PRELIMINARY SEM STUDIES OF DUST PARTICLES FROM THE L2021 AND L2036 NASA COLLECTORS: ARE ALL TCNs TERRESTRIAL CONTAMINANTS? N. Krestina, M. I. Petaev and S. B. Jacobsen, Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138, USA; (krestina@fas.harvard.edu)

Introduction: The interplanetary dust particles (IDPs) collected by the NASA highflying aircrafts since 1974 were initially classified on their EDS X-ray spectra. The particle types recognized so far include cosmic (C-type) particles, natural terrestrial contaminants (TCN), artificial terrestrial contaminants (TCA) and aluminum oxide (AO) spheres. According to [1] only 80 % particles were classified unambiguously, with the identity of the remaining 20% being uncertain. The intensive investigation of the returned 81P/Wild 2 cometary samples revealed a number of particles spectrally similar to TCNs. In addition to a typical C-type EDS spectrum such particles may be enriched in Na, Cr, and K [2, 3]. By default, these particles belong to the C-type.

The 81P/Wild 2 particle study has triggered the development of new methodology for automatic particles classification [1] based on matching their EDS spectra with known standards. The application of the new classification procedure to the particles from collectors L2021 and L2036 collected in 1994 [4] resulted in relabeling of 155 particles, with some, including 31 TCN, being reclassified as C- type.

Here we report the results of the SEM study of five particles from the NASA collectors L2021 (E8; E9; D1; D16) and L2036 (C7). In addition to typical EDS spectra, we also collected low energy spectra with well-resolved C, O, N and F peaks.

Sample Handling & Analytical Techniques: At our dust-free facility [5] the particles received were detached from the glass slide surface under the Olympus BX52 microscope using a tungsten-needle micromanipulator and re-located onto carbon tape attached to an Al holder for further investigation. The morphology and chemistry of the particles were studied in detail using the Supra55VP FESEM at the Harvard University Center for Nanoscale Science.

In contrast to old SEMs, Supra55VP FESEM allows acquisition of low kV spectra, which show C and O peaks of different intensities in all particles studied. However, no C signal was detected in the microprobe silicate standards except for from the areas of carbon paint. In these standards, we see O peaks of different intensities, consistent with known O contents of the standards. Because the particles studied were attached to the carbon tape, we explored a possibility of contamination of our C analyses from the tape by measuring compositional profiles across the particle-tape interfaces. We found that the C signal from the tape fades away after ~5 microns from the interface. Also, we observed large variations in the C signal intensity inside large, texturally heterogeneous particles (*e.g.*, Fig. 1), implying that our C contents did not result from contamination.

Results and Discussion: The TCN particle L2021 E9, in addition to Si, Mg and Fe, contains Al, with the peak intensity comparable to that of Mg. While such Al signal is too high for a C-type particle, consistent with the previous classification [4], this particle exhibit great textural and chemical variability that warrants its further study. For example, it contains a dumbbell-shaped C-rich object (Fig 1, insert) and shows large C variations (0 – 50 wt. %).

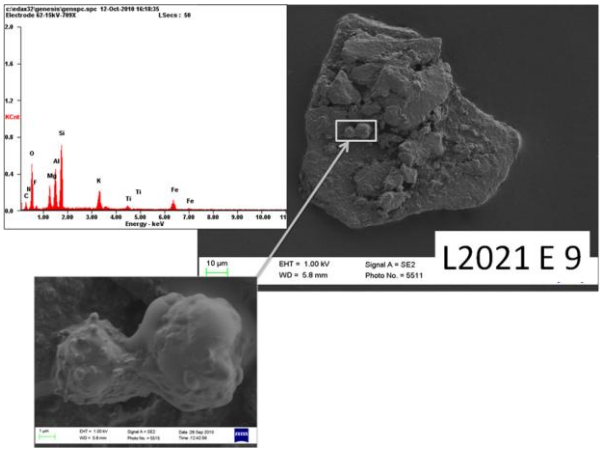

Fig. 1. Secondary electron image of the L2021 E9 particle and one of its surface fragments along with X-ray energy dispersive spectrum of the major elements.

The petrographic observations of the TCN L2036 C7 particle clearly show two objects, large opaque and small transparent, stuck together. During re-location the particle flipped over, so we acquired an EDS spectrum (Fig. 2) from the opposite side relative to the spectrum measured at NASA facilities [4]. The two spectra are quite different from one another – our spectrum (Fig. 2) shows strong Al, C, and O and very week Si peaks while the NASA spectrum very strong Si and very weak Al peaks. No carbon was measured by NASA. It appears that this composite particle consists of a clear alumina crystal stacked to a large, C- rich object. Based on these observations, we can classify the larger, C- rich object as a C- type particle.

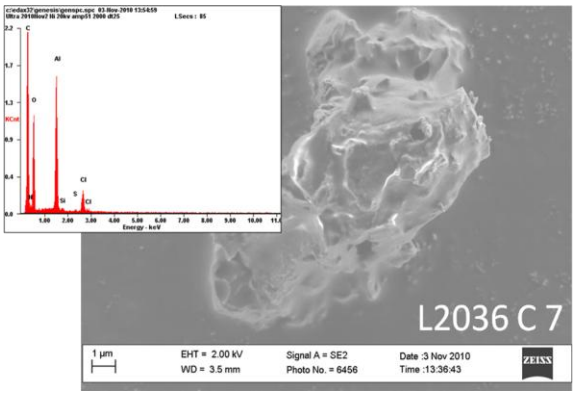

Fig. 2. SE image and EDX spectrum of the L2036 C7.

The EDS spectrum of the TCN L2021 D1 particle (Fig. 3) shows strong Al peak, with the intensity higher than Mg, consistent with its classification [4].

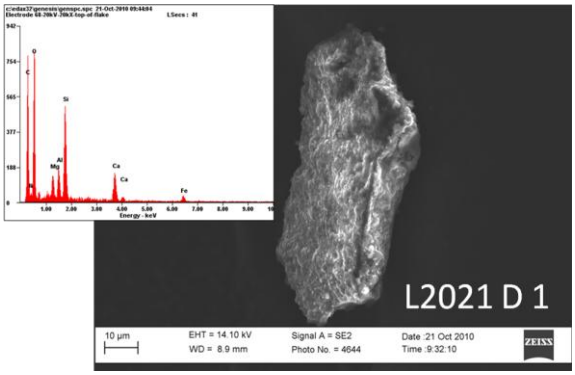

Fig. 3 SE image and EDX spectrum of the L2021 D1.

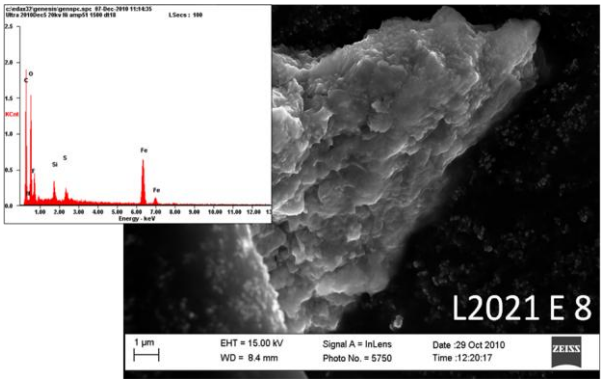

Fig. 4. SE image and EDX spectrum of the L2021 E8.

The EDS spectrum of the L2021 E8 particle (Fig. 4) displays strong C, O, and Fe peaks and no Al, suggestive of the C-type affinity of this particle. Surprisingly, there is also a strong F peak atypical for C-type particles. Given low abundance of F in extraterrestrial objects, F peak most likely results from terrestrial contamination, from either Teflon-based coatings or Freon gas used for cleaning filters. The uniform F concentrations in many EDS spectra of this particle suggest that the F signal most likely comes from the absorbed Freon.

The TCN L2021 D16 particle is very unusual in its appearance (Fig. 5). It consists of numerous small objects of different appearance such as balls, filaments, and plates. The whole particle is very rich in C. Among many EDS spectra of both whole particle and individual objects, none shows a significant Al peak, suggesting that this particle should be re-classified as C-type. The EDS spectra of individual objects show C and O peaks of varying intensities comparable to those of Mg, Si, and Fe.

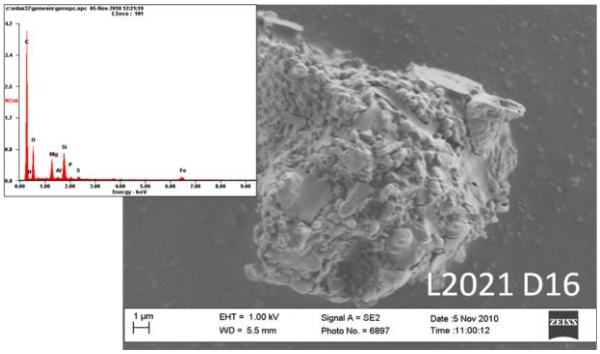

Fig. 5 SE image and EDX spectrum of the L2021 D16.

Conclusion: Among 5 particles from the L2021 (E8; E9; D1; D16) and L2036 (C7) collectors, three - L2021 E8, L2021 D16, and a portion of L2036 C7 – are reclassified as C-type. Clearly, a number of the particles labeled as TCNs at the NASA facilities may also prove to be of extraterrestrial origin.

References:

[1] Lasue J. et al. (2010) MAPS 45, 783-797. [2] Joswiak D. J. et al. (2007) LPSC, #2142. [3] Joswiak D.J. et al. (2008) LPSC, #2177. [4] http://curator.jsc.nasa.gov/dust/index.cfm [5] Krestina et al. (2010) LPSC #1949.