Cosmic Dust Catalog
Volume 20

Particles from Collectors U2153, U2157, U2158, U2159, U2162, and U2163
Compiled By:

Cosmic Dust Preliminary
Examination Team (CDPET)

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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 ultraclean (Class-100) laboratory constructed for this purpose at the Lyndon B. Johnson Space Center (JSC) in Houston, Texas. Particles are individually retrieved from the collectors, examined and cataloged, and then made available to the scientific community for research. Cosmic dust thereby joins lunar samples and meteorites as an additional source of extraterrestrial materials for scientific study.

This catalog summarizes preliminary observations on particles retrieved from collection surfaces U2153, U2157, U2158, U2159, U2162, and U2163. These surfaces were flat plate collectors which were coated with silicone oil (dimethyl siloxane) and then flown aboard NASA ER-2 aircraft during a series of flights as follows:

<table>
<thead>
<tr>
<th>Surface</th>
<th>Flight Time Details</th>
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<tbody>
<tr>
<td>U2153</td>
<td>15.1 hours of flight time on October 15 and 17, 2012, during the Draconid Showers</td>
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<tr>
<td>U2157, U2158 and U2159</td>
<td>23.2 hours of flight time over California during October 15, 2012 to October 17, 2012</td>
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<tr>
<td>U2162 and U2163</td>
<td>40 hours of flight time during July 10, 2014 to August 1, 2014</td>
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</tbody>
</table>

All of the collectors were installed in specially constructed wing pylons 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 collectors were exposed in the stratosphere by barometric controls and then retracted into sealed storage containers prior to descent.

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. Particles are individually removed from collectors using glass-needle micromanipulators under a binocular stereomicroscope. 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.
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 200-500X, 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 was performed with an ISI SEM at an accelerating voltage of 15 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 SEM. 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 30 sec. No system (artifact) peaks of significance appear in the spectra.

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

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

Shape is generalized to be spherical (S), equidimensional (E), or irregular (I).

Transparency

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

Color

Color is determined by optical microscopy using oblique (fiber optic, quartz halogen) illumination supplemented with normal reflected (tungsten-lamp) illumination.

Luster

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), and Vitreous (V). Lusters transitional between categories or difficult to identify are indicated accordingly (Dull/Submetallic, etc.).

**Type**

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 judgments 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:

**Cosmic (C)**

Interplanetary 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 “Cosmic” 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 “Cosmic” 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-NiS 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?” or “Possibly Cosmic”.

**Artificial Terrestrial Contamination (TCA)**

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 Cd, Ti, V, Cr, Mn, Ni, Cu, or Zn, and at abundances that are frequently much greater than those expected in common minerals. However, such compositions are similar to those expected for certain metal alloys.

In some cases, a high intensity (relative to intensities of characteristic X-ray peaks) of continuum radiation occurs in the EDS spectrum, suggesting that low atomic number elements not detectable by the EDS (e.g., H, C, N, O) are abundant in the particle. Such “TCA” particles are tacitly inferred to be 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).

**Natural Terrestrial Contamination (TCN)**

“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. Some Fe-S particles are classified as TCN despite the fact that they may well be extraterrestrial. This action is due to the lack of conclusive investigations regarding these particular particles. Many particles containing only low-Z elements are also classified as TCN for the same reason.

Morphologies and EDS spectra of most “TCN” particles compare favorably with respective properties of silica polymorphs, feldspar, or silicic volcanic glass, three materials that 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.

<table>
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<th>Aluminum or Aluminum Oxide Sphere (AOS)</th>
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<td>An AOS particle is transparent, subvitreous, vitreous to metallic 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”. Most AOS particles are products of solid fuel rocket exhausts.</td>
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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. All particles will require careful research examination before they can be satisfactorily identified.

**Comments**

Comments are included for particles with special features or histories. Any large “cluster” particles, which have broken apart on the collector, have small portions present in the catalog as different “sibling” grains; the comments reflect these relationships. For example, any particle with a cluster number designation in the comments field represents a much larger parent particle remaining on the collection plate, which is also available for allocation in part or in whole.
Sample Requests

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

Curator, Cosmic Dust Program  
NASA Johnson Space Center  
Code XI2  
Houston, Texas 77058 U.S.A.  
Telephone: (281) 483-5128  
FAX: (281) 483-5347

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. Publication reprints are frequently useful in sample allocation considerations. 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:

Discipline Scientist, Cosmochemistry Program  
NASA Headquarters  
Code SL  
Washington, DC 20546 U.S.A.

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

The ER-2 flight personnel at NASA Dryden Research Center performed the loading and unloading of the cosmic dust collectors on the ER-2 aircraft and provided flight log data and other critical assistance.
Standard Spectra

![Graph of ALLENDE (C3) METEORITE BULK POWDER (NMNH 3529) 20 KV](image1)

![Graph of DIOPSIDE JLC 99-63](image2)
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Astromaterials Acquisition and Curation
### Cluster Index

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Particle Descriptions

Cosmic and Possibly Cosmic Samples (C and C? Types)
U2153 N2

SEM Photo of sample U2153 N2 with labeled EDS testing locations.

Cluster of Origin: U2153 Cluster 4

Photo of cluster U2153 Cluster 4.
**U2153 N2 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2153-N-2 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2153-N-2 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2153-N-2 taken at test area 3. The test area is labeled in the particle SEM photo.
U2153 N3

Particle Size: 6.5x4 µm
Shape: Irregular
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Cosmic
Cluster No.: U2153 Cluster 1
Comments:

SEM Photo of sample U2153 N3 with labeled EDS testing locations.

Cluster of Origin: U2153 Cluster 1

Photo of cluster U2153 Cluster 1.
**U2153 N3 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2153-N-3 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2153-N-3 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2153-N-3 taken at test area 3. The test area is labeled in the particle SEM photo.
U2153 N5

SEM Photo of sample U2153 N5 with labeled EDS testing locations.

Cluster of Origin: U2153 Cluster 2

Photo of cluster U2153 Cluster 2.

Particle Size: 4x8 µm
Shape: Irregular
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Cosmic
Cluster No.: U2153 Cluster 2
Comments:
**U2153 N5 - EDS Spectra**

![Figure 1. EDS Spectra for sample U2153-N-5 taken at test area 1. The test area is labeled in the particle SEM photo.](image1)

![Figure 2. EDS Spectra for sample U2153-N-5 taken at test area 2. The test area is labeled in the particle SEM photo.](image2)
Figure 3. EDS Spectra for sample U2153-N-5 taken at test area 3. The test area is labeled in the particle SEM photo.
U2157 A2

Particle Size:  5 µm  
Shape:         Equidimensional  
Transparency:  Translucent to Opaque  
Color:         Clear  
Luster:        Pearly to Subvitreous  
Particle Type: Cosmic  
Cluster No.:   U2157 Cluster 2  
Comments:      

SEM Photo of sample U2157 A2 with labeled EDS testing locations.

Cluster of Origin: U2157 Cluster 2

Photo of cluster U2157 Cluster 2.
U2157 A2 - EDS Spectra

Figure 1. EDS Spectra for sample U2157-A-2 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2157-A-2 taken at test area 2. The test area is labeled in the particle SEM photo.
U2158 D16

SEM Photo of sample U2158 D16 with labeled EDS testing locations.

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Figure 1. EDS Spectra for sample U2158-D-16 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-16 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-16 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A1

Particle Size: 7x11 µm
Shape: Equidimensional
Transparency: Translucent to Transparent
Color: Clear
Luster: Pearly to Subvitreous
Particle Type: Possibly Cosmic
Cluster No.: U2159 Cluster 1
Comments:

SEM Photo of sample U2159 A1 with labeled EDS testing locations.

Cluster of Origin: U2159 Cluster 1

Photo of cluster U2159 Cluster 1.
U2159 A1 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-1 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2159-A-1 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2159-A-1 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A4

Particle Size: 7 μm  
Shape: Equidimensional  
Transparency: Opaque  
Color: Black  
Luster: Dull  
Particle Type: Possibly Cosmic  
Cluster No.: U2159 Cluster 4  
Comments: 

SEM Photo of sample U2159 A4 with labeled EDS testing locations.

Cluster of Origin: U2159 Cluster 4

Photo of cluster U2159 Cluster 4.
**U2159 A4 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2159-A-4 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2159-A-4 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2159-A-4 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 A9**

*SEM Photo of sample U2162 A9 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 9**

*Photo of cluster U2162 Cluster 9.*

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**U2162 A9 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-9 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-9 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-9 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A11

SEM Photo of sample U2162 A11 with labeled EDS testing locations.

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Cluster of Origin: U2162 Cluster 11

Photo of cluster U2162 Cluster 11.
**U2162 A11 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-11 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-11 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-11 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-11 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 B4

Particle Size: 17x9 µm  
Shape: Equidimensional  
Transparency: Opaque  
Color: Black  
Luster: Dull  
Particle Type: Cosmic  
Cluster No.: U2162 Cluster 21  
Comments:

SEM Photo of sample U2162 B4 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 21

Photo of cluster U2162 Cluster 21.
**U2162 B4 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-4 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-4 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-4 taken at test area 3. The test area is labeled in the particle SEM photo..
U2162 B17

SEM Photo of sample U2162 B17 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 36

Photo of cluster U2162 Cluster 36.
Figure 1. EDS Spectra for sample U2162-B-17 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-17 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-17 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 B7

SEM Photo of sample U2163 B7 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 21

Photo of cluster U2163 Cluster 21.
**U2163 B7 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2163-B-7 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2163-B-7 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-B-7 taken at test area 3. The test area is labeled in the particle SEM photo.
Particle Descriptions

Artificial Terrestrial Contamination (TCA Type)
**U2157 A3**

*SEM Photo of sample U2157 A3 with labeled EDS testing locations.*

- **Particle Size:** 15x30 µm
- **Shape:** Irregular
- **Transparency:** Translucent to Opaque
- **Color:** Clear, Gray
- **Luster:** Subvitreous to Dull
- **Particle Type:** Artificial Terrestrial Contamination
- **Cluster No.:** U2157 Cluster 3
- **Comments:**

*Cluster of Origin: U2157 Cluster 3*

*Photo of cluster U2157 Cluster 3.*
**U2157 A3 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2157-A-3 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2157-A-3 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2157-A-3 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2157 A4**

*SEM Photo of sample U2157 A4 with labeled EDS testing locations.*

**U2157 A4 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2157-A-4 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2157-A-4 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2157-A-4 taken at test area 3. The test area is labeled in the particle SEM photo.
U2157 A5

SEM Photo of sample U2157 A5 with labeled EDS testing locations.

Particle Size: 20x40 µm
Shape: Irregular
Transparency: Opaque
Color: Gray
Luster: Metallic to Subvitreous
Particle Type: Artificial Terrestrial Contamination
Cluster No.: 
Comments:

U2157 A5 - EDS Spectra

Figure 1. EDS Spectra for sample U2157-A-5 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2157-A-5 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2157-A-5 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2157-A-5 taken at test area 4. The test area is labeled in the particle SEM photo.
**U2158 D4**

*SEM Photo of sample U2158 D4 with labeled EDS testing locations.*

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**Cluster of Origin: U2158 Cluster 55**

*Photo of cluster U2158 Cluster 55.*
**U2158 D4 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2158-D-4 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2158-D-4 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2158-D-4 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2158-D-4 taken at test area 4. The test area is labeled in the particle SEM photo.
U2158 D7

Particle Size: 13 µm
Shape: Equidimensional
Transparency: Translucent to Transparent
Color: Clear
Luster: Pearly to Vitreous
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2158 Cluster 58
Comments:

SEM Photo of sample U2158 D7 with labeled EDS testing locations.

Cluster of Origin: U2158 Cluster 58

Photo of cluster U2158 Cluster 58.
U2158 D7 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-7 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2158-D-7 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2158-D-7 taken at test area 3. The test area is labeled in the particle SEM photo.
U2158 D12

Particle Size: 15 µm
Shape: Spherical
Transparency: Opaque to Translucent
Color: Gray
Luster: Pearly
Particle Type: Artificial Terrestrial Contamination
Cluster No.: 
Comments:

SEM Photo of sample U2158 D12 with labeled EDS testing locations.

U2158 D12 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-12 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-12 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-12 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2158-D-12 taken at test area 4. The test area is labeled in the particle SEM photo.
U2159 A5

Particle Size: 15 µm
Shape: Irregular
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2159 Cluster 5
Comments:

SEM Photo of sample U2159 A5 with labeled EDS testing locations.

Cluster of Origin: U2159 Cluster 5

Photo of cluster U2159 Cluster 5.
**U2159 A5 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2159-A-5 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2159-A-5 taken at test area 2. The test area is labeled in the particle SEM photo.*
**Figure 3.** EDS Spectra for sample U2159-A-5 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A2

SEM Photo of sample U2162 A2 with labeled EDS testing locations.

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Cluster of Origin: U2162 Cluster 2

Photo of cluster U2162 Cluster 2.
**U2162 A2 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-2 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-2 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-2 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-2 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 A3

SEM Photo of sample U2162 A3 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 3

Photo of cluster U2162 Cluster 3.
**U2162 A3 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2162-A-3 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2162-A-3 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-3 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-3 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 A4

**Particle Size:** 15 µm
**Shape:** Equidimensional
**Transparency:** Opaque to Subvitreous
**Color:** Black
**Luster:** Pearly to Subvitreous
**Particle Type:** Artificial Terrestrial Contamination
**Cluster No.:** U2162 Cluster 4
**Comments:**

*SEM Photo of sample U2162 A4 with labeled EDS testing locations.*

Cluster of Origin: U2162 Cluster 4

*Photo of cluster U2162 Cluster 4.*
**U2162 A4 - EDS Spectra**

**Figure 1.** EDS Spectra for sample U2162-A-4 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2162-A-4 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-4 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A8

Particle Size: 11 µm
Shape: Equidimensional
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2162 Cluster 8
Comments:

SEM Photo of sample U2162 A8 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 8

Photo of cluster U2162 Cluster 8.
**U2162 A8 - EDS Spectra**

![Figure 1. EDS Spectra for sample U2162-A-8 taken at test area 1. The test area is labeled in the particle SEM photo.](image1)

![Figure 2. EDS Spectra for sample U2162-A-8 taken at test area 2. The test area is labeled in the particle SEM photo.](image2)
Figure 3. EDS Spectra for sample U2162-A-8 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-8 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 A10

*SEM Photo of sample U2162 A10 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 10**

*Photo of cluster U2162 Cluster 10.*
**U2162 A10 - EDS Spectra**

Figure 1. EDS Spectra for sample U2162-A-10 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-10 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-10 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-10 taken at test area 4. The test area is labeled in the particle SEM photo.
SEM Photo of sample U2162 A12 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 12

Photo of cluster U2162 Cluster 12.
U2162 A12 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-A-12 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-12 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-12 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-12 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 A13

**Particle Size:** 23 µm

**Shape:** Irregular to Spherical

**Transparency:** Opaque

**Color:** Black

**Luster:** Dull

**Particle Type:** Artificial Terrestrial Contamination

**Cluster No.:** U2162 Cluster 13

**Comments:**

*SEM Photo of sample U2162 A13 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 13**

*Photo of cluster U2162 Cluster 13.*
U2162 A13 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-A-13 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-13 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-13 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2162-A-13 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 A14

Particle Size: 12 µm
Shape: Irregular
Transparency: Opaque to Subvitreous
Color: Black
Luster: Subvitreous to Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2162 Cluster 14
Comments:

SEM Photo of sample U2162 A14 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 14

Photo of cluster U2162 Cluster 14.
**U2162 A14 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-14 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-14 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-14 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 A18**

*SEM Photo of sample U2162 A18 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 16**

*Photo of cluster U2162 Cluster 16.*

- **Particle Size:** 26x11 µm
- **Shape:** Irregular
- **Transparency:** Opaque
- **Color:** Black
- **Luster:** Dull
- **Particle Type:** Artificial Terrestrial Contamination
- **Cluster No.:** U2162 Cluster 16
- **Comments:**
U2162 A18 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-A-18 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-18 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-18 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 B2**

Particle Size: 7 µm  
Shape: Irregular  
Transparency: Opaque  
Color: Black, Brown  
Luster: Pearly to Dull  
Particle Type: Artificial Terrestrial Contamination  
Cluster No.: U2162 Cluster 19  
Comments:

*SEM Photo of sample U2162 B2 with labeled EDS testing locations.*

*Cluster of Origin: U2162 Cluster 19*

*Photo of cluster U2162 Cluster 19.*
**U2162 B2 - EDS Spectra**

![EDS Spectra for sample U2162-B-2 taken at test area 1. The test area is labeled in the particle SEM photo.](image)

*Figure 1. EDS Spectra for sample U2162-B-2 taken at test area 1. The test area is labeled in the particle SEM photo.*

![EDS Spectra for sample U2162-B-2 taken at test area 2. The test area is labeled in the particle SEM photo.](image)

*Figure 2. EDS Spectra for sample U2162-B-2 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-2 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B3

Particle Size: 18x13 µm
Shape: Irregular to Equidimensional
Transparency: Opaque to Subvitreous
Color: Gray
Luster: Pearly to Vitreous
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2162 Cluster 20
Comments:

SEM Photo of sample U2162 B3 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 20

Photo of cluster U2162 Cluster 20.
U2162 B3 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-B-3 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-3 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-3 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B5

SEM Photo of sample U2162 B5 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 22

Photo of cluster U2162 Cluster 22.
**U2162 B5 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-5 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-5 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-5 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B7

*SEM Photo of sample U2162 B7 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 24**

*Photo of cluster U2162 Cluster 24.*

- **Particle Size:** 10 µm
- **Shape:** Equidimensional to Spherical
- **Transparency:** Translucent to Opaque
- **Color:** Gray, Yellow
- **Luster:** Pearly
- **Particle Type:** Artificial Terrestrial Contamination
- **Cluster No.:** U2162 Cluster 24
- **Comments:**
U2162 B7 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-B-7 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-7 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-7 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B10

Particle Size: 16 µm
Shape: Equidimensional to Spherical
Transparency: Opaque
Color: Gray
Luster: Pearly
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2162 Cluster 29
Comments:

SEM Photo of sample U2162 B10 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 29

Photo of cluster U2162 Cluster 29.
**U2162 B10 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-10 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-10 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-10 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 B11**

*SEM Photo of sample U2162 B11 with labeled EDS testing locations.*

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<thead>
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<th>Property</th>
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<td>Comments</td>
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</table>

*Cluster of Origin: U2162 Cluster 30*

*Photo of cluster U2162 Cluster 30.*
**U2162 B11 - EDS Spectra**

![EDS Spectra for sample U2162-B-11 taken at test area 1. The test area is labeled in the particle SEM photo.](image1)

*Figure 1. EDS Spectra for sample U2162-B-11 taken at test area 1. The test area is labeled in the particle SEM photo.*

![EDS Spectra for sample U2162-B-11 taken at test area 2. The test area is labeled in the particle SEM photo.](image2)

*Figure 2. EDS Spectra for sample U2162-B-11 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-11 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 B14**

*SEM Photo of sample U2162 B14 with labeled EDS testing locations.*

Cluster of Origin: U2162 Cluster 33

*Photo of cluster U2162 Cluster 33.*

**Particle Size:** 16 µm  
**Shape:** Irregular  
**Transparency:** Opaque  
**Color:** Black, Gray  
**Luster:** Dull  
**Particle Type:** Artificial Terrestrial Contamination  
**Cluster No.:** U2162 Cluster 33  
**Comments:**
**U2162 B14 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-14 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-14 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-14 taken at test area 3. The test area is labeled in the particle SEM photo.
### U2162 B16

**Particle Size:** 15 µm  
**Shape:** Equidimensional to Irregular  
**Transparency:** Opaque to Translucent  
**Color:** Black, Brown, Green  
**Luster:** Pearly to Subvitreous  
**Particle Type:** Artificial Terrestrial Contamination  
**Cluster No.:** U2162 Cluster 35  
**Comments:**

*SEM Photo of sample U2162 B16 with labeled EDS testing locations.*

---

**Cluster of Origin: U2162 Cluster 35**

*Photo of cluster U2162 Cluster 35.*
**U2162 B16 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-16 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-16 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-16 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 C3

**SEM Photo of sample U2162 C3 with labeled EDS testing locations.**

**U2162 C3 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-3 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-3 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-3 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2162-C-3 taken at test area 4. The test area is labeled in the particle SEM photo.
U2162 C6

**SEM Photo of sample U2162 C6 with labeled EDS testing locations.**

**U2162 C6 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-6 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-6 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-6 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 C8

**Particle Size:** 26 µm  
**Shape:** Irregular  
**Transparency:** Opaque  
**Color:** Black, Clear, Gray  
**Luster:** Pearly  
**Particle Type:** Artificial Terrestrial Contamination  
**Cluster No.:**  
**Comments:**

*SEM Photo of sample U2162 C8 with labeled EDS testing locations.*

**U2162 C8 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-8 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-8 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-8 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2162-C-8 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 A1

Particle Size: 18 µm
Shape: Equidimensional to Irregular
 Transparency: Opaque
Color: Brown, Red
Luster: Pearly to Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 1
Comments:

*SEM Photo of sample U2163 A1 with labeled EDS testing locations.*

Cluster of Origin: U2163 Cluster 1

*Photo of cluster U2163 Cluster 1.*
U2163 A1 - EDS Spectra

**Figure 1.** EDS Spectra for sample U2163-A1 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2163-A1 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-A-1 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 A2

Particle Size: 18x22 \( \mu \text{m} \)
Shape: Equidimensional to Irregular
Transparency: Opaque
Color: Brown, Red
Luster: Pearly to Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 2
Comments:

SEM Photo of sample U2163 A2 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 2

Photo of cluster U2163 Cluster 2.
**U2163 A2 - EDS Spectra**

![EDS Spectra](image1)

*Figure 1. EDS Spectra for sample U2163-A taken at test area 1. The test area is labeled in the particle SEM photo.*

![EDS Spectra](image2)

*Figure 2. EDS Spectra for sample U2163-A taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-A-2 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-A-2 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 A4

**SEM Photo of sample U2163 A4 with labeled EDS testing locations.**

**Cluster of Origin: U2163 Cluster 4**

**Photo of cluster U2163 Cluster 4.**
U2163 A4 - EDS Spectra

Figure 1. EDS Spectra for sample U2163-A-4 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2163-A-4 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-A-4 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 A7

Particle Size: 5x10 µm
Shape: Spherical to Equidimensional
Transparency: Translucent
Color: Green, Gray
Luster: Pearly to Subvitreous
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 7
Comments:

SEM Photo of sample U2163 A7 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 7

Photo of cluster U2163 Cluster 7.
**U2163 A7 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-A taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-A taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-A-7 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 A8

Particle Size: 22x15 µm
Shape: Irregular
Transparency: Opaque
Color: Gray
Luster: Pearly
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 8
Comments:

SEM Photo of sample U2163 A8 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 8

Photo of cluster U2163 Cluster 8.
**U2163 A8 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2163-A-8 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2163-A-8 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-A-8 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-A-8 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 A10

Particle Size: 10 µm
Shape: Spherical
Transparency: Opaque
Color: Gray
Luster: Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 10
Comments:

SEM Photo of sample U2163 A10 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 10

Photo of cluster U2163 Cluster 10.
**U2163 A10 - EDS Spectra**

![EDS Spectra for sample U2163-A-10 taken at test area 1. The test area is labeled in the particle SEM photo.](image1)

**Figure 1.** EDS Spectra for sample U2163-A-10 taken at test area 1. The test area is labeled in the particle SEM photo.

![EDS Spectra for sample U2163-A-10 taken at test area 2. The test area is labeled in the particle SEM photo.](image2)

**Figure 2.** EDS Spectra for sample U2163-A-10 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-A-10 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-A-10 taken at test area 4. The test area is labeled in the particle SEM photo.
# U2163 A11

**SEM Photo of sample U2163 A11 with labeled EDS testing locations.**

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**Cluster of Origin: U2163 Cluster 11**

**Photo of cluster U2163 Cluster 11.**
**U2163 A11 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-A-11 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-A-11 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-A-11 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 B1

**SEM Photo of sample U2163 B1 with labeled EDS testing locations.**

**Cluster of Origin: U2163 Cluster 15**

**Photo of cluster U2163 Cluster 15.**
**U2163 B1 - EDS Spectra**

Figure 1. EDS Spectra for sample U2163-B-1 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2163-B-1 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-B-1 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-B-1 taken at test area 4. The test area is labeled in the particle SEM photo.
Figure 5. EDS Spectra for sample U2163-B-1 taken at test area 5. The test area is labeled in the particle SEM photo.
**U2163 B5**

*SEM Photo of sample U2163 B5 with labeled EDS testing locations.*

**Cluster of Origin: U2163 Cluster 19**

*Photo of cluster U2163 Cluster 19.*
**U2163 B5 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-B-5 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-B-5 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-B-5 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 B6

**SEM Photo of sample U2163 B6 with labeled EDS testing locations.**

**Cluster of Origin: U2163 Cluster 20**

**Photo of cluster U2163 Cluster 20.**
**U2163 B6 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-B-6 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-B-6 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-B-6 taken at area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-B-6 taken at area 4. The test area is labeled in the particle SEM photo.
U2163 B8

Particle Size: 20×25 µm
Shape: Irregular to Equidimensional
Transparency: Opaque
Color: Gray
Luster: Dull
Particle Type: Artificial Terrestrial Contamination
Cluster No.: U2163 Cluster 22
Comments:

*SEM Photo of sample U2163 B8 with labeled EDS testing locations.*

*Cluster of Origin: U2163 Cluster 22*

*Photo of cluster U2163 Cluster 22.*
**U2163 B8 - EDS Spectra**

Figure 1. EDS Spectra for sample U2163-B-8 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2163-B-8 taken at test area 2. The test area is labeled in the particle SEM photo.
**U2163 B9**

*SEM Photo of sample U2163 B9 with labeled EDS testing locations.*

**Particle Size:** 12 \( \mu \text{m} \)  
**Shape:** Irregular  
**Transparency:** Opaque to Translucent  
**Color:** Gray  
**Luster:** Pearly to Dull  
**Particle Type:** Artificial Terrestrial Contamination  
**Cluster No.:** U2163 Cluster 23  
**Comments:**

---

**Cluster of Origin: U2163 Cluster 23**

*Photo of cluster U2163 Cluster 23.*
**U2163 B9 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-B-9 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-B-9 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-B-9 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-B-9 taken at test area 4. The test area is labeled in the particle SEM photo.
**U2163 B10**

*SEM Photo of sample U2163 B10 with labeled EDS testing locations.*

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**Cluster of Origin: U2163 Cluster 24**

*Photo of cluster U2163 Cluster 24.*
U2163 B10 - EDS Spectra

Figure 1. EDS Spectra for sample U2163-B-10 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2163-B-10 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-B-10 taken at test area 3. The test area is labeled in the particle SEM photo..
**U2163 B13**

*SEM Photo of sample U2163 B13 with labeled EDS testing locations.*

**Cluster of Origin: U2163 Cluster 27**

*Photo of cluster U2163 Cluster 27.*

**Properties:**
- **Particle Size:** 8 µm
- **Shape:** Equidimensional to Irregular
- **Transparency:** Opaque
- **Color:** Gray
- **Luster:** Dull
- **Particle Type:** Artificial Terrestrial Contamination
- **Cluster No.:** U2163 Cluster 27
- **Comments:**
**U2163 B13 - EDS Spectra**

![Figure 1. EDS Spectra for sample U2163-B-13 taken at test area 1. The test area is labeled in the particle SEM photo.](image)

![Figure 2. EDS Spectra for sample U2163-B-13 taken at test area 2. The test area is labeled in the particle SEM photo.](image)
Figure 3. EDS Spectra for sample U2163-B-13 taken at test area 3. The test area is labeled in the particle SEM photo.
Particle Descriptions

Natural Terrestrial Contamination (TCN Type)
U2153 N1

SEM Photo of sample U2153 N1 with labeled EDS testing locations.

Cluster of Origin: U2153 Cluster 4

Photo of cluster U2153 Cluster 4.
**U2153 N1 - EDS Spectra**

![EDS Spectra](image)

*Figure 1. EDS Spectra for sample U2153-N-1 taken at test area 1. The test area is labeled in the particle SEM photo.*

![EDS Spectra](image)

*Figure 2. EDS Spectra for sample U2153-N-1 taken at test area 2. The test area is labeled in the particle SEM photo.*
**Figure 3.** EDS Spectra for sample U2153-N-1 taken at test area 3. The test area is labeled in the particle SEM photo.
U2157 A1

Particle Size: 4x10 µm
Shape: Equidimensional
Transparency: Transparent to Translucent
Color: Clear
Luster: Subvitreous
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2157 Cluster 1
Comments:

SEM Photo of sample U2157 A1 with labeled EDS testing locations.
Cluster of Origin: U2157 Cluster 1

Photo of cluster U2157 Cluster 1.

U2157 A1 - EDS Spectra

Figure 1. EDS Spectra for sample U2157-A-1 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2157-A-1 taken at test area 2. The test area is labeled in the particle SEM photo.
U2157 A6

Particle Size: 7 µm
Shape: Equidimensional to Irregular
Transparency: Opaque
Color: Gray
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments:

SEM Photo of sample U2157 A6 with labeled EDS testing locations.

U2157 A6 - EDS Spectra

Figure 1. EDS Spectra for sample U2157-A-6 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2157-A-6 taken at test area 2. The test area is labeled in the particle SEM photo.
U2157 A7

SEM Photo of sample U2157 A7 with labeled EDS testing locations.

U2157 A7 - EDS Spectra

Figure 1. EDS Spectra for sample U2157-A-7 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2157-A-7 taken at test area 2. The test area is labeled in the particle SEM photo.
U2157 A10

SEM Photo of sample U2157 A10 with labeled EDS testing locations.

<table>
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<td>Color:</td>
<td>Clear</td>
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<tr>
<td>Luster:</td>
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<td>Particle Type:</td>
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<td>Cluster No.:</td>
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<td>Comments:</td>
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Figure 1. EDS Spectra for sample U2157-A-10 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2157-A-10 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2157-A-10 taken at test area 3. The test area is labeled in the particle SEM photo.
U2158 D1

Particle Size: 8 µm
Shape: Irregular
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2158 Cluster 51
Comments:

SEM Photo of sample U2158 D1 with labeled EDS testing locations.

Cluster of Origin: U2158 Cluster 51

Photo of cluster U2158 Cluster 51.
U2158 D1 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-1 taken at test area 1. The test area is labeled in the particle SEM photo..

Figure 2. EDS Spectra for sample U2158-D-1 taken at test area 2. The test area is labeled in the particle SEM photo.
**U2158 D2**

*SEM Photo of sample U2158 D2 with labeled EDS testing locations.*

**Cluster of Origin: U2158 Cluster 52**

*Photo of cluster U2158 Cluster 52.*

- **Particle Size:** 5 µm
- **Shape:** Irregular to Equidimensional
- **Transparency:** Translucent
- **Color:** Black, Brown
- **Luster:** Pearly
- **Particle Type:** Natural Terrestrial Contamination
- **Cluster No.:** U2158 Cluster 52
- **Comments:**

Astromaterials Acquisition and Curation
**U2158 D2 - EDS Spectra**

**Figure 1.** EDS Spectra for sample U2158-D-2 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2158-D-2 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2158-D-2 taken at test area 3. The test area is labeled in the particle SEM photo.
U2158 D3

Particle Size: 9 µm
Shape: Irregular
Transparency: Translucent
Color: Clear
Luster: Pearly to Subvitreous
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2158 Cluster 54
Comments:

SEM Photo of sample U2158 D3 with labeled EDS testing locations.

Cluster of Origin: U2158 Cluster 54

Photo of cluster U2158 Cluster 54.
**U2158 D3 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2158-D-3 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2158-D-3 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2158-D-3 taken at test area 3. The test area is labeled in the particle SEM photo.
U2158 D5

SEM Photo of sample U2158 D5 with labeled EDS testing locations.

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Cluster of Origin: U2158 Cluster 56

Photo of cluster U2158 Cluster 56.

U2158 D5 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-5 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-5 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-5 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2158-D-5 taken at test area 4. The test area is labeled in the particle SEM photo.
SEM Photo of sample U2158 D6 with labeled EDS testing locations.

**U2158 D6**

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**Cluster of Origin: U2158 Cluster 57**

Photo of cluster U2158 Cluster 57.

**U2158 D6 - EDS Spectra**

![EDS Spectra](image)

*Figure 1. EDS Spectra for sample U2158-D-6 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2158-D-6 taken at test area 2. The test area is labeled in the particle SEM photo.
**U2158 D8**

*SEM Photo of sample U2158 D8 with labeled EDS testing locations.*

**Cluster of Origin: U2158 Cluster 59**

*Photo of cluster U2158 Cluster 59.*
U2158 D8 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-8 taken at test area 1. The test area is labeled in the particle SEM photo.
**U2158 D9**

![SEM Photo](image)

*SEM Photo of sample U2158 D9 with labeled EDS testing locations.*

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**U2158 D9 - EDS Spectra**

![EDS Spectra](image)

*Figure 1. EDS Spectra for sample U2158-D-9 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2158-D-9 taken at test area 2. The test area is labeled in the particle SEM photo.
U2158 D10

SEM Photo of sample U2158 D10 with labeled EDS testing locations.

<table>
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U2158 D10 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-10 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-10 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-10 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2158-D-10 taken at test area 4. The test area is labeled in the particle SEM photo.
U2158 D11

**Particle Size:** 20 µm  
**Shape:** Spherical  
**Transparency:** Opaque to Translucent  
**Color:** Black, Brown  
**Luster:** Pearly to Subvitreous  
**Particle Type:** Natural Terrestrial Contamination  
**Cluster No.:**  
**Comments:**

*SEM Photo of sample U2158 D11 with labeled EDS testing locations.*

**U2158 D11 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2158-D-11 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2158-D-11 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-11 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2158-D-11 taken at test area 4. The test area is labeled in the particle SEM photo.
U2158 D13

Particle Size: 14 μm
Shape: Equidimensional
Transparency: Opaque
Color: Black, Brown
Luster: Pearly to Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments: 

SEM Photo of sample U2158 D13 with labeled EDS testing locations.

U2158 D13 - EDS Spectra

Figure 1. EDS Spectra for sample U2158-D-13 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-13 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-13 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2158 D14**

*SEM Photo of sample U2158 D14 with labeled EDS testing locations.*

**U2158 D14 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2158-D-14 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2158-D-14 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-14 taken at test area 3. The test area is labeled in the particle SEM photo.
U2158 D15

SEM Photo of sample U2158 D15 with labeled EDS testing locations.

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<td>Luster:</td>
<td>Pearly to Dull</td>
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<td>Particle Type:</td>
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</table>

Cluster No.: Comments:

Figure 1. EDS Spectra for sample U2158-D-15 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2158-D-15 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2158-D-15 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2159 A2**

**Particle Size:** 15x27 µm  
**Shape:** Irregular to Equidimensional  
**Transparency:** Translucent to Transparent  
**Color:** Black, Clear, Orange  
**Luster:** Pearly to Subvitreous  
**Particle Type:** Possibly Natural Terrestrial Contamination  
**Cluster No.:** U2159 Cluster 2  
**Comments:**

*SEM Photo of sample U2159 A2 with labeled EDS testing locations.*

**Cluster of Origin: U2159 Cluster 2**

*Photo of cluster U2159 Cluster 2.*
**U2159 A2 - EDS Spectra**

*Figure 4. EDS Spectra for sample U2159-A-2 taken at test area 4. The test area is labeled in the particle SEM photo.*

*Figure 5. EDS Spectra for sample U2159-A-2 taken at test area 5. The test area is labeled in the particle SEM photo.*
Figure 6. EDS Spectra for sample U2159-A-2 taken at test area 6. The test area is labeled in the particle SEM photo.

Figure 1. EDS Spectra for sample U2159-A-2 taken at test area 1. The test area is labeled in the particle SEM photo.
**Figure 2.** EDS Spectra for sample U2159-A-2 taken at test area 2. The test area is labeled in the particle SEM photo.

**Figure 3.** EDS Spectra for sample U2159-A-2 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2159 A3**

*SEM Photo of sample U2159 A3 with labeled EDS testing locations.*

**Cluster of Origin: U2159 Cluster 3**

*Photo of cluster U2159 Cluster 3.*

- **Particle Size:** 7 µm
- **Shape:** Equidimensional
- **Transparency:** Opaque
- **Color:** Black
- **Luster:** Dull
- **Particle Type:** Natural Terrestrial Contamination
- **Cluster No.:** U2159 Cluster 3
- **Comments:**
**U2159 A3 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2159-A-3 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2159-A-3 taken at test area 2. The test area is labeled in the particle SEM photo.*
U2159 A6

SEM Photo of sample U2159 A6 with labeled EDS testing locations.

Cluster of Origin: U2159 Cluster 6

Photo of cluster U2159 Cluster 6.
**U2159 A6 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2159-A-6 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2159-A-6 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2159-A-6 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2159 A9**

**Particle Size:** 16x11 µm  
**Shape:** Equidimensional  
**Transparency:** Opaque  
**Color:** Black  
**Luster:** Dull  
**Particle Type:** Natural Terrestrial Contamination  
**Cluster No.:** U2159 Cluster 9  
**Comments:**

*SEM Photo of sample U2159 A9 with labeled EDS testing locations.*

---

**Cluster of Origin: U2159 Cluster 9**

*Photo of cluster U2159 Cluster 9.*
**U2159 A9 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2159-A-9 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2159-A-9 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2159-A-9 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2159-A-9 taken at test area 4. The test area is labeled in the particle SEM photo.
Figure 5. EDS Spectra for sample U2159-A-9 taken at test area 5. The test area is labeled in the particle SEM photo.
U2159 A10

Particle Size: 13 µm
Shape: Spherical
Transparency: Opaque
Color: Black
Luster: Subvitreous
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments:

SEM Photo of sample U2159 A10 with labeled EDS testing locations.

U2159 A10 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-10 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-10 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-10 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A11

SEM Photo of sample U2159 A11 with labeled EDS testing locations.

U2159 A11 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-11 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-11 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-11 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A12

SEM Photo of sample U2159 A12 with labeled EDS testing locations.

U2159 A12 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-12 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-12 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-12 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A13

Particle Size: 14 μm
Shape: Equidimensional to Irregular
Transparency: Translucent to Transparent
Color: Clear
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments:

SEM Photo of sample U2159 A13 with labeled EDS testing locations.

U2159 A13 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-13 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-13 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-13 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A14

Particle Size: 20 µm
Shape: Spherical
Transparency: Translucent to Transparent
Color: Yellow
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments: 

SEM Photo of sample U2159 A14 with labeled EDS testing locations.

U2159 A14 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-14 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-14 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-14 taken at test area 3. The test area is labeled in the particle SEM photo.
U2159 A15

SEM Photo of sample U2159 A15 with labeled EDS testing locations.

U2159 A15 - EDS Spectra

Figure 1. EDS Spectra for sample U2159-A-15 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2159-A-15 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-15 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2159-A-15 taken at test area 4. The test area is labeled in the particle SEM photo.
**U2159 A16**

*SEM Photo of sample U2159 A16 with labeled EDS testing locations.*

**U2159 A16 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2159-A-16 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2159-A-16 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2159-A-16 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A1

Particle Size: 20 µm
Shape: Equidimensional to Spherical
Transparency: Opaque to Translucent
Color: Black
Luster: Pearly to Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2162 Cluster 1
Comments:

SEM Photo of sample U2162 A1 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 1

Photo of cluster U2162 Cluster 1.
**U2162 A1 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-1 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-1 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-1 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A7

SEM Photo of sample U2162 A7 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 7

Particle Size: 23x9 µm
Shape: Equidimensional to Irregular
Transparency: Opaque to Subvitreous
Color: Black
Luster: Pearly to Subvitreous
Particle Type: Possibly Natural Terrestrial Contamination
Cluster No.: U2162 Cluster 7
Comments:

Photo of cluster U2162 Cluster 7.
**U2162 A7 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-7 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-7 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-7 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 A15**

![SEM Photo of sample U2162 A15 with labeled EDS testing locations.](image)

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*Cluster of Origin: U2162 Cluster 15*

![Photo of cluster U2162 Cluster 15.](image)
**U2162 A15 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-15 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-15 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-15 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 A16**

*SEM Photo of sample U2162 A16 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 26**

*Photo of cluster U2162 Cluster 26.*
**U2162 A16 - EDS Spectra**

Figure 1. EDS Spectra for sample U2162-A-16 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-16 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-16 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A17

SEM Photo of sample U2162 A17 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 25

Photo of cluster U2162 Cluster 25.
U2162 A17 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-A-17 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-A-17 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-A-17 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 A19

SEM Photo of sample U2162 A19 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 17

Photo of cluster U2162 Cluster 17.
**U2162 A19 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-A-19 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-A-19 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-A-19 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B1

SEM Photo of sample U2162 B1 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 18

Photo of cluster U2162 Cluster 18.
Figure 1. EDS Spectra for sample U2162-B-1 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-1 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-1 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 B6**

*SEM Photo of sample U2162 B6 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 23**

*Photo of cluster U2162 Cluster 23.*

- **Particle Size:** 13 µm
- **Shape:** Equidimensional to Spherical
- **Transparency:** Opaque
- **Color:** Black
- **Luster:** Dull
- **Particle Type:** Natural Terrestrial Contamination
- **Cluster No.:** U2162 Cluster 23

Comments:
U2162 B6 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-B-6 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-6 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-6 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 B8**

*SEM Photo of sample U2162 B8 with labeled EDS testing locations.*

**Cluster of Origin: U2162 Cluster 27**

*Photo of cluster U2162 Cluster 27.*
**U2162 B8 - EDS Spectra**

*Figure 1.* EDS Spectra for sample U2162-B-8 taken at test area 1. The test area is labeled in the particle SEM photo.

*Figure 2.* EDS Spectra for sample U2162-B-8 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-8 taken at test area 3. The test area is labeled in the particle SEM photo.
### U2162 B9

**SEM Photo of sample U2162 B9 with labeled EDS testing locations.**

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<td>Opaque to Translucent</td>
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<td>Color:</td>
<td>Brown</td>
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<tr>
<td>Luster:</td>
<td>Pearly to Subvitreous</td>
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<td>Particle Type:</td>
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<td>Cluster No.:</td>
<td>U2162 Cluster 28</td>
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<td>Comments:</td>
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</tbody>
</table>

**Cluster of Origin: U2162 Cluster 28**

*Photo of cluster U2162 Cluster 28.*
**U2162 B9 - EDS Spectra**

**Figure 1.** EDS Spectra for sample U2162-B-9 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2162-B-9 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-9 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B12

Particle Size: 10x6 μm
Shape: Equidimensional to Spherical
Transparency: Opaque
Color: Black
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2162 Cluster 31
Comments:

SEM Photo of sample U2162 B12 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 31

Photo of cluster U2162 Cluster 31.
**U2162 B12 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-12 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-12 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-12 taken at test area 3. The test area is labeled in the particle SEM photo.
### U2162 B13

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<td>Color</td>
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*SEM Photo of sample U2162 B13 with labeled EDS testing locations.*

*Cluster of Origin: U2162 Cluster 32*

*Photo of cluster U2162 Cluster 32.*
**U2162 B13 - EDS Spectra**

**Figure 1. EDS Spectra for sample U2162-B-13 taken at test area 1. The test area is labeled in the particle SEM photo.**

**Figure 2. EDS Spectra for sample U2162-B-13 taken at test area 2. The test area is labeled in the particle SEM photo.**
Figure 3. EDS Spectra for sample U2162-B-13 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B15

SEM Photo of sample U2162 B15 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 34

Photo of cluster U2162 Cluster 34.
U2162 B15 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-B-15 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2162-B-15 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2162-B-15 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 B18

Particle Size: 11x18 µm
Shape: Irregular to Equidimensional
Transparency: Opaque to Subvitreous
Color: Black, Gray
Luster: Pearly to Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2162 Cluster 37
Comments:

SEM Photo of sample U2162 B18 with labeled EDS testing locations.

Cluster of Origin: U2162 Cluster 37

Photo of cluster U2162 Cluster 37.
**U2162 B18 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-B-18 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2162-B-18 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2162-B-18 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 C1

SEM Photo of sample U2162 C1 with labeled EDS testing locations.

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<td>Color:</td>
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<tr>
<td>Luster:</td>
<td>Submetallic to Subvitreous</td>
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<td>Cluster No.:</td>
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<tr>
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</table>

U2162 C1 - EDS Spectra

Figure 1. EDS Spectra for sample U2162-C-1 taken at test area 1. The test area is labeled in the particle SEM photo.
Figure 2. EDS Spectra for sample U2162-C-1 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-1 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 C2

Particle Size: 13x22 µm
Shape: Equidimensional to Irregular
Transparency: Opaque to Translucent
Color: Black, Gray
Luster: Pearly to Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: 
Comments:

*SEM Photo of sample U2162 C2 with labeled EDS testing locations.*

U2162 C2 - EDS Spectra

*Figure 1. EDS Spectra for sample U2162-C-2 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-2 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-2 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 C4**

*SEM Photo of sample U2162 C4 with labeled EDS testing locations.*

**Particle Size:** 20x30 µm  
**Shape:** Irregular  
**Transparency:** Opaque  
**Color:** Black, Gray  
**Luster:** Pearly to Subvitreous  
**Particle Type:** Natural Terrestrial Contamination

**Cluster No.:**  
**Comments:**

---

**U2162 C4 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-4 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-4 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-4 taken at test area 3. The test area is labeled in the particle SEM photo.
**U2162 C5**

*SEM Photo of sample U2162 C5 with labeled EDS testing locations.*

**U2162 C5 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-5 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-5 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-5 taken at test area 3. The test area is labeled in the particle SEM photo.
U2162 C7

**SEM Photo of sample U2162 C7 with labeled EDS testing locations.**

**U2162 C7 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2162-C-7 taken at test area 1. The test area is labeled in the particle SEM photo.*
Figure 2. EDS Spectra for sample U2162-C-7 taken at test area 2. The test area is labeled in the particle SEM photo.

Figure 3. EDS Spectra for sample U2162-C-7 taken at test area 3. The test area is labeled in the particle SEM photo.
Figure 4. EDS Spectra for sample U2162-C-7 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 A9

Particle Size: 25 µm  
Shape: Equidimensional  
Transparency: Opaque  
Color: Black, Gray, Yellow  
Luster: Pearly  
Particle Type: Natural Terrestrial Contamination  
Cluster No.: U2163 Cluster 9

SEM Photo of sample U2163 A9 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 9

Photo of cluster U2163 Cluster 9.
U2163 A9 - EDS Spectra

Figure 1. EDS Spectra for sample U2163-A-9 taken at test area 1. The test area is labeled in the particle SEM photo.

Figure 2. EDS Spectra for sample U2163-A-9 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-A-9 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-A-9 taken at test area 4. The test area is labeled in the particle SEM photo.
**U2163 A12**

*SEM Photo of sample U2163 A12 with labeled EDS testing locations.*

**Cluster of Origin: U2163 Cluster 12**

*Photo of cluster U2163 Cluster 12.*
**U2163 A12 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-A-12 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-A-12 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-A-12 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 A13

SEM Photo of sample U2163 A13 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 13

Photo of cluster U2163 Cluster 13.
**U2163 A13 - EDS Spectra**

**Figure 1.** EDS Spectra for sample U2163-A-13 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2163-A-13 taken at test area 2. The test area is labeled in the particle SEM photo.
U2163 A14

SEM Photo of sample U2163 A14 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 14

Photo of cluster U2163 Cluster 14.
**U2163 A14 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-A-14 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-A-14 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-A-14 taken at test area 3. The test area is labeled in the particle SEM photo..

Figure 4. EDS Spectra for sample U2163-A-14 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 B3

Particle Size: 8 µm
Shape: Equidimensional to Spherical
Transparency: Opaque to Translucent
Color: Brown
Luster: Pearly to Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2163 Cluster 17
Comments:

SEM Photo of sample U2163 B3 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 17

Photo of cluster U2163 Cluster 17.
**U2163 B3 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-B-3 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-B-3 taken at test area 2. The test area is labeled in the particle SEM photo.*
Figure 3. EDS Spectra for sample U2163-B-3 taken at test area 3. The test area is labeled in the particle SEM photo.
U2163 B4

Particle Size: 10x7 µm
Shape: Equidimensional
Transparency: Opaque
Color: Black, Gray
Luster: Dull
Particle Type: Natural Terrestrial Contamination
Cluster No.: U2163 Cluster 18
Comments:

SEM Photo of sample U2163 B4 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 18

Photo of cluster U2163 Cluster 18.
U2163 B4 - EDS Spectra

![Full scale counts: 5473](image)

Figure 1. EDS Spectra for sample U2163-B-4 taken at test area 1. The test area is labeled in the particle SEM photo.

![Full scale counts: 3681](image)

Figure 2. EDS Spectra for sample U2163-B-4 taken at test area 2. The test area is labeled in the particle SEM photo.
Figure 3. EDS Spectra for sample U2163-B-4 taken at test area 3. The test area is labeled in the particle SEM photo.

Figure 4. EDS Spectra for sample U2163-B-4 taken at test area 4. The test area is labeled in the particle SEM photo.
U2163 B11

**SEM Photo of sample U2163 B11 with labeled EDS testing locations.**

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<td>Cluster No.:</td>
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</table>

**Cluster of Origin: U2163 Cluster 25**

*Photo of cluster U2163 Cluster 25.*
**U2163 B11 - EDS Spectra**

**Figure 1.** EDS Spectra for sample U2163-B-11 taken at test area 1. The test area is labeled in the particle SEM photo.

**Figure 2.** EDS Spectra for sample U2163-B-11 taken at test area 2. The test area is labeled in the particle SEM photo.
U2163 B12

SEM Photo of sample U2163 B12 with labeled EDS testing locations.

Cluster of Origin: U2163 Cluster 26

Photo of cluster U2163 Cluster 26.
**U2163 B12 - EDS Spectra**

*Figure 1. EDS Spectra for sample U2163-B-12 taken at test area 1. The test area is labeled in the particle SEM photo.*

*Figure 2. EDS Spectra for sample U2163-B-12 taken at test area 2. The test area is labeled in the particle SEM photo.*