

FILE NAME: RT Vanderbilt (RTV)

DATE: 2002 Dec 13

DOC#: RTV235

DOCUMENT DESCRIPTION: Report - Sample Analysis Vanderbilt IT3X
Talc

Report of Results: MVA 5318

**Sample Analysis
Vanderbilt IT3X Talc**

Prepared for:

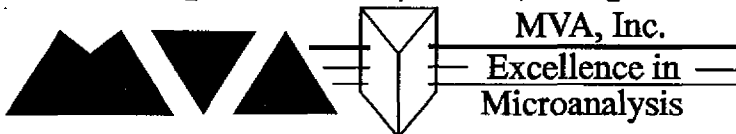
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Report of Results

MVA Project No. 5318 Sample Analysis Vanderbilt IT3X Talc

INTRODUCTION

MVA, Inc., has analyzed one talc sample submitted for particulate characterization and received at MVA, Inc. on 4 November 2002. The sample was labeled: IT3X Industrial talc, tremolitic talc from the R.T. Vanderbilt Company, Inc. Upon receipt, the sample was assigned a unique laboratory identification number: M3832. It was requested that the sample be characterized as to the nature of the tremolite fibers. A sample of the National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1867 - tremolite asbestos was also characterized.

Asbestos refers to a set of fibrous mineral materials. Amosite, chrysotile and crocidolite are considered common asbestos minerals. Tremolite, actinolite and anthophyllite are considered uncommon asbestos minerals. The asbestiform (morphology) habit of asbestos has been described in several analytical methods. A population of fibers as observed in a bulk sample having the asbestiform habit is generally recognized by the following characteristics (EPA/600/R-93/116):

Mean aspect ratios ranging from 20:1 to 100:1 or higher for fibers longer than 5 μm . Very thin fibrils, usually less than 0.5 μm in width, and two or more of the following:

- Parallel fibers occurring in bundles,
- Fiber bundles displaying splayed ends,
- Matted masses of individual fibers, and/or
- Fibers showing curvature.

Fibers occurring in the form of thin needles were also included as an asbestiform characteristic by Wylie, 1990.

It is more difficult to classify individual fibers as to asbestiform or cleavage fragments because individual fibers do not exhibit all the characteristics of a population. One fiber counting procedure considers a fiber with length greater than 5 μm and an aspect ratio of $\geq 3:1$ to be a countable fiber for asbestos exposure assessment (NIOSH 7400 with NIOSH 7402). Other methods use an aspect ratio of $\geq 5:1$ and lengths of either 0.5 μm or 5 μm to measure asbestos levels in the air (AHERA, ISO 10312).

Fiber widths are not generally considered in air analyses, except that fibers less than 0.25 μm are not seen by the NIOSH 7400 method. As a consequence, only those fibers greater than 0.25 μm in width are considered by the NIOSH 7402 method. When counting those fibers over 5 μm in length, the ISO 10312 method uses an upper limit for fiber width of 3 μm . Based on review of various studies, it has been suggested that only fibers with widths less than 1 μm should be considered as those important for regulation (Wylie et al. 1993).

ANALYSIS PROCEDURES

The sample was first examined by stereomicroscopy utilizing a Zeiss Stemi 2000 stereomicroscope having a magnification range from 6.5X to 47X. The sample was then examined by polarized light microscopy utilizing an Olympus BH-2 polarized light microscope having a magnification range from 40X to 1000X. Representative portions from the sample were examined and analyzed by scanning electron microscopy (SEM) using a JEOL 6500 coupled with an x-ray energy dispersive spectrometry (EDS) Noran Vantage system. Representative portions of the sample were also analyzed with analytical electron microscopy (AEM) using a JEOL 1200, 100 kV scanning transmission electron microscope (STEM), equipped with a Noran EDS x-ray analysis system.

RESULTS

Sample M3832 (IT3X) is a white powder containing talc fibers, talc ribbons, platy particles (lizardite) and tremolite particles. The tremolite particles exhibit morphologies from blocky (aspect ratios (AR) < 2:1) to acicular (AR up to approximately 50:1). The tremolite particles exhibiting aspect ratios greater than 3:1 comprise 20% to 35% by volume of the sample. Tremolite exhibiting aspect ratios greater than 20:1 comprise less than 1% by volume of the entire sample. As a population of particles, the tremolite particles in sample M3832 are consistent with a population of tremolite cleavage fragments as described by Wylie, 1990.

A number of the tremolite fibers in Sample M3832 are long and thin (have aspect ratios higher than 5:1, 10:1 or 20:1). A number of the tremolite fibers in M3832 are consistent with the tremolite asbestos fibers found in the NIST Standard Reference Material 1867 - tremolite asbestos. Aspect ratios were determined by SEM from 100 fibers (> 5 μm) of each sample of SRM 1867 and M3832. Representative images appear in the Appendix. The data are compared in Table 1 and Figure 1. There is a significant overlap between the two populations. Representative transmitted light images appear as Figures 2 and 3.

Twenty-three percent (23%) of the 100 tremolite fibers measured in Sample M3832 (IT3X) had fiber widths less than 1.0 μm . Some of the tremolite fibers are very thin, less than 0.5 μm in width. Four percent (4%) of the 100 tremolite fibers measured in Sample M3832 (IT3X) had fiber widths less than 0.5 μm . These thin fibers had aspect ratios ranging from 15:1 to 47:1. These findings differ somewhat with the report by Wylie in 1990 and Wylie et al. in 1993 of 9% less than 1.0 μm and 0% less than 0.5 μm in width for a sample of New York tremolite. It is not clear whether or not this New York tremolite was from a similar source as M3832. Both the sample in the Wylie report and Sample M3832 were analyzed by SEM.

A number of the individual fibers exhibit the characteristics of asbestos fibers. Some show parallel fibers occurring in bundles, fiber bundles displaying splayed ends, and/or fibers showing curvature. The tremolite fibers in Sample M3832 did not show evidence of matted masses of individual fibers.

DISCUSSION

The population of tremolite fibers in Sample M3832 is not consistent with commercial asbestos fibers. The population of tremolite particles in sample M3832 is consistent with a population of tremolite cleavage fragments. However, many of the individual tremolite fibers in M3832 exhibit characteristics of asbestos fibers and are consistent with the tremolite asbestos fibers in the NIST Standard Reference Material 1867. Some individual tremolite fibers in Sample M3832 would be counted by the various standard methods as asbestos fibers. There are some tremolite fibers in Sample M3832 that appear to be consistent with the tremolite fibers found in the lungs of mesothelioma cases as reported by Roggli et al., 2002. The Roggli report states that all tremolite fibers counted in the samples from the lung tissue were at least 5 μm in length and almost all had aspect ratios of 5 or greater.

REFERENCES

Baron, P., Method 7400, Revision No. 3, NIOSH Manual of Analytical Methods, National Institute for Occupational Safety and Health Administration, Cincinnati, Ohio, 7400-1 - 7400-14 (1994).

-NIOSH Method 7402, "Asbestos Fibers by Transmission Electron Microscopy (TEM)", NIOSH Manual of Analytical Methods, 4th Ed., U.S. Department of HHS, NIOSH Publ. 94-113, 1994.

International Standards Organization (ISO), Ambient Air - Determination of Asbestos Fibres - Direct-transfer Transmission Electron Microscopy Procedure. ISO-10312.

Roggli, V. L., Vollmer, R. T., Butnor, K.J. and Sporn, T. A. Tremolite and Mesothelioma, Ann. Occup. Hyg. Vol 46 (5):447-453, 2002.

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U.S. EPA, 40 CFR Part 763. Asbestos-Containing Materials in Schools, Final Rule and Notice. Fed. Reg. 52(210): 41870-41893 (1987).

Wylie, A. G. Discriminating Amphibole Cleavage Fragments from Asbestos: Rationale and Methodology. Proc. Intern. Pneumoconiosis Conf. Nov. 1990. Publication No. 90-108 Part II.

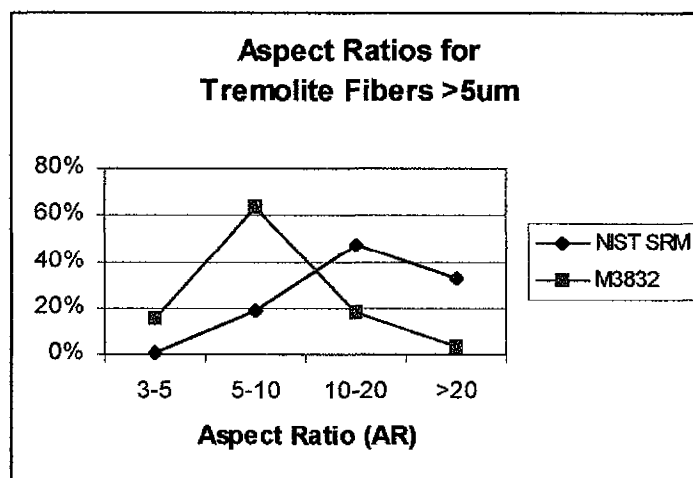
Wylie, A. G. , Bailey, K.F. Kelse, J.W. and Lee, R.J. The Importance of Width in Asbestos Fiber Carcinogenicity and Its Implications for Public Policy. Am. Ind. Hyg. Assoc. J. 54:239-252, 1993.

Table 1. Data from SEM Analysis of 100 Tremolite Fibers >5 μm

M3832	Length	Width	Aspect Ratio
Mean	14.5	2.1	8.5
St. Dev	9.9	1.6	5.5
Min.	5.2	0.3	3.8
Max.	55.6	9.1	47.7

SRM 1867 Tremolite	Length	Width	Aspect Ratio
Mean	46.7	2.6	19.9
St. Dev	41.4	1.9	13.6
Min.	6.0	0.3	4.4
Max.	224.0	10.3	93.4

Figure 1. Comparison of Aspect Ratio Data from Sample M3832 and SRM 1867 Tremolite Asbestos



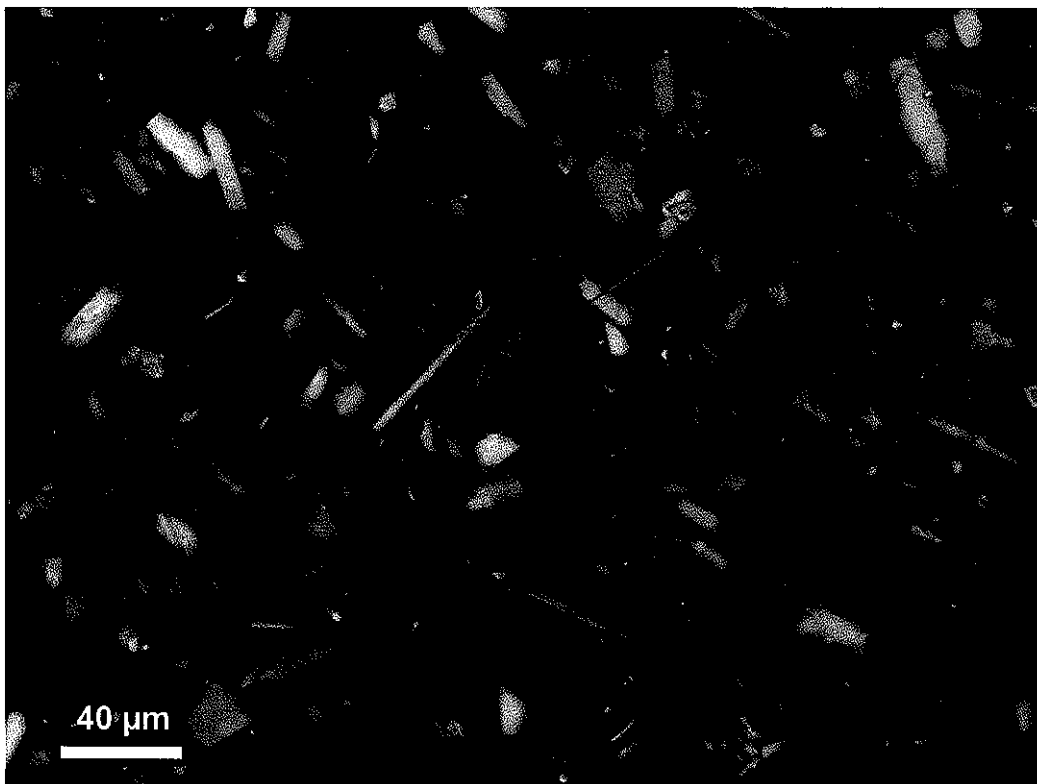


Figure 2. Light Microscope Image of Sample M3832.

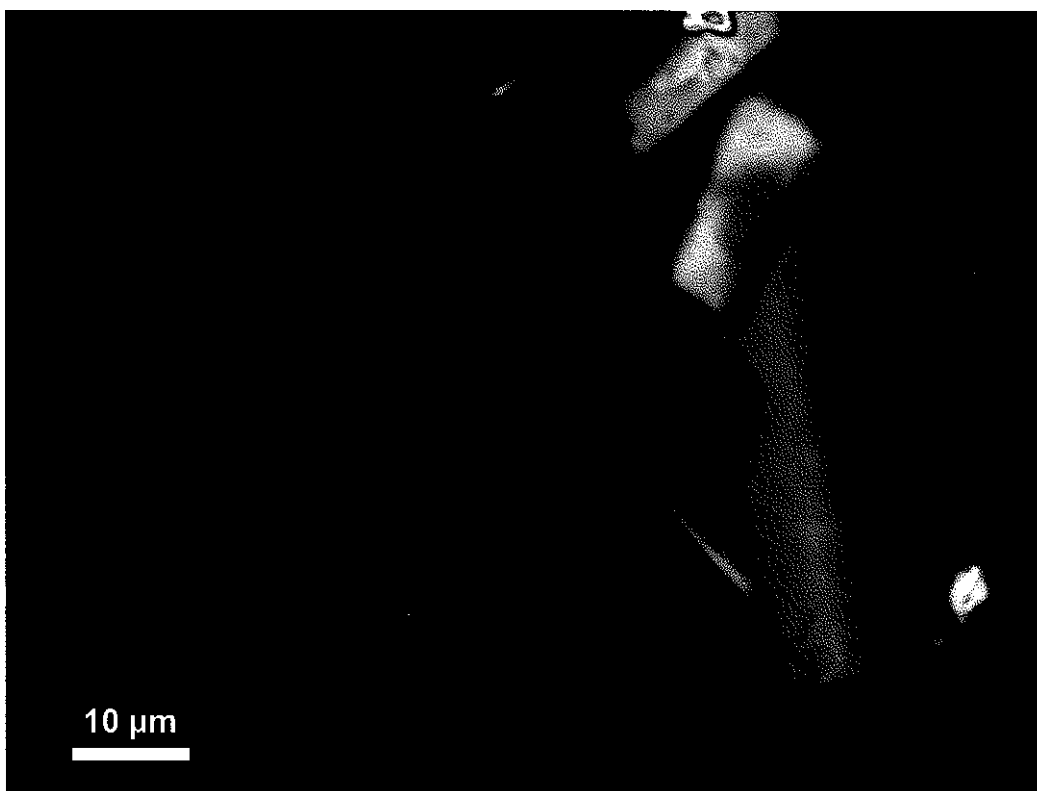
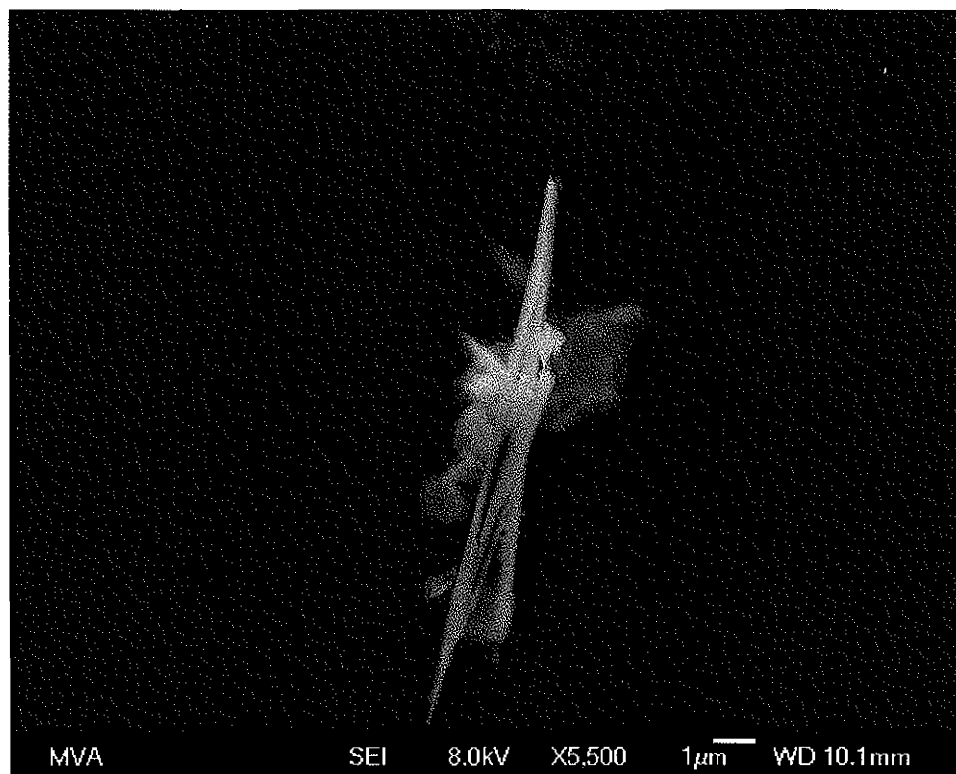


Figure 3. Light Microscope Image of an acicular tremolite fiber in Sample M3832.

APPENDIX
MICROGRAPHS OF TREMOLITE
FROM SAMPLES M3832 AND SRM 1867



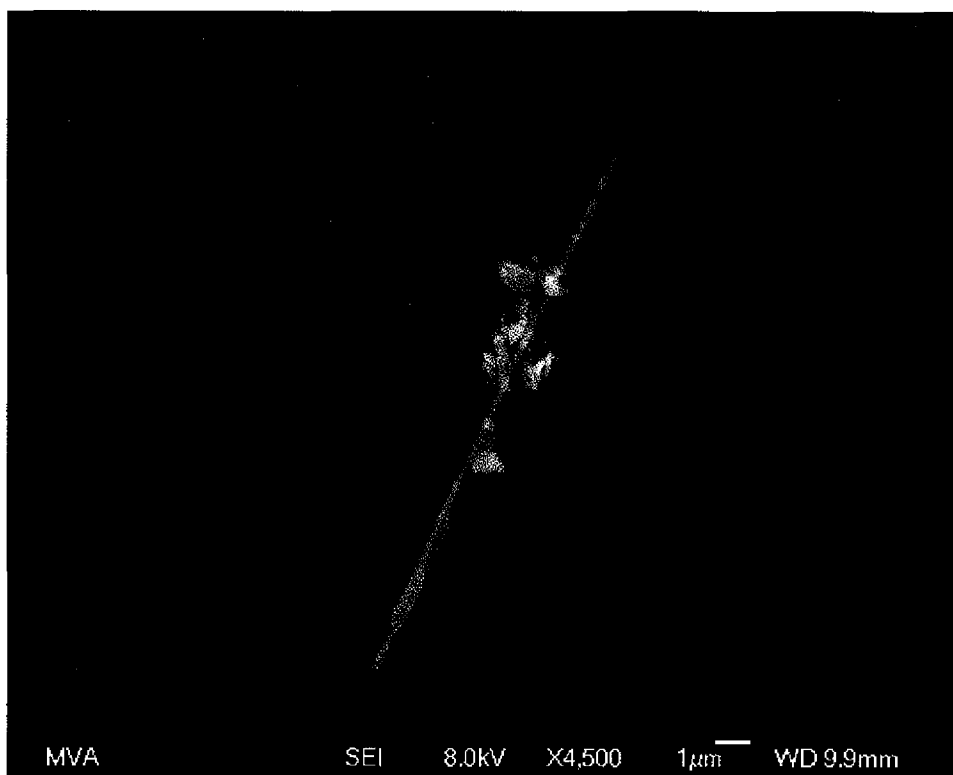
Micrograph 1. SEM Image of Tremolite from Sample M3832.



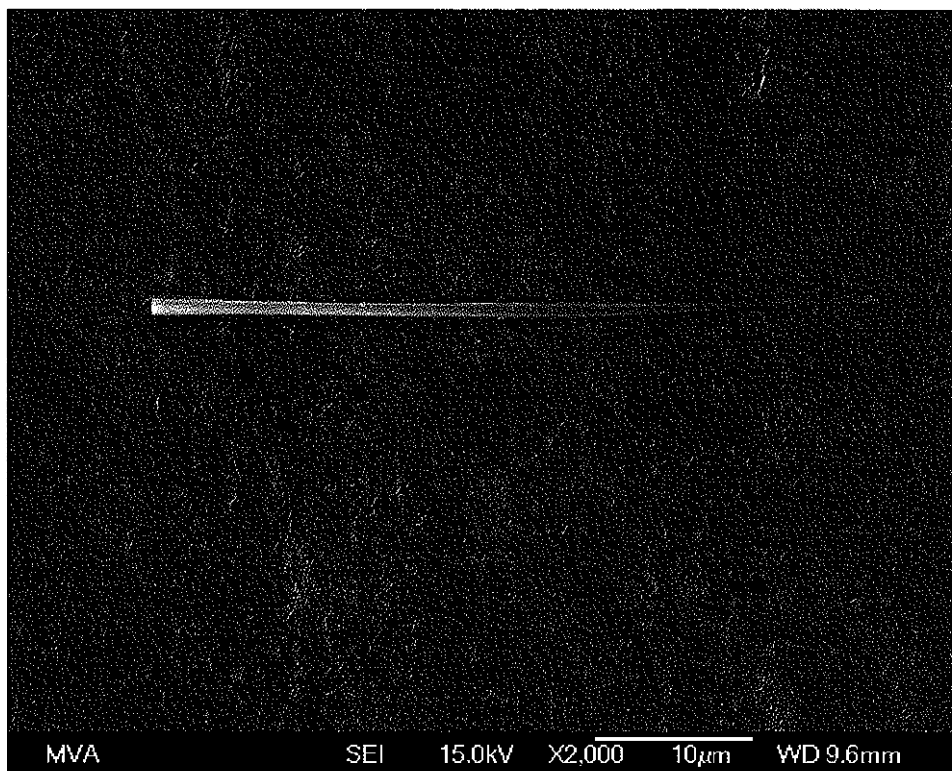
Micrograph 2. SEM Image of Tremolite from Sample M3832.



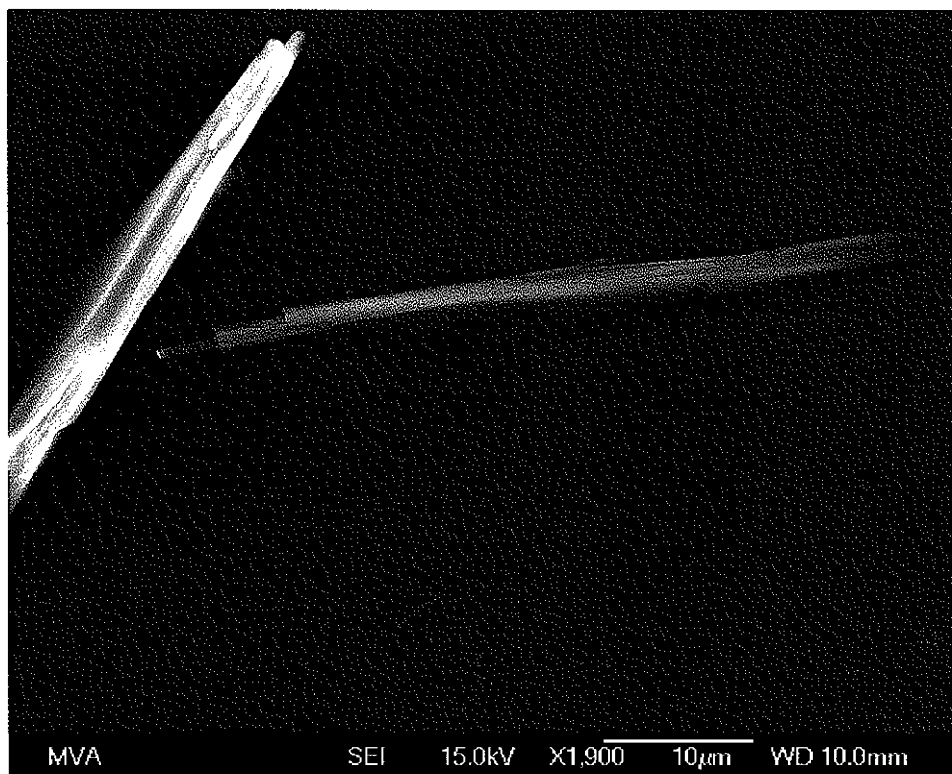
Micrograph 3. SEM Image of Tremolite from Sample M3832.



Micrograph 4. SEM Image of Tremolite from Sample M3832.



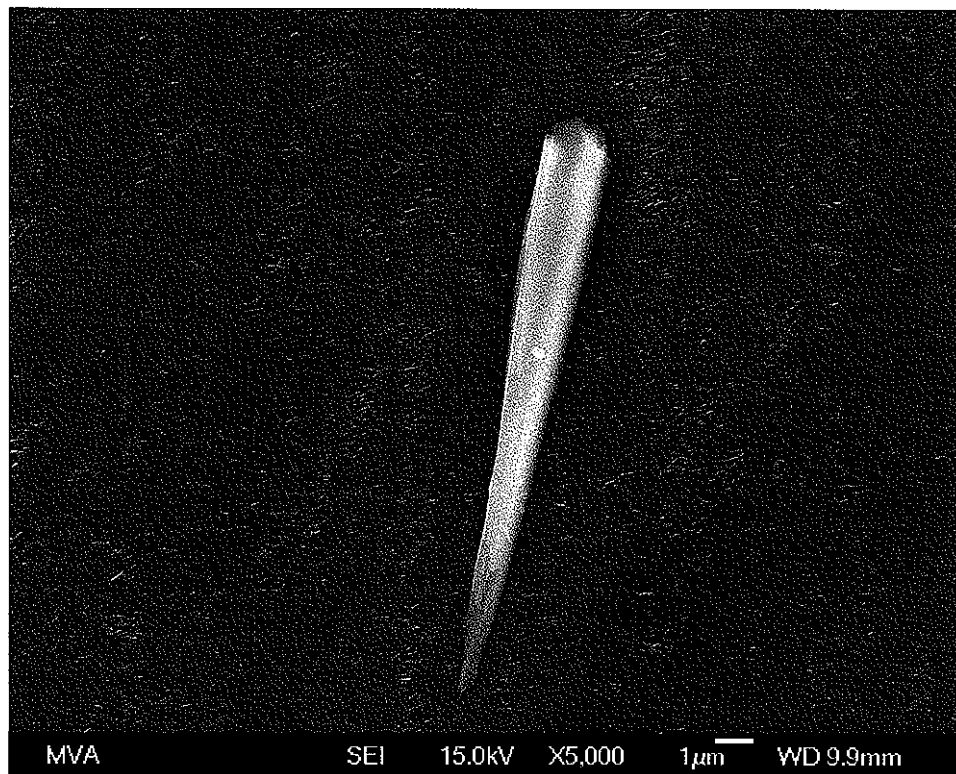
Micrograph 5. SEM Image of Tremolite from SRM 1867.



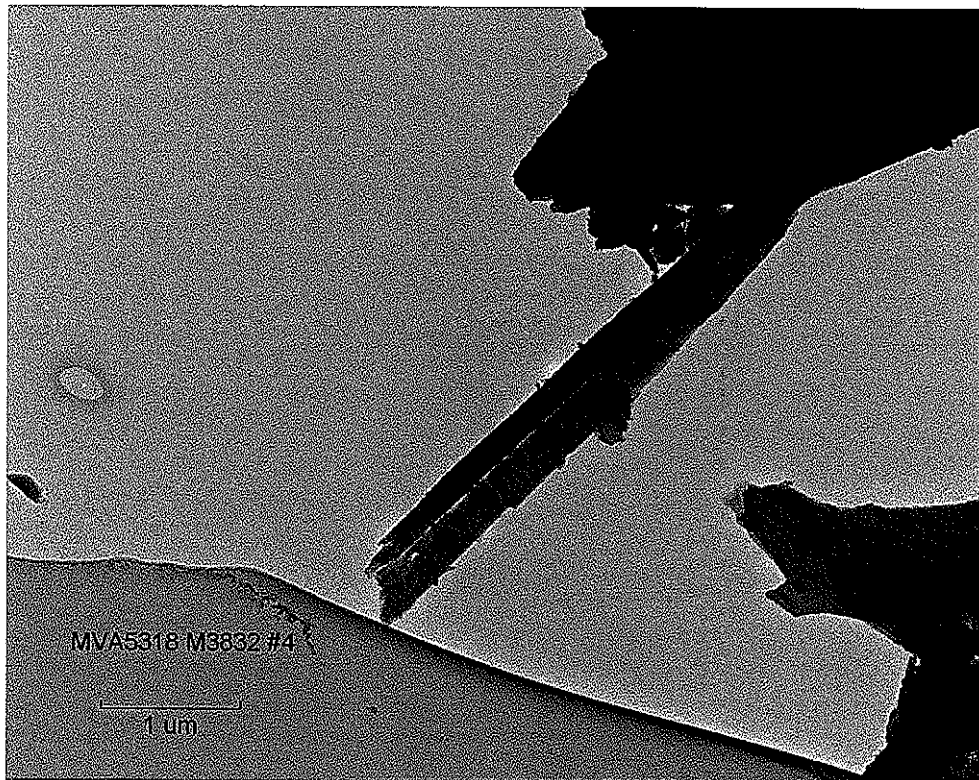
Micrograph 6. SEM Image of Tremolite from SRM 1867.



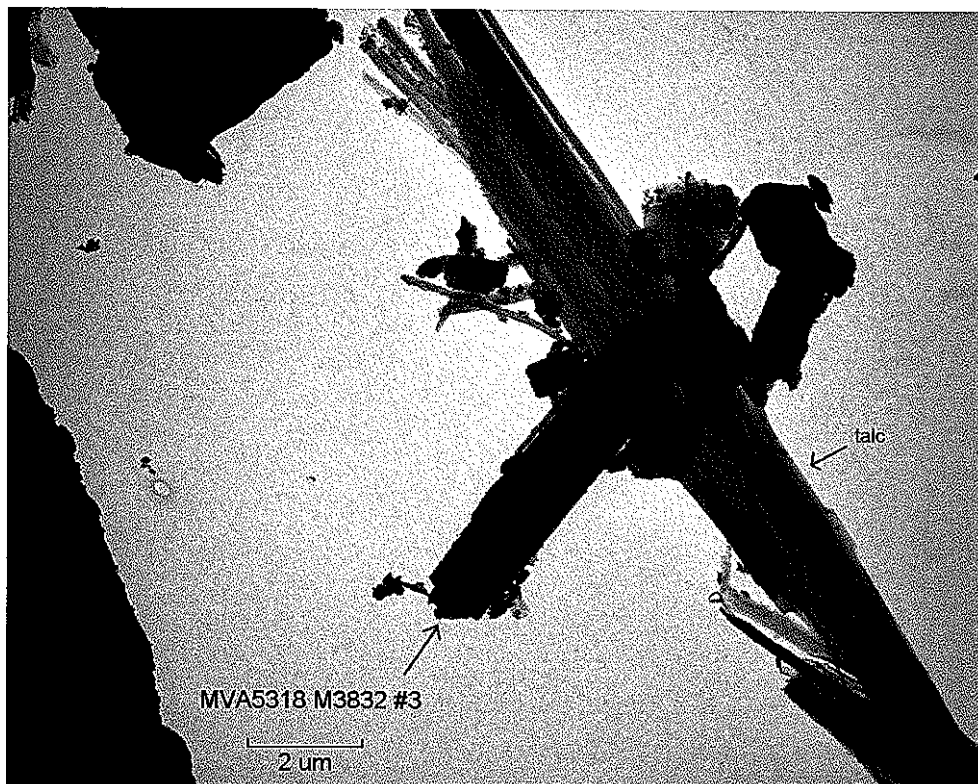
Micrograph 7. SEM Image of Tremolite from SRM 1867.



Micrograph 8. SEM Image of Tremolite from SRM 1867.



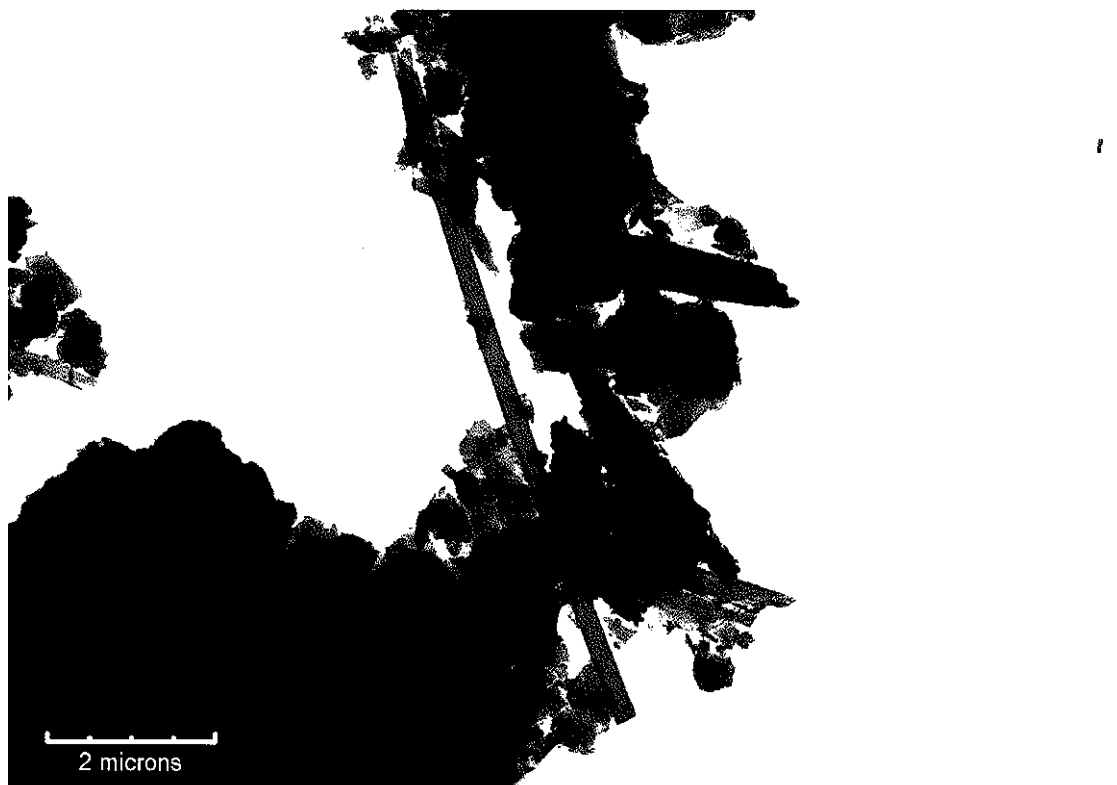
Micrograph 9. TEM Image of Tremolite from Sample M3832.



Micrograph 10. TEM Image of Tremolite from Sample M3832.



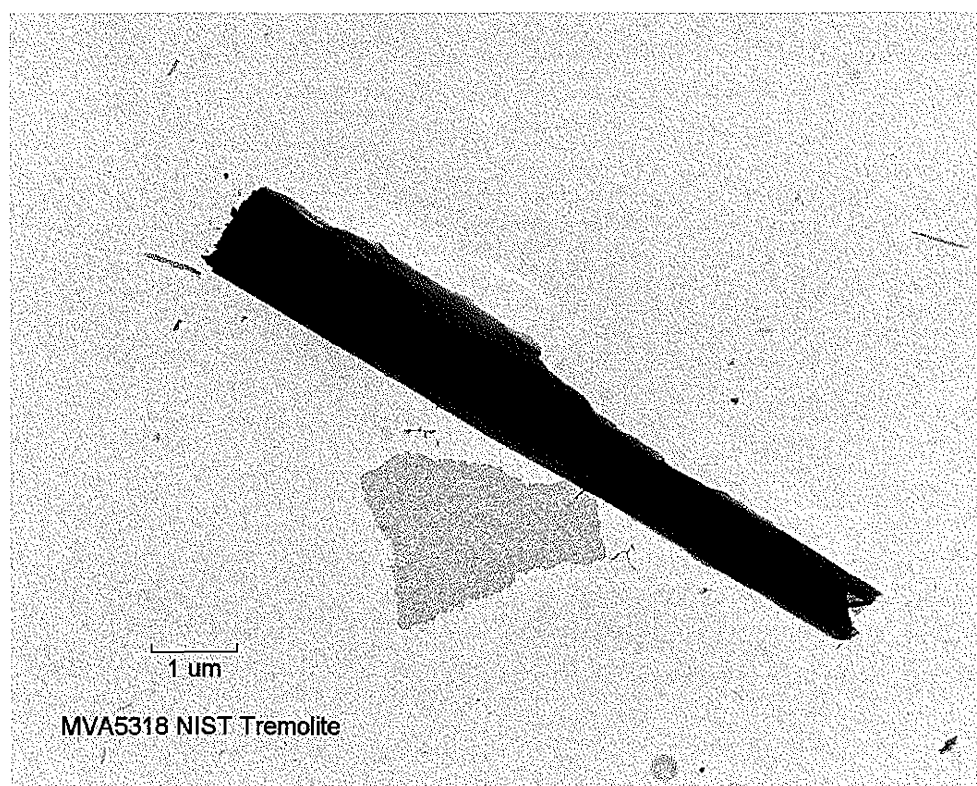
Micrograph 11. TEM Image of Tremolite from Sample M3832.



Micrograph 12. TEM Image of Tremolite from Sample M3832.



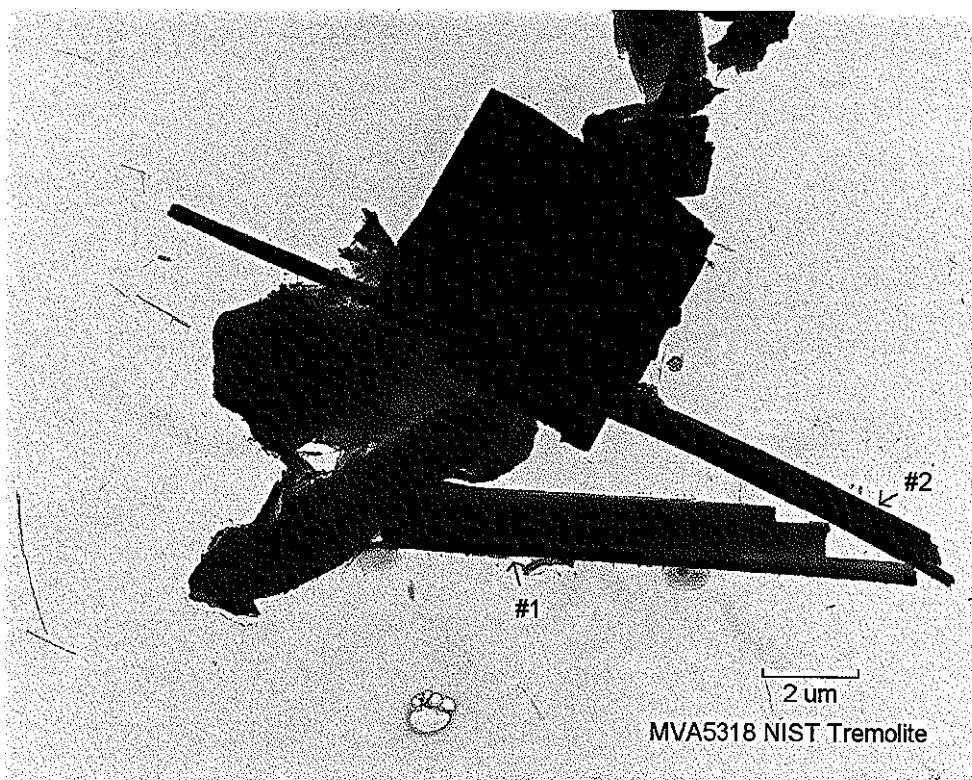
Micrograph 13. TEM Image of Tremolite from SRM 1867.



Micrograph 14. TEM Image of Tremolite from SRM 1867.



Micrograph 15. TEM Image of Tremolite from SRM 1867.



Micrograph 16. TEM Image of Tremolite from SRM 1867.