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SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES

ESTHER KATHERINE NOSSE, Plaintiff, vs. ARVINMERITOR, INC, et al., Defendants.	JCCP Case No. 4674 CASE NO. BC603354 **DECLARATION OF SEAN FITZGERALD, P.G.** Date: June 17, 2016 Time: 9:00 a.m. Dept: 1 Judge: Hon. Joseph Kalin Complaint Filed: December 4, 2015 Trial Date: June 27, 2016

I, SEAN FITZGERALD, P.G., declare that:

1. My name is Sean Fitzgerald P.G. I am a Senior Research Scientist at Scientific Analytical Institute. I am a licensed Professional Geologist, mineralogist, and asbestos expert, with 25 years of experience analyzing asbestos minerals and researching and developing the science of asbestos. I am familiar with and have substantial training and experience in the analysis of asbestos and asbestos-containing materials, including by transmission electron microscopy, scanning electron microscopy, x-ray diffraction, and polarized light microscopy. I

am also familiar with OSHA, NIOSH and EPA methods and regulations regarding the analysis of asbestos and asbestos-containing materials.

2. In my years of service, I have firsthand experience with many of the key events that have impacted the asbestos analytical community, including product identification of asbestos-containing materials, discovery and interpretation of asbestos contamination in vermiculite from Libby Montana, discovery and interpretation of environmental impact of naturally occurring asbestos in California and Virginia, even analysis of materials from the World Trade Center before and after 9/11. The findings of the research and testing that I and my laboratory have conducted have proven invaluable to both the industrial engine that drives commerce, and to the safety community that strives to protect our health.

3. The mission of our studies is to bring the best possible science to our understanding and awareness of asbestos- how it occurs, and where it can be found. Our state-of-the-art laboratory is equipped with light and electron microscopes capable of resolving the chemistry and crystalline structure of materials to the nanoscale, as well as x-ray, plasma and laser technologies employed to give our multidisciplinary scientific staff the tools they need to bring that science to bear. I have analyzed thousands of building materials for the presence of asbestos. I have conducted many specialized analyses, such as lung tissue and releasability testing. I have tested the extent a given material may release asbestos fibers, including asbestos gaskets, spackling compounds, fireproofing, brakes, paints, and even cigarettes. I have tested consumer products and found asbestos in a myriad of materials, most notably, children's toys including crayons, play clays, and fingerprinting powders.

4. I graduated with honors from the University of Tennessee in 1988, with a Bachelor of Science degree in Geologic Studies. From approximately 1988 to 1990, I worked as a Project Representative for Law Associates, Inc., an engineering consulting firm in Atlanta, Georgia, where, among others things, I performed asbestos-related site inspections. From approximately 1989 to 1997, I worked as a geologist and analyst at Material Analytical Services, Inc. (MAS), a laboratory and materials testing and research facility in Norcross, Georgia. My duties at MAS included, but were not limited to, laboratory analysis of minerals and materials, including asbestos and asbestos-containing materials, using transmission electron microscopy, scanning electron microscopy, x-ray diffraction, and polarized light microscopy. From approximately 1997 to 1998, I worked as a branch manager for EMSL Analytical, Inc. (EMSL) in Seattle, Washington, where, in addition to management duties, my work included laboratory analysis of asbestos and asbestos-containing materials using electron and light microscopy. From approximately 1998 to 2000, I worked as Director of Analytical Services for White Environmental Consultants, Inc. in Anchorage, Alaska, where, in addition to duties involving business development and growth, I performed laboratory analysis of asbestos and asbestos-containing materials. From approximately 2000 to 2001, I returned to work at EMSL as Western Regional Manager. My primary responsibilities involved management of the company's western regional laboratory facilities, but I also performed laboratory research and analysis of asbestos and asbestos-containing materials. In 2002, I worked as Director of Business Development for Asbestos TEM Laboratories, Inc. in Berkeley, California, where, in addition to management responsibilities, I conducted field

research and analysis of naturally occurring asbestos. From 2002 to 2005, I worked as a branch manager for RJ Lee Group. Inc. at its laboratory facility in San Leandro, California. My work there included analysis and microscopic examination of asbestos and asbestos-containing products, including geological analysis of naturally occurring asbestos. Since 2005, I have been Vice President, President, Quality Assurance Director, and Senior Research Scientist of Scientific Analytical Institute, Inc., an environmental and materials testing and research laboratory in Greensboro, North Carolina. Approximately 70 to 80 percent of SAI's business involves the analysis of asbestos and asbestos-containing materials using a variety of analytical techniques, including electron microscopy (TEM & SEM), light microscopy (PLM) and x-ray diffraction (XRD), and I personally perform research on asbestos and asbestos-containing materials.

5. In 1988, I received training and instruction for asbestos-related air sampling and analysis, building inspection and assessment, project management planning, and asbestos abatement project supervision at The Environmental Institute in Marietta, Georgia. In 1990 and 1992, I received training and instruction in the analysis of asbestos and asbestos-containing materials using transmission electron microscopy and polarized light microscopy at the McCrone Research Institute in Chicago, Illinois. I have also been a certified EPA Asbestos Inspector.

6. I have been a guest speaker at asbestos workshops and conferences, as well as local, state, and federal regulatory meetings and reviews, and have advised private and governmental entities on issues of asbestos regulation, science, and process development. I have been retained and given testimony as an expert researcher on asbestos in soils, naturally occurring asbestos, talc, vermiculite, and asbestos in household products, with work appearing before English Parliament and the US Senate. I have been a repeated keynote and technical session speaker and coordinator on asbestos issues before the Environmental Information Association (National Asbestos Council), ASTM International, the American Industrial Hygiene Association (AIHA), the Geologic Society of America (GSA), and have presented results of my asbestos research at the National Press Club in Washington, DC. I have also been an invited guest speaker at NOA asbestos conferences, including in South Lake Tahoe, and EPA Peer Review of Asbestos Risk Assessment in San Francisco.

7. I am a repeatedly-published author in the peer-reviewed literature, including a book chapter on Naturally Occurring Asbestos (NOA) for ASTM International (ASTM), as well as articles on the science of asbestos, talc (including cosmetics), geology, and mineralogy, and have given numerous asbestos-related presentations to various organizations, including the Environmental Information Association (EIA) (formerly the National Asbestos Council), the American Industrial Hygienist Association (AIHA), and ASTM.

8. I am a member of the Geological Society of America (GSA), the Mineralogical Society of America (MSA), the American Society of Trace Evidence Examiners (ASTEE), the Materials Research Society (MRS), the Environmental Information Association (EIA), the American Industrial Hygiene Association (AIHA), and the ASTM International: D-22 Air Quality Committee. Further, I have been the US Delegate Asbestos Expert to the International

Standards Organization (ISO) through the American National Standard Institute (ANSI), a committee editor and peer reviewer for the US EPA Asbestos Purple Book, and a talc method expert from 2015-2020 for US Pharmacopeia.

9. Further, I have written articles for publication and given presentations on asbestos, many of which are on the topics of asbestos and talcum powder. These presentations and articles include the *Analysis for Asbestos Content in Commonly Available Products Using Light and Electron Microscopy and Matrix Reduction Techniques, S. Fitzgerald 07/11/07: 17p; 27p. as published to USEPA & CPSC;* the *Analysis of Talc for Asbestos*, at the 30th Annual National EIA Technical Conference, in Washington D.C., on March 25, 2013; *What is Asbestos?* at the 2014 GSA Conference held in Vancouver, BC CANADA, on October 19, 2014. In addition, I have authored peer-reviewed literature on asbestos and talc including: *Is Antigorite the Asbestos Forgotten?*, S. Fitzgerald, E. Harty; Professional Safety Journal, August 2014; *Asbestos in Commercial Cosmetic Talcum Powder as a Cause of Mesothelioma in Women*, R.E. Gordon, S. Fitzgerald, J. Millette; International Journal of Occupational and Environmental Health, September 2014; and *Asbestos Control: Surveys, Assessment, Abatement and Maintenance,* A. Oberta, S. Fitzgerald, J. Spencer, and A. Segrave *Chapter 3:Naturally Occurring Asbestos* by S. Fitzgerald ASTM International Publishing, 2015.

10. In addition, I have attended several continuing education seminars over the years, including: *M&C Environmental*, EPA Asbestos Inspector, San Leandro, CA 2005; *McCrone Research Institute*, Transmission Electron Microscopy Polarized and Light Microscopy, Chicago, Ill 1990; 92; and *The Environmental Institute*, Building Inspection and Assessment (EPA Inspector), Management Planning, Project Supervision, Sampling And Analysis (NIOSH 582 equivalent), Marietta, GA 1988.

11. I have previously been retained and have testified as an expert witness in litigation involving asbestos and asbestos-containing materials, including talc contaminated with asbestos.

12. A true and correct copy of my current *curriculum vitae* is attached hereto as Exhibit A. A true and correct copy of a list of my former testimony is attached hereto as Exhibit B.

13. I have been retained as an expert in this case for my expertise regarding geology, historic testing of talc, including testing of Cashmere Bouquet products, and my own testing of Cashmere Bouquet products. I have reviewed the testimony of the plaintiff and other relevant testimony to determine if it was my opinion, to a reasonable degree of scientific certainty that through the use of Cashmere Bouquet Ms. Elizabeth M. Alfaro would have been significantly exposed to asbestos.

14. I have had the opportunity to review materials including depositions, expert reports, company records, articles, and studies relevant to body powders produced by the Colgate-Palmolive Company, specifically, historical productions of Cashmere Bouquet® talcum powders. These talc products have been repeatedly analyzed and shown to contain asbestos, including anthophyllite, tremolite, and chrysotile asbestos fibers

THE MINERALOGY OF TALC AND ASBESTOS

15. In order to understand why we often see asbestos in talc, let me first explain what these minerals are. Continental rocks are dominated by the elements silicon (Si) and aluminum (Al), and ocean or basalt is relatively silica poor; magnesium (Mg) and Iron (Fe) rich. Ocean crustal rocks are therefore called "Mafic" or "Ultramafic", and mostly occur on land when they are split or planed from the ocean floor and then faulted through the silica-rich continental "country" rock, normally in tectonic mountain-building processes.

Silicates

16. Silicon is one of the most common elements in the earth's crust (it would be the most common if it wasn't for oxygen). A "mineral" is defined as a regular and specific arrangement of a given chemistry (elements present in a certain ratio or amount). It therefore falls to reason that the group of minerals based on Si would be the most common. In fact, there are only 10 elements that make up 98.8% of the crust, namely (in order of abundance): Oxygen (O), Si, Al, Fe, Calcium (Ca), Sodium (Na), Potassium (K), Mg, Titanium (Ti), and Hydrogen (H). Silicates can contain all 10 of these elements, as they form many different minerals depending on what elements are present and the pressures and temperatures at the time of crystallization.

17. How silicate minerals are constructed is based on their most fundamental unit: the silica tetrahedron. A very stable building block, Si will bond to 4 oxygen atoms to form a triangular, tetrahedral (4-sided) polygon. Minerals that form with a network of isolated SiO_4 tetrahedra are the most basic of the silicates, like olivine. Forsterite is an olivine that has the formula Mg_2SiO_4, based on single SiO_4 networks. When the tetrahedra share corner oxygen atoms, they string together to form chains, and those minerals are known as single-chain silicates. If two adjacent chains then share corner oxygens, different minerals called double-chain silicates can form. Chain silicates include pyroxene and amphibole minerals, like the simple amphibole anthophyllite: $Mg_7Si_8O_{22}(OH)_2$. Figure 1 demonstrates this double chain structure.

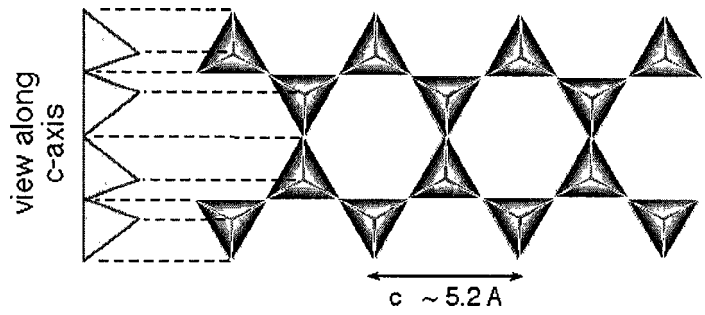


Figure 1: Amphiboles consist of double chains of silicate tetrahedra aligned along the c-axis of the unit cell.

18. If more than two chains link together, silica sheets can form, creating plate-like minerals such as micas and clays. Note that tetrahedral molecular arrangement creates a hexagonal (6-sided) form, which accounts for the hexagonal patterns we see both in the morphology and atomic arrangement imaging (e.g., electron diffraction) patterns common to clays and micas. An example of a sheet-silicate mineral includes one of our subjects: talc. Finally, 3-dimensional networks of silica tetrahedra form the minerals common to continental rocks, like feldspars or simply pure silica, i.e., quartz $(SiO)_2$.

19. Generally speaking, the silicate minerals form in more complex or connected network of the tetrahedral building blocks as more Silicon (Si) is available in the host rock. Silicate minerals are grouped based on the arrangement of their silica tetrahedra building blocks, in order of increasing relative Si content:

i. Isolated silica tetrahedron (olivine)
ii. Tetrahedral silica chains: single (pyroxene) and double (amphibole)
iii. Tetrahedral silica sheets (mica, clay, serpentine & talc)
iv. 3-D framework (feldspars & quartz).

Talc

20. Talc is a hydrated (hydroxylated) magnesium silicate mineral. It has magnesium in structure, is a silicate, and has some amount of water (or hydroxyl ion). Talc is one of the softest known minerals. Talc has the basic formula of $Mg_3Si_4O_{10}(OH)_2$. Figure 2 shows the unit cell (most basic motif, or building block of the mineral) of talc.

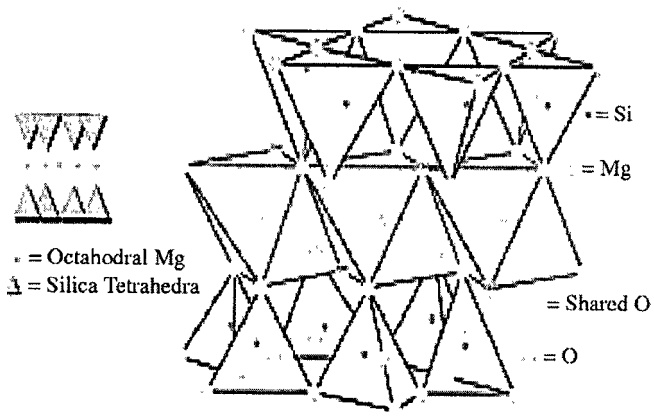


Figure 2: Talc consists of silica tetrahedra in a sheet, with magnesium sandwiched in a molecular arrangement called "octahedral coordination" by dint of the sharing of oxygens in 6 corners. Notice the hexagonal ring formed by the silica tetrahedra (as viewed from above).

Asbestos

21. The six regulated asbestos minerals are chrysotile (the fibrous form of serpentine) and the asbestiform varieties of five amphibole minerals: actinolite, tremolite, anthophyllite, crocidolite, and amosite. Although actinolite is often found in association with

its close relative tremolite, and crocidolite and amosite have been found in only a couple of unique talc formations, I will focus on the other four minerals. That leaves us with chrysotile (serpentine), tremolite, and anthophyllite as asbestos types most likely to be found in talc.

22. The serpentine minerals are all polymorphs of the same basic chemistry of $Mg_3Si_2O_5(OH)_2$, and are called antigorite, lizardite, and chrysotile. As sheet silicates, they are structurally similar to clay or talc: platy minerals consisting of a continuous silica sheets joined to a continuous octahedral sheet (e.g., in serpentine, the MgO, or "brucite layer"). Alternatively, they can be considered as a talc-like structure with the silica layer stripped from one side, like an open-faced sandwich. Serpentine has octahedral magnesia joined to a silica layer, but not without structural stress. The octahedral and tetrahedral layers do not line up very well for the purpose of oxygen sharing. This mismatch is compensated for by a stretching of the apical silica oxygens so that they can form the common oxygen link. This stretching results in structure bending.

23. Geometrically, there are only a few ways the mineral can form to compensate for this molecular curvature: by either linking reversed silica sheets in an undulating "jelly-side-up to jelly-side-down" in a microscopic wave, or by linking curved sheets with the jelly-side-up to form finite scrolls. When serpentine waves are created, either the regular wave form antigorite or the irregular wave lizardite is the result. When scrolls form, chrysotile asbestos is the result, with its characteristic "soda-straw" fiber morphology.

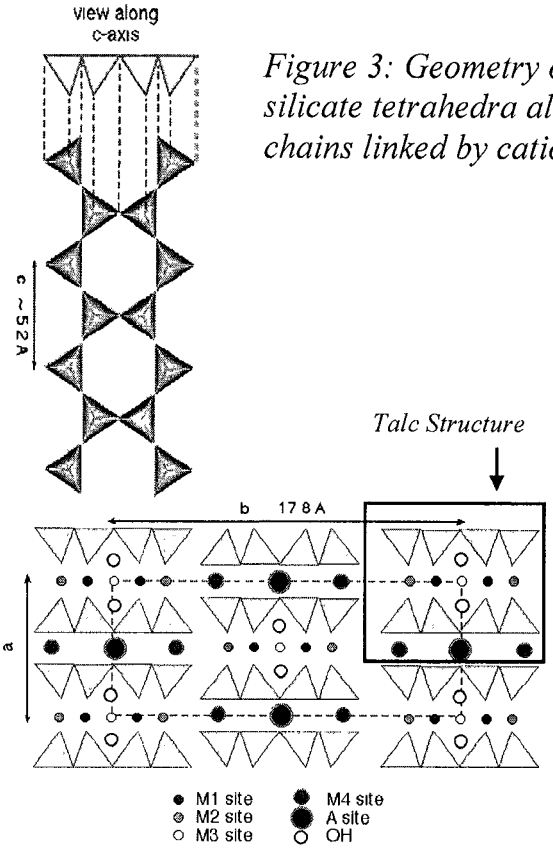


Figure 3: Geometry of amphibole. Amphiboles consist of double chains of silicate tetrahedra along the c-axis of the unit cell, with the individual chains linked by cations in octahedral coordination.

The structure of amphibole, with chain-linking cations, is shown below as projected along the c-axis of the unit-cell. The octahedral cation sites are labeled M1, M2, M3, and M4. The hydroxyl group (OH) is added from water during formation.

In anthophyllite, the M sites are occupied by Mg. In tremolite, Ca fills the M4 site. Note that the "A" site is left open in regulated asbestos minerals, but can be occupied in Libby amphiboles.

Note that every other 1/6, or "silica sandwich" is a polysome of talc (see callout).

24. Serpentine forms most often in geologic units resulting in ocean crust faulted through country rock in the presence of water, usually on the ocean face side of mountain ranges, as one would expect from a subducted ocean plate under a continental land mass. Serpentine-rich formations of this genesis are called ophiolites (*ophio-* is Greek for "snake").

25. The asbestos amphiboles tremolite and anthophyllite are, as we already know, double-chain silicates. Tremolite most often occurs in contact or regional metamorphism of carbonates. In other areas of formation, actinolite is more likely to form. Anthophyllite is commonly developed, often with an asbestiform habit, during regional metamorphism of ultrabasic rocks, and in this paragenesis is usually associated with talc (Deer, Howie, & Zussman). As we can see in figure 3, the fundamental building block (unit cell) of talc is actually a subset of the unit cell for amphiboles.

"Transitional" Minerals

26. As you can see by looking at the subtle differences in the chemistry and structure of the minerals talc, anthophyllite, tremolite, and serpentine, these minerals are closely related and can easily be altered from one to the next. All of these minerals form under similar conditions in regional or contact metamorphism of ultramafic rocks especially in the presence of carbonates and water, as all of these minerals are hydroxylated magnesium silicates.

27. Iron-poor anthophyllite is actually quite common in metamorphic talcs, and often can act as both the chemical supply for the formation of talc, or be formed in retrograde from talc, in a hydrated magnesium silicate cycle of mineralization. In the presence of calcium available from carbonates, tremolite enters this cycle, and may also act as both source and resulting mineral. When the new mineral retains the morphology of its parent, it is called "pseudomorphic", e.g., fibrous talc is often pseudomorphic after anthophyllite asbestos.

28. Geologically speaking, fibrous talc structures, especially asbestiform talc, are relict structures of former amphibole asbestos structures in most cases, with the possible exception of less common ribbony talc fiber morphemes. Fibrous talc has proven more pathogenic than their more platy-dominant assemblages (Rohl & Langer, 1974), and most all fibrous talcs are contaminated to varying degrees with their mother minerals in their asbestos forms. It has also been long known that the metamorphosis of siliceous dolomites almost invariably creates asbestiform tremolite, for instance.

29. There are two basic geologic conditions that produce talc:

i. Hydrothermal alteration of mafic and ultramafic rocks, or
ii. Hydrothermal metamorphism of siliceous dolomites.

30. "Hydrothermal alteration of mafic and ultramafic rocks" means chemical change of silica-poor minerals by waters heated in the earth by magma (mafic or ultramafic rocks such as olivines or pyroxenes are often derived from oceanic crust, and are also called "ultrabasic" rock). In this first group, other more complex silicates including asbestos rarely form in the talc forming process, but can have been formed in the mafic bodies before the

hydrothermal episode of talc formation.

31. "Hydrothermal metamorphism of siliceous dolomites" is usually at higher temperatures due to contact or regional relatively close proximity to igneous bodies or magma, like a dike cutting through carbonate country rock, or a magma cooling to granite below, effectively "pressure cooking" the surrounding rocks. In this second group, Mg is often contributed to the formation of the talc, as the silicon comes from the carbonates as well. In some deposits of the second group amphiboles may be very abundant, especially in those formed during high temperature regional metamorphism of impure dolomites. As a large magmatic body at the root of the Adirondacks did just exactly that, the Gouverneur District has tremolite comprising between 30 and 70% of the talc product (Harben & Kuzvart, 1996). In that area, alteration of the tremolite schists have exhibited full-range alteration from tremolite to anthophyllite to talc to serpentine, and most all permutations of those end member transitions, e.g.;

Tremolite + Talc → Anthophyllite + Talc
Tremolite → Anthophyllite → Talc (Fullerville; Wight)
Anthophyllite → Talc (Fowler)
Tremolite → Serpentine (Arnold)

32. "All of the very fine-grained talc, anthophyllite, and serpentine noted in the Gouverneur schists appear to have grown by a latter alteration of tremolite or anthophyllite. The coarsely crystalline talc is associated with clear unaltered tremolite and appears to be a primary metamorphic assemblage; not a result of any retrograde alteration. The coarsely crystalline talc is not valuable commercially because of its poor milling quality. The fine grained alteration products of the amphiboles form the commercial ore. The superior milling quality of this ore is probably due to the fine-grained nature of the magnesium silicate alteration products" (Ross, 1968).

33. As the interrelationship between talc formation and asbestos is further examined, these two basic modes of talc formation can be further defined by four different groups, as I, II, III, and IV:

i. Type I, *ultramafic origin*: Begins as ultramafic rock, e.g., olivine or pyroxene that is serpentinized, and the resulting serpentine subsequently carbonitized by CO_2 and water to form talc and carbonates. Accessory minerals include magnesite, sulfides, chlorite, and **serpentine**.

ii. Type II, *mafic origin*: Begins as mafic rock, e.g., gabbro; serpentinized, and the resulting serpentine subsequently carbonitized by CO_2 and water to form talc and carbonates. Accessory minerals include magnesite, chlorite, parent minerals (e.g., gabbro) and **serpentine**.

iii. Type III, *metasedimentary origin*: begins as dolomite or magnesite, hydrothermally altered by silica-bearing fluids. Accessory minerals include dolomite, calcite, chlorite, quartz, and feldspars.

iv. Type IV, *metamorphic origin*: begins as carbonates, e.g., dolomite or silica -containing dolomitic marble. Recrystallization of host rock forms tremolite or actinolite within the host, which is subsequently steatized (altered to talc) by heat and pressure. Accessory minerals include carbonates, quartz, **serpentine**, **tremolite**, and **actinolite**; occasionally **anthophyllite** (McCarthy et.al, 2006).

34. Although talc and asbestos are not the same minerals, they are members of the same family of minerals and are formed from the same minerals. Talc is primarily formed from the metamorphism of magnesian minerals, including serpentine and amphibole, through heat and pressure. Talc can also form hydrothermically through a reaction between dolomite, a carbonate mineral, and silica. As noted, asbestos is the asbestiform variety of serpentine and amphibole. Because asbestos and metamorphically-formed talcs are formed from the same minerals (serpentine and amphibole), metamorphically-formed talc is more likely to contain or be found with asbestos than hydrothermically-formed talc.

35. In review of the above refined four modes of talc formation we see either serpentine or amphiboles as possible accessory minerals in three of the four modes of formation, leaving only type III (metasedimentary) as the only geologic process unlikely to contain the asbestos-forming minerals as accessory (contaminating) minerals. In fact, in the field we see that even talcs formed from the hydrothermal alteration of carbonates, a.k.a., hydrothermal or metasedimentary origin, can sometimes have some amount of alteration to asbestos by the other processes. In other words, although a talc body may chiefly be formed in a matter in which it is unlikely to contain asbestos, it is possible that asbestos can still be a contamination of the overall mine. Because of the close relationship of talc and the asbestos-forming minerals we can see why asbestos fibers can and do occur at some level in talc reserves all over the world. In fact, geologists have known for well over a century of the intimate relationship between talc and asbestos (Dana, 1895). What we can learn from these lessons in geology and mineralogy is that we must closely and carefully examine each formation of talc in the earth, both from the macroscopic geology of formation to the microscopic examination of materials and minerals as they change through time.

36. Further, as to the determination of the presence or absence of asbestos in hand sample, the concept that a mineral must be visibly fibrous in hand sample in order to be asbestos is misleading. I often find asbestos fibers, bundles, and veins in rocks in the field that were only recognizable as such with the aid of a microscope, especially when we consider the size necessary to be released into the air and potentially inhaled by humans. Indeed, much of the asbestos that I was able to find in the laboratory under the microscope was not perceivable as asbestos in hand sample in the field. I have repeatedly found this to be true with natural occurrences of asbestos in soil and rock, including my field studies in North Carolina, Montana, Vermont, Canada, Alaska, and many more excursions, where I have repeatedly been surprised that rocks that appeared to not contain asbestos in hand sample were found to contain substantial asbestos under the microscope. On the tenuous foundation of defining asbestos as only a gross population, the actual particle size fractions that are only resolvable at the microscopic level are discarded as inconsequential. Unfortunately, this is the very size fraction

that is of concern when considering asbestos, as airborne breathable asbestos is far smaller than can be seen by the naked eye. In fact, it would take over a hundred respirable-size fraction asbestos fibers to equate the thickness of one human hair.

GEOLOGICAL EVIDENCE OF ASBESTOS IN SOURCE TALC ORES FOR CASHMERE BOUQUET TALC

37. Given that asbestos is the causative factor of mesothelioma, it is important to note that this historic cosmetic talc contained asbestos. It has been demonstrated that the contamination was from the mining process, since ore specimens taken directly from the mines have repeatedly been tested and proven to contain asbestos, most often anthophyllite and tremolite, but also serpentine chrysotile asbestos.

38. In addition, the Federal Food and Drug Administration specifically acknowledged that "cosmetic talc produced in the 1960s and early 1970s did contain asbestiform minerals." (July 11, 1986, Letter from J.W. Swanson, Acting Director of the Federal Food and Drug Administration, to P. Douillet, re: Citizen Petition "Warning Labeling of Asbestos in Cosmetic Talc," at p. 1, Exhibit K.)

39. From review of corporate documents, sworn testimony of those responsible for the sourcing of talc used in Cashmere Bouquet products, and Colgate's discovery responses, Colgate has admitted that the talc used to manufacture Cashmere Bouquet talcum powders was supplied from Charles Mathieu, Inc. and Cyprus Industrial Minerals. Colgate has further admitted that from 1940 to 1979, Charles Mathieu was the exclusive supplier of the talc used in Colgate's Cashmere Bouquet products and that, from 1979 until 1995. Cyprus was the exclusive supplier of talc used in Colgate's Cashmere Bouquet products.

40. I have determined from my review of Colgate's Cashmere Bouquet formula cards, interrogatory responses, and depositions of witnesses who worked for Colgate and Colgate's talc suppliers, that three mines were historically the primary sources of talc for the subject. They were the Regal mine near Murphy, North Carolina, the Willow Creek mine in Southwest Montana, and talc imported from the Val Chisone/Val Germanesca region of the Italian Piedmont. As the specific geology of talc can be an important indicator of whether a talc source may contain or be contaminated with the asbestos forming minerals, an evaluation of the geology relevant to these three mines is necessary.

Regal Mine Near Murphy, North Carolina

41. The Regal mine in North Carolina was in the Murphy marble belt, a 150+ mile formation in which marble and talc have been mined for decades. Several geologic evaluations of this belt have found it rich in amphiboles, including anthophyllite. Tremolite is also commonly found in metamorphosed dolomites and marbles, and has been historically

repeatably found associated with this formation as well. Studies by the geologists Hopkins and Van Horn found evidence in the Murphy marble belt of both hydrothermal and metamorphic talcs, with silicates including tremolite and actinolite most developed 5 miles northeast of Murphy. (Geological Survey of Georgia by Oliver B. Hopkins, *A Report on the Asbestos, Talc and Soapstone Deposits of Georgia,* published in 1914 (Chas. P. Byrd, State Printer 1914), at 232 [The Talc and Soapstone Deposits of North Carolina], 233 [tremolite deposits], Exhibit E.) The Regal mine was approximately 3.5 miles northeast of Murphy. Van Horn went on to describe the talc as consistently fibrous and pseudomorphic, and Hopkins and Pratt reported that the talc is largely due to alteration of tremolite, and is microscopically fibrous.

42. Asbestos has been repeatedly found in testing of talc from the Murphy belt. In fact, consistent with what was recorded in publically-available geological surveys, in 1948, researchers independently reported the presence of tremolite and actinolite asbestos in the talc formation of the Murphy Marble Belt: "throughout the marble formation and usually is accompanied by pyrite...In the Murphy marble, tremolite is found in sizes from microscopic particles to bladed crystals up to 20 inches long...Tremolite replaces and is replaced by tale and most of the other accessory minerals, demonstrating several different stages of formation...when tremolite crystals are replaced by talc, it is not unusual for the talc to form as a broad encroaching wave." (Earl C Van Horn article, Talc Deposits of the Murphy Marble Belt, at 25 (1948), Exhibit F; W. Robert Power & Joseph T. Forrest, Stratigraphy and Structure of the Murphy Belt, North Carolina, published in Carolina Geological Society, at 5 (Nov. 13-14, 1971), *see also,* p. 5 [Noting that the Murphy Marble Belt's "[c]ommon accessory minerals include graphite, biotite, **amphibole,** talc, and pyrite"], Exhibit G.)

43. In May, 1977 the McCrone Institute in Chicago reported their testing results of talcs from all over the world by X-Ray Diffraction (XRD) and Polarized Light Microscopy (PLM), under contract to the National Institute for Occupational Safety and Health (NIOSH). Their testing found tremolite asbestos in the talc from the Hitchcock mine, 1.5 miles southwest of Murphy.

44. Moreover, I have personally visited this area and confirmed tremolite presence in the talc mines of the Murphy, NC marble and talc belt formation recently.

Willow Creek Mine in Southwest Montana

45. The Willow Creek mine was well documented as contaminated with asbestos. A geological survey conducted by the Montana Bureau of Mines confirms that this region was contaminated with serpentine and tremolite asbestos. Specifically, in the Montana mine, geologists observed as early as 1979 that fibrous talc was pseudomorphous after tremolite, and chrysotile vienlets were observed in olivine porphyoblasts (inclusions) at Willow Creek, both clear indications of co-mineralization of the talc with ultramafic asbestos-forming minerals. (Geological Survey in 1979 by Richard B. Berg, entitled *Talc and Chlorite Deposits in Montana*, at 43, 45-46 ["Talc pseudomorphs after tremolite blades are observed in one specimen ... Serpentine was also observed in thin sections of both the calcite marble and

the dolomitic marble ... Phlogopite and tremolite also occur in calcite marble"], Exhibit H.)

46. *Talc in Southwestern Montana* by Cerino, et.al., Northwest Geology, v. 36, 2007 describes mineral assemblage at the Yellowstone mine, located in the foothills of the Gravelly Range, on the eastern side of the mountain range opposite Willow Creek on the Western side of the same ridgeline 14 miles away. There are many similarities in the observed geology and mineralogy at Willow Creek and Yellowstone, including the presence of dolomite and marble stained maroon by the iron rich minerals hematite and pyrite, found heavily faulted and folded as a host rock for their daughter mineral that constitutes the mineral being mined: talc. Both talc mines are situated in medium to high grade Archean dolomitic marble, with the talc ore bodies hosted in that siliceous dolomitic marble. As Cerino points out in his description of the methods of talc formation in southwest Montana, many authors have described and mapped these Archean rocks in the region. He reports to us however that the geologic setting of the talc deposits is somewhat enigmatic, in that some investigators, including Berg (1979), suggested that the talc formed in a retrograde metamorphic event based on replacement of tremolite by talc and biotite by chlorite. In 1990, Anderson and others suggested a hydrothermal model of talc formation. Cerino went on to say that there are replacement textures of the parent minerals as relic structures; to include euhedral talc perfectly preserving the original dolomite rhombs (rhombohedral crystals), further: "Other replacement texture observed include replacement of olivine and diopside which are products of the amphibolite to granulite facies M1 metamorphic event". A mafic or ultramafic component responsible for talc formation was also suggested by trace element geochemistry of the talc conducted by Cyprus minerals, which found elevated chromium and nickel content indicative of such.

47. In the 1990 USGS report *Pre-Cambrian Geology and Bedded Iron Deposits of the Southwestern Ruby Range, Montana*, Harold L. James described the Archean rocks as containing the dolomitic marble that was the host predecessor of talc formation. From that study I quote: "*A notable analogy exists between this area and, for example, the Adirondack Mountains of New York. Though younger by considerably more than 1 billion years, the Adirondack lithic assemblage is similar, containing marble, amphibolite, and various layered gneisses, as well as widespread deposits of talc.*" I found this correlation remarkable, in that the talc from upstate New York has been repeatedly found to contain anthophyllite, tremolite, and chrysotile asbestos, and, similar to the rocks found and reported by James, the talc of the Gouverneur region of New York formed as a combination of hydrothermal alteration of carbonates *and* metamorphic alteration of ultramafic asbestos-forming minerals, with replacement textures and pseudomorphic fibrous talc repeatedly found in both formations. Although the specific section in the James report on talc addresses the hydrothermal model for talc formation, he described the entire lithologic units that hosted the talc as so extensively metamorphically altered to constitute a "virtual field laboratory for studies of metamorphism." He describes the process of talc formation as the introduction of silica and water, loss of calcium and carbonate (CO2) "presumably through the agency of hydrothermal fluids", though the source of such fluids and timing remain unclear. On the other hand, virtually all of the ultramafic and metamorphic asbestos forming minerals are found throughout the James report including anthophyllite, actinolite, tremolite, and chrysotile. In fact, James notes that serpentine is associated and found locally abundant. In a section named "ASBESTOS" in his

report he writes "golden-yellow cross-fiber asbestos (chrysotile) is found as thin veinlets in altered dolomite marble."

48. In 1984, a letter from Cyprus minerals described the tremolite occurrence at Willow Creek as fibrous and selective mining was deemed "not feasible to avoid" the inclusion of the asbestos. I have personally visited the Willow Creek mine to take samples for analysis. I analyzed those samples by transmission electron microscopy for asbestos content. My analysis confirmed asbestos presence throughout the Willow Creek talc mine, including chrysotile and asbestiform tremolite. Further, the Willow Creek mine in Montana, was in fact shut down due to the tremolite asbestos problem in Montana.

49. Furthermore, I personally traveled to Montana and evaluated the Willow Creek mine site in August 2014. As reported to Colgate through counsel in October 2014, I concluded as follows: *"My boots on the ground evaluation at the Willow Creek mine site, coupled with subsequent laboratory mineral identification, finds that there is extensive and pervasive presence of asbestos throughout the mine. I find the geology as reported by Berg, Serino, James, and Cyprus minerals consistent with these findings, especially in regard to the viability of the location as a source of mineable talc. It is my opinion, with a reasonable degree of scientific certainty, the talc that occurs at Willow Creek could not be selectively mined to preclude the mining and disturbing of asbestos; especially chrysotile and pervasive asbestiform tremolite. In fact, it is my opinion that it would be difficult if not impossible to fill a small wheelbarrow full of talc from this location without including some amount of asbestos, at least at the microscopic scale."*

50. I am aware Colgate has suggested that talc from the Beaverhead mine, also in Southwestern Montana, formed "in a manner that does not even allow for the possibility of asbestos contamination." It is notable, however, that Dr. Mickey Gunter, who Colgate often retains as an expert in mineralogy and geology in cases involving exposure to Cashmere Bouquet, has previously testified that all talc deposits in Southwestern Montana "formed from the same geological processes, from hydrothermal alteration of these preexisting carbonate rocks." (Trial Testimony of Dr. Mickey Gunter, *Fishbain* case, July 28, 2015, at pp. 805:15-25, Exhibit FF.) Colgate's position is therefore contradicted by the geologic studies discussed above, identifying the common occurrence of asbestos in the mineralogic assemblage that characterizes the Southwestern Montana talc deposits. Colgate offers no reason to assume that asbestos would not be a contaminant of the Beaverhead talc deposit, when it has been repeatedly identified at other nearby talc mines, including Willow Creek.

Val Chisone/Val Germanesca Region of the Italian Piedmont

51. *Industrial Minerals and Rocks, 7th ed.* has a chapter on the mineral talc, by McCarthy, et. al., as referenced earlier in this document regarding the four "types" of talc formation. Italian talc, specifically Val Chisone, is cited therein as an example location for Type IV: talc of metamorphic origin. Metamorphic talc is is formed by a two-step process. Starting with dolomitic marble recrystallized to form tremolite/actinolite, subsequent

steatization of amphiboles constitutes metamorphism to talc and carbonate, derived directly from the asbestos forming minerals. *Metamorphic talc is therefore known for the accessory minerals serpentine, actinolite, and tremolite; minerals that, when asbestiform, are regulated as asbestos.*

52. In the Annals of the New York Academy of Sciences, volume 643, 1991 the section on public health control entitled *The Third Wave of Asbestos Disease: Exposure to Asbestos in Place* as edited by Landrigan and Kazemi reports on the hazards of talc contaminated with tremolite, and examines different example tremolites from around the world, including tremolite from Ala di Stura, in northwestern Italy which formed in the same basic formation that formed the talc in the nearby Talco Graffiti talc mining region of the valleys of the Chisone and Germanesca rivers (Val Chisone/Val Germanesca), the very talc region mined extensively for the talc milled in Italy in earlier years and sent to US distributors including providers of Italian talc to Colgate, and also as a primary source of Italian talc in later years shipped to be ground in America as AGI 1615 grade, also extensively sold to Colgate for products such as Cashmere Bouquet.

53. Further, *The Third Wave* describes the tremolite in that formation as containing both non-fibrous and fibrous/asbestiform varieties, which is consistent with the tremolite found in the talc ore and products tested historically and recently, including testing of Cashmere Bouquet, e.g., Figure 4 (p.480) shows tremolite asbestos from Ala di Stura; tremolite from the same basic formation as Val Chisone talc.

54. A 1966 geological study of this region of Italy documents that "accessory minerals, including ... amphiboles of the tremolite-actinolite series," are diffused throughout the deposit, at times in "considerable volumes." The 1966 survey reveals that inclusions of such accessory minerals is "constant and regular," and are indeed in "every deposit." Specifically, the amphibole tremolite inclusions terminate "in clumps of rigid asbestoid fibers, with silky brightness." (Article by Luigi Peretti entitled, Geology and Genesis of the Talc Deposits in the Pinerolese, published in Bulletin of the Subalpine Mining Association in September-December 1966, at pp. 283, 289, 293-294, Exhibit D.)

55. The largest and most active chrysotile mine in all of Europe was also in the same basic formation in the Piedmont region near Torino, Italy. Recent papers regarding the geology of associated chrysotile, tremolite, and talc include Ilgren, et al., *Critical Reappraisal of Balangero*, 2015, and supplemental data as published as *Critical Reappraisal of Balangero Chrysotile and Mesothelioma Risk* (Ilgren, et.al., 2015). In those articles the importance of the geology of this formation, namely, the Lanzo massif, is described as conducive to the formation of tremolite asbestos through numerous serpentine and associated talc bodies. Further, the Chisone Valley is specifically named as a location where the presence of tremolite "is a plausible explanation for the most Western mesothelioma clusters".

56. In the published proceeds of the 32nd International Geological Congress, Italia 2004, the Germanesca Valley was studied in a field trip led by G. Lollino. In the description provided in the published field trip guide Lollino et.al. tells us that Val Chisone contains serpentinites, and describes ophiolitic sequences apparent in the rock. Ophiolites are the very

types of rock that are responsible for most of the asbestos formation in the earth, including the formation of tremolite. Further, presence of carbonate rocks in metamorphic sequences described in the region where major talc deposits were found as alteration of those carbonates is indicative of likely inclusion of tremolite in the final talc, as it is well recognized in the geologic literature that metamorphism of siliceous dolomites invariably produces asbestiform tremolite, for instance (Van Gosen, et. al.).

57. In 2007, the Periodico di Mineralogia (Periodical of Mineralogy) published an article relevant to the geology of the region at issue named *Metamorphic Veins from the Serpentinites of the Piedmont Zone Western Alps, Italy: a review*, by Groppo and Compagnoni. This article describes the metamorphic nature of the region, and the mineralogy and petrology of associated chrysotile, tremolite, and talc, and their common occurrence in the fibrous habit, lending further evidence of the conducive nature of the regional geology to the intimate formation of talc and asbestos.

58. The mineral industry of Italy was described by Newman, 1995, and subsequently by McCarthy, et. al. in 2006. Specifically in regard to Italian production of talc, Newman reported underground mines at Pinerolo near Turin, and Talco e Grafite Val Chisone is the major producers of the country, described as "white talc, mined from metamorphic rocks, has been a very high quality". McCarthy describes the Italian talc Luzenac Val Chisone, near Pinerolo, as in the ore of metamorphic origin. In Type 4 metamorphic origin talc, the host rock is silica-containing dolomitic marble, where tremolite and/or actinolite are formed within the host marble which is subsequently altered from the amphibole (tremolite or actinolite) to talc and carbonates, with tremolite and serpentine as common accessory minerals.

59. Further, in 2013, I personally tested samples of talc ore (AGI 1615) given to me for testing from Mt. Sinai and Langer. The samples were confirmed as originating from the Val Chisone/Val Germanesca region, finding both asbestiform anthophyllite and asbestiform tremolite, and occasional chrysotile asbestos.

HISTORICAL TESTING OF SOURCE ORES TO CASHMERE BOUQUET

60. From as early as 1942, scientific literature reported the presence of serpentine and amphibole minerals in samples of various talc products, including talcum powder. (Article in Journal of Industrial Hygiene and Technology by R.Z. Shultz and Charles R. Williams, entitled Commercial Talc Animal and Mineralogical Studies, published in April 1942 in Volume 24, No. 4, at p. 75, Exhibit C.)

61. Review of the historic records of ongoing testing by Cyprus of talc ore for the presence of asbestos in talc from many different sources demonstrated repeated findings of the asbestos-forming minerals by XRD, with follow-up testing confirming asbestos by light microscopy. Talc found to contain detectable tremolite by Cyprus testing was often that sourced from Italy, to be sold as talc products, e.g. 1615, to Colgate for use in various products including cosmetic products such as Cashmere Bouquet. Even though the records of testing of the Cyprus lots was found less than adequate for the amount of talc being produced, talc grades sold to Colgate were repeatedly held due to positive testing for tremolite. Further, lots

where a single sample may well represent 20 tons of talc in which testing only sensitive to 0.1% content of asbestos (at best) would give license to release of the entire 20 tons, which, in light of our understanding of lower levels of asbestos contamination in their commiserate potential for significant fiber release, is unacceptable. Further, in lots where XRD peaks were indicative of the presence of tremolite, individual samples were taken of the held lot to determine if individual tons could be found acceptable to ship. In the records of Cyprus' testing of these sub-lot tests also revealing repeated positive results for the presence of tremolite in Italian talc; indicative of significant potential of contamination of the talc being supplied to Colgate with asbestos.

62. Lot testing of Italian talc ore was done repeatedly due to the discovery of the mineral tremolite by XRD. A grade of talc from Italy was named "American Ground Italian", or AGI 1615, as the Italian ore was shipped to the US for processing. In 1971, testing by McCrone found chrysotile in 1615 grade, but also reported the possibility of contamination. Subsequent testing by ES laboratories confirmed the presence of chrysotile in June of 1972. Additionally, ES found the presence of anthophyllite in this material. Grade 1615 was further tested in 1972 by the New York University Department of Chemistry. Their initial test by XRD showed *"some features in its x-ray pattern that suggested that it might contain some tremolite"*. The report reads on: *"accordingly, the specimen was subjected to a detailed microscopic examination. Both tremolite and chrysotile fibers were found to be present in the sample. It is estimated the tremolite content is about 2% by weight, and the chrysotile about 0.5%"*. Ironically, that 1972 NYU report ended with a proposed solution to the asbestos content of the Italian talc, by diluting it with another grade of talc in which they had <u>not</u> found potential asbestos by XRD screening. It was quoted: "*Please note that the asbestos content of talc number 1615 is just at the minimum level of capability. It is evident that if this lot is blended with, e.g., talc No. 141, in the proportion of one part of the former to two parts of the later, the resulting mixture will be fully acceptable by the analytical protocol described above*" (XRD).

63. Furthermore, the Val Chisone talc from Italy also was studied by Pooley in 1972. The study described the mineral assemblage from which the talc is mined as metamorphic, which included the amphibole mineral tremolite. The samples were taken from within the mine itself. Fibrous talc was observed as intimate intergrowths with serpentine.

64. Further, in 1977, 1615 was retested by McCrone and found to contain tremolite. (November 16, 1977, letter from McCrone to Mr. Simko of Colgate-Palmolive, Exhibit Z.)

65. Asbestos contamination in Colgate's source talc was further confirmed during an evaluation of the Willow Creek mine beginning in 1979. At that time, Cyprus Mines corporation, an independent talc mining and processing company that purchased the Willow Creek mining rights from Colgate's supplier, conducted its own study ("the Cyprus Study") to determine the viability of the mine. Cyprus purchased the Willow Creek mining rights from Resource Processors, Inc., which was the mining division of Charles Mathieu during the time Charles Mathieu was supplying talc to Colgate. The Cyprus Study concluded that fibrous tremolite asbestos existed "along 80 percent of the

strike length of the ore body," in quantities comprising up to 20 percent. Due to the prevalence of the tremolite in the mine, the Cyprus Study concluded that "selective mining methods could not be successfully employed to avoid mining tremolite" at Willow Creek, and therefore "the presence of tremolite throughout the carbonate zone negates [Willow Creek] for consideration for mining." (April 6, 1984 Report, Willow Creek Mine and Greenhorn Claims, Madison County, Montana, at 0406-0407, Exhibit I.)

TESTING OF CASHMERE BOUQUET CONFIRMS ASBESTOS

66. In 1968, Johns-Manville performed testing on several different talcum powders, including Cashmere Bouquet talcum powder, and found trace tremolite in the Cashmere Bouquet talcum powder (October 31, 1968 Johns-Manville Corporation testing, Body Talcum Powders – Petrographic Examination, at pp. 1-2, Exhibit J.)

67. In 1972, Professor Seymour Lewin, a chemist at New York University, tested 102 products for the presence of asbestos, including cosmetic talcs. One of the products tested was Cashmere Bouquet. The results were submitted to the FDA noting a finding of 2% chrysotile asbestos in "sample 81" of Cashmere Bouquet. (August 3, 1972 Letter from Seymour Lewin to Alfred Weissler, Acting Director, Division of Colors and Cosmetics Technology of the Federal Food and Drug Administration, at p. 1, 5, and 11, Exhibit N.)

68. In March 1976, Rohl and Langer, then an Associate Professor of Mineralogy at the Mount Sinai School of Medicine, met with the Federal Food and Drug Administration (FDA), Division of Cosmetics Technology at Mount Sinai's Environmental Sciences Laboratory to discuss their findings of asbestos in various cosmetic talcum powders. Rohl and Langer tested 20 consumer products labeled as talc or talcum powder, including body powders, baby powders, facial talcum, and pharmaceutical talc. Of those 20 products, 10 were found to contain detectable amounts of tremolite and anthophyllite, principally asbestiform. In correspondence with the FDA, Dr. Langer confirmed that the product that had the highest amount of asbestos content was Cashmere Bouquet. (March 22, 1976, Memorandum of Meeting at the Environmental Sciences Laboratory in Mount Sinai School of Medicine, City University of New York, between Members of the Staff or Environmental Sciences Laboratories, Arthur Langer and Arthur Rohl and the Federal FDA, Division of Cosmetics Technology, Clifton H. Wilson and Ronald L. Yates, regarding Analytical Methodology for the Detection of and Determination of Asbestos Minerals in Talc, at p. 1, Exhibit O.)

69. Rohl, et al., analyzed the samples by Polarized Light Microscopy (PLM), X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM) equipped with energy dispersive x-ray (EDS) and electron diffraction (SAED) capabilities. The authors noted that while some asbestos was resolvable by light microscopy, most samples were too fine-grained, with particle dimensions two small for light microscopy, and that "naturally occurring asbestiform minerals often lie below the working resolution capabilities of light microscope." They further noted that by comparing the results of optical microscopy and quantitative XRD with those from TEM analysis they observed that

large numbers of fibers could go undetected by the less sensitive techniques. Both asbestiform anthophyllite and asbestiform tremolite were found in that testing of cosmetic talcum powder, with the anthophyllite described as having greater length to width (aspect) ratios than the tremolite asbestos. Furthermore, the anthophyllite asbestos concentration was reported as 4 to 5 times that of the asbestiform tremolite in that product, as tested and reported over 37 years ago.

70. During his meeting with the FDA, Professor Langer prepared a slide using Cashmere Bouquet talc to demonstrate his findings of tremolite and anthophyllite asbestos in the product, which he confirmed by x-ray and optical microscopy. An additional microscopist on Dr. Langer's staff conducted separate testing which confirmed the findings. At the meeting, "Dr. Langer was somewhat disgusted by the talc industry's attitude. He said the result of his work has been known to the industry for several years but nothing was done until the analytical results became public." (March 22, 1976, Memorandum of Meeting at the Environmental Sciences Laboratory in Mount Sinai School of Medicine, City University of New York, between Members of the Staff or Environmental Sciences Laboratories, Arthur Langer and Arthur Rohl and the Federal FDA, Division of Cosmetics Technology, Clifton H. Wilson and Ronald L. Yates, regarding Analytical Methodology for the Detection of and Determination of Asbestos Minerals in Talc, at pp. 2-3.)

71. The New York Times, The Washington Post, and The Ottawa Citizen all reported Dr. Langer's findings. The New York Times reported that Cashmere Bouquet was among the talc products with the highest concentration of asbestos. The findings were based on a report issued by Mount Sinai using TEM (transmission electronic microscopy). "The tests at Mount Sinai, which Federal health officials described as the country's leading research facility looking into the possible dangers of asbestos, used an electron microscopy, which Heinz J. Eiermann, Director or Cosmetics Technology in the Food and Drug Administration, said was too expensive and too time-consuming for his agency to use." (March 10, 1976 The New York Times article entitled Asbestos Found in Ten Powders, Exhibit V; March 9, 1976 article published in the Ottawa Citizen entitled, "Asbestos in Talc Powders Dangerous," Exhibit P.)

72. On March 8, 1976, the Washington Post printed an article, "Asbestos Fibers Found in Baby Powder." The Washington Post reported that Cashmere Bouquet contained asbestos and that the powders with the greatest concentration of asbestos fibers ranging from 8 to 20 percent were...Cashmere Bouquet..." (Washington Post article published on March 8, 1976, entitled "Asbestos Fibers Found in Baby Powder," Exhibit W.)

73. In response to the 1976 Mount Sinai study, Colgate "got the sample" of Cashmere Bouquet and did its own testing. Colgate's own internal testing confirmed the presence of anthophyllite as well as "possible tremolite" and "other amphiboles." (March 11, 1976 Colgate Laboratory Notebook, 6490-2, Exhibit Q.)

74. Further, in April 2011, I was contacted by attorneys from New York involved in Cashmere Bouquet litigation. They informed me that they had had many of these products tested by reputable laboratories, and asked me if I would serve as an expert geologist to

determine if I could conclude, based on the geology of the source materials, if the asbestos found in the talcum powders was feasibly derived from those talc ores, and whether or not the historical testing and geologic surveys confirmed such to a reasonable degree of scientific certainty. In review of the historic geologic surveys, corporate documents, and testimony, I was able to form the opinion that it was reasonable that Cashmere Bouquet could contain asbestos, based on associated mineralogy of the source talc mines alone. With the results of that research, independent of any testing of the material myself or reliance on the recent testing of others, I was deposed as an expert for those New York cases by Colgate in December 2011.

75. Eight months later (August 2012), I was contacted by attorneys working on similar litigation from Baltimore. In those cases, I was asked not only to review the geologic and historic records relative to Cashmere Bouquet, but to use my laboratory expertise to better understand the releasability of asbestos from the actual products by simulated product use in a controlled environment, leading to testing which began in September of 2012, continuing until February 2013. That testing is described in detail below, as glovebox testing of cashmere bouquet.

GLOVE BOX TESTING OF CASHMERE BOUQUET

76. In September of 2012, I tested two Cashmere Bouquet samples: a pink soft plastic 4 ounce shaker bottle of body powder, and a pink hard plastic container of dusting powder labeled as containing 5 ounces. The body powder had blue lettering, a white cap, and a molded "sunflower" shape in the pink plastic, front and back (see figure 4). There was also a black magic marker scribble on the bottom of the bottle. The dusting powder came in a round container with a hard plastic molded lid and handle. Text description labeling was embossed in the molded pink base (see figure 5). Reports of findings of these two studies were sent on September 6, 2012. After completing releasability tests on the two products, they were sent back to the attorney-client that had sent them to me.

77. Two months later, the body powder previously sent to me was returned to the laboratory for a second round of testing in November 2012. The intent of the second round was to confirm the findings of the original tests, and to determine if minimal aerosolization of the product would create measurable quantities of asbestos on air filters in the glovebox chamber using direct filter preparation techniques. My report of the second testing of this product was sent December 7, 2012.

78. I was subsequently sent back the dusting powder sample for more testing, conducted in January of 2013. My report of the second testing of this product was sent February 6, 2013.

79. In February of 2013 I tested a third Cashmere Bouquet product, this time packaged in a small pink tin. The label read "*Cashmere Bouquet Selected White Talcum Powder, NET WT 1.5 OZ*" (see figure 6). Report of findings of glovebox releasability of this product was issued on February 6, 2013.

80. Five distinct glovebox releasability tests were thusly conducted on three Cashmere Bouquet products. Many testing parameters were held constant throughout all five release studies conducted on the three products, to include:

- Size of the box (all studies were conducted in same)
- Sealing of enclosure (6-mil black poly sheeting; Black duct tape seams)
- Air testing methods (one low-volume sample in the center, two high-volume samples taken left and right in the chamber; 25 mm TEM 0.45μm MCE filter cassettes)
- Aerosolization technique (hand to hand; hand to arm)
- Clearance testing before and after to assure no cross-contamination.

81. Some testing parameters and methods differed from test to test, to maximize information garnered from the studies. For example, the second test of the 4-ounce plastic body powder bottle was specifically designed to use less powder than that aerosolized in the first testing of the same material. The reason for this alteration of the procedure was to determine if the initial finding of asbestos released from the talc could be repeated using less product, and analyzed by direct preparation of the filter rather than the indirect method necessitated in the first phase as the higher level of dust created an over-abundance of particulate on the filter for direct preparation.

82. Another alteration of the simulation was the additional testing of dust that fell to the floor and that clung to the walls during and after simulated use. The basic reasoning behind these added samples was this: air samples would theoretically only represent the episodic asbestos (if found) released into the air column at the time of actual use. In review of testimony of historical users of these products, including plaintiffs, the overall conditions were not only dusty during use of the product, but after the product use as well. Such post-use environments were described as dusty, and dry sweeping was often employed. The potential for re-entrainment was therefore suspected as significant and merited examination. To capture potentially asbestos-containing dust after product use, a 9"x9" clean dry cloth (type specified by ASTM asbestos dust testing methods) was placed on the floor of the glovebox before product use simulation. After a settling period, the dust fall wipe was carefully removed. A second wipe was then used in a manner consistent with ASTM test sampling protocol to sample an area of the interior glovebox wall. This addition was implemented for the second testing of the dusting powder and for the testing of the 1.5 ounce tin.

83. By these methods, 5 low-volume air samples (2-2.5 lpm) and 10 high-volume air samples (~10 lpm) were taken in the five tests (three samples per event). Six of those 15 air samples were analyzed by direct preparation, namely: the three samples taken in the second round of testing of the 4oz. body powder, and the three samples taken of the air during aerosolization from the 1.5oz tin. 2 dust fall wipes and 2 wall wipes were also produced in the five tests, for a total of 19 samples of air and dust produced from the three Cashmere Bouquet products. **All 19 samples were found to contain quantifiable asbestos.**

BULK TESTING OF CASHMERE BOUQUET

84. Standard bulk asbestos testing by Polarized Light Microscopy (PLM) was not conducted by my laboratory on the Cashmere Bouquet samples received from the Baltimore or New York cases, as previous testing by other reputable laboratories had previously confirmed the presence of asbestos, in addition to the a'priori knowledge that asbestos was repeatedly found in historic testing of the products and talc ores. I was commissioned in those cases to determine if those example Cashmere Bouquet products would release quantifiable asbestos structures into the environment and breathing zone of the user, when the products were used in a manner consistent with use, in simulation of use confirmed as consistent by sworn testimonials of users of Cashmere Bouquet talcum powders.

85. Subsequently through the process of litigation in those cases I became aware of the work of those other laboratories and experts that had also repeatedly tested Cashmere Bouquet talc and talcum products, and it was decided that we should share our results in the form of formal peer-reviewed publication, which we did in the *International Journal of Occupational and Environmental Health*, Volume 20, Issue 4 (October 2014), pp. 318-332, in the article titled *Asbestos in commercial cosmetic talcum powder as a cause of mesothelioma in women.* As that collaborative review substantiated, historic Cashmere Bouquet talc products (although the specific brand was not named in the public article) were repeatably shown to contain asbestos that would release significant asbestos into the air on typical use, I decided that further iterations of such products would only need to be confirmed as containing asbestos, as we have proven such capable of producing airborne asbestos.

86. By that reasoning, when two more samples of historic Cashmere Bouquet talcum powders were sent to my laboratory from your firm in September (2014), I tested them by bulk analysis by PLM and TEM, both of which confirmed fibrous talc, asbestiform tremolite, and asbestiform anthophyllite as constituents in Cashmere Bouquet talc products. The samples were analyzed for asbestos following analytical procedures described in the U.S. Environmental Protection Agency "Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials". The samples were examined by stereo microscopy at magnifications from 7-40x and by grain mount analysis in refractive index liquid by Polarized Light Microscopy (PLM) at magnifications between 100 and 400x, using optical properties to verify asbestos content. Example PLM microphotographs taken of these samples are in figures 14 and 15 below.

87. These Cashmere Bouquet product samples were further examined by Transmission Electron Microscopy (TEM), by suspension of approximately 0.1g of each talc product in 200ml alcohol and DI water, aliquots filtered through a 0.2µm MCE filter, and prepared by standard techniques on to carbon-coated 200 mesh copper grids. TEM analysis was conducted on a JEOL 2000FX Transmission Electron Microscope (TEM) equipped with an Energy-Dispersive X-ray Analyzer detector (EDS) and Selected Area Electron Diffraction (SAED) at magnifications up to 50,000X. TEM micrographs, EDS spectra, and SAED images taken during this phase of testing and are figures 16, 17, 18, and 19 below.

88. These tests further confirmed by both PLM and TEM bulk testing in my laboratory that historical Cashmere Bouquet talc products contain releasable tremolite and anthophyllite asbestos.

COLGATE'S OWN TESTING CONFIRMS ASBESTOS IN CASHMERE BOUQUET

89. In 1971, Colgate conducted what appears to be its first tests on Cashmere Bouquet "North Carolina Regal'" talc to "[i]nvestigate the possibility of finding chrysotile asbestos." (Colgate Laboratory Notebook 3-3388 received by Pasquale Briscese, subject 4044-1, entry dated September 20, 1971, Exhibit L.)

90. Colgate found more evidence of asbestos in "Old Regal North Carolina Talc," "New Montana Talc," and "Recent Italian talc" in 1976. Colgate found the Regal talc "positive for tremolite," the New Montana talc "positive for Anthophyllite & tremolite,'" and the recent Italian talc "positive for tremolite." (Colgate Laboratory Notebook 3-3388 received by Pasquale Briscese, subject 6164-99, entries dated March 5 and 8, 1976, Exhibit M; see also Colgate Laboratory Notebook 3-3388, received by Pasquale Briscese, subject 6164-85 and 6464-87, entries dated January 27, 1976 [Colgate found asbestos in three samples of Cashmere Bouquet], Exhibit R.) Colgate even found tremolite and anthophyllite in a Cashmere Bouquet sample obtained from an industry lobbying group, the Cosmetic Toiletries and Fragrance Association (CTFA). (Colgate Laboratory Notebook 3- 3388 received by Pasquale Briscese, subject 6490-5, entry dated March 25, 1976, Exhibit S.) Colgate found evidence of amphiboles in Cashmere Bouquet Body Powder. (Colgate Laboratory Notebook 3- 13388 received by Pasquale Briscese, subject 6490-54, entry dated October 27, 1976, Exhibit T.)

91. In 1974, Colgate hired an outside company, McCrone Associates, to test its talc for the presence of asbestos. McCrone used TEM (transmission electron microscopy) analysis to test for the presence of asbestos. When McCrone started testing samples of Colgate's cosmetic talc, it found asbestos in the samples.

92. On February 5, 1974, McCrone reported that "we have finished our analysis of your samples designated 516, Cashmere Bouquet at N.C. Regal." McCrone found chrysotile asbestos in "all" of the samples: "In none of the samples did we detect tremolite; however, chrysotile was detected in all of them." (Bates No. MCCRONE 0170, February 5, 1974 correspondence from McCrone to Colgate reporting presence of chrysotile asbestos in all talc samples, Exhibit X.)

93. On December 10, 1974, McCrone reported to Colgate that it had found amphibole asbestos in the sample. "Using the electron microscope, we have analyzed three samples of talc identified as Samples A, F and S." McCrone reported that "Sample A contained two fibers of amphibole, which we believe to be tremolite." Colgate could not confirm that Sample A was discarded and not used in the finished product. (December 10, 1974 correspondence from McCrone to Colgate reporting presence of tremolite asbestos in Colgate talc samples, Exhibit Y.)

94. McCrone continued to test talc samples for Colgate and continued to find asbestos in the samples, including tremolite. On November 18, 1976, McCrone confirmed that Cashmere Bouquet sample 4915 contained fibrous tremolite. (November 1, 1976 Letter from J.P. Simko, Jr. of Colgate-Palmolive Company to Gene Grieger, Senior Research Physicist of McCrone Associates requesting testing, and the November 18, 1976 Letter from Mr. Grieger of McCrone Associates to Mr. Simko of Colgate-Palmolive reporting testing results, collectively attached as Exhibit U.)

95. On November 16, 1977, McCrone informed Colgate that "we also found a small amount of tremolite in Talc 1615." (November 16, 1977, letter from McCrone to Mr. Simko of Colgate-Palmolive, Exhibit Z.)

96. In March 1981, McCrone notified Cyprus that a sample tested positive by way of TEM for "chrysotile asbestos." (March 16, 1981, Letter from Richard Ellis, Jr. to Mr. Lou Murino at Cyprus Industrial Minerals, Bates No. MCCRONE 0205, Exhibit AA.)

97. In July 1983, McCrone notified Colgate that the sample tested positive for chrysotile asbestos. (July 26, 1983, Letter from Richard Ellis, Jr. to Ms. Grace at Colgate-Palmolive, Bates No. MCCRONE 0215, Exhibit BB.)

98. In October 1983, McCrone performed an asbestos analysis of three talc samples, labeled 12873, 13080 and 13081. McCrone reported that "Chrysotile asbestos was detected in all three samples."(October 27, 1983, Letter from Deborah Palenik to Dr. Simko, Jr., Bates No. Exhibit CC.)

99. In January 1984, Colgate sent six samples of talc to McCrone for testing. Colgate requested an analysis for asbestos using TEM (transmission electronic microscopy) and SAED (selective area electron diffraction). Some of the samples were finished products. Three of the six samples that were tested using TEM "detected chrysotile asbestos." (January 24, 1984 letter from Colgate to McCrone, requesting testing of 6 samples, Bates No. MCCRONE 223, Exhibit DD; April 27, 1984, McCrone letter reporting that three of the six samples tested positive for chrysotile asbestos, Bates No. MCCRONE 221, Exhibit EE.)

REANALYSIS OF RJLG CASHMERE BOUQUET PREPARATIONS

100. It is common procedure in the scientific community to assure quality of analytical testing by repeating the results from analyst to analyst, or laboratory to laboratory. In recent testing of the Cashmere Bouquet products, four independent laboratories repeatedly found the minerals that form asbestos, including serpentine, anthophyllite, and tremolite. All laboratories except the RJ Lee Group, Inc. (RJLG) consistently repeated finding asbestos in and generated from Cashmere Bouquet. In order to resolve this discrepancy, a request was made of Dr. Lee of RJLG to provide the sample preparations of the Cashmere Bouquet talc products from RJLG for the opportunity to reanalyze those preparations, to duplicate their results by another laboratory. I was given limited access to the preparations in RJLG's facility

on their equipment, with the caveats that counsel for Colgate-Palmolive Co. and RJLG personnel would chaperone and oversee the entire visit. This on-site visit to their facility began as an initial visit in May, 2013. A second trip was arranged for supplemental analyses on December 2nd through 5th, 2013.

101. In those two visits, I was thusly able to re-analyze the TEM preparations of 20 Cashmere Bouquet products prepared by RJLG. Many asbestos structures were found in that reanalysis, some of which were as were either named by the original analysis as cleavage fragments, intergrowths, or fibrous talc rather than asbestos. Although I agreed with many of the non-asbestos fiber types identified, many analyses were incomplete. In other cases, asbestos found on reanalysis was located on areas of the filter were no fibers whatsoever were recorded in the original benchsheets or reports. In some instances, the overall distribution of particulate on the preparations was inhomogeneous, which clashed with the apparent method of choosing grid openings for the original analysis of basically skipping every other opening in a "checkerboard" fashion. Furthermore, the methods named on the analytical count sheets were not the same as the methods cited by the reports from this laboratory.

102. Although 16 of the 20 products reviewed were found by the original analyses to contain fibers and 4 of the 20 products reanalyzed were reported by the original analysis as containing amphiboles, no *asbestos* was reported in any of the 20 on original analyses by TEM, SEM, PLM, nor XRD. In reanalysis of those same 20 samples by TEM alone, 16 of the same preparations as originally analyzed were found to contain asbestiform anthophyllite, 6 of them asbestiform tremolite, and 2 of them were found to contain chrysotile fibers, even though the reanalysis was not in all cases a complete replication of the original analysis due to time constraints or damaged or unsuitable preparations.

103. Further, it is well recognized that XRD is not a useful tool for the detection of low levels of accessory mineral content. XRD is useful for determining what mineral phases may constitute the majority of the crystalline material in a sample, but it is severely limited in its ability to resolve minerals that constitute less than 5% of the crystal material overall. Further, XRD cannot be used to rule out the presence of the asbestos-forming minerals because the screening for the asbestos minerals by XRD is not capable of detecting such dependably at or below 0.1% by weight, a limit that is often pushed by interfering phases to over 1%. As individual tests of talc production often represent much larger lots, a talc containing 0.1% asbestos could be tested by XRD and ruled "asbestos free". If that sample represented only one ton of talc, 20 pounds of pure asbestos could be left in the raw material undetected. Representative sampling in just such a manner was conducted on at least some of the talc used for Cashmere Bouquet, and many lots were deemed acceptable in this manner. Some lots were found to contain tremolite detectable by XRD, which we see in the record as lots held from shipment: further evidence that the asbestos-forming mineral content was not insignificant.

104. Although I was not able to re-analyze or evaluate all the analyses conducted by the RJ Lee Group laboratory of Cashmere Bouquet® products, the TEM grids that I reviewed, provided as the very preparations of their original analyses of these products, consistently

contained asbestos. Moreover, the particulate observed on those preparations I found consistent with the source ore geology, mineralogy, and other evidence relevant to this material. This body of evidence, including the asbestos found in my reanalysis on their preparations, is in significant contrast with the conclusions of the RJ Lee Group that there is no asbestos in this material. It is my professional opinion, to a reasonable degree of scientific certainty, that these products, Cashmere Bouquet® talc and talcum products manufactured by Colgate, as produced in the time periods from which the samples originated contain asbestos. The types of asbestos that they contain include asbestiform tremolite and anthophyllite, and occasionally chrysotile. Interestingly, in repeated tests of Cashmere Bouquet® by the RJ Lee group, all of the asbestos-forming minerals were found in their analysis as well, just not in the asbestiform habit. Therefore, the presence of the *minerals* was not in question with RJLG; just the presence of *asbestos*.

105. The results of these visits were reported in the aforementioned peer-reviewed IJOEH article titled *Asbestos in commercial cosmetic talcum powder as a cause of mesothelioma in women,* without naming "Laboratory D" as the RJ Lee Group laboratory. It is significant to note that experts from the RJ Lee Group, the very laboratory that could not find asbestos in these products, have been repeatedly named as experts for Colgate in many if not all cases involving Cashmere Bouquet.

CONCLUSIONS

106. As to the releasability of asbestos, repeated testing of these products adds even more evidence that low concentrations of asbestos in materials do not necessarily correlate to low potential for human health risk. Examples from recent studies of low asbestos content producing significant airborne concentrations in simulated activity include activity-based monitoring of asbestos as it naturally occurs in several sites conducted by the EPA and ATSDR, and vermiculite-containing attic insulation studies. These studies have repeatedly proven substantial airborne concentrations derived from materials with fractions of a percent asbestos content. Especially when a product is in a friable state, or where the obvious use of material intimates aerosolization of fibers, significant airborne concentrations can be expected to be easily generated from such products when asbestos is a constituent, which is the case for Cashmere Bouquet® talcum powders.

107. The talc sources for the historic Cashmere Bouquet® talcum powders were formed in geologic formations that can and do have asbestos minerals associated with them, and asbestos has been confirmed by geologists and associated with those talc ores. Like asbestos, the talc from these regions was itself formed from amphibole or serpentine minerals. Repeated testing over a period of decades of Italian talc from Val Chisone, and the talc from the Regal mine in North Carolina and the Willow Creek mine in Montana, has identified asbestos, including anthophyllite, tremolite, and chrysotile asbestos, in the geologic formations that characterize these talc deposits. The Willow Creek mine in Montana was in fact shut down due to the tremolite asbestos problem in Montana.

108. The Cashmere Bouquet product used by Ms. Ester Nosse from approximately 1957 until 1985 included asbestos. Bulk testing by my laboratory and the laboratories of my co-authors has

repeatedly found asbestos in Cashmere Bouquet. The results of such testing are consistent with the makeup of the product, the ore, and the geology of the talc sources used by Colgate. Further, releasability tests of Cashmere Bouquet® have repeatedly found significant concentrations of airborne asbestos, including the same three mineral species historically identified, namely chrysotile, anthophyllite, and tremolite asbestos, when these historic products were used in a manner consistent with the testimony of Ms. Ester Nosse.

109. It is therefore my opinion, to a reasonable degree of scientific certainty, that Ms. Ester Nosse was repeatedly exposed to significant airborne asbestos by her use of Colgate Cashmere Bouquet talcum powders.

I declare under the penalty of perjury under the laws of I declare under the penalty of perjury under the laws of the State of California that the foregoing is true and correct.
Executed on May 25th, 2016 at Greensboro, North Carolina

SEAN FITZGERALD, P.G.

Additional Figures

Figure 4: 4oz. Cashmere Bouquet product in test chamber before testing.

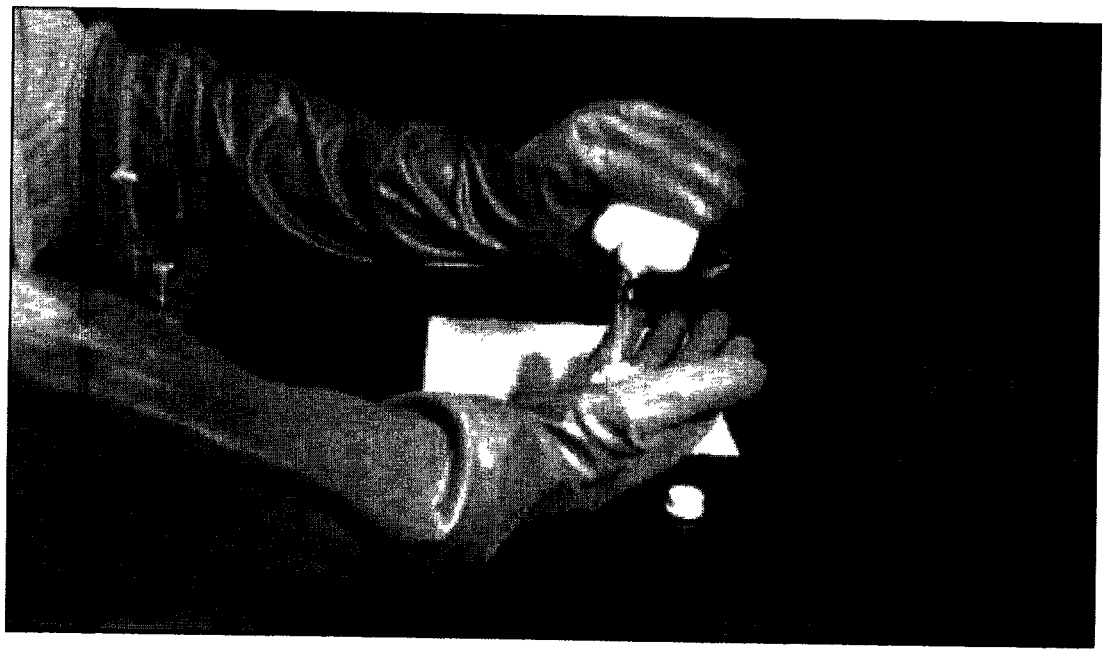


Figure 5: Pouring of powder into hands in glovebox; 1.5 oz Cashmere Bouquet.

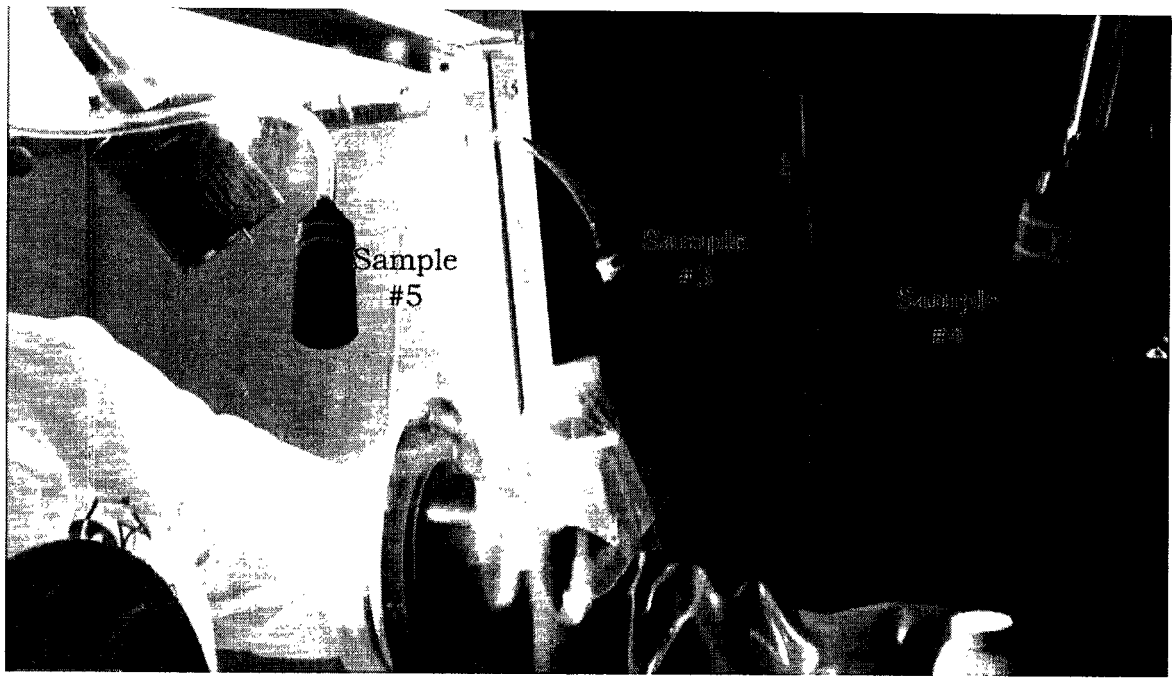


Figure 6: TEM cassettes in simulation area in glovebox.

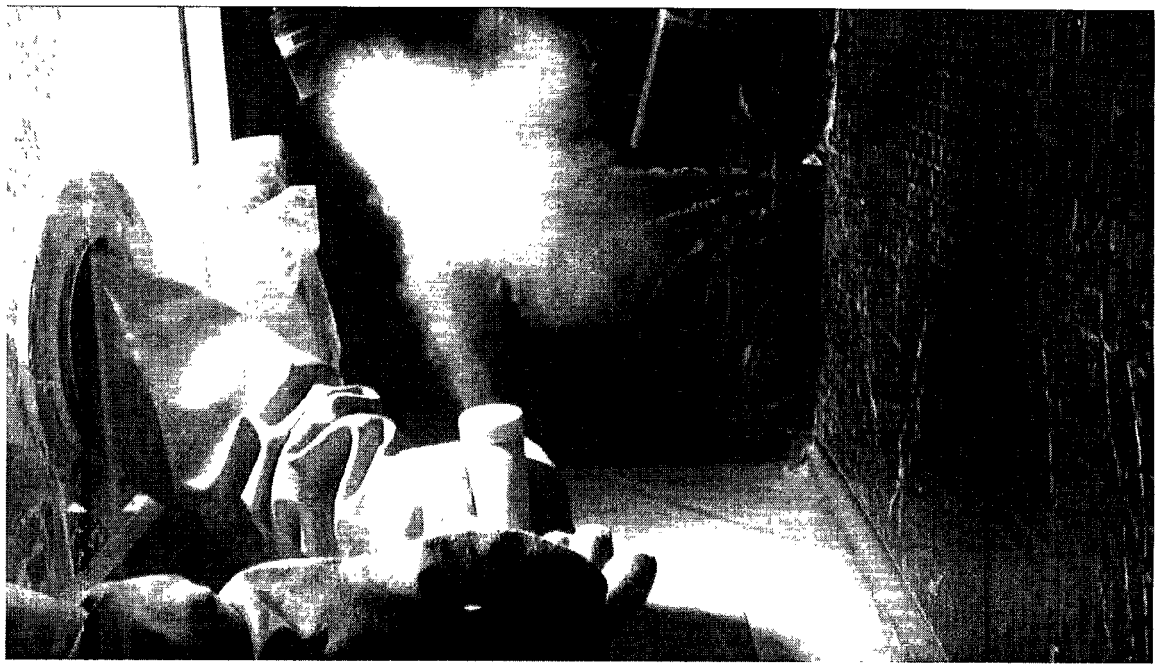
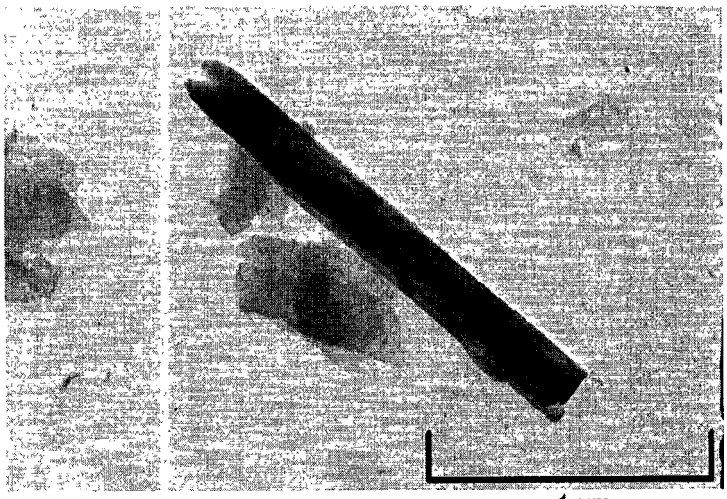


Figure 7: high intensity light demonstration of visible dust.



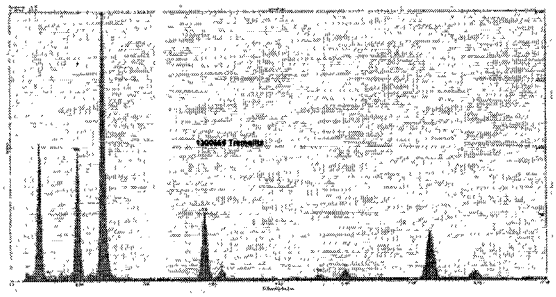


Figure 8: Tremolite asbestos from TEM analysis of releasability air testing of product (images, EDS, and SAED).

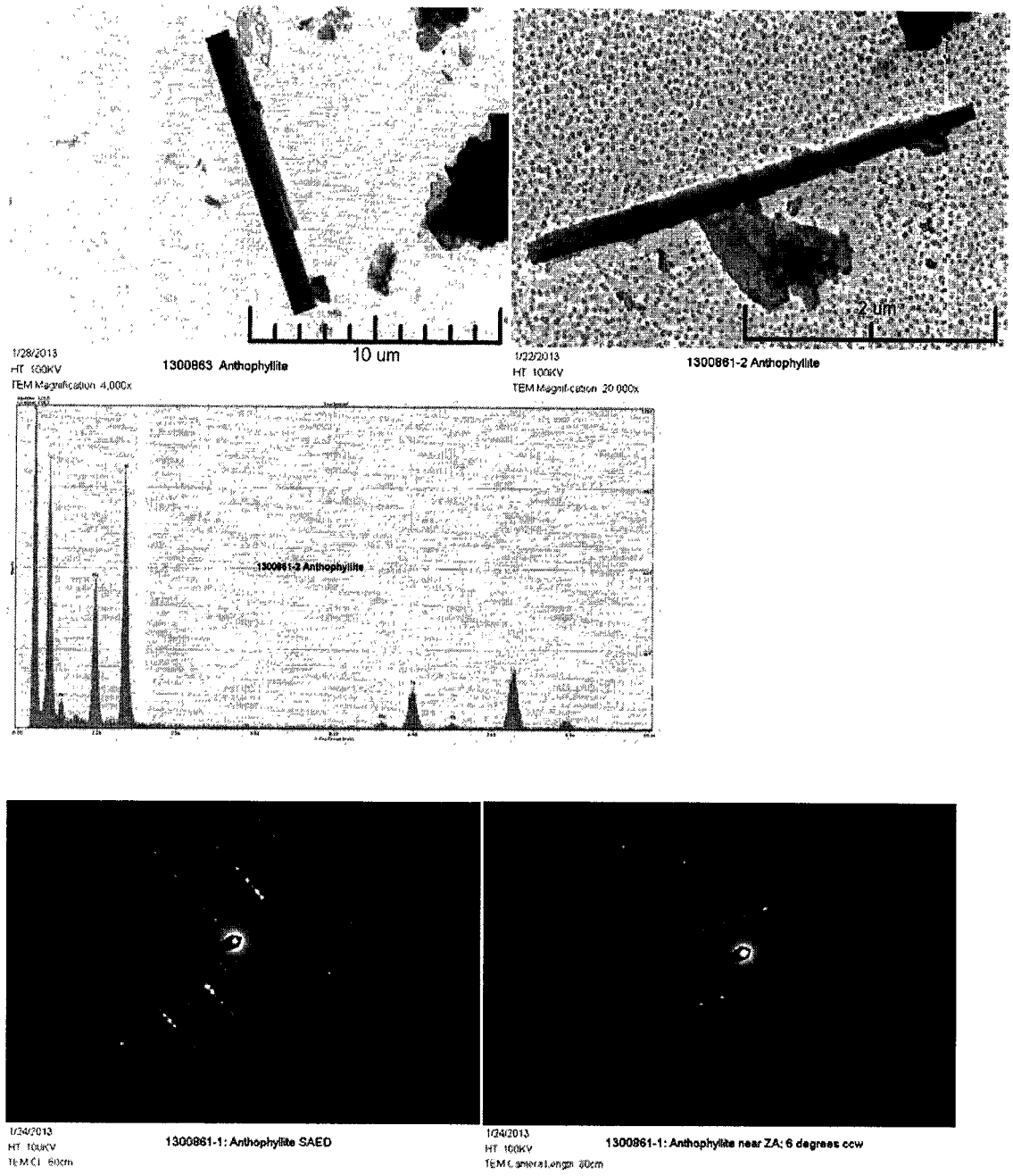
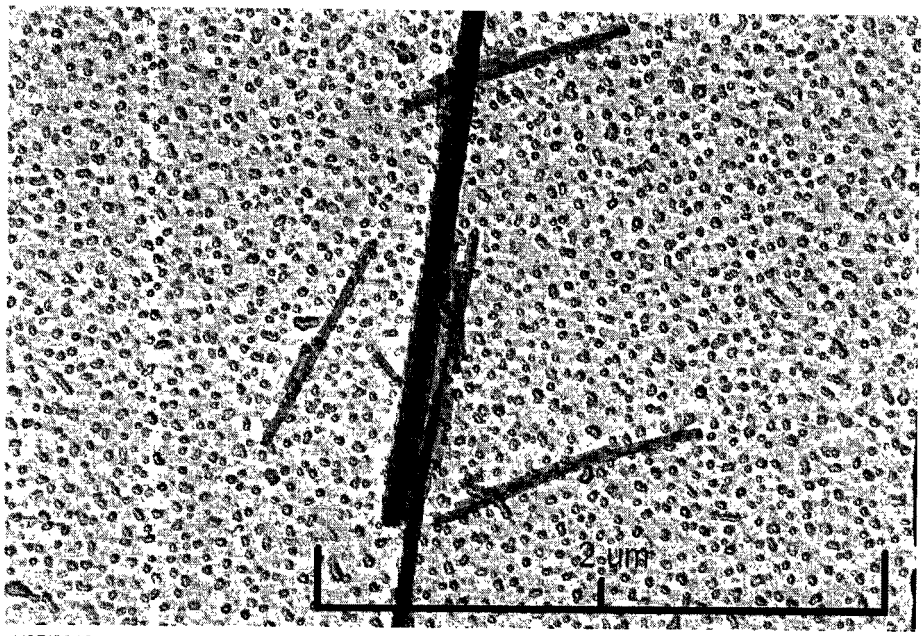
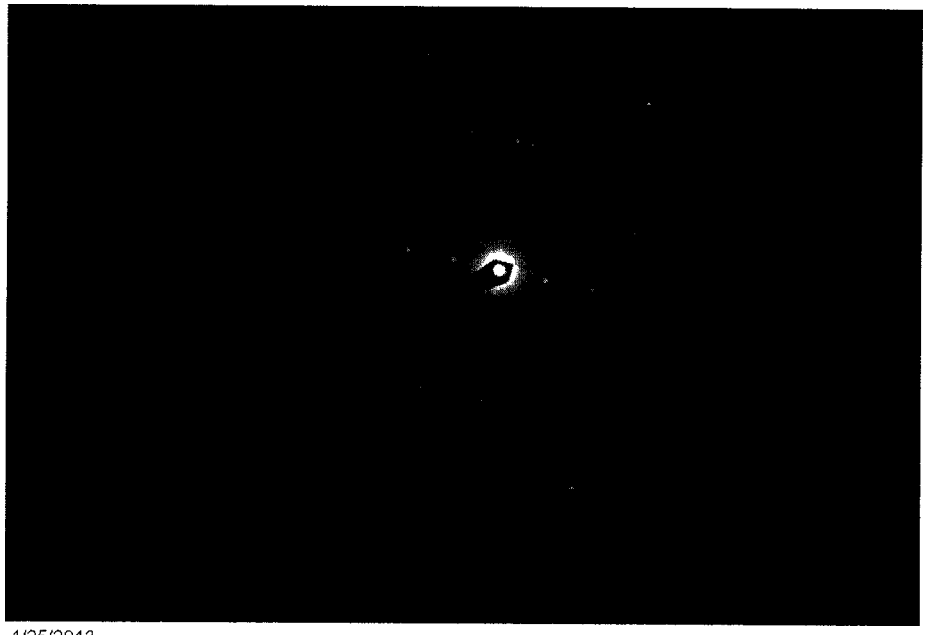


Figure 9: Anthophyllite asbestos from TEM analysis of releasability air testing of product (images, EDS, and SAED).



1/25/2013
HT 100KV
TEM Magnification 25,000x

1300866 Chrysotile Cluster (detail)



1/25/2013
HT 100KV
TEM CL 80cm

1300866 Chrysotile

Figure 10: Chrysotile asbestos from TEM analysis of releasability air testing of product (image and SAED).

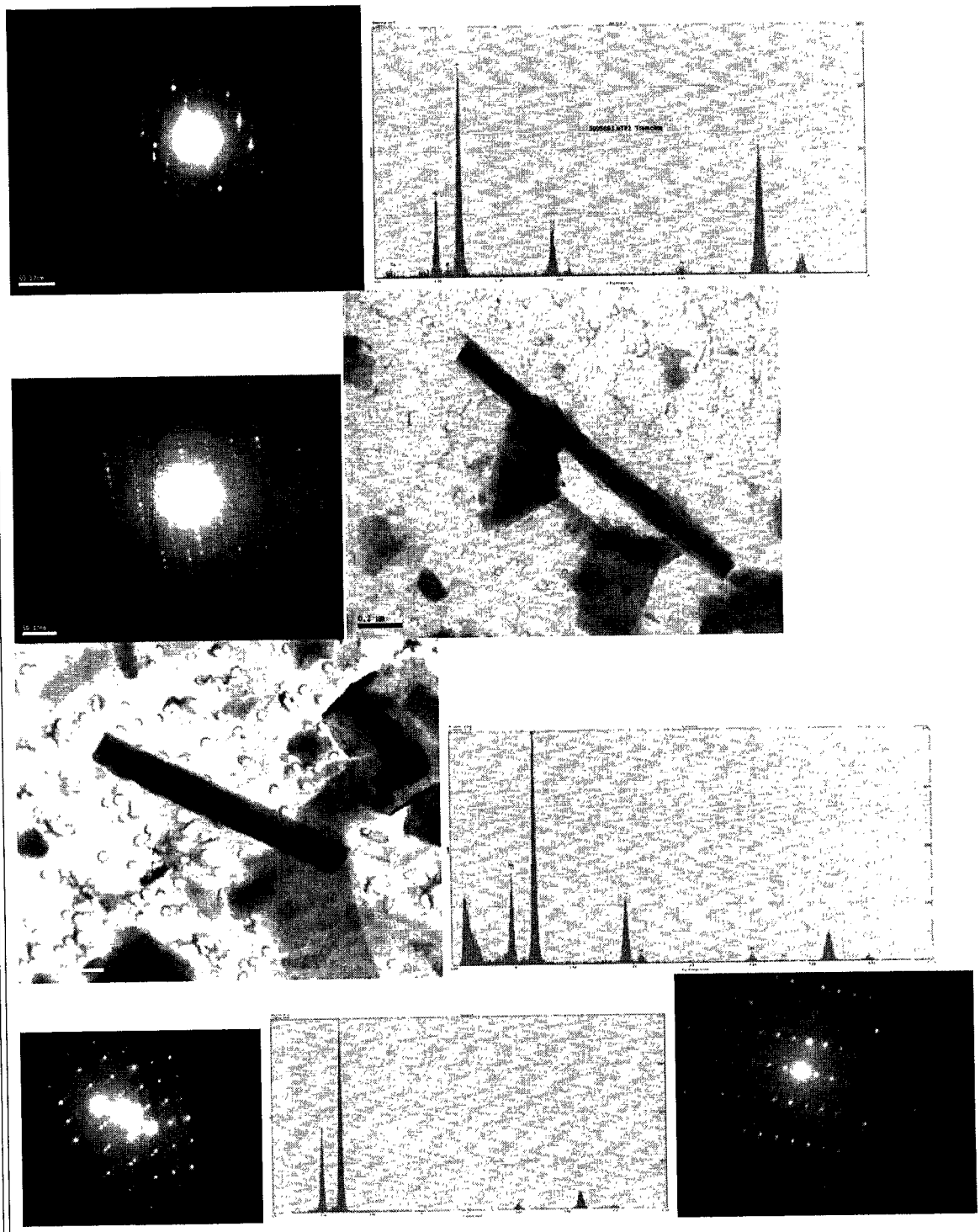


Figure 11: Tremolite & Anthophyllite Asbestos from Re-Analyses of RJLG Preparations (images, EDS, and SAED).

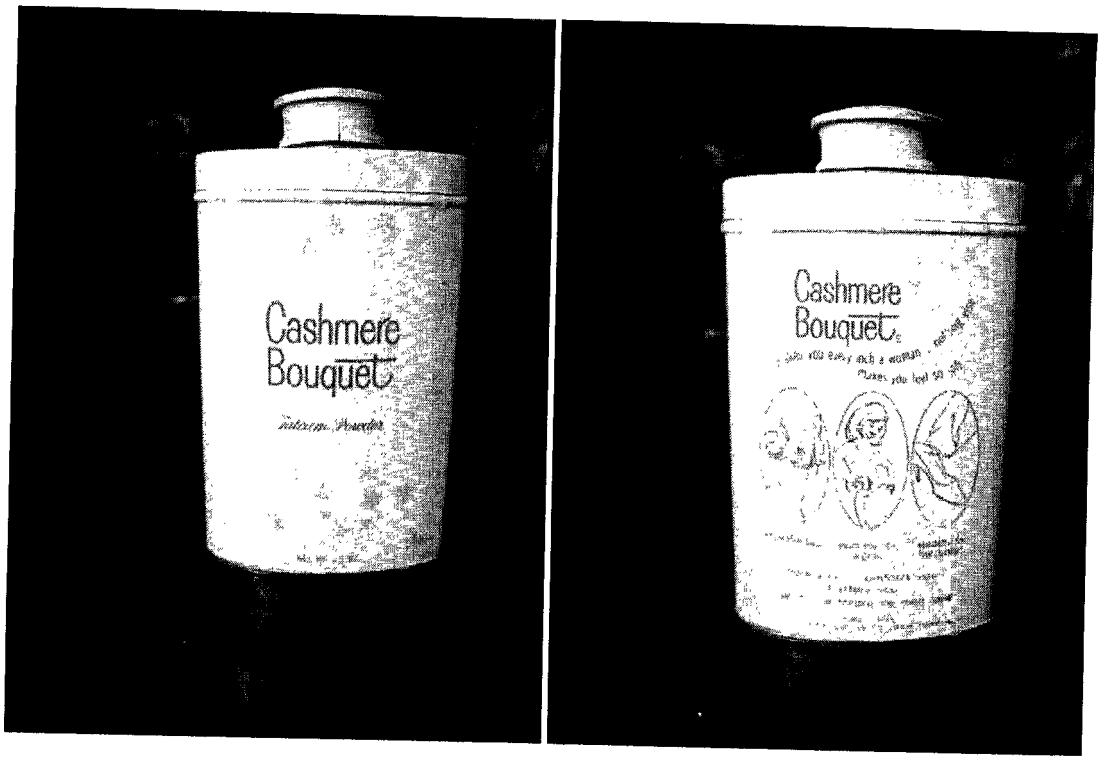


Figure 12: 1.5oz. Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

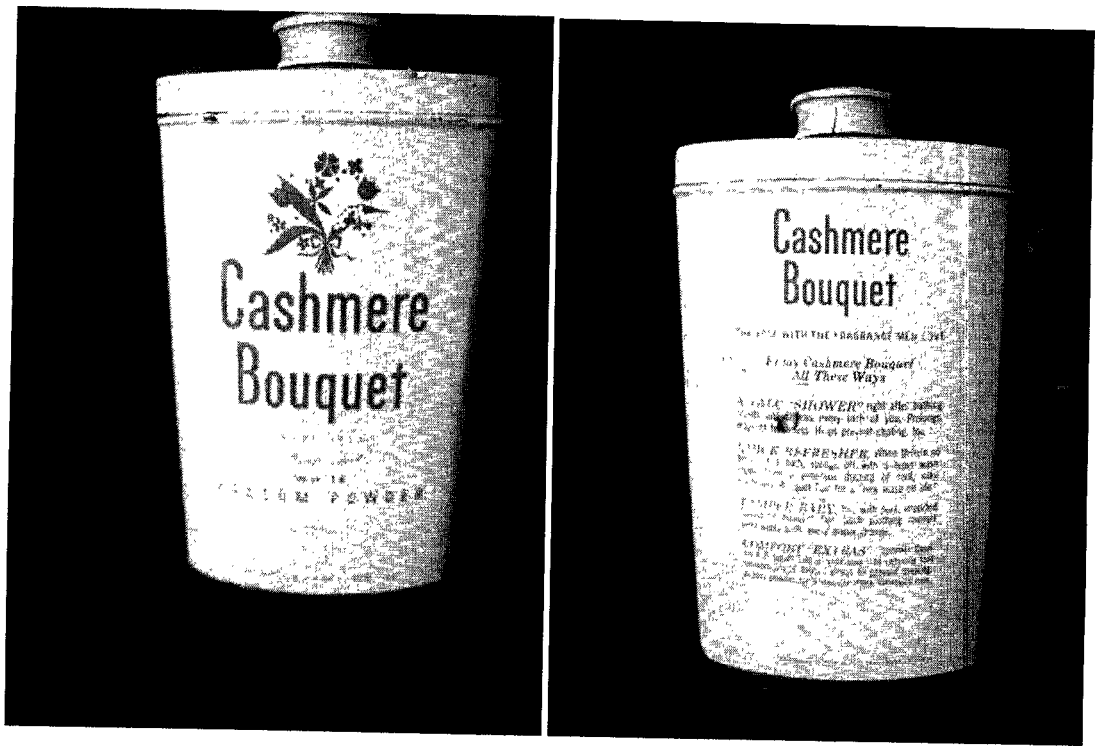


Figure 13: 6.5oz. Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

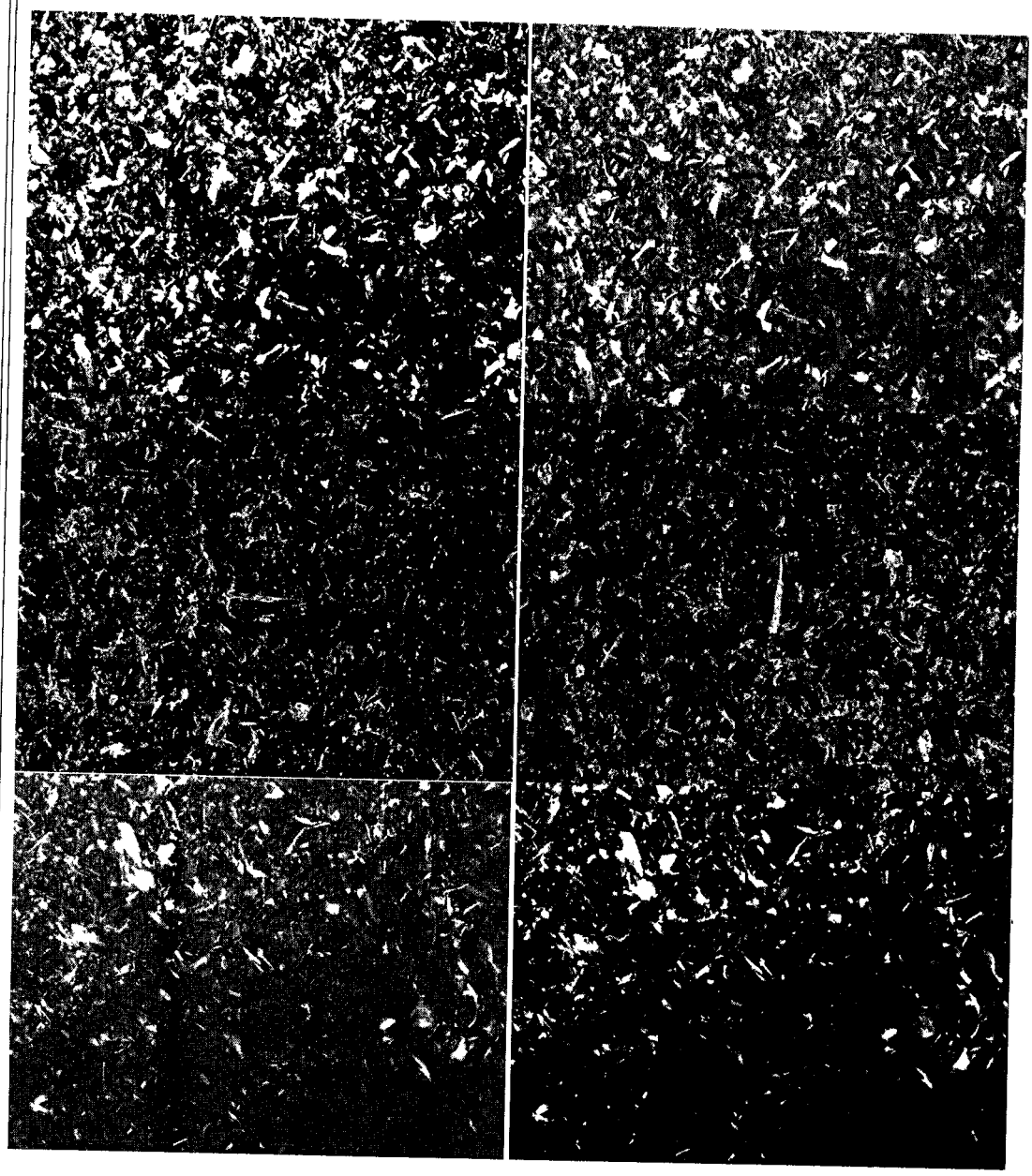


Figure 14: PLM optical properties confirmation of tremolite and anthophyllite asbestos presence by dispersion staining and cross-polarized light with and without wave retardation in 1.5oz. Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

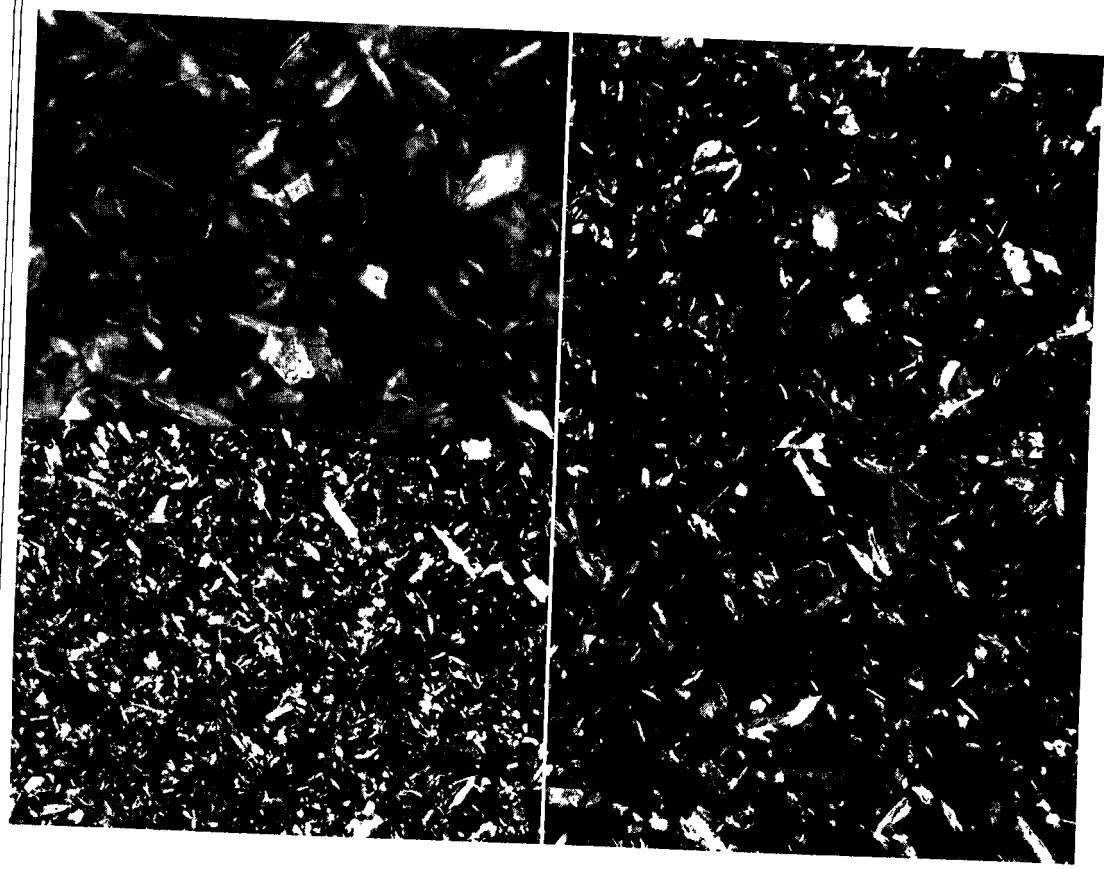


Figure 15: PLM optical properties confirmation of tremolite and anthophyllite asbestos presence by dispersion staining and cross-polarized light with and without wave retardation in 6.5oz. Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

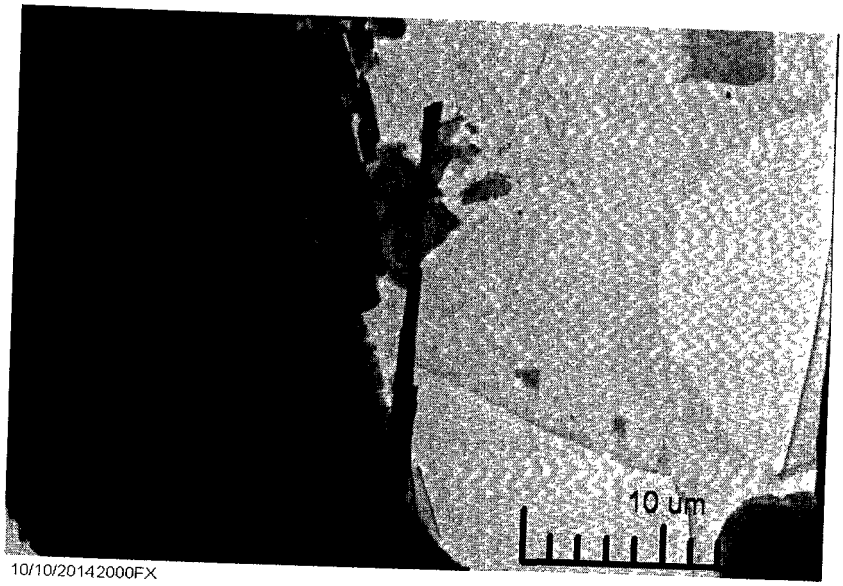


Figure 16: TEM photomicrograph of tremolite asbestos in Cashmere Bouquet talcum powder

product received from Simon Greenstone Panatier Bartlett September 12, 2014.

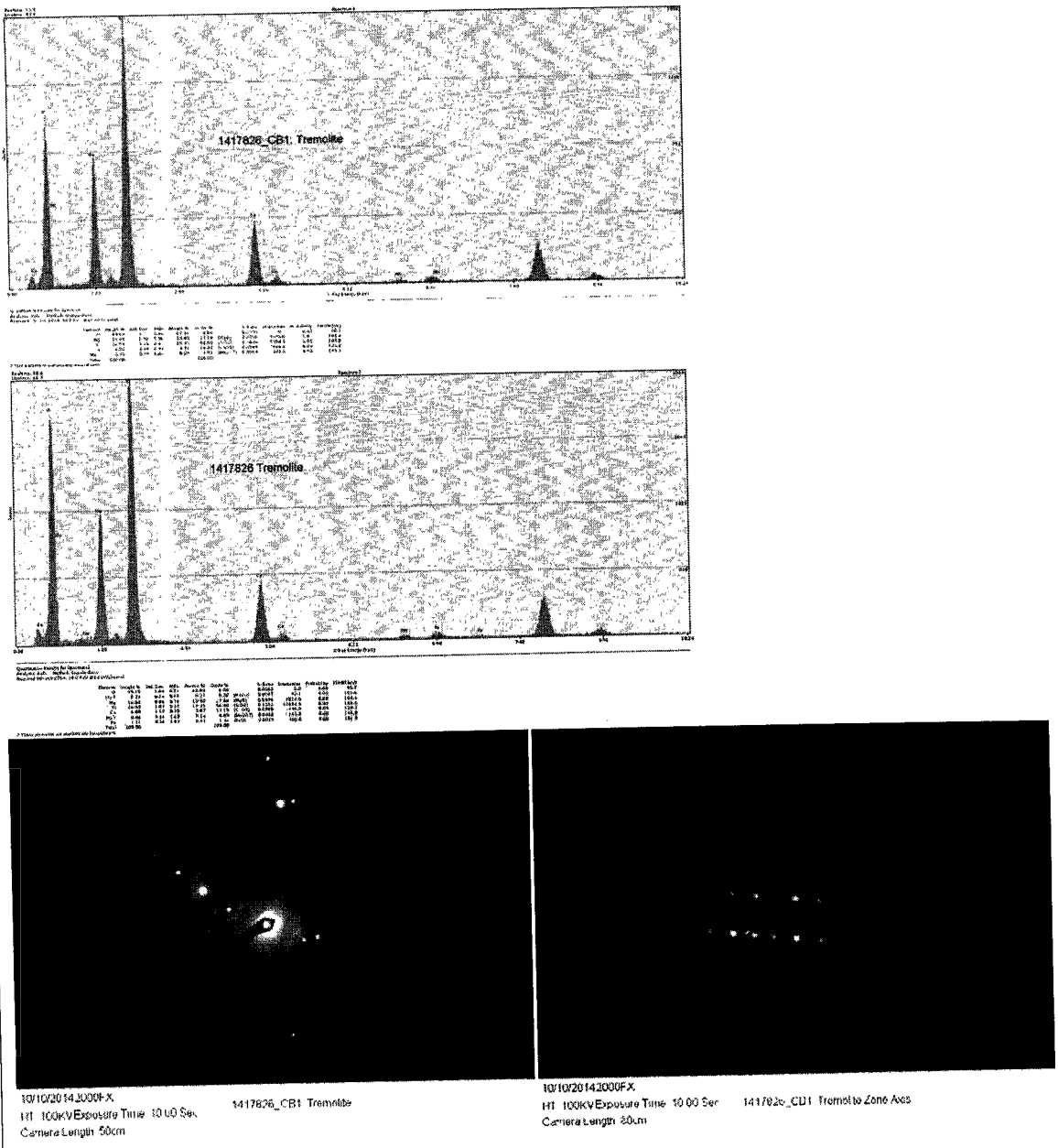


Figure 17: TEM EDS showing consistent chemistry with tremolite, SAED, and Zone axes confirming crystalline structure of tremolite asbestos in Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

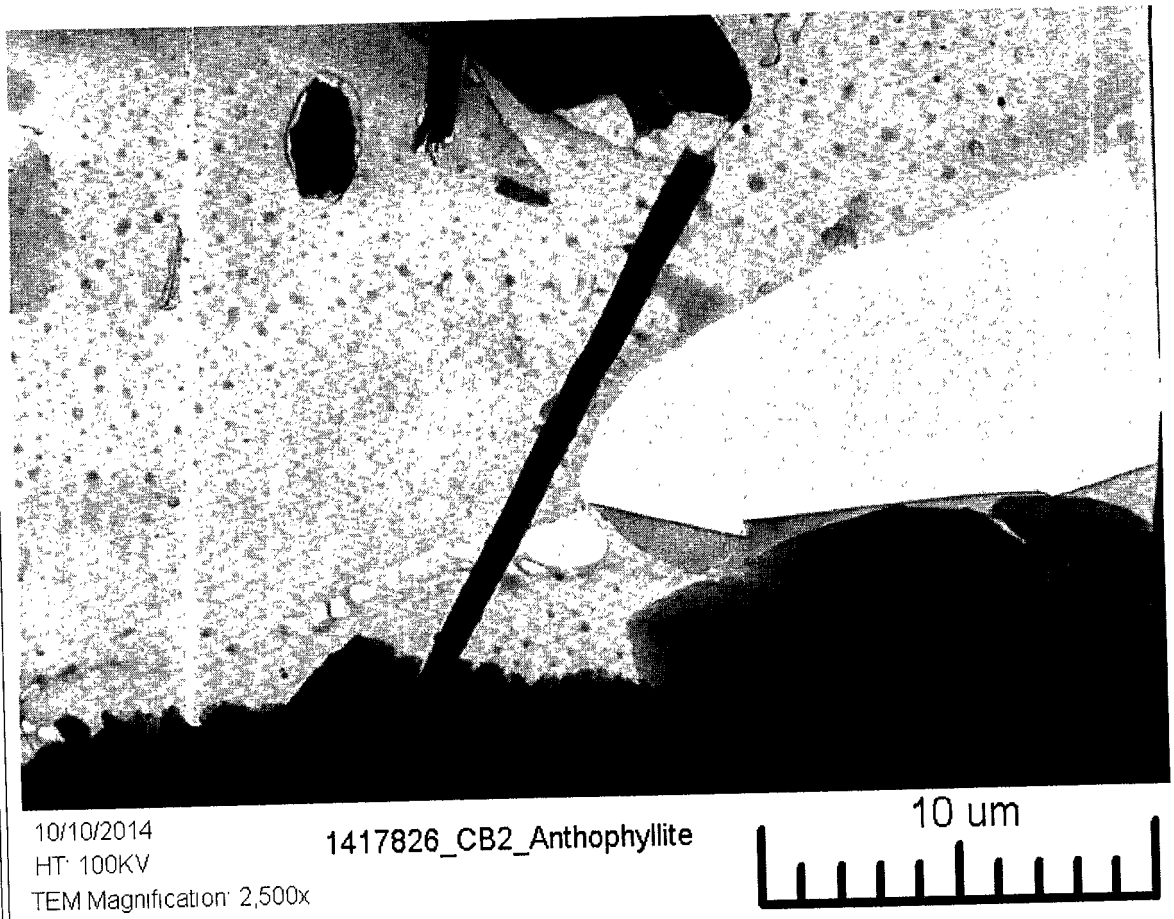


Figure 18: TEM photomicrograph of anthophyllite asbestos from Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.

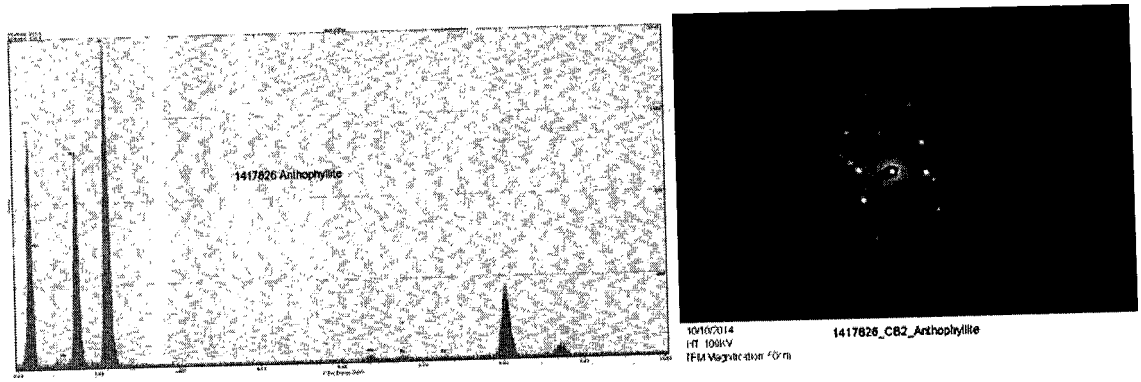


Figure 19: TEM EDS showing consistent chemistry with anthophyllite and SAED confirming crystalline structure of anthophyllite asbestos in Cashmere Bouquet talcum powder product received from Simon Greenstone Panatier Bartlett September 12, 2014.