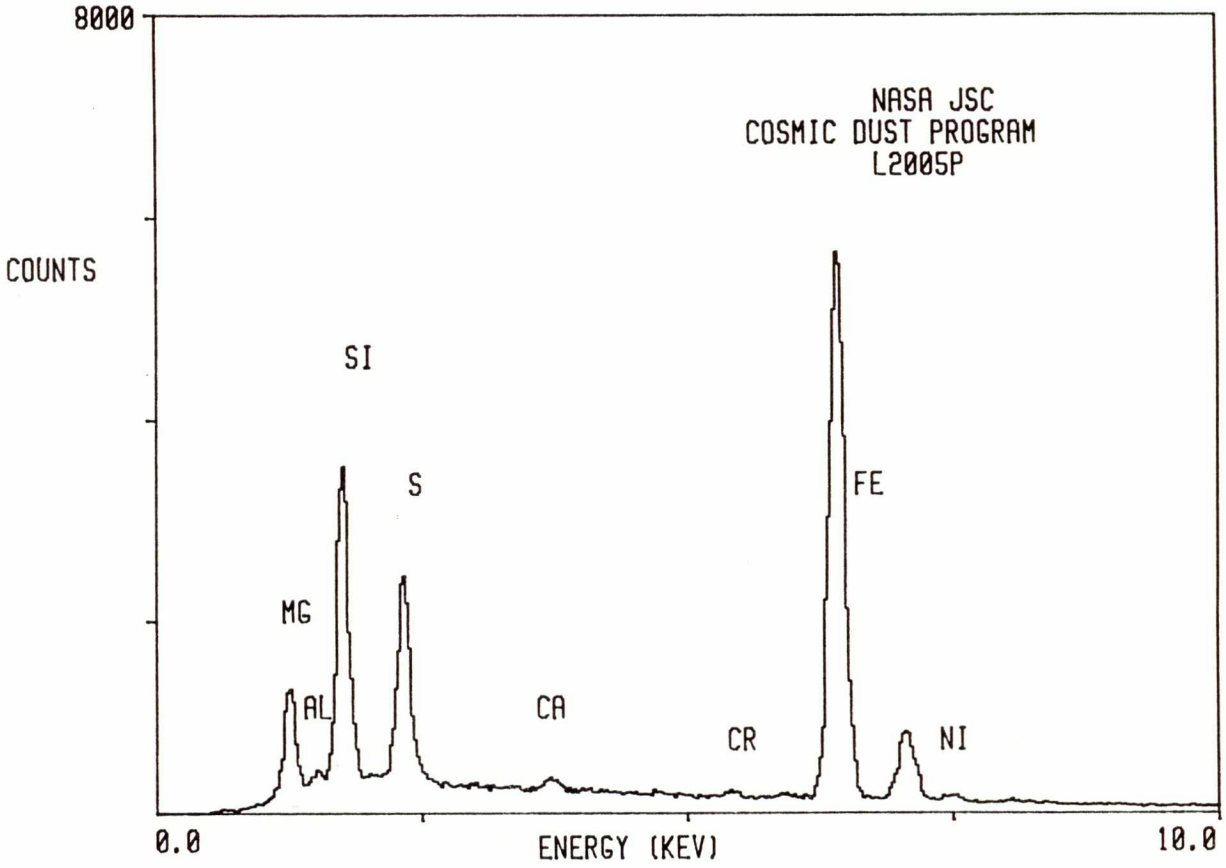
L2005 P 2



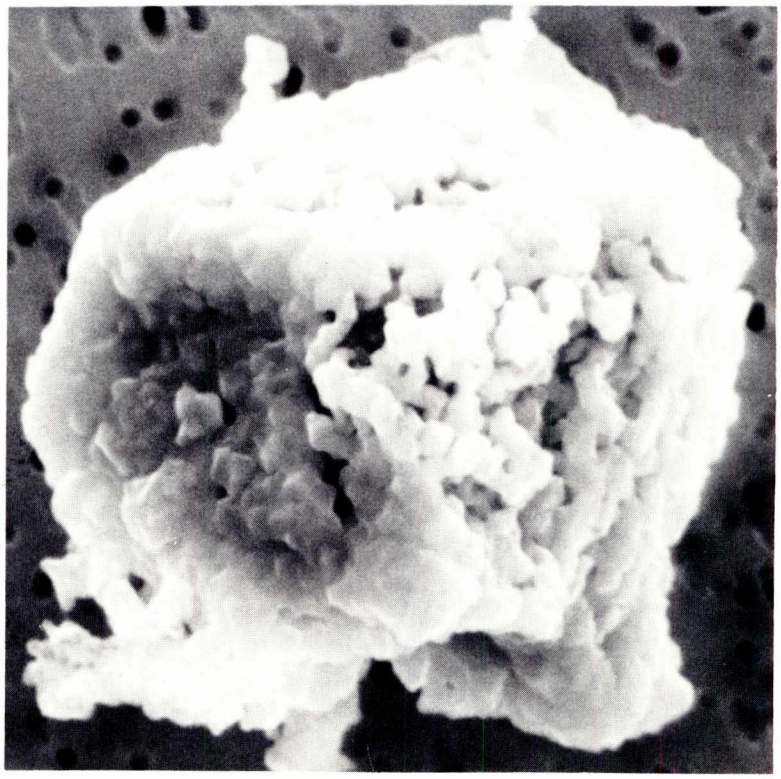
S-90-38251

SIZE: 14x20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



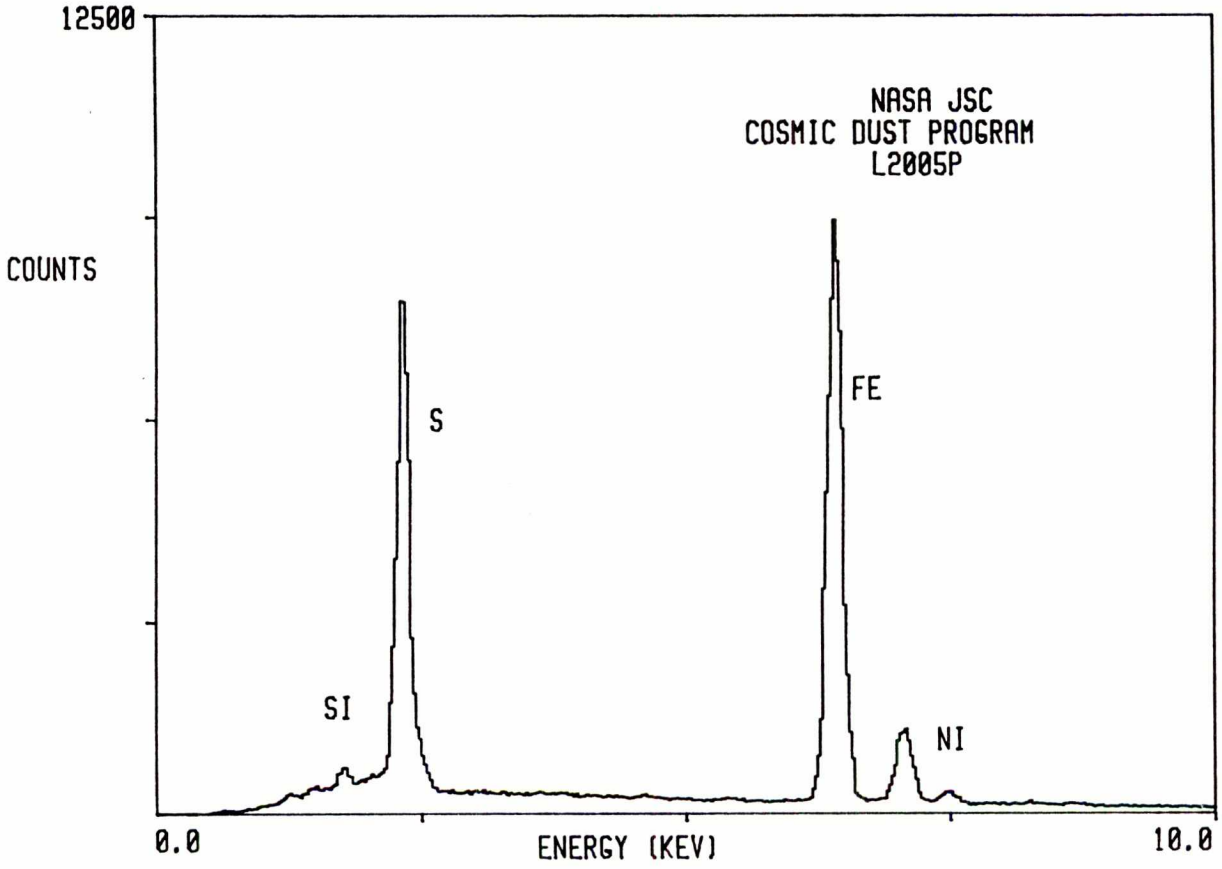
L2005 P 3



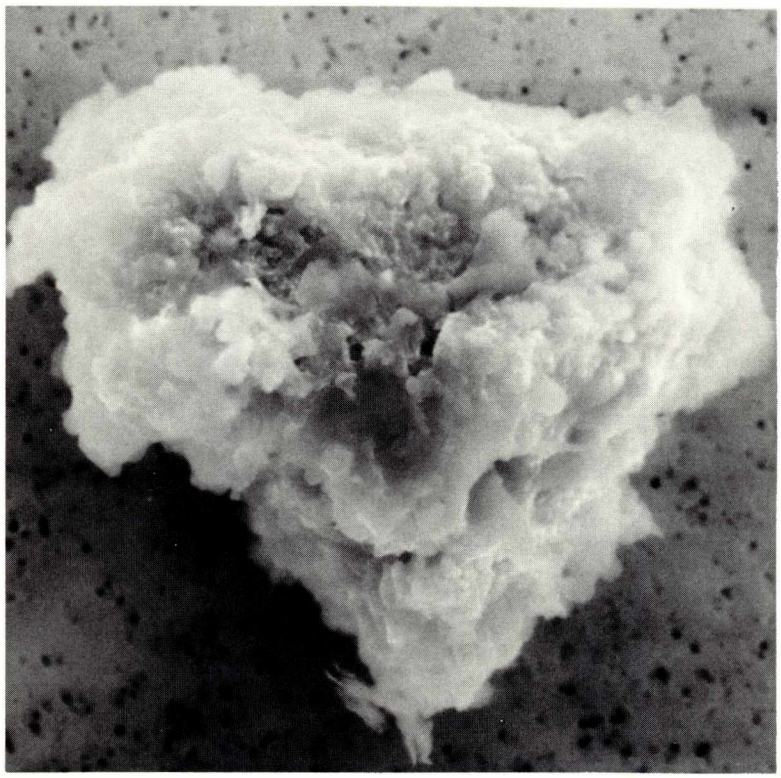
S-90-38252

SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Black to Brown
LUSTER: D/SM
TYPE: C?

COMMENTS:



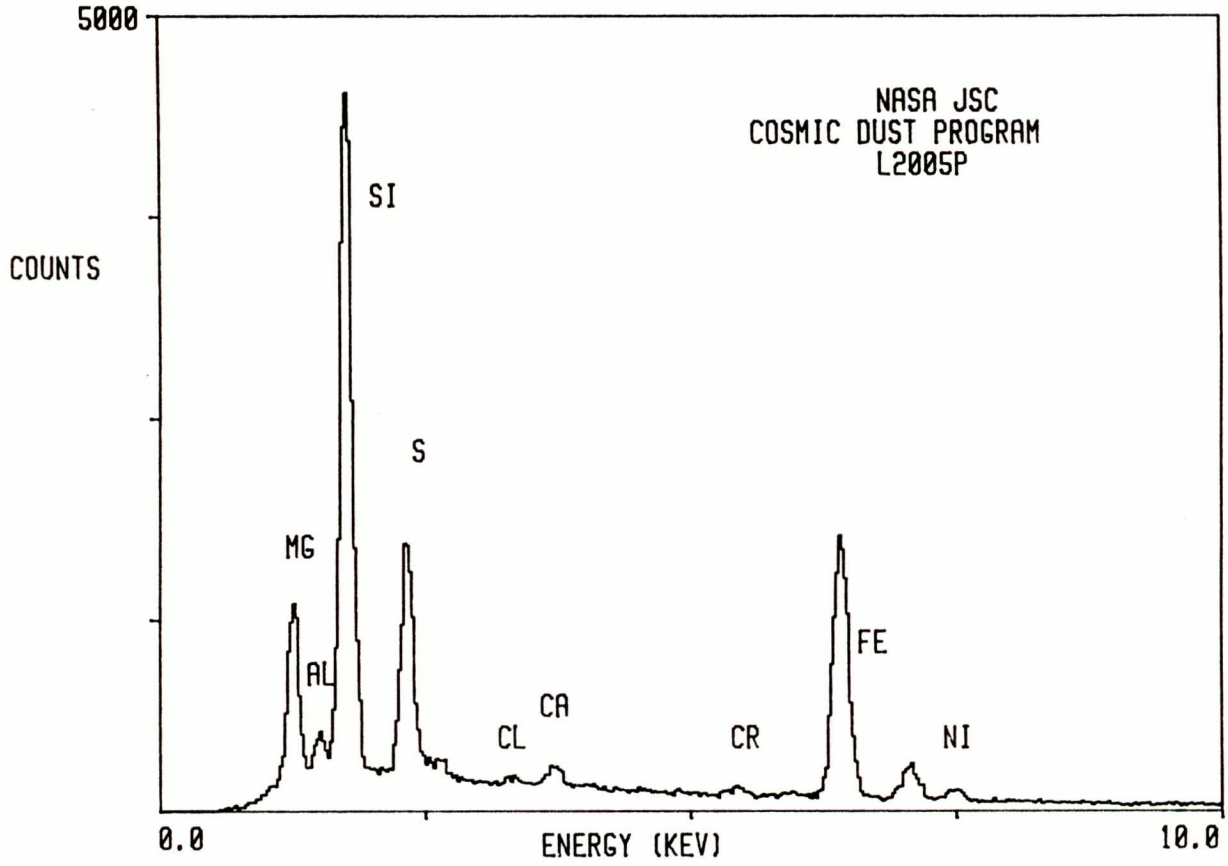
L2005 P 5



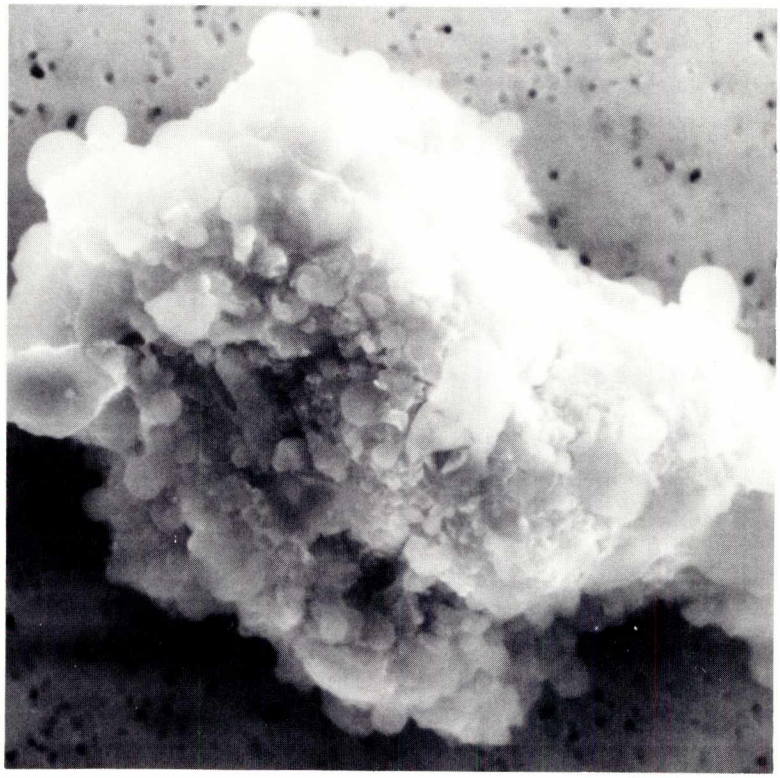
S-90-38254

SIZE: 22x25
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



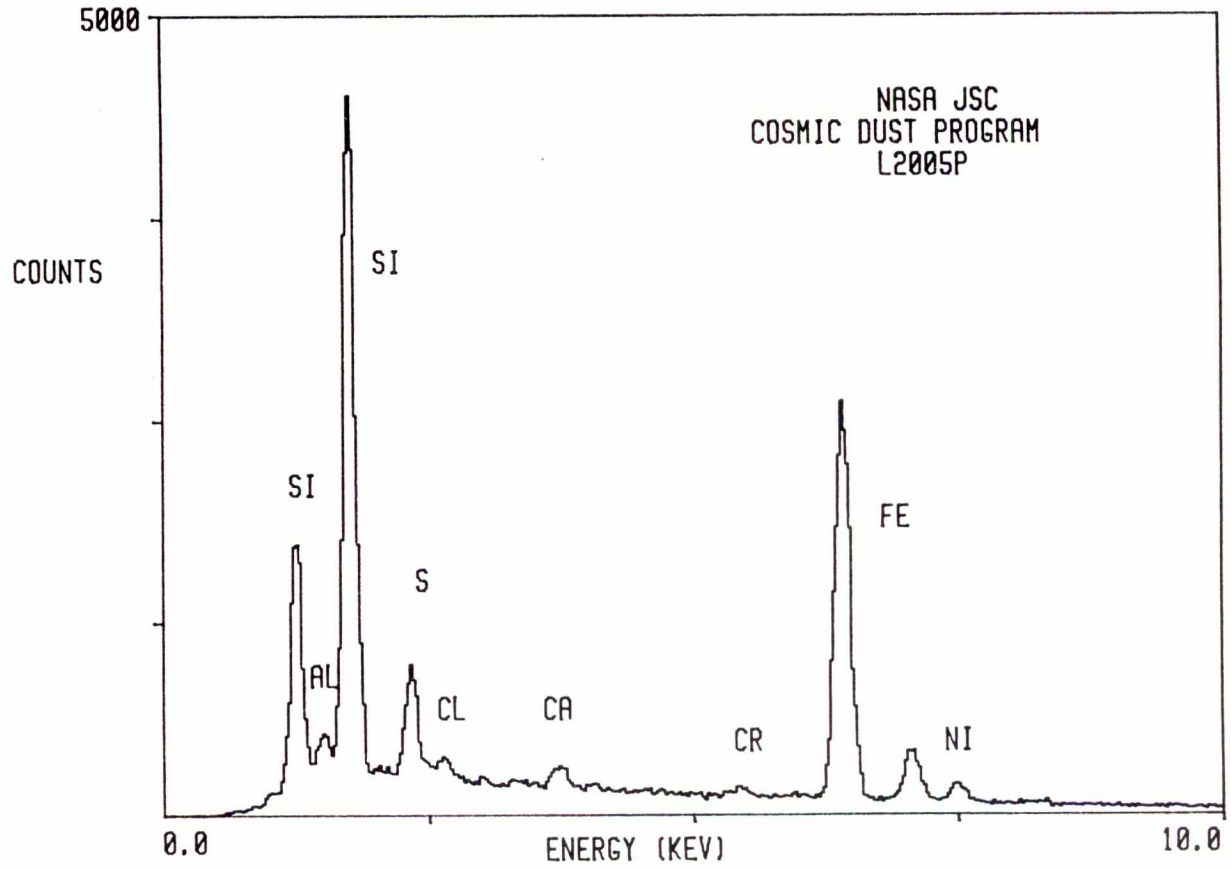
L2005 P 6



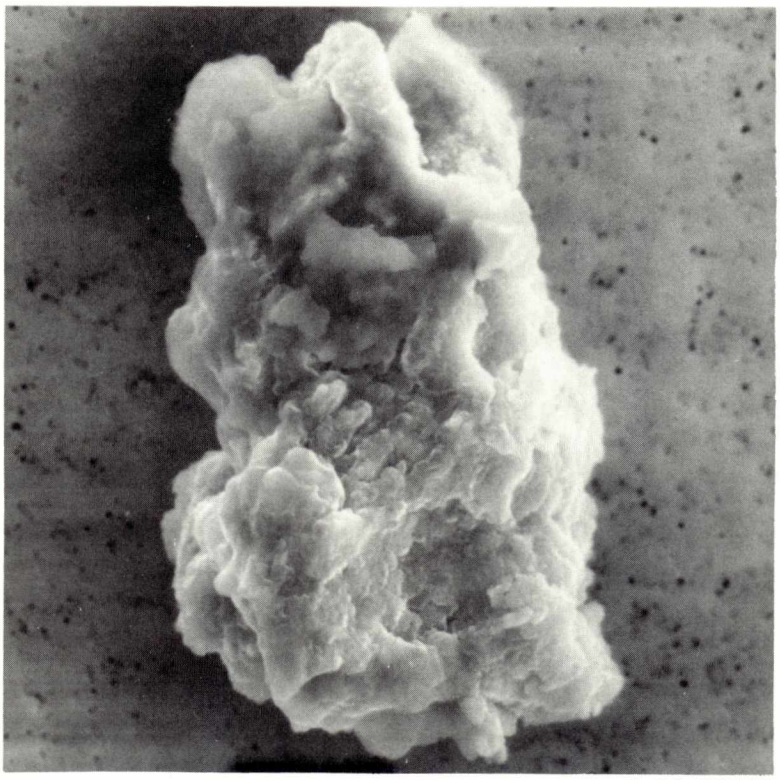
S-90-38255

SIZE: 17x26
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



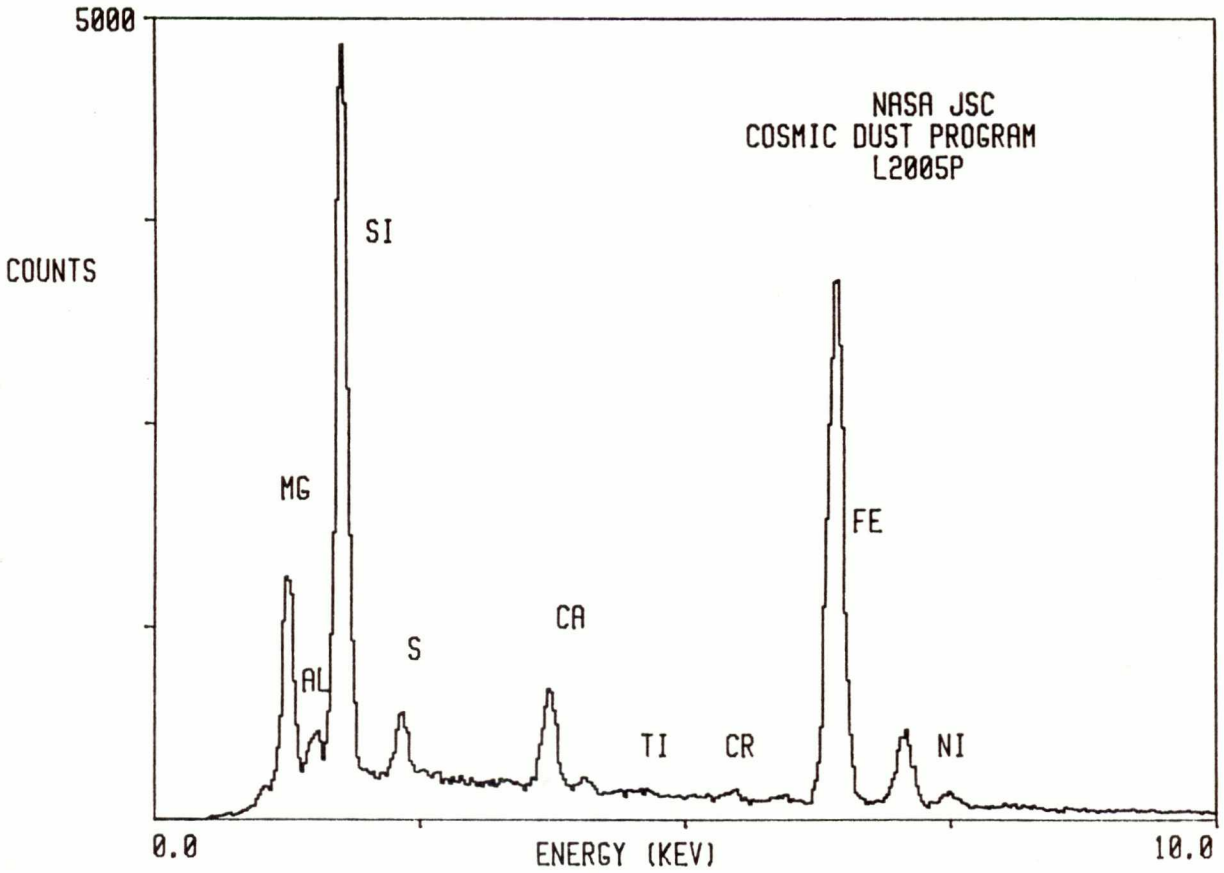
L2005 P 7



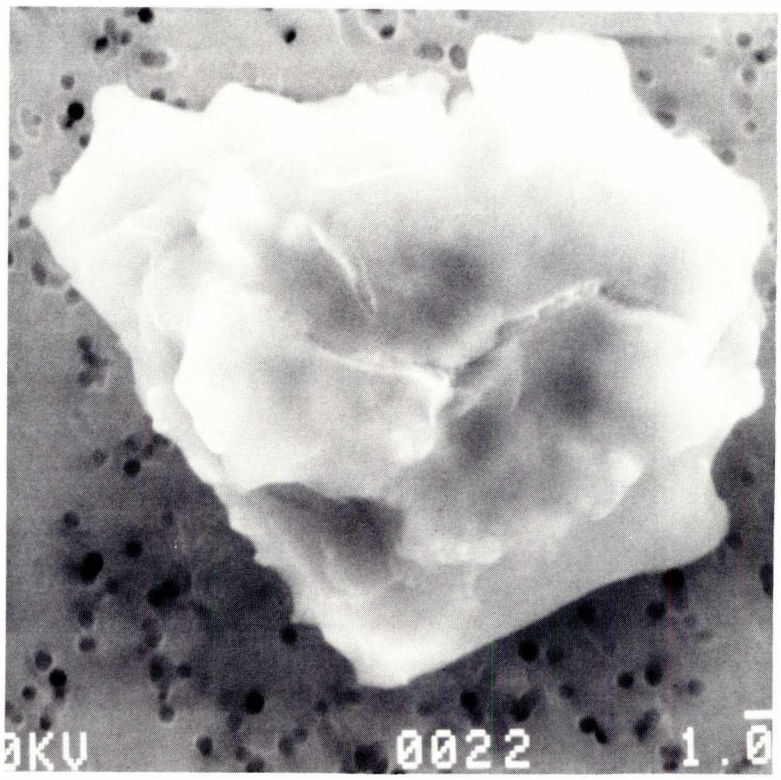
S-90-38256

SIZE: 20x30
SHAPE: I
TRANS.: O/TL
COLOR: Black
LUSTER: D/SM
TYPE: C?

COMMENTS:



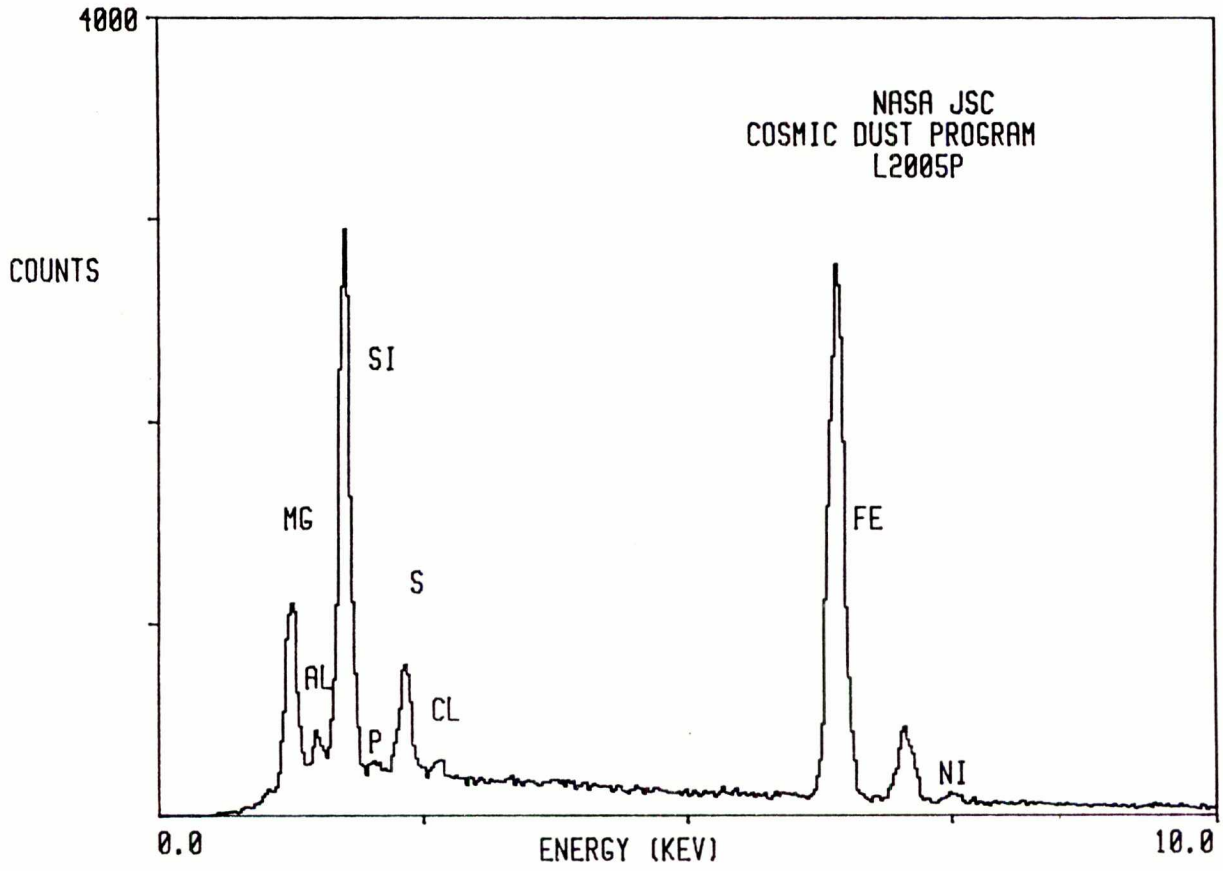
L2005 P 9



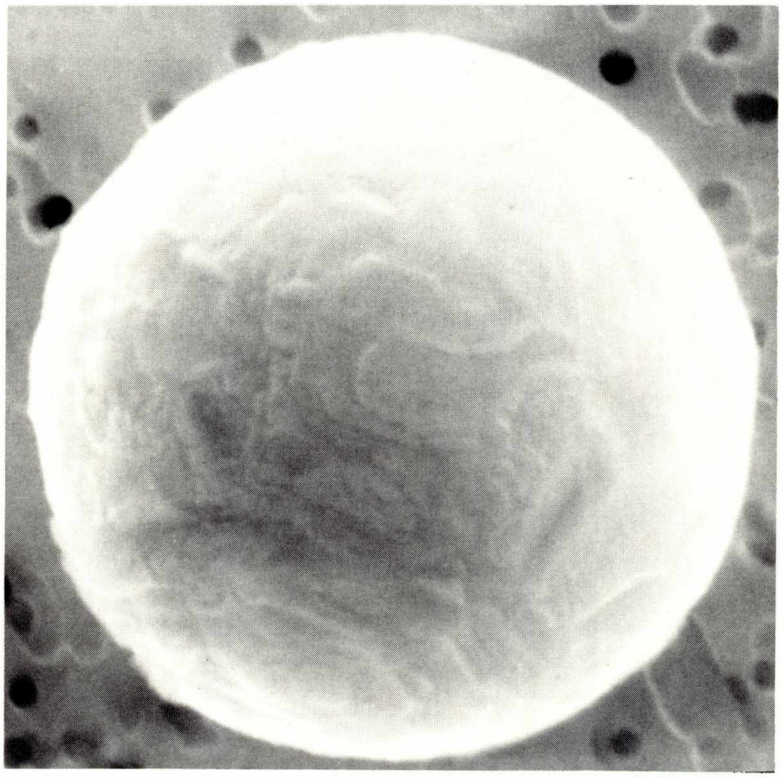
S-90-38258

SIZE: 11x14
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



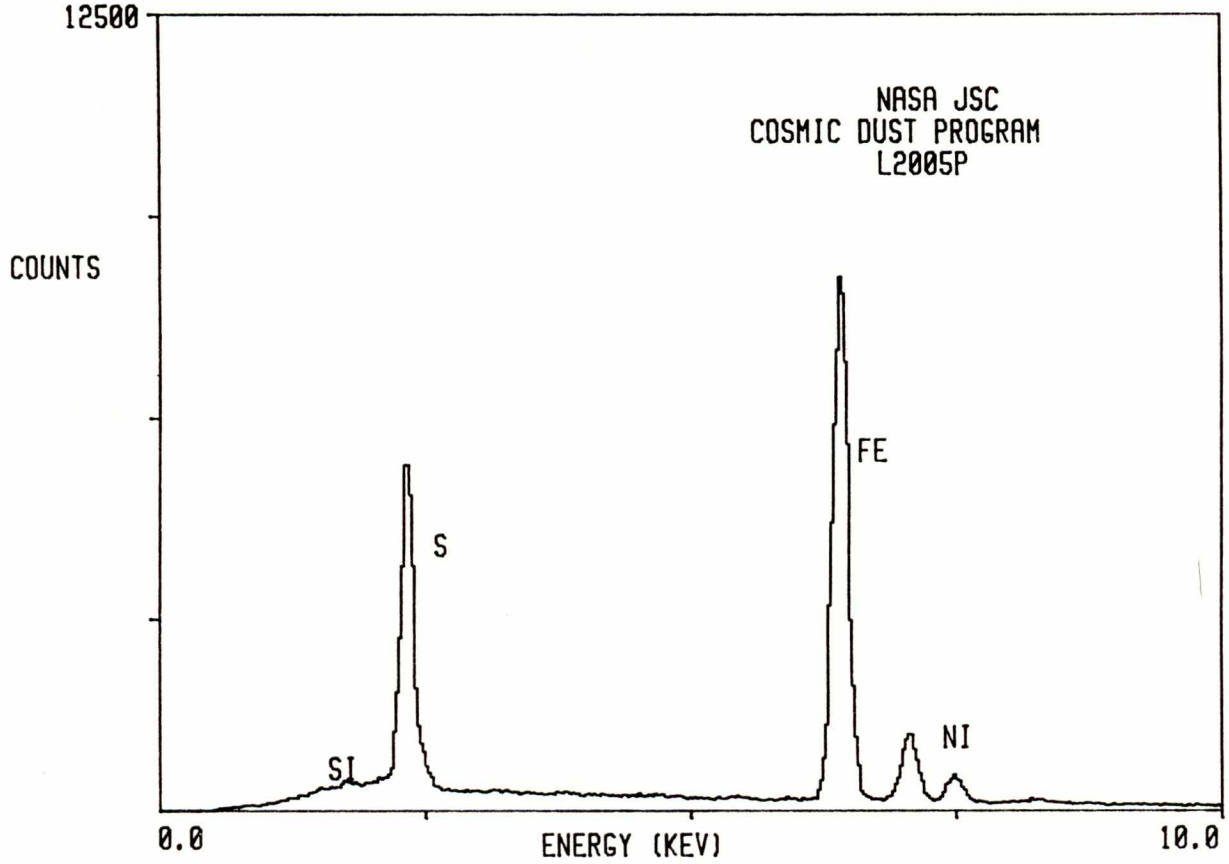
L2005 P 10



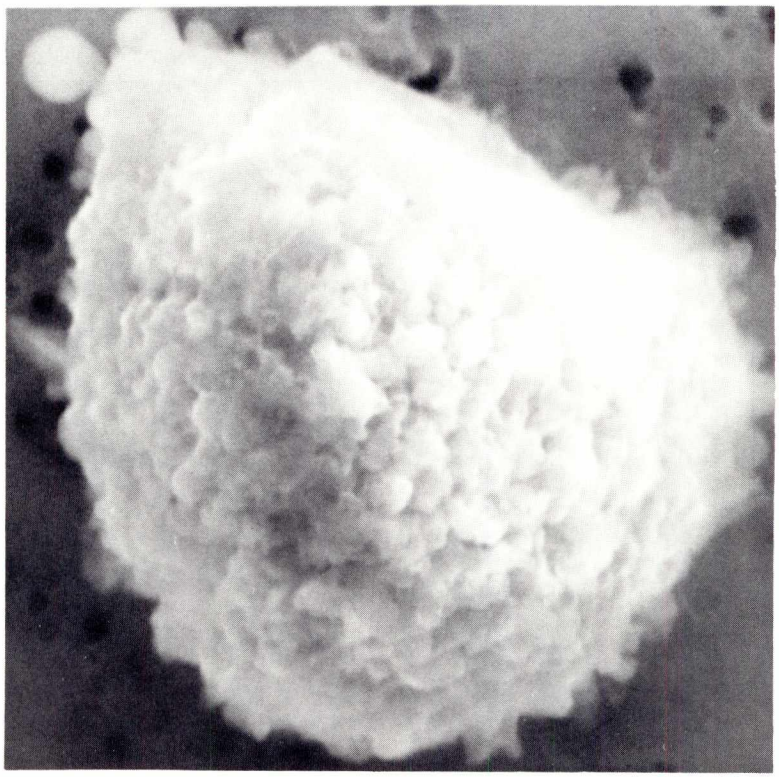
S-90-38259

SIZE: 7
SHAPE: S
TRANS.: O
COLOR: Black to Brown
LUSTER: D/SM
TYPE: C?

COMMENTS:



L2005 P 12



S-90-38261

SIZE: 10x11

SHAPE: I

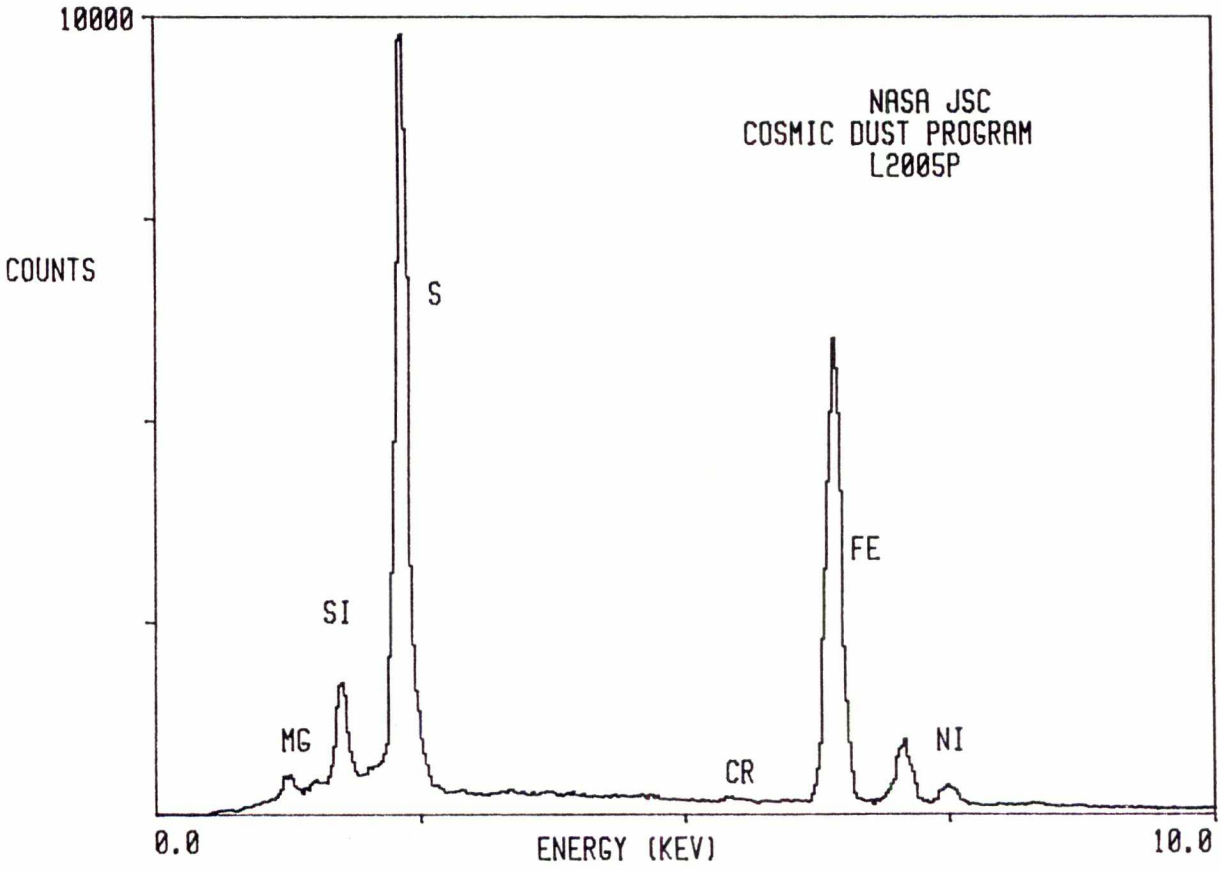
TRANS.: O/TL

COLOR: Black to Brown

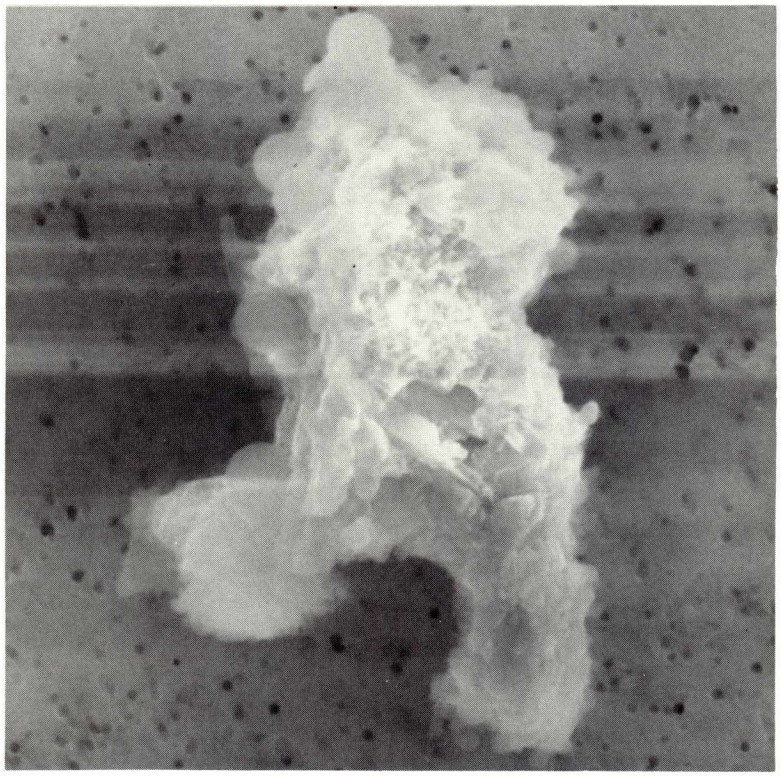
LUSTER: D/V

TYPE: C?

COMMENTS:



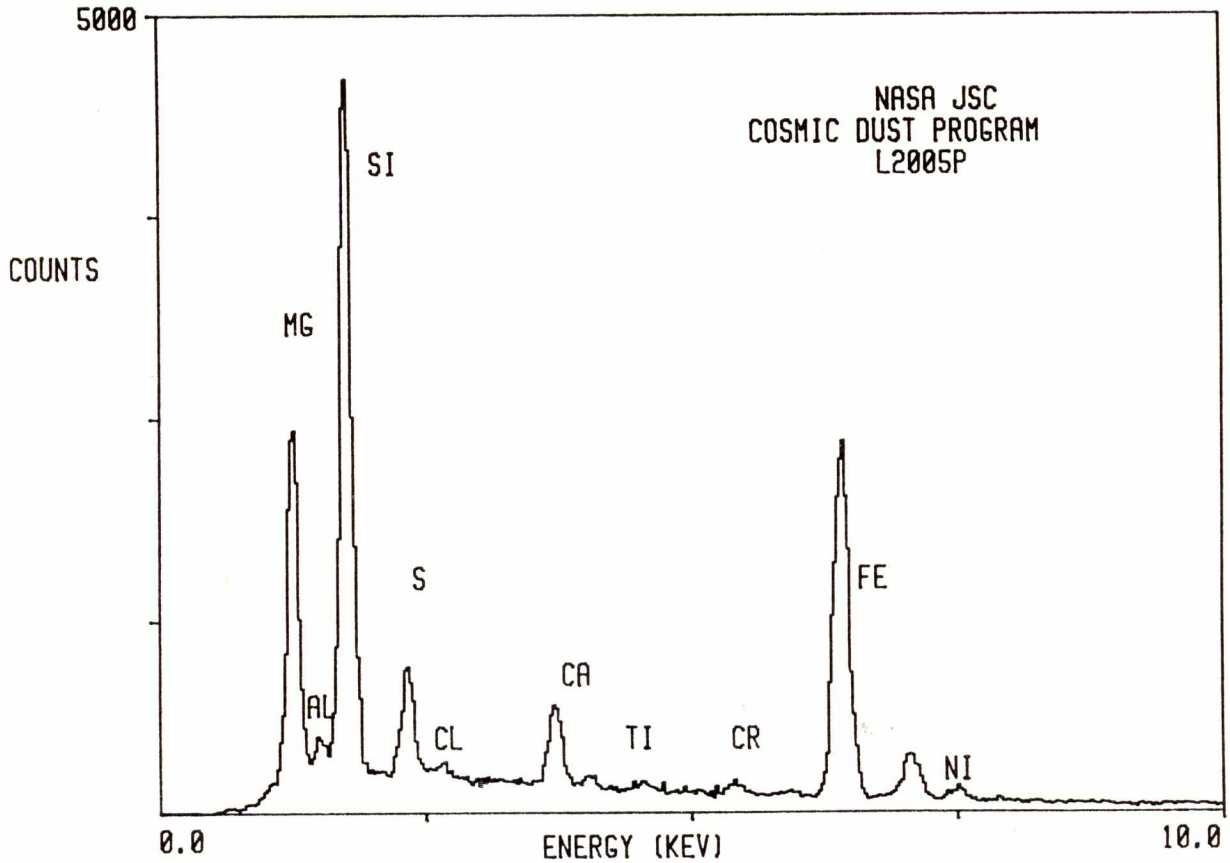
L2005 P 13



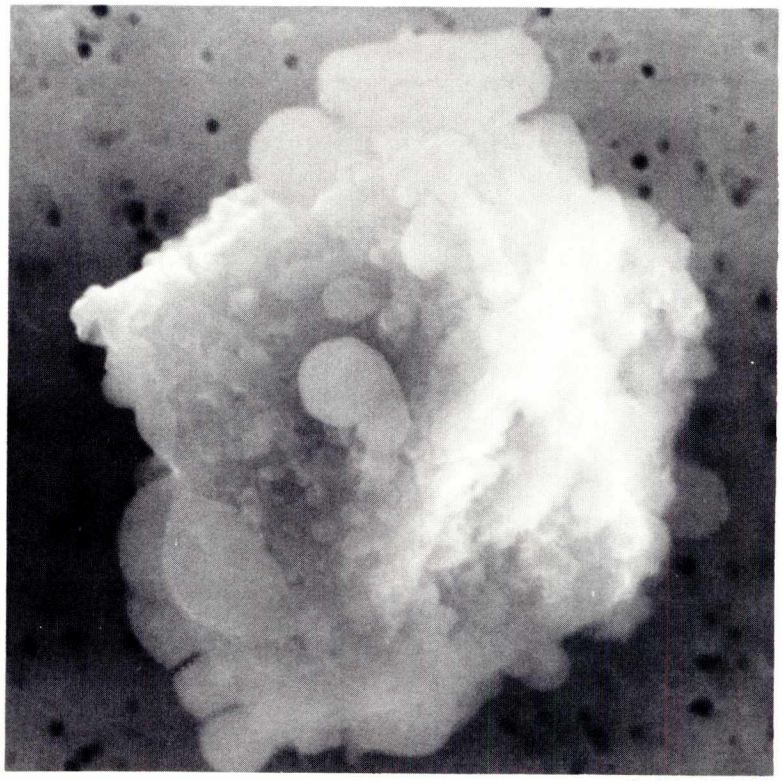
S-90-38262

SIZE: 14x20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



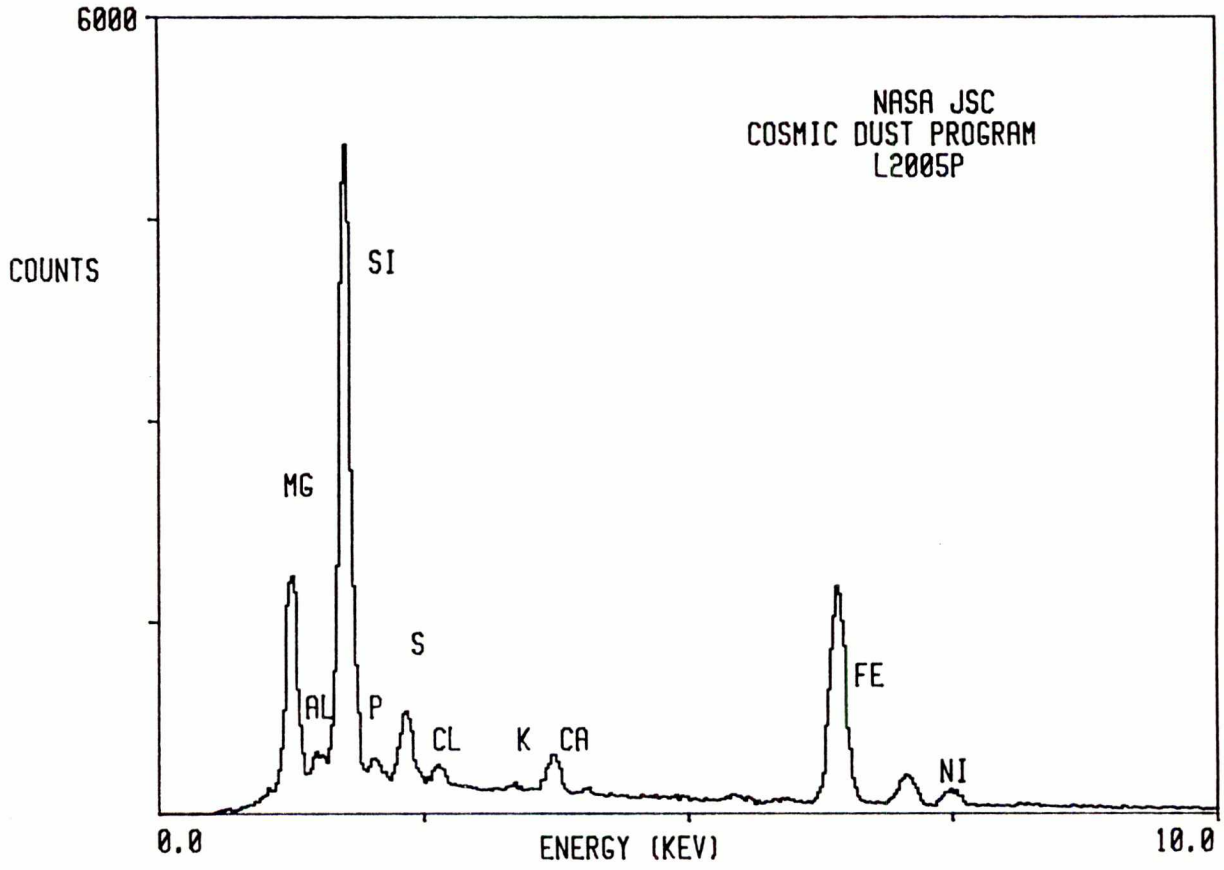
L2005 P 16



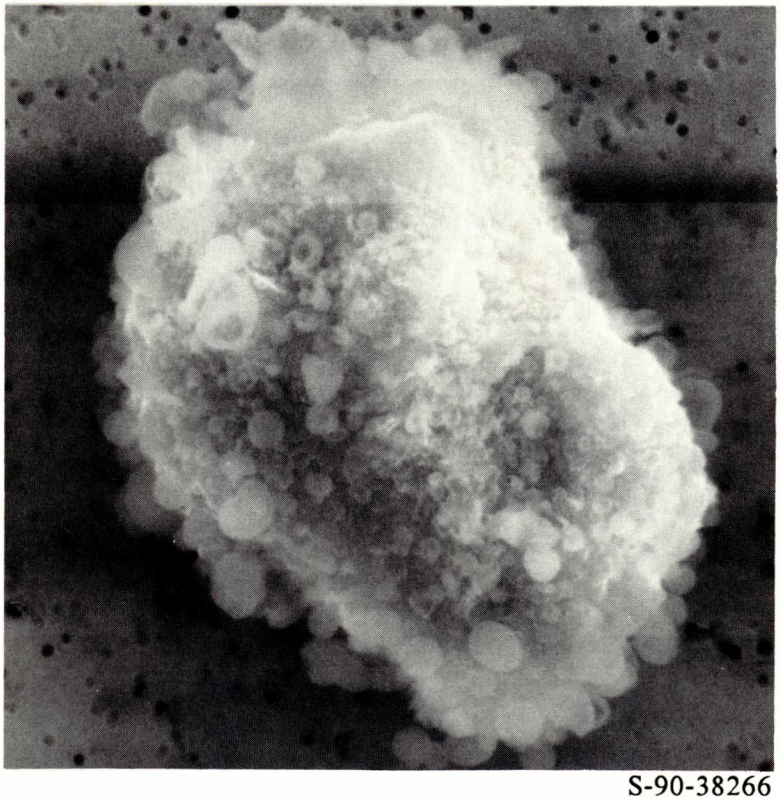
S-90-38265

SIZE: 14x16
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



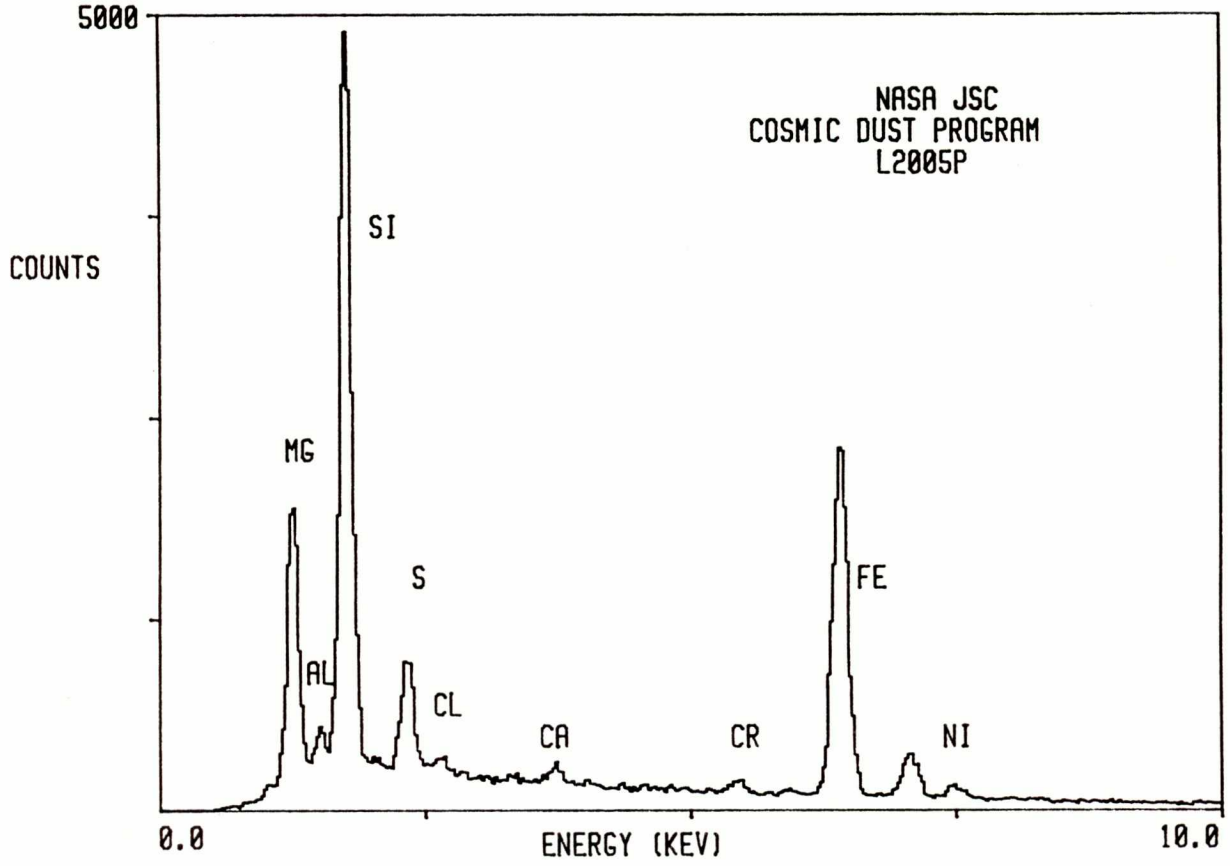
L2005 P 17



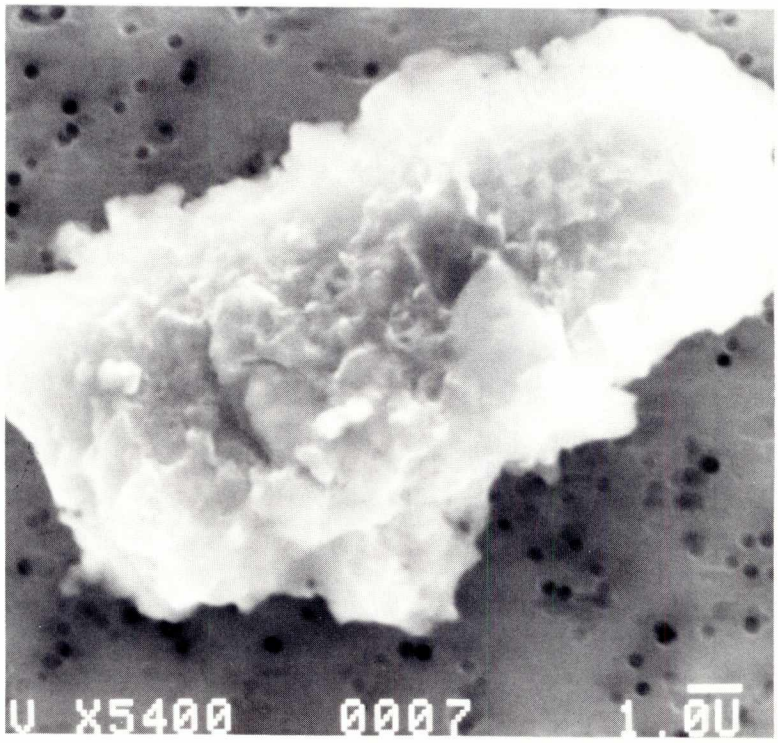
S-90-38266

SIZE: 15x22
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



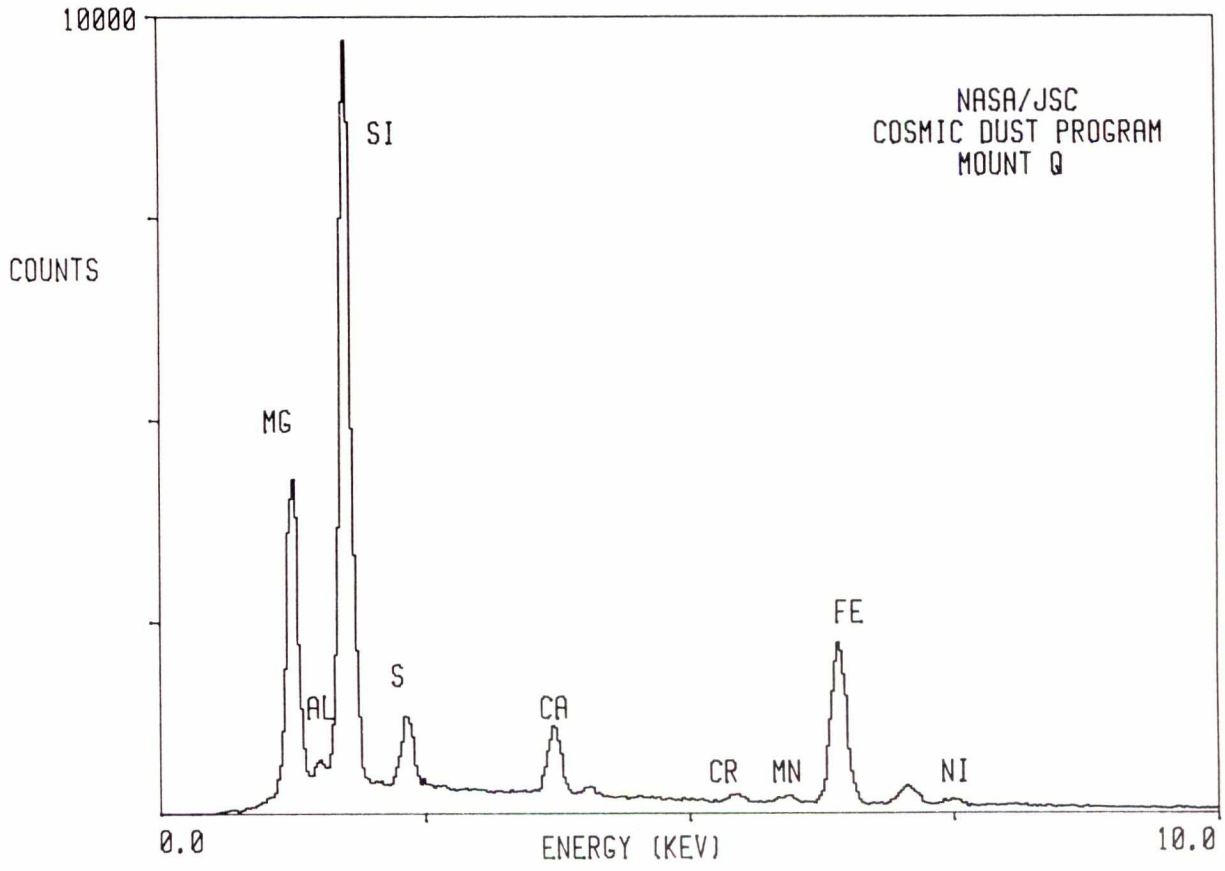
L2005 Q 1



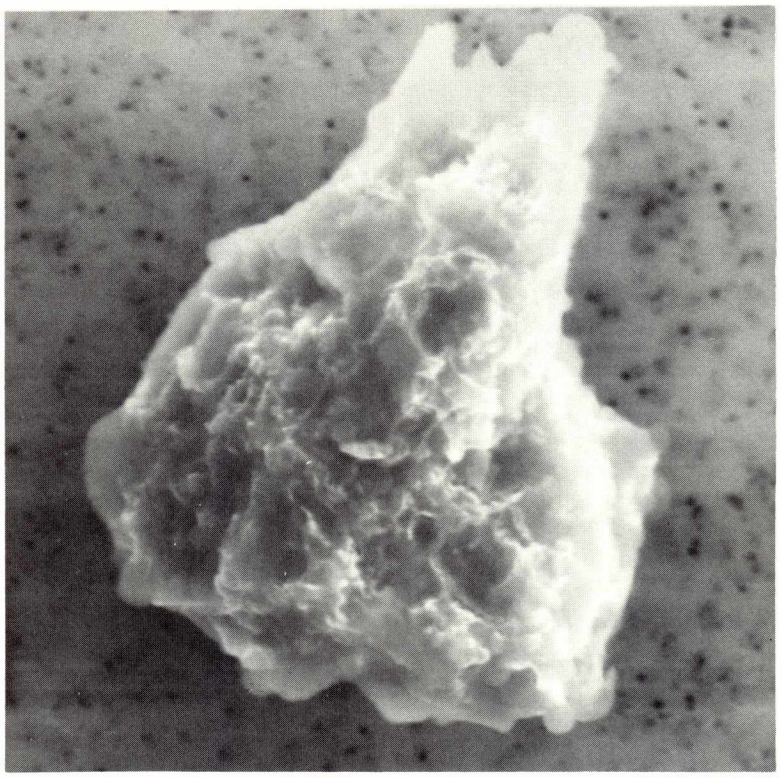
SIZE: 10x15
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

S-90-38267

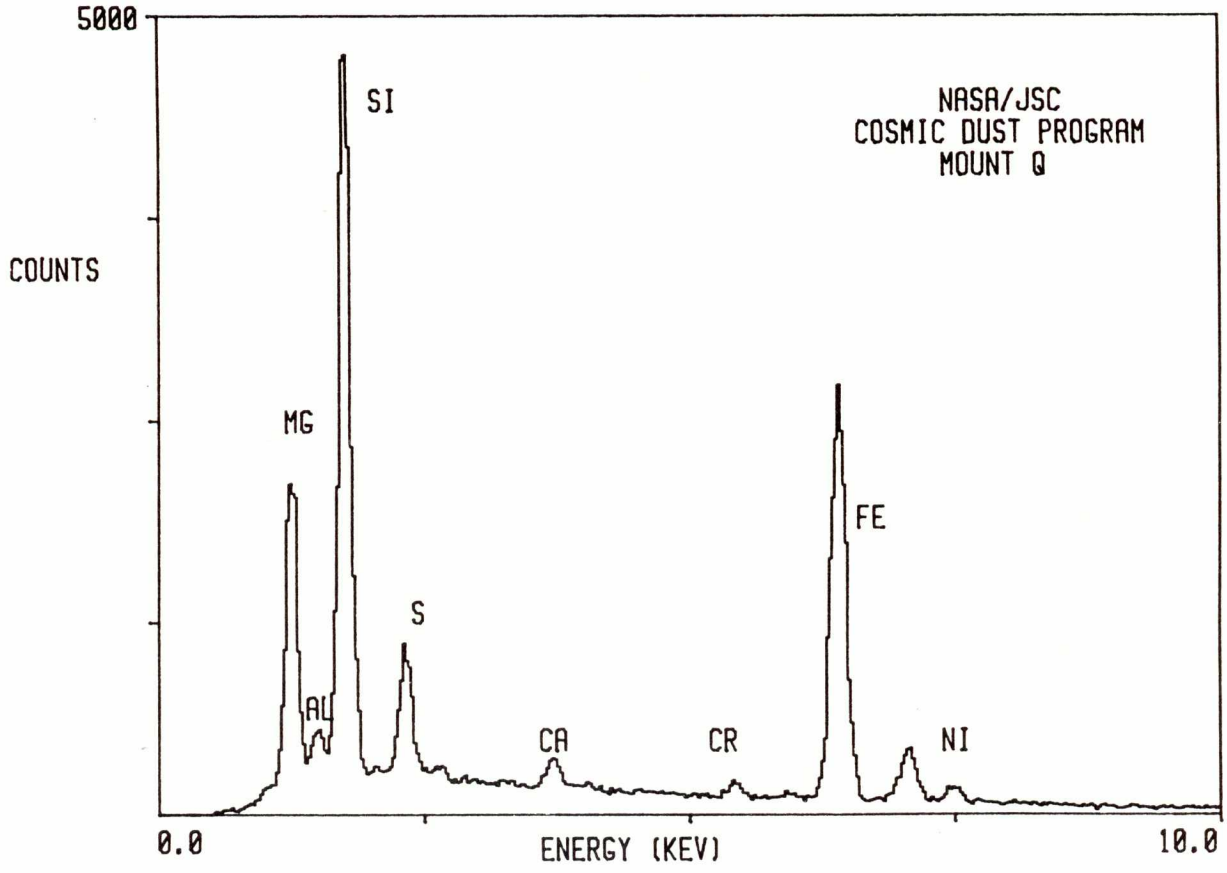


L2005 Q 2

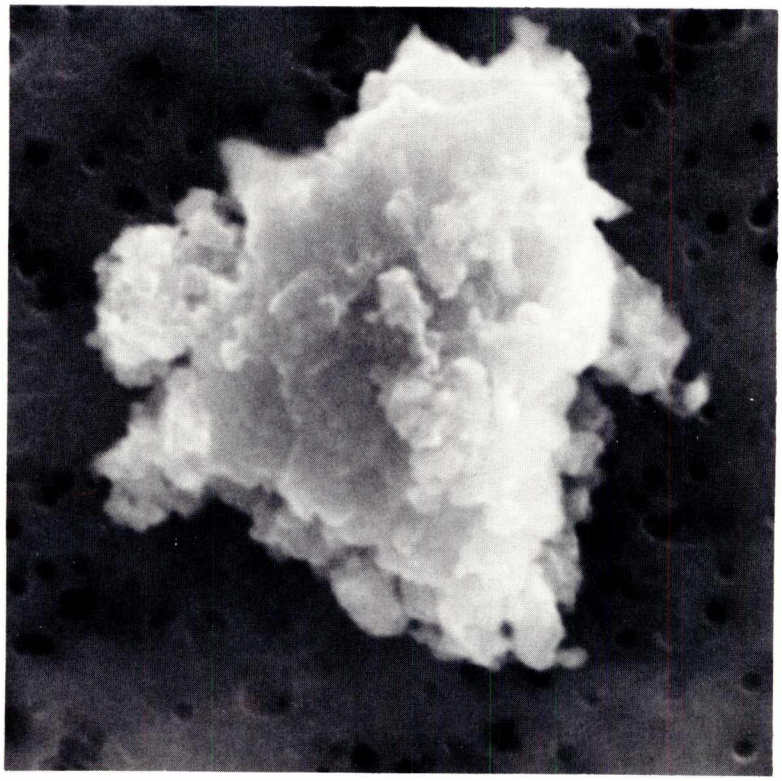


S-90-38268

SIZE: 20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C
COMMENTS:



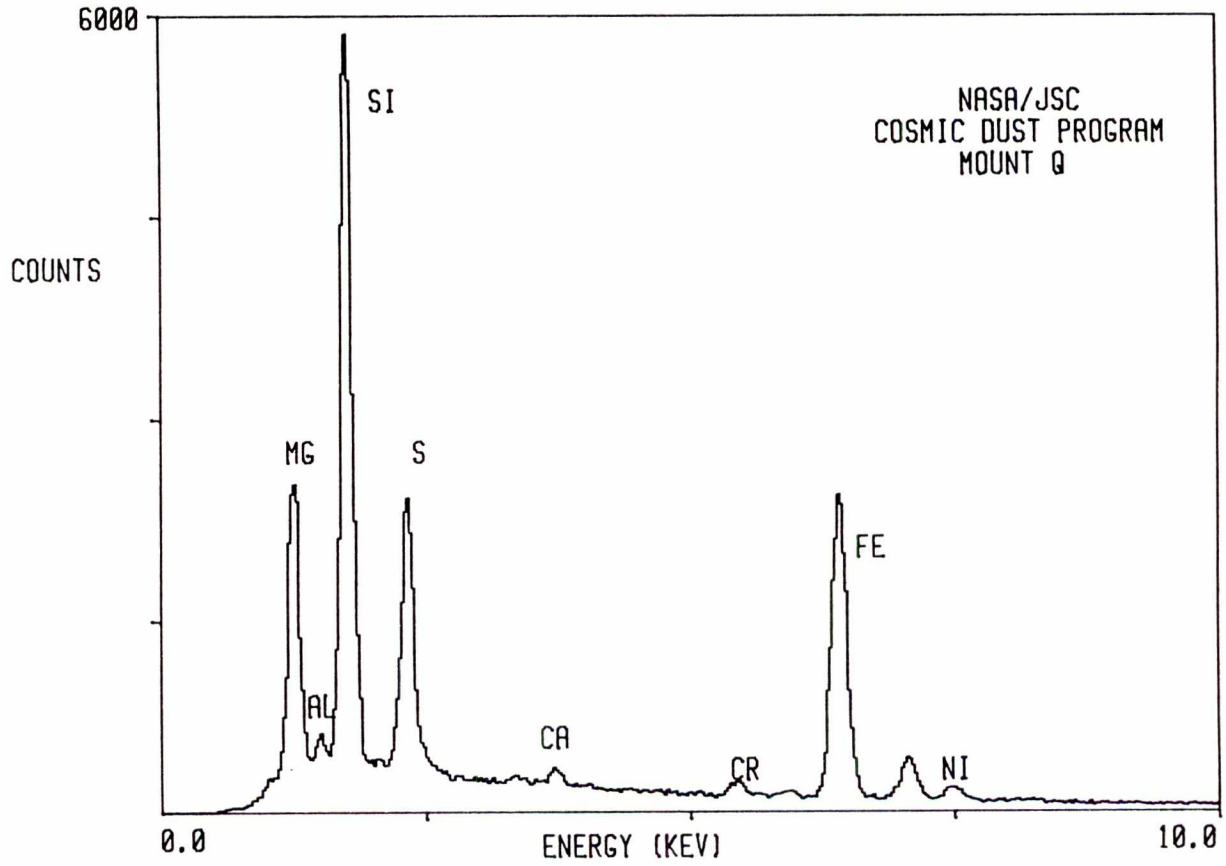
L2005 Q 4



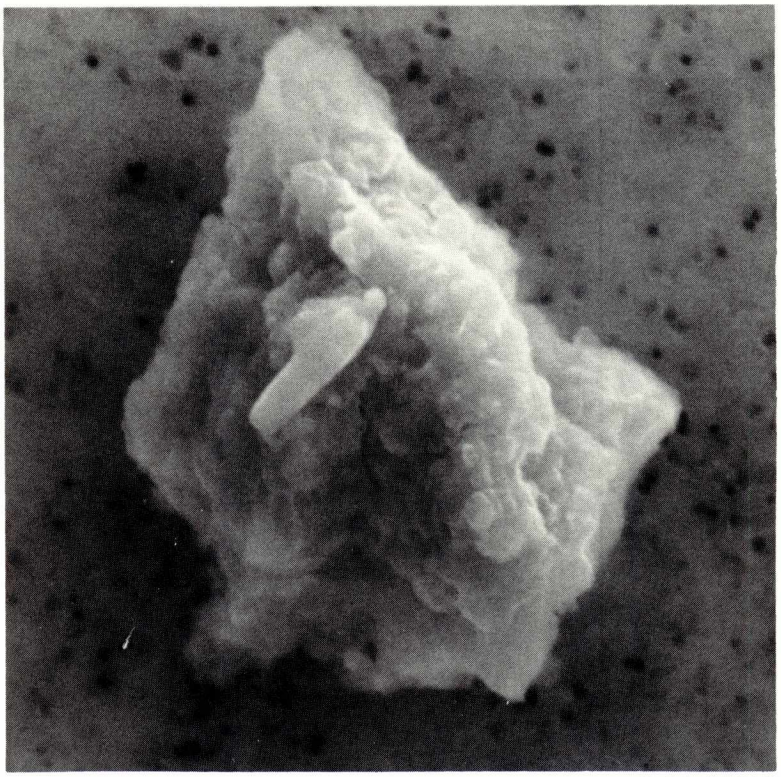
S-90-38270

SIZE: 7x8
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



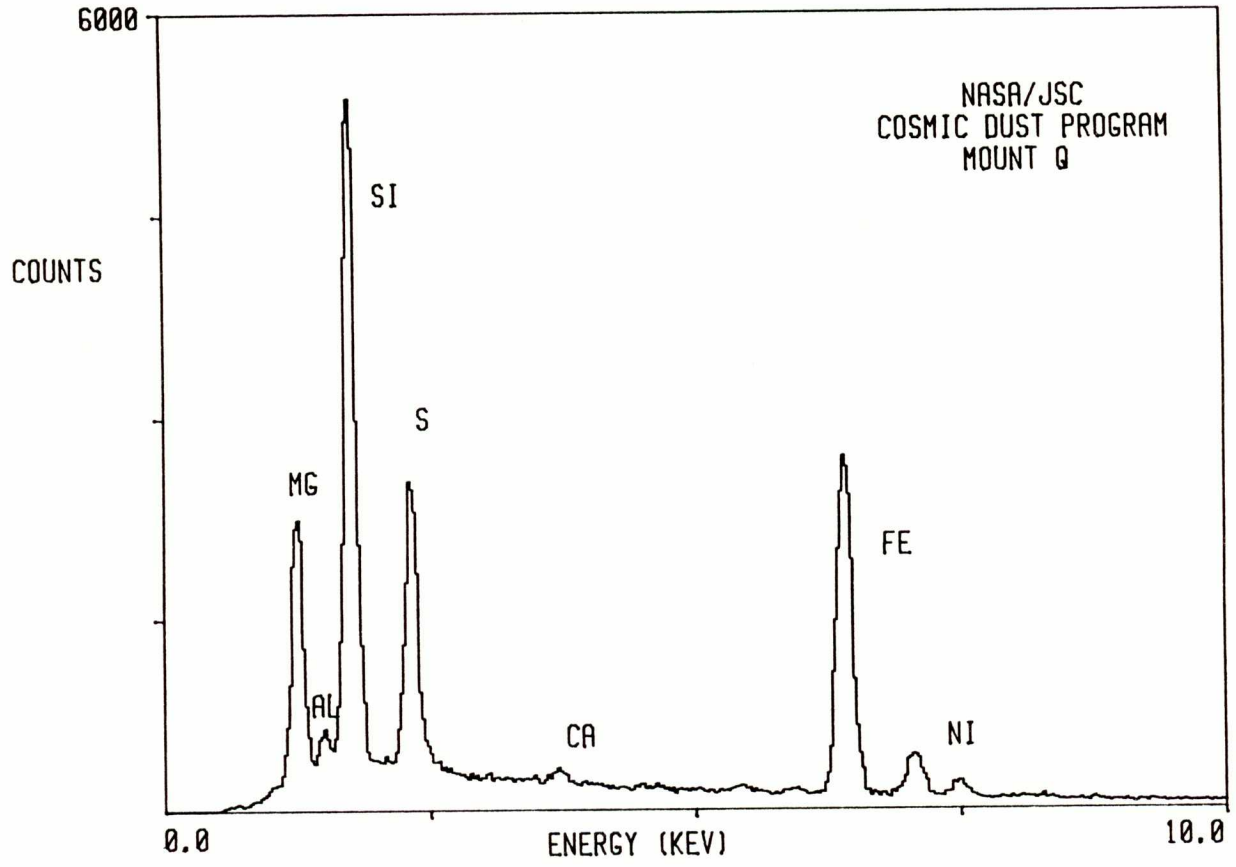
L2005 Q 6



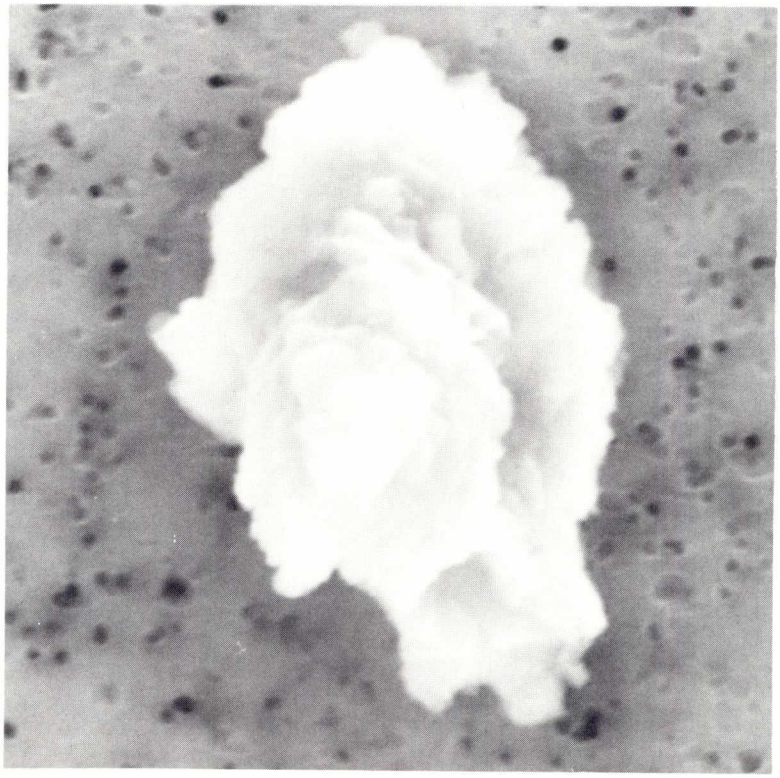
S-90-38272

SIZE: 15x20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



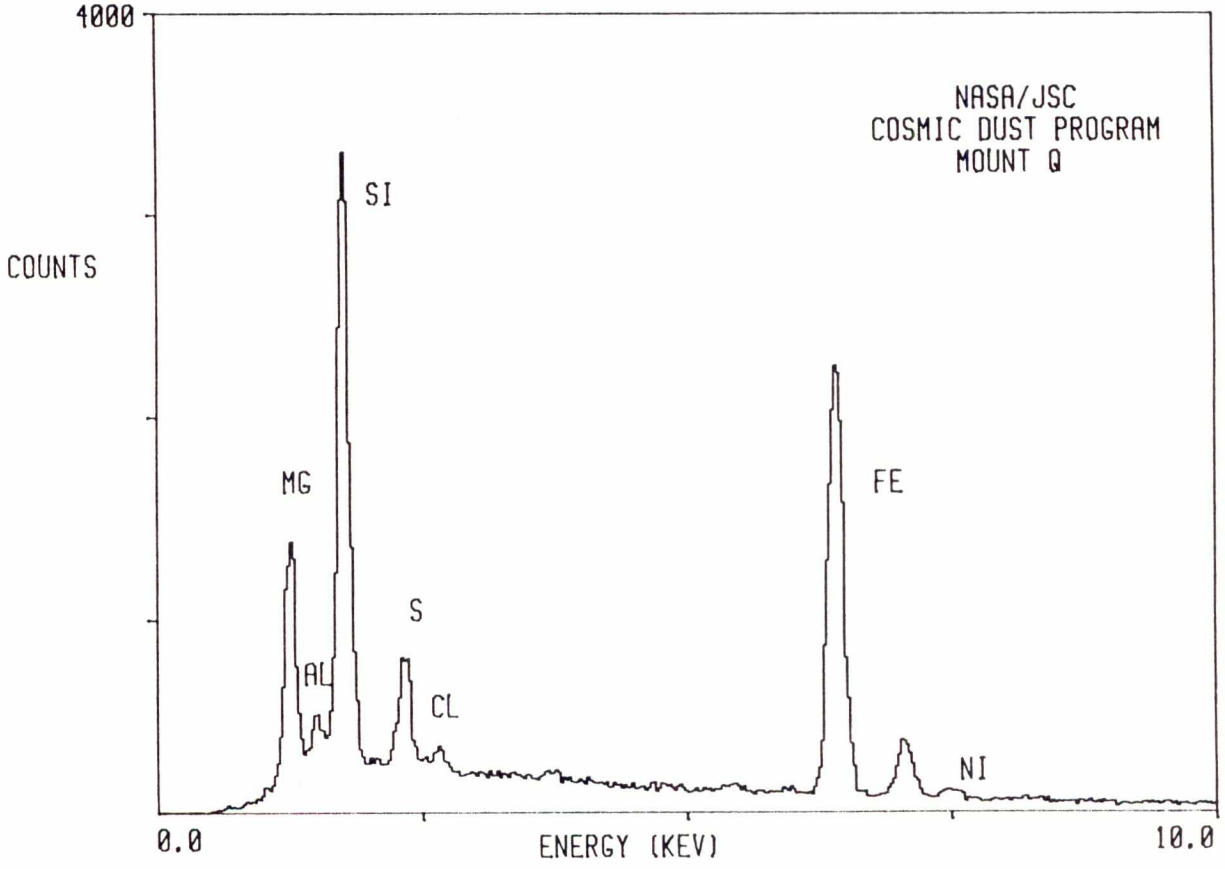
L2005 Q 7



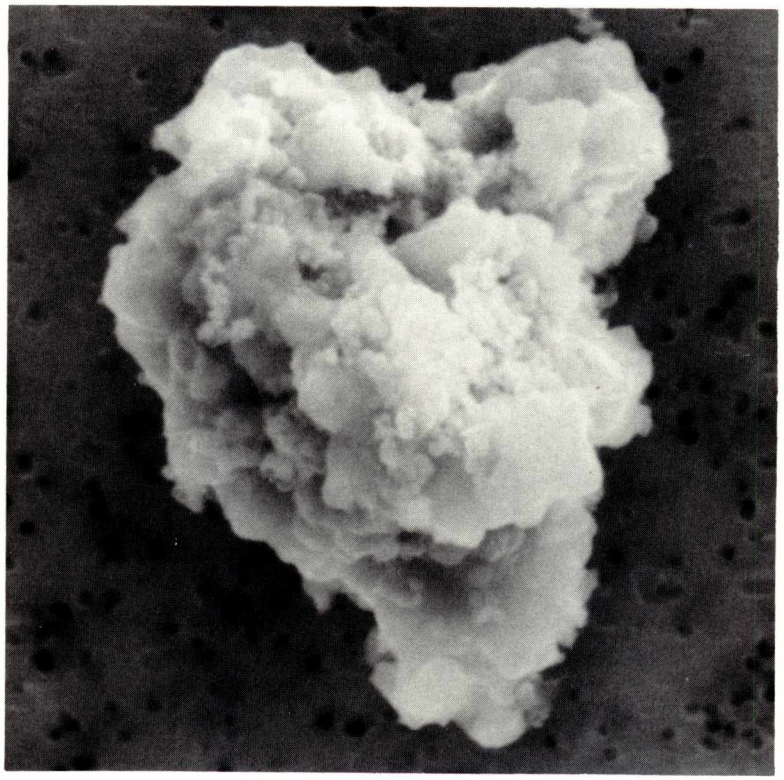
S-90-38273

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

COMMENTS:



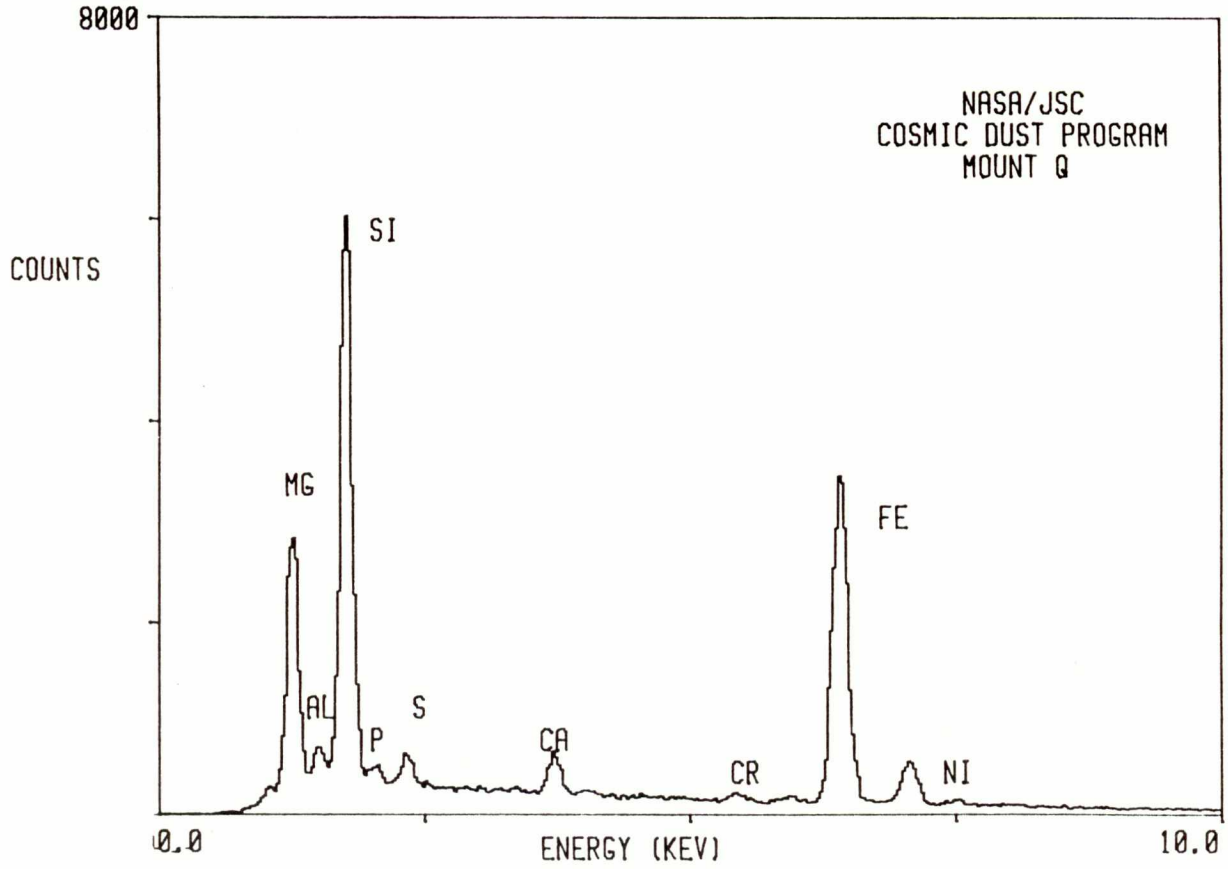
L2005 Q 8



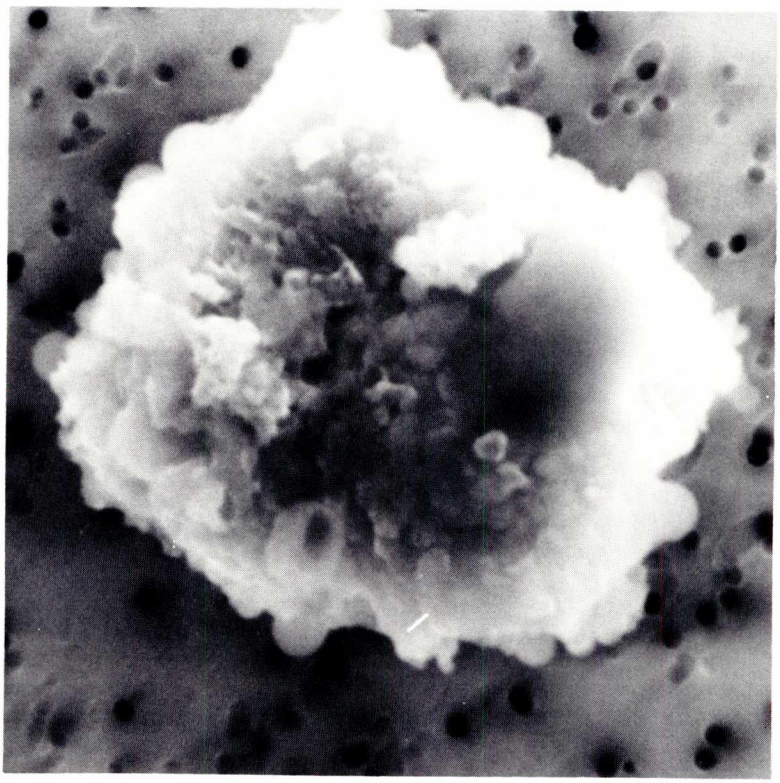
S-90-38274

SIZE: 12
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



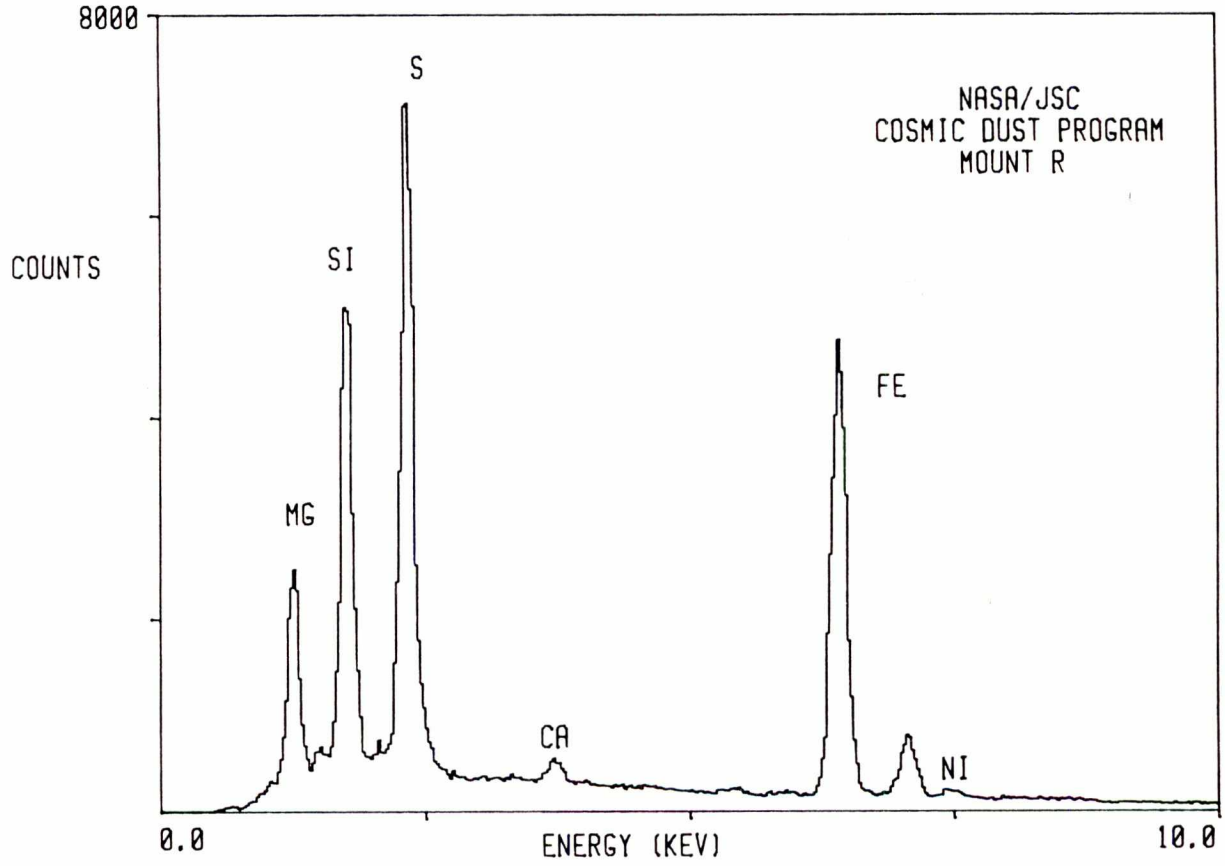
L2005 R 1



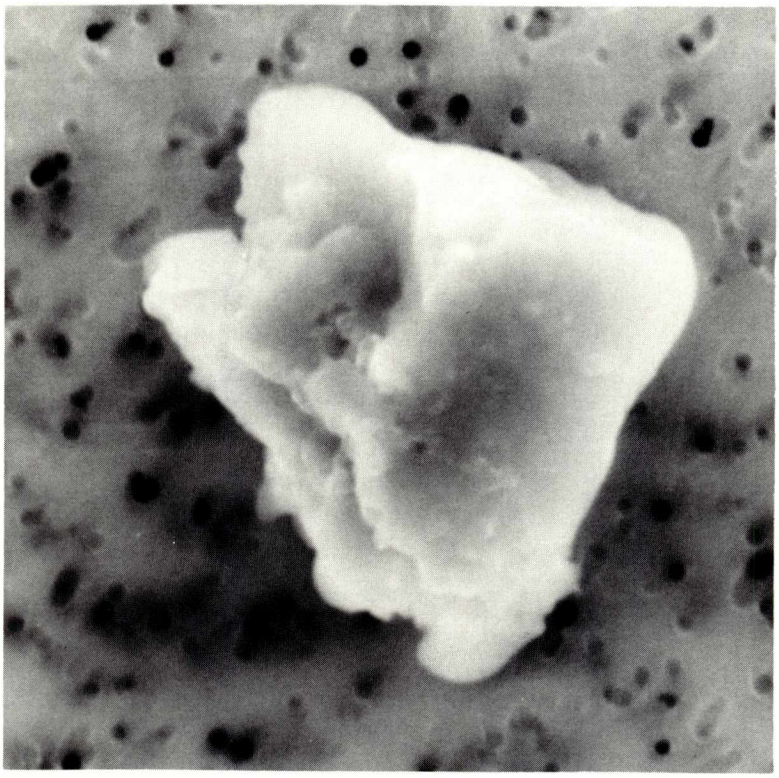
S-90-38275

SIZE: 15
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



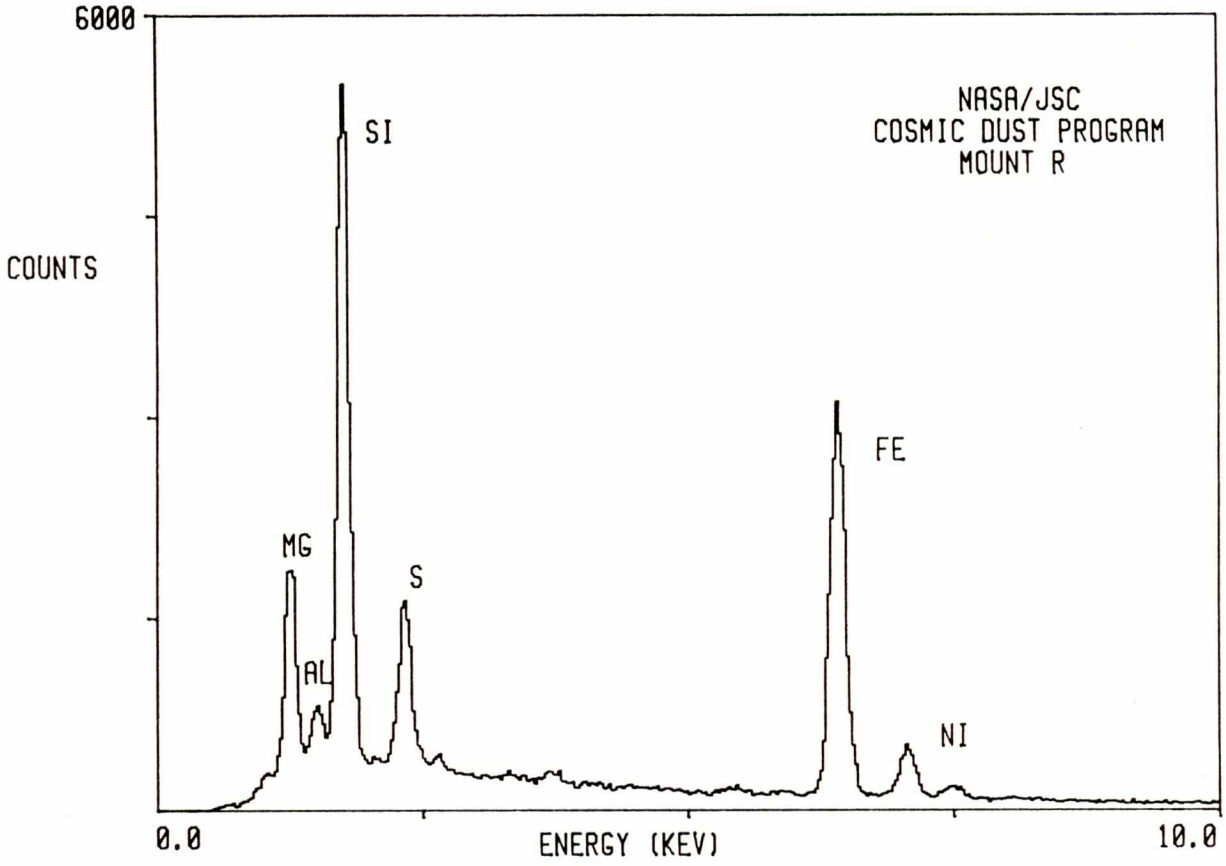
L2005 R 3



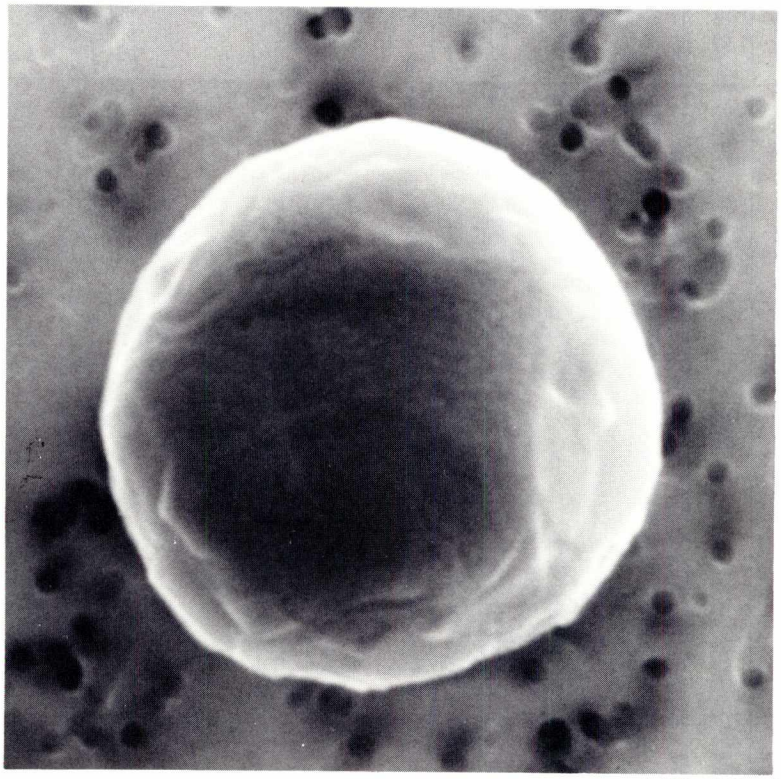
S-90-38277

SIZE: 6
SHAPE: E
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:



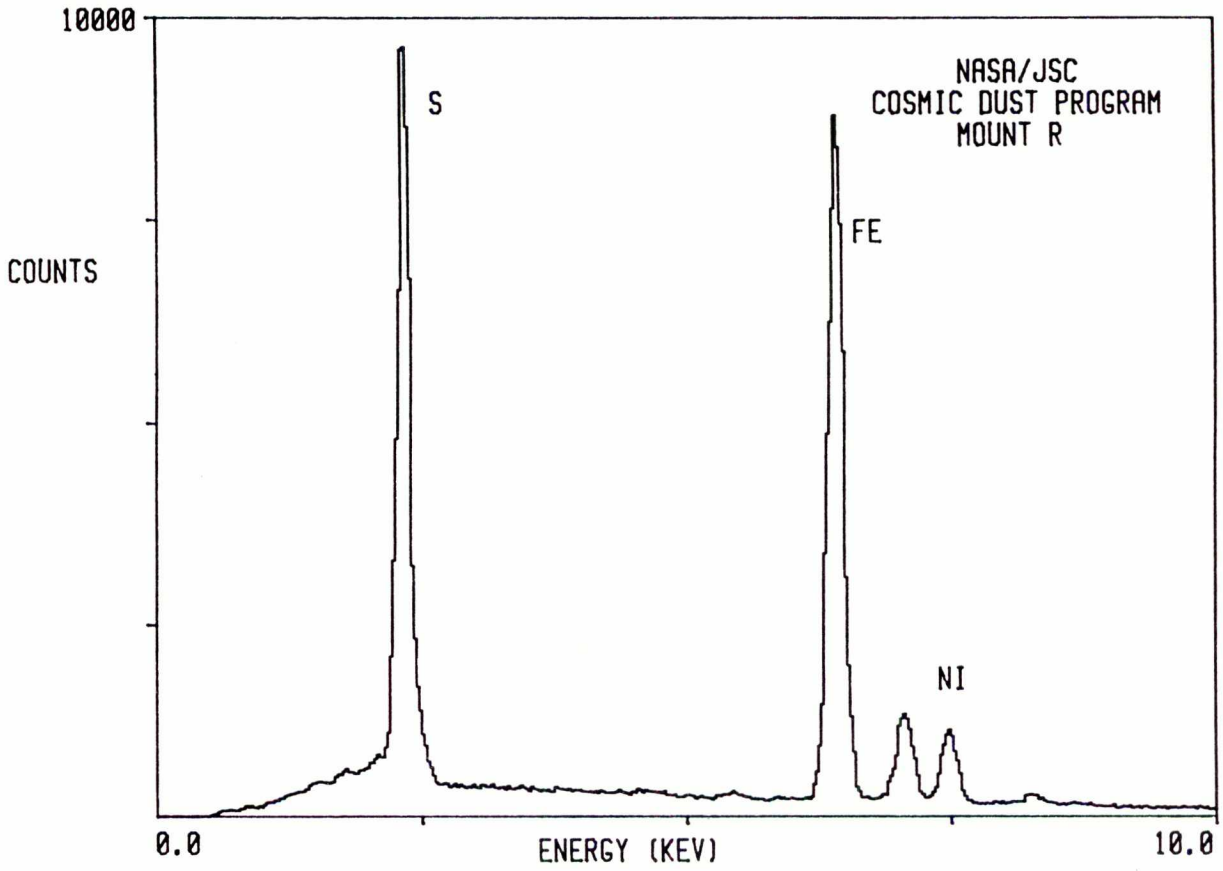
L2005 R 4



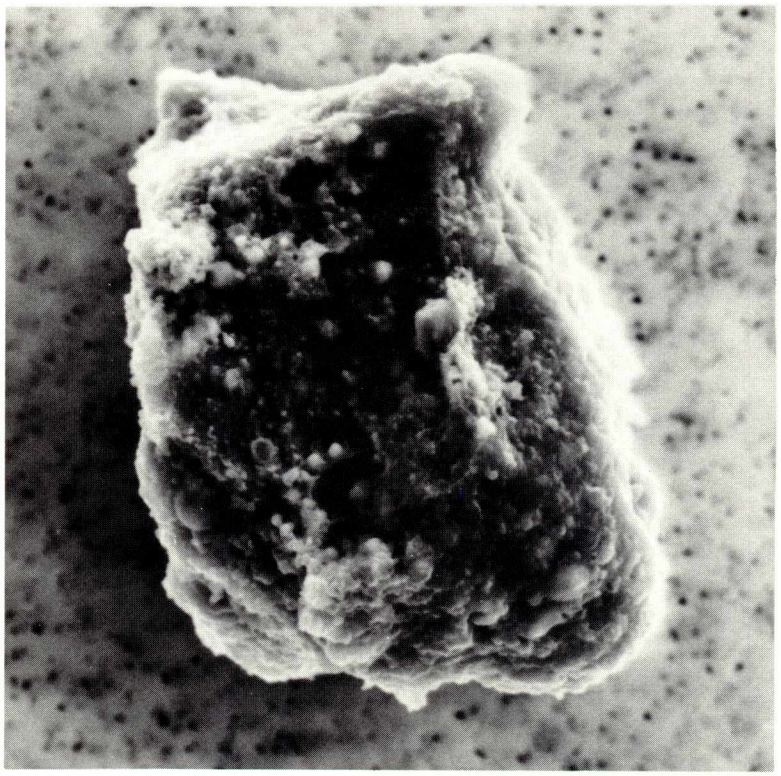
S-90-38278

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

COMMENTS:



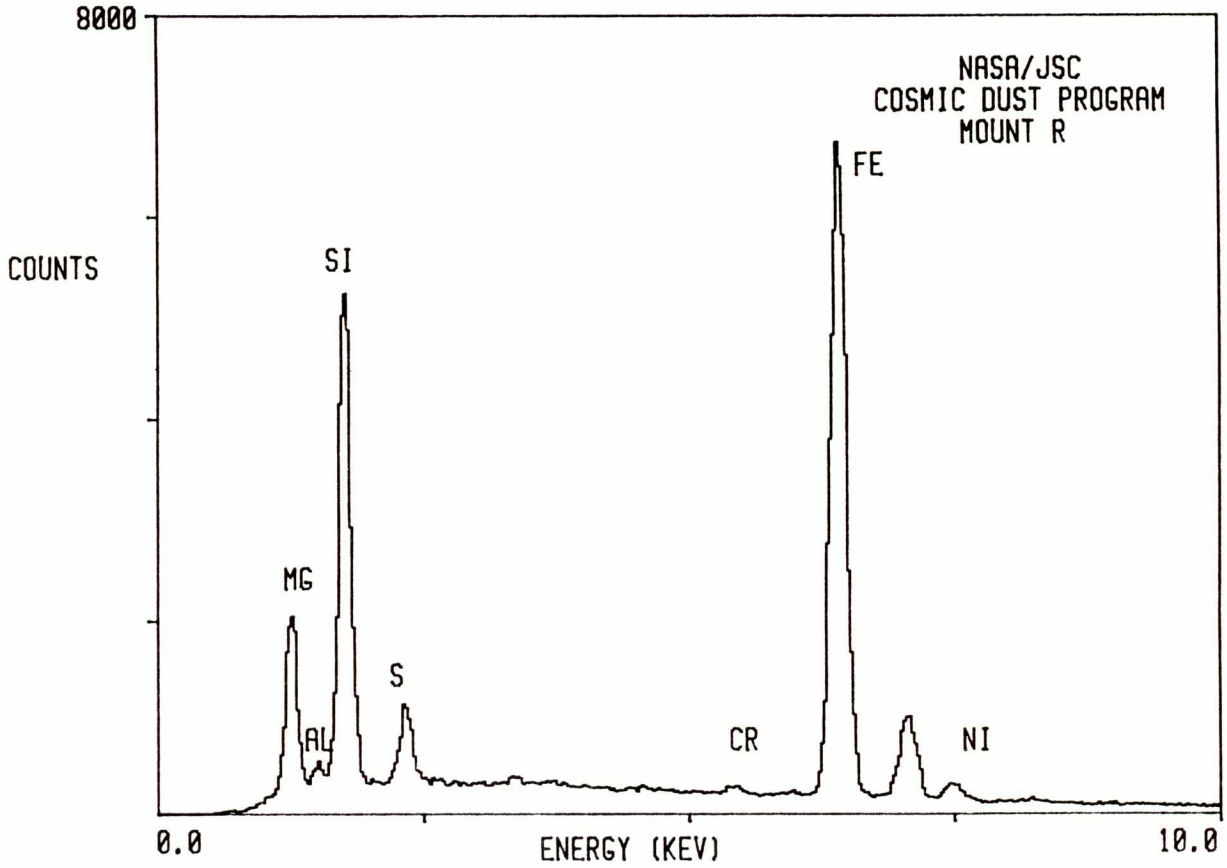
L2005 R 5



S-90-38279

SIZE: 20x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: C

COMMENTS:

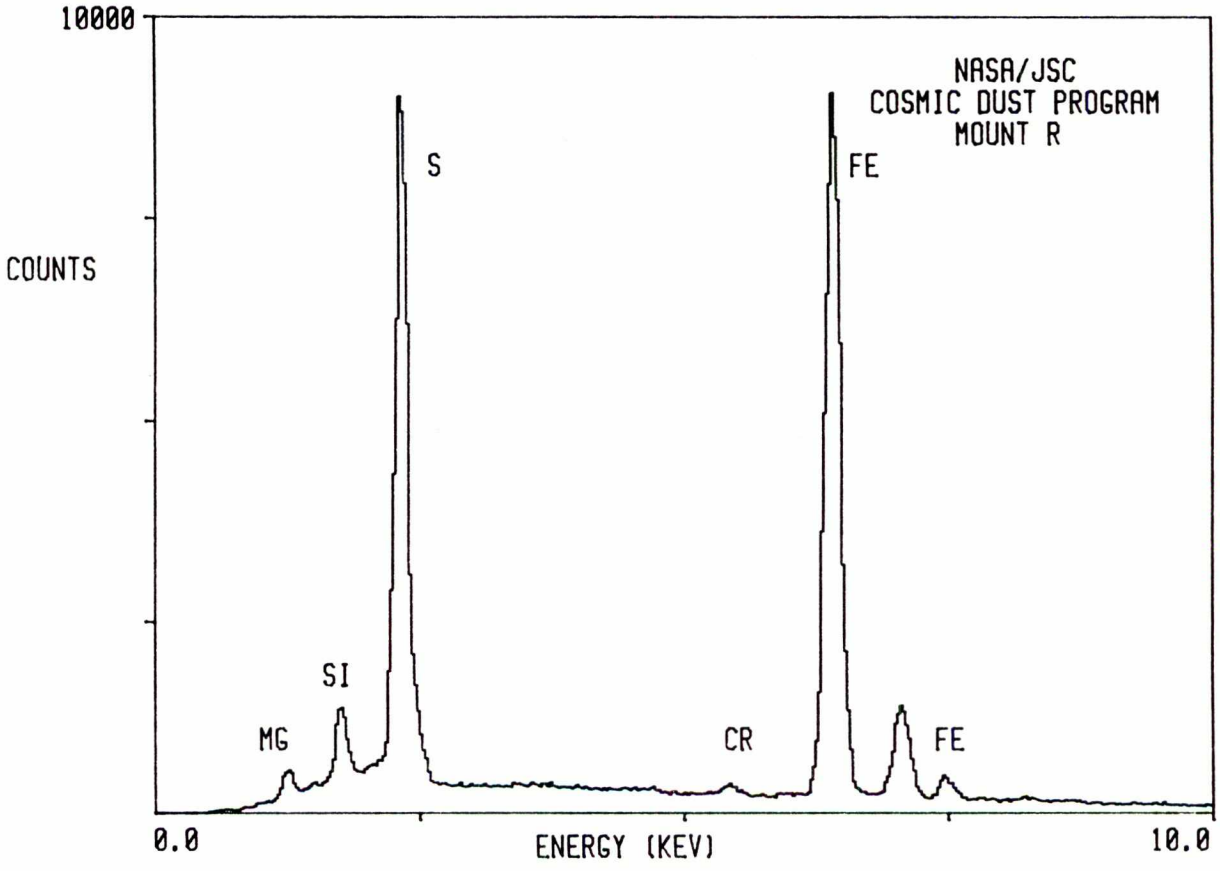


L2005 R 6

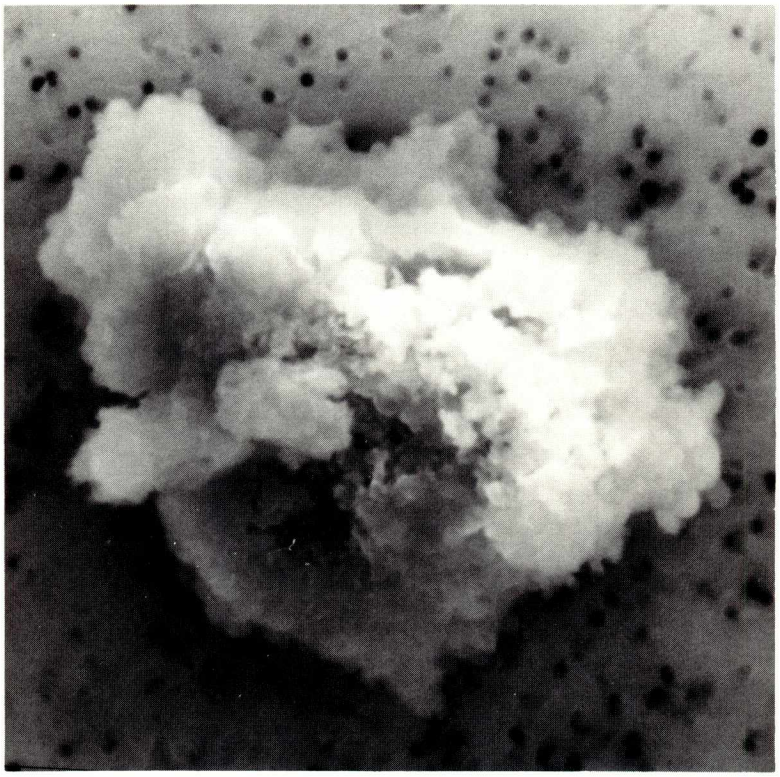
S-90-38280

SIZE: 15x25
SHAPE: I
TRANS.: O
COLOR: Black to Brown
LUSTER: SM
TYPE: C?

COMMENTS:



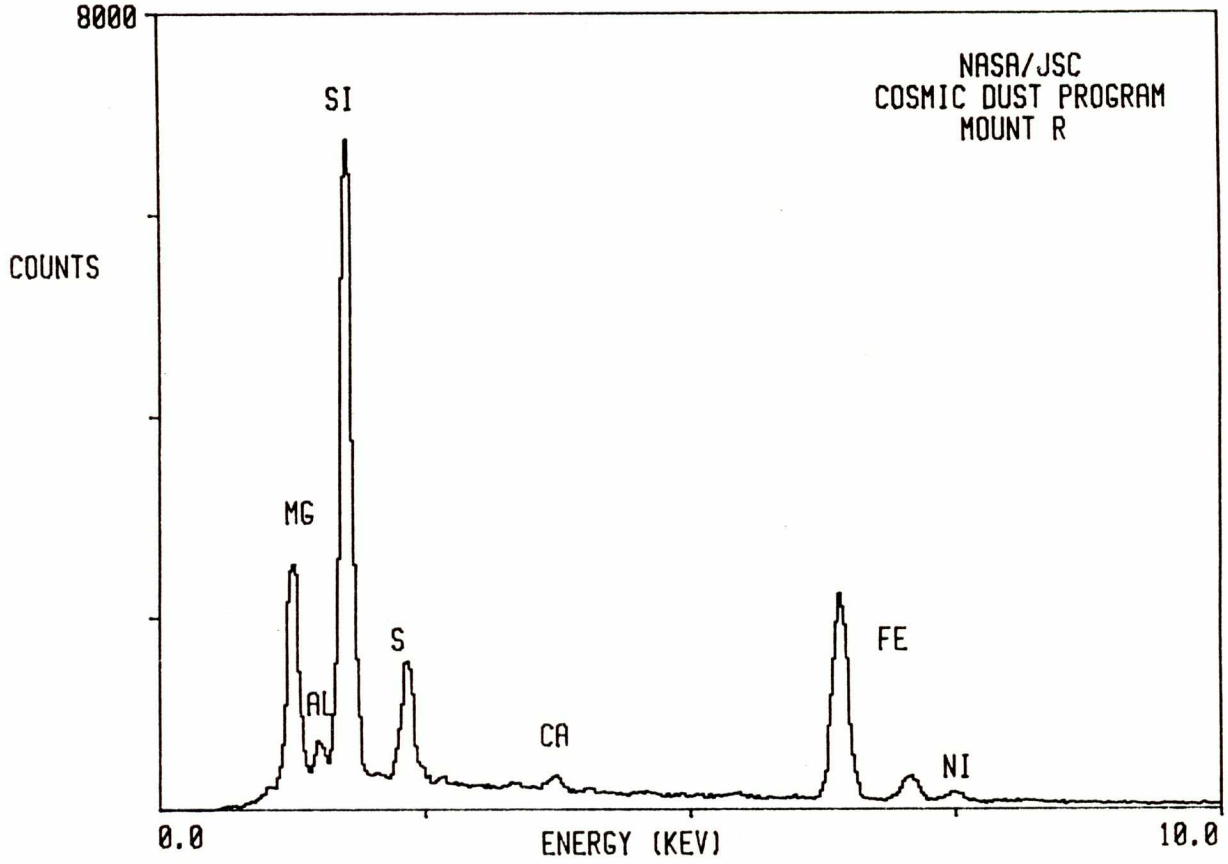
L2005 R 7



S-90-38281

SIZE: 13x15
SHAPE: E
TRANS.: O/TL
COLOR: Black
LUSTER: D
TYPE: C

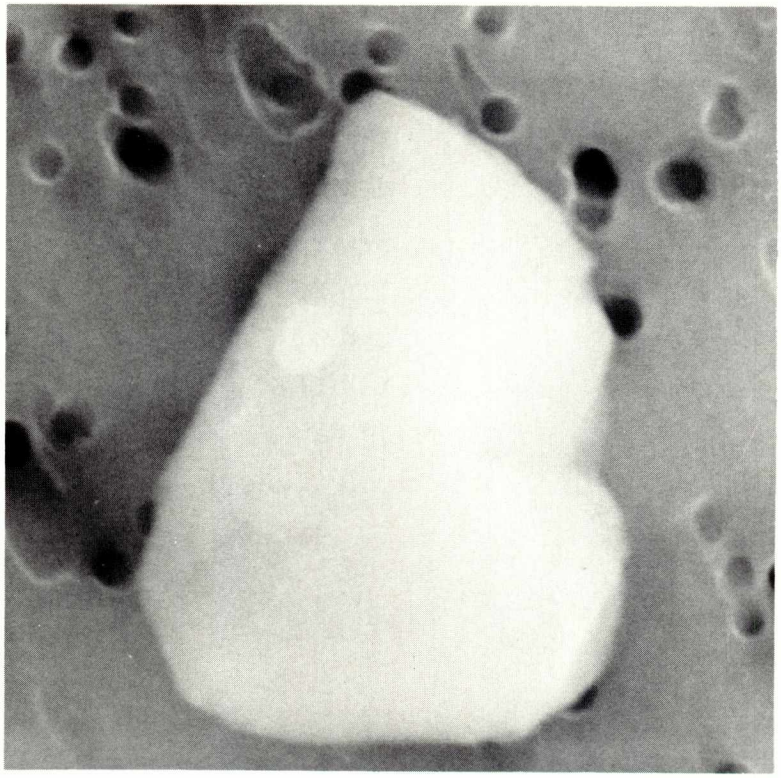
COMMENTS:



Particle Descriptions

TCN Type

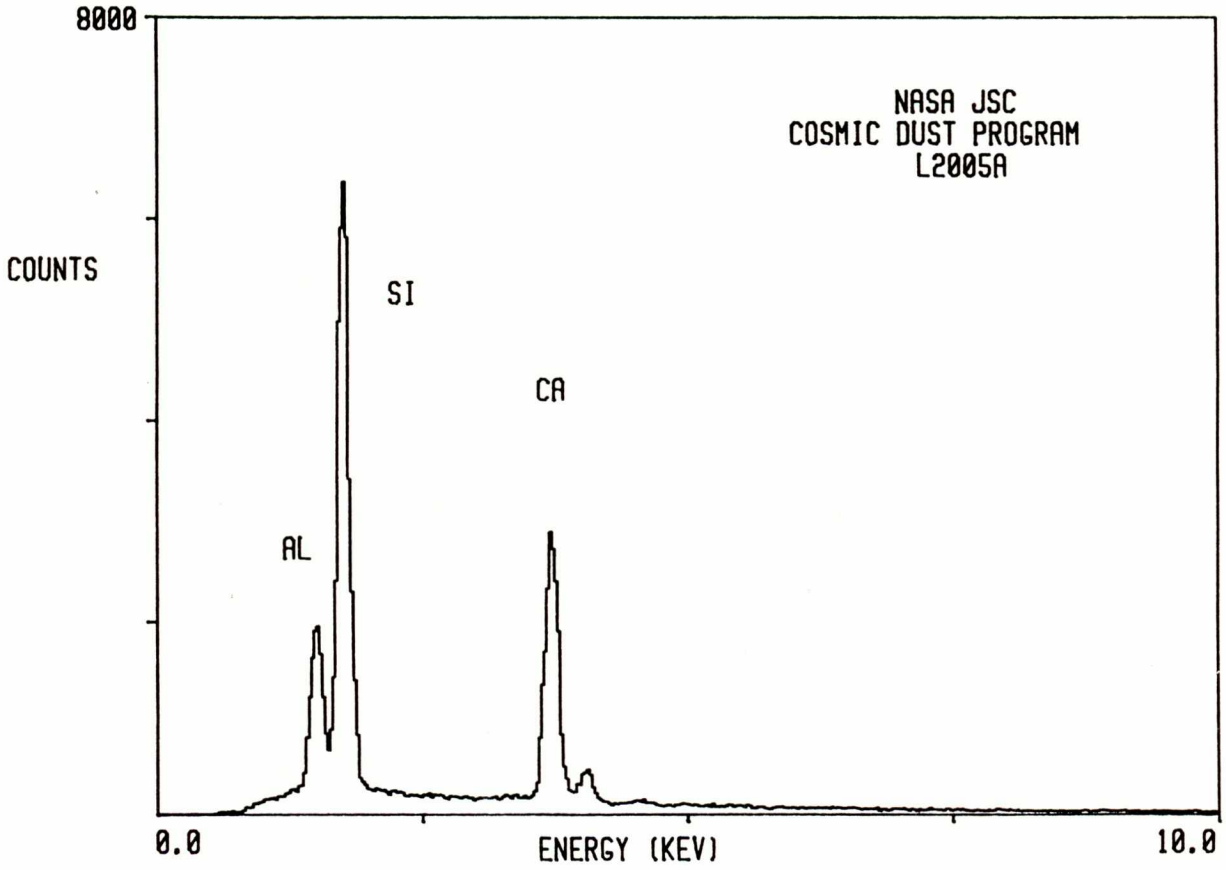
L2005 A 1



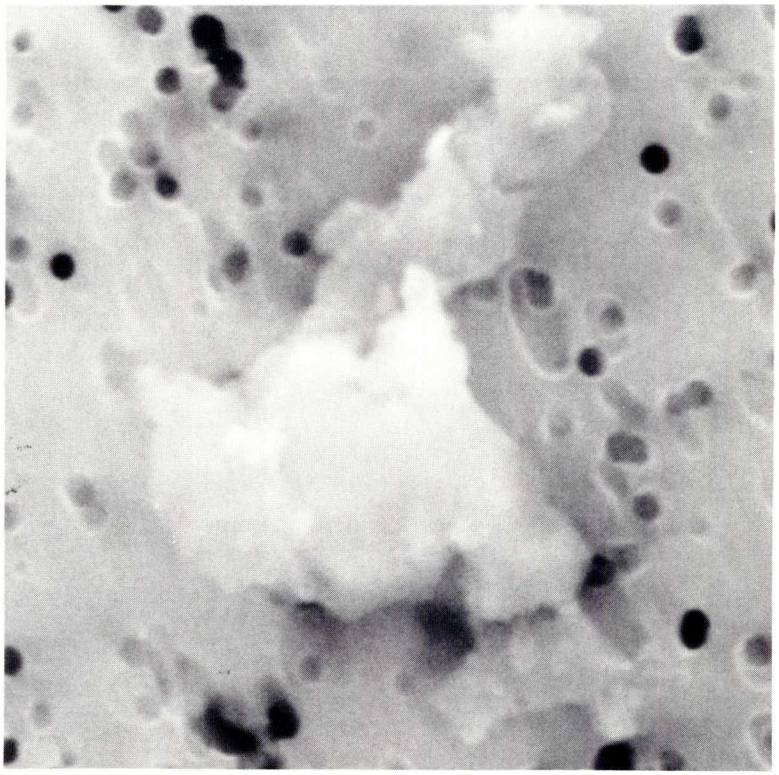
S-90-38127

SIZE: 4.5
SHAPE: I
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



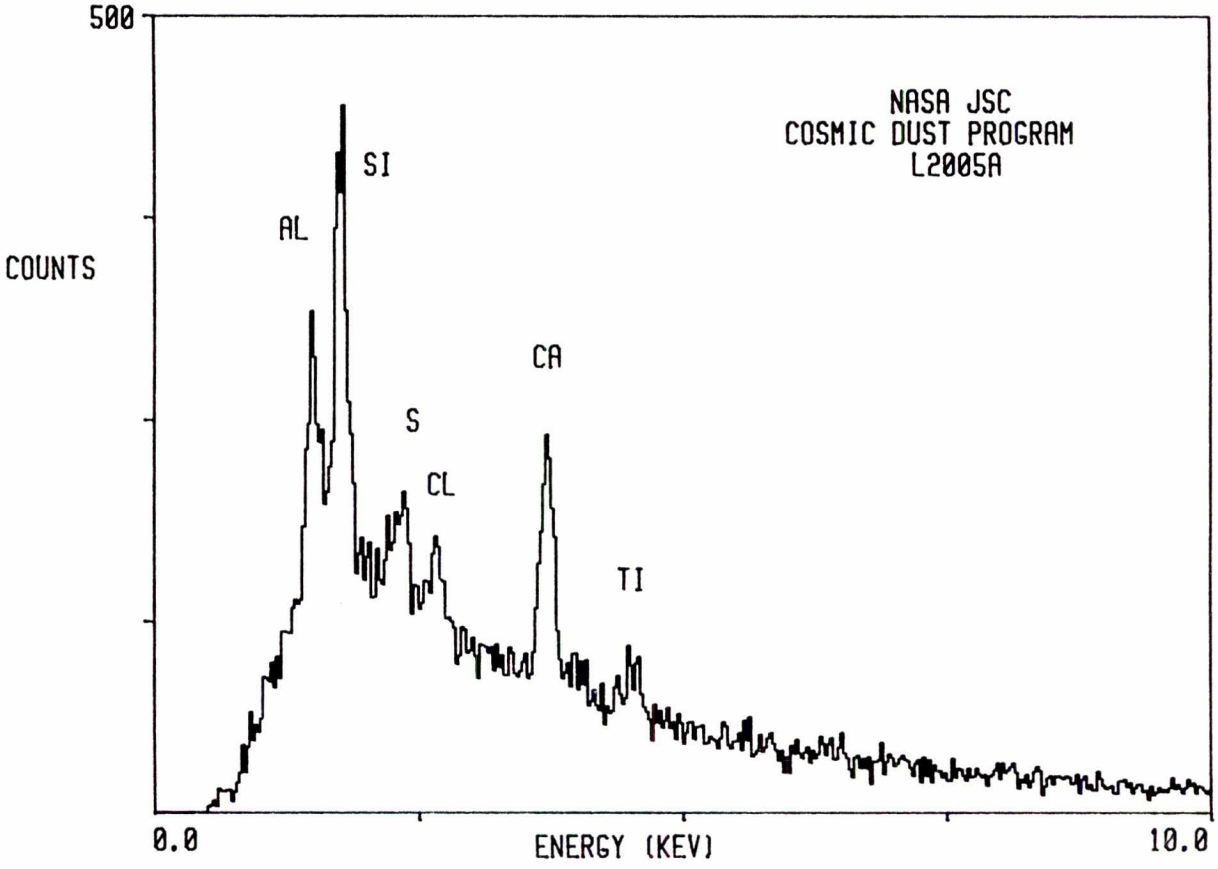
L2005 A 4



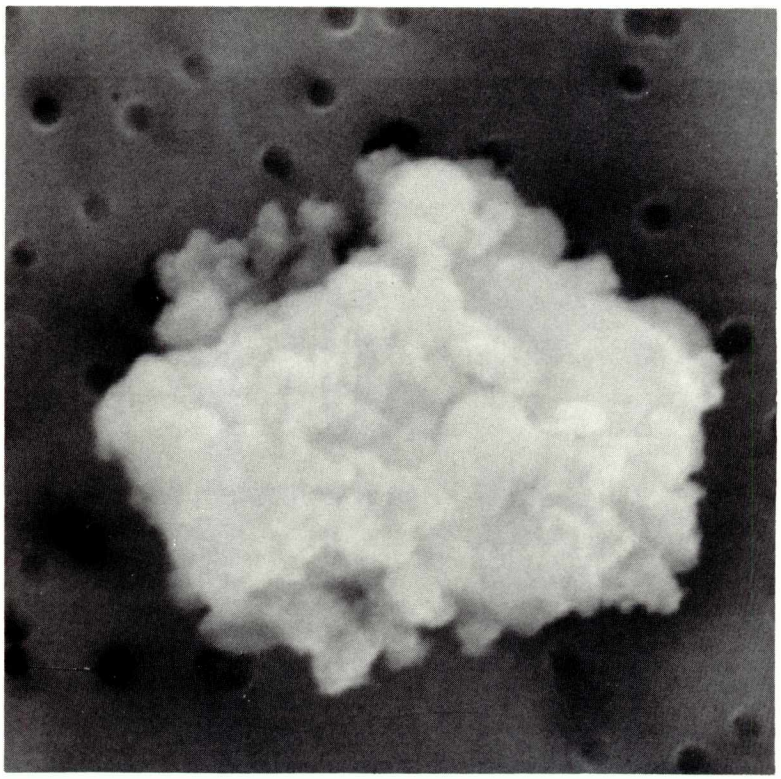
S-90-38128

SIZE: 6
SHAPE: I
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



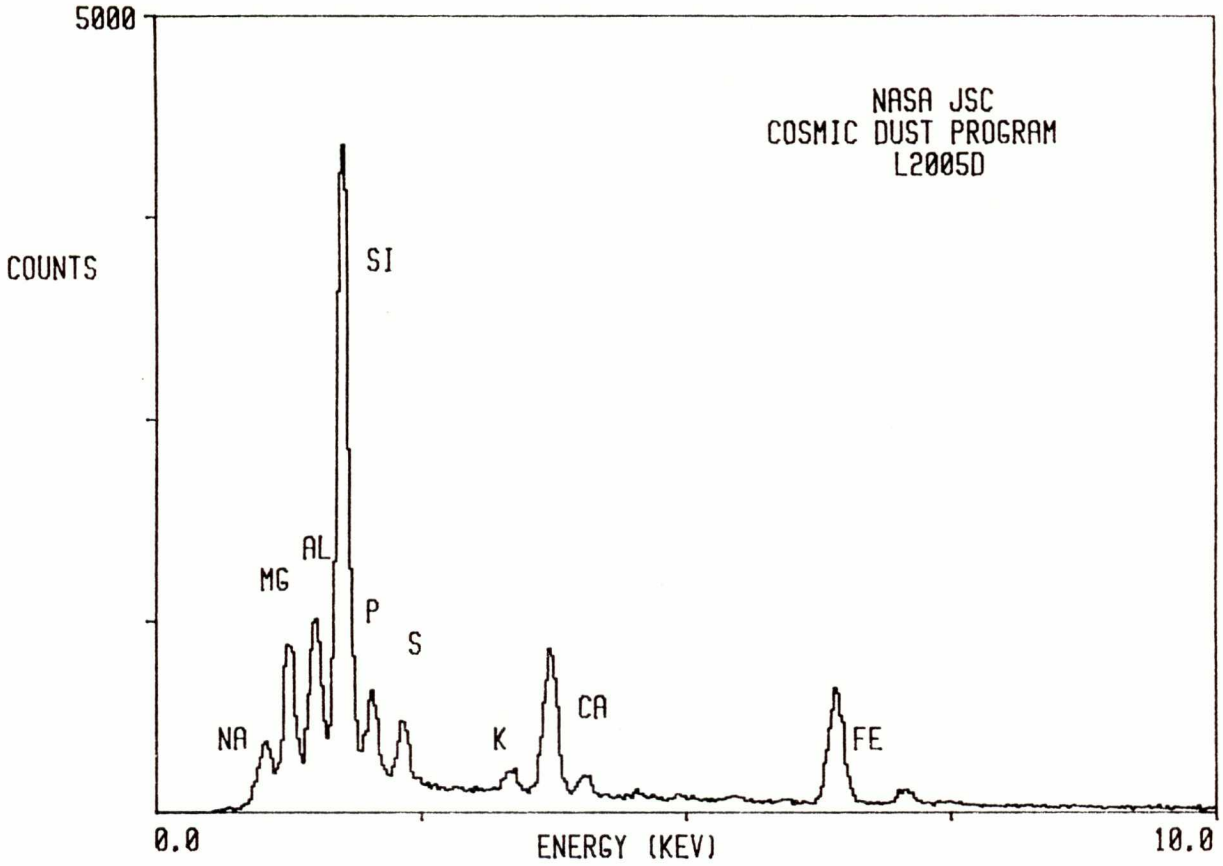
L2005 D 21



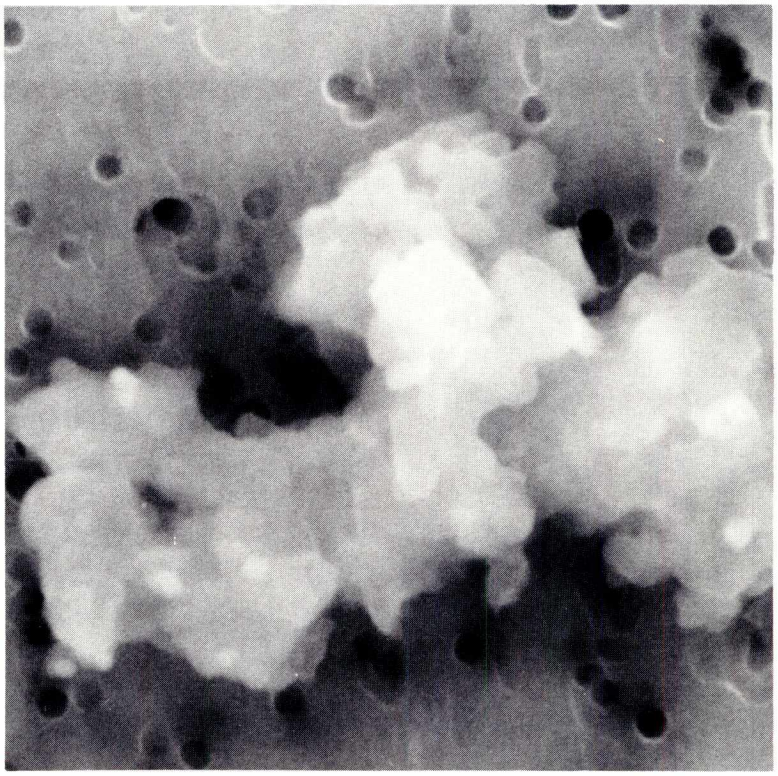
S-90-38150

SIZE: 4
SHAPE: I
TRANS.: O/TL
COLOR: Brown
LUSTER: D
TYPE: TCN

COMMENTS:



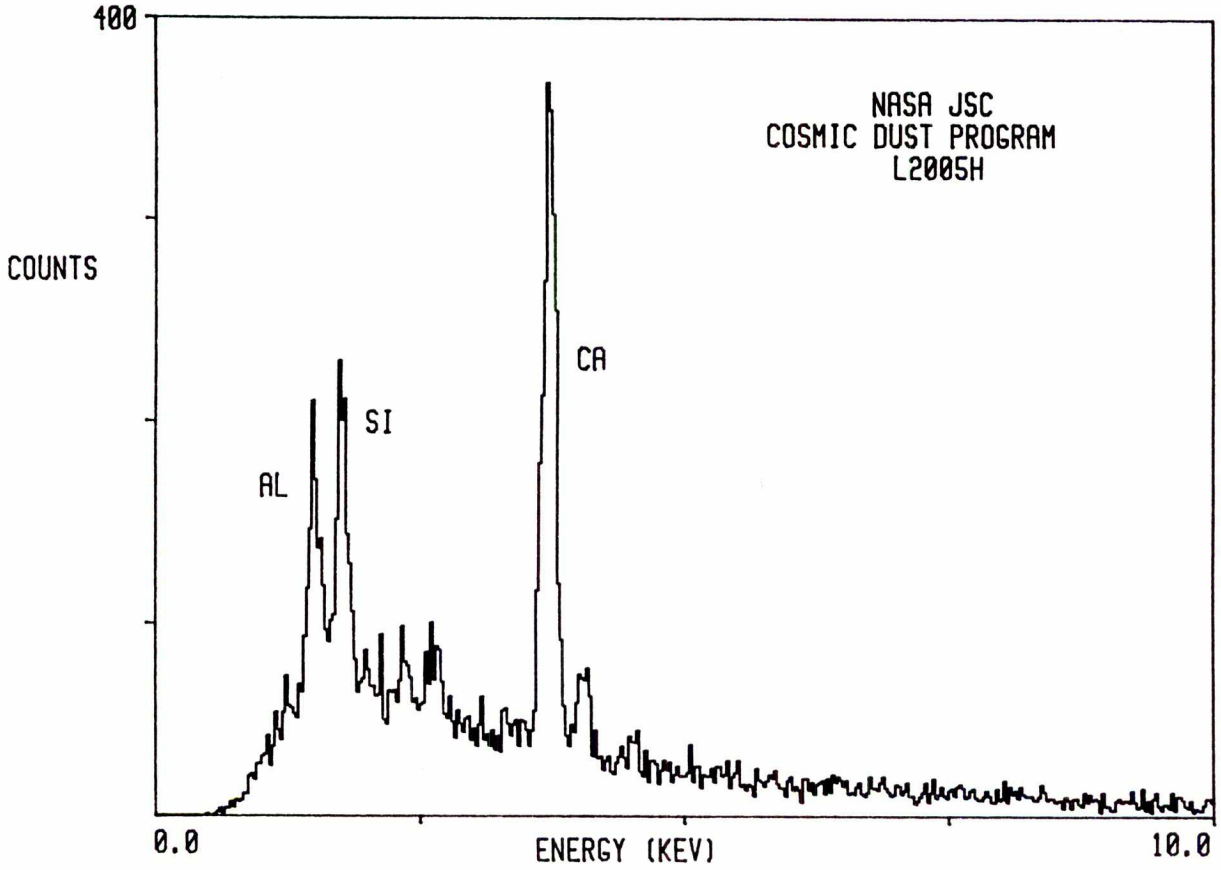
L2005 H 46



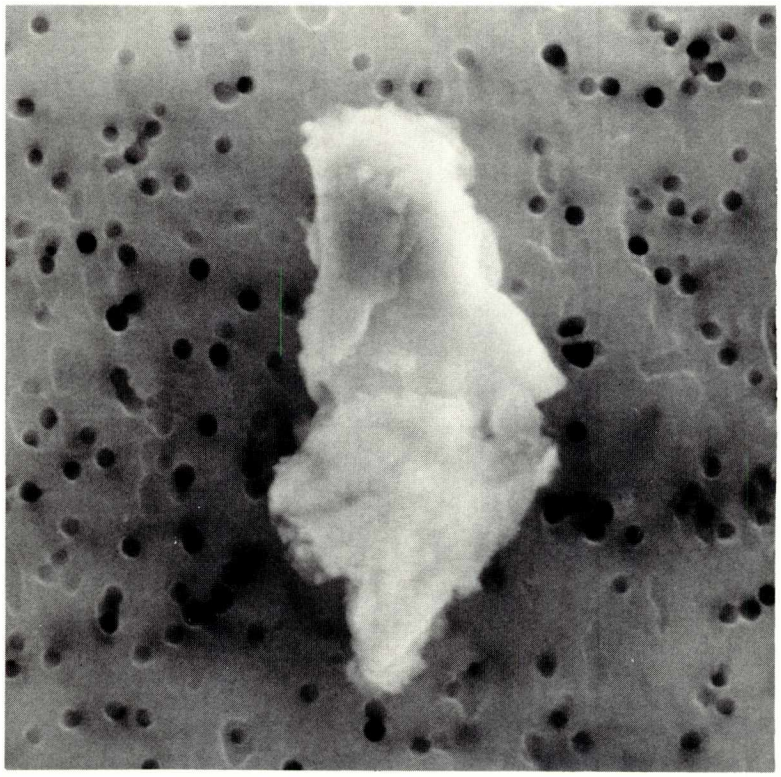
S-90-38189

SIZE: 5x8
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: D/SV
TYPE: TCN

COMMENTS:



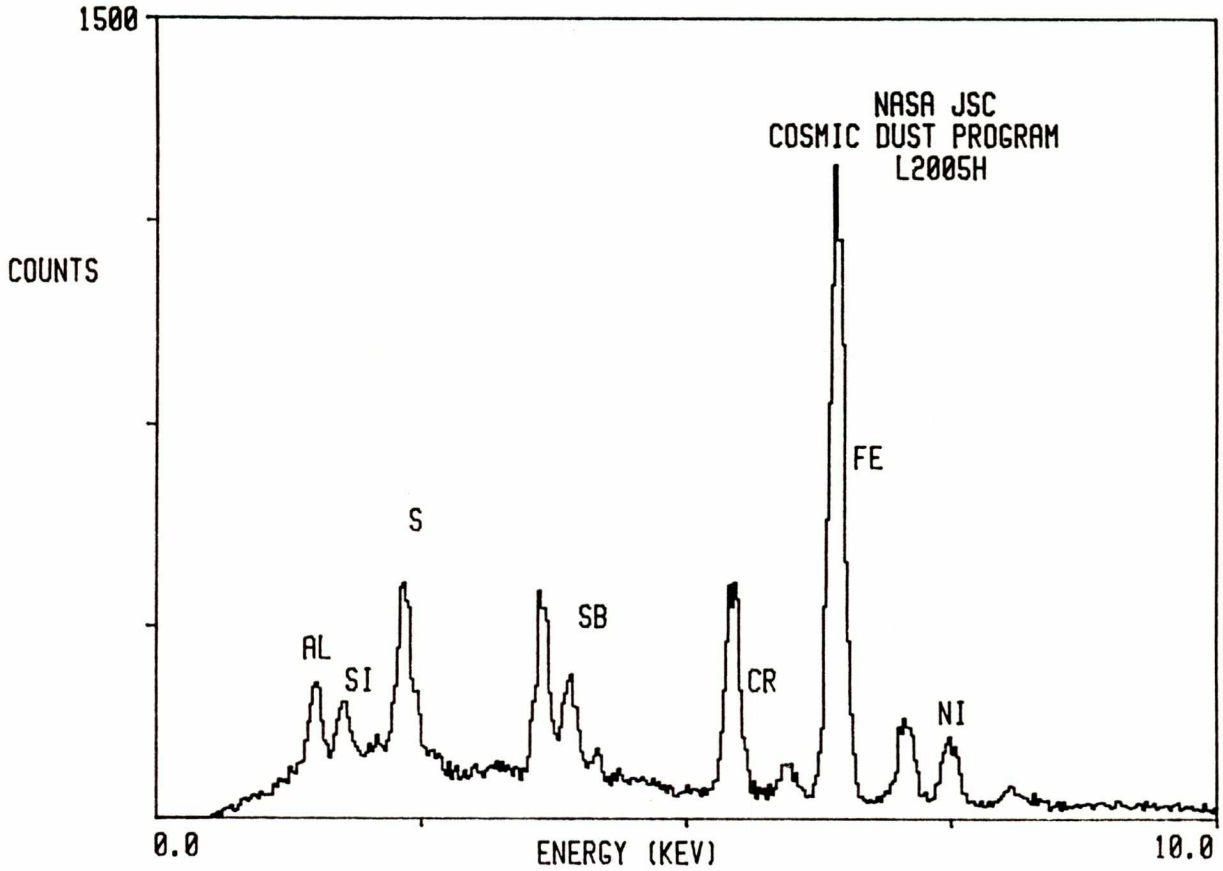
L2005 H 48



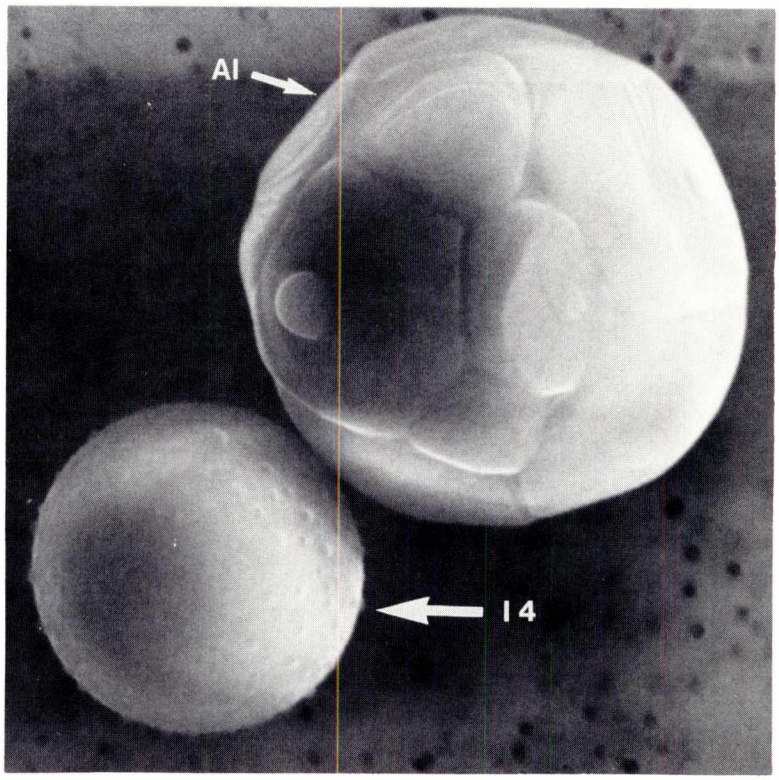
S-90-38190

SIZE: 5x10
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: D/SV
TYPE: TCN

COMMENTS:



L2005 I 4



S-90-38191

SIZE: 6

SHAPE: S

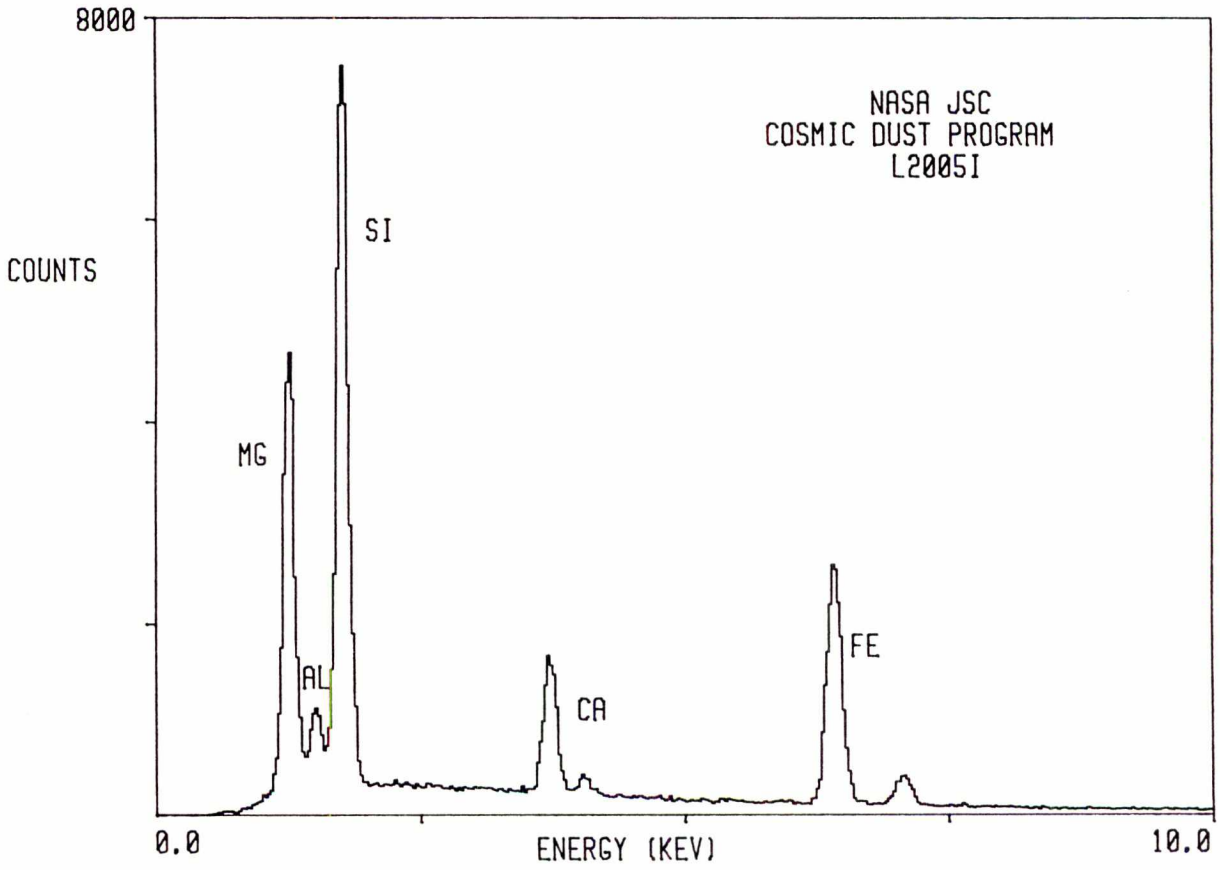
TRANS.: TL

COLOR: Brown

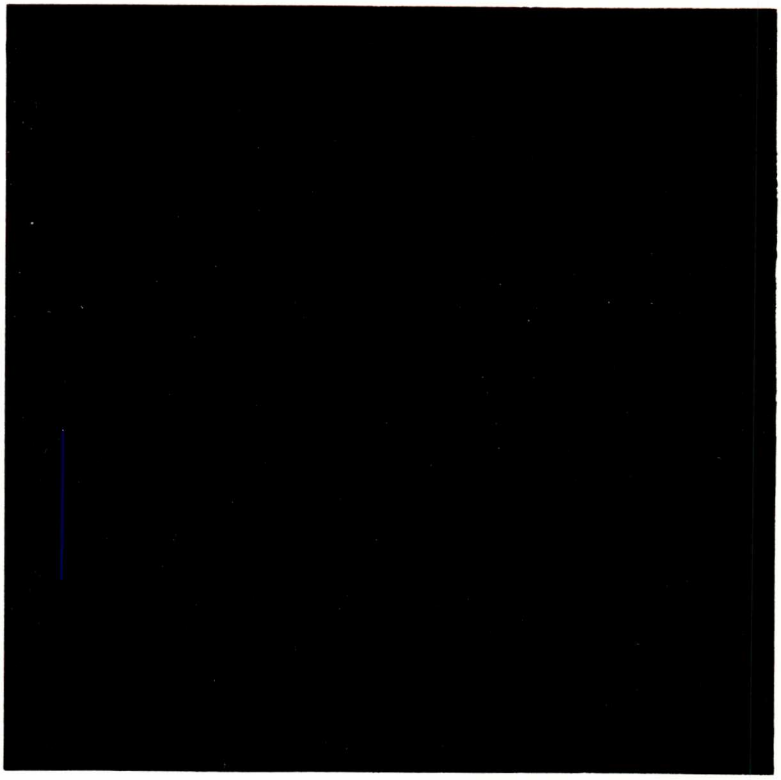
LUSTER: V

TYPE: TCN

COMMENTS:
May be attached to AOS particle

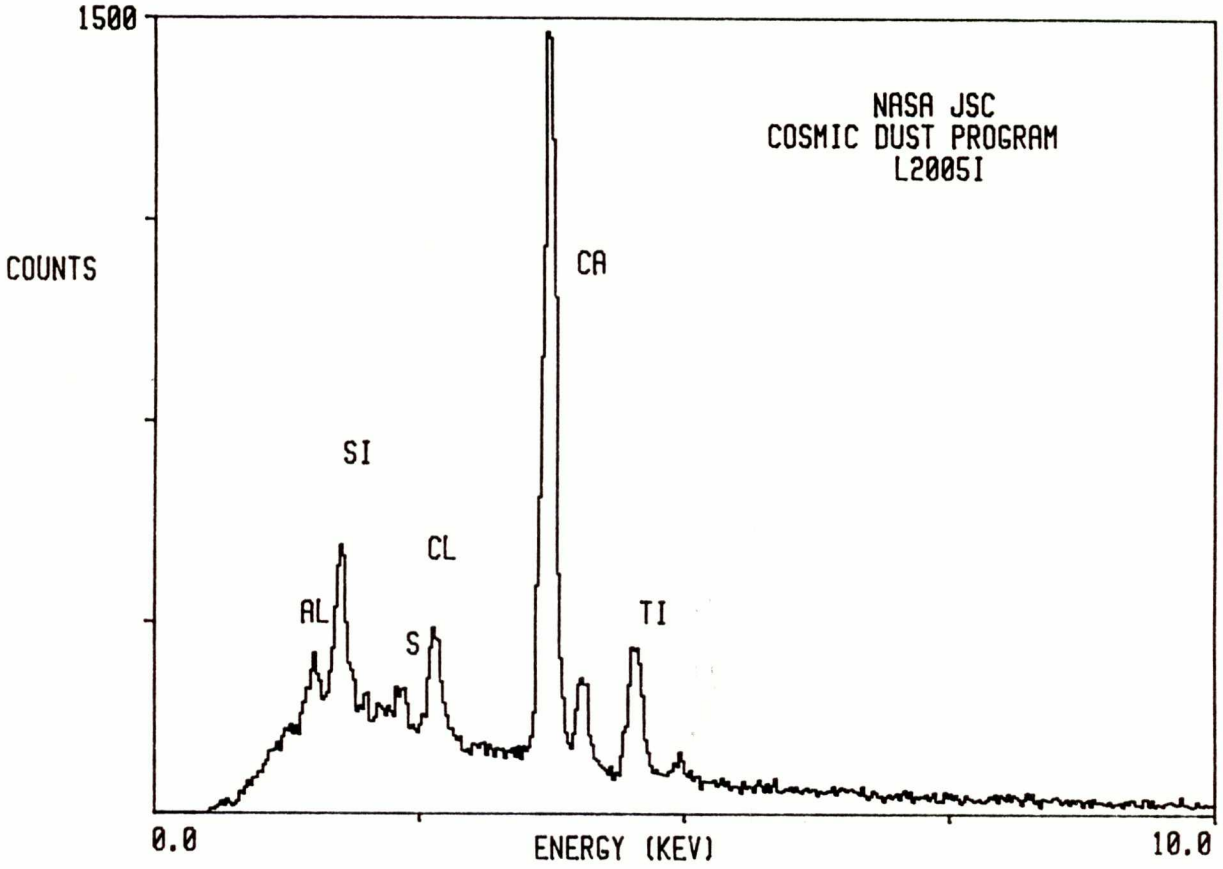


L2005 I 6

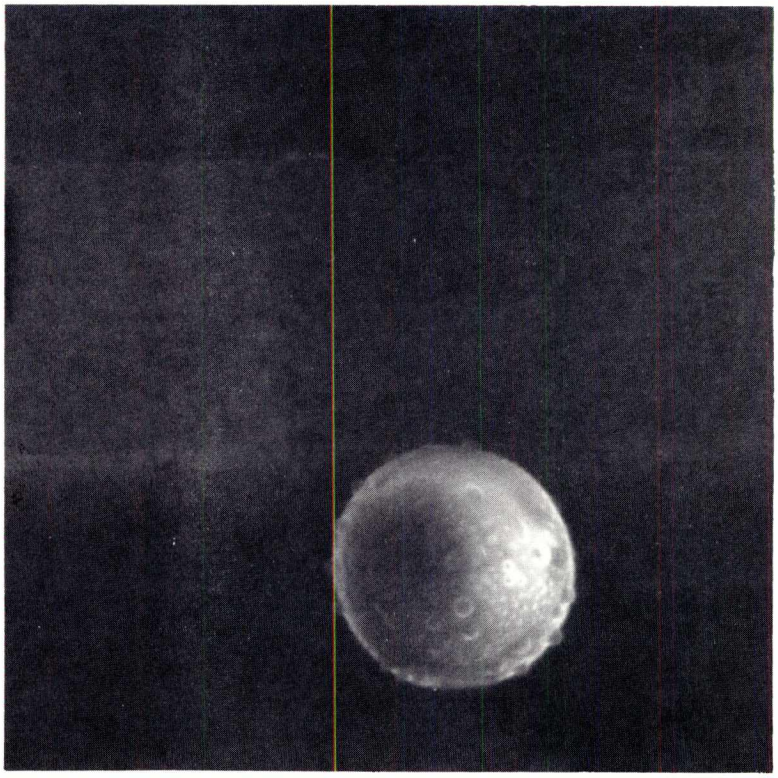


SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:
No photo due to specimen charging



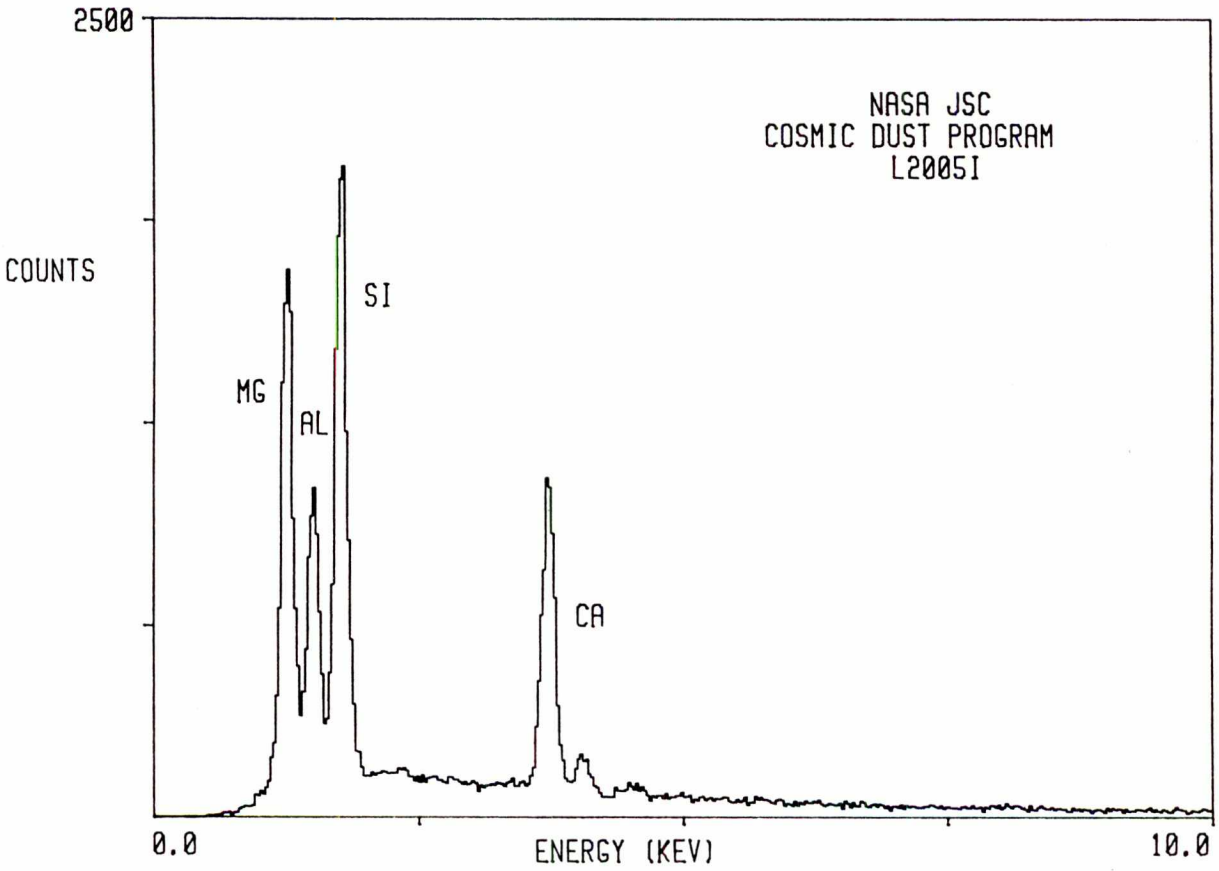
L2005 I 7



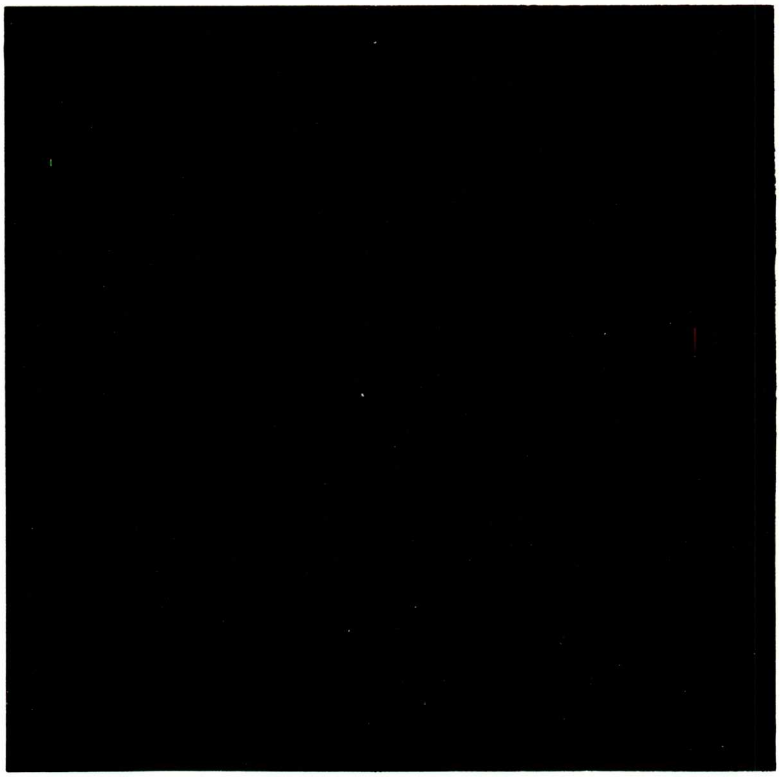
S-90-38126

SIZE: 9
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:

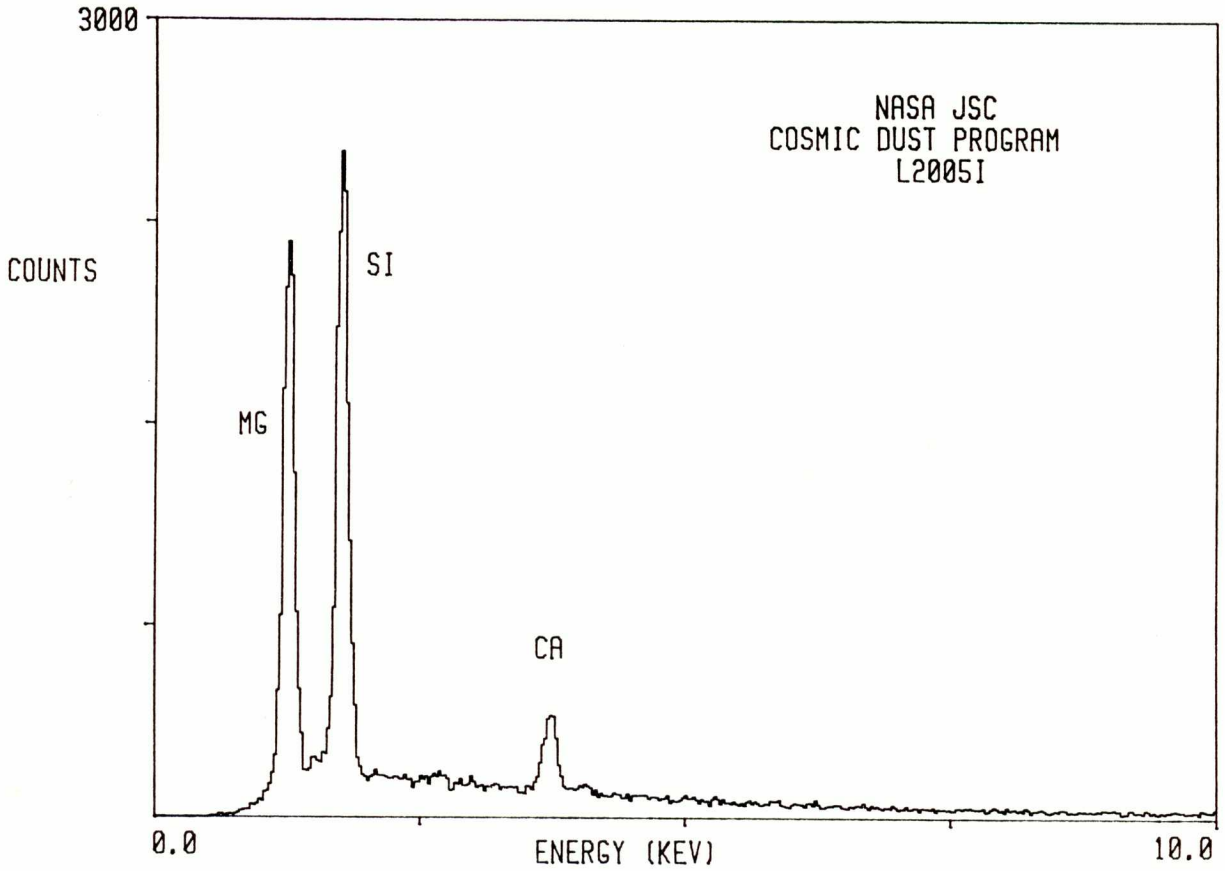


L2005 I 19

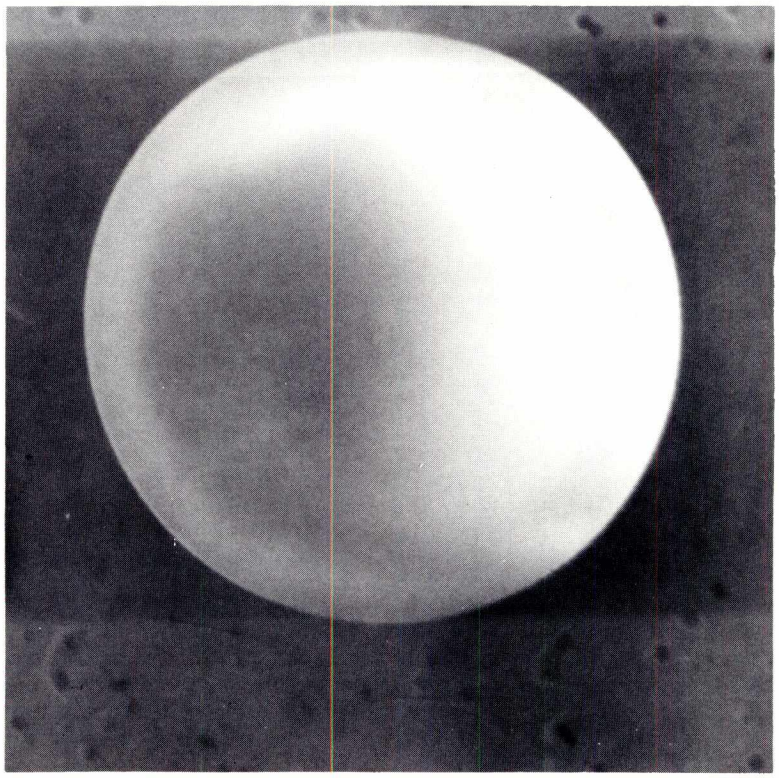


SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:
No photo due to specimen charging



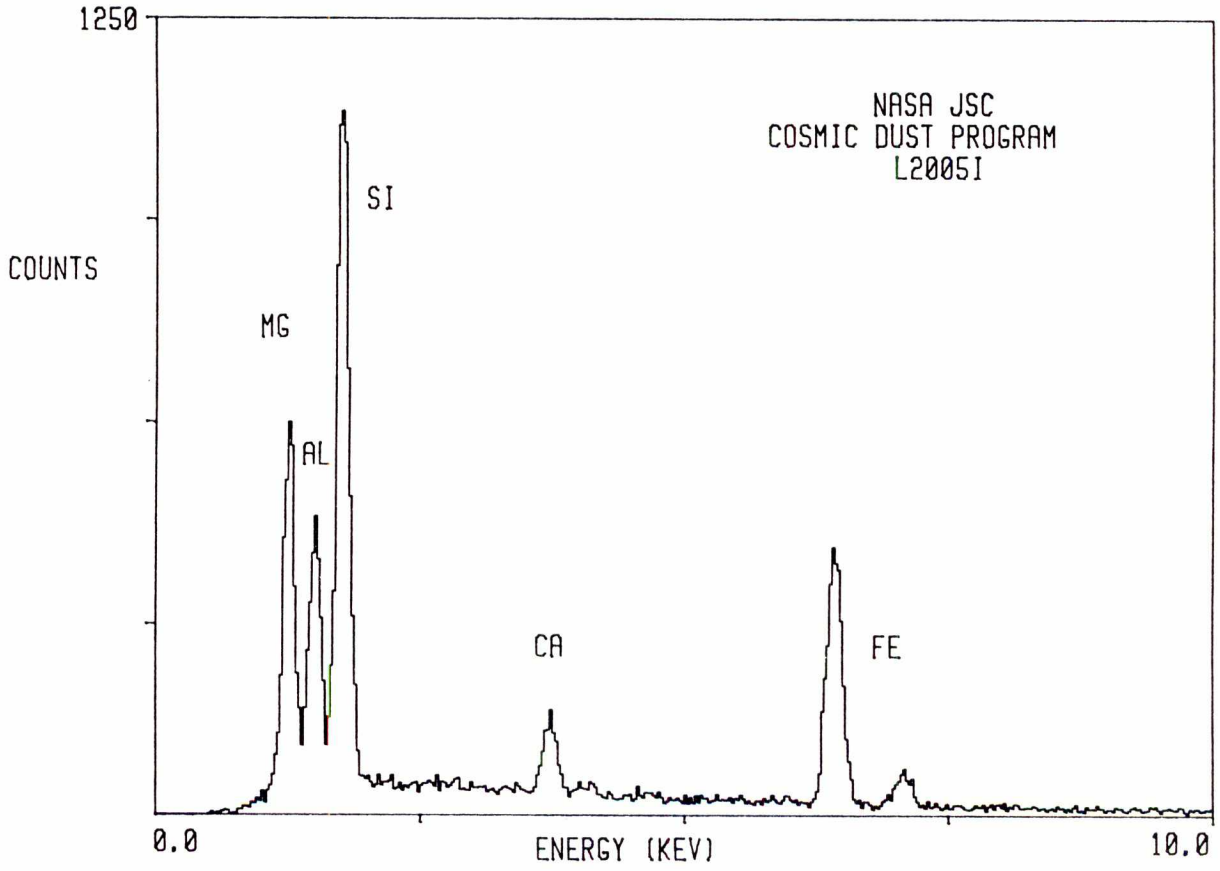
L2005 I 24



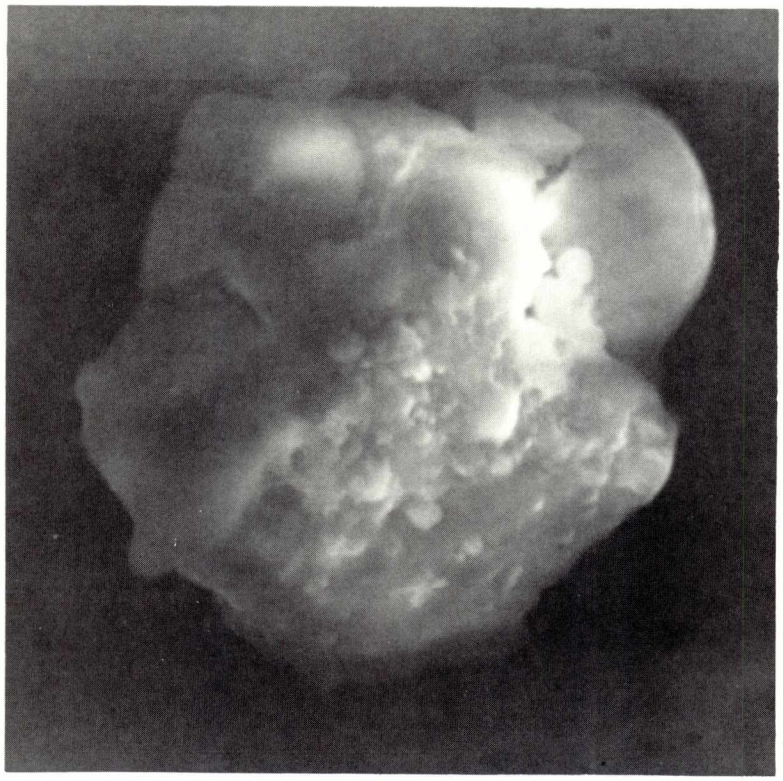
S-90-38193

SIZE: 7
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



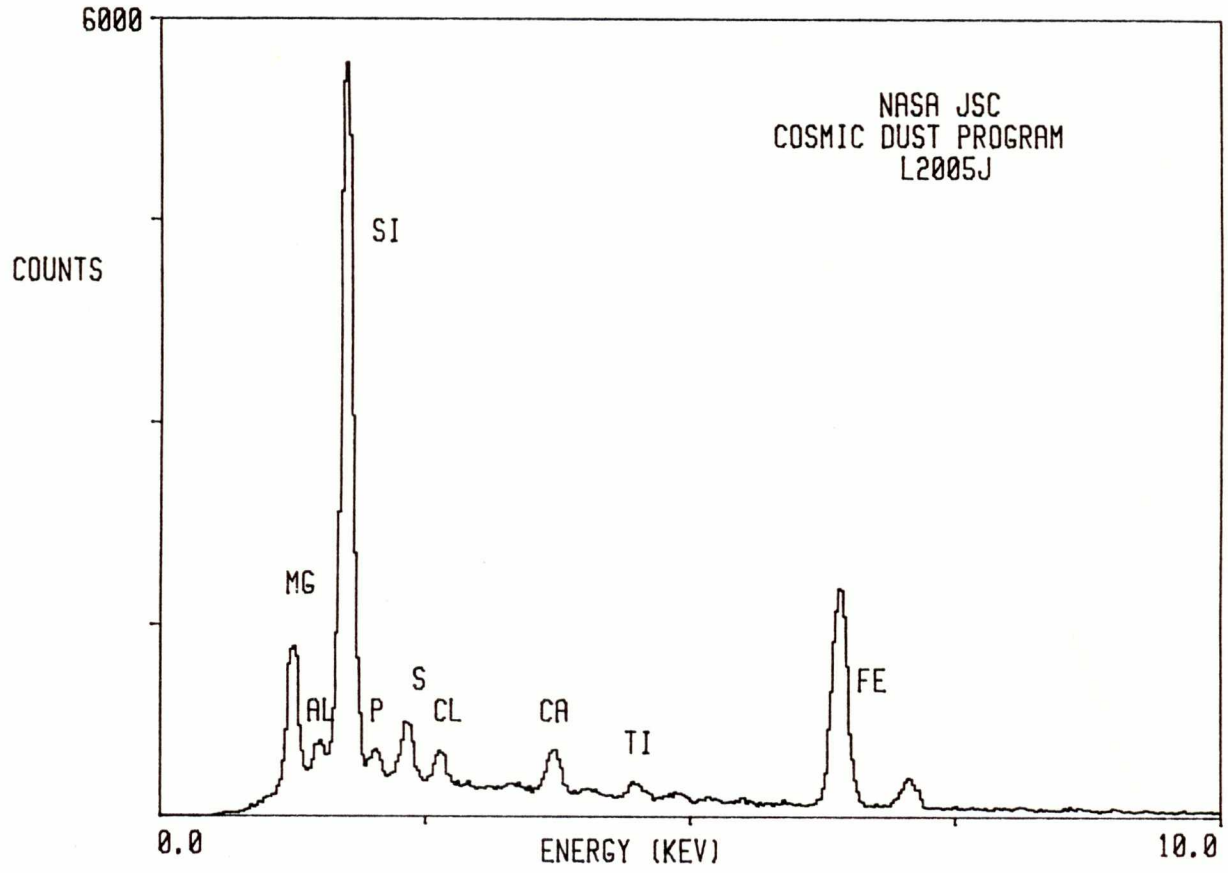
L2005 J 1



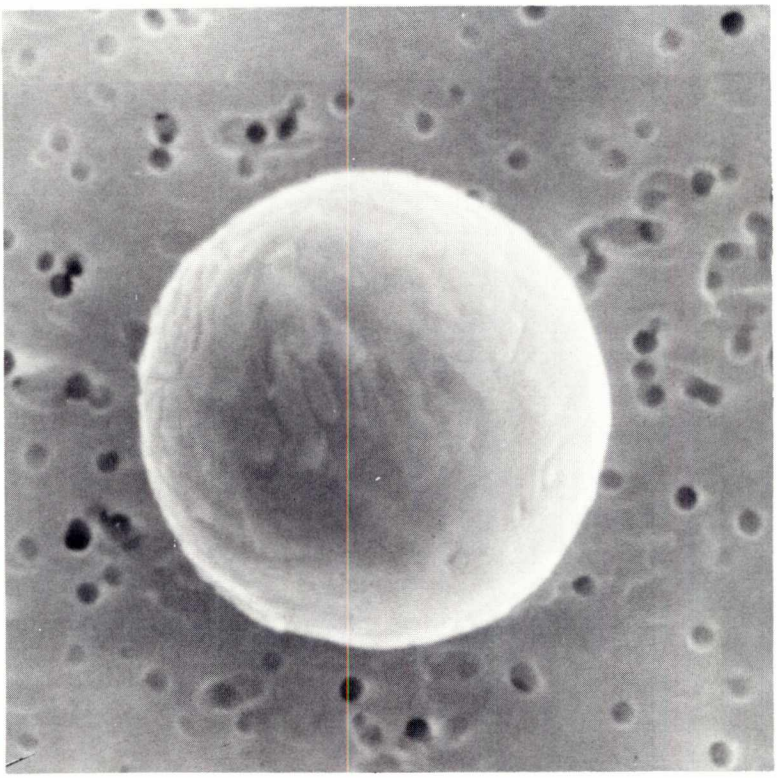
S-90-38194

SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



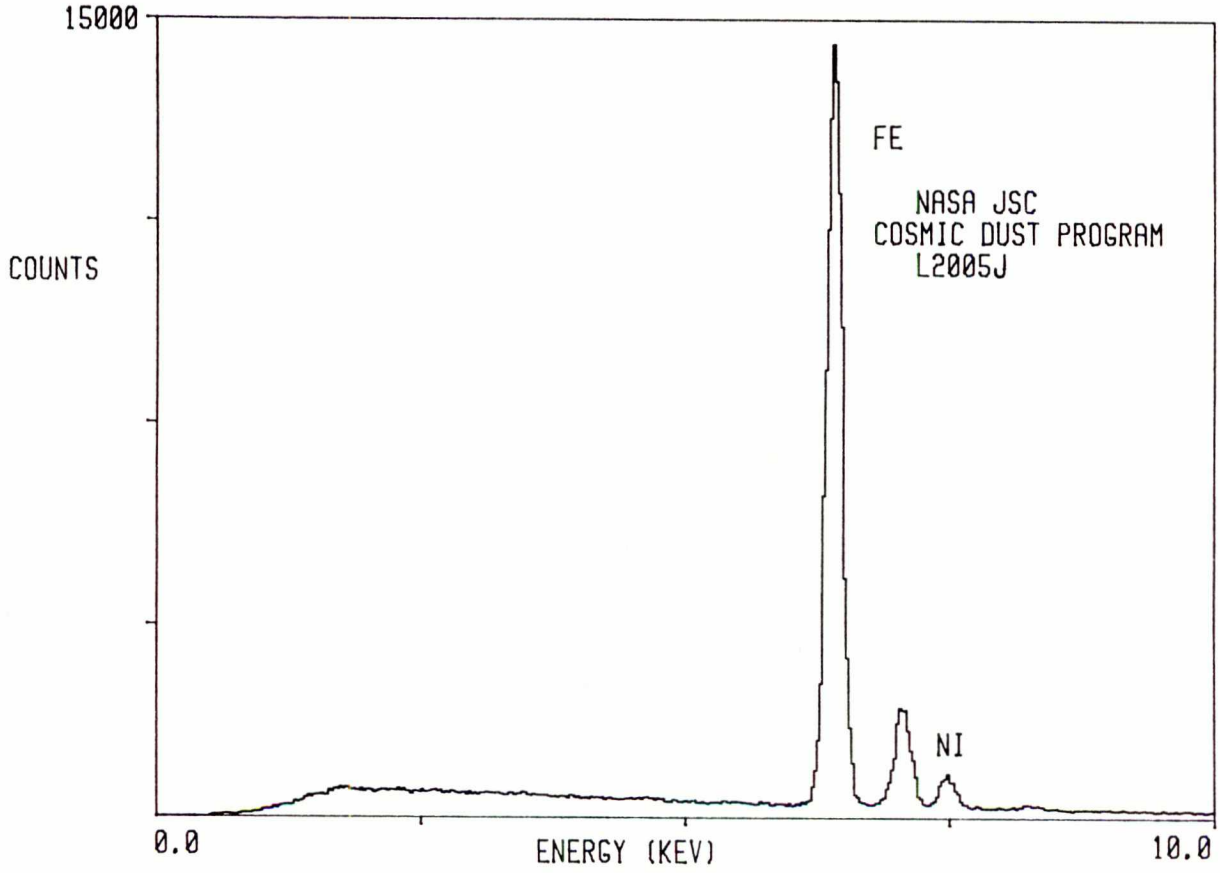
L2005 J 2



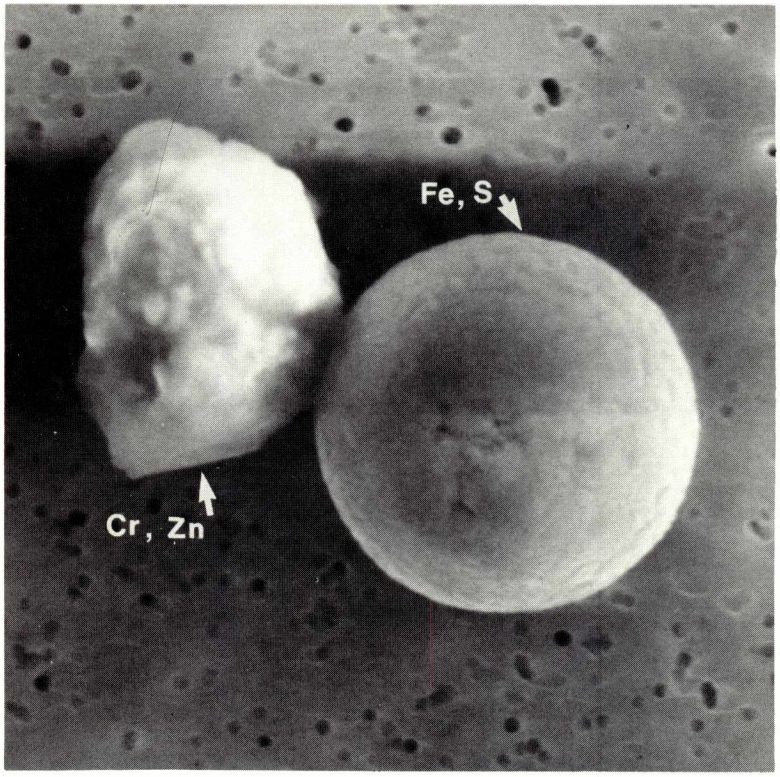
S-90-38195

SIZE: 8
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



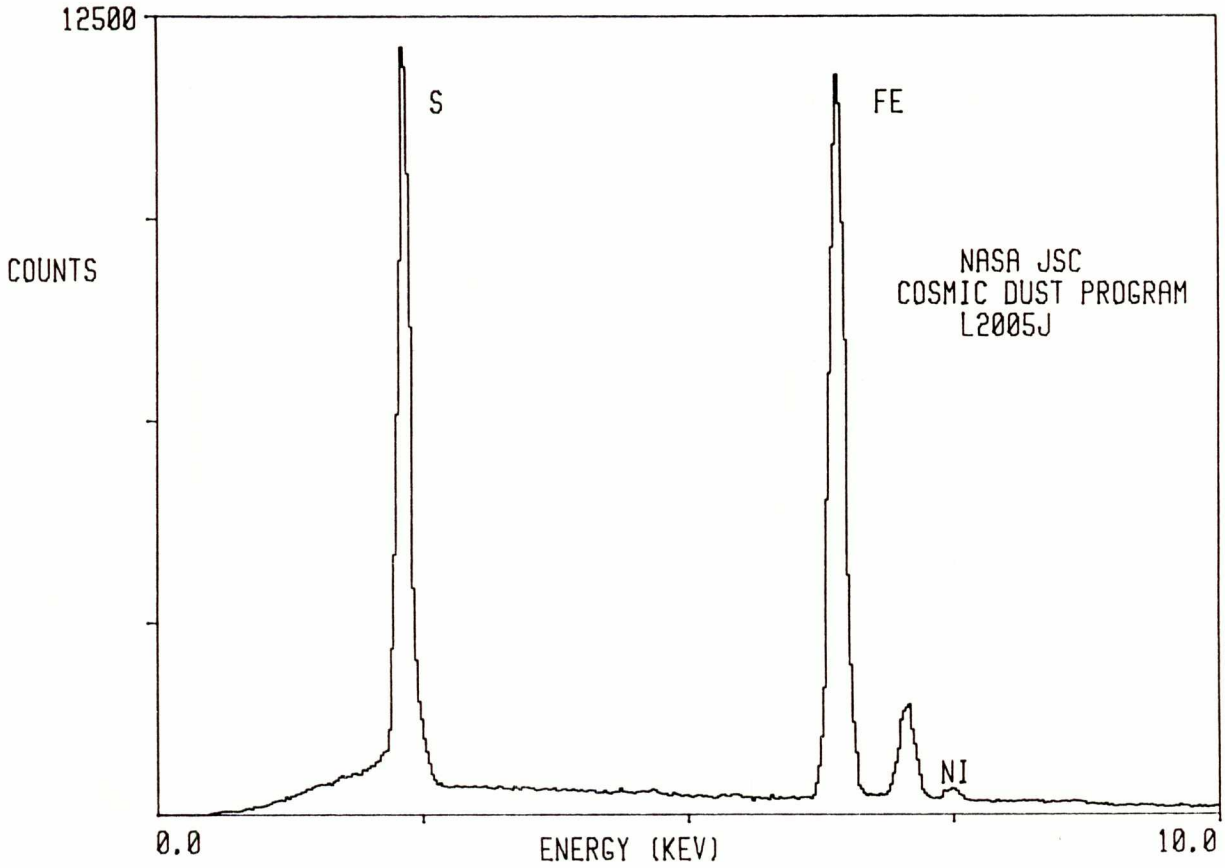
L2005 J 4



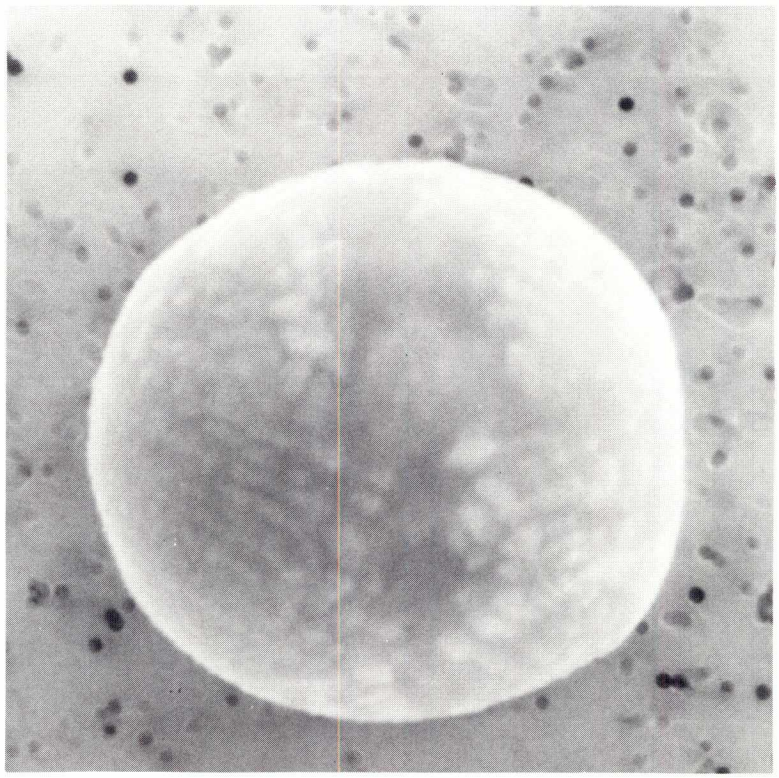
S-90-38197

SIZE: 8
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: M
TYPE: TCN

COMMENTS:



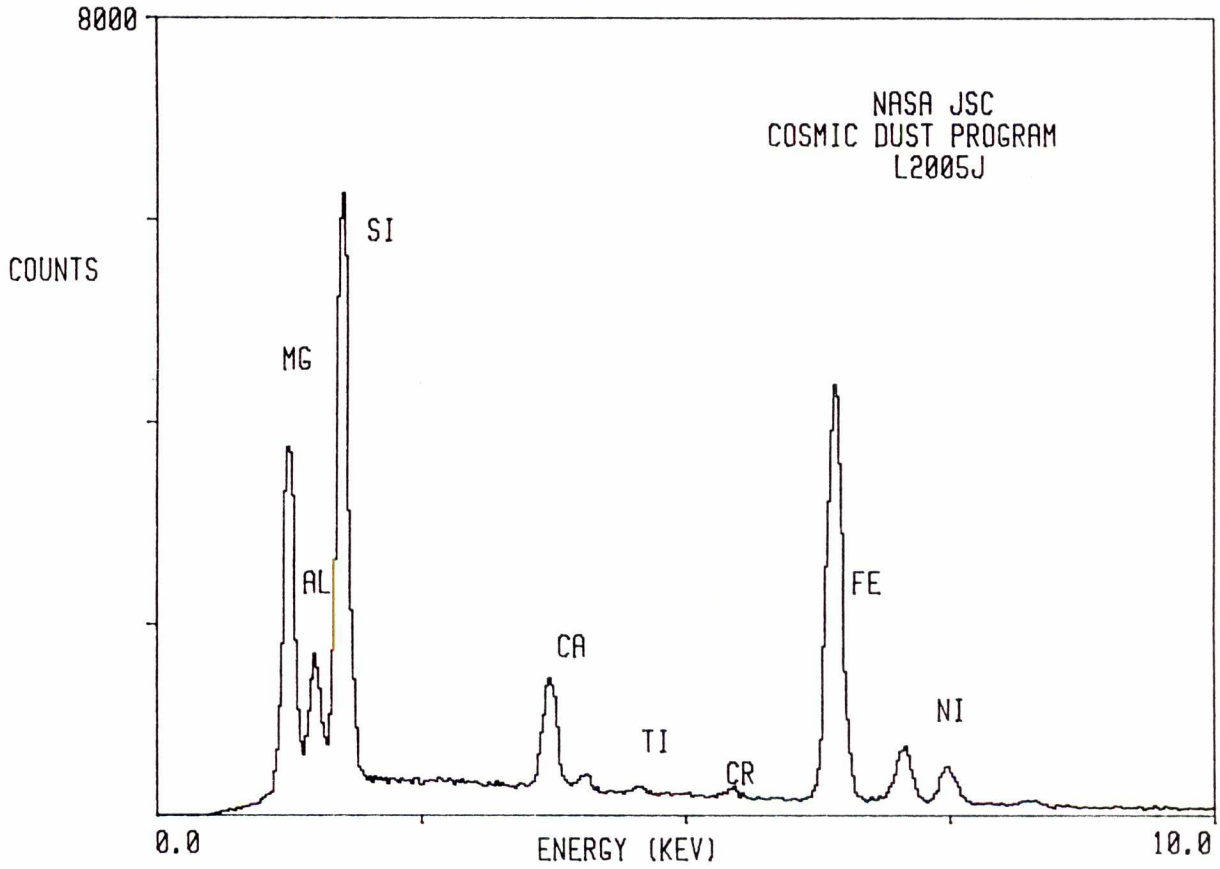
L2005 J 5



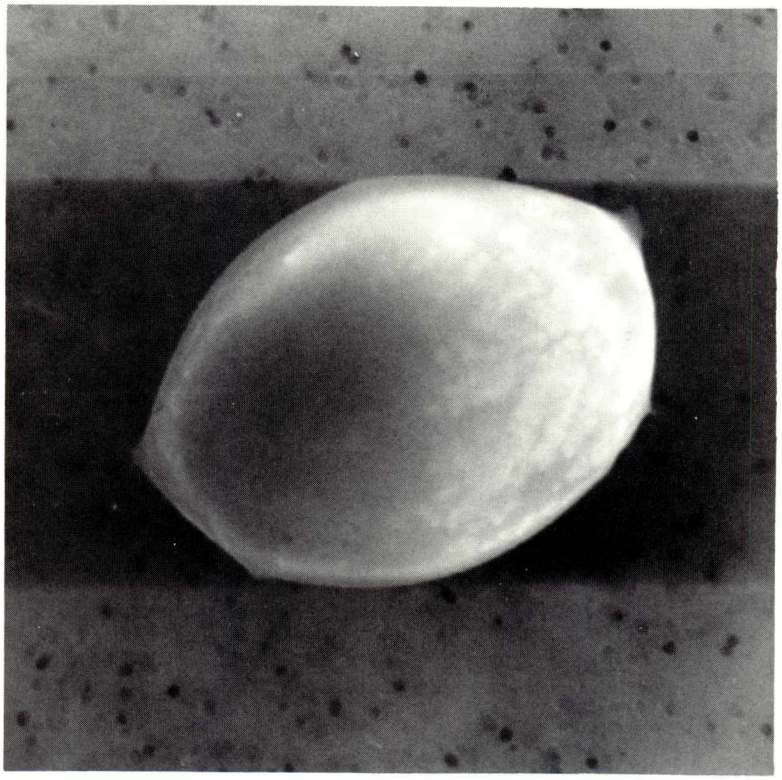
S-90-38198

SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



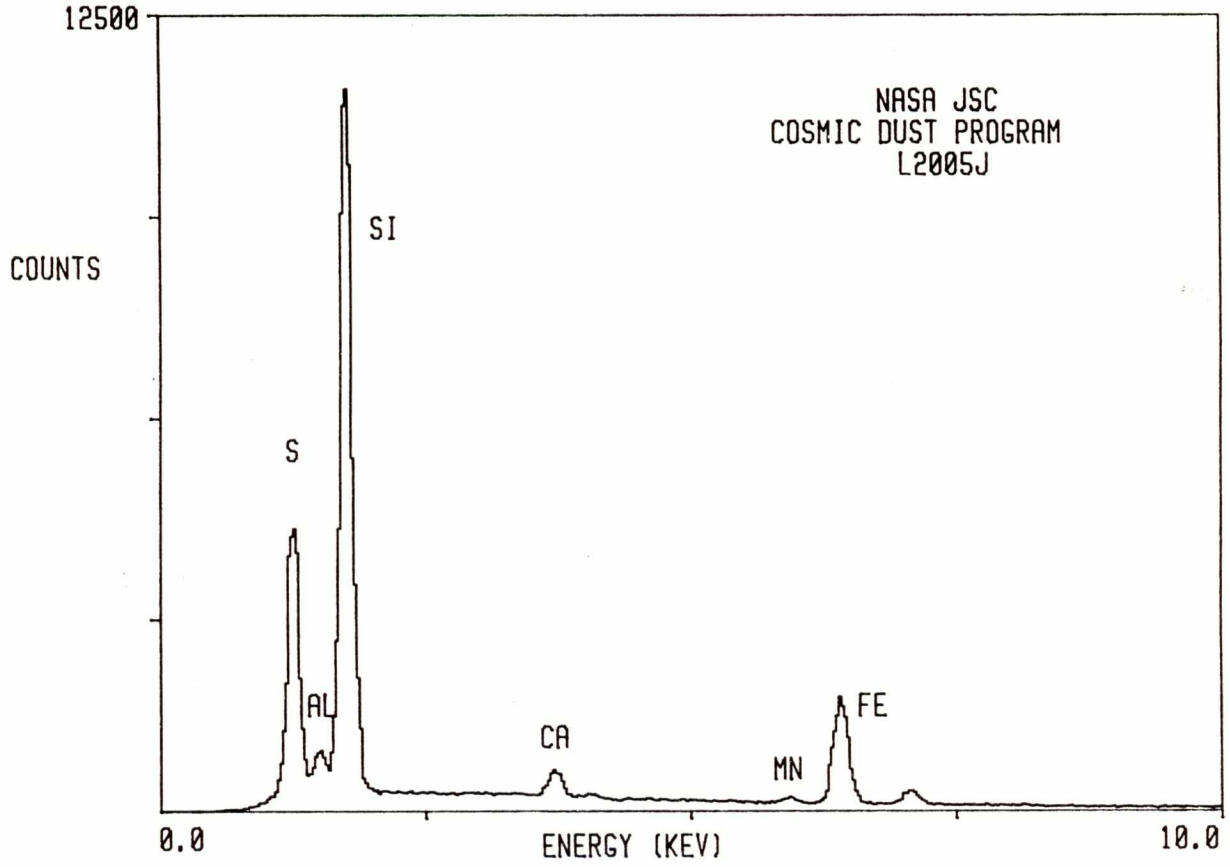
L2005 J 6



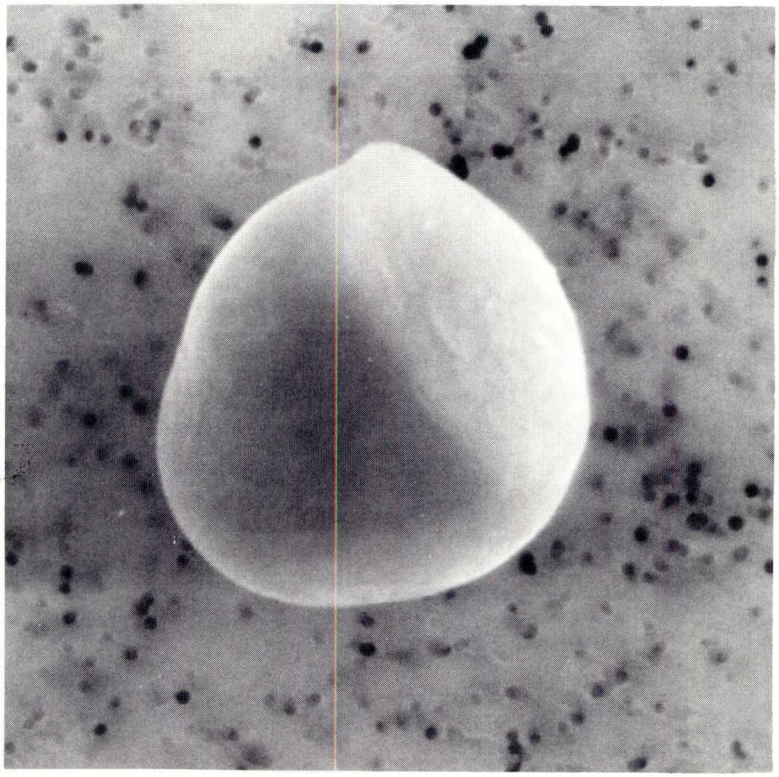
S-90-38199

SIZE: 15
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



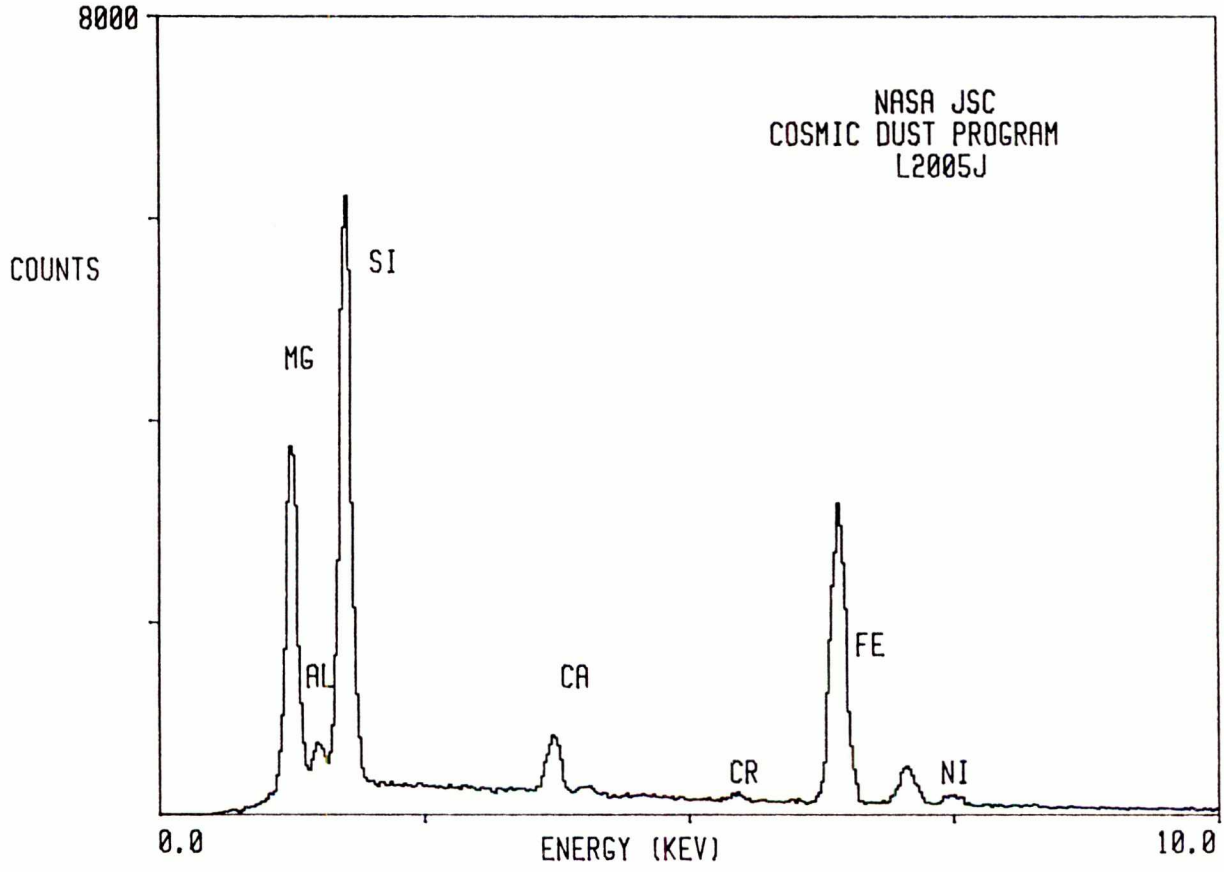
L2005 J 12



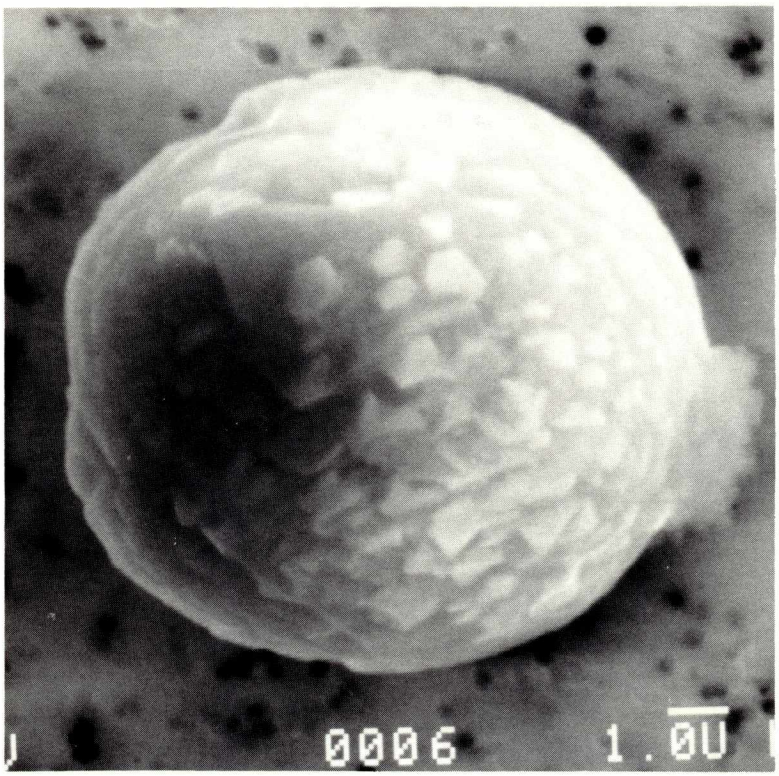
S-90-38205

SIZE: 10
SHAPE: S
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



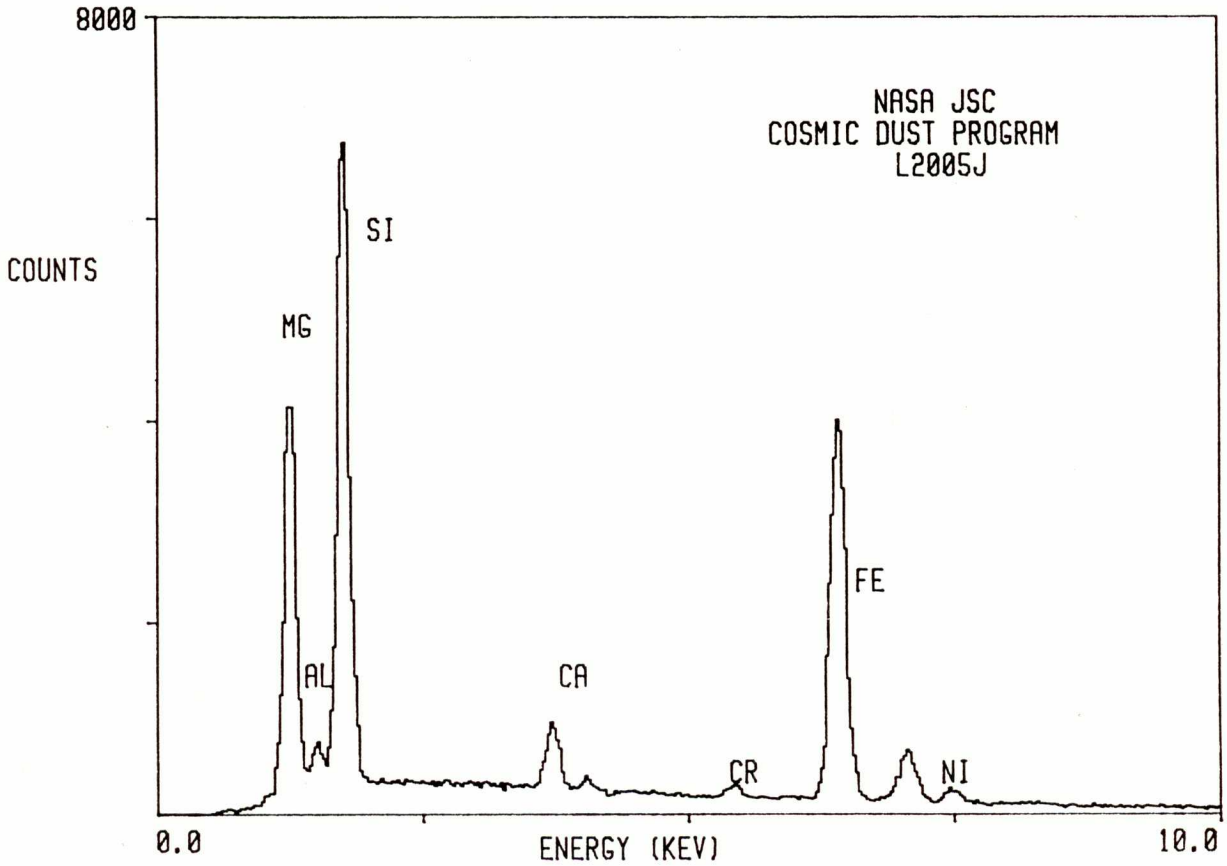
L2005 J 20



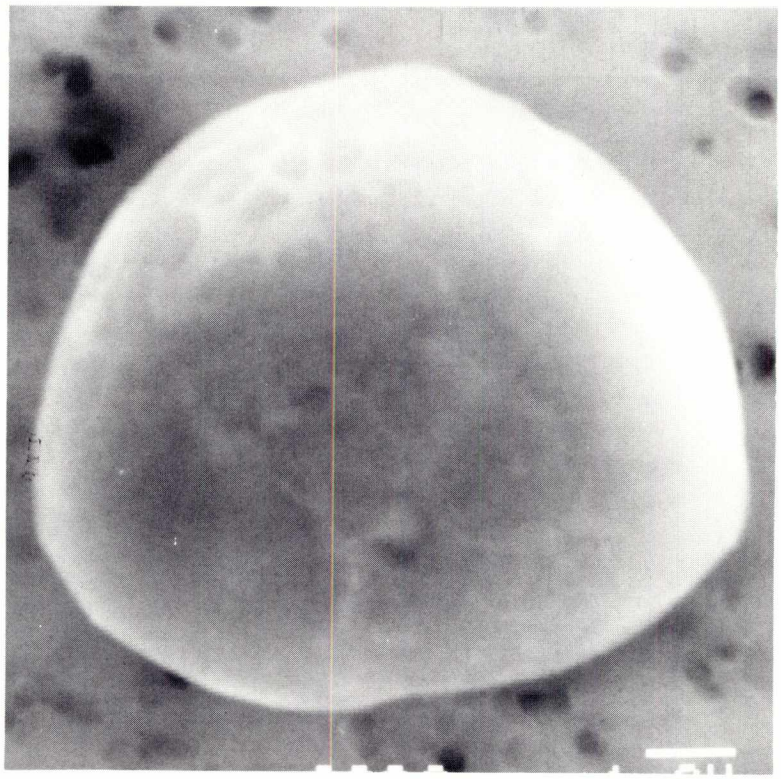
S-90-38212

SIZE: 11
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D
TYPE: TCN

COMMENTS:



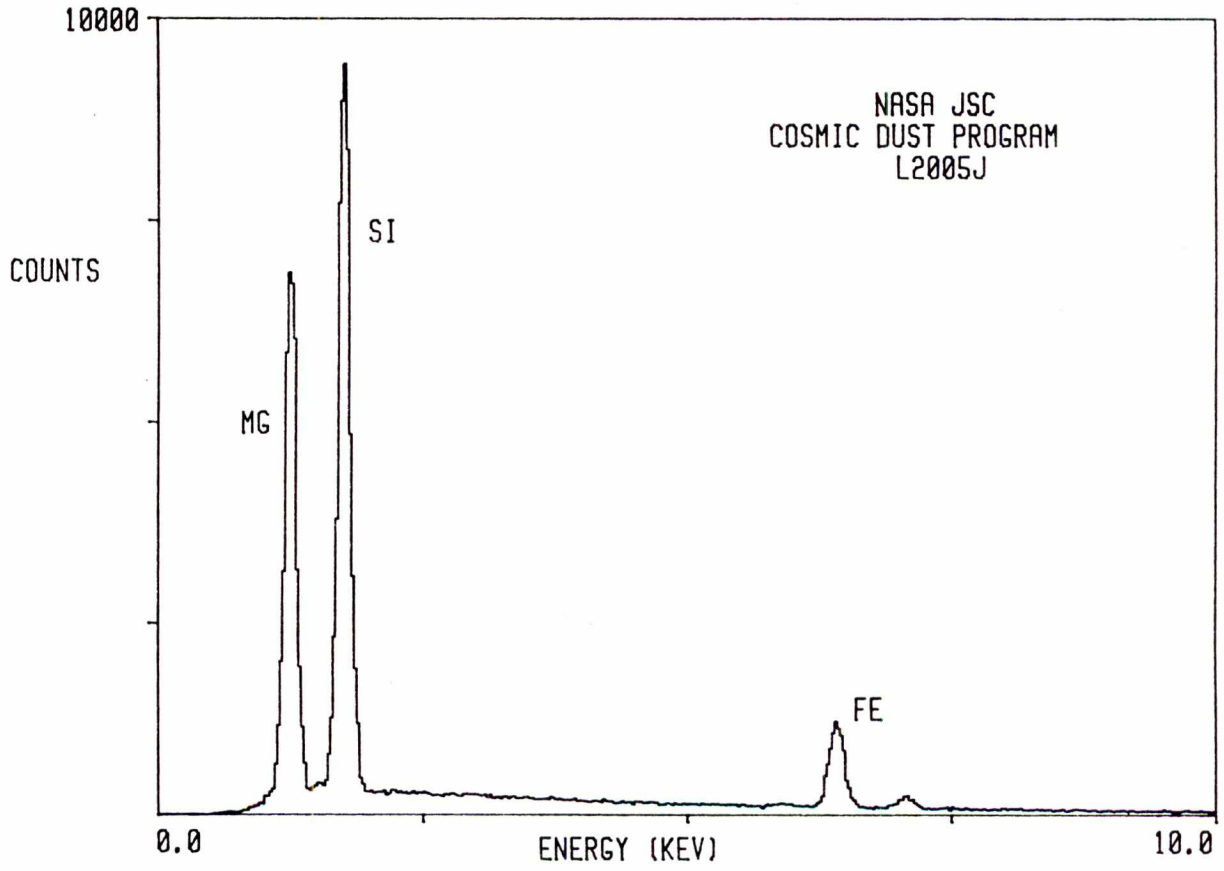
L2005 J 25



S-90-38217

SIZE: 7x8
SHAPE: S
TRANS.: O/TL
COLOR: Brown
LUSTER: D/V
TYPE: TCN

COMMENTS:

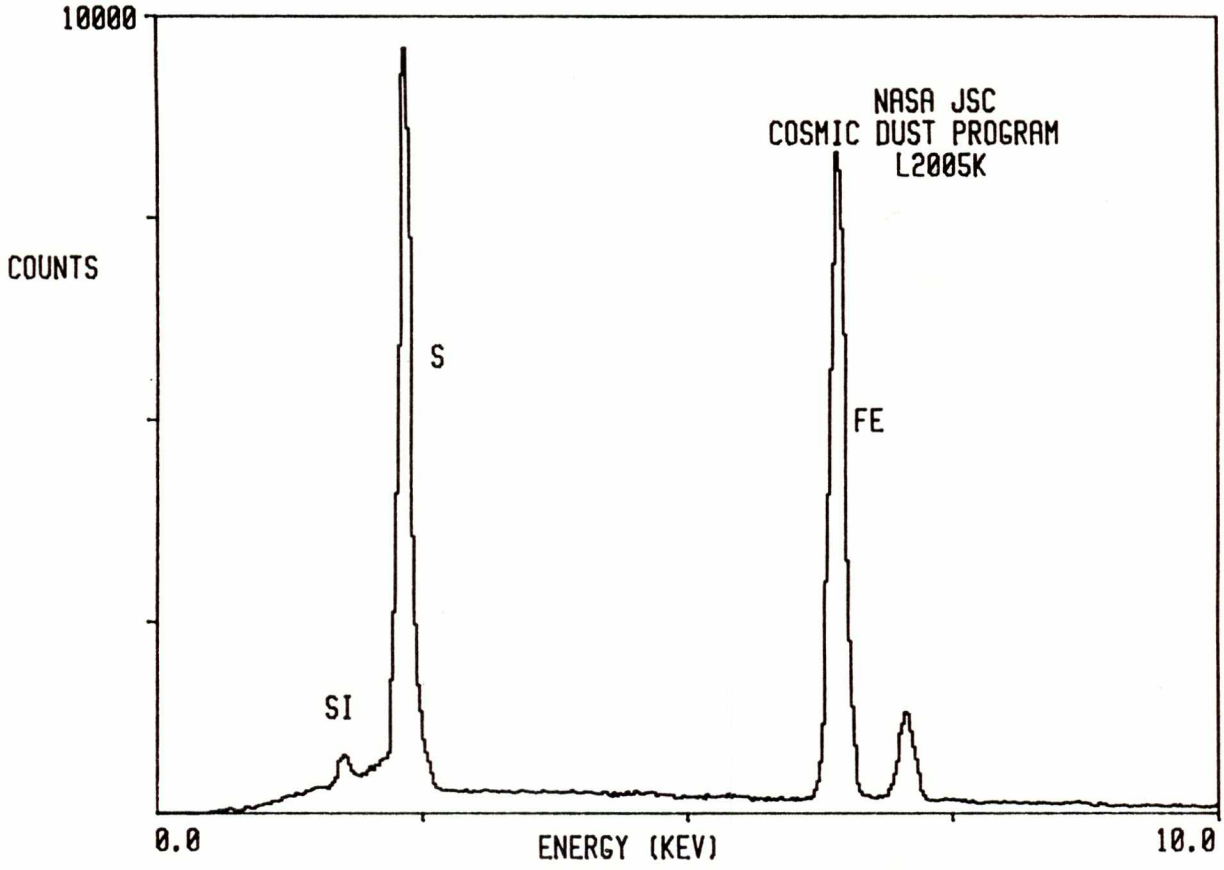


L2005 K 4

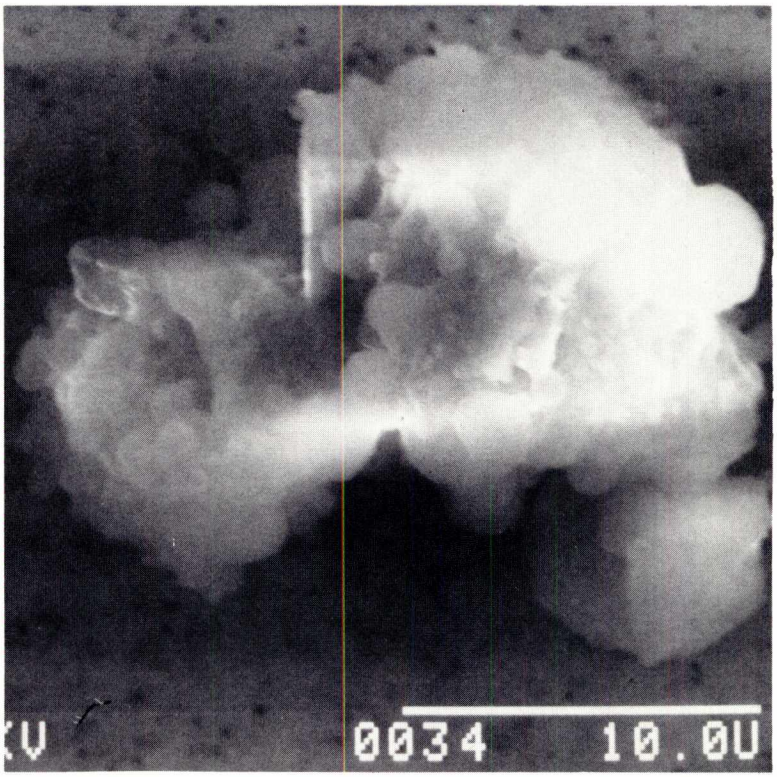
S-90-38155

SIZE: 11x14
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: TCN

COMMENTS:



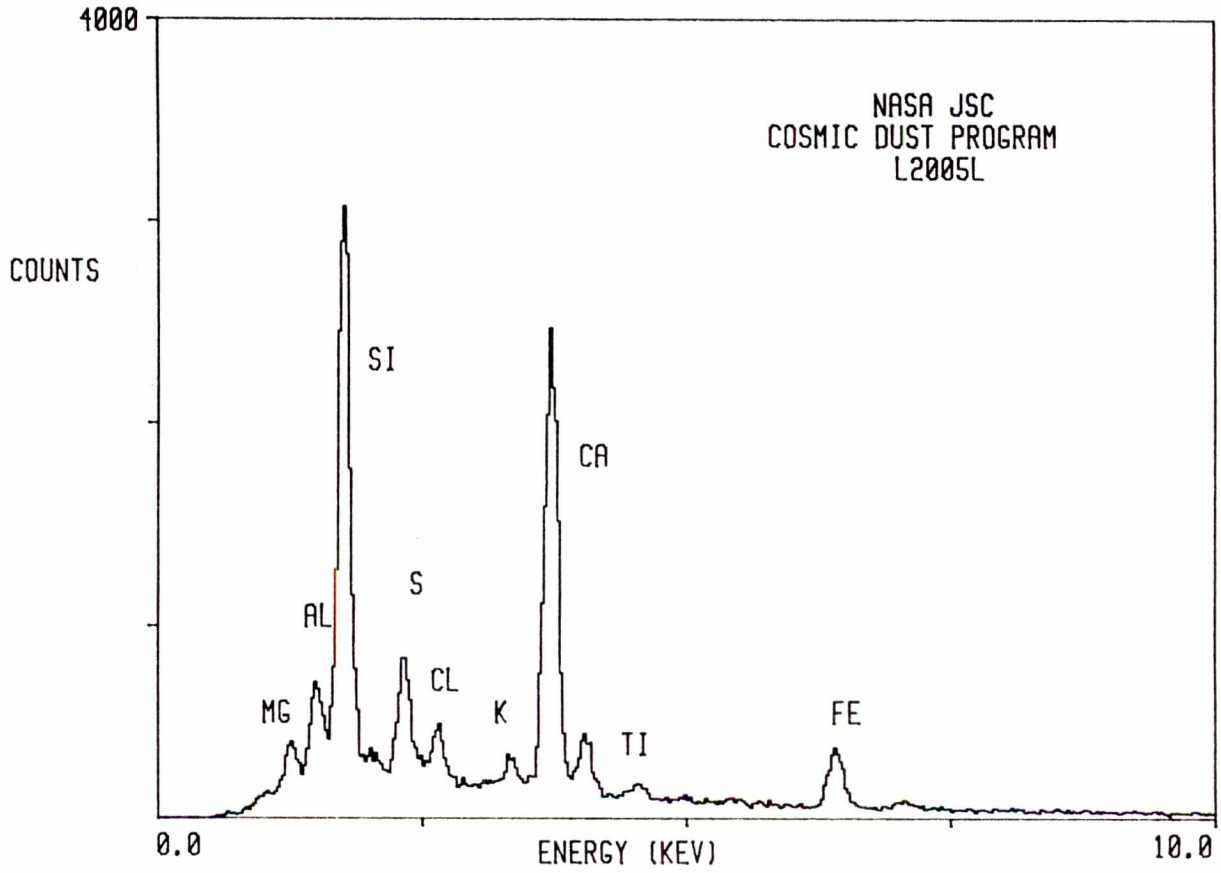
L2005 L 3



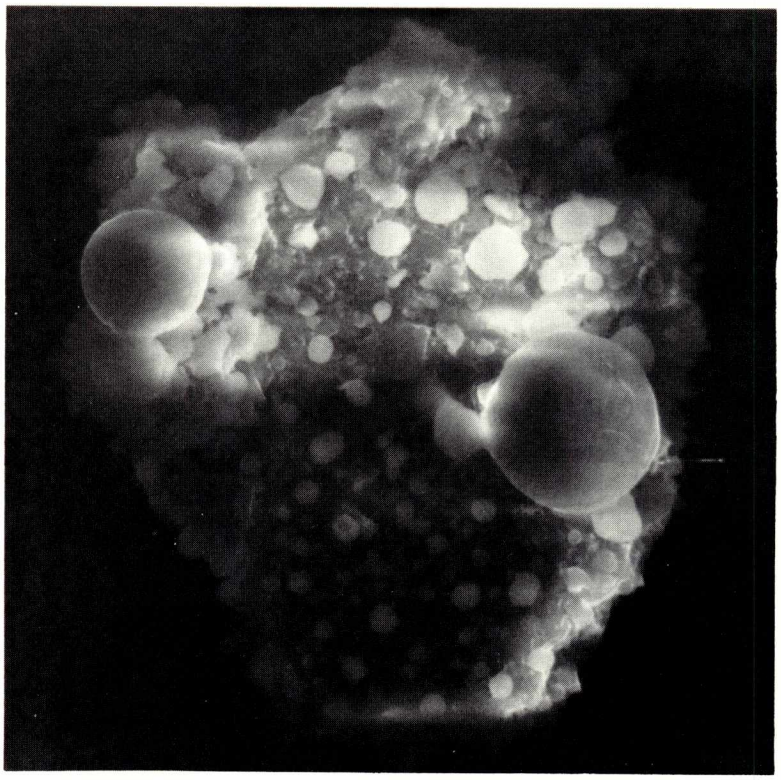
S-90-38222

SIZE: 21x23
SHAPE: I
TRANS.: TL
COLOR: White
LUSTER: D
TYPE: TCN

COMMENTS:



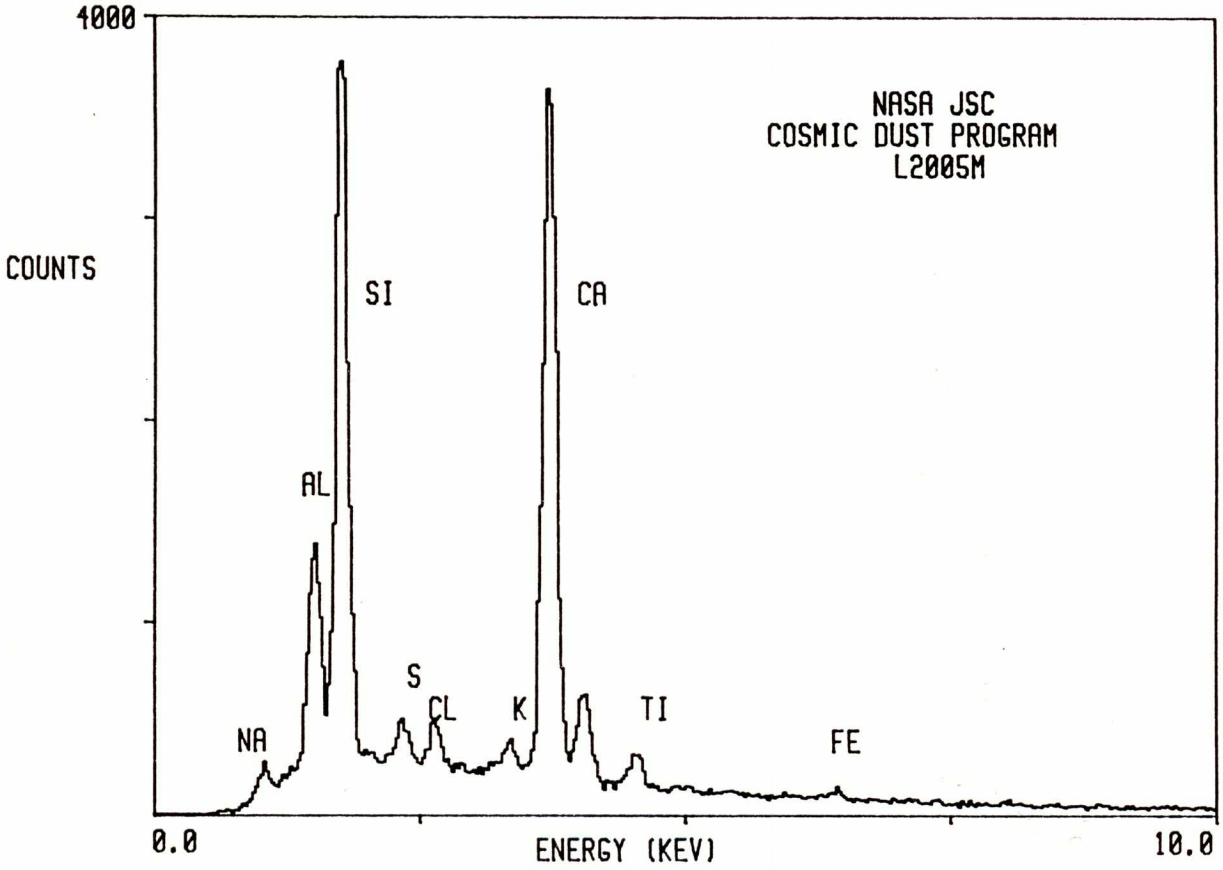
L2005 M 1



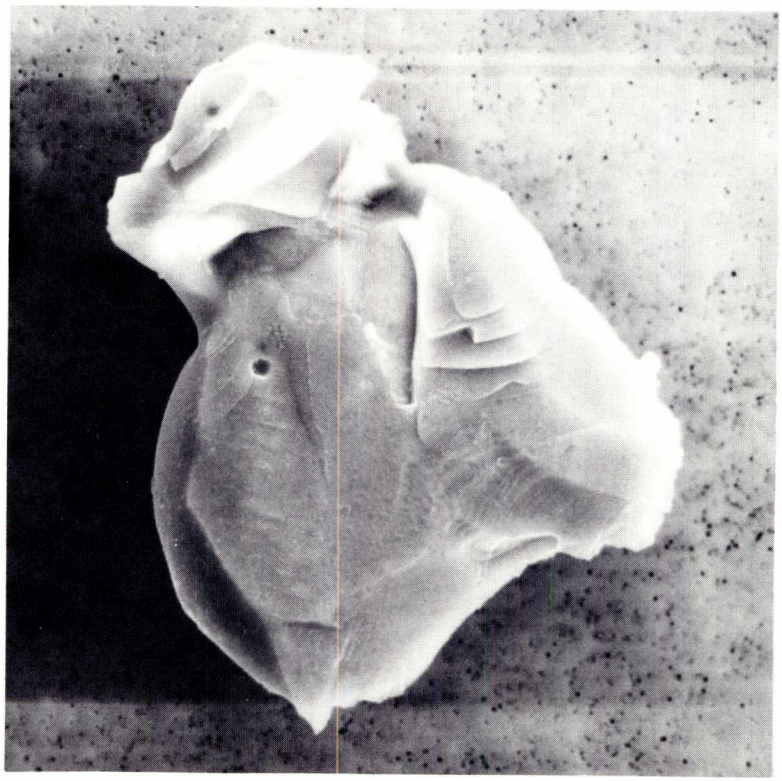
S-90-38229

SIZE: 55x65
SHAPE: I
TRANS.: O/TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



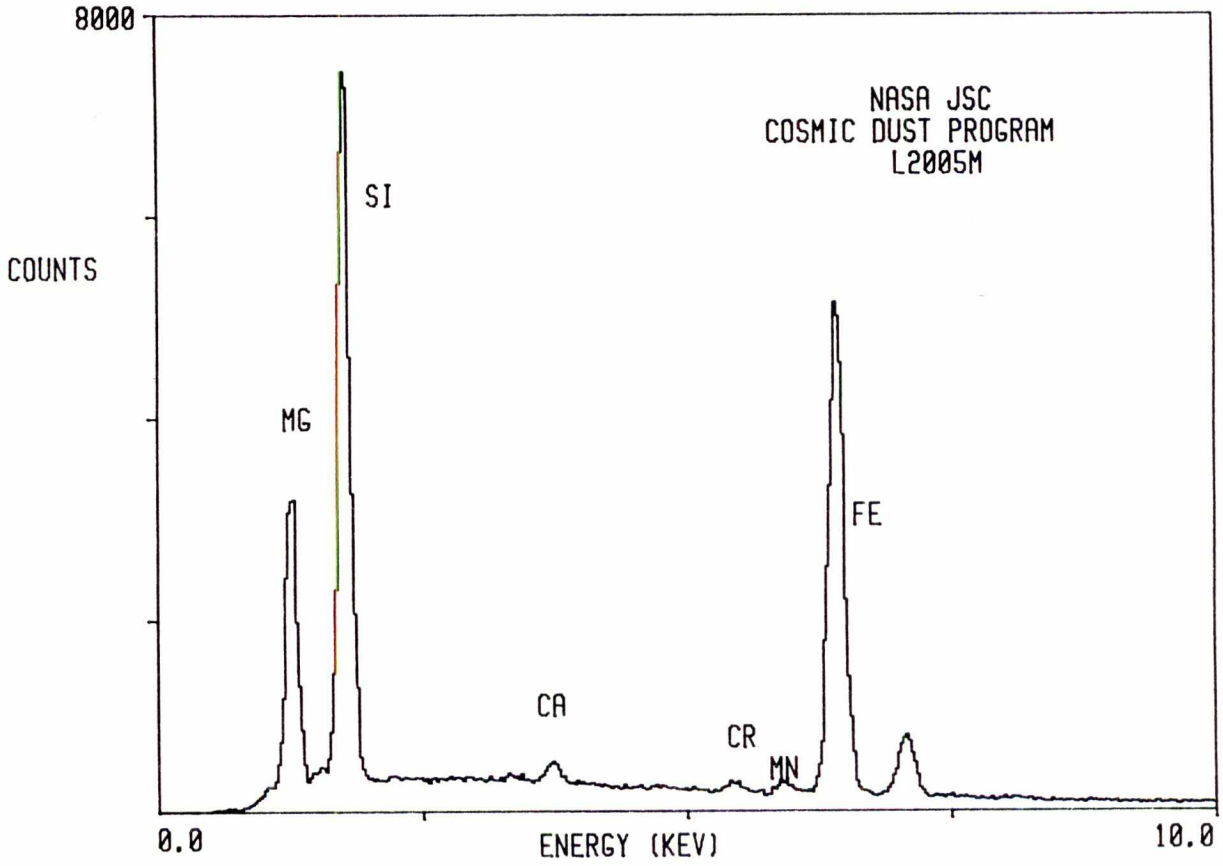
L2005 M 4



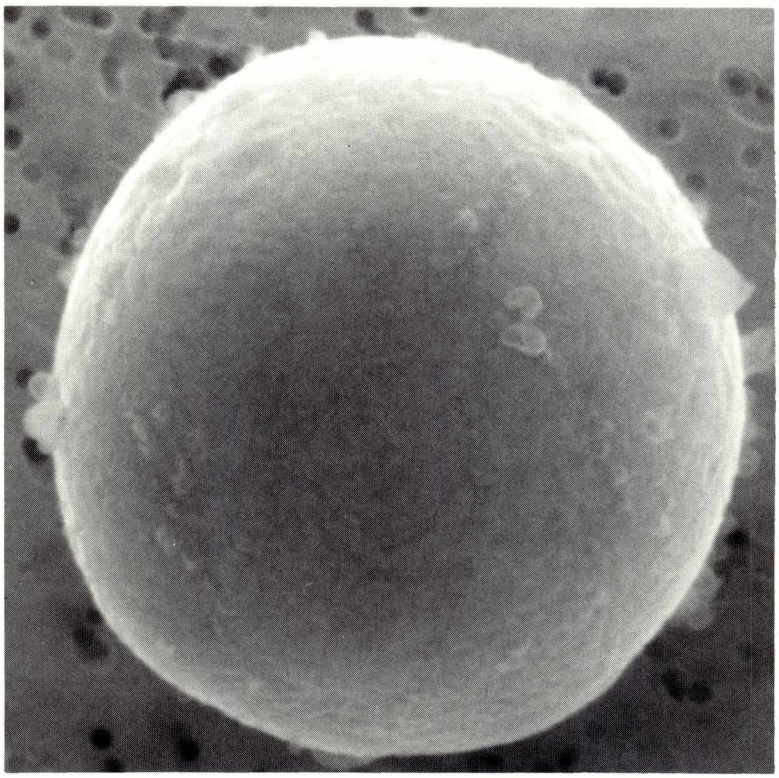
S-90-38232

SIZE: 36x42
SHAPE: I
TRANS.: TC
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



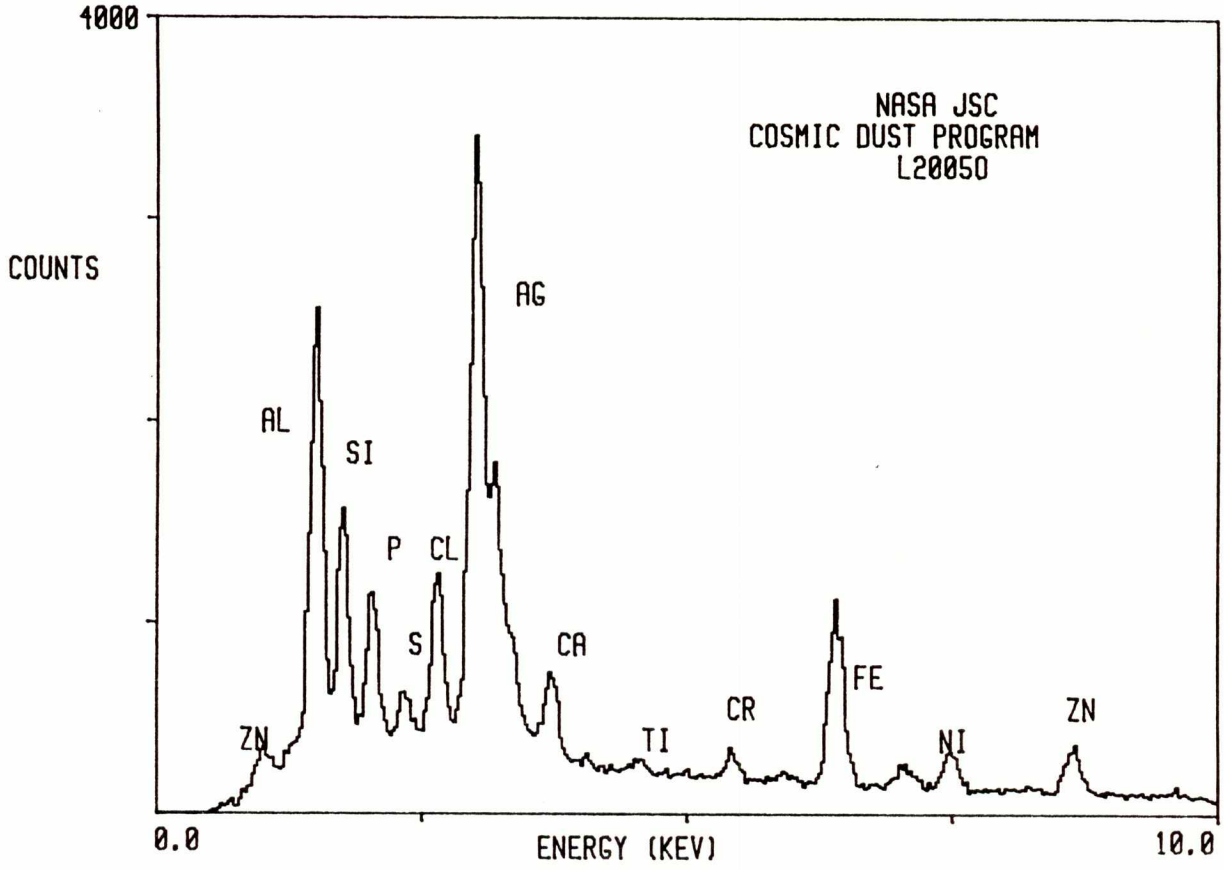
L2005 O 5



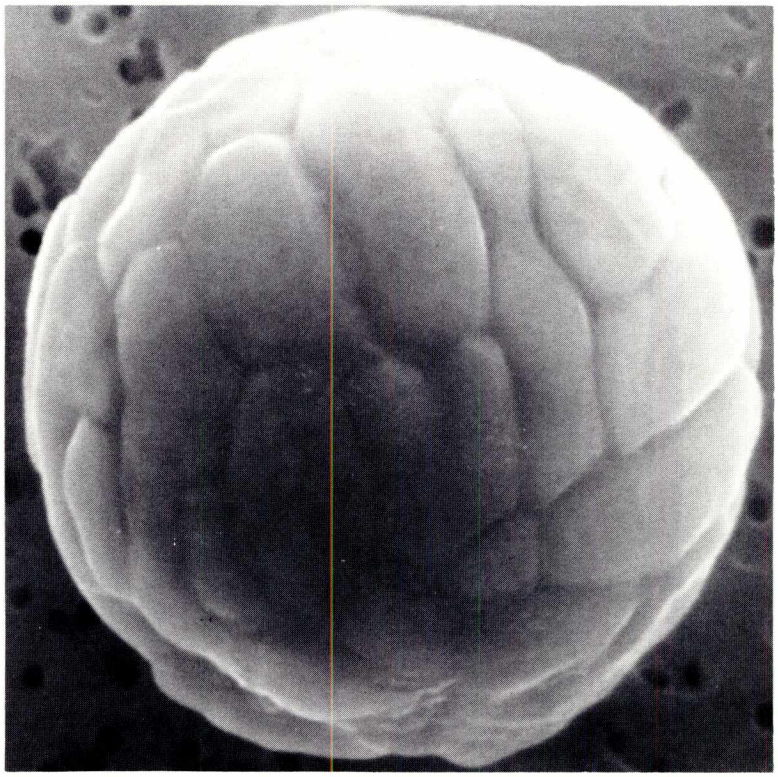
S-90-38244

SIZE: 11
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: D/SM
TYPE: TCN

COMMENTS:



L2005 O 8



S-90-38247

SIZE: 8

SHAPE: S

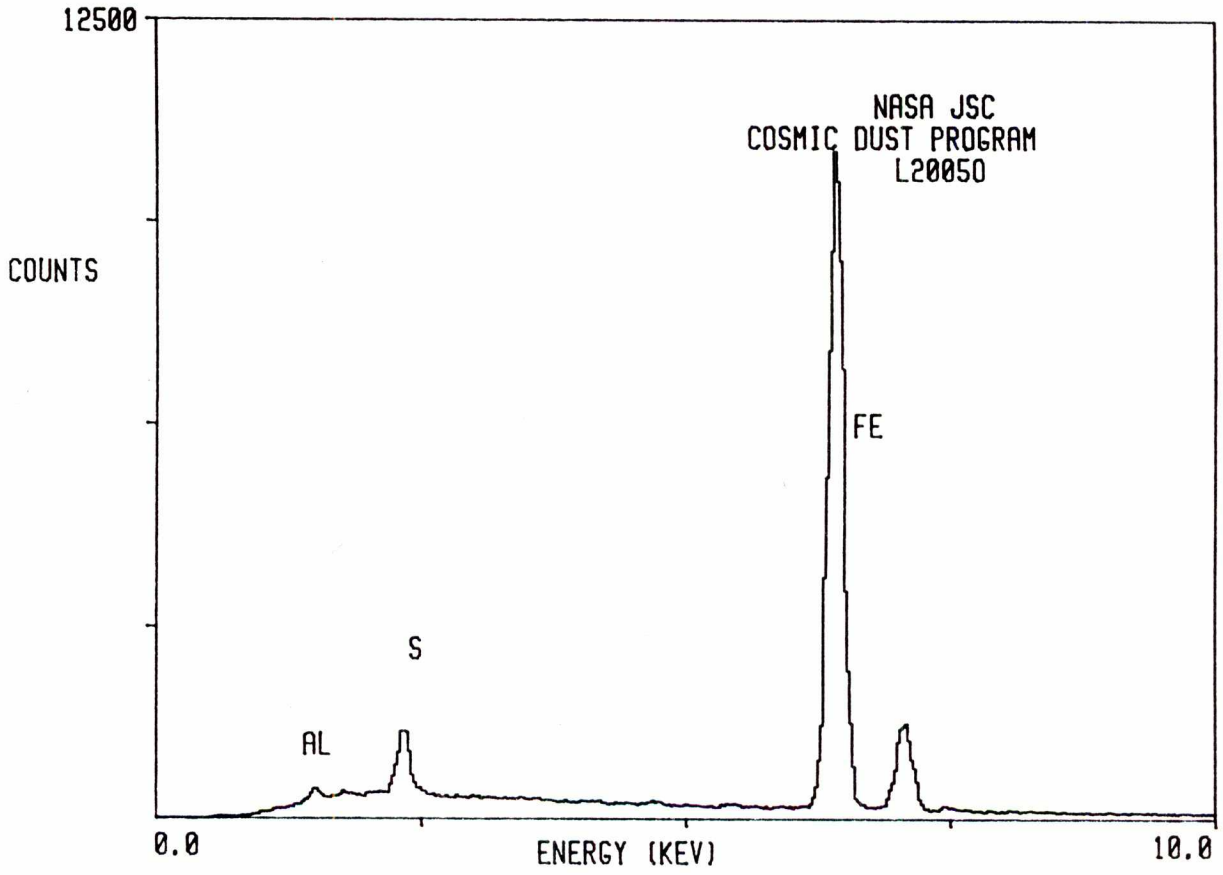
TRANS.: O/TL

COLOR: Black to Brown

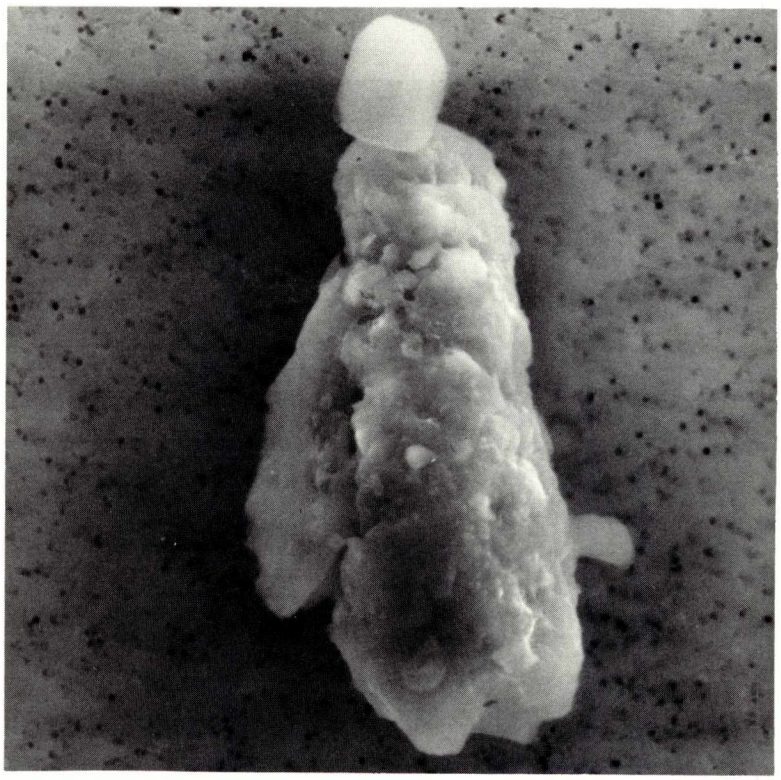
LUSTER: D

TYPE: TCN

COMMENTS:

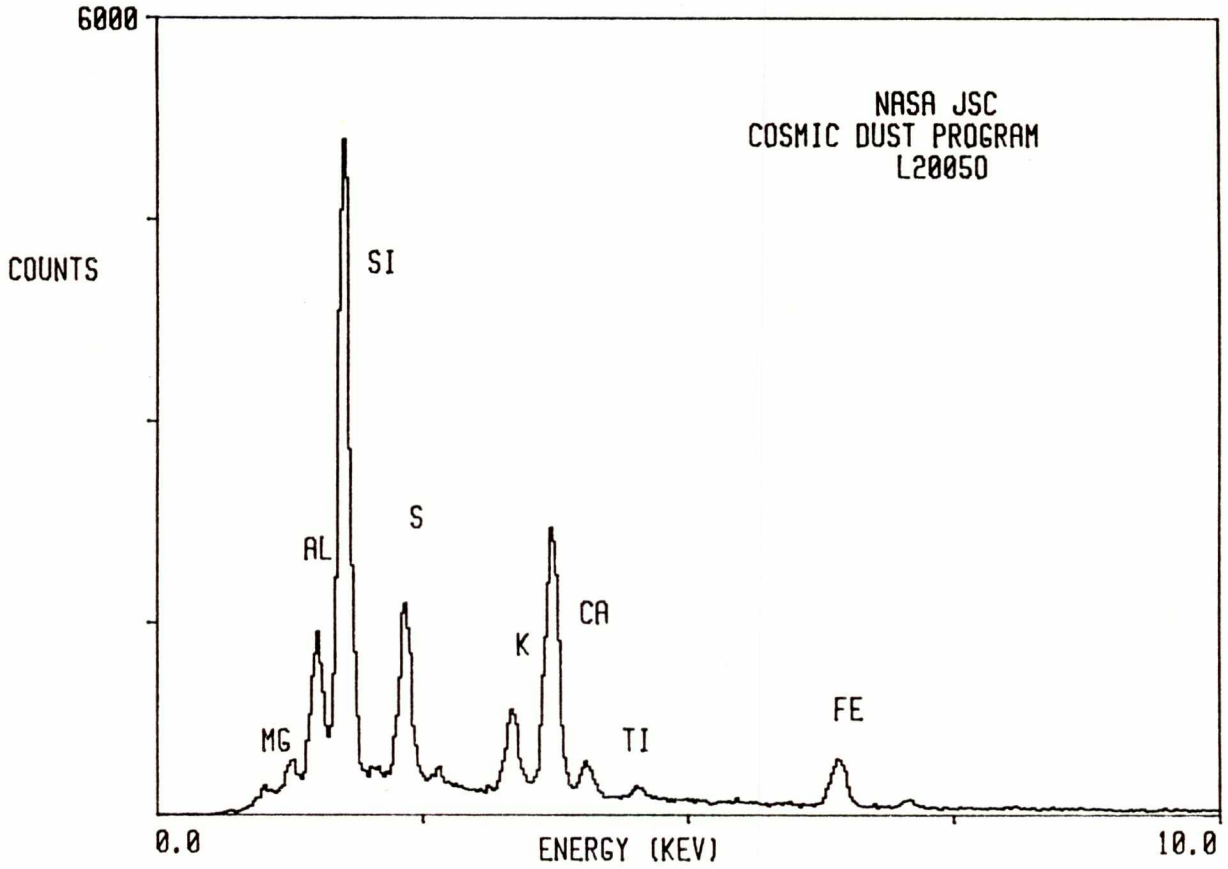


L2005 O 9

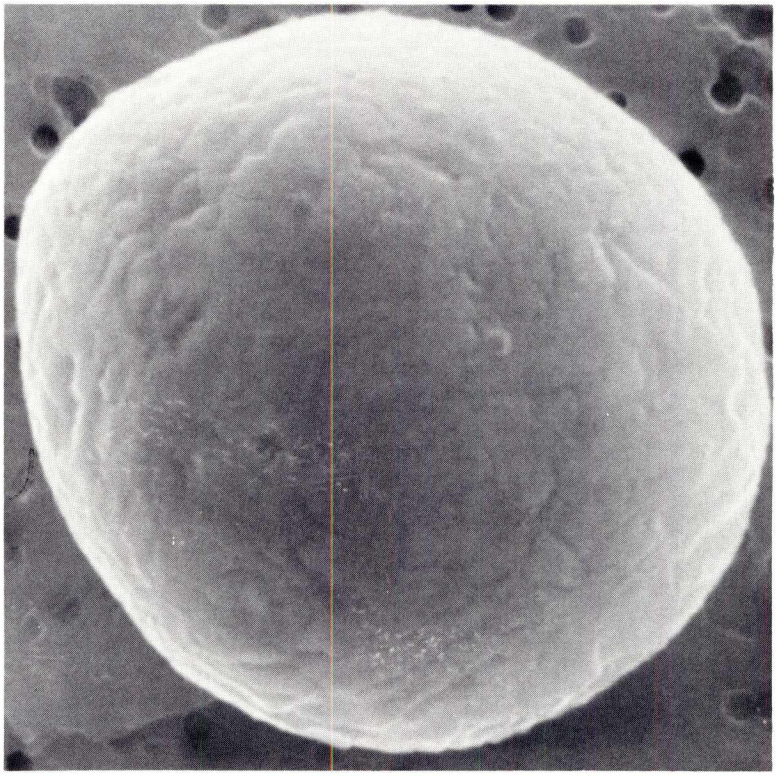


S-90-38248

SIZE: 18x33
SHAPE: I
TRANS.: TL
COLOR: WHITE
LUSTER: V
TYPE: TCN
COMMENTS:



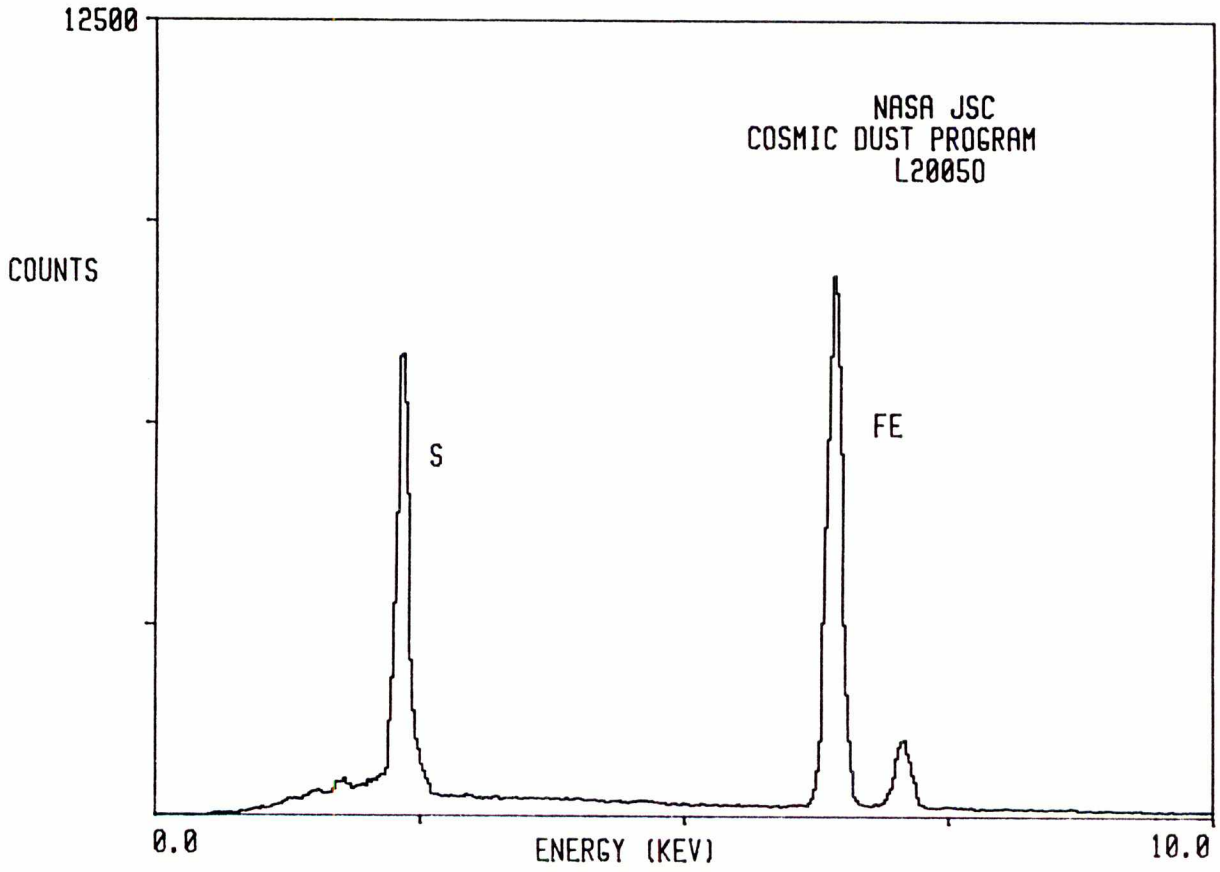
L2005 O 10



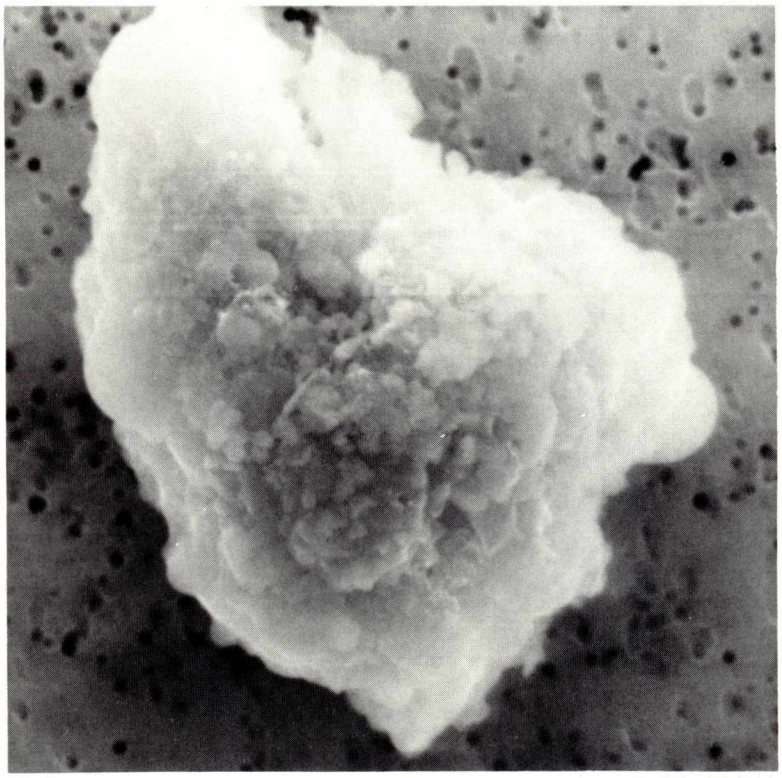
S-90-38249

SIZE: 8
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: TCN

COMMENTS:



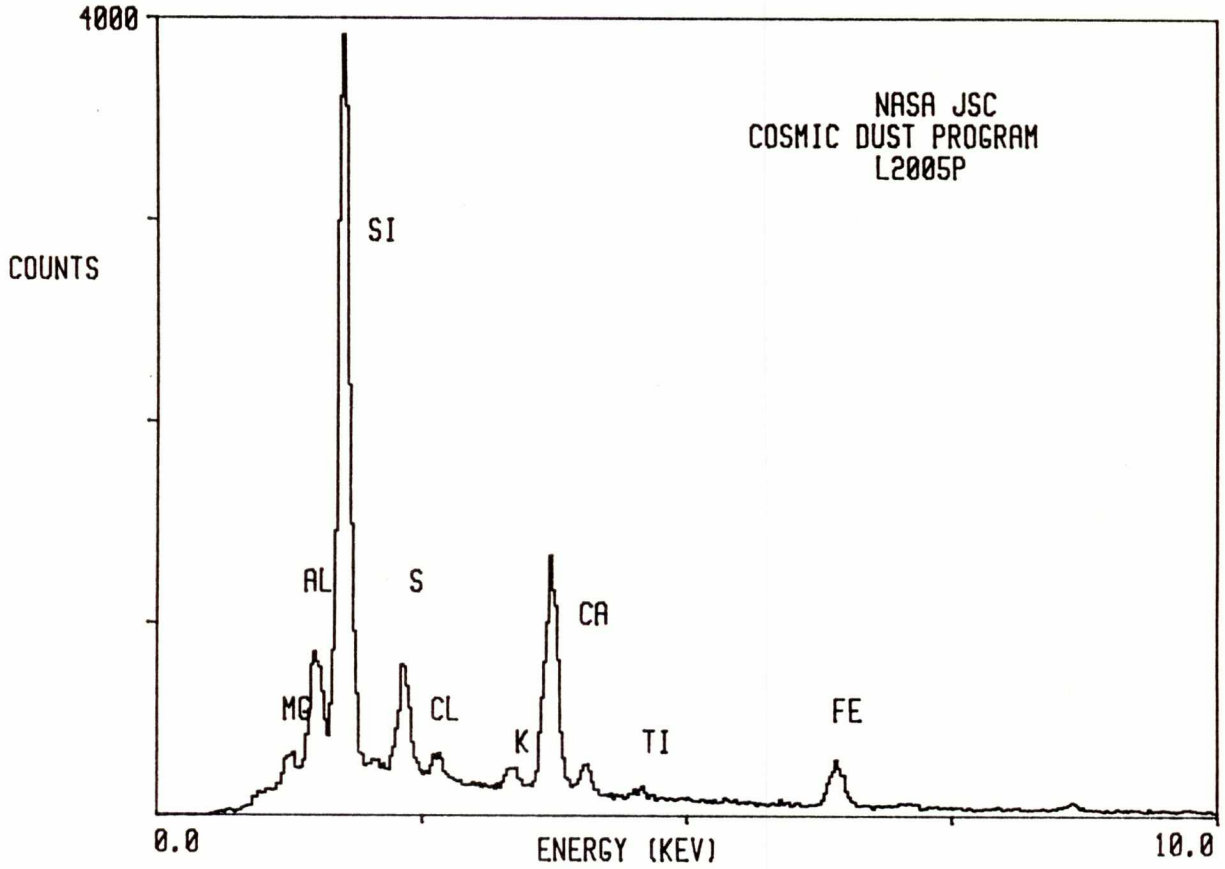
L2005 P 4



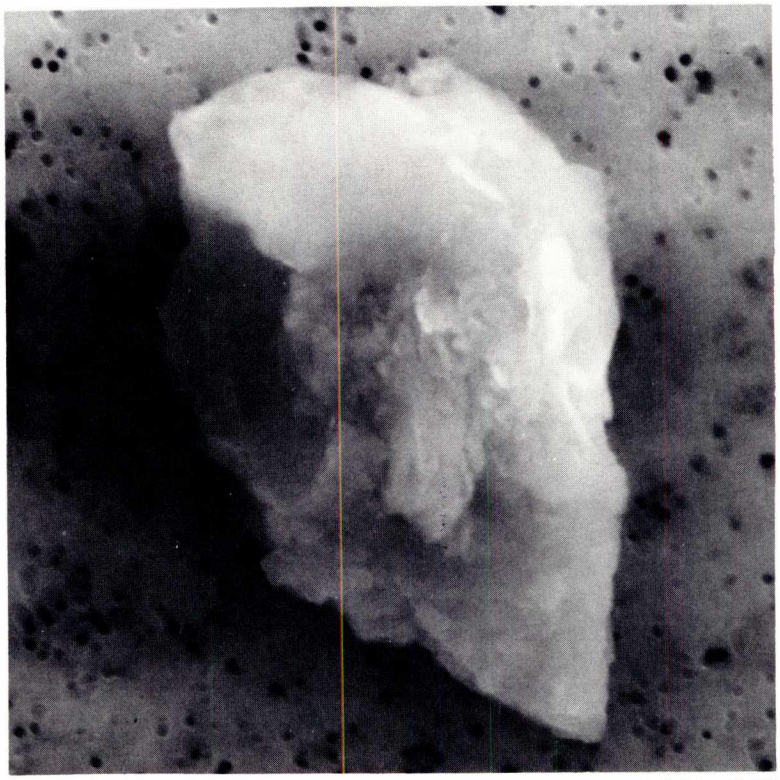
S-90-38253

SIZE: 12x16
SHAPE: I
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



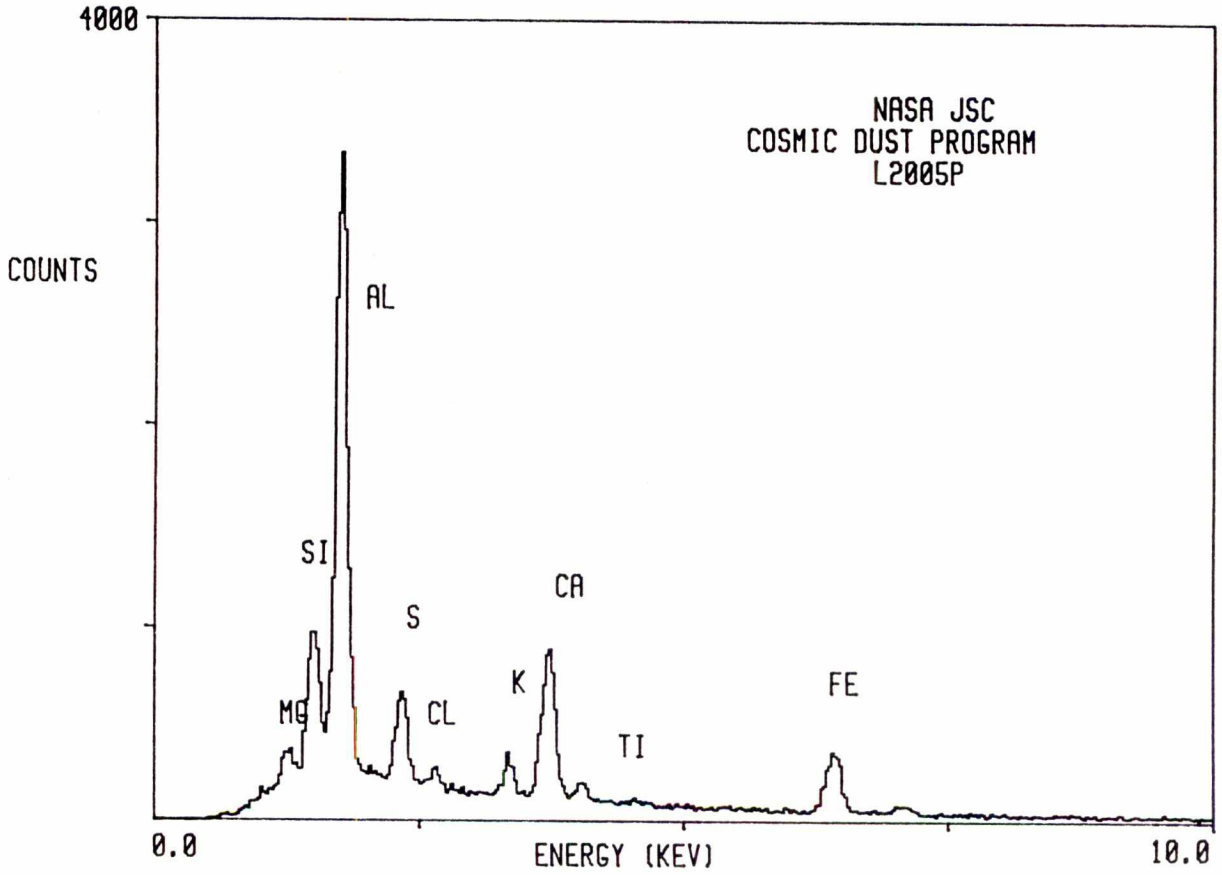
L2005 P 8



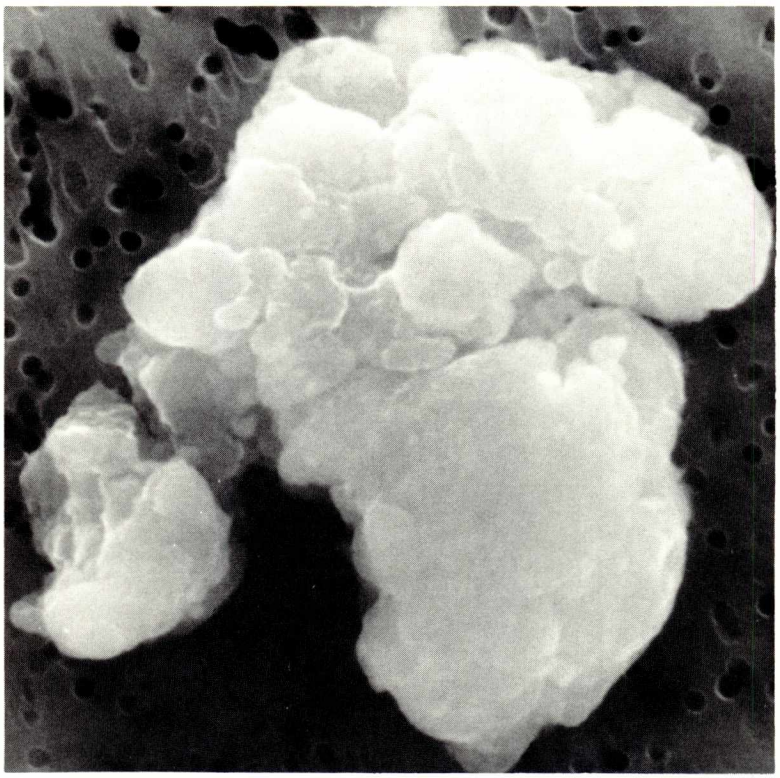
S-90-38257

SIZE: 10
SHAPE: I
TRANS.: TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



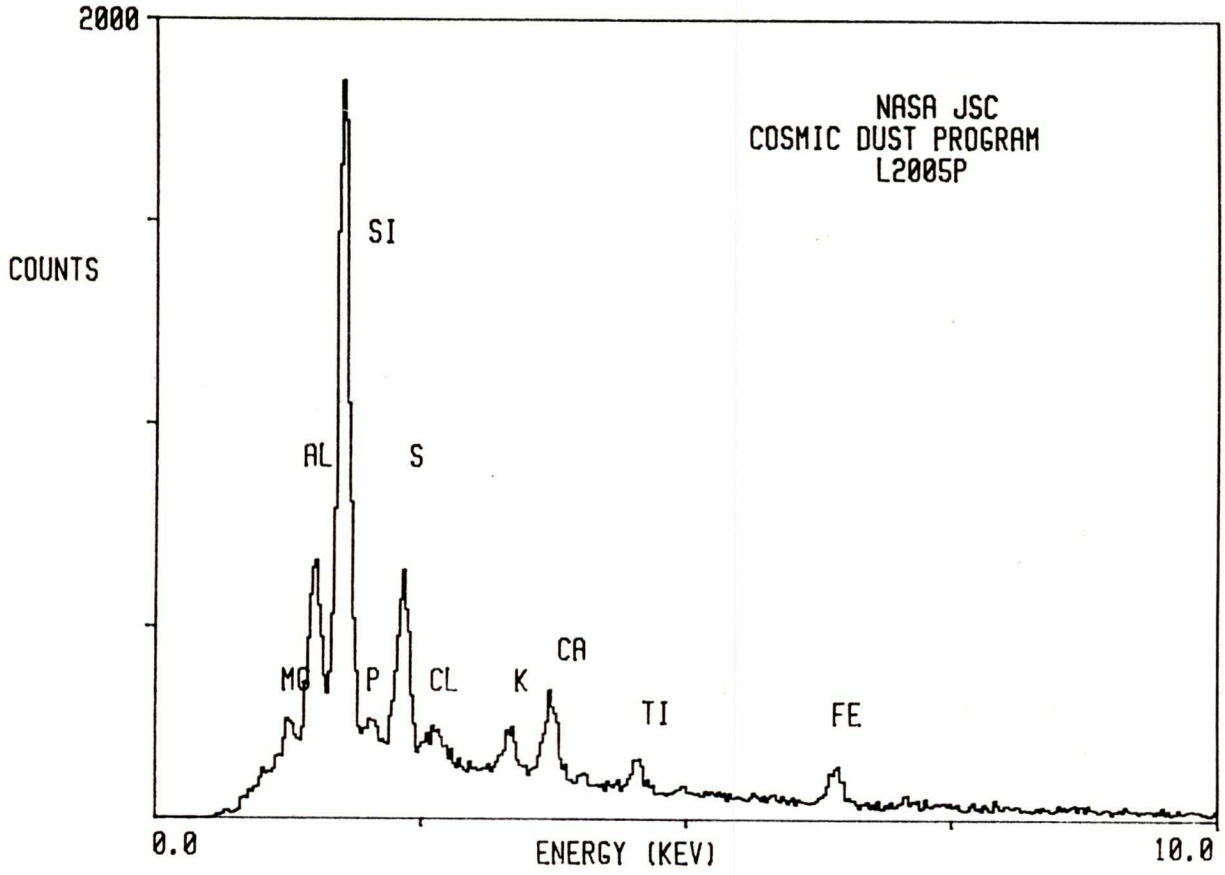
L2005 P 11



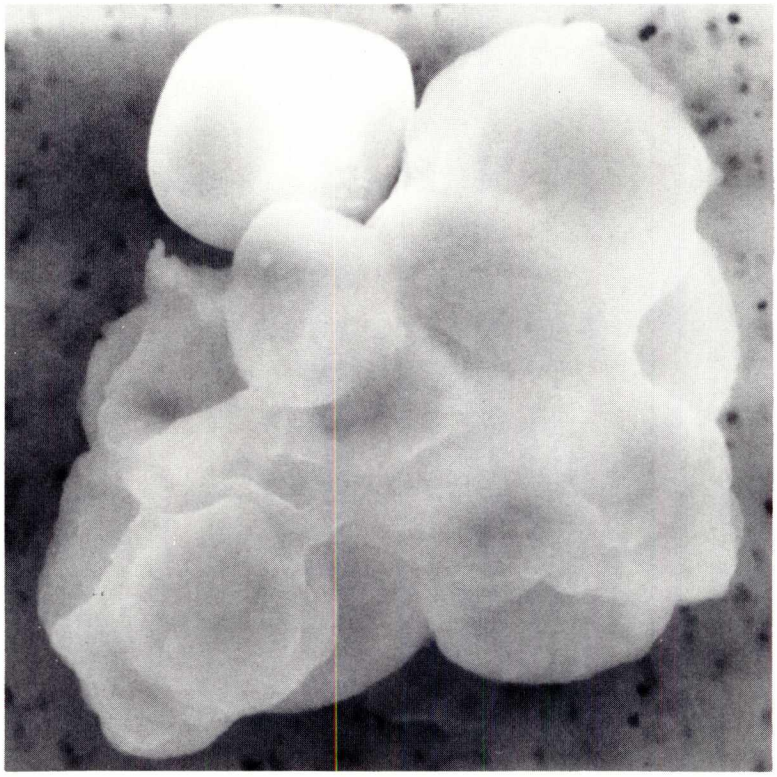
S-90-38260

SIZE: 10x13
SHAPE: I
TRANS.: T/TL
COLOR: White
LUSTER: V
TYPE: TCN

COMMENTS:



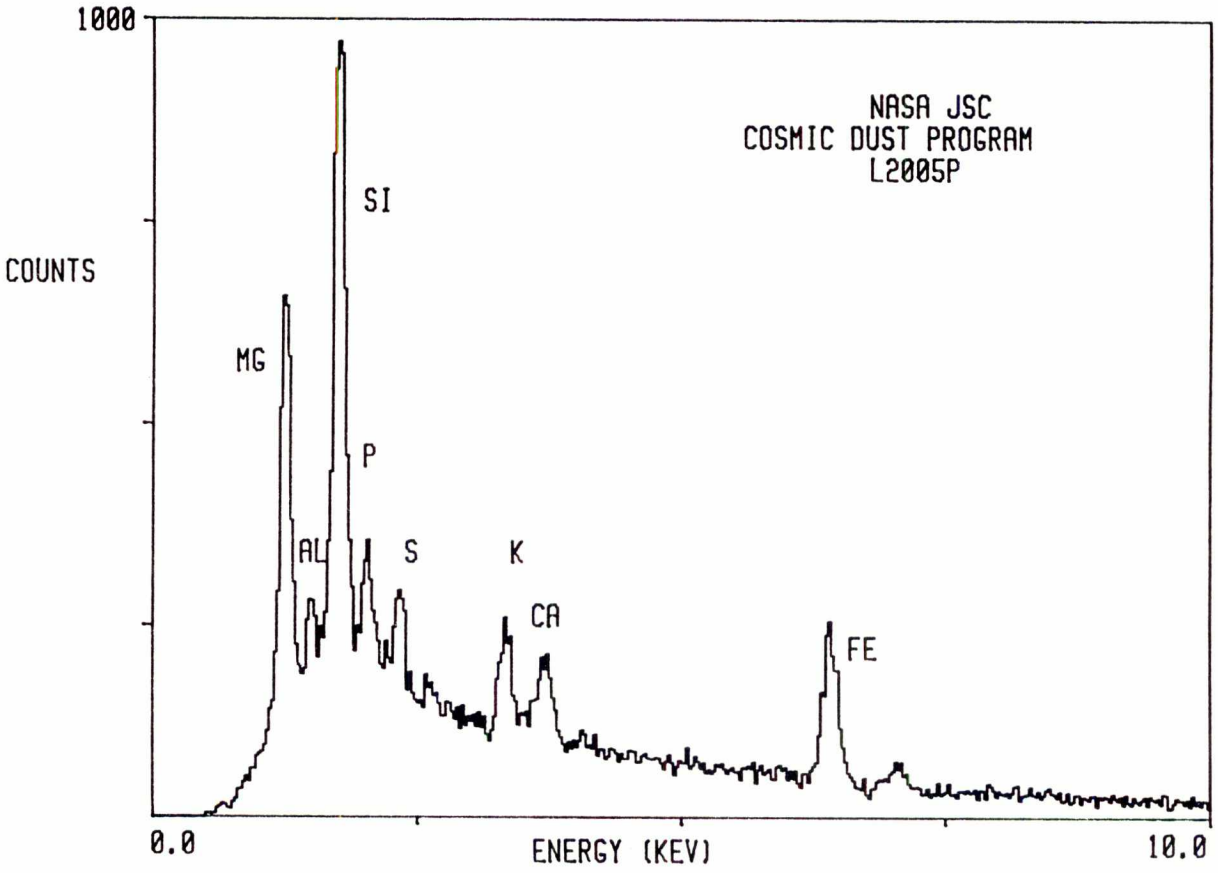
L2005 P 14



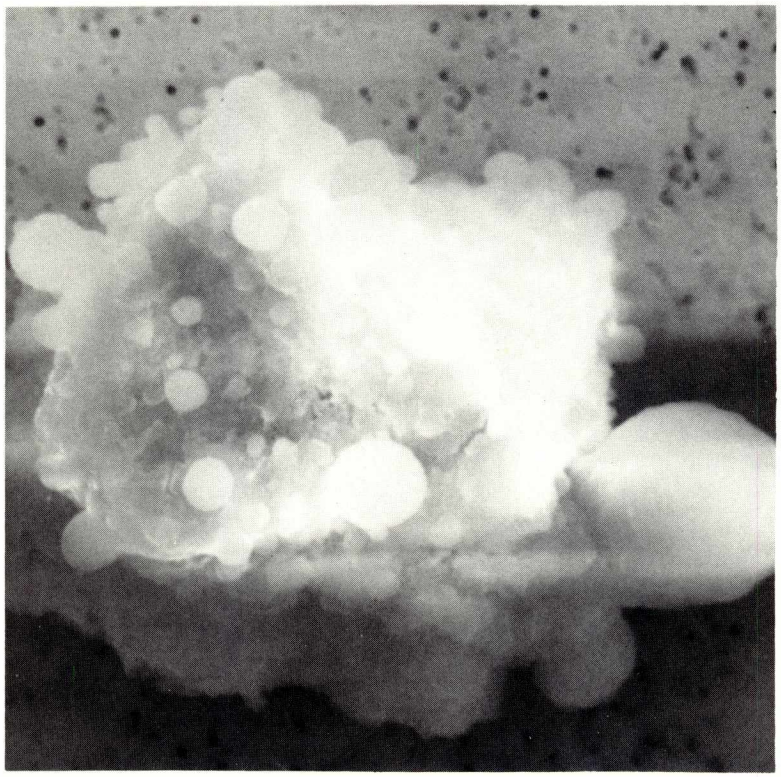
S-90-38263

SIZE: 22x23
SHAPE: I
TRANS.: O
COLOR: Black to Brown
LUSTER: D/V
TYPE: TCN

COMMENTS:



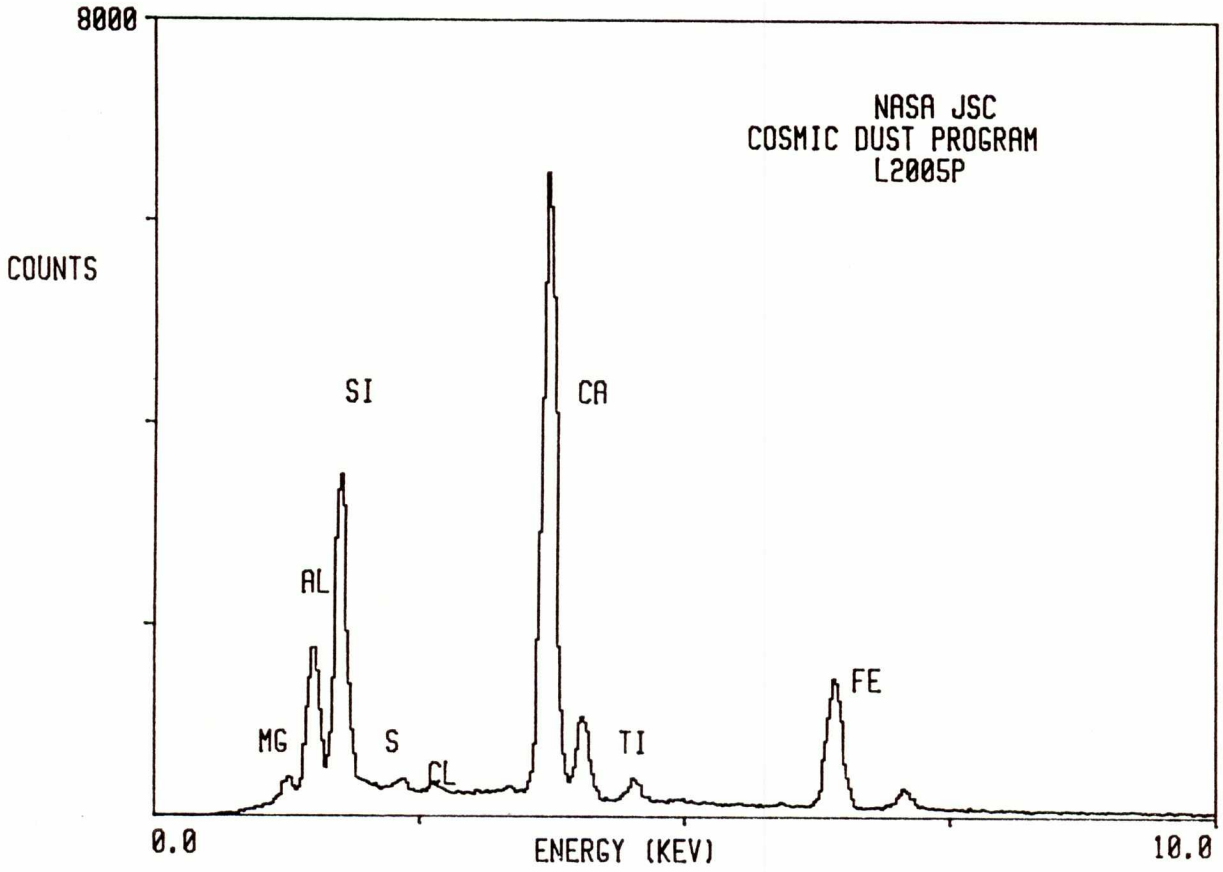
L2005 P 15



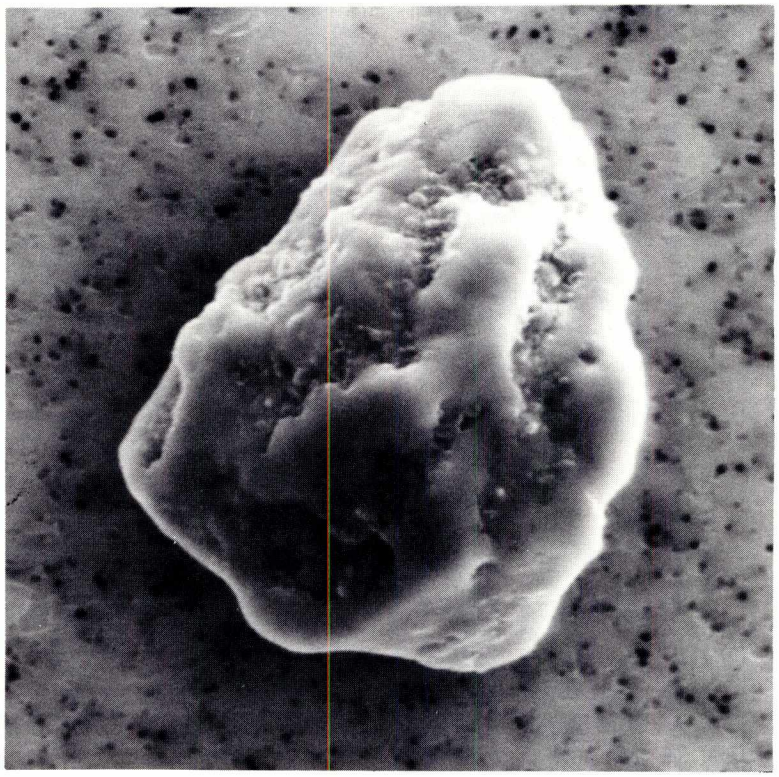
S-90-38264

SIZE: 17x27
SHAPE: I
TRANS.: O/TL
COLOR: Brown
LUSTER: V
TYPE: TCN

COMMENTS:



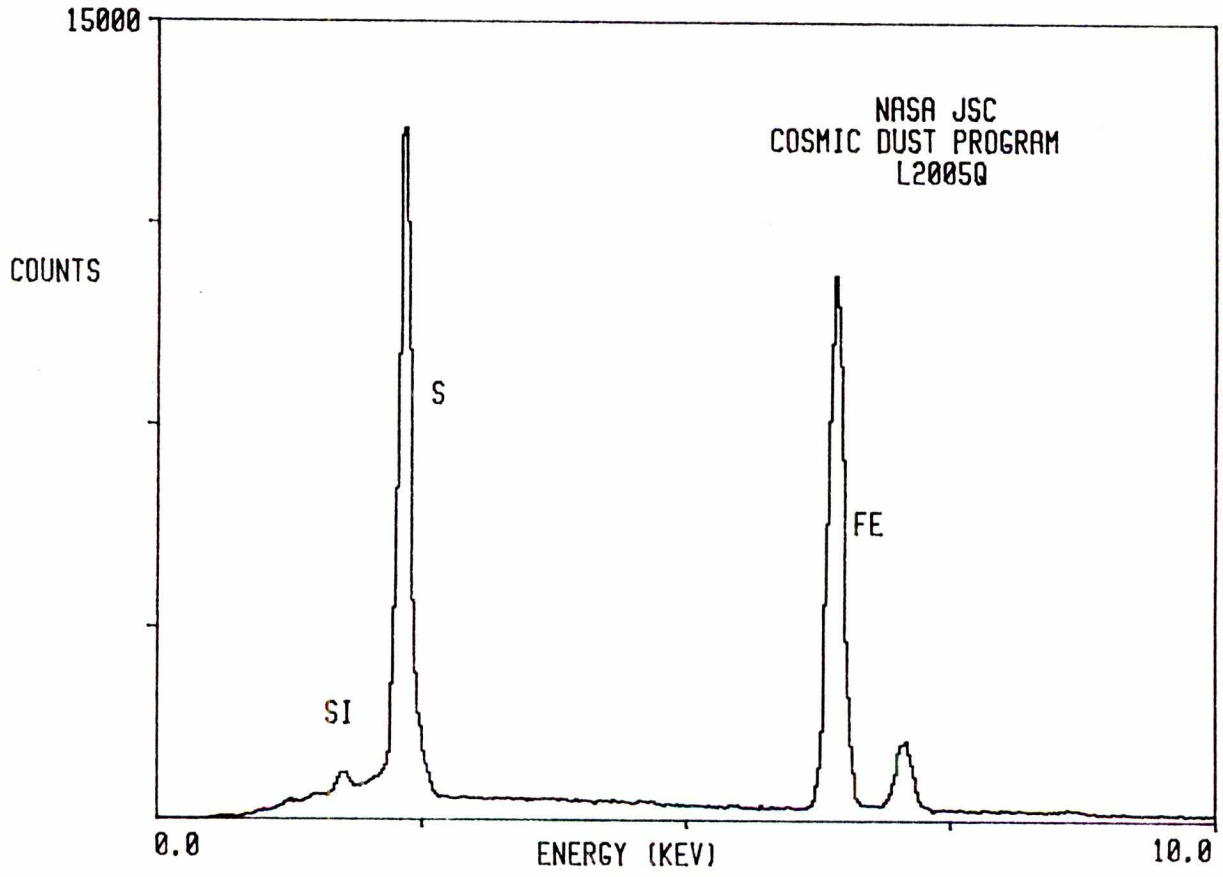
L2005 Q 5



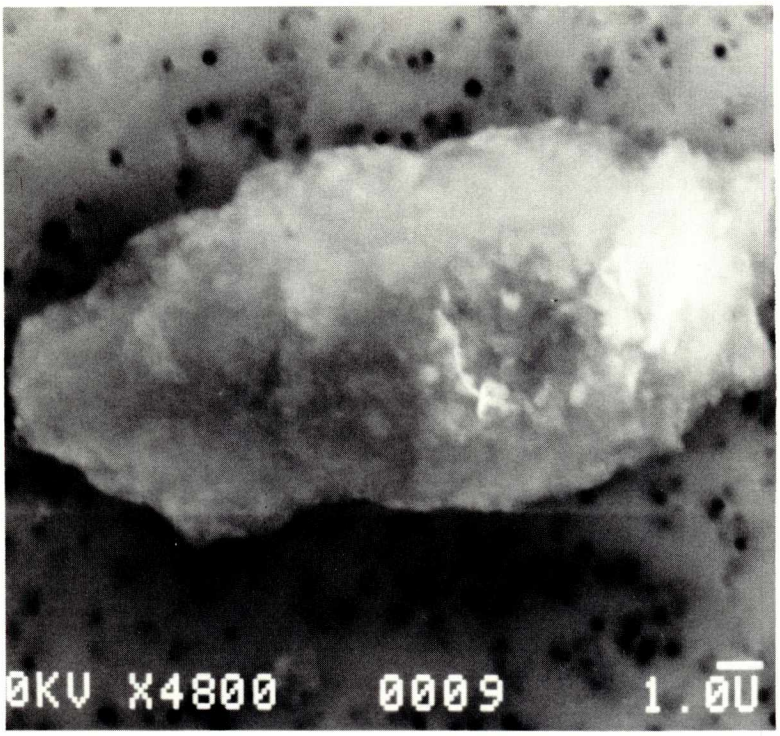
S-90-38271

SIZE: 20
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM
TYPE: TCN

COMMENTS:



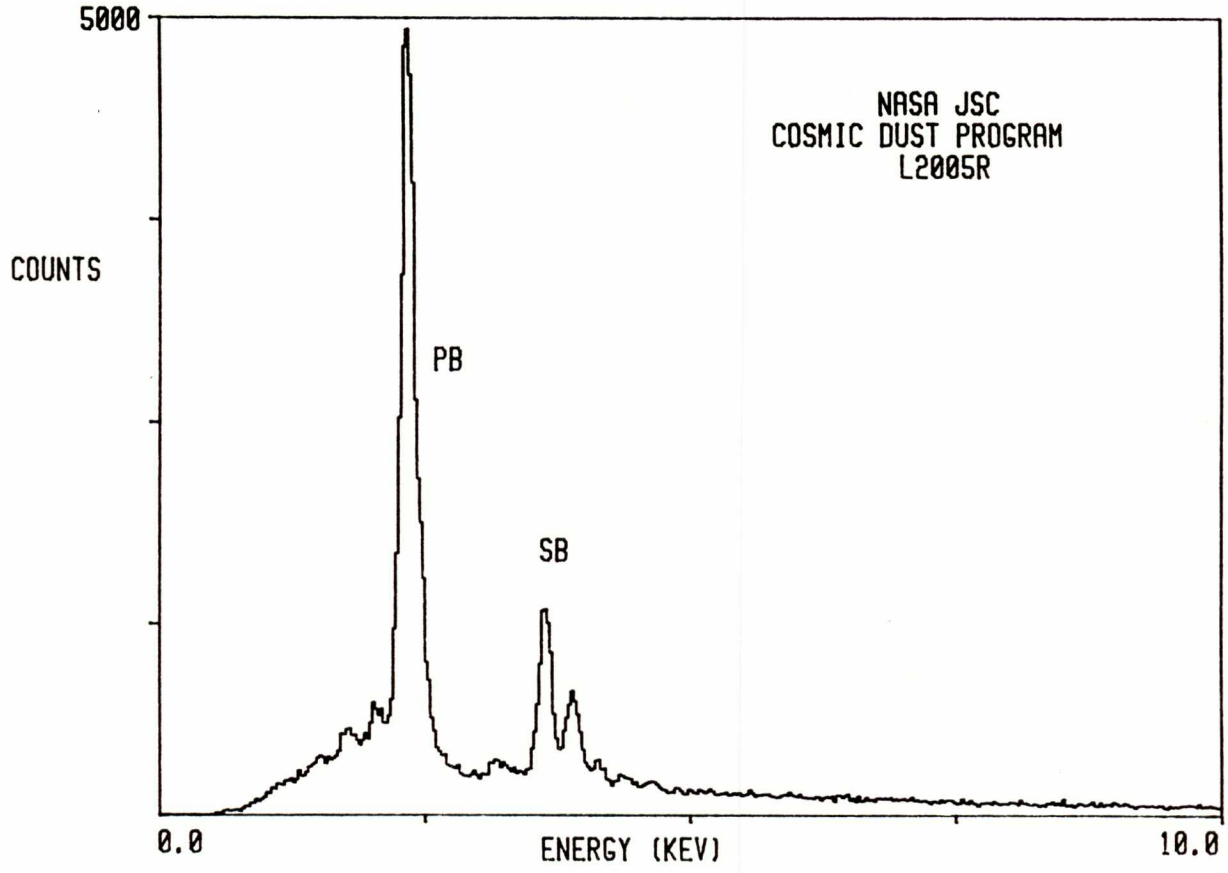
L2005 R 2



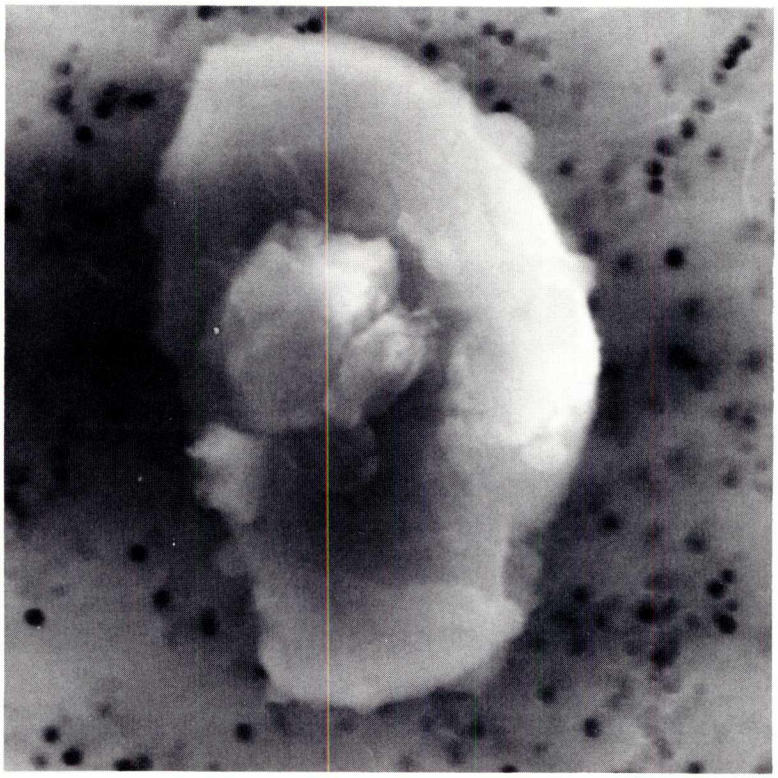
SIZE: 15x30
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM
TYPE: TCN

COMMENTS:

S-90-38276



L2005 S 8



S-90-38282

SIZE: 8x10

SHAPE: E

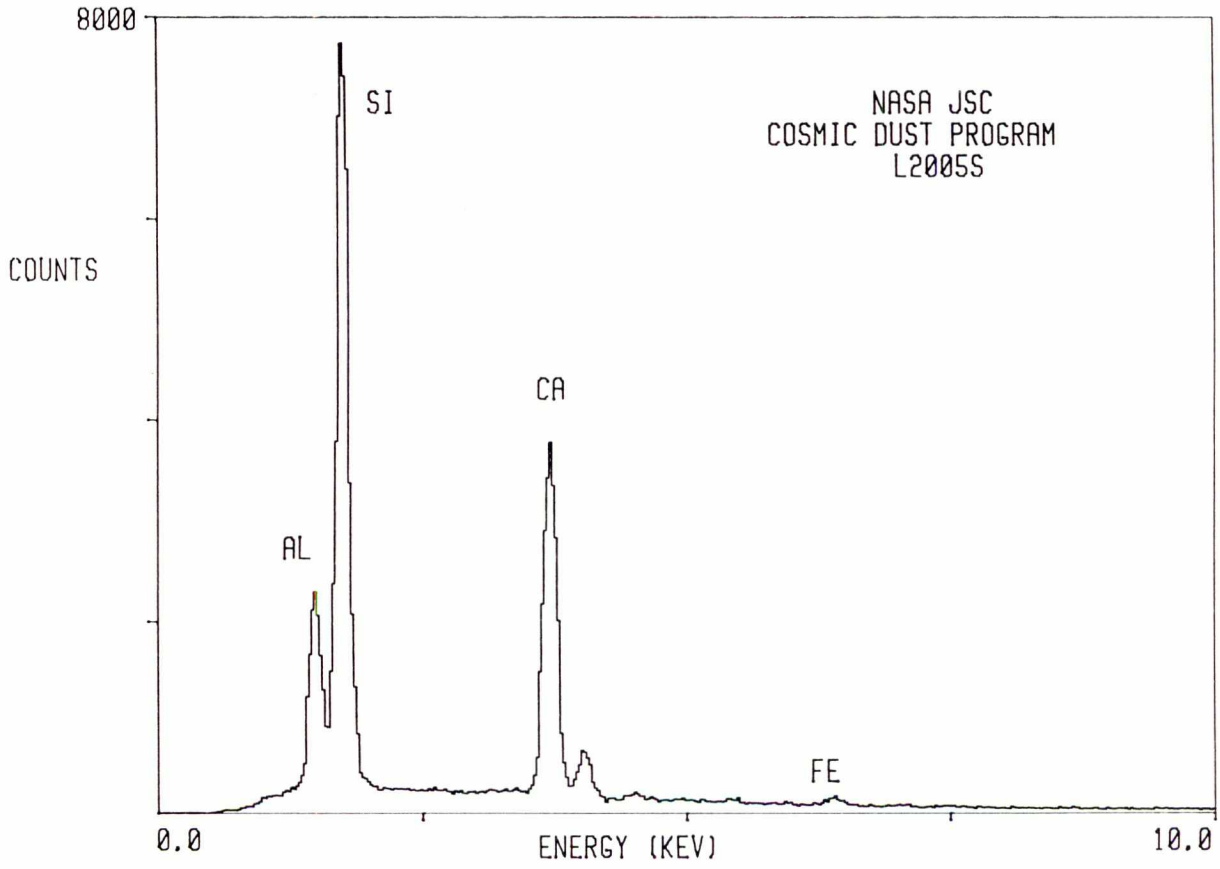
TRANS.: TL

COLOR: White

LUSTER: V

TYPE: TCN

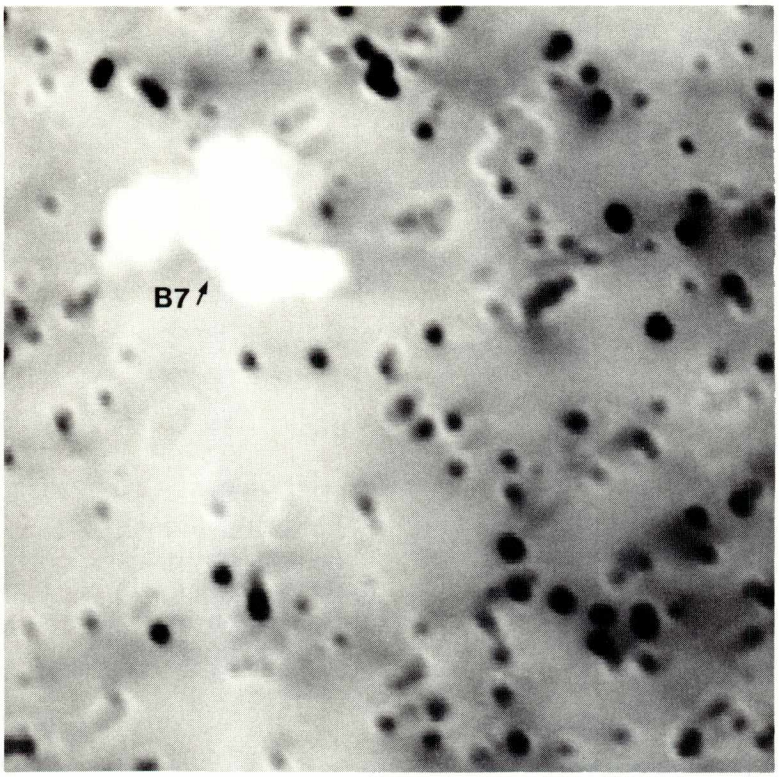
COMMENTS:
Related grains up to 8 microns remain on collector



Particle Descriptions

TCA Type

L2005 B 7



S-90-38131

SIZE: 7

SHAPE: I

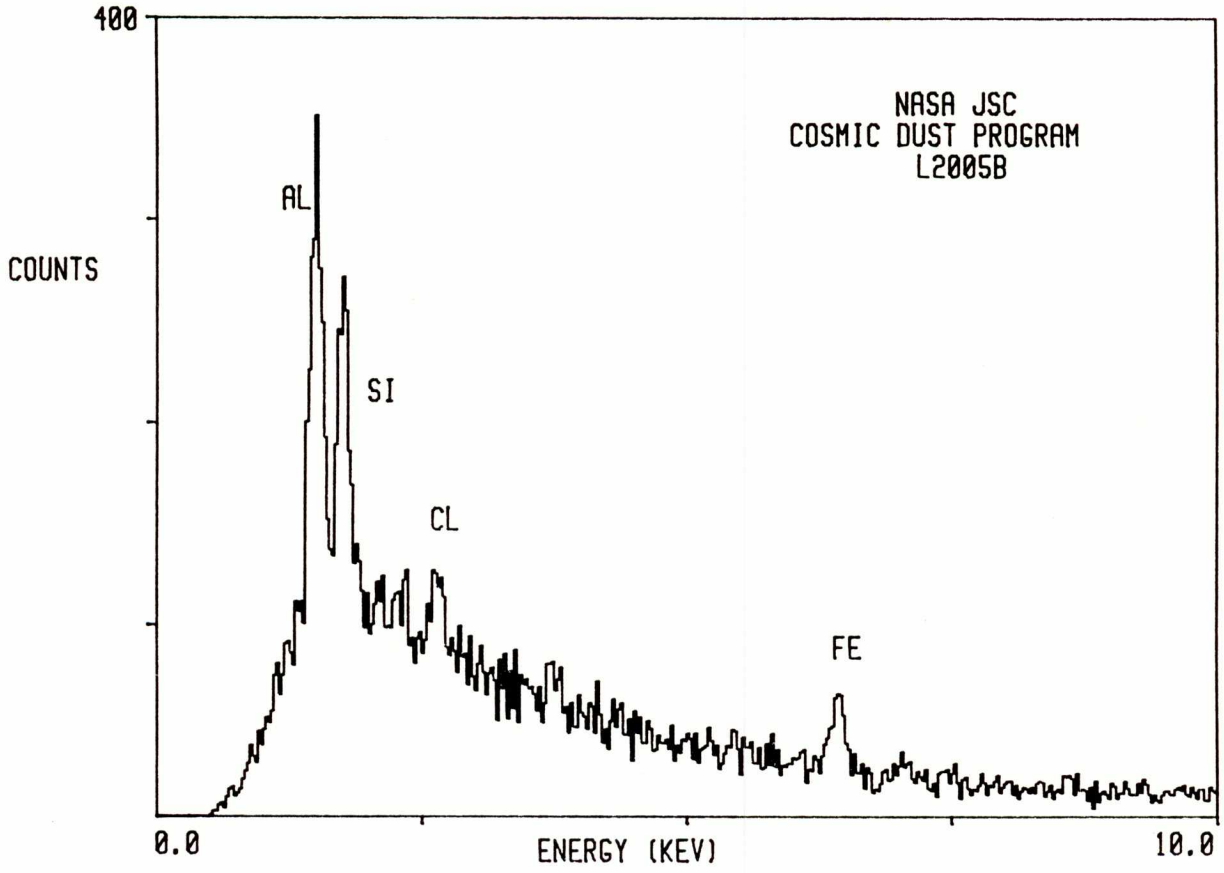
TRANS.: TL

COLOR: Brown

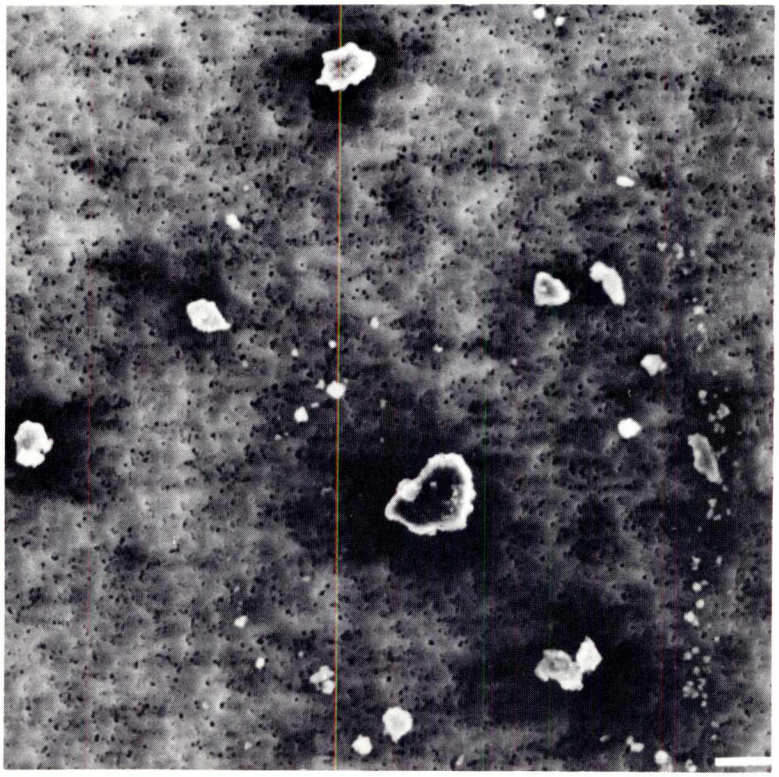
LUSTER: V

TYPE: TCA

COMMENTS:
Related grains up to 7 microns remain on collector



L2005 F 32



S-90-38176

SIZE: 10

SHAPE: I

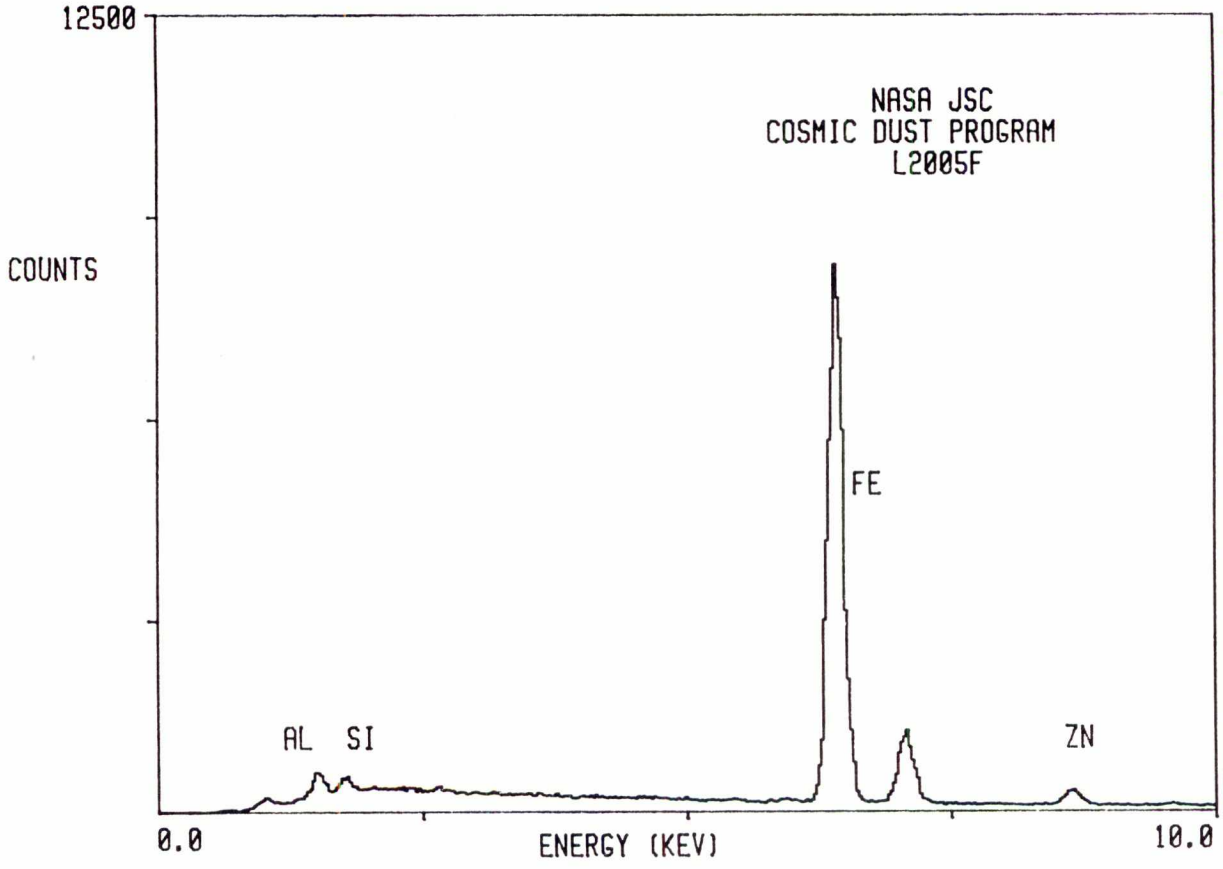
TRANS.: O

COLOR: Black

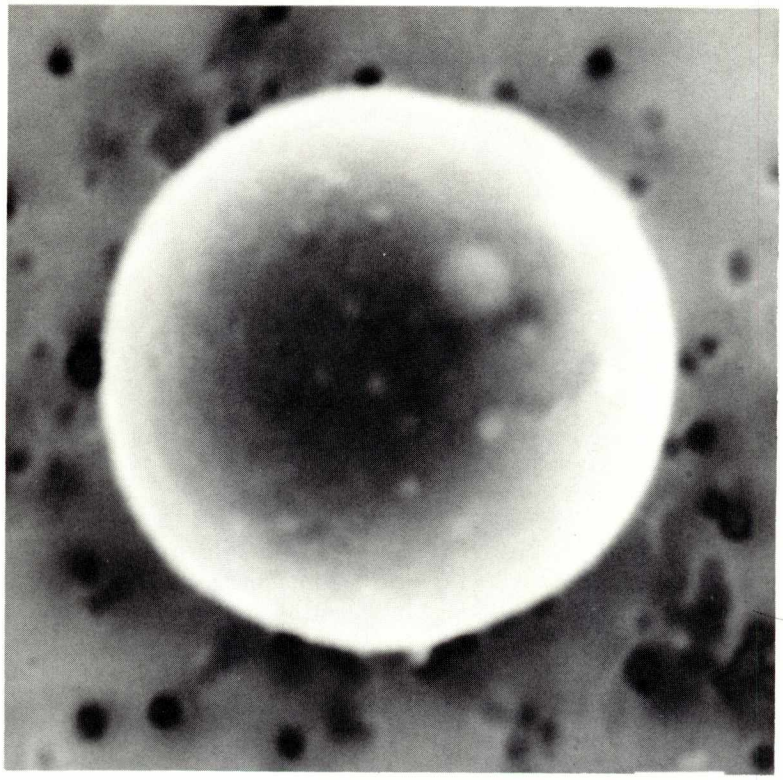
LUSTER: D/SM

TYPE: TCA

COMMENTS:
Largest grain. Related grains up to 16 microns remain on and off collector



L2005 F 34



S-90-38178

SIZE: 6

SHAPE: S

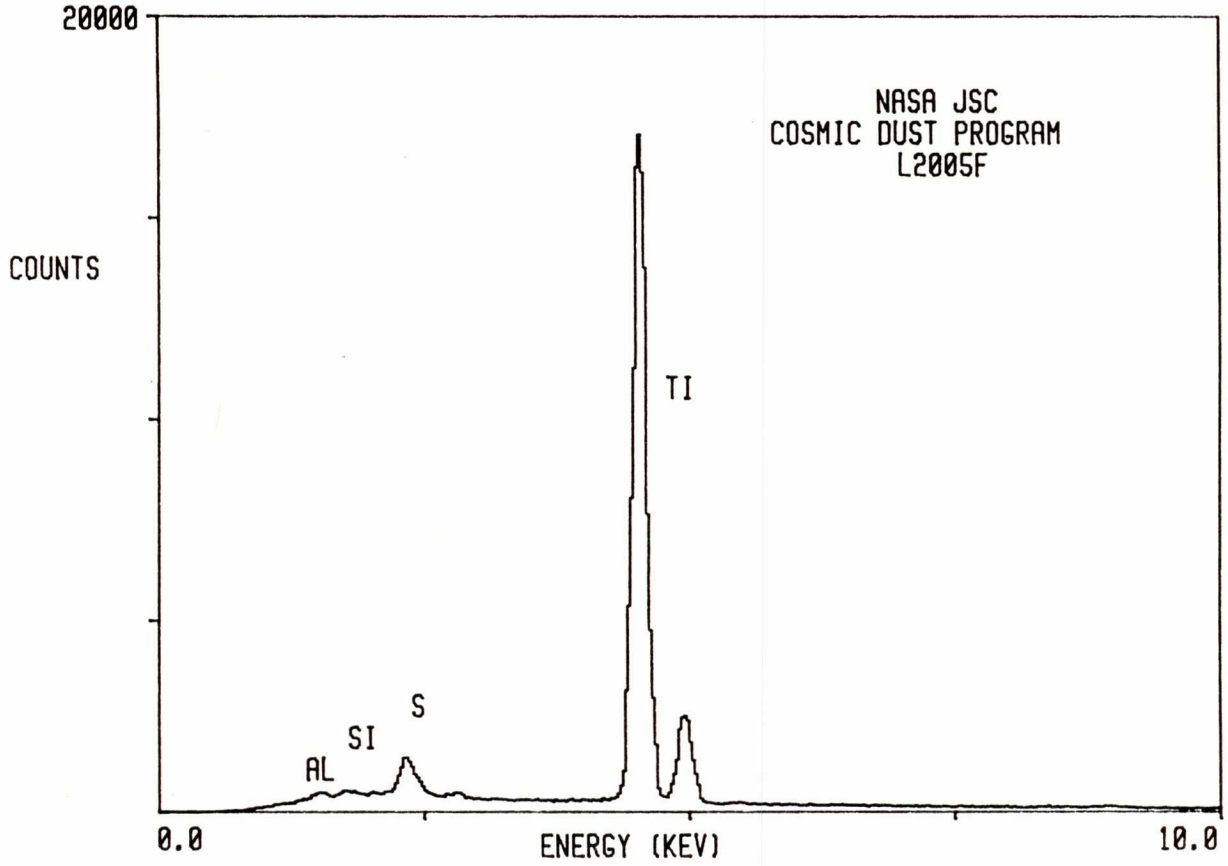
TRANS.: O

COLOR: Black

LUSTER: D

TYPE: TCA

COMMENTS:
Related grains up to 24 microns remain on and off collector



L2005 F 36

S-90-38179

SIZE: 34

SHAPE: I

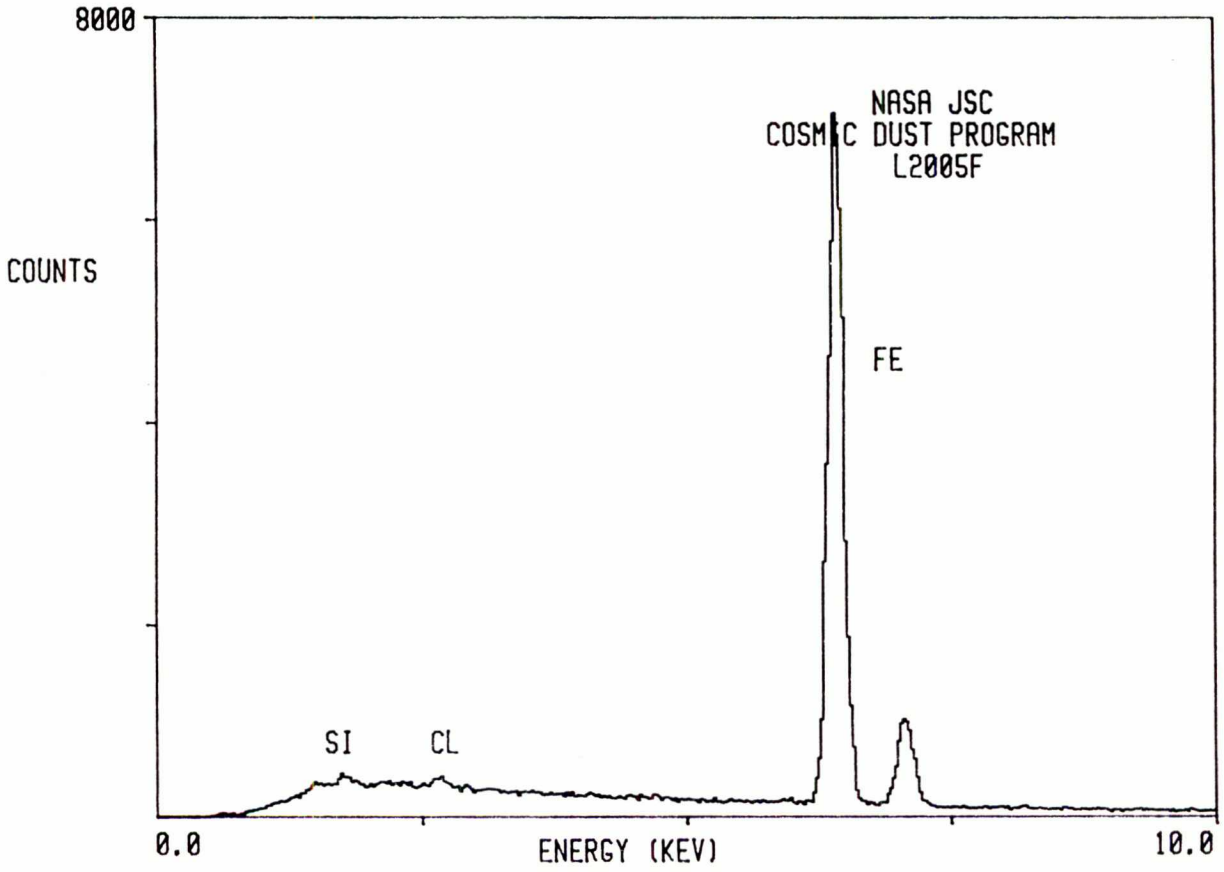
TRANS.: O

COLOR: Black to Brown

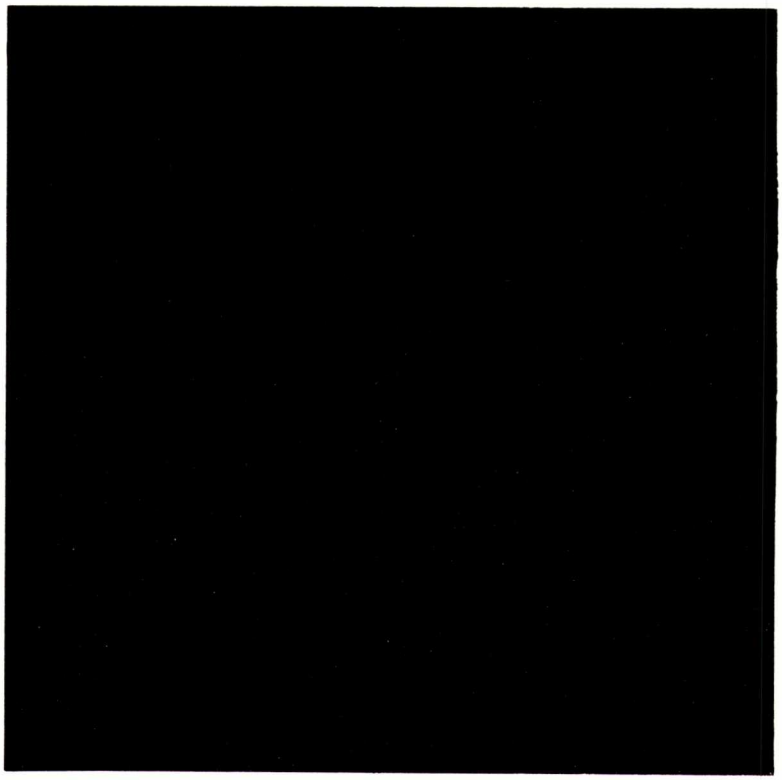
LUSTER: D

TYPE: TCA

COMMENTS:
Related grains up to 120 microns remain on collector

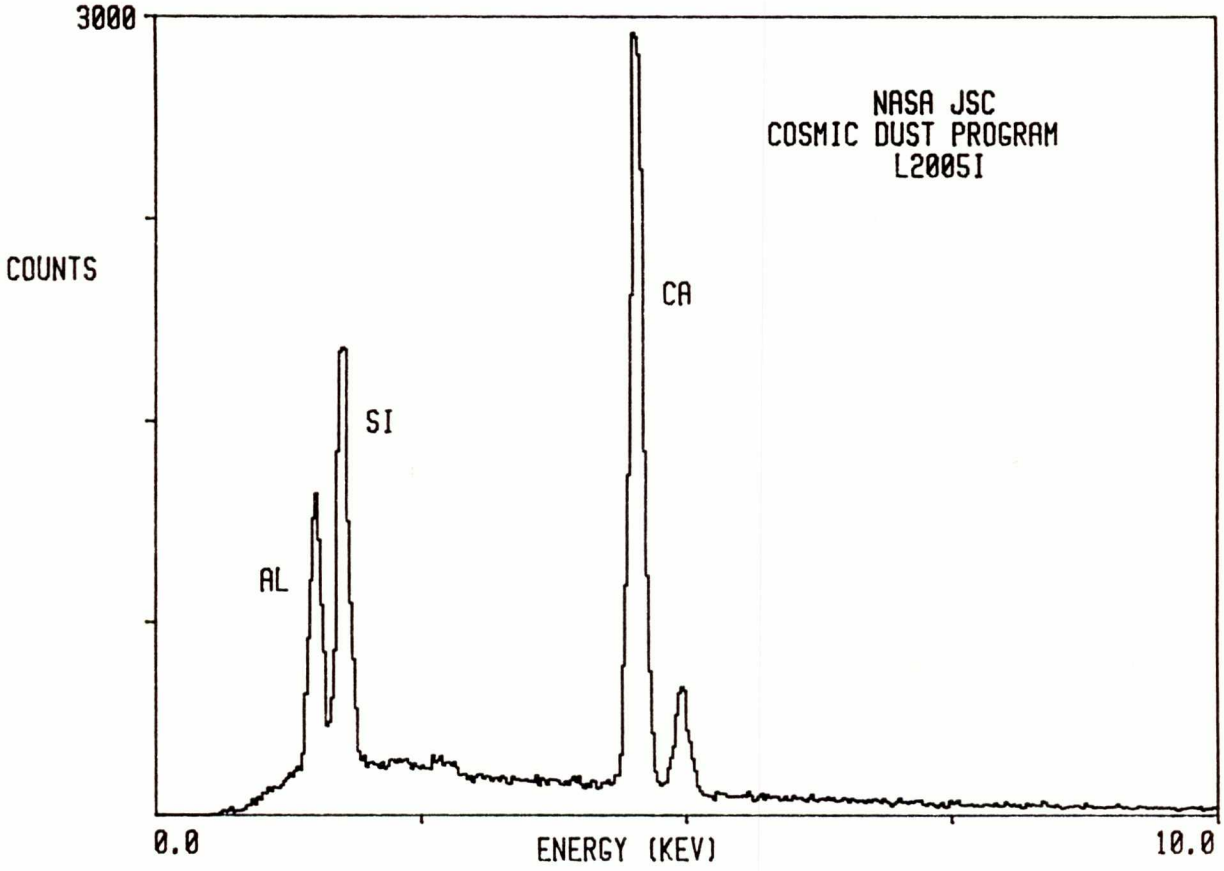


L2005 I 13

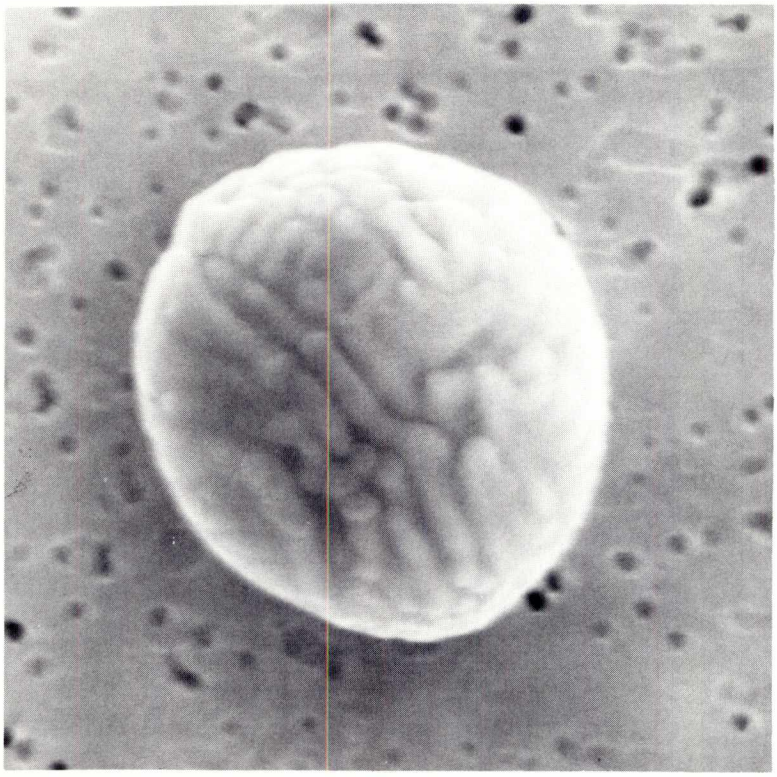


SIZE: 18
SHAPE: S
TRANS.: TL
COLOR: Brown
LUSTER: V
TYPE: TCA

COMMENTS:
No photo due to specimen charging



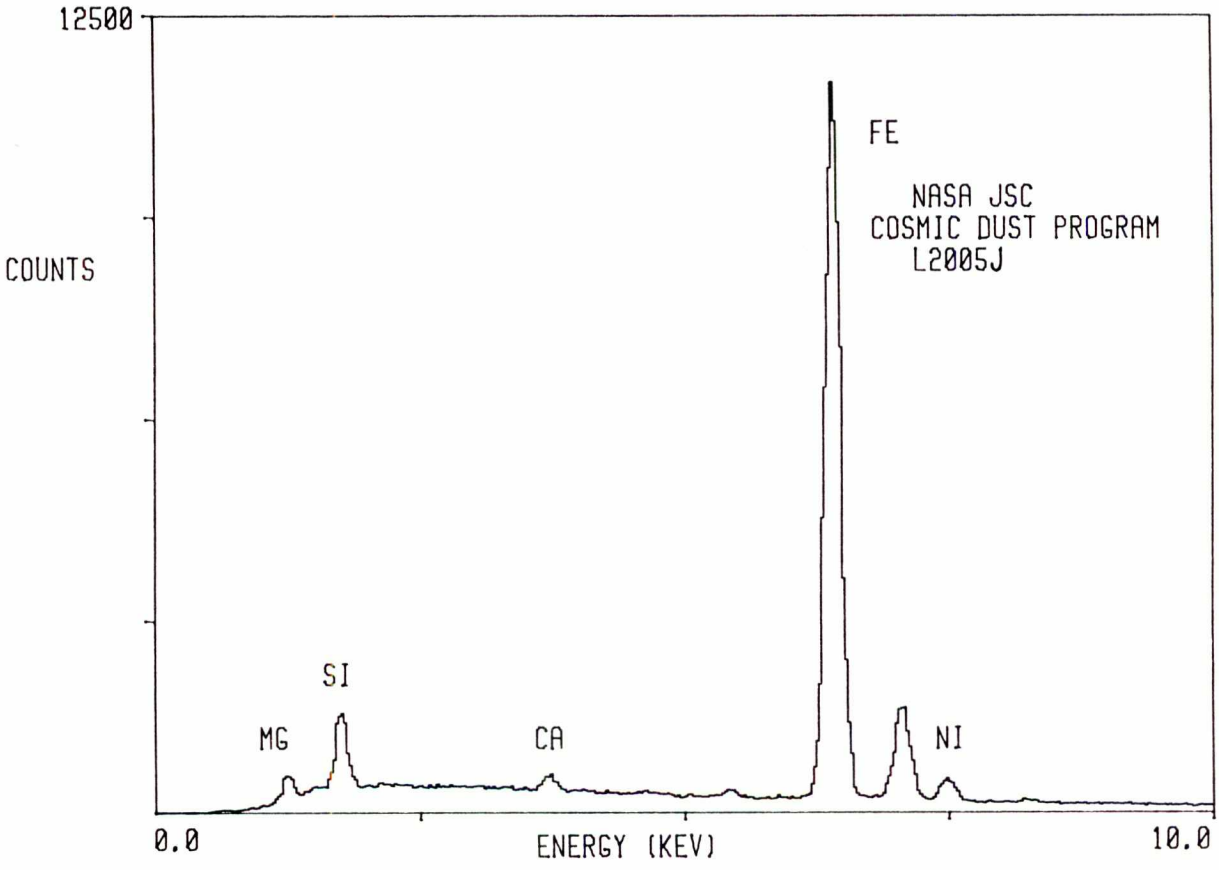
L2005 J 3



S-90-38196

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

COMMENTS:

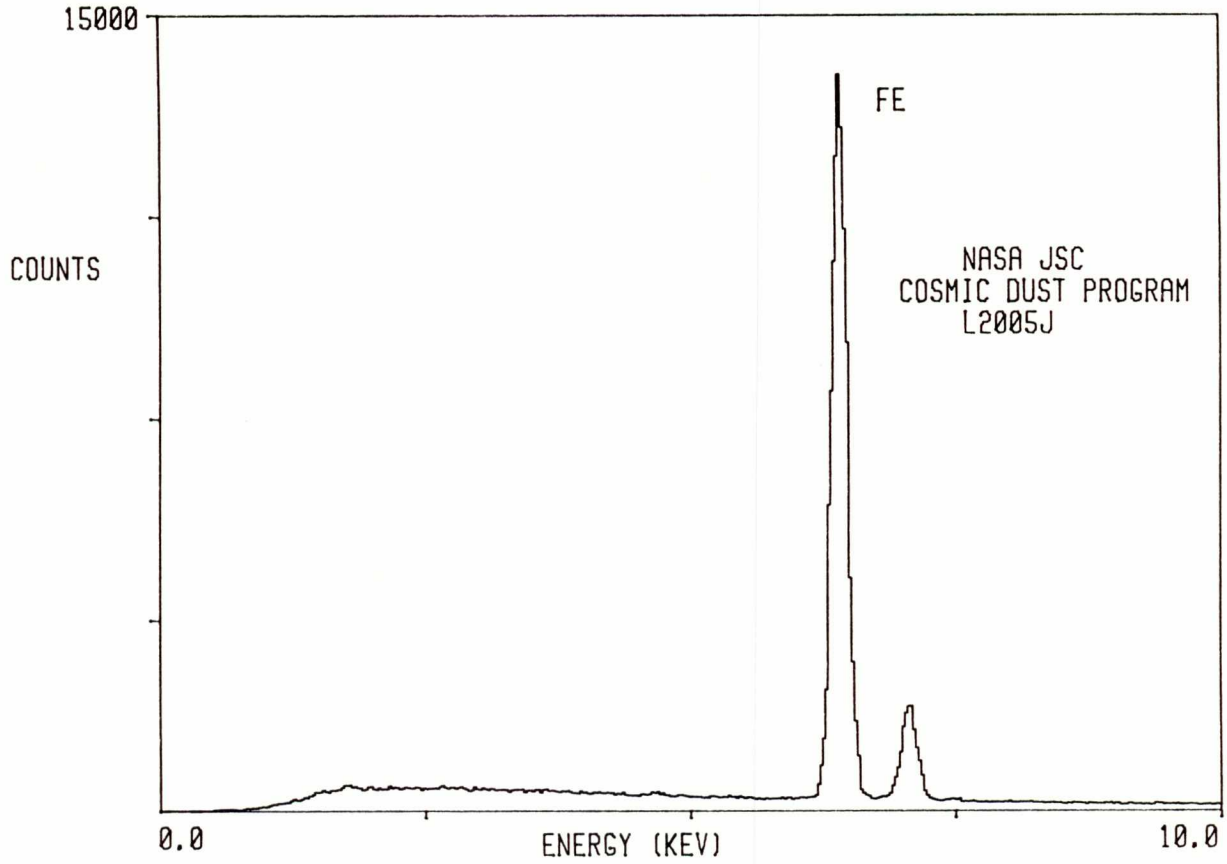


L2005 J 7

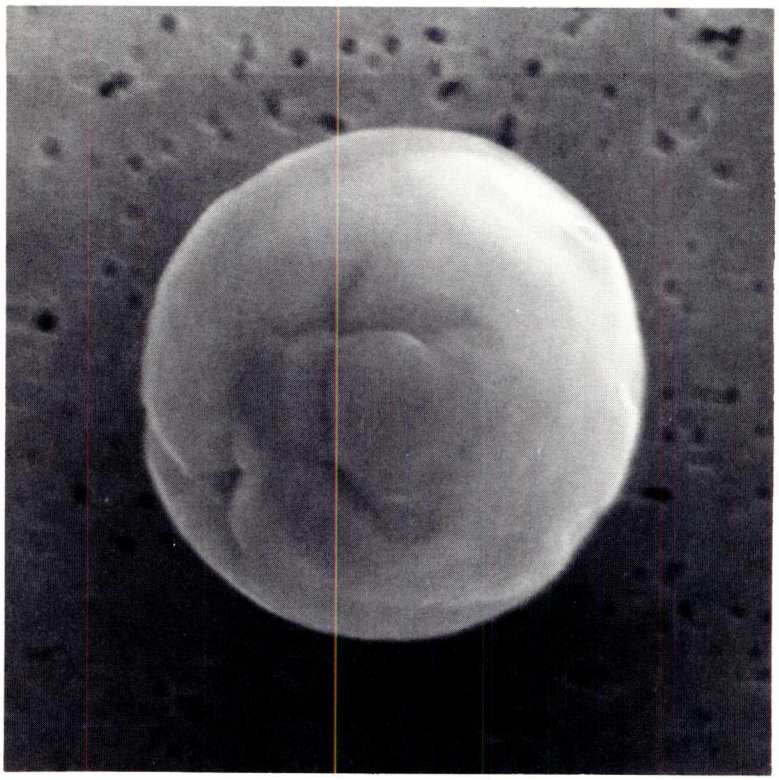
S-90-38200

SIZE: 15
SHAPE: S
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: TCA

COMMENTS:



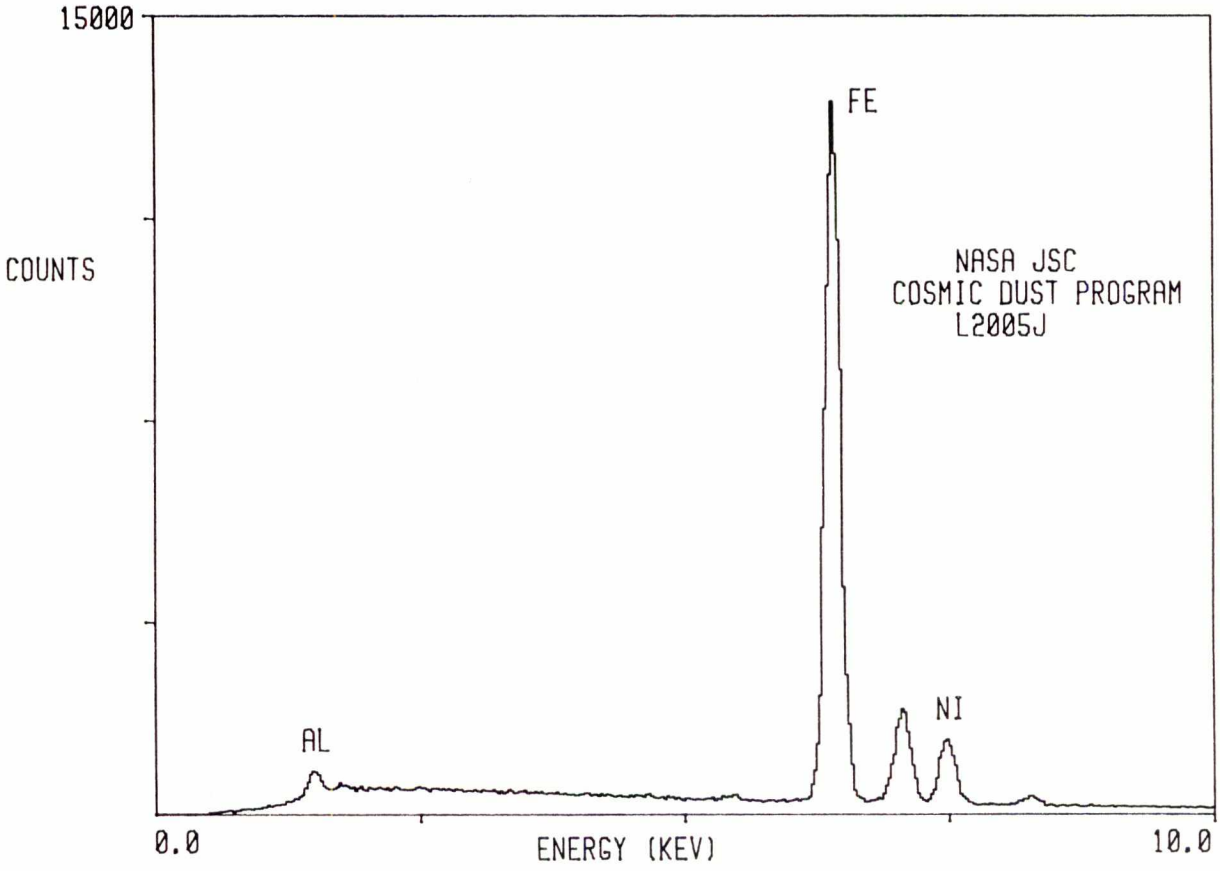
L2005 J 8



S-90-38201

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

COMMENTS:



L2005 J 21

S-90-38213

SIZE: 7

SHAPE: S

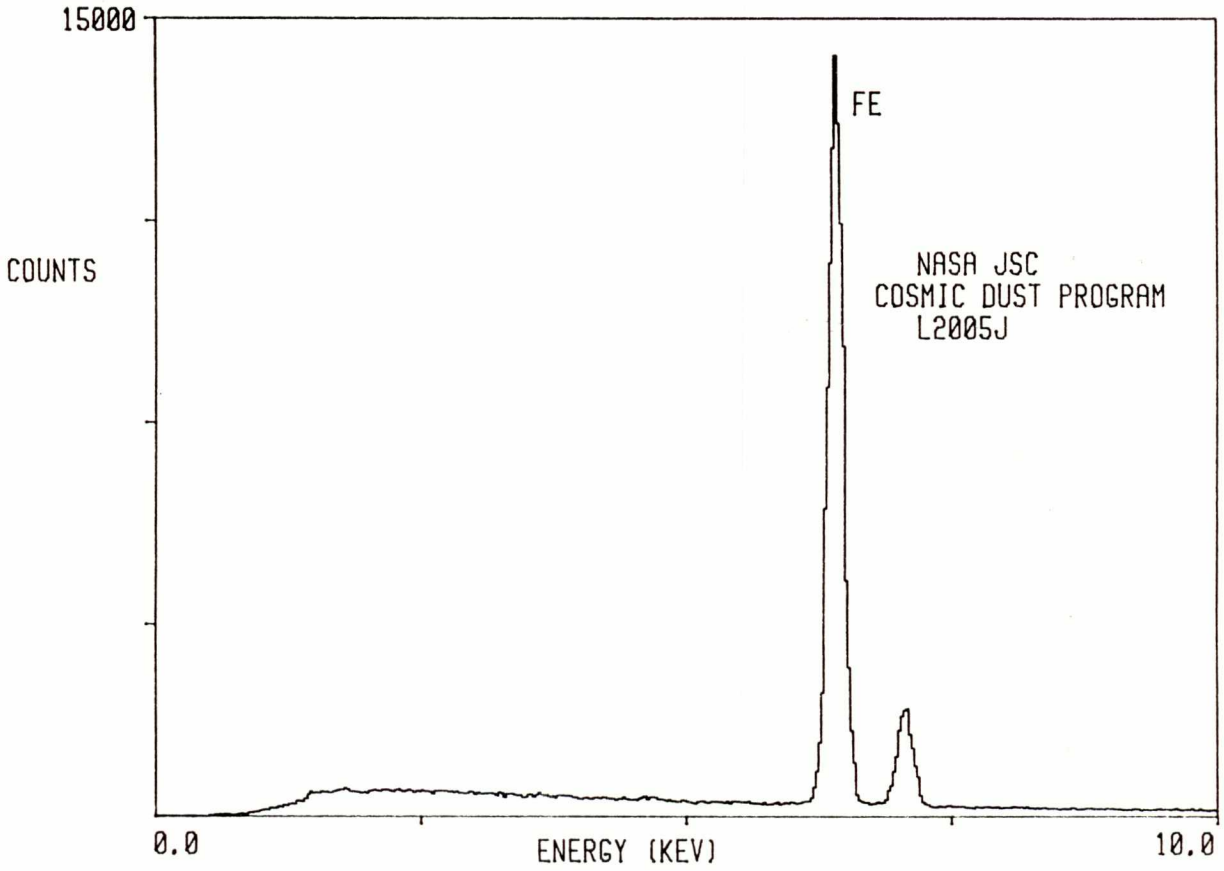
TRANS.: O

COLOR: Brown

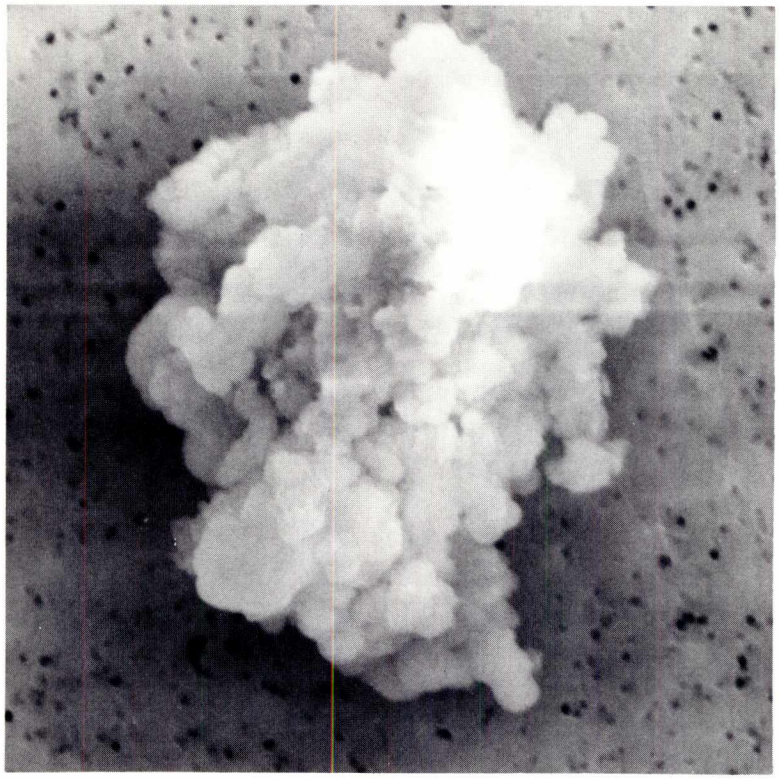
LUSTER: D/V

TYPE: TCA

COMMENTS:
Attached to 10 microns Al sphere



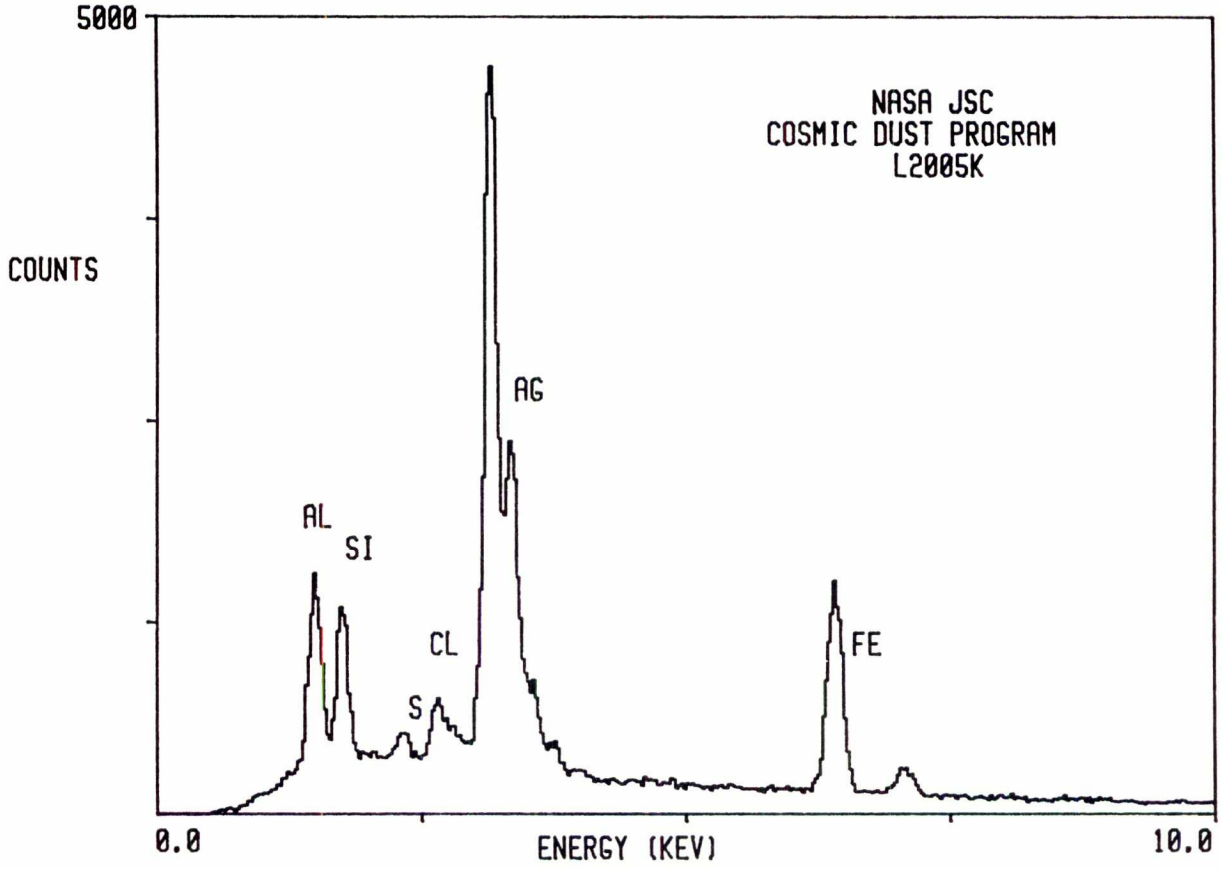
L2005 K 1



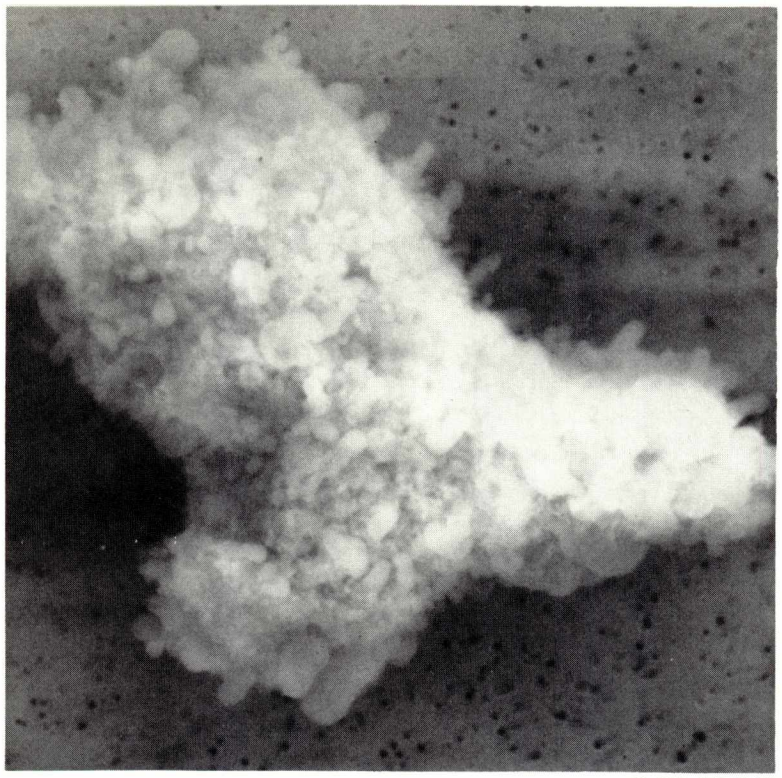
S-90-38152

SIZE: 15x21
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM/D
TYPE: TCA

COMMENTS:



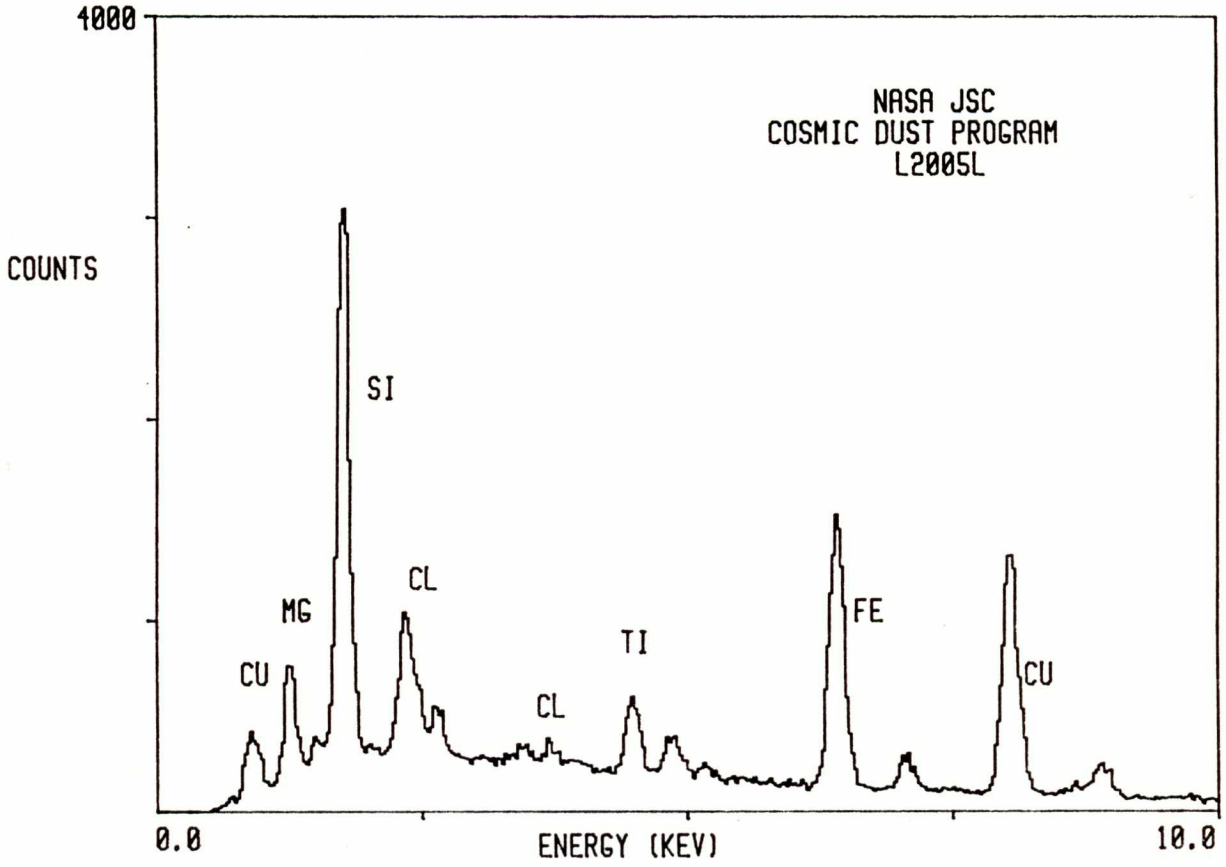
L2005 L 1



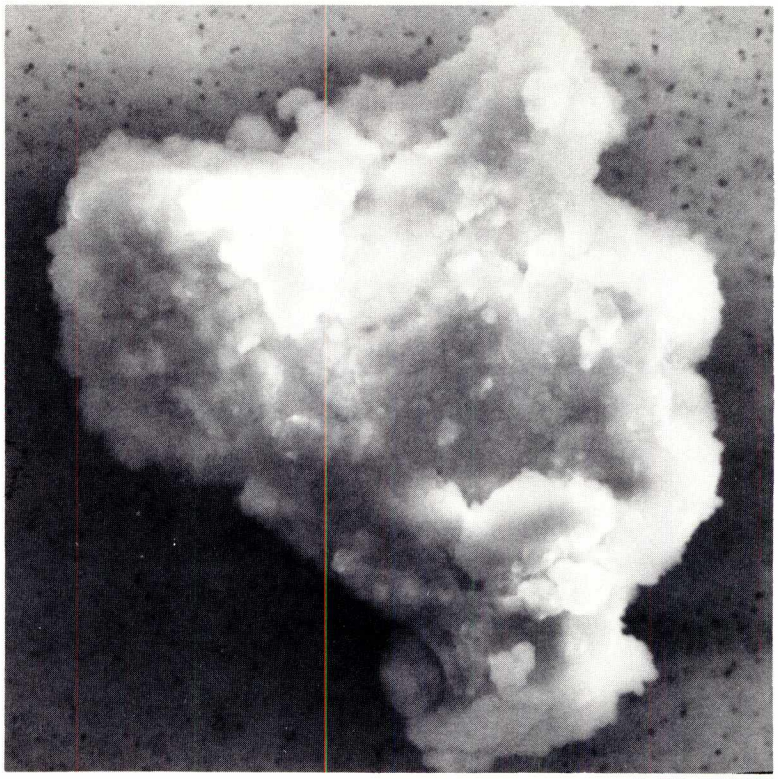
S-90-38220

SIZE: 21x35
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: D/V
TYPE: TCA

COMMENTS:



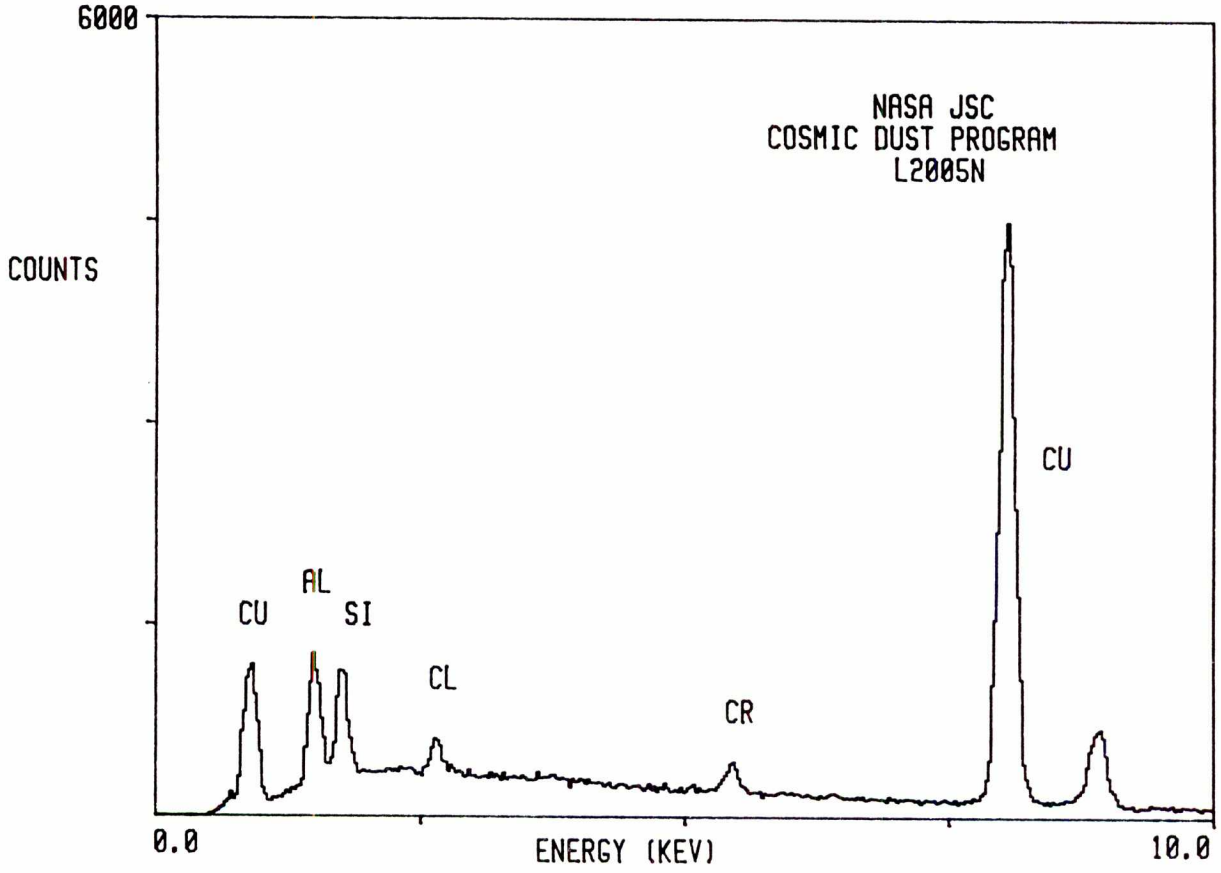
L2005 N 1



S-90-38233

SIZE: 32x38
SHAPE: I
TRANS.: O
COLOR: Brown
LUSTER: SM
TYPE: TCA

COMMENTS:

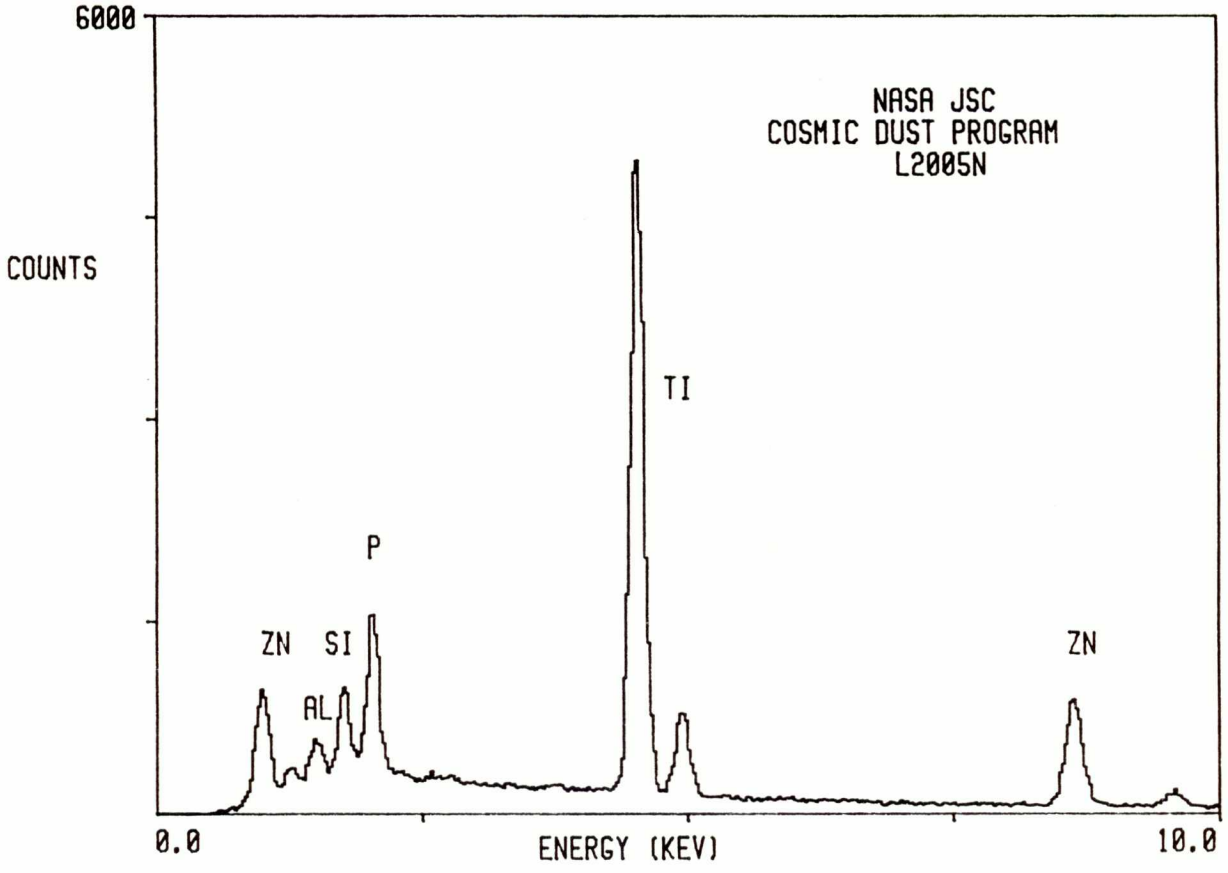


L2005 N 4

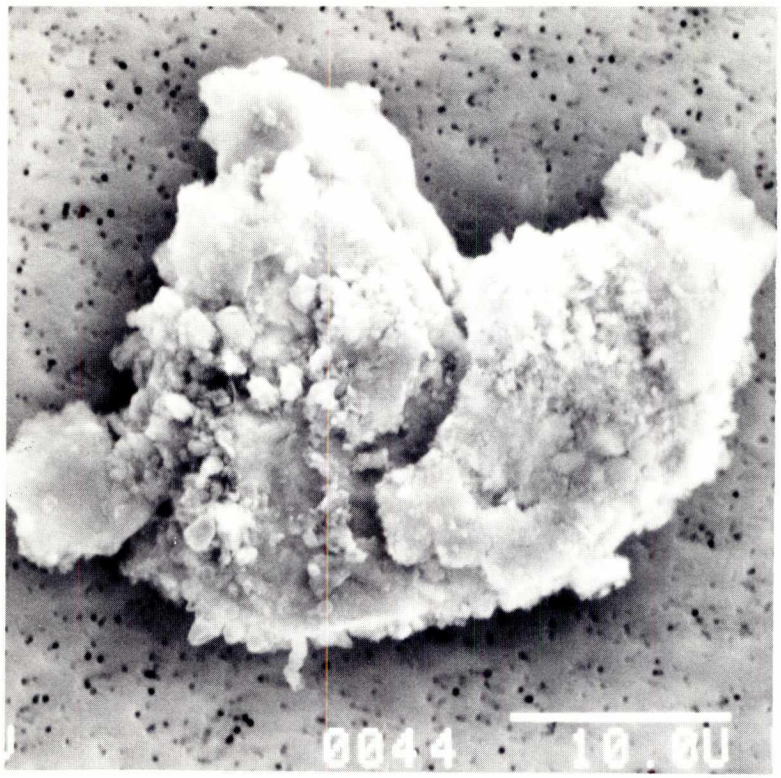
S-90-38236

SIZE: 8x10
SHAPE: S
TRANS.: O
COLOR: Black
LUSTER: D/SM
TYPE: TCA

COMMENTS:



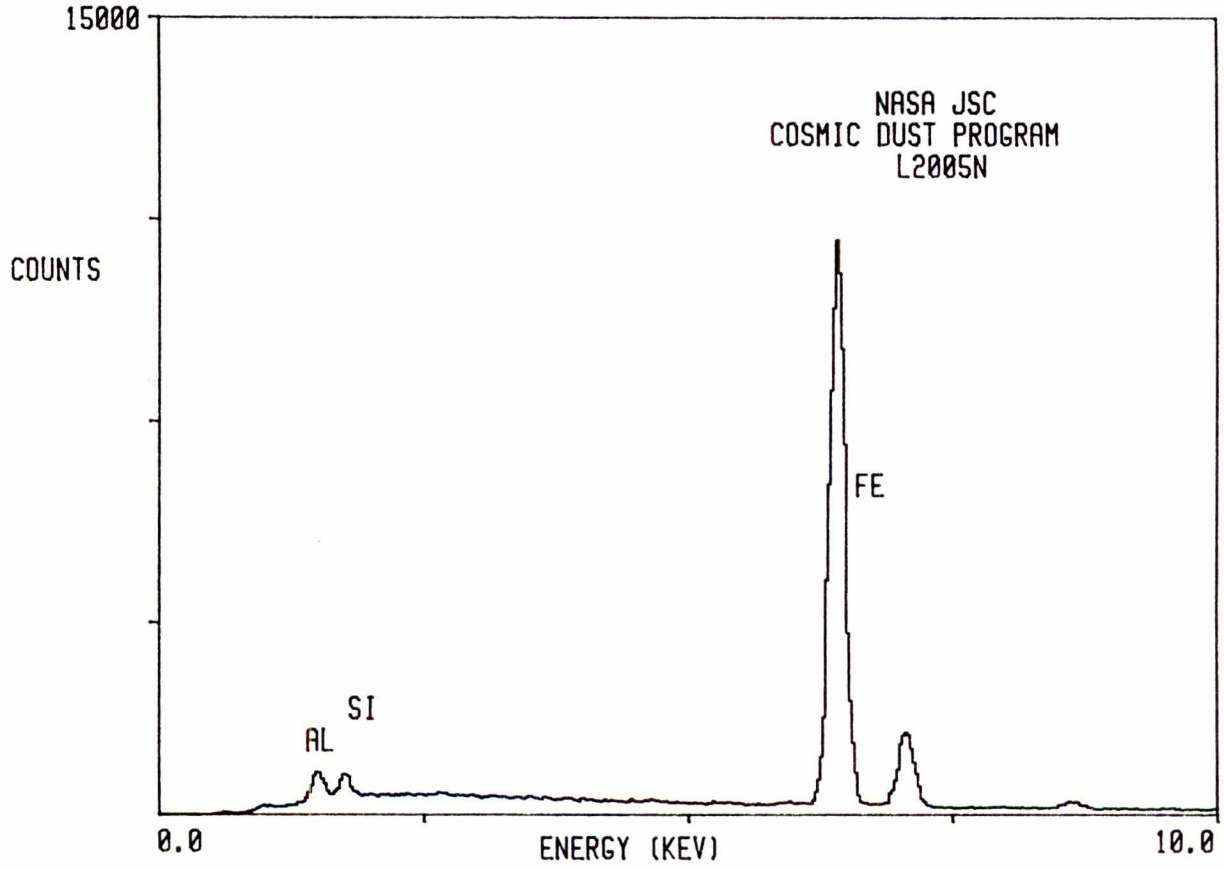
L2005 N 6



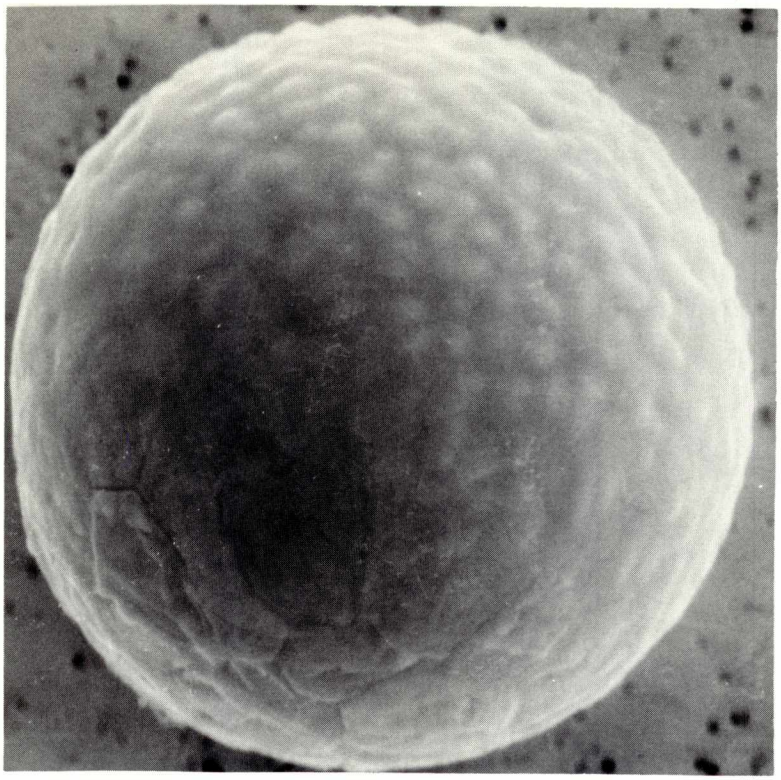
S-90-38238

SIZE: 30x38
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM
TYPE: TCA

COMMENTS:



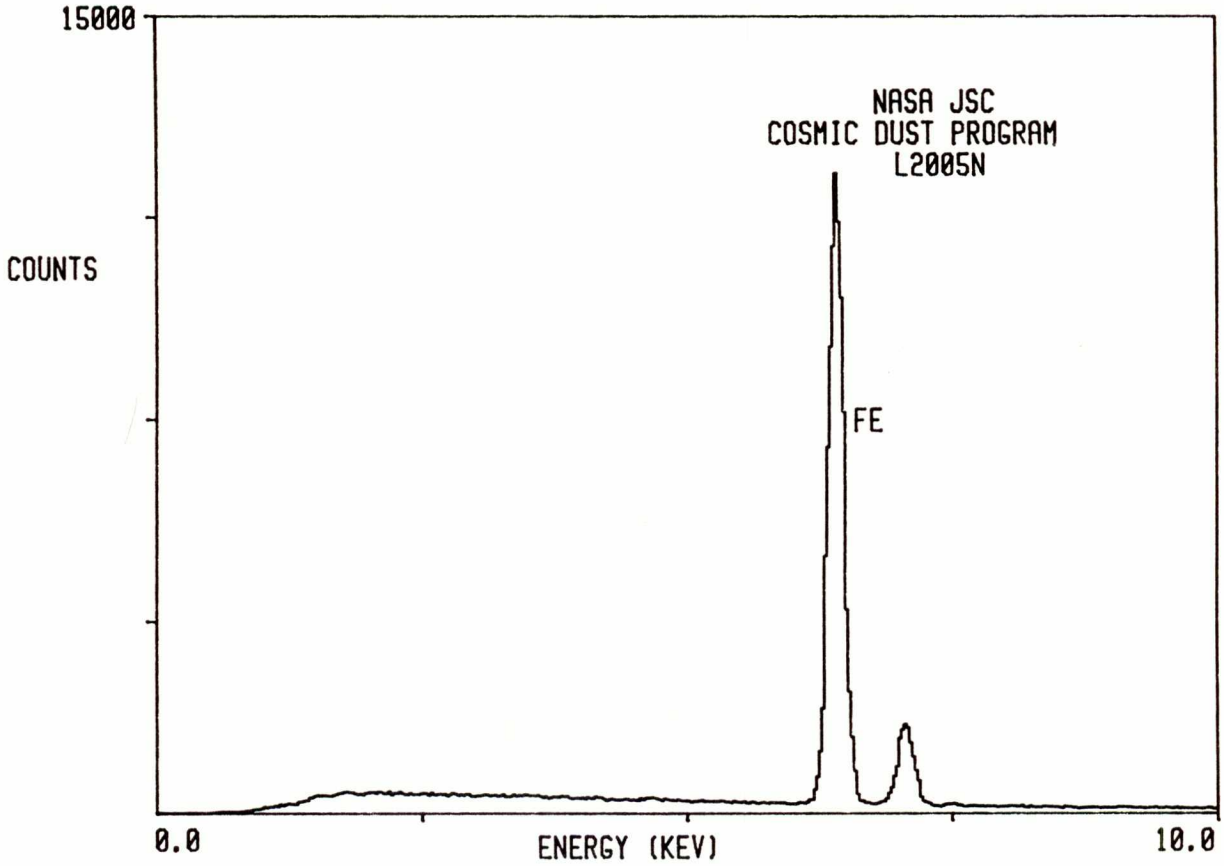
L2005 N 7



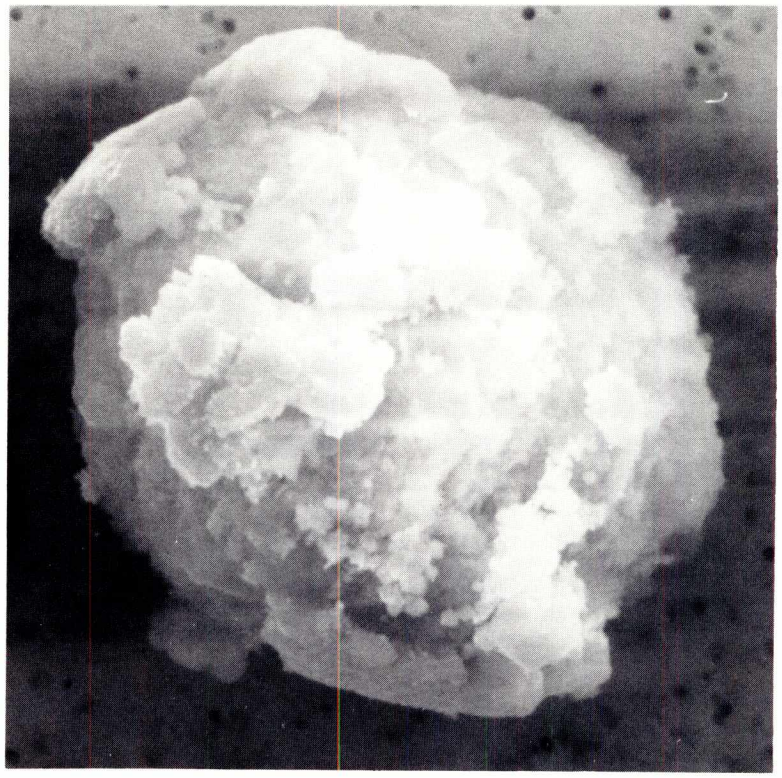
S-90-38239

SIZE: 17
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: SM
TYPE: TCA

COMMENTS:



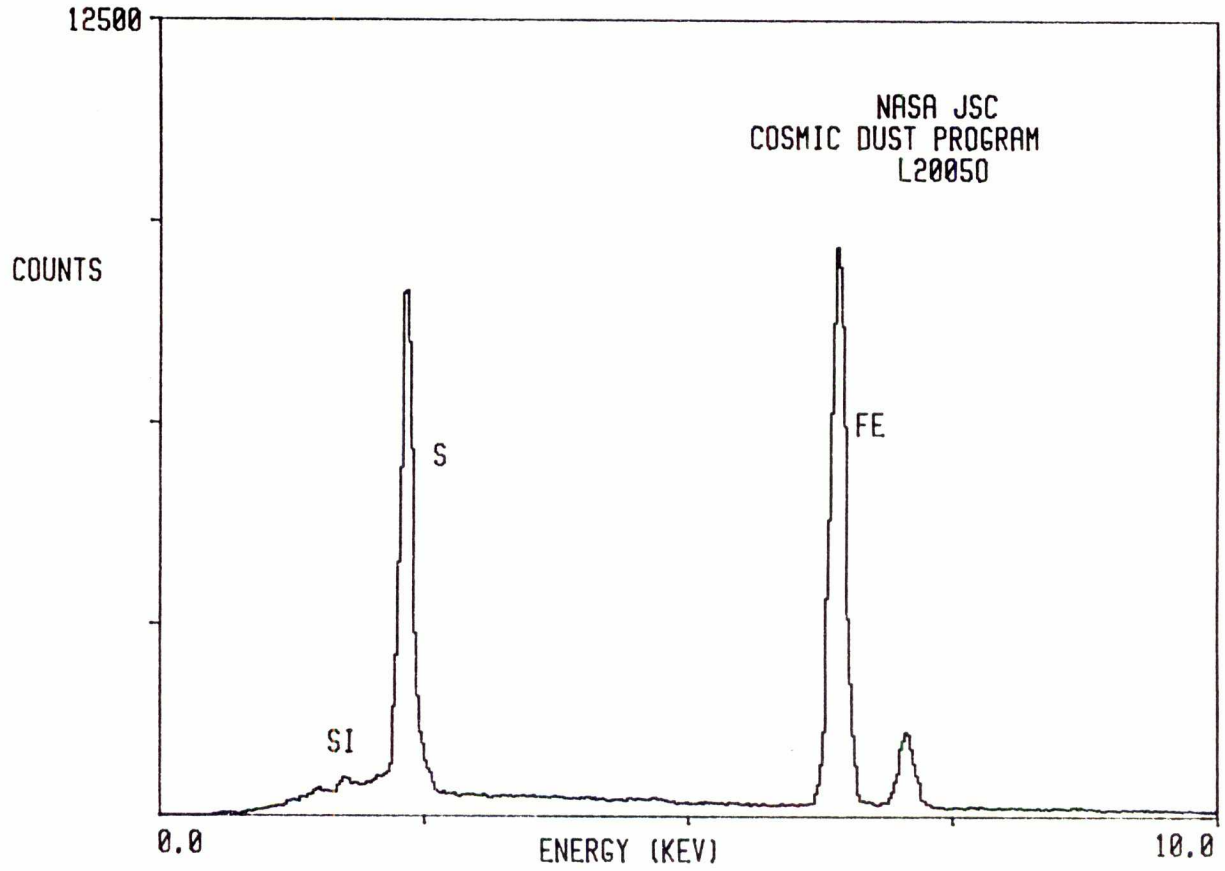
L2005 O 2



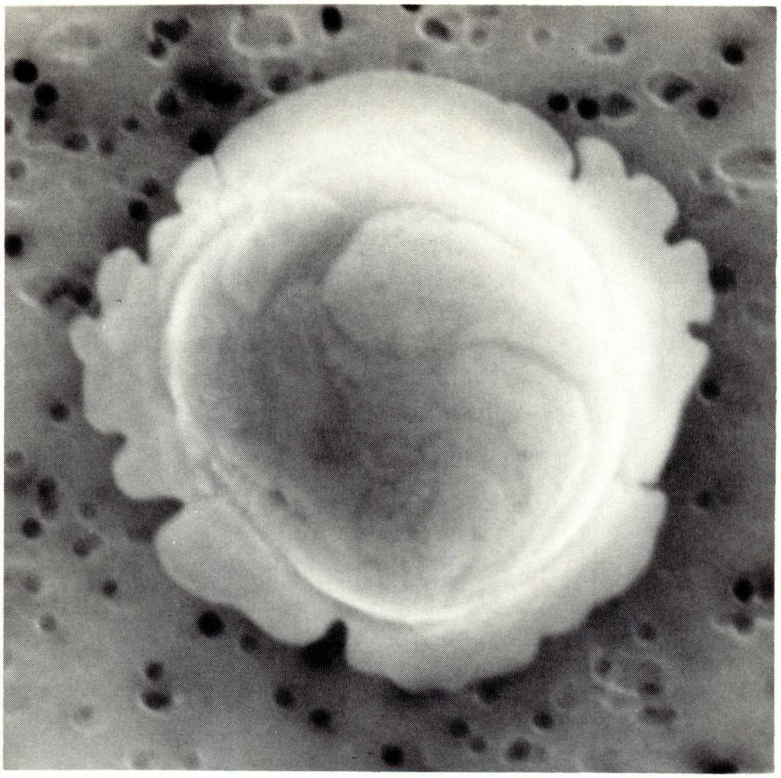
S-90-38241

SIZE: 10x13
SHAPE: I
TRANS.: O
COLOR: Black
LUSTER: D/SM
TYPE: TCA

COMMENTS:



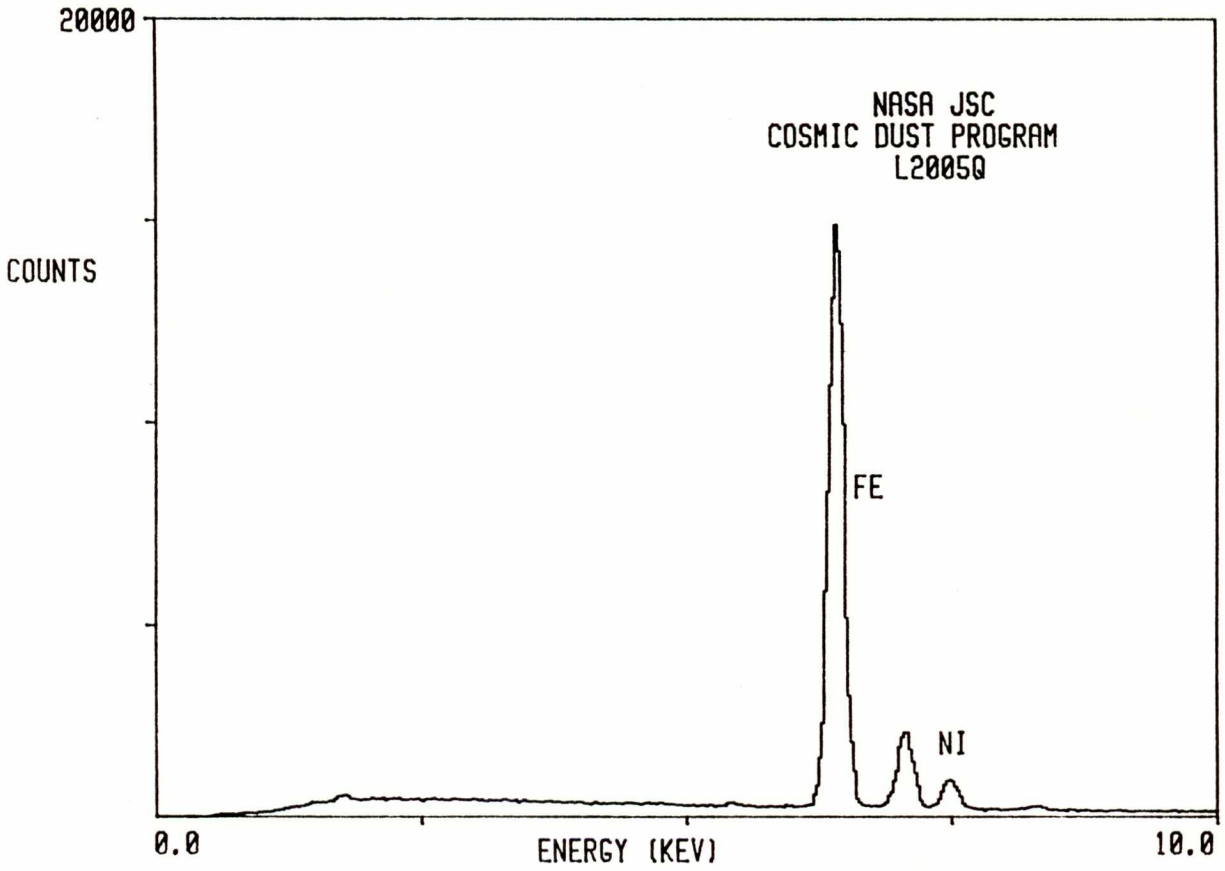
L2005 Q 3



S-90-38269

SIZE: 15
SHAPE: S
TRANS.: O
COLOR: Black
LUSTER: SM
TYPE: TCA

COMMENTS:



☆U.S. Government Printing Office: 1990 — 762-918