TALC: ASBESTOS ISSUES AND MANAGEMENT

- **Asbestos has long been considered a known human carcinogen**
  - Almost uniquely causes mesothelioma, a distinct type of aggressive lung and pleural cancer.
  - The regulatory definition of asbestos covers six minerals in asbestiform habit.
  - Because there is no recognized “safe” level of exposure to asbestos, the presence of any amount in talc would be a serious problem.

TALC: ASBESTOS ISSUES AND MANAGEMENT

- **Talc is not like asbestos:**
  - Talc is platy or particulate (however sometimes can be “fibrous”).
  - Talc has a different internal structure and surface characteristics, but can have similar chemistry.
  - Talc is not associated with mesotheliomas.
  - So-called “Vanderbilt talc” (from upper New York State) has been controversial because it contains tremolite, which in its asbestiform habit is considered to be asbestos.

HISTORICAL CONTEXT OF ASBESTOS AND TALC

- Asbestos as a carcinogen received wide publicity in the 70s.
- Also in the 70s, there were reports of asbestos in talc, including some body powders, although the reliability of the detection techniques was disputed.
- In 1976, CTFA promulgated a voluntary industry standard that called for cosmetic talc to be free of detectable fibrous materials, including asbestos.
  - Some skepticism because voluntary, but self-enforcing as a litigation reality.

FALLOUT FROM THE ASBESTOS-IN-TALC CONTROVERSY

- Pervasive statements on consumer websites that talc is like asbestos
- Similar statements in some epidemologic study reports in 1980s and 1990s (for body powders)
- Great reduction in sales of cosmetic talc in the U.S. (possibly > 80%)
- A primary basis for the proposal in 2000 to list talc (even “non-asbestiform) in the National Toxicology Program Report on Carcinogens.

CONTINUING PURITY ISSUES

- Widespread marketing of consumer products as “talc-free”
- Some literature, used by IARC in 2006 review, indicating asbestos/asbestiform and quartz content in cosmetic-grade talc outside the U.S. (e.g., Pakistan)
  - IARC seemed more concerned with possible quartz content than asbestos
- Recent jury verdict ($3 mill.) against Vanderbilt for pottery talc causing mesothelioma, and new case, along with wide reporting of case, have reinforced public perceptions of asbestos in talc and carcinogenicity.
- Libby, MT Vermiculite – trend toward expanding the list of regulated asbestos types to include additional phases

ASBESTOS ISSUES WORLDWIDE

Regulations are often contradictory e.g., "Banned" *v.* "None" *v.* "Not detectable" *v.* "Incidental trace - not intentionally added" *v.* "<0.1%" *v.* <0.5% (Japan)

Definitions are ambiguous e.g., >5 µm *v*. >0.5 µm, 3:1 *v.* 5:1 v. "cleavage fragment" *v.* "asbestiform"

Asbestos analyses and identification e.g., PLM *v.* PCM *v.* SEM *v.* TEM *v.* XRD; differing interpretation philosophies at outside laboratories

Talc containing asbestos is an IARC Group 1 carcinogen, a NTP known carcinogen, an OSHA carcinogen, a Prop 65 carcinogen, etc. But how much asbestos does it take to meet this classification???? 1.0%? 0.5%? 0.1%? 100 ppm? 1 ppm?

INCREASING CUSTOMER SENSITIVITY TO ASBESTOS

- **Requests for letters, visits, product spec compliance**
  - U. S. Gypsum
  - Congoleum
  - Bondo
  - National Gypsum
  - Johnson & Johnson
  - …

INTERNAL ASBESTOS ISSUES

- **Mine planing activities**
  - Avoidance of contact zones (edge of deposit, near/associated with cross-cutting dikes (amphiboles), or
  - Avoidance of blocks with questionable material (i.e. chrysotile)
- **Import certification**
- **Due diligence**
  - Four projects in the last year associated with potential merger/acquisition

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CLASSIC DEFINITION OF ASBESTIFORM

"With the light microscope, the asbestiform habit is generally recognized by the following characteristics:

- **Mean aspect ratio ranging from 20:1 to 100:1 or higher for fibers longer than 5 µm.**
- **Very thin fibrils, usually less tan 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"**

-Federal Register Part II, Department of Labor, Mine Safety and Health Administration, 30 CFR Parts 56, 57, and 71.

-OSHA 1992 Final Asbestos Standard, Intro to 29 CFR Parts 1910 and 1926, Occupational Exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Section 4 – Mineralogical Considerations (testimony provided by Dr. Ann Wylie)

-EPA/600/R-93/116: Method for the determination of asbestos in bulk building materials

COMPARISON OF TERMS

ASBESTOS – a term applied to six specific silicate minerals...which have crystallized in the asbestiform habit…

ASBESTIFORM – a specific type of fibrous mineral growth habit in which the fibers and fibrils exhibit a polyfilamentous growth habit and possess a high tensile strength and flexibility. *"All materials regulated as asbestos are asbestiform but not all asbestiform minerals are classified as asbestos. Characteristics such as tensile strength and flexibility cannot be ascertained from microscopic evaluation."*

FIBER – an elongated particle longer than "…" with a minimum aspect ratio of "…" (depends on method, i.e. "countable").

CLEAVAGE FRAGMENT – mineral particles formed by comminution (breakage along cleavage planes). – Johnson Conference: Developing conventions for distinguishing asbestos fibers from cleavage fragments

KEY ISSUES

- Asbestiform fibers are characterized as having a high strength and durability which may relate to their biopersistence.
- It is not known whether cleavage fragments of similar dimensions to asbestiform fibers pose the similar health risks.
- Amphiboles are naturally elongated; when ground consistently produce “cleavage fragments” that meet 3:1 and 5:1 criteria
- On a microscopic scale, one cannot distinguish between asbestiform and cleavage fragment
- Deposits can contain both asbestiform and nonasbestiform particles
- Therefore, it is nearly impossible to characterize individual amphibole fibers as truly asbestiform or nonasbestiform.

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ASBESTOS AND TALC

Mineral Name	Ideal Chemical Formula	Mineralogical Family/Group
Talc	$Mg_3Si_4O_{10}(OH)_2$	Sheet Silicate
Anthophyllite	$(Mg,Fe^{2+})_7[Si_8O_{22}](OH)_2$	Amphibole Family
Chrysotile	$Mg_3[Si_2O_5](OH)_4$	Serpentine Group
Riebeckite (Crocidolite)	$Na_2Fe_2^{3+}(Fe^{2+},Mg)_3[Si_8O_{22}](OH)_2$	Amphibole Family
Grunerite (Amosite)	$(Mg,Fe^{2+})_7[Si_8O_{22}](OH)_2$	Amphibole Family
Tremolite	$Ca_2Mg_5[Si_8O_{22}](OH)_2$	Amphibole Family
Actinolite	$Ca_2(Mg,Fe^{2+})_5[Si_8O_{22}](OH)_2$	Amphibole Family

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ASBESTOS TESTING METHODS

Bulk

- EPA-600/ M4-82-020 1982
- EPA-600/ R-93/116 1993 (10:1)
- NIOSH 9002
- OSHA ID-191 (3:1/100:1)
- ASTM & ISO Bulk in progress

Air

- NIOSH 7400 (3:1)
- NIOSH 7402 (3:1)
- AHERA: (EPA 40 CFR Part 763) (5:1)
- ISO 10312/13794 (5:1/3:1)
- ASTM D6281-04 (5:1)
- NIOSH 9000

Dust

- ASTM D5756-02 (5:1)
- ASTM D5755-02 (5:1)
- ASTM D6480-99 (5:1)
- EPA-600/ J-93/167 (5:1)

Water

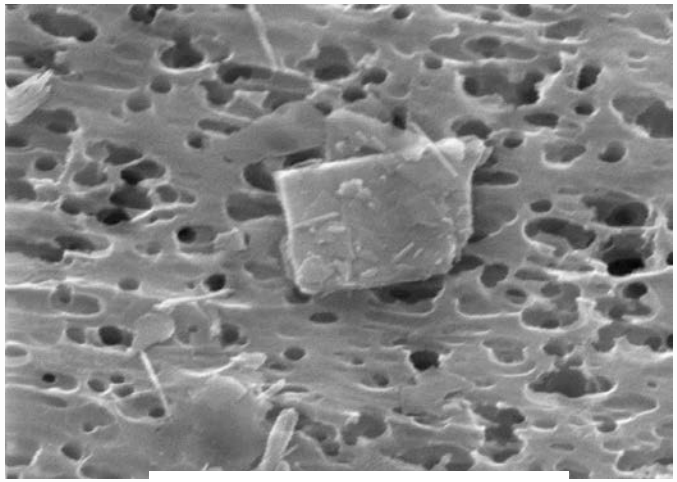
- EPA 100.1 (5:1)
- EPA 100.2 (5:1)
- AWWA 2570 (5:1)

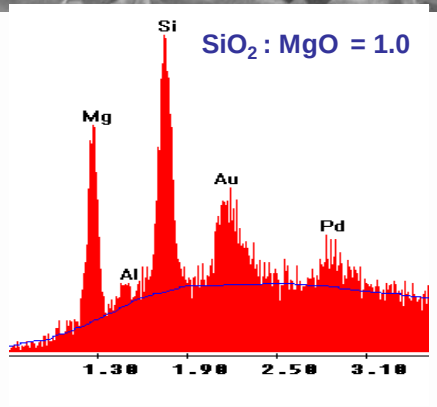
Soil

- EPA Superfund (5:1)
- EPA Region 1 Screening (5:1)

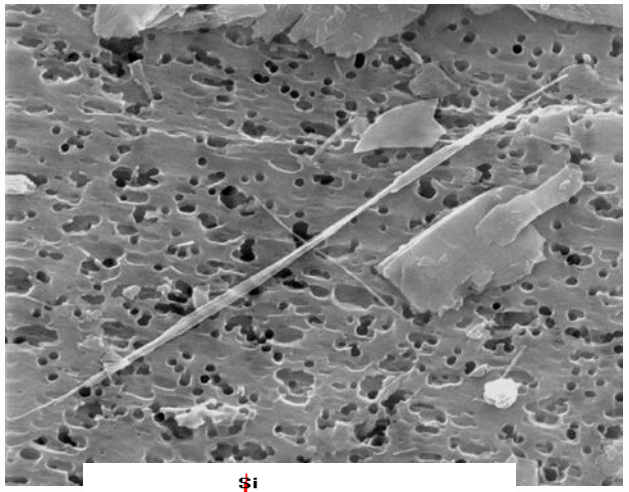
SERPENTINE MORPHOLOGY

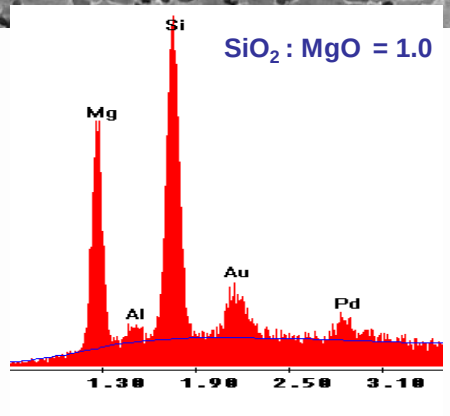
Lizardite Serpentine





Chrysotile Serpentine





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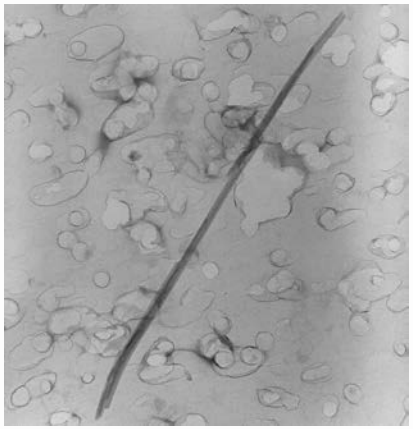
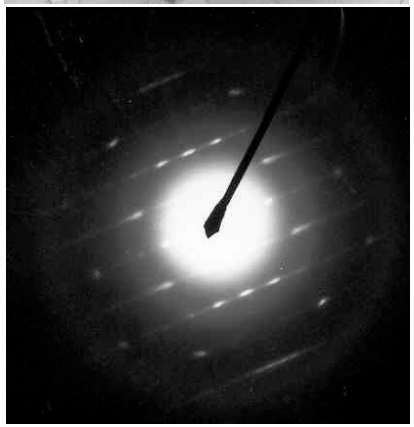
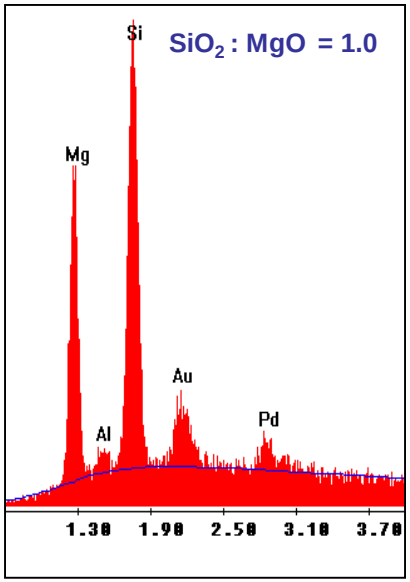
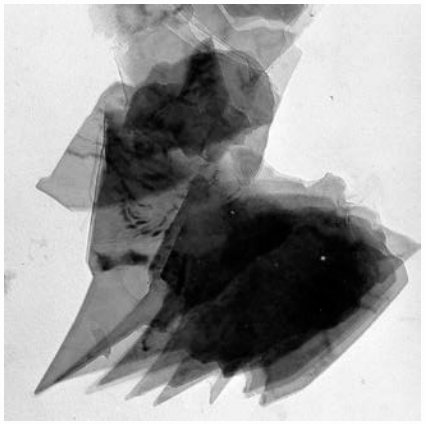
Analysis by Transmission Electron Microscopy (TEM) Morphology-Chemistry-SAED

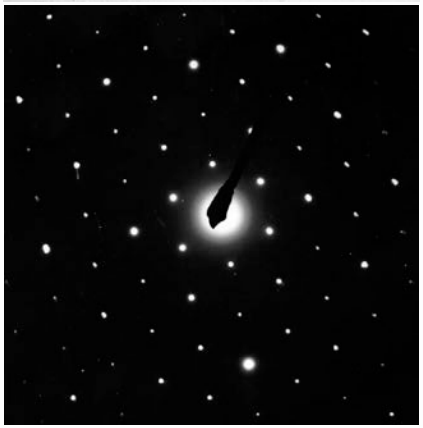




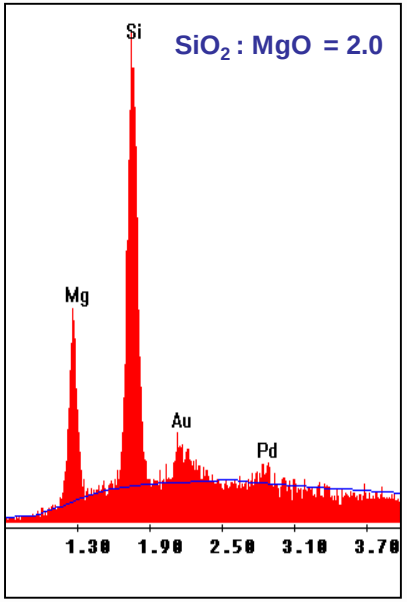
Chrysotile asbestos





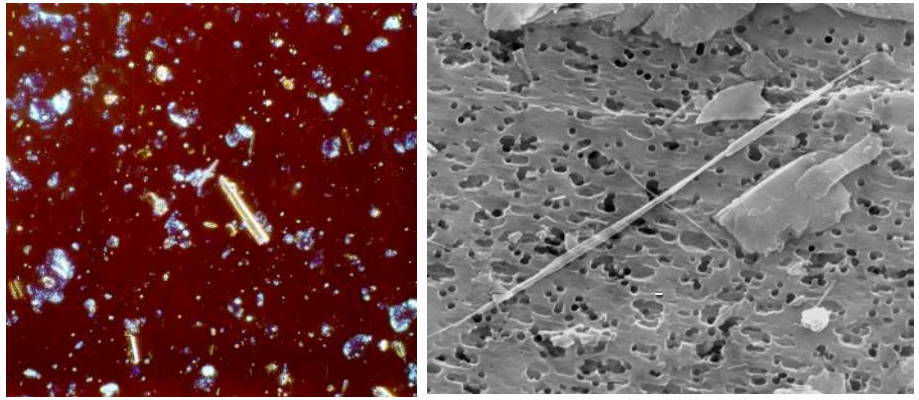


Talc

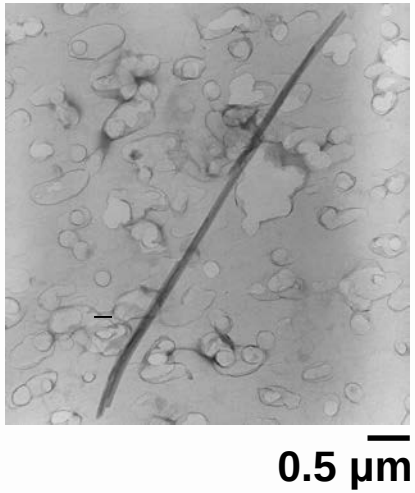


COMPARISON OF TECHNIQUES

- **PLM and SEM**
  - Detection of fibers:
    - >5 µm in length
    - >0.3 µm in width
    - Typically “bundles”
  - Detection limit ~1%
  - “OSHA” definition of asbestos



- **TEM**
  - Detection of fibers:
    - >0.5 µm in length
    - >0.03 µm in width
    - Bundles and fibrils
  - Detection limit <1 ppm



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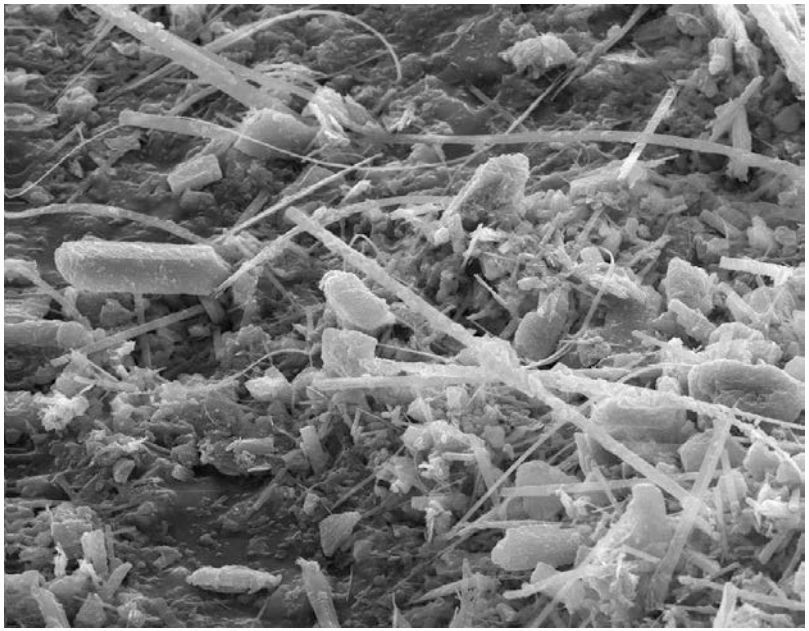
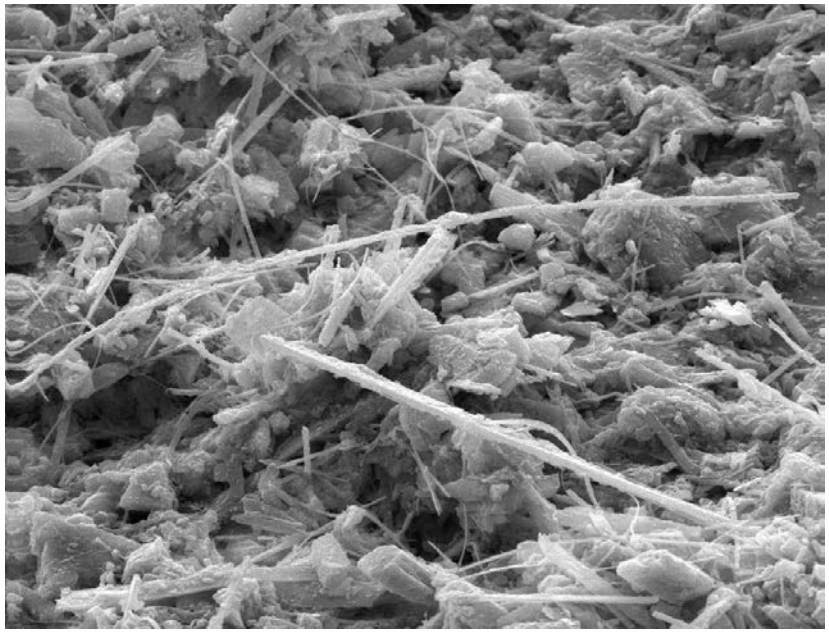
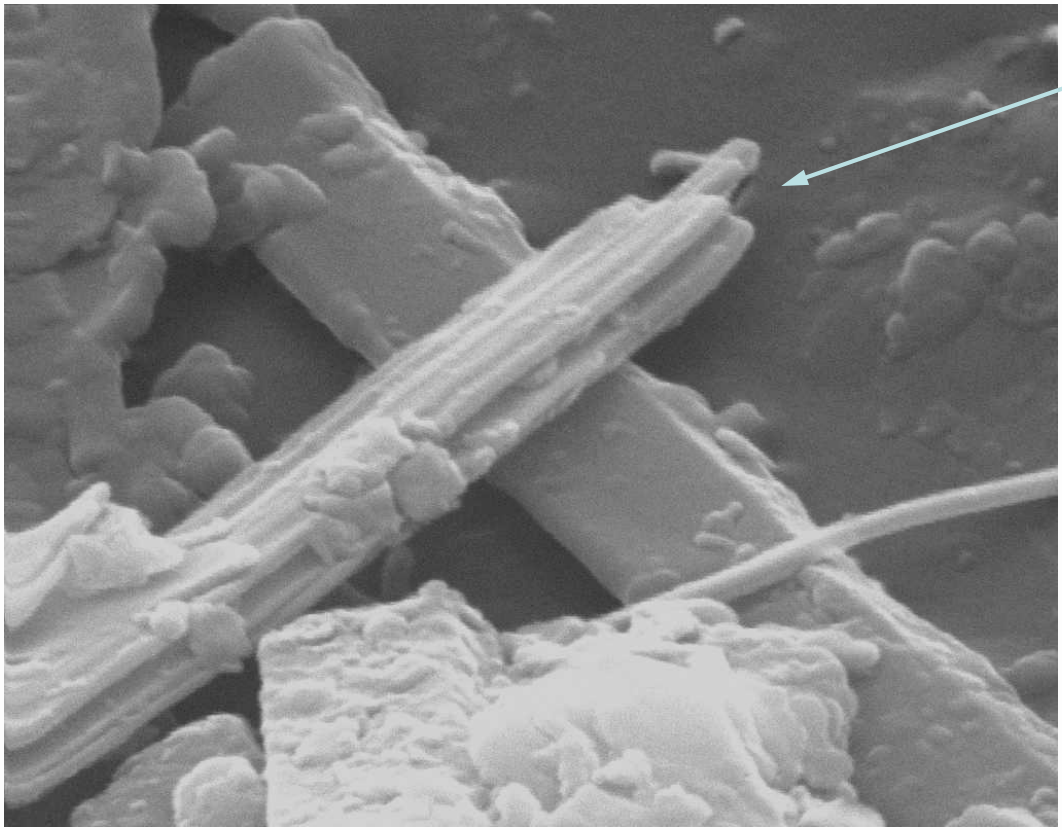
NEW YORK STATE TREMOLITIC TALC





10 µm

NEW YORK STATE TREMOLITIC TALC



Amphibole
“bundle”

1 µm

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NORTH AMERICAN ORE TESTING

Ore	Sample type	Previous Frequency	No. Samples	Current Frequency	No. Samples
Argonaut	Coarse/fine grind product composites	Monthly	24	Quarterly	8
Penhorwood	Feed/coarse/medium/fine grind product composites	Monthly	48	Monthly	24
Guangxi	Import ore shipment composite	Per shipment	8 - 12	Per shipment	8 - 12
Yellowstone	Ore composite	Monthly	12	Quarterly	4
San Fabian	P&G product composite	None	0	Quarterly	4
Mine Planning			80		80
Prospective/ competitor			20		20
TOTAL			**196**		**152**

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TEM SAMPLES ANALYZED AT RTM PER YEAR