CARSON HELICOPTERS INC.

March 11, 2011

Dear Honorable Chairman Hersman:

Carson Helicopters, Inc. is writing to the National Transportation Safety Board regarding the final report and findings of the NTSB on the Sikorsky S61N helicopter crash near Weaverville, California on August 5, 2008. By this letter Carson is hereby filing a Letter of Petition to review the findings in this accident. Carson contends that, A) there is new and additional information regarding contaminants in the fuel system that should be given careful consideration, and B) the Board was not given complete and accurate performance information for review in reaching its findings regarding aircraft flight performance.

A. New Information Regarding Contamination and Contamination Sources

Carson strongly disagrees with the Board's conclusion as to the cause of the accident. Carson remains firm in its experienced opinion that the aircraft crashed due to a loss of power to an engine during takeoff from the helipad. Foreign contaminants were found in the fuel control of the engine that suffered torque loss, and Carson has brought to light new information that will help identify the source of the contaminants.

1. *Contaminants found in the fuel control were significant and would affect operation of the unit*

In the course of this investigation, clear physical evidence was brought forth that showed significant physical pieces of foreign contamination were present in the number two fuel control unit (FCU). During the Board hearing, the investigators stated that the contamination was not enough to affect operation of the FCU, and that both engines showed engine rpm (Ng) of 102%. The NTSB final report on page 52 states "Examination of the PRV assembly using a microscope revealed unidentified fiber strands resting in the second balance groove from the

metering end of the spool. No other evidence of contamination was observed." The NTSB concluded the strands in the spool were not enough to affect operation of the PRV. Both of these statements are incorrect.

a. The statement regarding "no other evidence of contamination" is incorrect and contradicted by the Materials Lab report 08-121. The NTSB Materials Lab report in the public docket details how numerous particles were removed from the interior of the PRV assembly when the spool was separated. Figure 14 shows a large quantity of contaminants from the PRV stub.
b. The volume of contaminants is more than enough to jam the spool as well as cause other issues with other valves within the FCU. In fact, contrary to the statement made by NTSB investigators at the hearing, Hamilton Sunstrand's Engineering Manager (manufacturer of the JFC26 FCU) stated in a 2004 email to GE about contaminants that were actually smaller than those found in N612AZ, "Any contaminant in the size range .0004-.001 in. could potentially cause erratic behavior/seizure of the PRV if the contaminant finds its way into the diametrical clearance of the valve.....ultimately valve seizure is likely in the future if contamination of this size and amount is introduced into the fuel control."

Contaminants of this size can and do affect pilot valves, stator vane operation, and fuel metering, which in turn can affect power available to the transmission; *in a free turbine engine, this can happen regardless of full engine rpm (Ng at 102%).*

2. *Significant JFC26 Contaminant History*

a. The magnitude of this contamination problem in the JFC-26 FCU is documented by the NTSB; on pages 76-77 of the Final Report, it states that a review of the Columbia overhaul facility records from 2005 to 2008 revealed that of the 152 FCUs removed from customer helicopters, contamination was found in 38 units (25 %).
b. Carson Helicopters (and other S61 operators) experienced a significant upswing in unscheduled FCU removal for power loss since 2003, with many of the reports back from the overhaul facility noting that significant contaminant was found. Carson discussed this with GE and the overhaul facility at that time, and both acknowledged the foreign contaminants as an ongoing problem.
c. Sikorsky and GE were both well aware of this problem up to and after the time of the accident. Both companies were party members to the investigation team and **yet failed to ever bring this to the attention of the NTSB** (*see the chain of emails documented in the Carson Party Submission to the Public Docket, pages 32-36*).
d. After discovery of the contaminants in the number two FCU during the accident investigation, Carson repeatedly urged the NTSB to try to discover the source of the

contaminants. After a cursory look at the fuel tank collector, the NTSB did no further investigative work. Carson has continued to look into the fuel system for possible sources of contamination similar to those found in several S61 FCUs.

3. *New Information regarding contaminant sources within the fuel control system*

Among the many different contaminant particles found in several S61 FCUs since 2003, micron photographs show that the most numerous and consistent particles are, 1) long, fairly straight fibers of a few microns in diameter and 5-200 microns in length, and 2) irregular pieces of "flat" fibrous material. These particles are found in every sample of contaminated material. The question remains as to the origin of these materials. A GE report on the FCU contamination from 2005 in the Public Docket states in part "Common factors found during the investigation would include 1) the use of common aerospace fuel system components, 2) common type of fuel, and 3) same fuel control maintenance facility."

a. In 2002 the overhaul facility (Columbia) began using a GE-approved repair procedure for fuel system parts that involves the resurfacing of the inside of the parts with a synthetic coating called E-poly, which restores original wall thickness to bring parts back into original specification.
b. Carson had a section of this coating examined at an independent laboratory via electron microscope and spectral analysis (*see attached photo section*). The coating contains long fiber particles and irregular flat particles that have spectral element peak signatures and physical characteristics that are nearly identical with the particles found in the FCU of N612AZ.
c. The long strand fibers found in every contamination sample in NTSB possession are (in Carson's opinion and by data comparison) a remarkable match for the composition and size of the long strand fibers contained in the E-poly matrix. It should be noted that these contamination samples also match those from other FCU failures on non-Carson aircraft.
d. The maintenance work orders for N612AZ show that the E-poly coating was applied to the T2 sleeve, the PRV valve body, and the pump housing of the number 2 fuel control prior to the accident.
e. Based on the evidence recently gathered by Carson, it is apparent that there is a high likelihood that the degraded interior poly coating is a major contributor of contamination inside the FCU which can and did cause partial power loss to an engine for N612AZ.
f. The NTSB final recommendation for limiting contamination was to go along with the recommended 10 micron replacement airframe filter as specified by Sikorsky in January 2010. However, the pieces subject to this coating are located in the fuel system AFTER the

airframe filter and thus a finer micron filter will have no remedial effect on limiting potential contamination in the FCU from these sources.

g. A search of FAA documents shows that there is no record of the 10 micron replacement paper filter recommended by Sikorsky as being FAA-certified as anything but a replacement 40 micron filter. *The NTSB recommendation for the 10 micron filter replacement as specified by Sikorsky is in error and is not currently certified by the FAA as a 10 micron filter.*

The NTSB made no serious attempt to track the source of this contamination, despite a demonstrated history of foreign contaminant issues causing power loss problems in this aircraft. The NTSB did not verify the FAA certification for the recommended replacement filter, which is not 10 micron. Failure to adequately address these issues could result in another loss of power to another S61 in the future.

B. *The NTSB investigators utilized faulty data from Sikorsky for the GenHel simulations to determine aircraft performance in the final report*

In Section 2.3.2 of the Final Report and in the Hover Study Addendum in the Public Docket, the NTSB relied heavily on flight simulations done with a GenHel flight simulation program provided by Sikorsky Aircraft Company (SAC) to determine actual aircraft performance.

The GenHel simulation was done utilizing performance figures from 1) the FAA-certified performance charts for the Composite Main Rotor Blade (CMRB)- equipped S61N helicopter and 2) from a set of flight data provided by Sikorsky that was acquired by SAC in 2008. In their final report and in the hearing, the investigators chose to rely on the SAC flight data simulation exclusively. This data set and the resulting simulation is badly flawed and should not have been used for any CMRB-S61 flight simulation purpose, let alone determining the probable flight path of the accident helicopter. Indeed, as pointed out by Professor of Aerodynamics H.C. Curtiss (who has witnessed the GenHel program from its earliest stages of development), this computer program was developed for handling qualities, load prediction, and flight control development. Performance analysis is not described as a design goal of the program. Further, the program does not have the capability to accurately predict power required for a given lift, and thus requires severe "corrections" to approximate conclusions. In this case, Sikorsky utilized faulty SAC flight data for the corrections (*see attached "Comments on GenHel Simulation", by H.C. Curtiss, professor emeritus, Princeton University*).

1. *The SAC 2008 flight data was acquired with inferior, experimental CMRB blades and ignored FAA procedures*

a. The SAC 2008 flight data was generated in 2008 when Sikorsky undertook private flight testing with a Navy SH3A shortbody S61 helicopter utilizing Carson composite blades. The standard FAA-certified Carson CMRB blade sets are manufactured to extremely high precision to fly in exact trim with each blade in the rotor system without trim tabs. Nevertheless, Sikorsky requested that Carson provide a set of CMRB blades equipped with large added trim tabs (similar to conventional Sikorsky metal blades) so they could be manually "trimmed" to balance with other blades in the set.

b. Sikorsky had no experience with the Carson CMRB blades and were warned repeatedly by Carson engineers that the CMRB were not designed to be flown with trim tabs and that poor performance would certainly result from deviating from the FAA-certified design. In the actual flight testing, Sikorsky's own test pilots reported that the trim-tabbed bladeset flew with large amounts of vibration and degraded lift performance.

c. The flight data that Sikorsky procured in 2008 in testing for the Navy was achieved using this non-certified design of the CMRB blades, on a shortbody military variant aircraft with a small diameter tail rotor assembly. The blades were equipped with external wire strain gauges that more than doubled the vibration level of the aircraft and affected lift and forward flight speed. As predicted, the experimental bladeset did not achieve good lift performance.

d. This 2008 dataset with uncertified, one-off inferior CMRB blades is the only actual flight data that Sikorsky used in the GenHel simulation and which the NTSB investigators subsequently used in their final report (*see attached NTSB simulation results 9c, 9d*). It is no surprise that such a simulation would result in a flight path showing the aircraft without available performance to clear the trees, since by Sikorsky's own admission this dataset does not remotely represent the actual superior performance of a commercial longbody S61N with regular FAA-approved CMRB blades.

e. Sikorsky stated that they were able to take into account the configuration differences between the accident aircraft and the SAC-Navy experimental data in the simulator. However, Sikorsky did not possess any representative actual flight data of Carson FAA-approved composite rotor blades on a commercial longbody S61N with FireKing tank and large tail rotor assembly. It would therefore be impossible for Sikorsky to accurately address the substantial differences in performance between the two configurations in a flight simulation. *For the NTSB investigators to consider this to be a useful dataset with any validity for accident simulations is completely unsupportable.*

This is undoubtedly new information to the Board Members, because the fact that this Sikorsky dataset (also incorrectly referred to as a DoD dataset) was acquired using inferior and

unapproved experimental CMRB blades is not noted in the NTSB final report, nor was it mentioned in the hearing presentation to Board members. Thus, the NTSB Board members were supplied with a faulty simulation which NTSB investigators represented as the most accurate portrayal of the flight capability of the aircraft; in fact the data upon which it was based was for an inferior performing aircraft that ignored basic FAA test procedures. No results from this dataset are useful to this investigation.

2. *The FAA-approved performance charts have been repeatedly validated and are the most accurate flight representation of the accident aircraft*

There was a second GenHel flight simulation done by SAC and the NTSB team, which was not included in the final report nor presented to the Board in the hearing. The second simulation was done using the FAA-approved flight performance chart data for a standard CMRB-equipped longbody S61 aircraft.

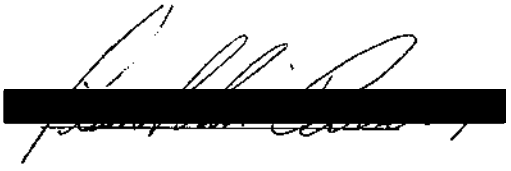
a. The FAA-approved performance charts were certified with flight testing conducted with the aid of an FAA DER (designated engineering representative) and this flight data is extensive, factual and unbiased. The DER was an ex-Sikorsky test pilot with 33 years of helicopter flight experience. Subsequent to the accident, the FAA (which, unlike Sikorsky, is a neutral party in this investigation) did a full review of the Carson CMRB performance chart certification data for the longbody S61N. The FAA concluded that the approved performance charts accurately reflected the true aircraft performance capability.
b. The GenHel flight simulation that was done utilizing the FAA-approved performance for the aircraft clearly and conclusively shows that the S61 as equipped that day had more than adequate performance to clear the trees at the helipad H44, either at 20 deg. C or 23 deg. C (*see attached simulation plots from NTSB Hover Study 9a, 9b*). This data was not used or presented to Board members at the hearing.
c. Carson commissioned an independent flight test done with an exemplar S61 at the same density conditions as the accident aircraft that clearly demonstrated the aircraft could lift weights up to and in *excess* of the FAA approved performance charts. The NTSB investigators repeatedly refused Carson's offer to participate in the flight testing done at actual accident density conditions, and plainly informed Carson that the NTSB "did not do flight testing". In fact, there are multiple cases in the public record that show that the NTSB certainly has participated in flight testing in past investigations.
d. In the face of large amounts of credible, repeated empirical flight data it is plain that the FAA performance charts for this aircraft are accurate, unbiased and conservative for the performance of the longbody CMRB-equipped helicopter.
e. Why did NTSB investigators utilize a flight dataset with no factual integrity to construct faulty simulations to reach a conclusion instead of relying on the correct and proven FAA

approved performance data ? The *only data* that should have been presented to the Board was the FAA-approved chart information, which is corroborated directly by the independent flight testing that was conducted at the same density conditions.

The purpose of our letter of petition is not to rehash old arguments. It is to point out to the board that there are two very important issues (among several) in this case where, 1) the investigating team has not presented the Board with the full facts and, 2) has failed to fully investigate probable causes for which new evidence has been discovered.

Carson urges the Board to act to fulfill its responsibilities in this matter by fully re-considering the true facts regarding the actual power and performance available to the aircraft and the new information regarding the source of the very real contaminant danger discovered in the course of this investigation.

Sincerely,

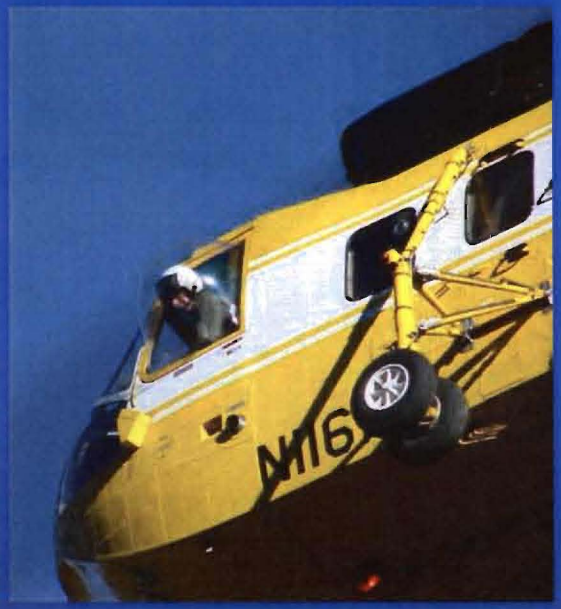


Franklin Carson

President

Carson Helicopters, Inc.

CARSON HELICOPTERS INC.



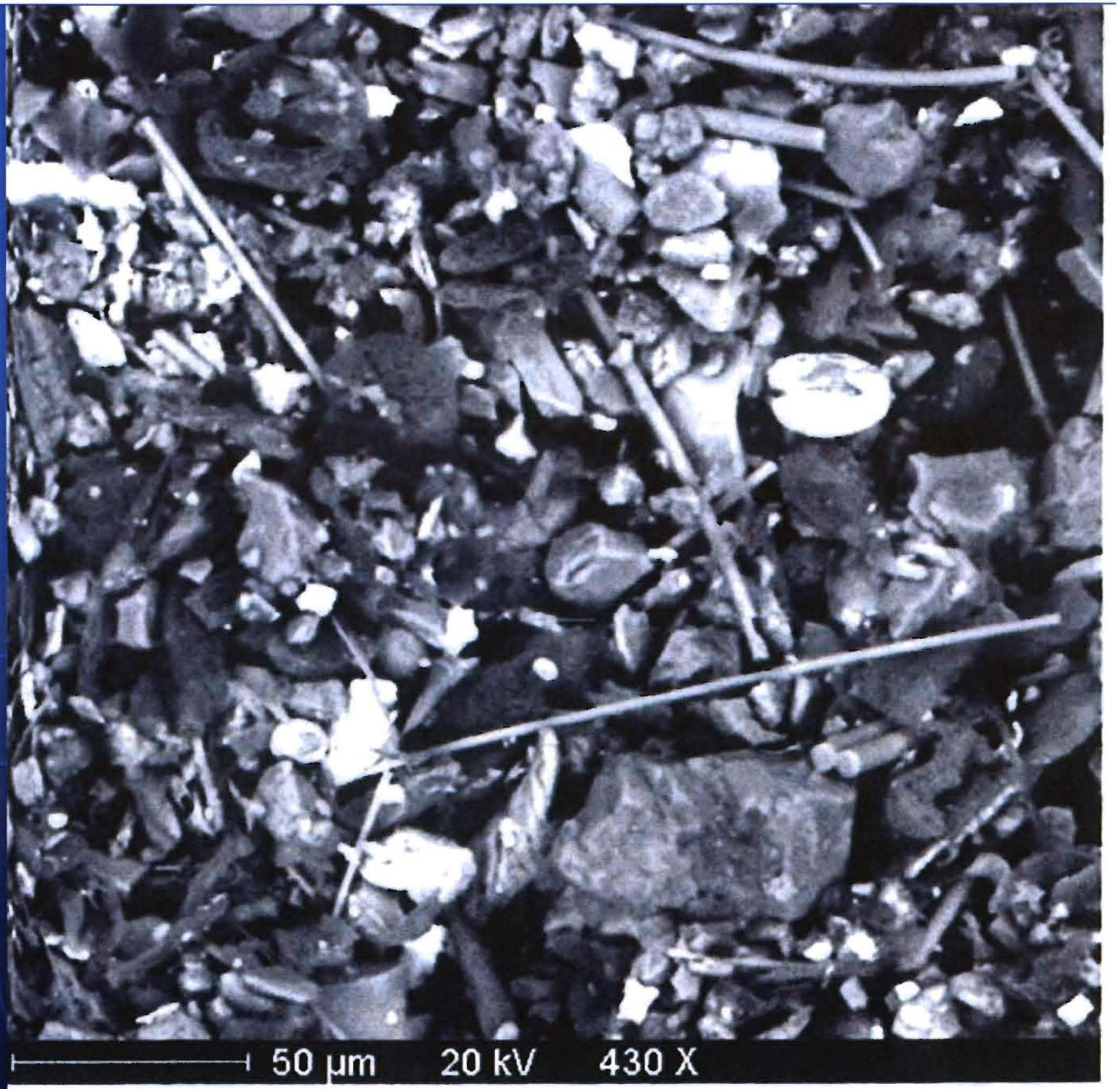
Comparison of four sets of FCU-PRV Particle Contamination and E-Poly fuel pump coating

Hayes Helicopter	2002
Carson-GE	2004
N612AZ	2008
N103WF	2008
E-Poly coating	2011

Hayes Helicopter
(Canada)

PRV- FCU
Contaminant
2002

430 X

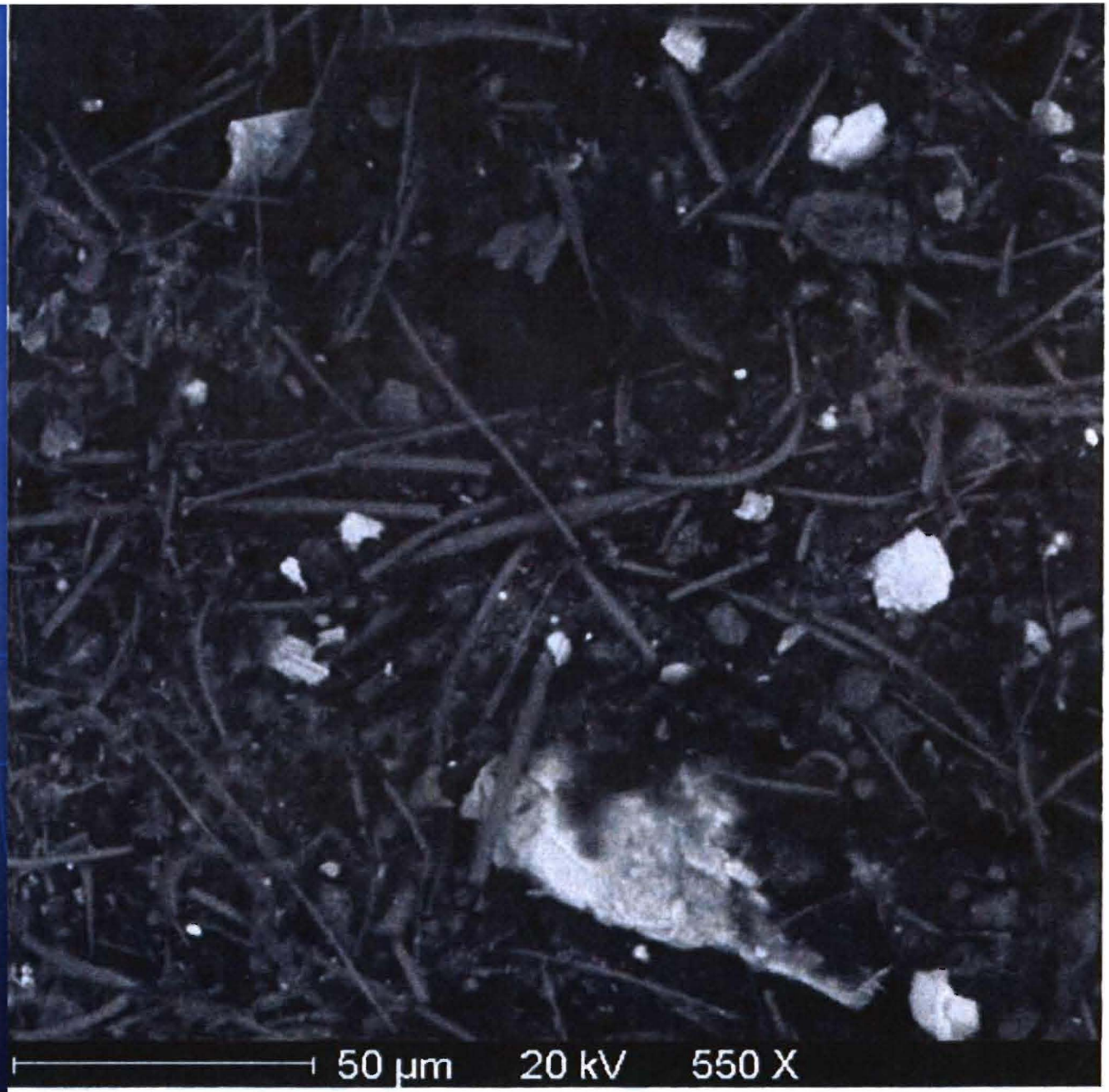


B.S.E.

Carson
Helicopters

PRV-FCU
Contaminant
2004

550 X



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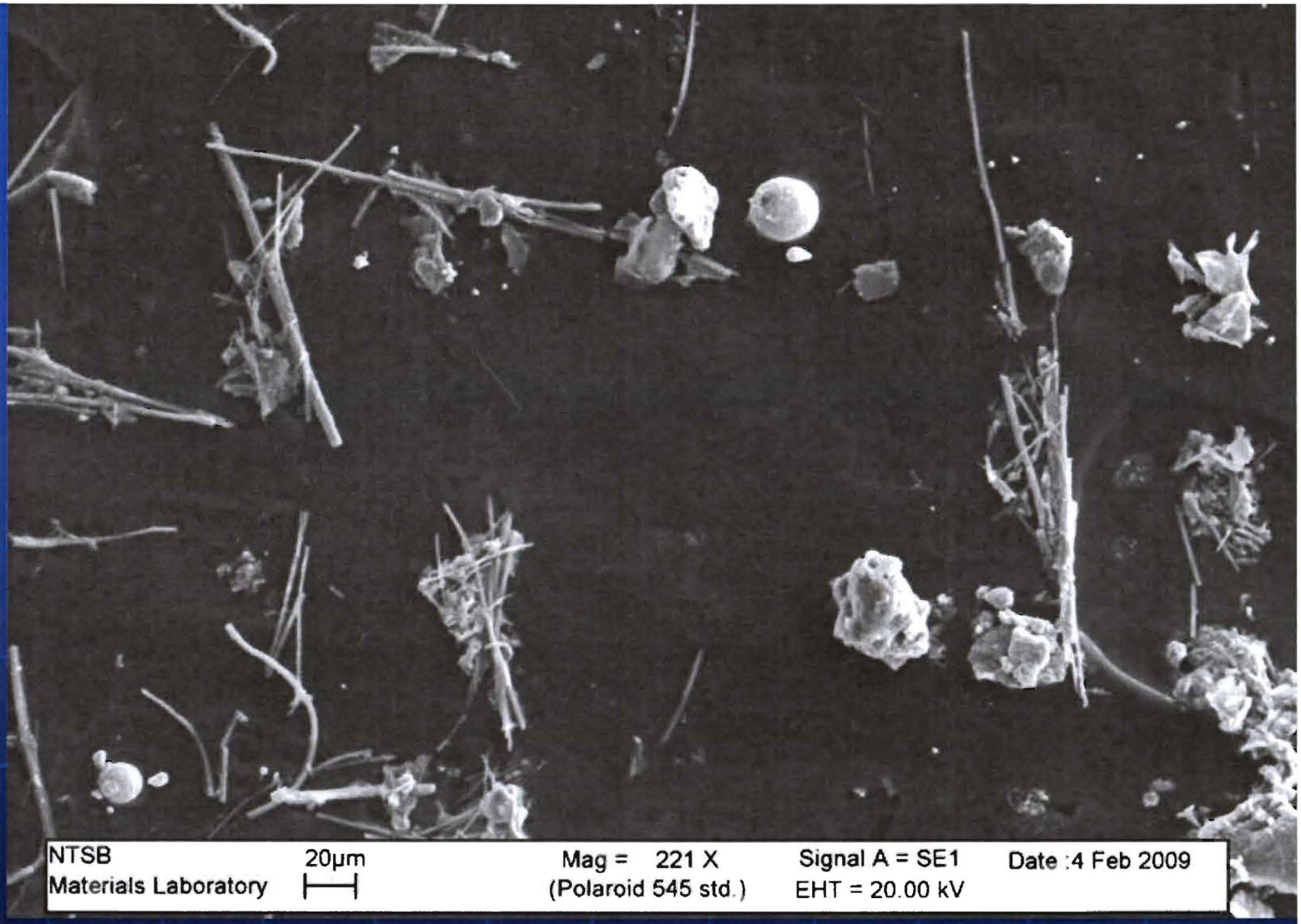
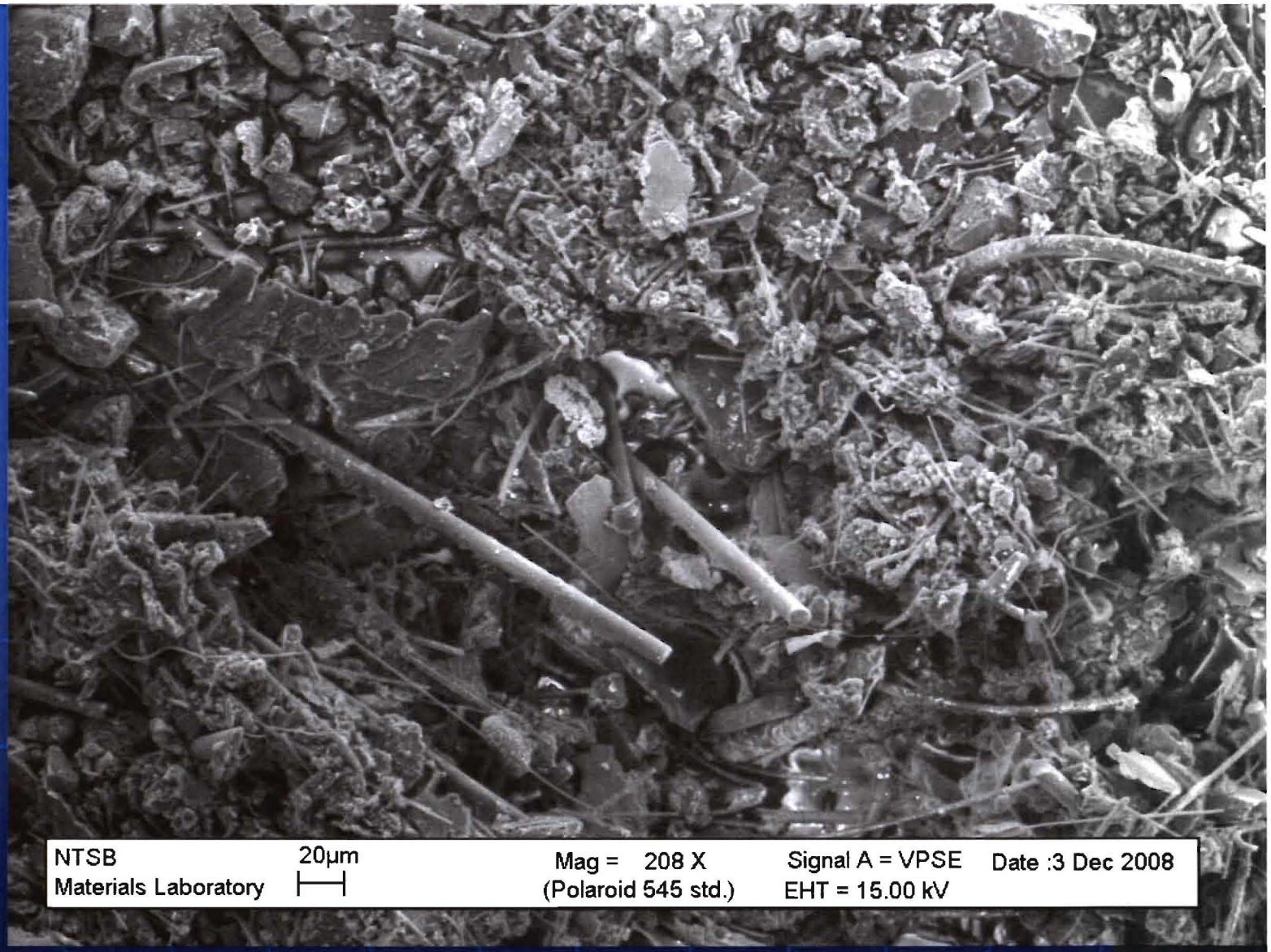
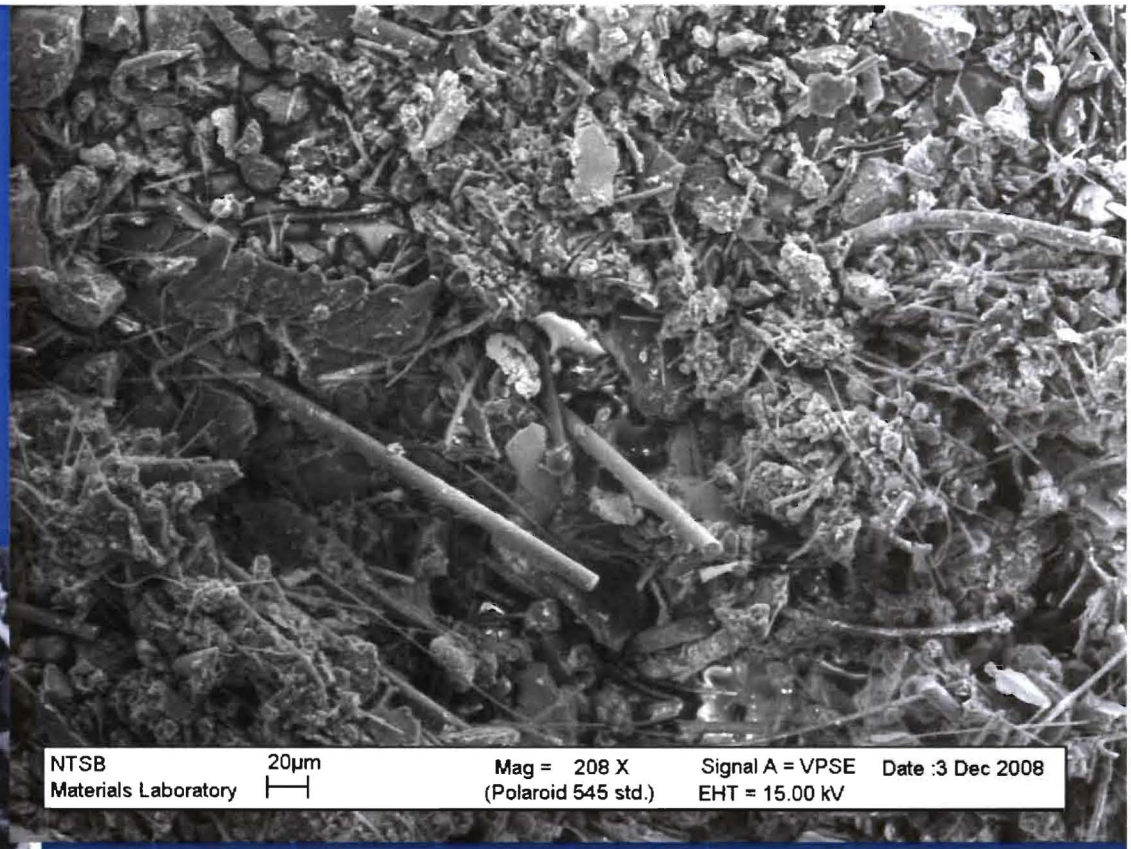


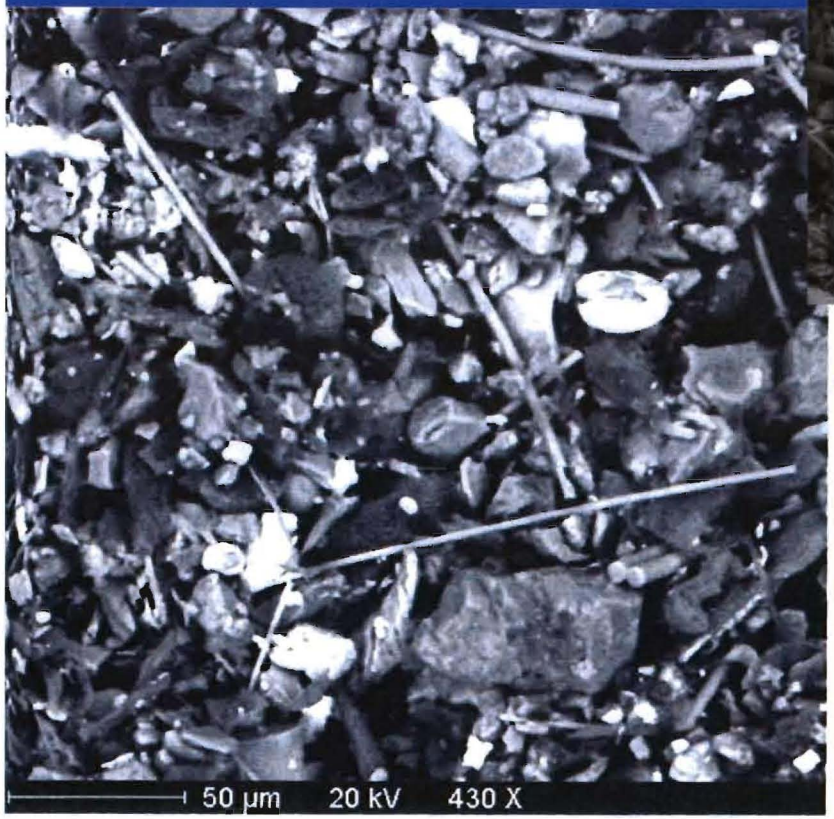
Accident Helicopter N612AZ
from # 2 FCU Filter 221 X



Accident Helicopter N612AZ # 2 FCU-PRV 208 X

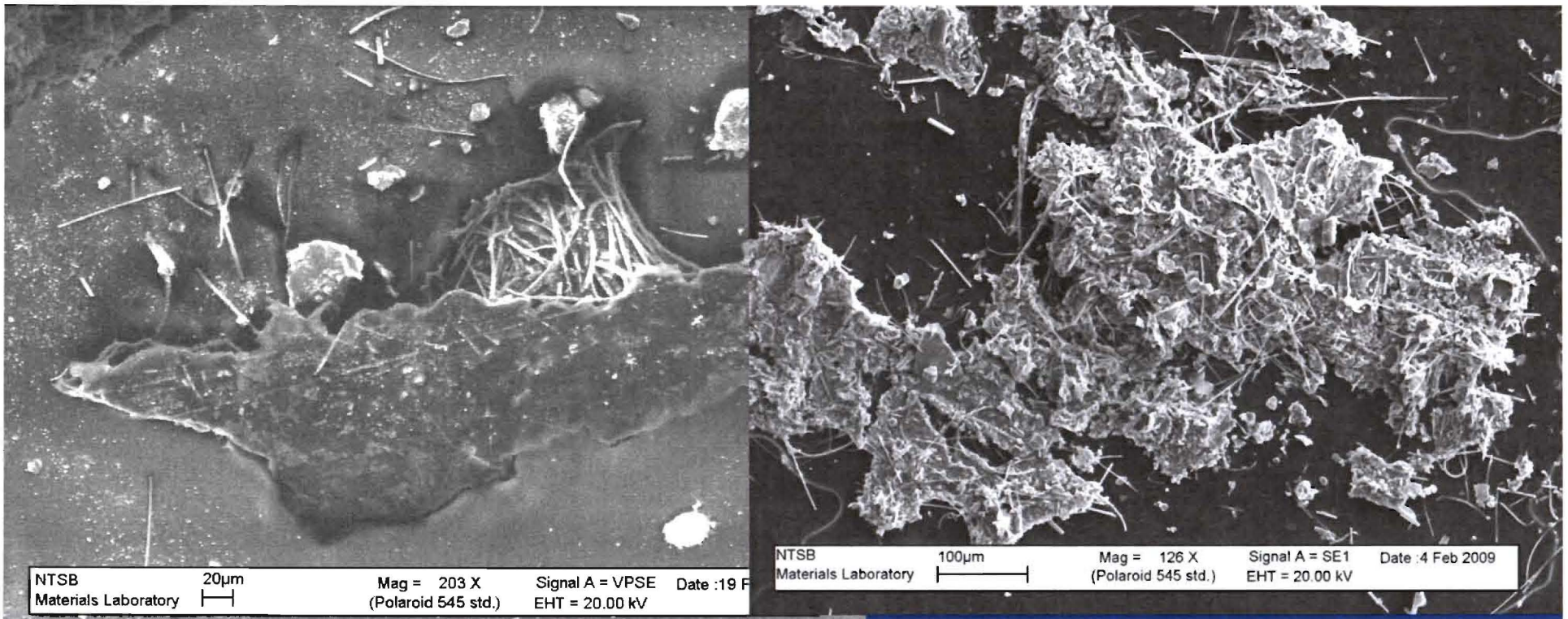
N612AZ PRV - 208X



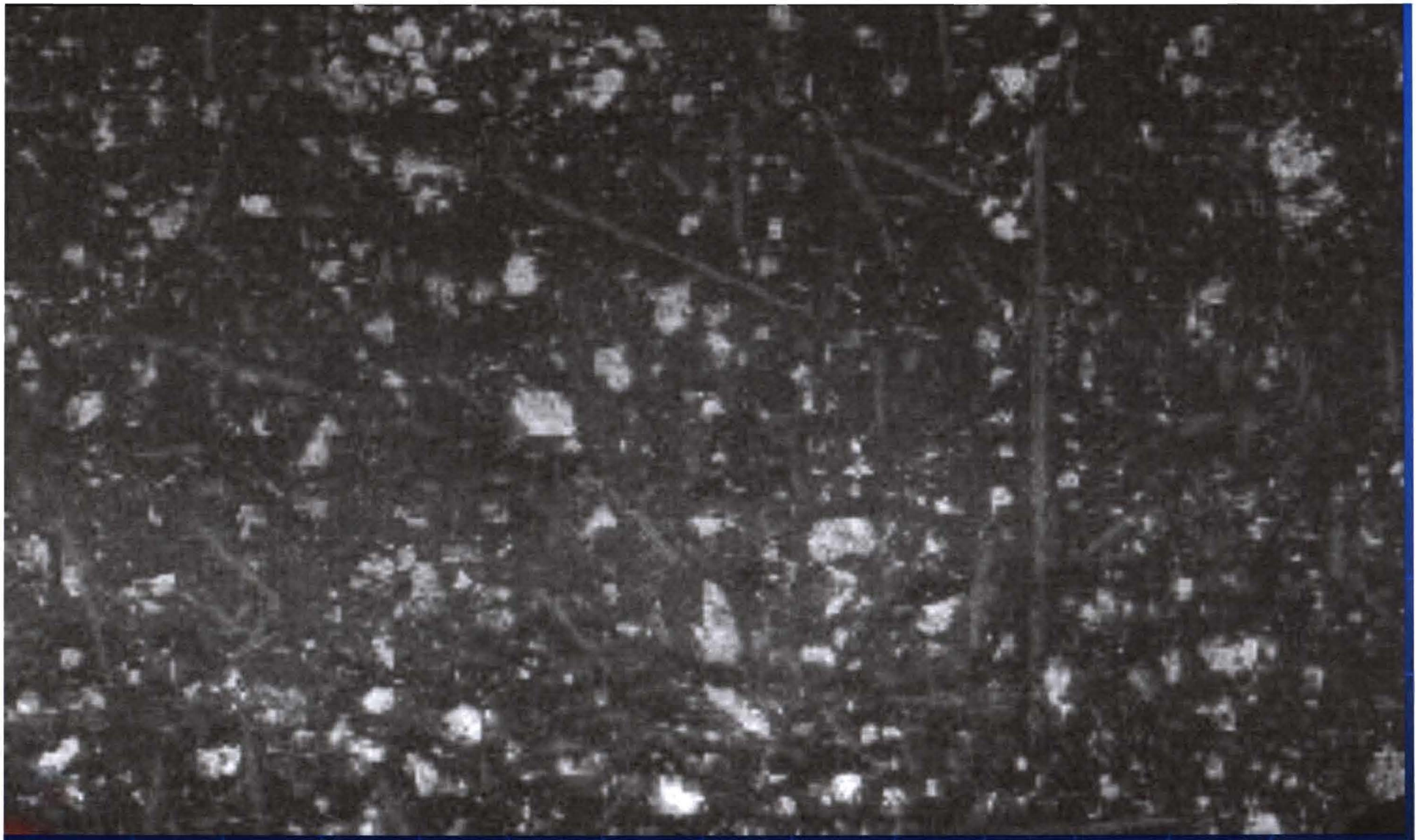


B.S.E.

Hayes Helicopter
PRV 430 X

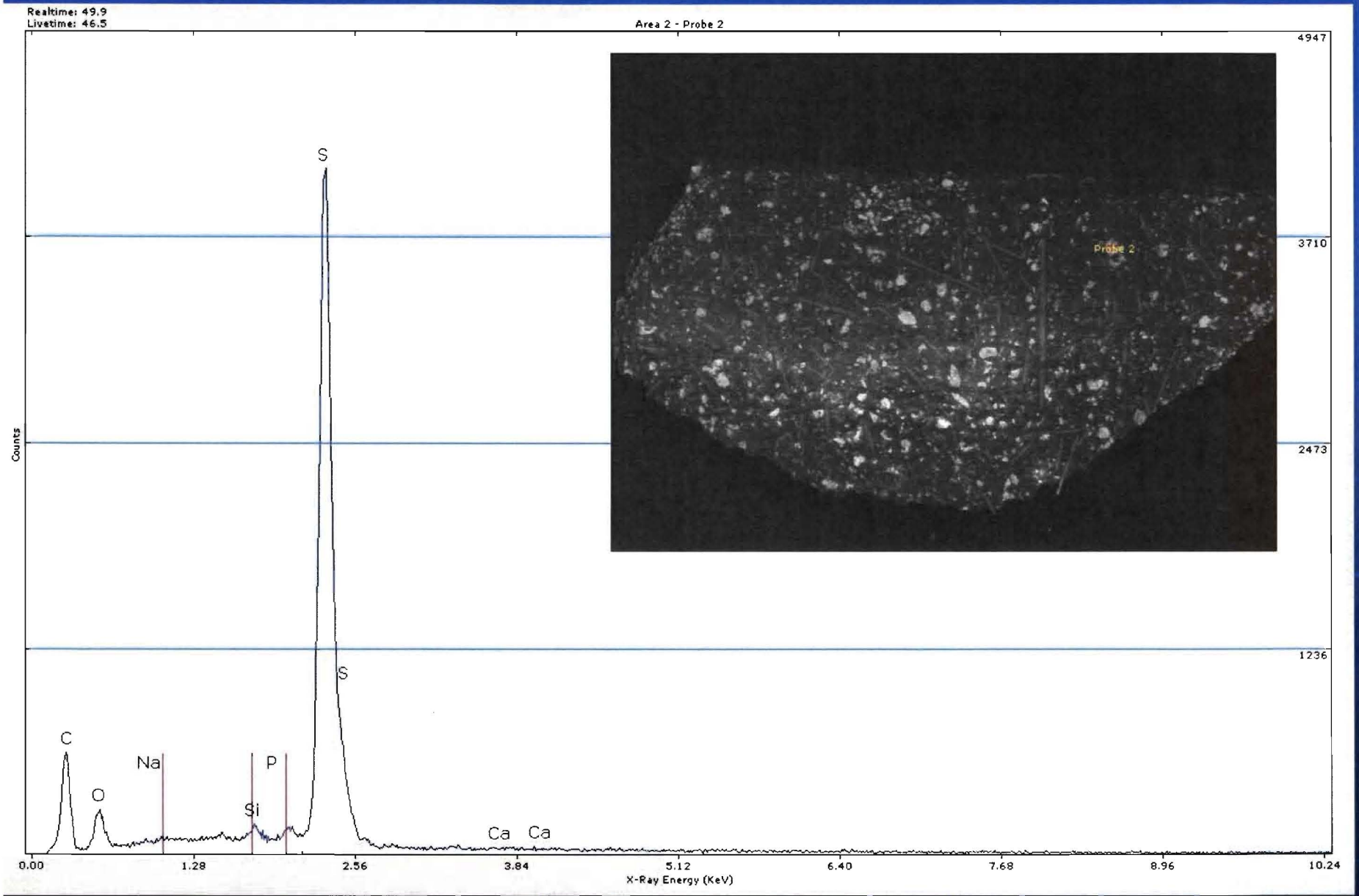


N612AZ #2 PRV – Note irregular flat-backing material on left photo.

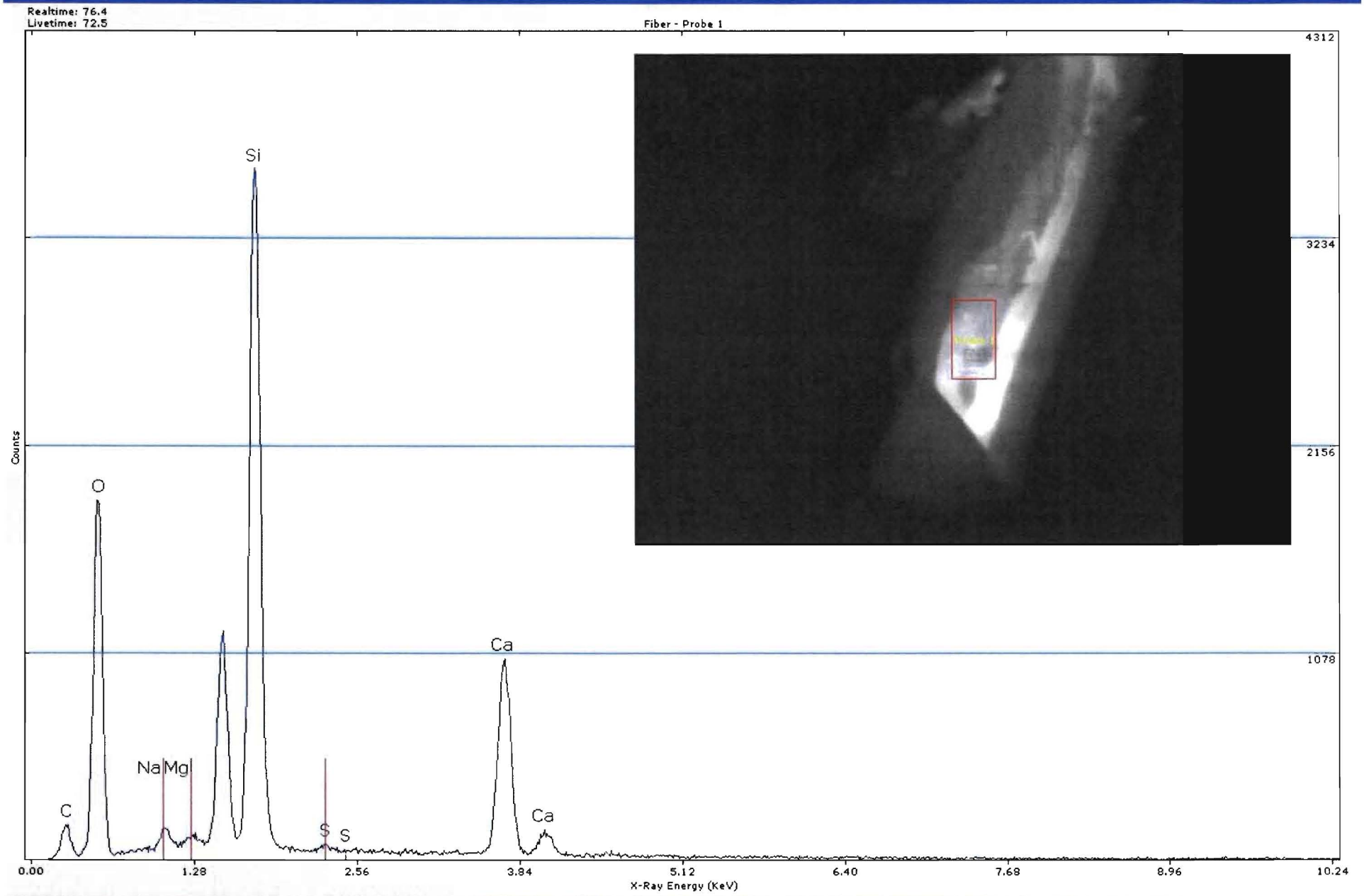


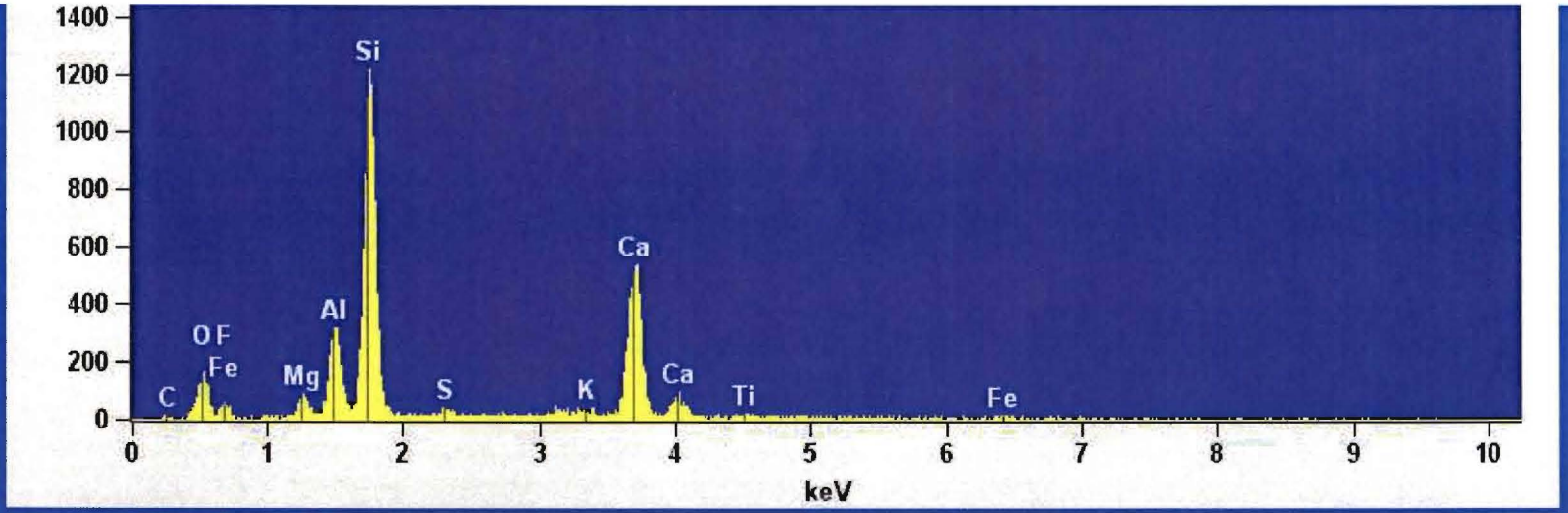
E Poly Coating matrix – Note long straight singular fibers and irregular flat pieces contained in matrix

E-Poly coating lab micron photo and spectra – note long straight fibers in matrix along with irregular flat pieces

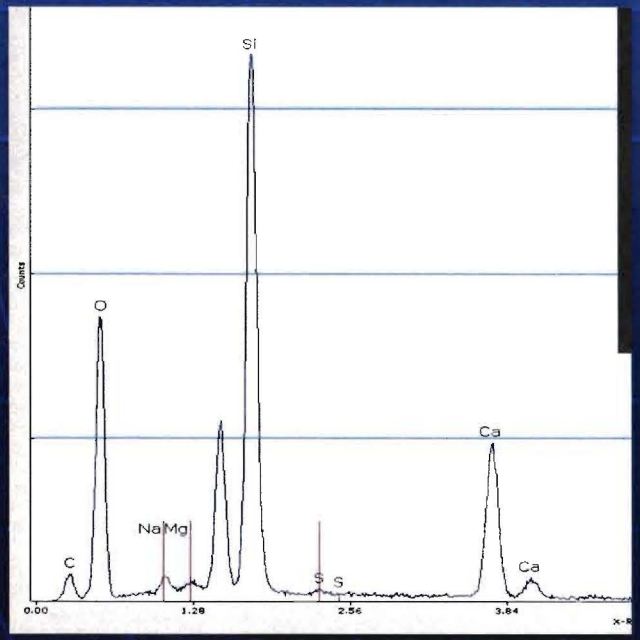


Blow-up scale of long straight fiber from matrix – note ED spectra.





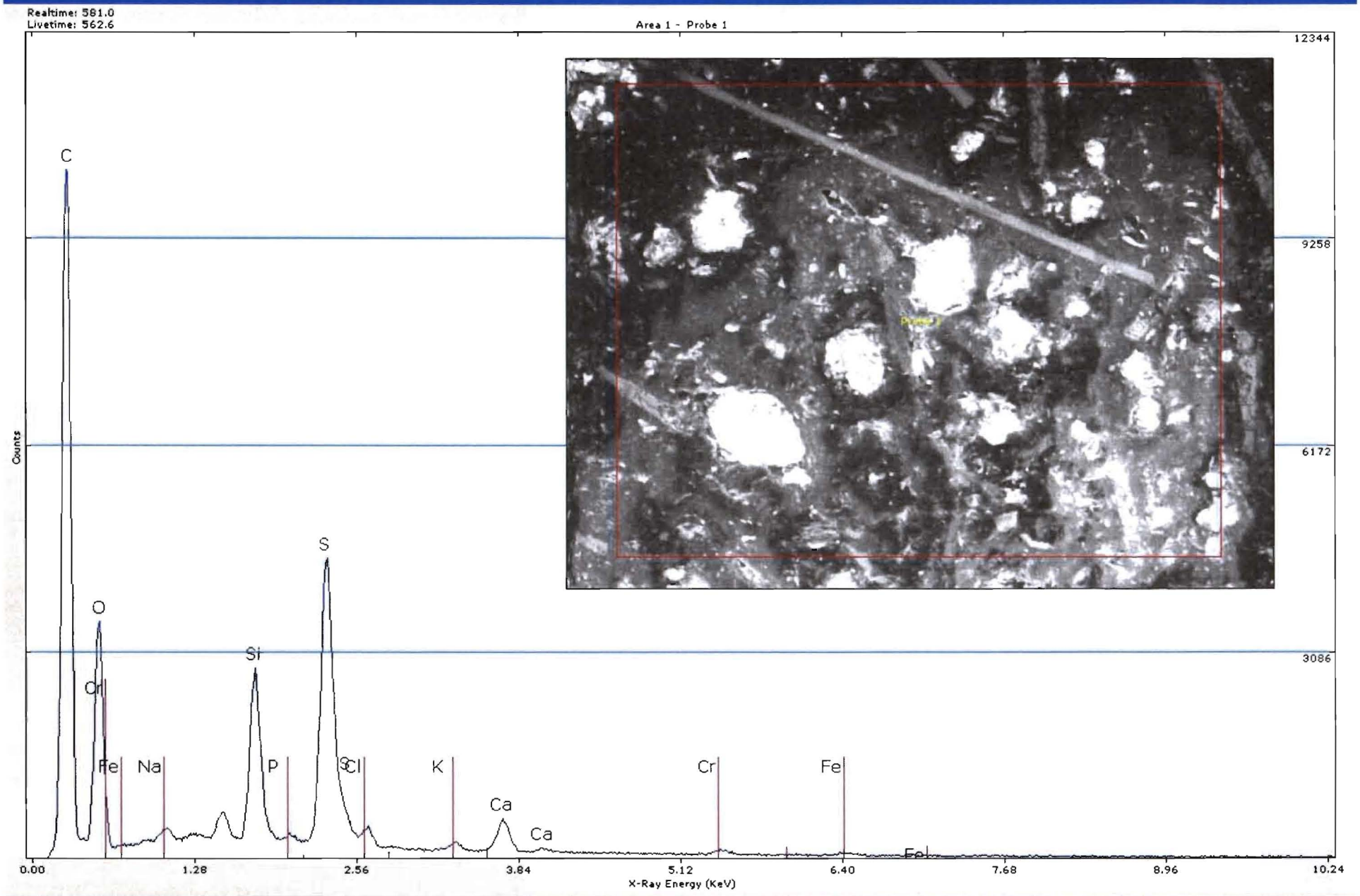
NTSB EDS spectrum of the straight fiber from N612AZ PRV contained major elemental peaks of silicon, aluminum and calcium with minor elemental peaks of iron, magnesium, carbon, and oxygen, consistent with e-glass.(direct from NTSB Materials report)



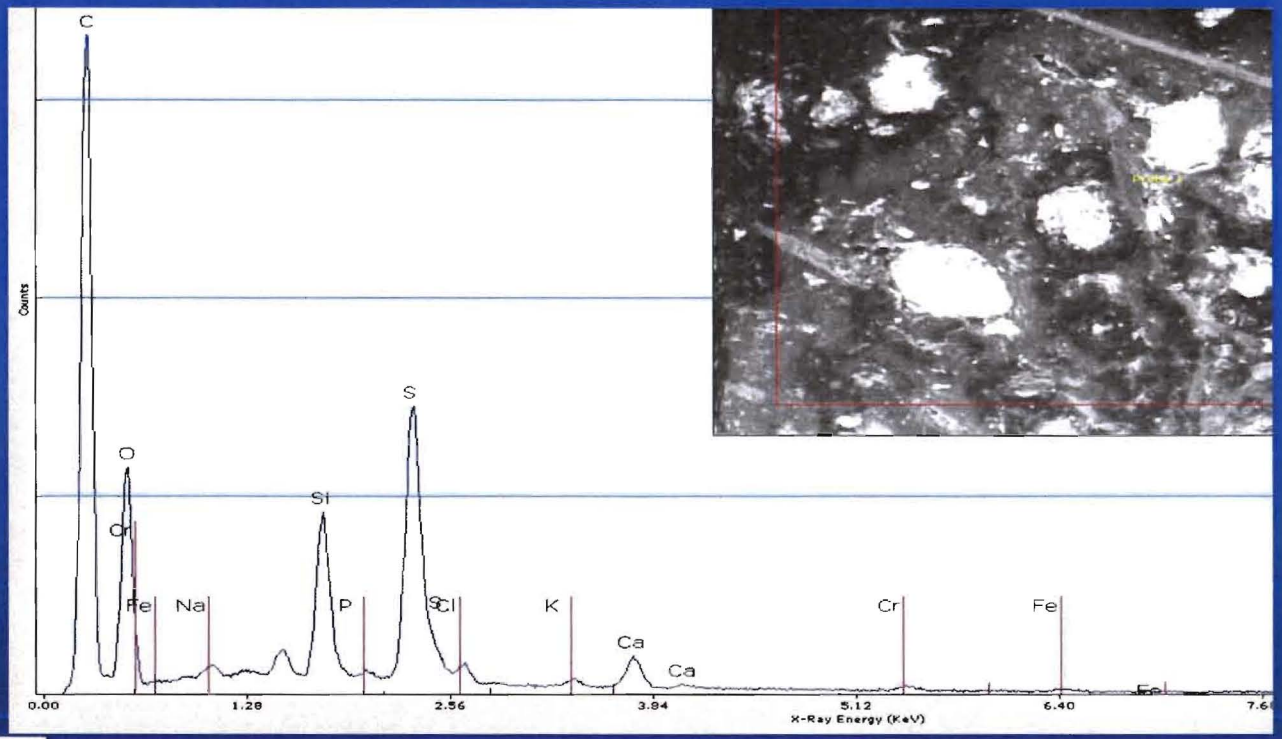
EDS Spectra from long straight fiber from E-poly coating .

Virtual identical match.

Blow-up scale of material with flat pieces in E-poly coating matrix.

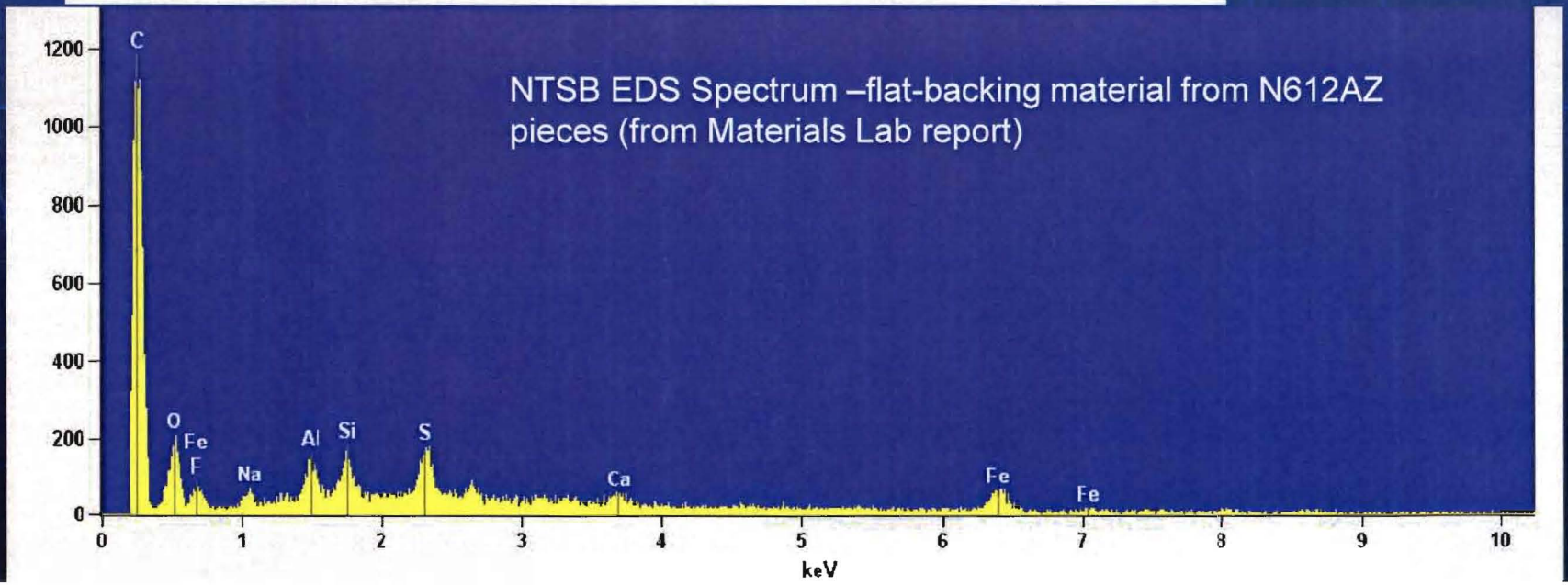


EDS spectrum irregular flat pieces in E-Poly matrix



Flat backing pieces from E-Poly and N612AZ

Extremely similar Spectra match



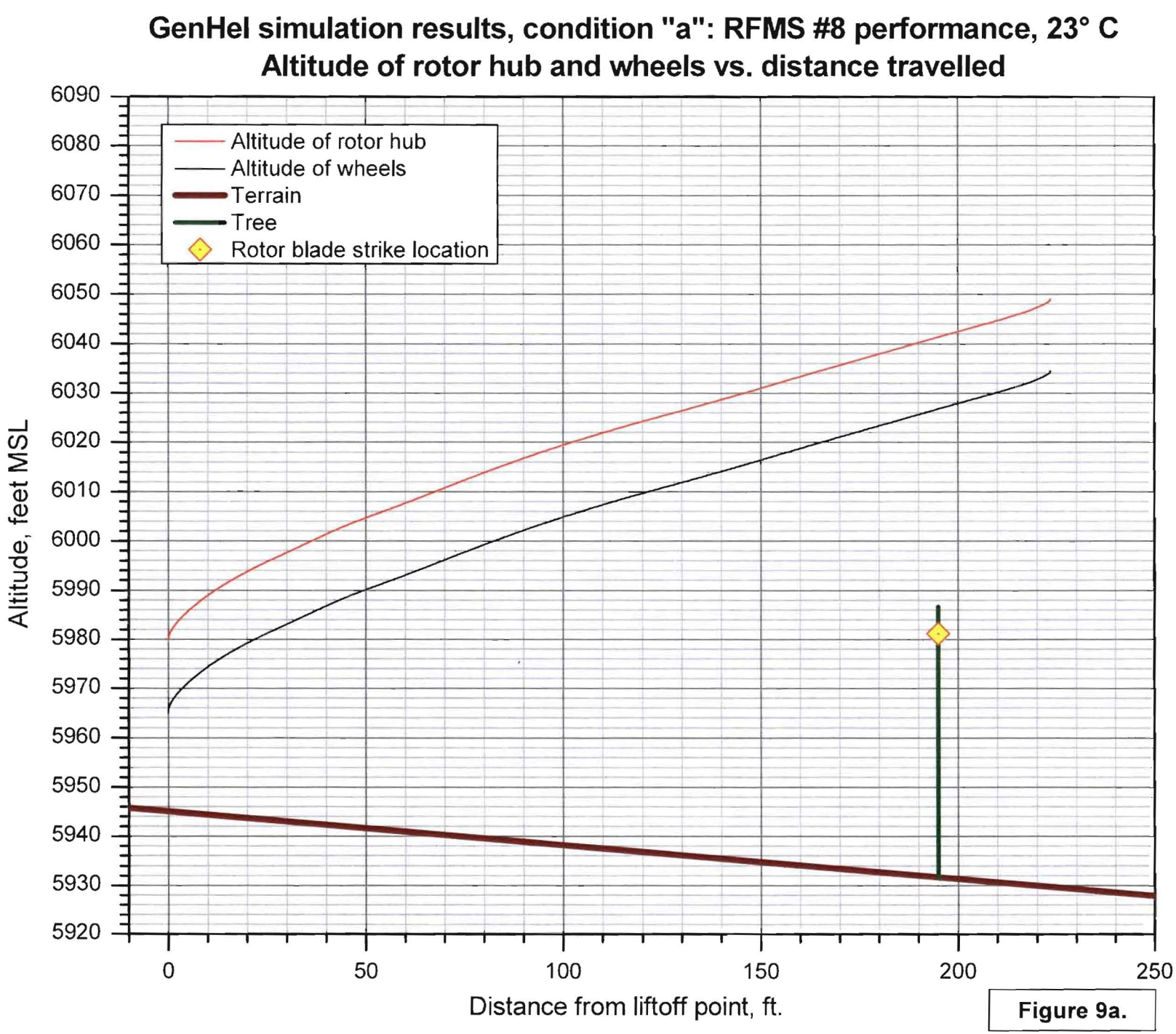

GenHel simulation results, condition "a": RFMS #8 performance, 23° C
Altitude of rotor hub and wheels vs. distance travelled
Altitude of rotor hub
Altitude of wheels
Terrain
Tree
Rotor blade strike location
Altitude, feet MSL
6090
6080
6070
6060
6050
6040
6030
6020
6010
6000
5990
5980
5970
5960
5950
5940
5930
5920
0
50
100
150
200
250
Distance from liftoff point, ft.

Figure 9a.

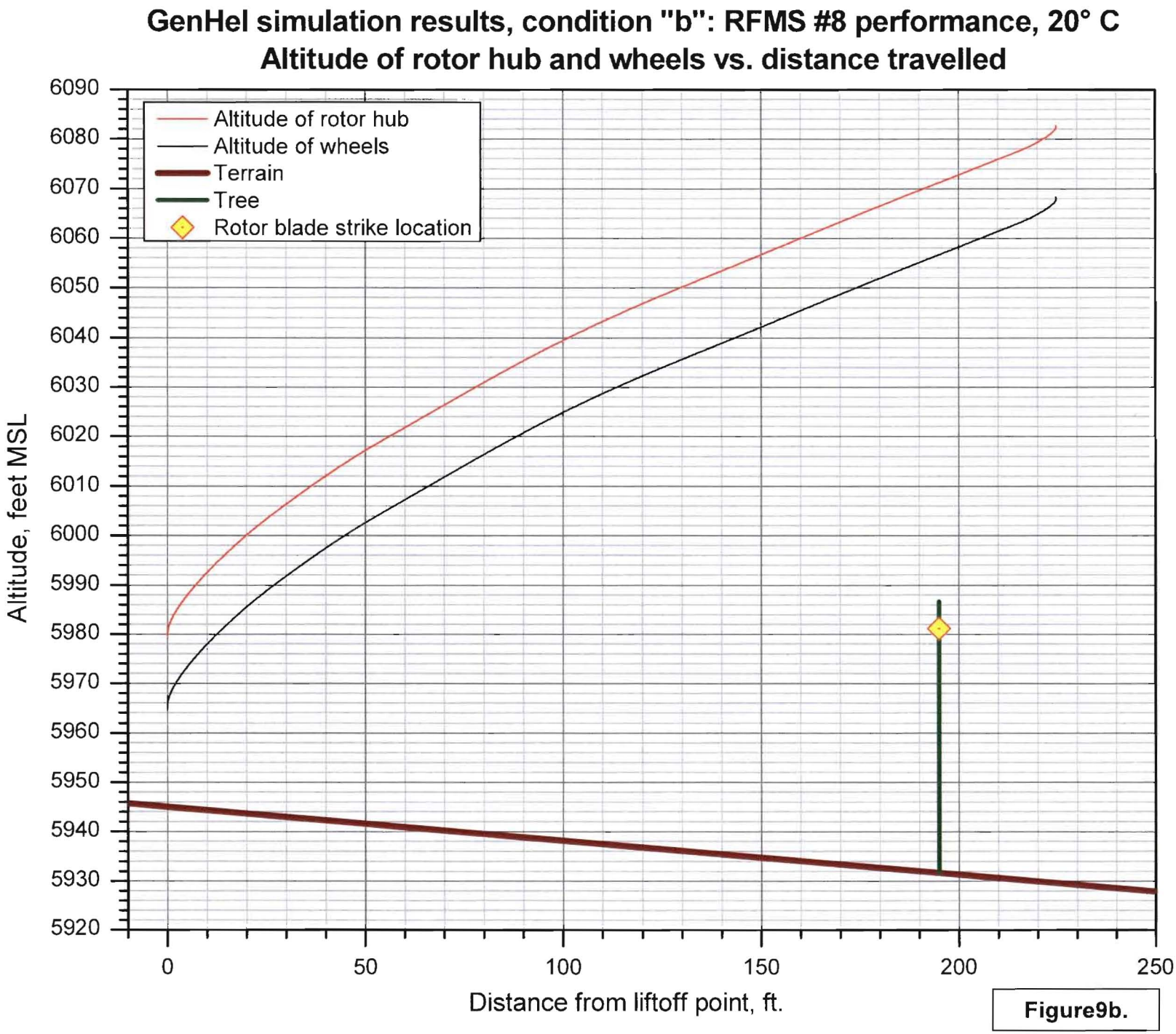
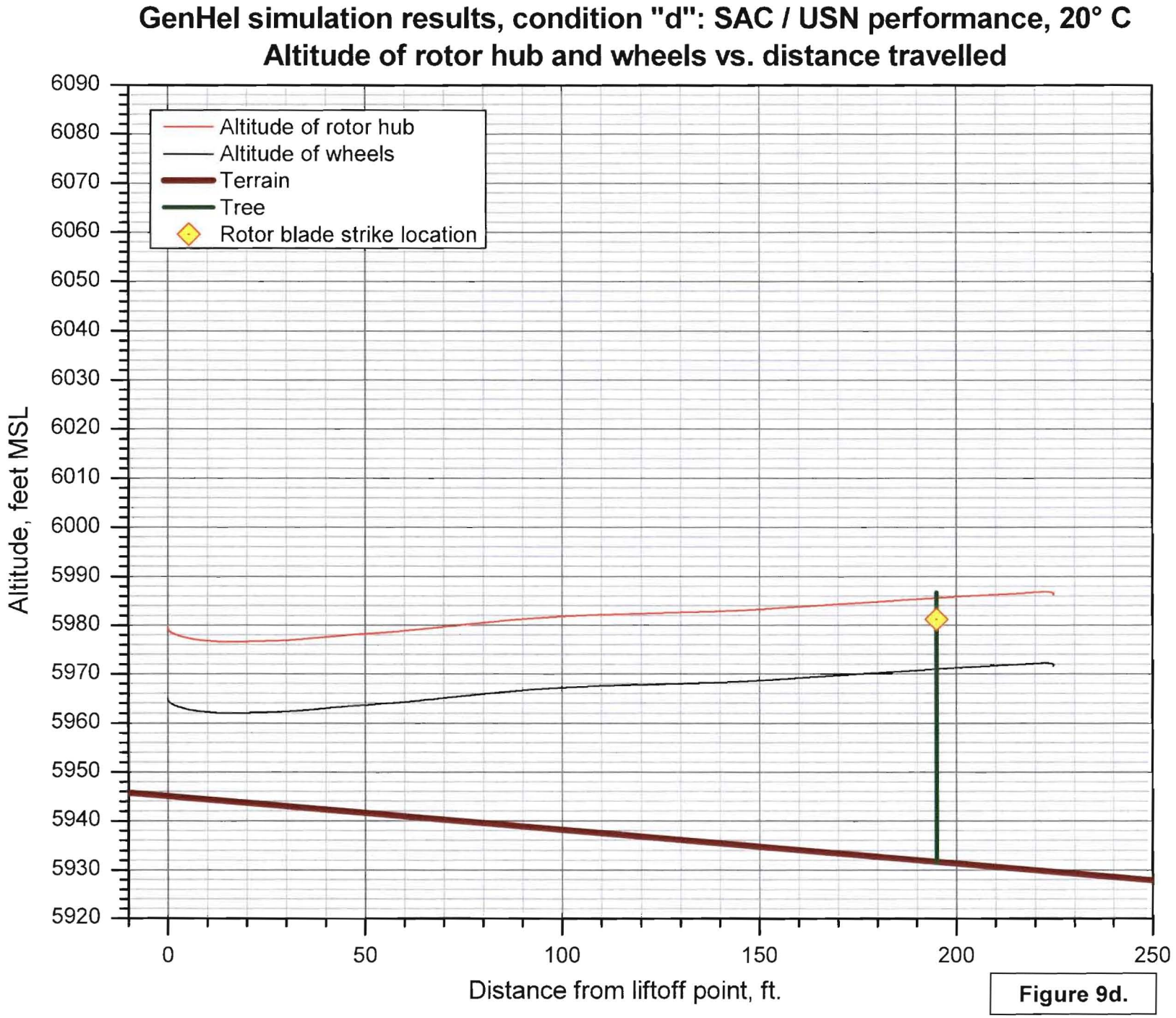

GenHel simulation results, condition "b": RFMS #8 performance, 20° C
Altitude of rotor hub and wheels vs. distance travelled
Altitude of rotor hub
Altitude of wheels
Terrain
Tree
Rotor blade strike location
Altitude, feet MSL
6090
6080
6070
6060
6050
6040
6030
6020
6010
6000
5990
5980
5970
5960
5950
5940
5930
5920
0
50
100
150
200
250
Distance from liftoff point, ft.

Figure9b.


GenHel simulation results, condition "d": SAC / USN performance, 20° C
Altitude of rotor hub and wheels vs. distance travelled
Altitude of rotor hub
Altitude of wheels
Terrain
Tree
Rotor blade strike location
Altitude, feet MSL
6090
6080
6070
6060
6050
6040
6030
6020
6010
6000
5990
5980
5970
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5920
0
50
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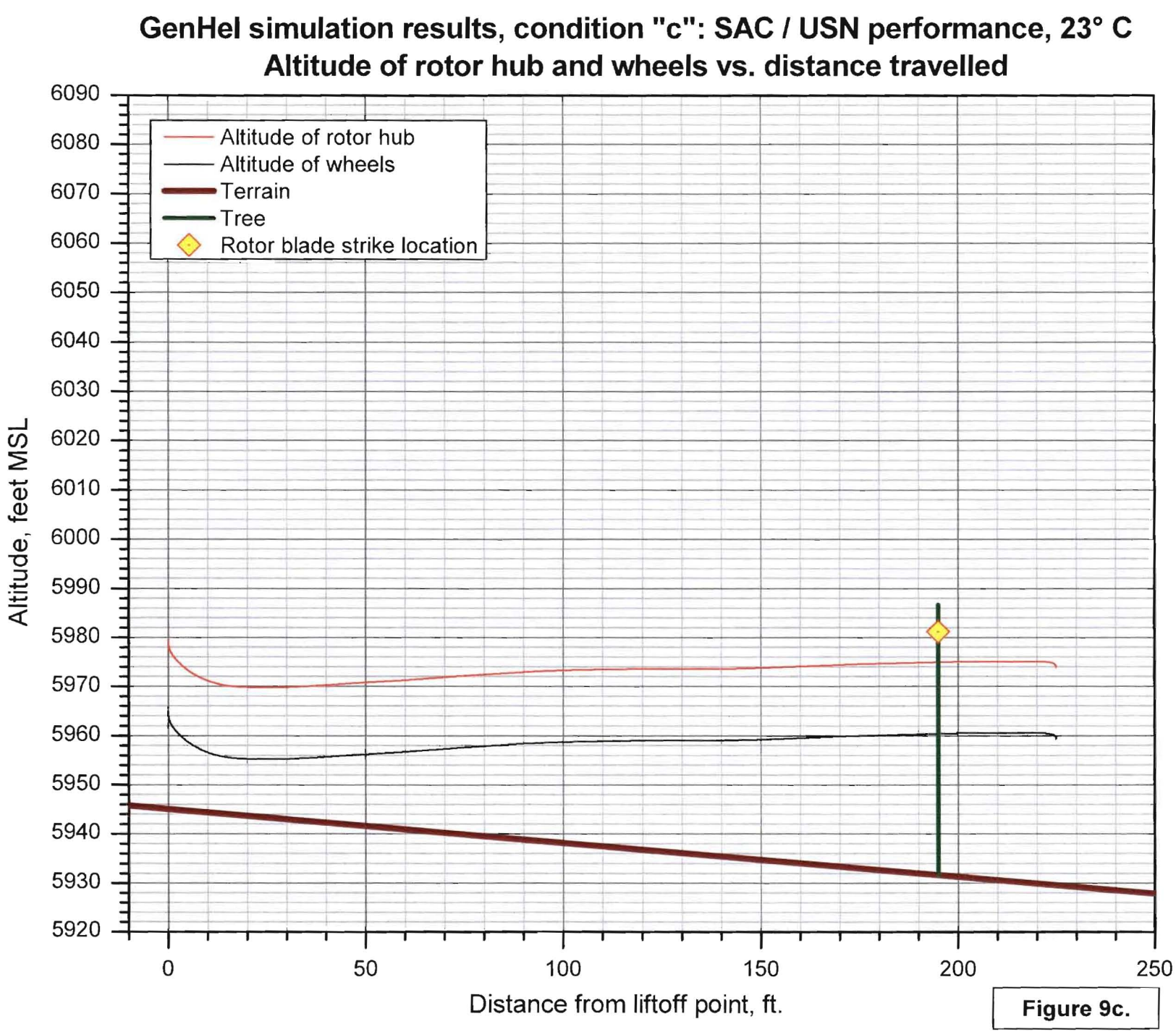
150
200
250
Distance from liftoff point, ft.

Figure 9d.


GenHel simulation results, condition "c": SAC / USN performance, 23° C
Altitude of rotor hub and wheels vs. distance travelled
Altitude of rotor hub
Altitude of wheels
Terrain
Tree
Rotor blade strike location
Altitude, feet MSL
6090
6080
6070
6060
6050
6040
6030
6020
6010
6000
5990
5980
5970
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5930
5920
0
50
100
150
200
250
Distance from liftoff point, ft.

Figure 9c.

Comments on the Gen Hel Simulation for NTSB by Sikorsky Aircraft

February 28, 2011

H. C. Curtiss
Carson Helicopters, Inc

In Reference 1, Sikorsky refers to a simulation called GenHel, used to predict the flight path of an S-61N in connection with an accident (NTSB Accident File:LAX08PA259). This note considers the validity of the use of this simulation when applied to the specific problem of interest: the achievable takeoff path of an S-61N from hover.

GenHel (a version is found in Ref. 2) is a large computer program developed by Sikorsky (SAC) that is "...used at Sikorsky Aircraft for handling qualities analysis, loads prediction, pilot-in the-loop simulation, flight control law development, and incident/accident investigation." (Ref. 1, pg.18) Note that performance analysis is not included in this list.

Gen Hel is applied in this case to predict the possible flight paths of an S-61 taking off from a high altitude site (estimated Hp is 6100 ft.). Since GenHel is not suitable for performance analysis it has to be "...corrected for the accident case..." (Ref. 1, pg.18) to account for the increased performance of an S-61N with Carson main rotor blades. This "correction" was necessary due to the limitations of GenHel. Sikorsky used flight test data from a different configuration S-61* for this "correction". So further "corrections" to the GenHel were necessary to account for the configuration differences between the test aircraft and the aircraft involved in the accident.

The difficulty is that GelHel uses a simplified model of main rotor aerodynamics that does not have the capability to accurately predict the power required for a given lift. This is why SAC had to "correct" the input data. The "corrections" would not be required if Gen Hel were fully capable of accurate performance prediction. This attribute is particularly important for the case of interest here since the calculated trajectory depends strongly on an accurate prediction of the relationship between lift and power in the hover and low speed regime.

The sensitivity of the results of this study by SAC to modeling issues is clearly illustrated by the statement in Ref.1: "In all the evaluated scenarios, a light headwind of only 5 knots makes the takeoff possible. It is most likely that the presence of absence of headwind was the most important factor...". Indeed,

this statement implies that an aerodynamic model that does not require "corrections" is required to investigate this problem. The fact that "corrections" were applied to Gen Hel, and the nature of these corrections, do not give confidence that the results of the GenHel study are valid.

*It might be noted that well-documented Carson flight test data for the same configuration S-61 was available (recently verified by Sikorsky tests at the Carson facility). Sikorsky elected to use data from a very different configuration S-61 that required the additional corrections.

References

1. Sikorsky Aircraft Corporation, Accident Investigation Submission (NTSB accident File: LAX08PA259.,May 28,2010

2. Howlett, J.J., UH-60A Blackhawk Engineering Simulation Program: Volume I- Mathematical Model, NASA Contractor Report 166309, December 1981