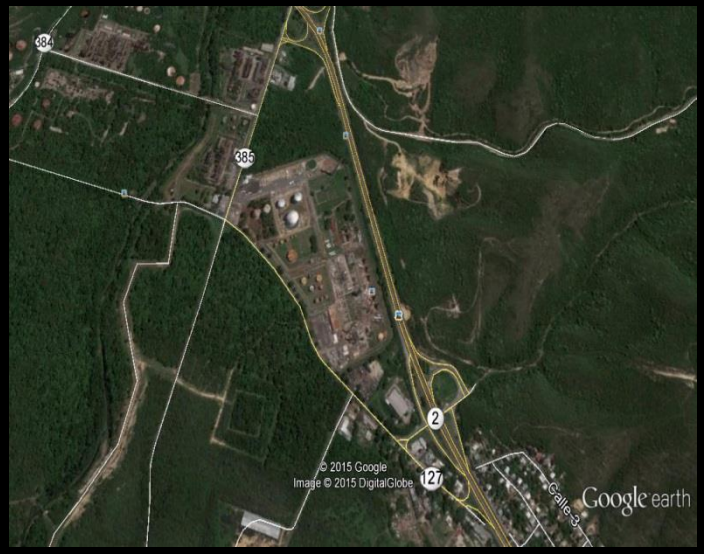
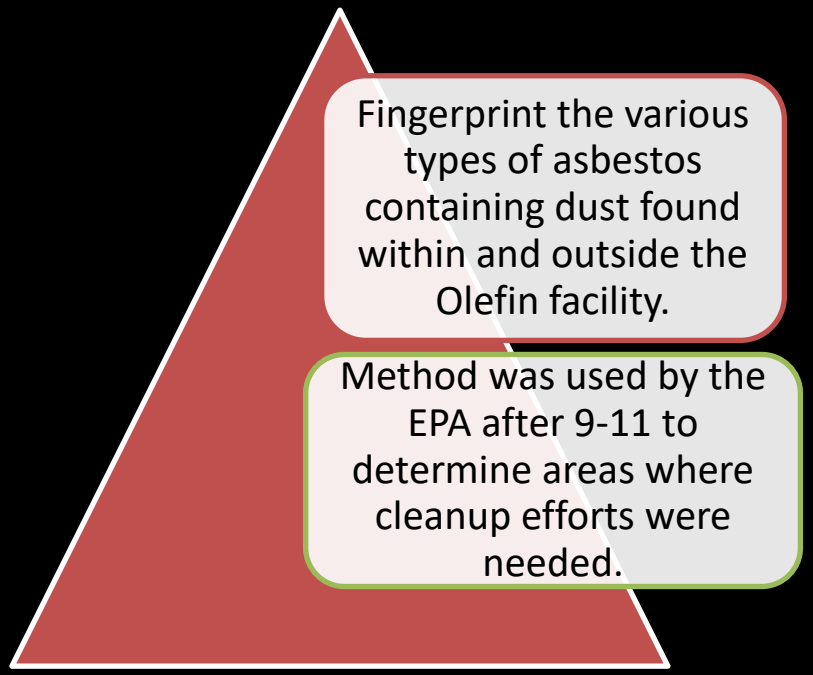
DUST FINGERPRINTS FINDINGS AT OLEFIN SITE PENUELAS PUERTO RICO

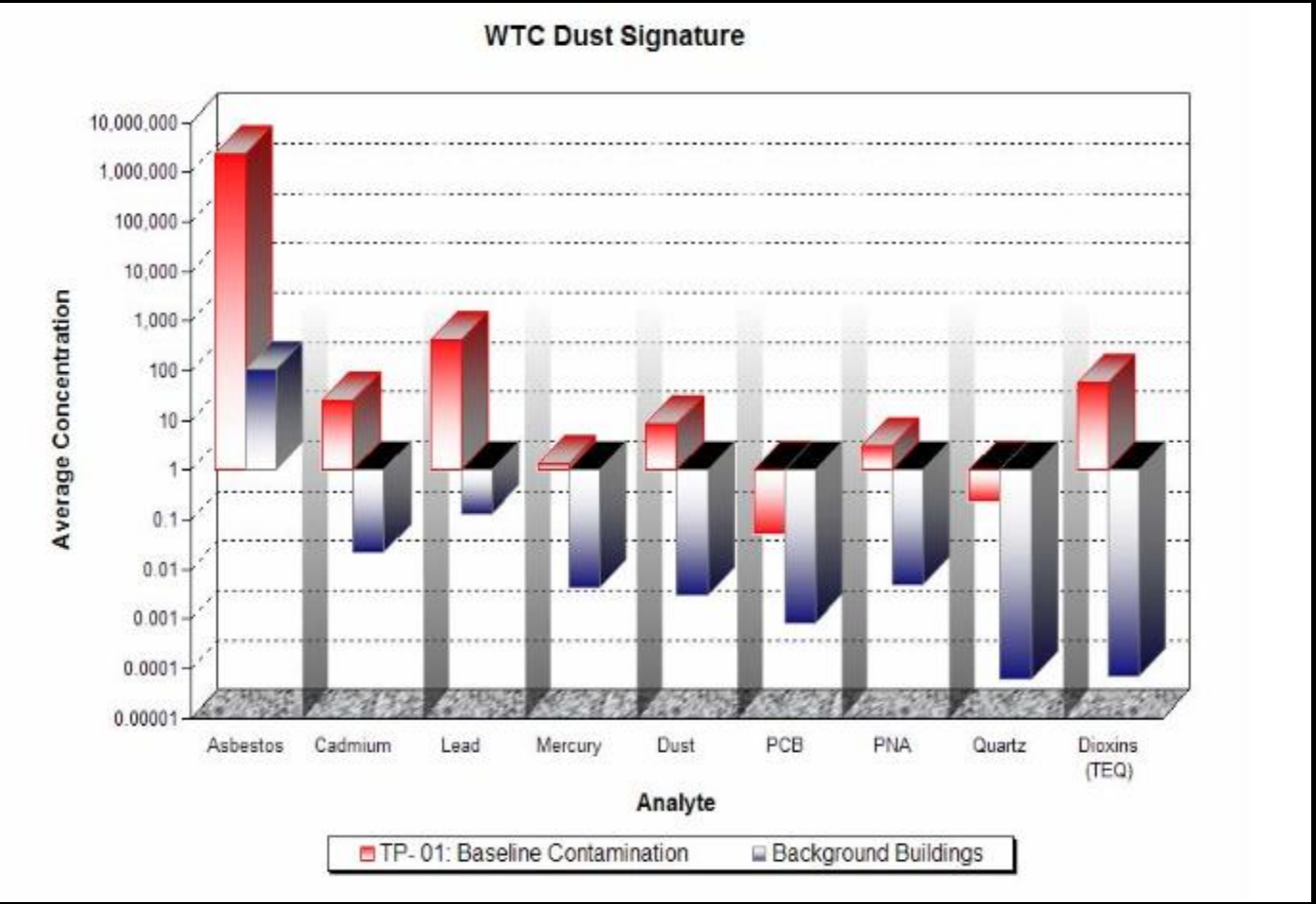
AES International Inc.

Ady Padan, Ph.D, P.G.



Scope of Work




WTC Dust Signature
Average Concentration
10,000,000
1,000,000
100,000
10,000
1,000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
Asbestos
Cadmium
Lead
Mercury
Dust
PCB
PNA
Quartz
Dioxins (TEQ)
Analyte
TP- 01: Baseline Contamination
Background Buildings

GENERAL BACKGROUND

EPA conducted five dust wipe sampling events (*I, IIIA, IIIB, IIIC, IIID), two air sampling events (II and **IV) and one dust micro-vacuum event (**IV).

- *Phase I also included soil and bulk sampling.
- **Phase IV included both air and micro-vacuum sampling.

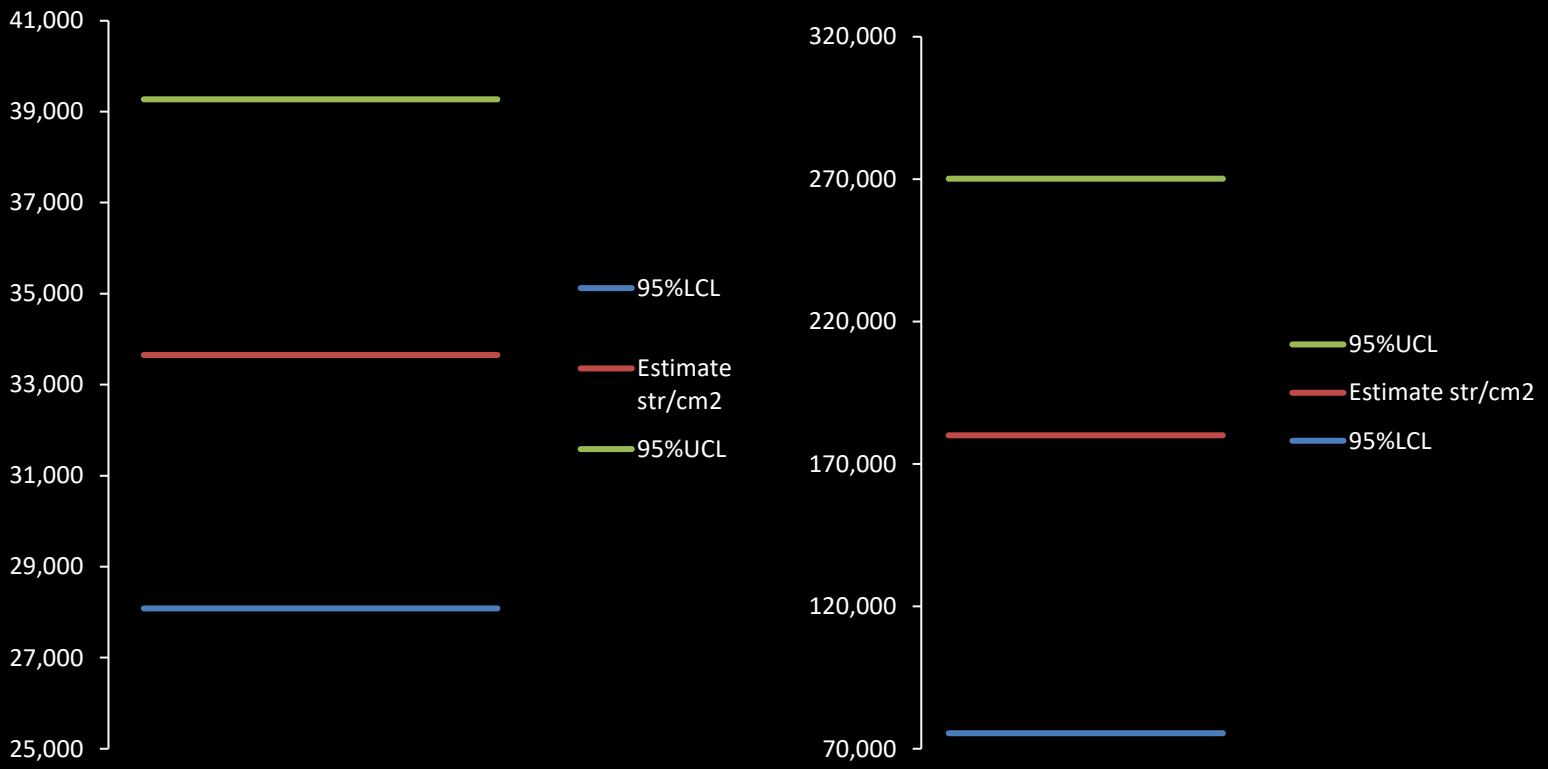
EPA concluded that potential asbestos contamination is present throughout the Site and in residential neighborhoods downwind of the Site.

WHAT IS THE STANDARD FOR ASBESTOS IN DUST?

There are no regulatory standards established to determine what asbestos dust contamination is. The contamination extent can be determined by ASTM standard D7390-07

Comparison to the background	• If one environment is typical to the building (or area) this could be used as the source of background samples against which study samples from the area in question shall be compared.
Comparison to control	• One environment may be taken as control against which to compare study samples from other area.

Example of ASTM 7390 standard use



CHOOSING SAMPLING LOCATIONS

- Step 1-Look at existing data
- Step 2-Pick up outliers
- Step 3-Select representative samples with high amount of asbestos

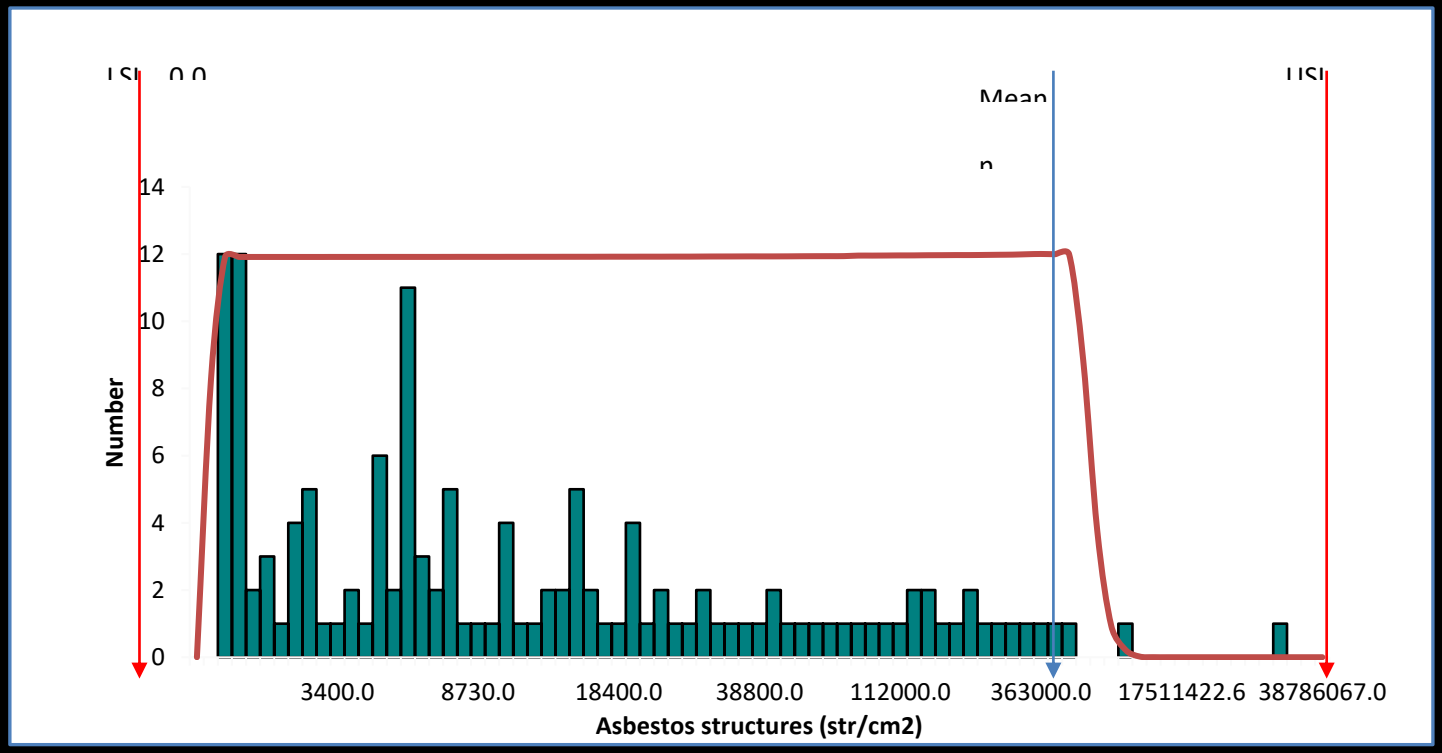
Summary of EPA Dust Wipe Results for Sampling Phases Outside Olefin

- 97 samples out of 123 dust wipe samples are showing only Chrysotile as the asbestos mineral present. Only two are showing both Amosite and Chrysotile and one sample shows Chrysotile and Actinolite. The other samples have reported asbestos fibers below the limit of detection

Samples reported to have Chrysotile and Amosite (No data on distribution)

- Sample W-008-001 374,000 (El Velorio Restaurant)
- Sample W -006-001 15,500 (Metal Fence Highway)

Weston samples dust wipe histogram



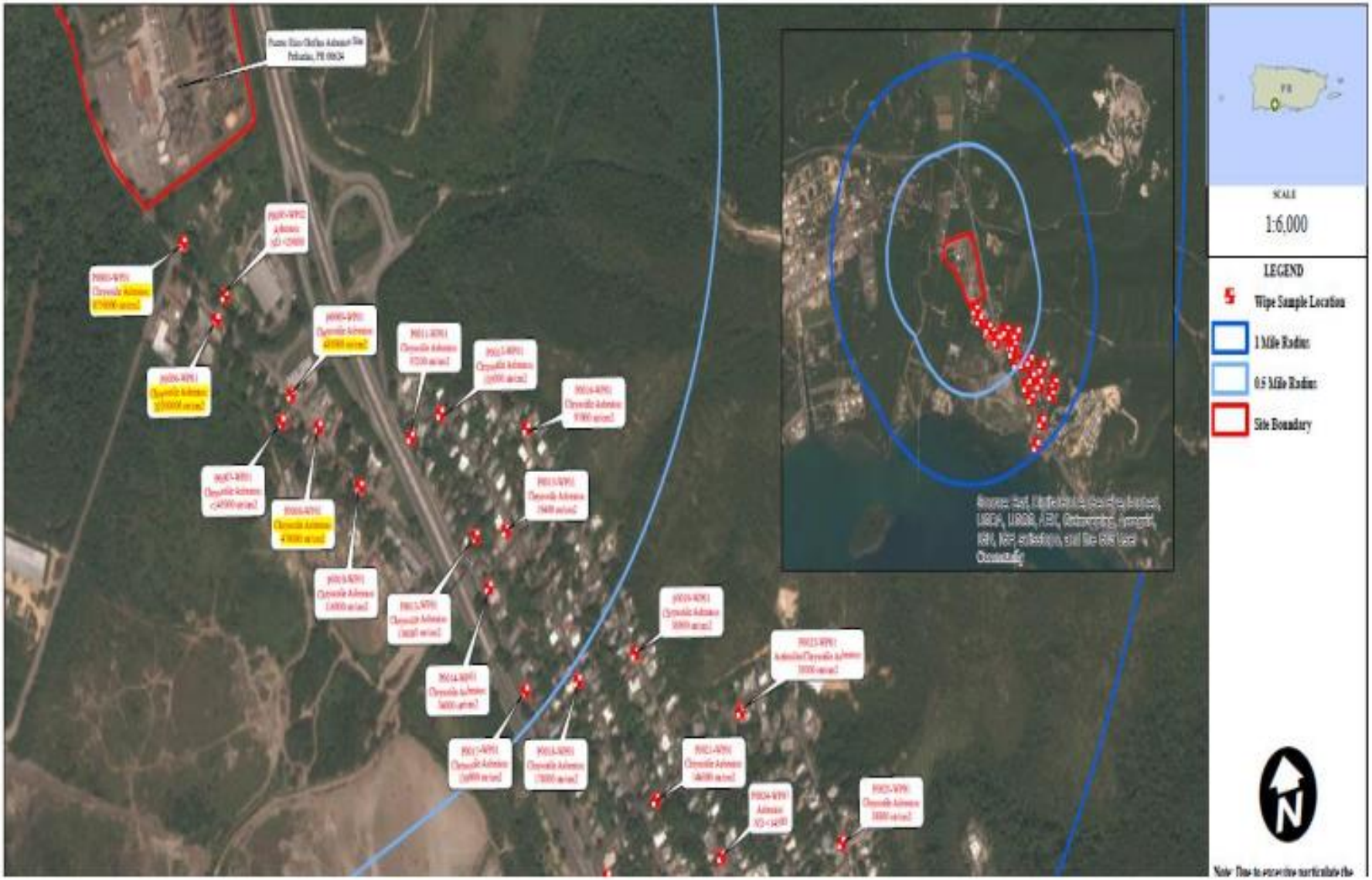


Figure 6. Dust sampling points (Highlighted) found by Weston to contain Chrysotile concentrations higher than 400,000 str/cm^2 (data from Weston report IIIB).

Comparison of asbestos average structures and confidence limits for dust wipes sampled during Phases I thru III-Data from Weston reports (ASTM D-7390-07)

Site	LCL (95%)	Weighted Average	UCL (95%)
Two outliers-Area A	13,145,000	14,599,000	16,113,000
Community (except 2 outliers)	31,297	34,009	37,128
School	7,420	7,650	7,910
Headstart	11,058	14,170	17,848
Background 6 miles radius	18,963	22,004	25,284

QUESTIONS?

Backgrounds

- Why is the asbestos background so high?
- What is the source of the asbestos contamination for site locations above the background levels?

Selection of Dust Samples (1)

in Weston samples (Data from Weston reports).

EPA SAMPLING PHASE	WESTON SAMPLE LOCATION/CONCENTRATIONS	WESTON SAMPLE ID	AESI SAMPLE LOCATION	AESI SAMPLE ID
Phase I	Area OV409-bulk sample-Amosite 2%, Chrysotile 20%	ACM-004-001	Bulk, area OV409	B-OL-OV409-ER1
	Front flare-dust-Amosite/Chrysotile (102,000 str/cm2)	W-001-001	Dust, front flare	D-OL-FF-ER2
	Front flare-soil-Amosite/Chrysotile-0.1%	S0001-0006-001	Soil, front flare	S-OL-FF-ER3
	Front flare-bulk-Amosite-40%, Chrysotile-2%	ACM-003-001	Bulk , front flare	B-OL-FF-ER4
	Scrap metal front Crane-dust-Chrysotile (252,000 str/cm2)	W-003-001	Dust, front of previous crane	D-OL-SM-ER6
	El Velorio-outside porch-dust- (374,000).-Amosite/Chrysotile	W-008-001	Dust, El Velorio, front porch	D-EV-FP-ER1
Phase IIIA School	Classroom 10, entrance/near window-dust (desk near window, vinyl 146,000 and concrete floor entrance 194,000 str/cm^2).	P0002-CR10-WP01-01	Dust, hallway, 1st bldg.	D-JLPV-CR10-1F-H-ER5
	Classroom 19-dust (shelf, wood, dusty area 363,000 str.cm^2).	P0002-CR19-WP03-01	Dust, hallway, bldg. next to basketball court	D-JLPV-CR19-1F-H-ER4
	Classrooms 23-dust (metal bottom of student desk 257,000 str.cm^2)	P0002-CR23-WP03-01	Dust, hallway, 2nd floor, Adm. Bldg.	D-JLPV-CR23-2F-H-ER3

Selection of Dust Samples (2)

Phase IIIB Community Tallaboa	Emergency generator, facility entrance-dust-Chrysotile (8,730.000)	P0005-WP01-01	Dust, Gulf facility entrance	D-TEC-GULF-GS-ER8
	Top of air conditioning, facility entrance,-dust-Chrysotile (32,200.000)	P0006-WP01-01	Dust, AR Exchange Boiler	D-TEC-ARE-P0006-ER7
	Top of garage wall-dust-Chrysotile (178,000)	P0018-WP01-01	Dust, corner street 2	D-TEC-P0018-C2-ER12
	Top of table-garage-dust-Chrysotile (146,000)	P0021-WP01-01	Dust, street 2, intersection with 4	D-TEC-P0021-C2-ER11
Phase IIIC	Bus stop, seat, concrete-dust- (160,000)	P0036-WP01-01	Dust MV, bus stop bench, Rd.385, Int. 384 (10/2/14)	D-NOW-P0036-BS-ER10
	Traffic barrier, metal-dust- (116,000)	P0035-WP01-01	Dust, traffic barrier rd.384, km3.2	D-NOW-P0035-TB-ER09
			Dust wipe, bench left side bus stop (10/23/14)	D-385-W-ER1 D-NOW-P0036-BS-ER1
			Dust MV, bus stop bench, (11/11/14)	
			Dust wipe, bus stop bench, (11/11/14)	W-NOW-P0036-BS-ER1
			Dust MV, bus stop bench, (11/18/14)	D-NOW-P0036-BS-ER1
			Dust wipe, bus stop bench, (11/18/14)	W-NOW-P0036-BS-ER1
Phase IIID	Headstart, entrance, concrete floor-dust- Chrysotile (41,700)	P0014-WP02-01	Dust, exterior next to playground	D-HS-PG-ER2

DUST RESULTS

Dust samples results (1)

Table 4. Summary of Analytical Results for Samples Collected 01 October 2014

MVA #	Sample I. D.	PLM Analysis Results % Asbestos	Additional Materials Observed	TEM Analysis Results	Comments
Z2124	D-EV-FP-ER1	Trace Chrysotile	Carbonate, iron/rust, quartz, cellulose, insect parts, rubber, tarry particles	Calcic and clay minerals, two chrysotile bundles	Iron/rust adhering to chrysotile (PLM) Trace Fe/Al present in chrysotile (TEM)
Z2125	D-HS-PG-ER2	NAD	Cellulose, carbonate, quartz	Calcic and clay minerals, two chrysotile fibers	Trace Fe/Al present in chrysotile (TEM)
Z2126	D-JLPV-CR23-2F-H-ER3	NAD	carbonate, quartz, cellulose, paint, rubber	Clay minerals	Small sample volume
Z2127	D-JLPV-CR19-1F-H-ER4	NAD	cellulose, carbonate, cotton, hair, insect parts	Clay minerals, one chrysotile bundle	Trace Fe/Al present in chrysotile (TEM)
Z2128	D-JLPV-CR10-1F-H-ER5	NAD	Carbonate, quartz, cellulose, plant debris, insect parts, plastic/polymer	Clay minerals	Small sample volume
Z2129	BLK-ER6	NA	---	NAD	ASTM D5755 Analysis

NA – Not Analyzed
NAD – No Asbestos Detected

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Dust samples results (2)

Table 5. Summary of Analytical Results for Samples Collected 02 October 2014

MVA #	Sample I. D.	PLM Analysis Results % Asbestos	Additional Materials Observed	TEM Analysis Results	Comments
Z2130	D-TEC-ARE-PO006-E-ER7	Trace Chrysotile	Lizardite, carbonate, iron/rust, quartz, cellulose	Clay minerals, one chrysotile fiber	SEM (clay minerals, lizardite)
Z2131	D-TEC-GULF-GS-ER8	NAD	Lizardite, carbonate, quartz, feldspar, pollen	Clay minerals, one chrysotile fiber, one chrysotile bundle	SEM (clay minerals, lizardite, quartz) Trace Fe/Al present in chrysotile (TEM)
Z2132	D-NOW-P0035-TB-ER9	NAD	Carbonate, quartz, cellulose, plant debris, insect parts, rubber, iron/rust, fungal material	Clay minerals	---
Z2133	D-NOW-P0036-BS-ER10	NAD	Lizardite, quartz, carbonate, iron/rust, hornblende	Clay minerals, one chrysotile bundle	Trace Fe/Al present in chrysotile (TEM) [Five additional structures detected during D5755 analysis - reported separately]
Z2134	D-TEC-P0021-C2-ER11	Trace Chrysotile	Lizardite, quartz, carbonate, iron/rust, feldspar	Calcic and clay minerals	---
Z2135	D-TEC-P0018-C2-ER12	NAD	Lizardite, magnetite, quartz, carbonate	Clay minerals and four chrysotile fibers/bundles	Trace Fe/Al present in Mg-reduced chrysotile (TEM)
Z2136	BLK-FB-ER13	NA	NA	NAD	[Analysis via D5755 - reported separately]

NA – Not Analyzed
NAD – No Asbestos Detected

Dust samples results (3)

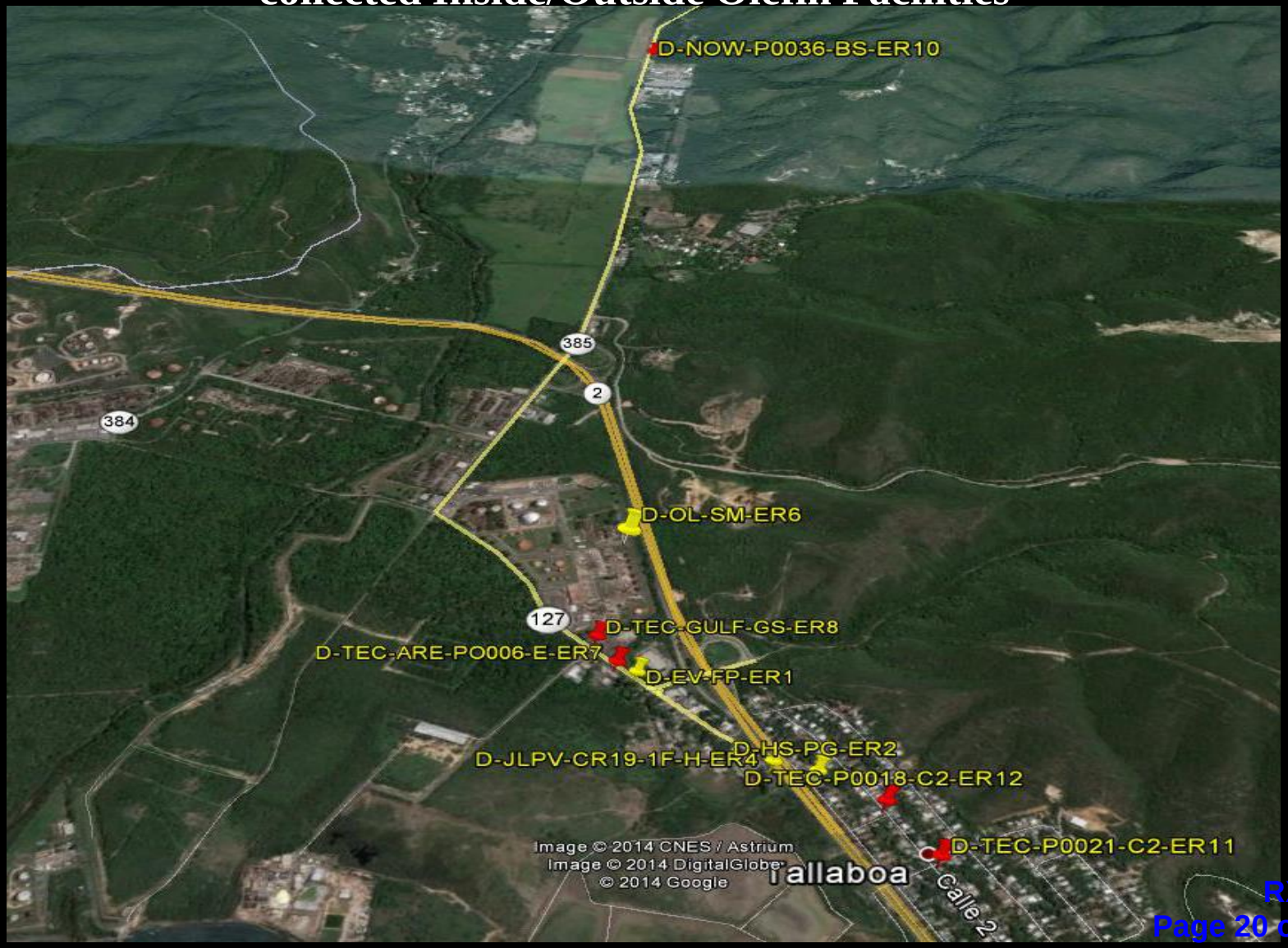
Table 6. Summary of Analytical Results for Samples Collected 23 October 2014

MVA #	Sample I. D.	PLM Analysis Results % Asbestos	Additional Materials Observed	TEM Analysis Results	Comments
Z2376	D-OL-FF-ER2	NAD	Iron/rust, carbonate, quartz, cellulose	Iron and quartz particles	Small sample volume
Z2377	D-OL-SM-ER6	Trace amosite Trace chrysotile	Iron/rust, vermiculite, quartz, carbonate, cellulose, glass fibers, fungal material	Iron, aluminum, clay particles, one amosite fiber, two chrysotile bundles	SEM (probable chrysotile) Trace Fe/Al Present in chrysotile (TEM)

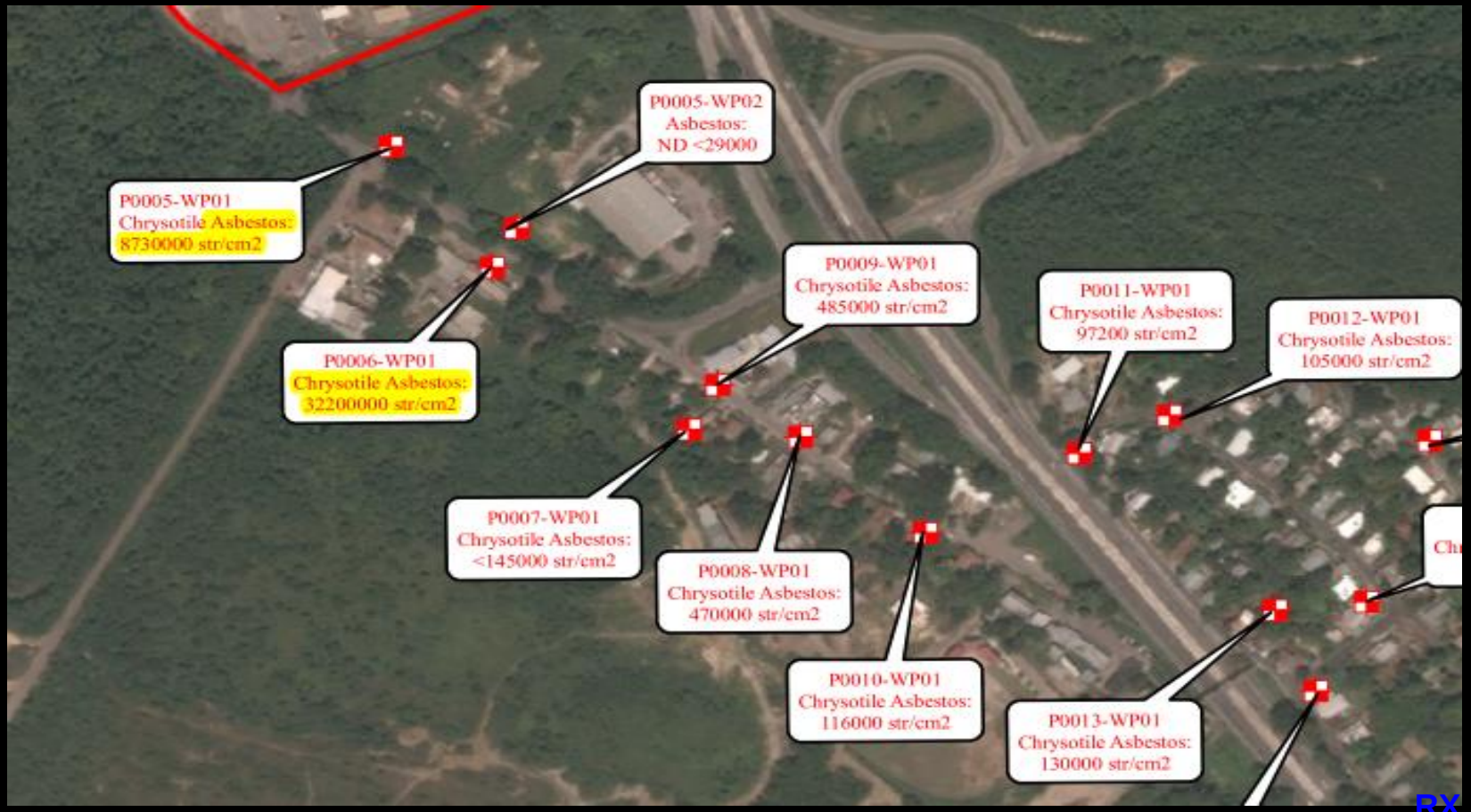
NA – Not Analyzed

NAD – No Asbestos Detected

Distribution of Chrysotile and Lizardite in Dust Samples collected Inside/Outside Olefin Facilities

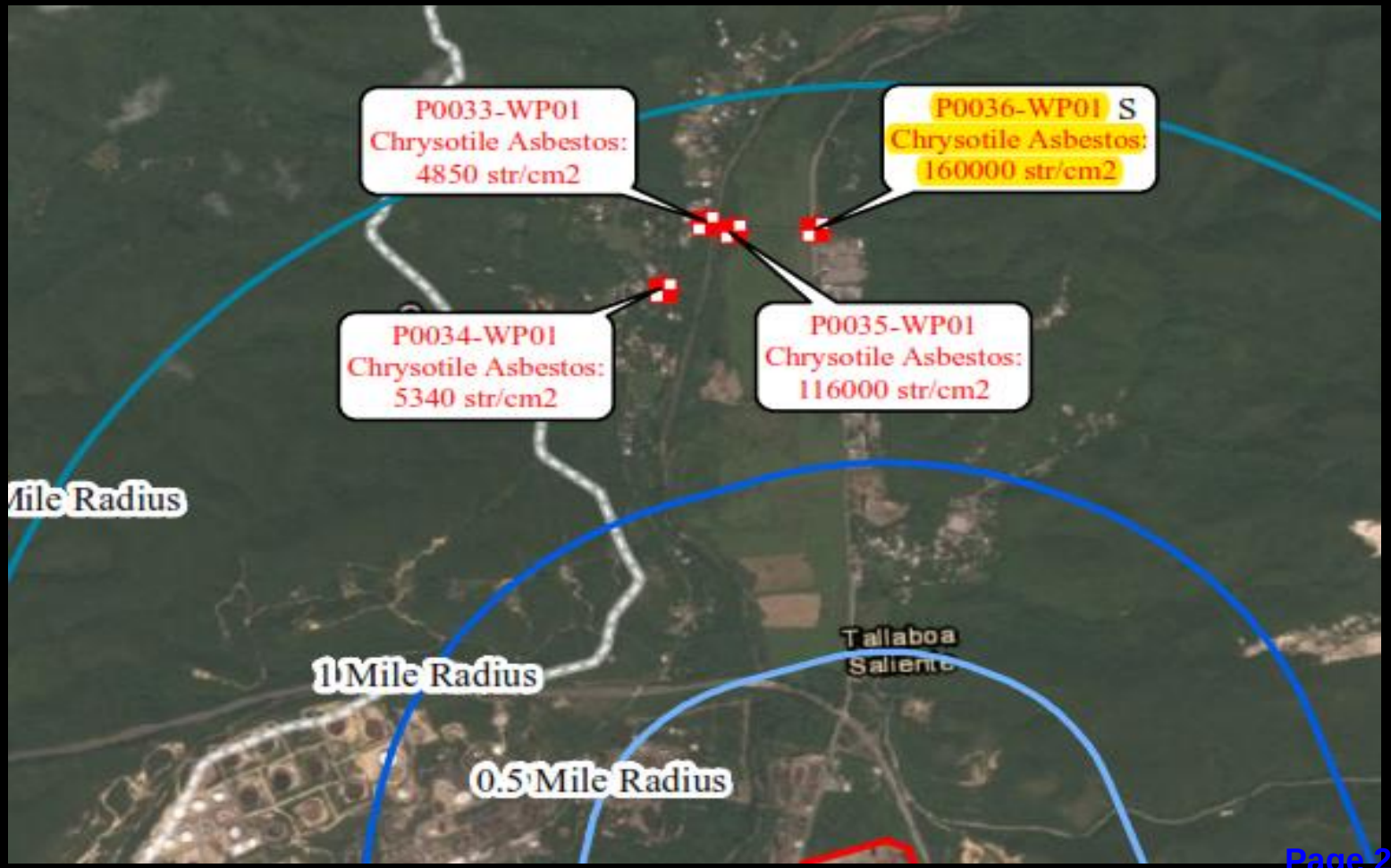


Lizardite/Chrysotile results in dust wipes-Tallaboa Encarnacion Community <0.5 miles (Weston report IIIB)



Lizardite/Chrysotile distribution in the Tallaboa Encarnacion Community Map (Weston report IIIB, >0.5 miles from the site)

Lizardite/Chrysotile distribution on the 6 miles map (Background, Weston report IIIC)



Tallaboa Encarnación Community

West of Street 2

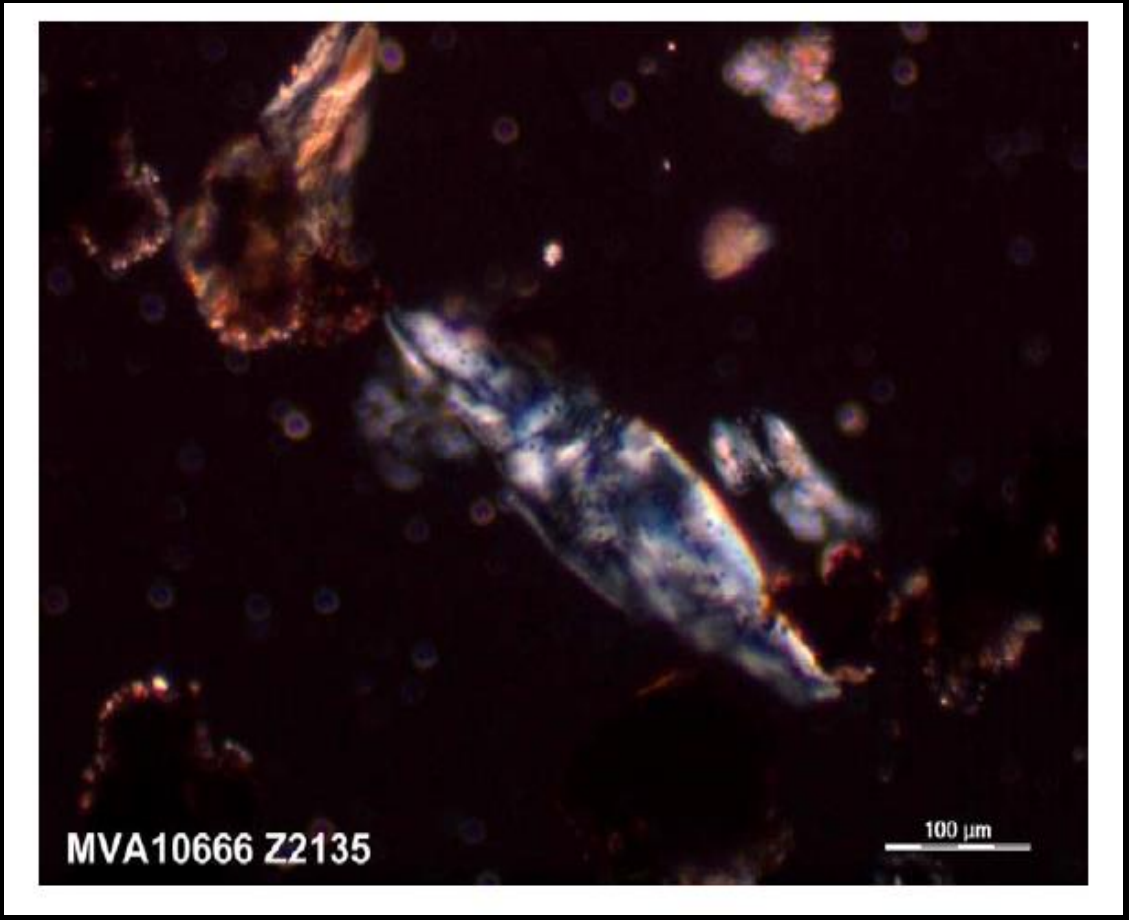
Sampling Point: D-TEC-P0018-C2-ER12

Area Sampled 100 cm^2

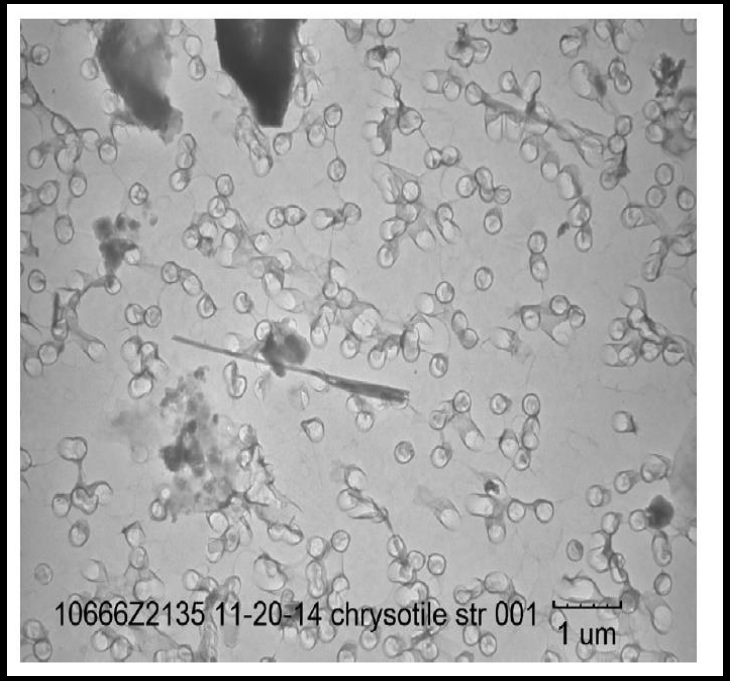
PLM image of a Lizardite particle detected during analysis of sample

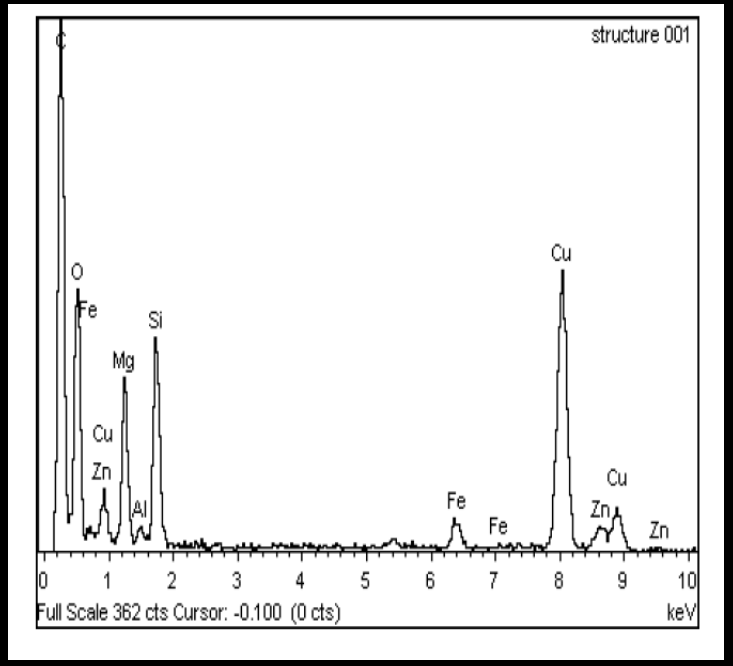
D-TEC-P0018-CR-ER12

Dust, corner street 2, west of street 2, Tallaboa Encarnation Community



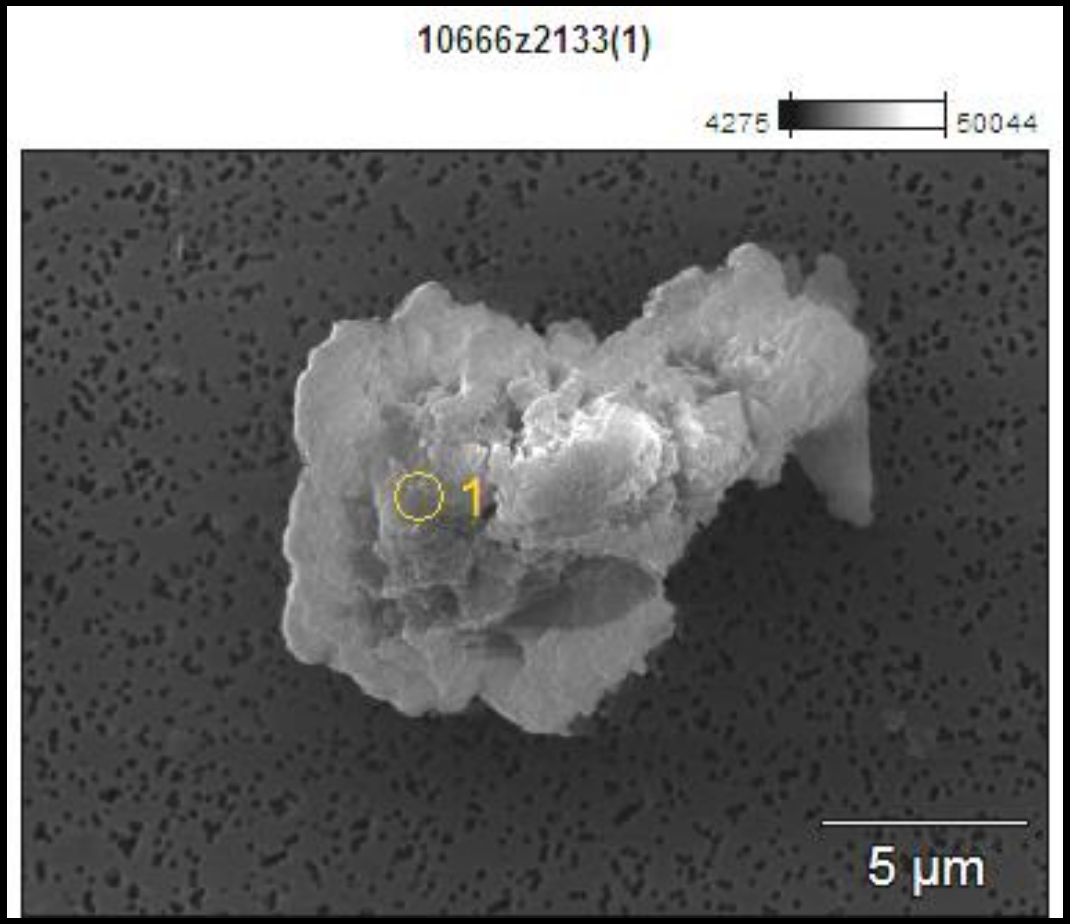
TEM image (left) and EDS spectrum (right) of a Chrysotile asbestos bundle detected in sample D-TEC-P0018-C2-ER12, Dust floor, corner street 2, west of street 2, Tallaboa Encarnation Community





North Side of Olefin
Intersection of Road 384-385
Bus Stop
General View

SEM image of a Lizardite particle detected during analysis of sample D-NOW-P0036-BS-ER10 collected from the bus station at the intersection of State roads 384 and 385.



The Serpentine Family

Clinochrysotile; $Mg_3Si_2O_5(OH)_4$; monoclinic.

Orthochrysotile; $Mg_3Si_2O_5(OH)_4$; orthorhombic.

Parachrysotile; $(Mg,Fe)_3Si_2O_5(OH)_4$; orthorhombic.

Lizardite; $Mg_3Si_2O_5(OH)_4$; trigonal and hexagonal.

Antigorite; $(Mg,Fe)_3Si_2O_5(OH)_4$; monoclinic.

Serpentine Group

- **Lizardite :**

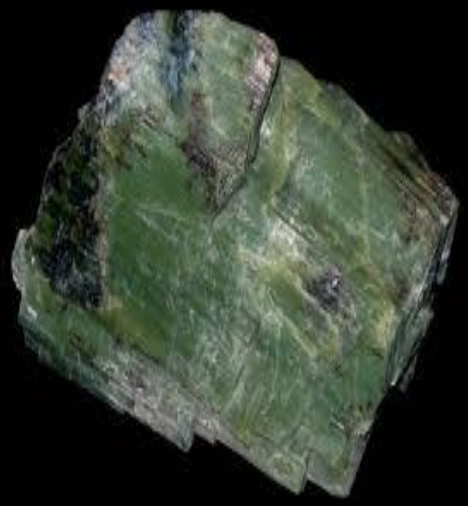
$Mg_3(Si_2O_5)(OH)_4$

Serpentine Group

- Chrysotile :

$Mg_3(Si_2O_5)(OH)_4$

Serpentine Group



- **Antigorite :**

$Mg_3(Si_2O_5)(OH)_4$

Serpentinite

Serpentinite is the name for a rock which is made up dominantly of the Serpentine Group minerals, which include:

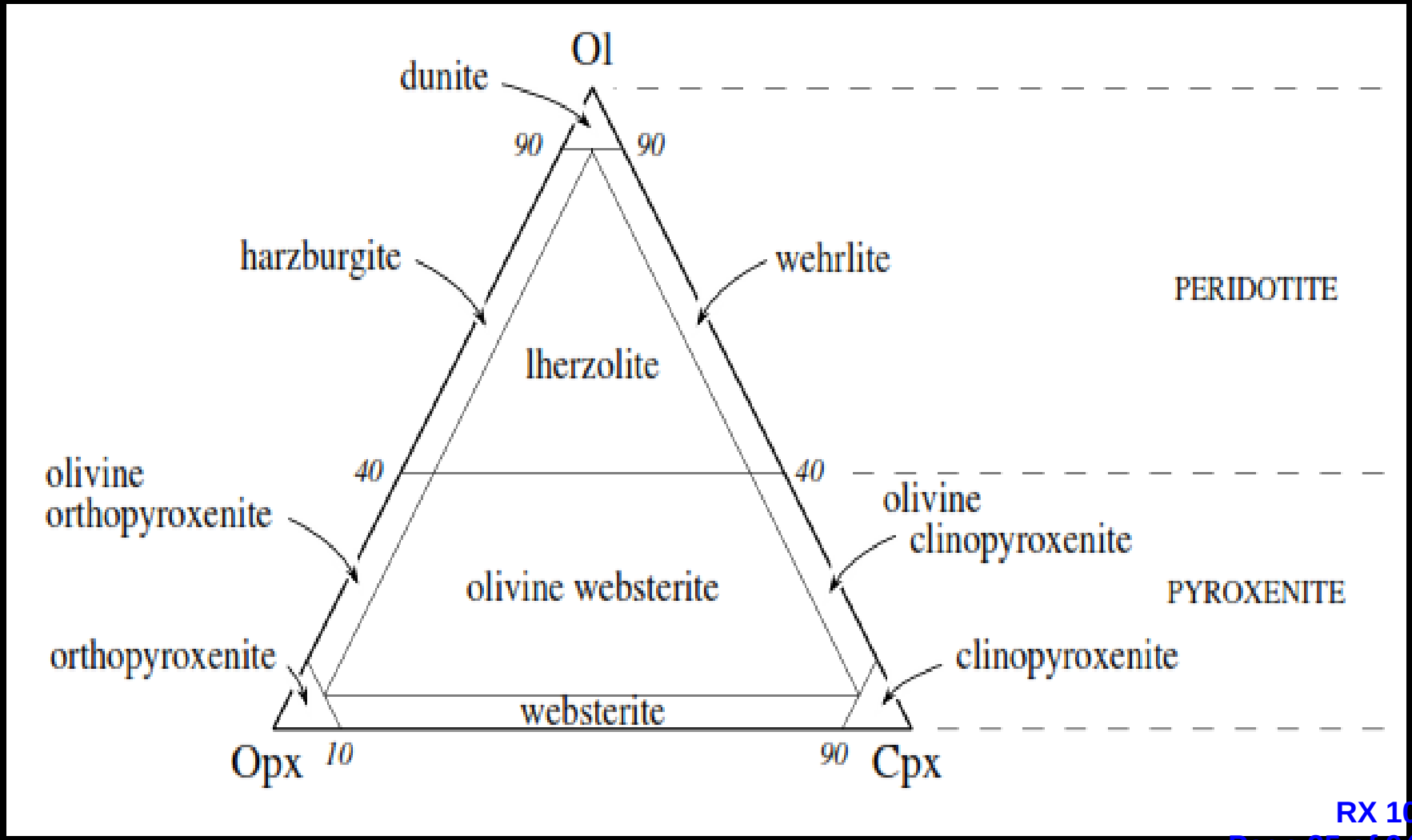
Lizardite and Chrysotile ($Mg_3Si_2O_5(OH)_4$)

Antigorite $(Mg,Fe^{++})_3Si_2O_5(OH)_4$).

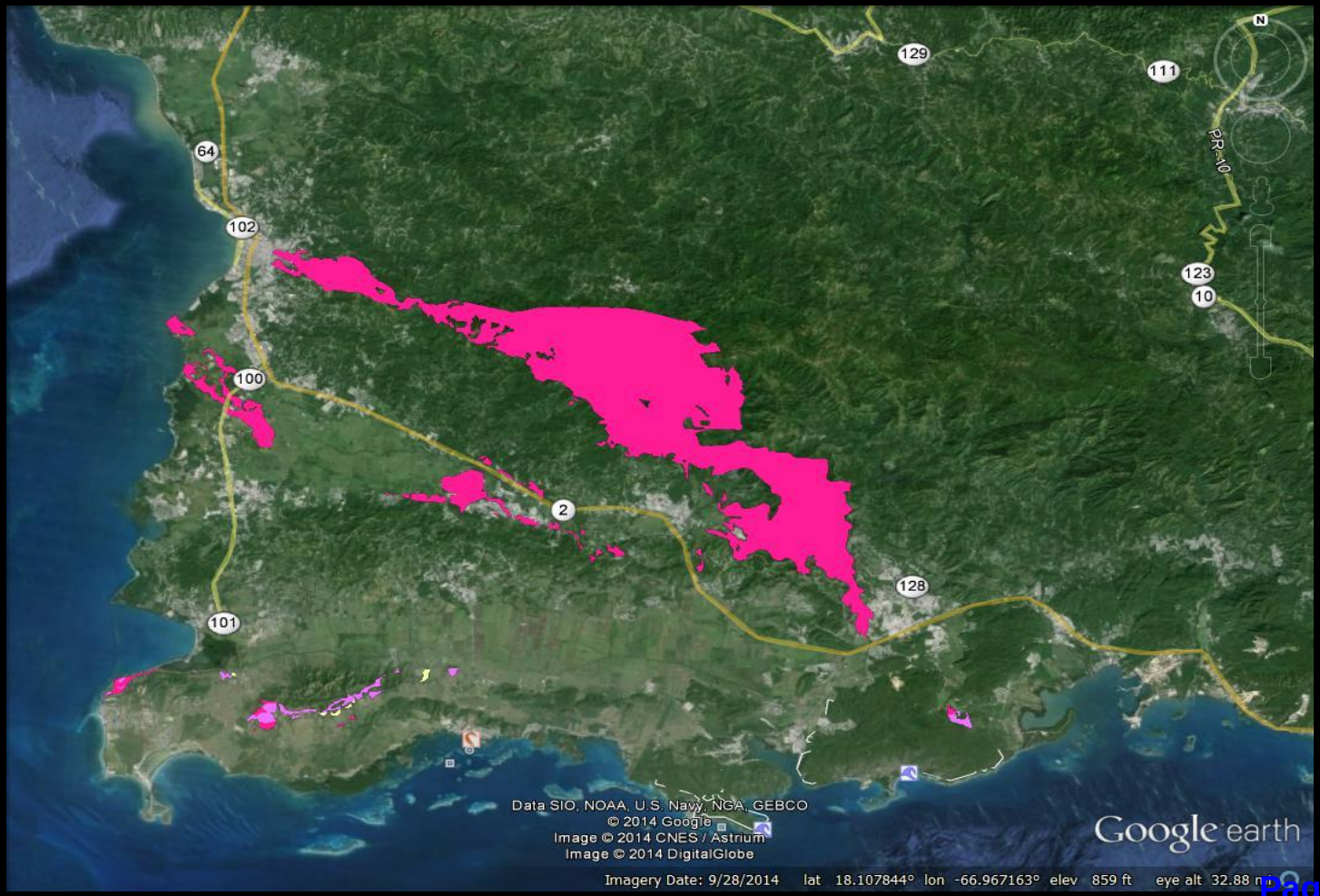
NATURAL OCCURING ASBESTOS (NOA) IN PUERTO RICO

SERPENTINITES

IUGS peridotite classification (Le Maitre 1989)



Distribution of Serpentinites in Puerto Rico



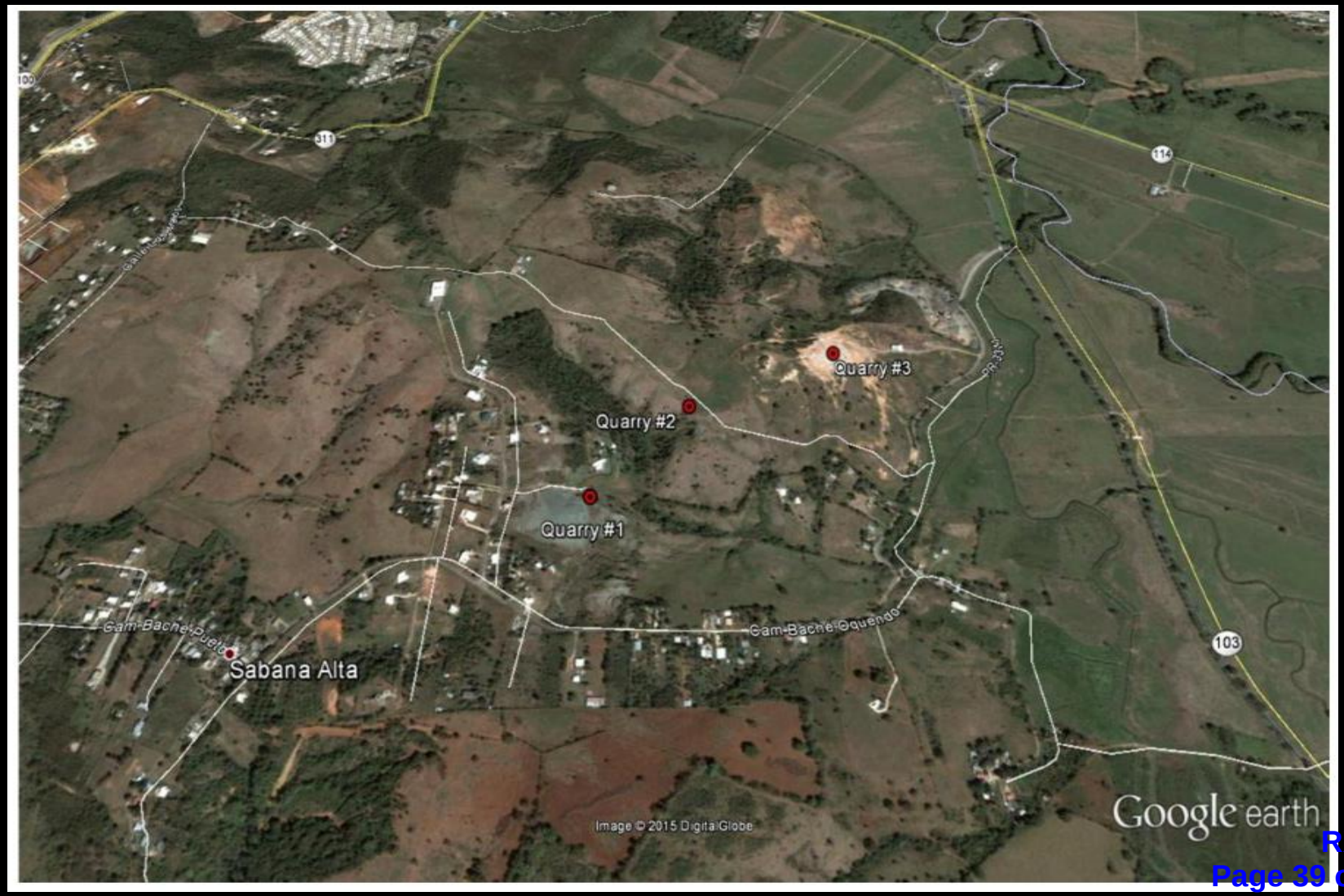
Quarries investigation

Twenty (20) quarries were found in the southwest area.

- Eleven (11) of them are still active
  - #1, #2 and #3 in Cabo Rojo
  - #9 in Sabana Grande
  - #11, 12, 13, 14, 15 and 17 in Yauco
  - #20 in San Germán.

Active Quarries in Puerto Rico

Active Quarries in Puerto Rico



Sampled area where serpentinite rocks are exposed on the surface Media Quijada (cut on the road)

Sampled area where serpentinite rocks are exposed on the surface Yauco (quarry)

Serpentine from Quarry 1, Yauco
R-Q1-AP4

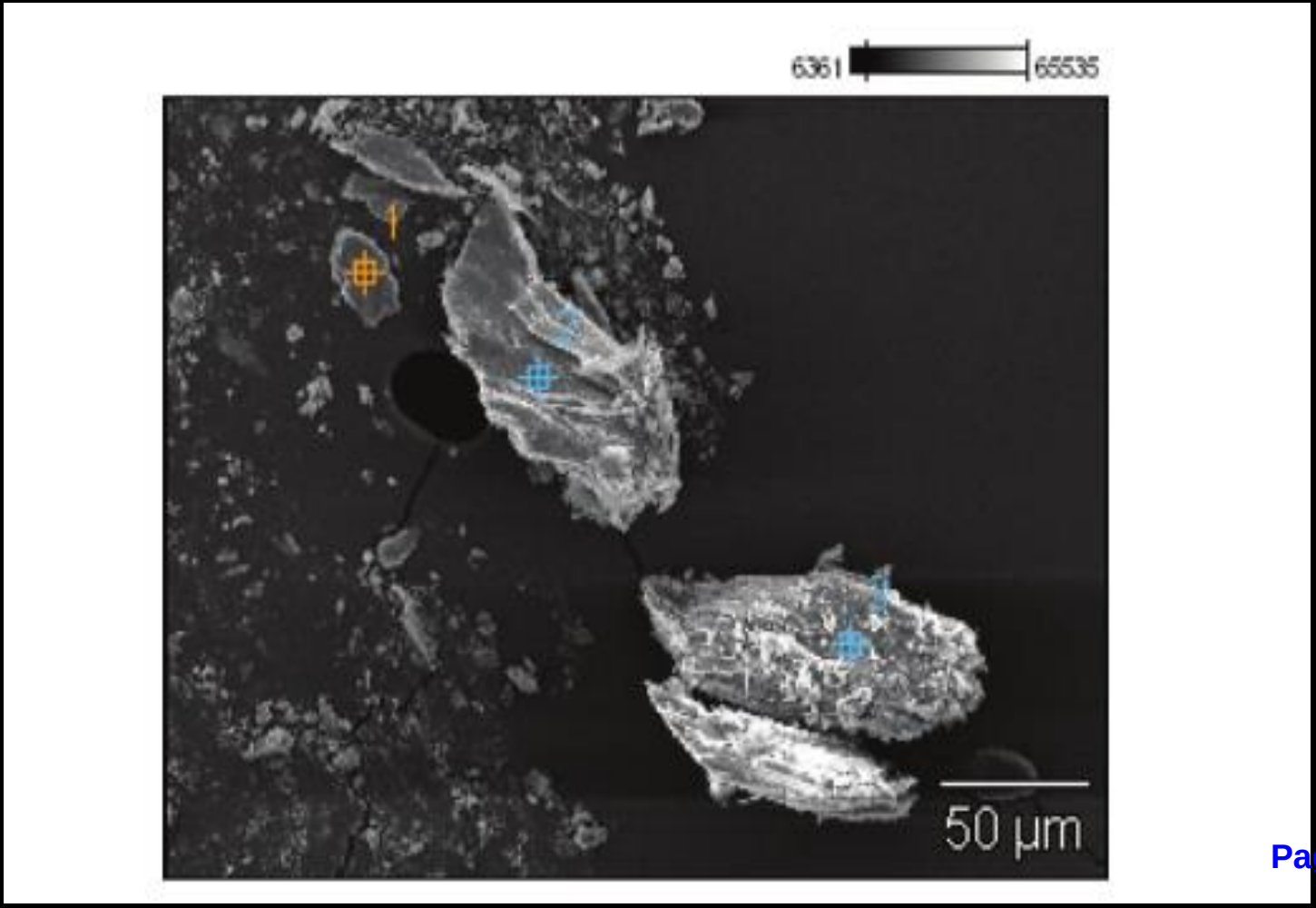
Results of mineral samples

MVA #	PLM Analysis Results % Asbestos	Additional Materials Observed	SEM Analysis Results	TEM Analysis Results
Z2284	NAD	Non-fibrous Serpentine (Lizardite), Magnetite	NA	*Composite Sample* Non-fibrous (Lizardite) and Fibrous (Chrysotile)
Z2285	Trace Chrysotile	Non-fibrous Serpentine (Lizardite), Magnetite	Serpentine: Non-fibrous (Lizardite) and Fibrous (Chrysotile)	

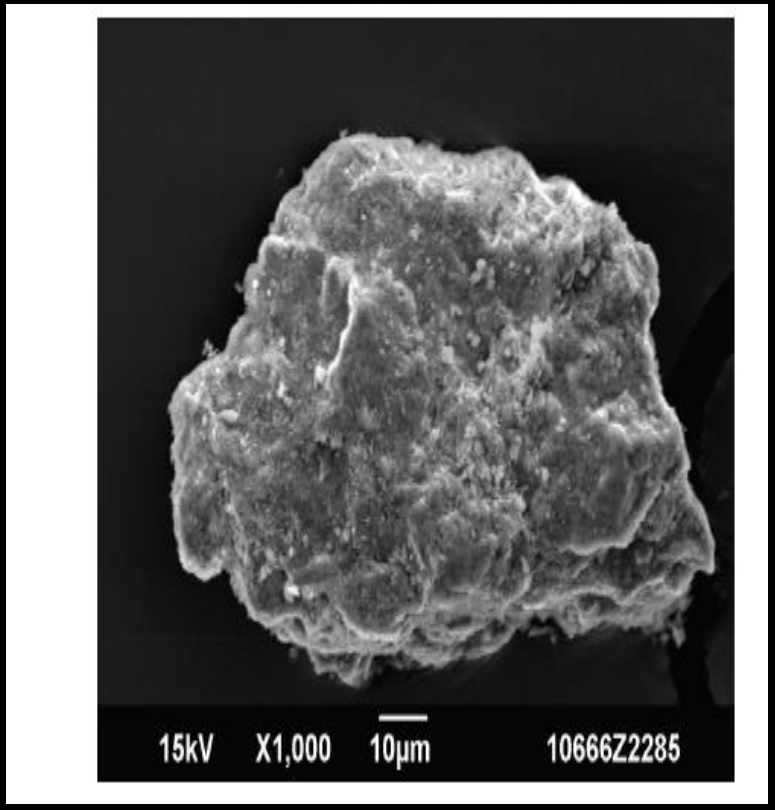
NA – Not Analyzed

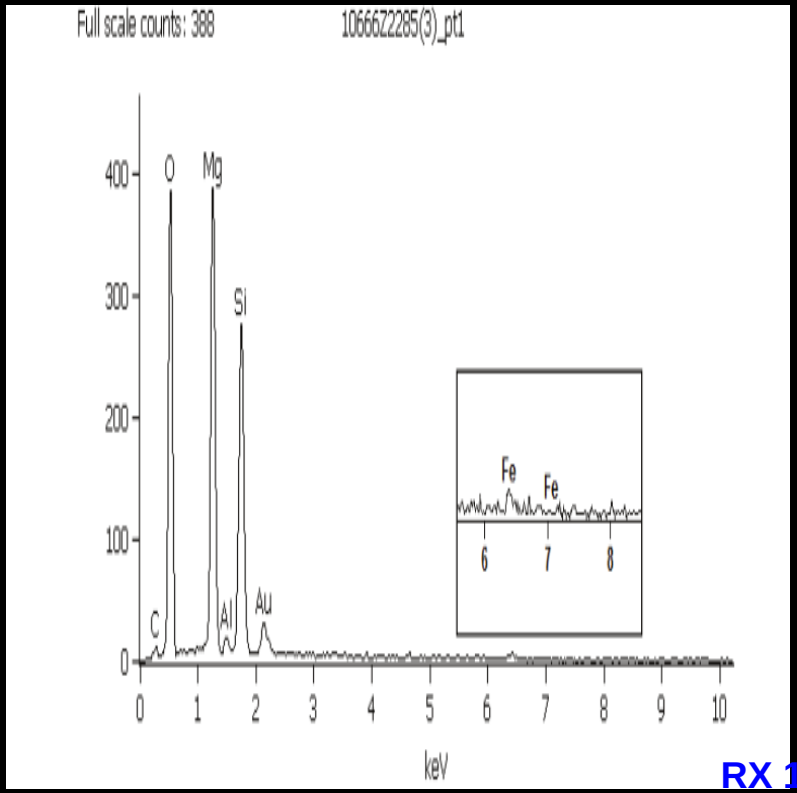
NAD – No Asbestos Detected

SEM photo of fibrous and non-fibrous serpentine Lizardite (#1) and Chrysotile (#2 and #3) detected during analysis of sample, R-Q1-AP4

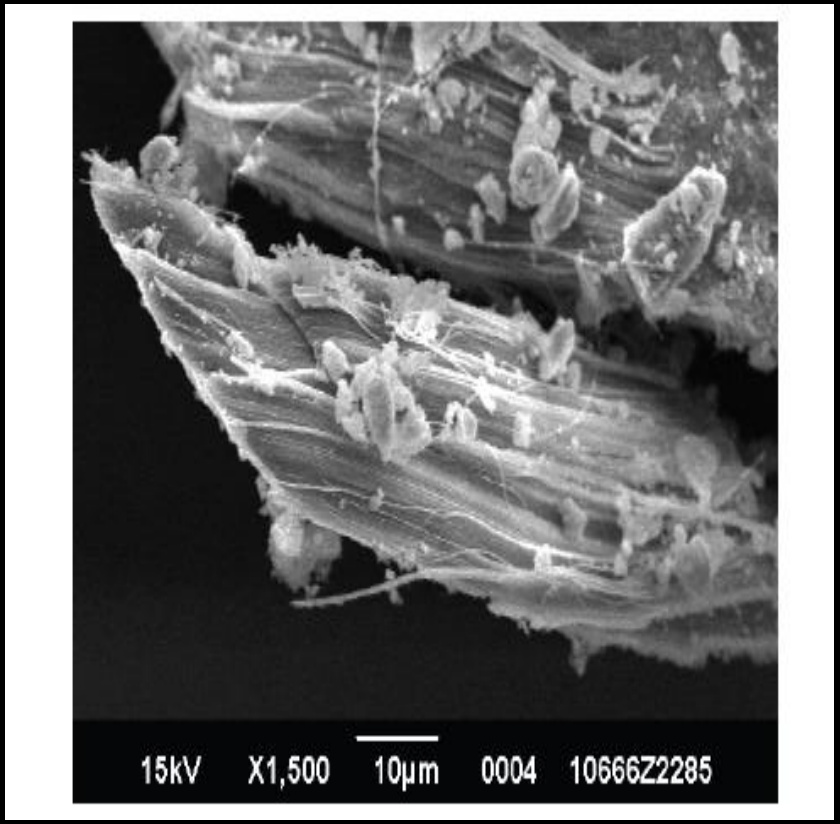


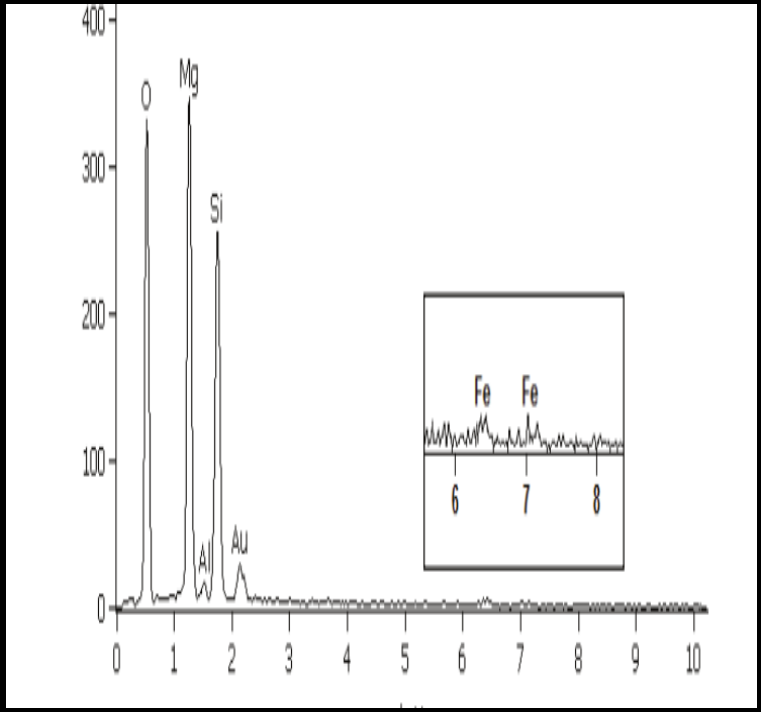
SEM photo (left) and EDS spectra (right)of non-fibrous serpentine (lizardite)detected during analysis of Quarry 1 sample R-Q1-AP4)





SEM photo (left) and EDS spectra (right) of a fibrous serpentine (Chrysotile)detected during analysis of Quarry 1 sample R-Q1-AP4). Chrysotile appears to be a pseudomorph.





A concrete plant (Hormigonera Mayaguezana) is present in the vicinity of the quarry suggesting that the extracted material was crushed and used for commercial purposes (see photo below).

A quarry (Cantero y Gravero) located in the Municipality of San Germán route PR-329 KM 3.2. There is no permit number on the sign. The access road is currently paved with Serpentinite aggregate.

AGGREGATES

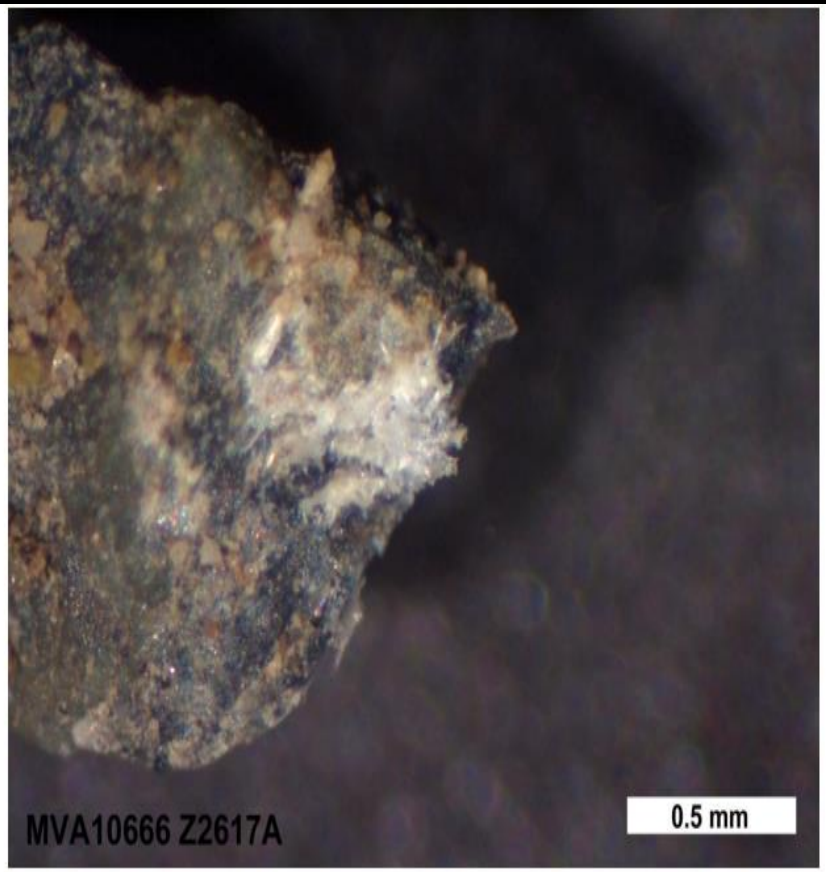
Location of Sampling Points

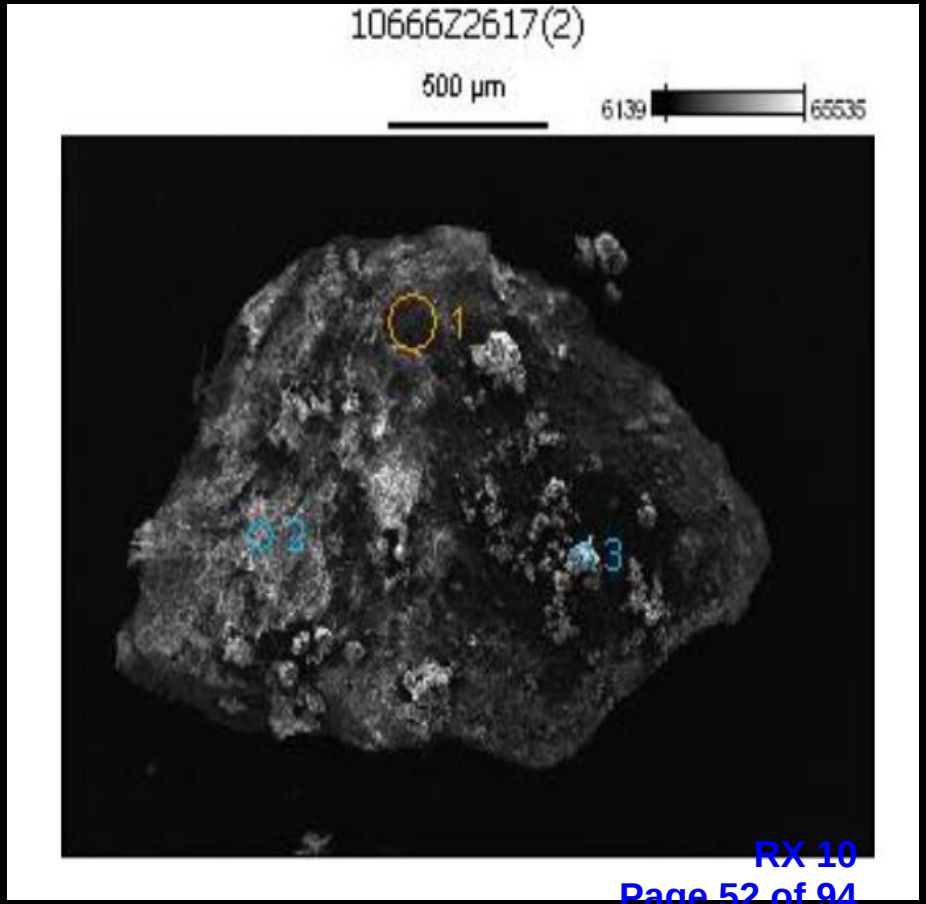
Dirt road south of road PR127

Results of aggregates samples

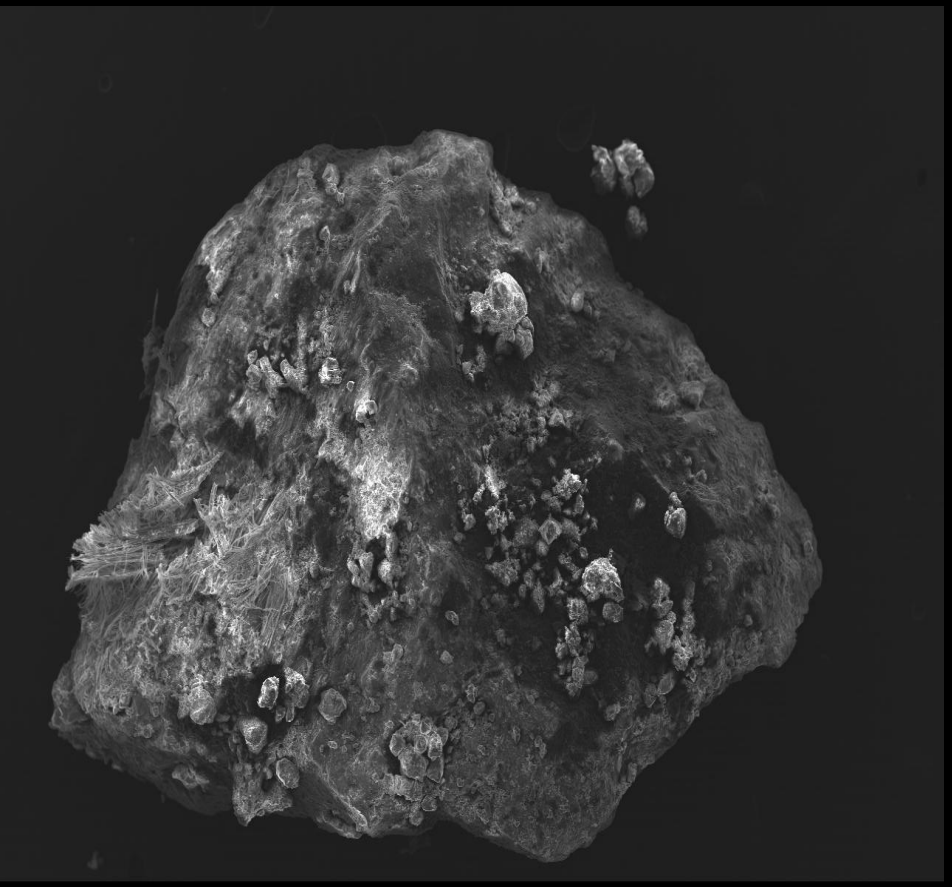
MVA #	AESI #	PLM Analysis Results % Asbestos	Additional Materials Observed	SEM Analysis Results	TEM Analysis Results
Z2617	S-TEC-ARE-P0006-ER1	Trace Chrysotile	Plant Debris and Gravel - Including: Carbonate, **Serpentine (Lizardite)**, Magnetite	**Non-fibrous (Lizardite)** and Fibrous (Chrysotile) Serpentine; Other Soil Minerals	**Non-fibrous (Lizardite)** and Fibrous (Chrysotile) Serpentine Particles, and Other Soil Minerals
Z2618	S-TEC-MEOL-ER2	NAD	Plant Debris, Asphalt, and Gravel - Including: Quartz, Carbonate, **Serpentine (Lizardite)**, Magnetite	NA	**Non-fibrous (Lizardite)** and Fibrous (Chrysotile) Serpentine Particles, and Other Soil Minerals
Z2754	S-TEC-TNT-SER1	Trace Chrysotile	Plant Debris and Gravel - Including: Carbonate, **Serpentine (Lizardite)**, Magnetite	Fibrous Serpentine (Chrysotile) and Other Soil Minerals	Fibrous (Chrysotile) Serpentine and Other Soil Minerals
Z2755	S-TEC-BV-S-ER2	Trace Chrysotile	Plant Debris and Gravel - Including: Carbonate, **Serpentine (Lizardite)**	Fibrous Serpentine (Chrysotile) and Other Soil Minerals	Fibrous (Chrysotile) Serpentine and Other Soil Minerals

Stereo-micrograph (left) and SEM (right) of non-fibrous serpentine mineral (lizardite) with fibrous serpentine intergrowth (chrysotile) observed in aggregate sample S-TEC-ARE-P0006-ER1.

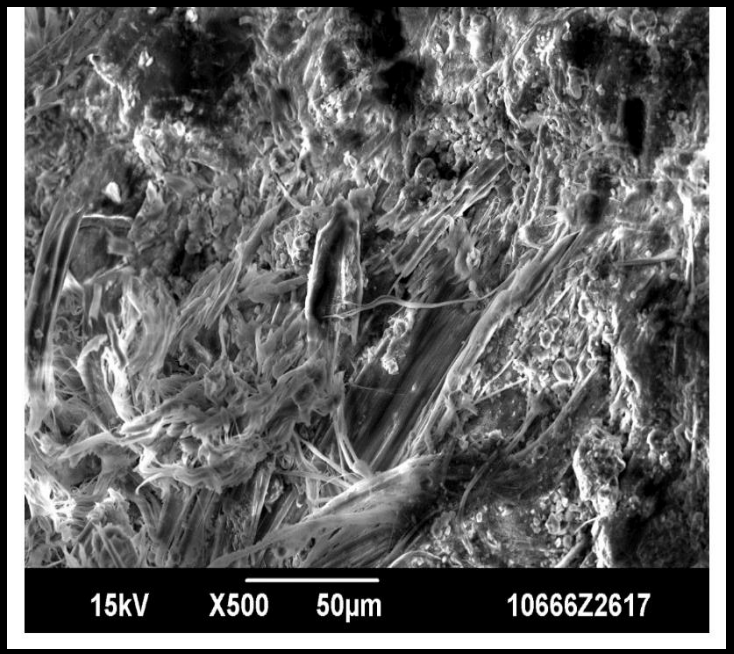




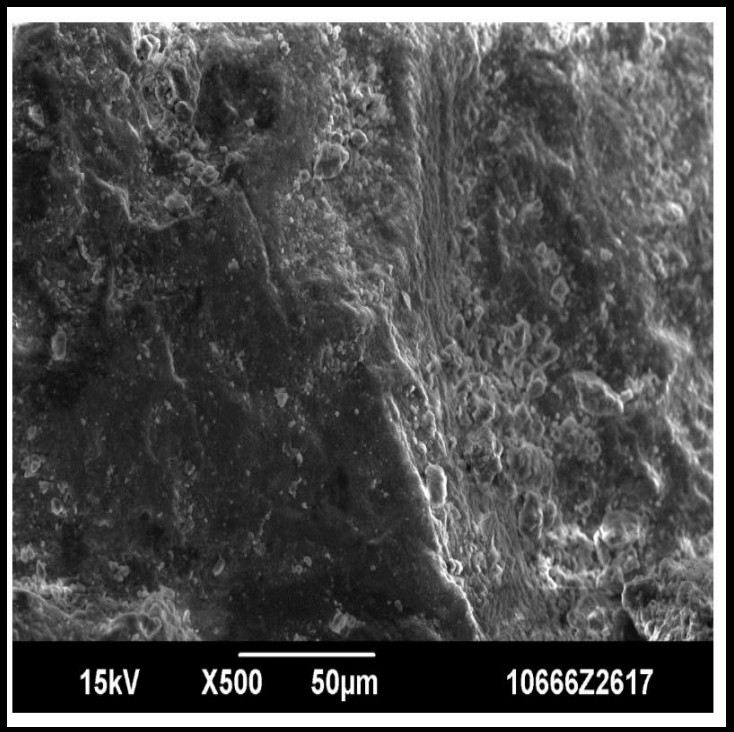
SEM image of Chrysotile intergrowth with Lizardite (the large aggregate). The aggregate was collected from gravel sample S-TEC-ARE-P0006-ER1

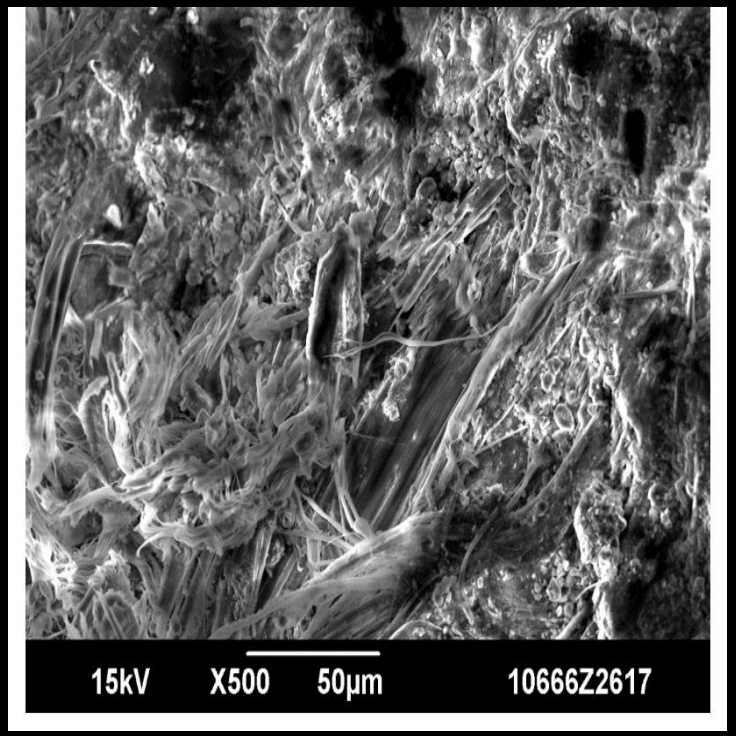


Chrysotile from the left side of the aggregate

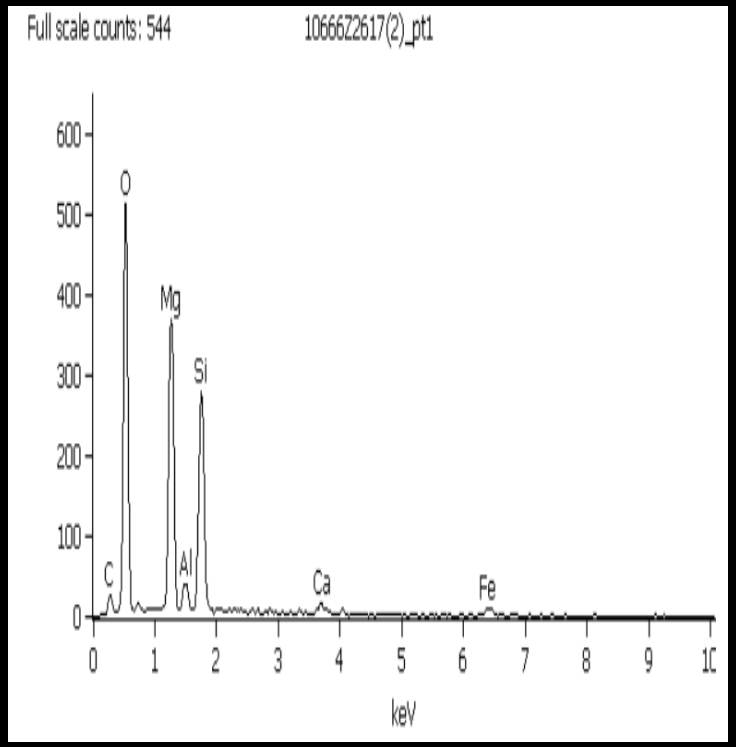


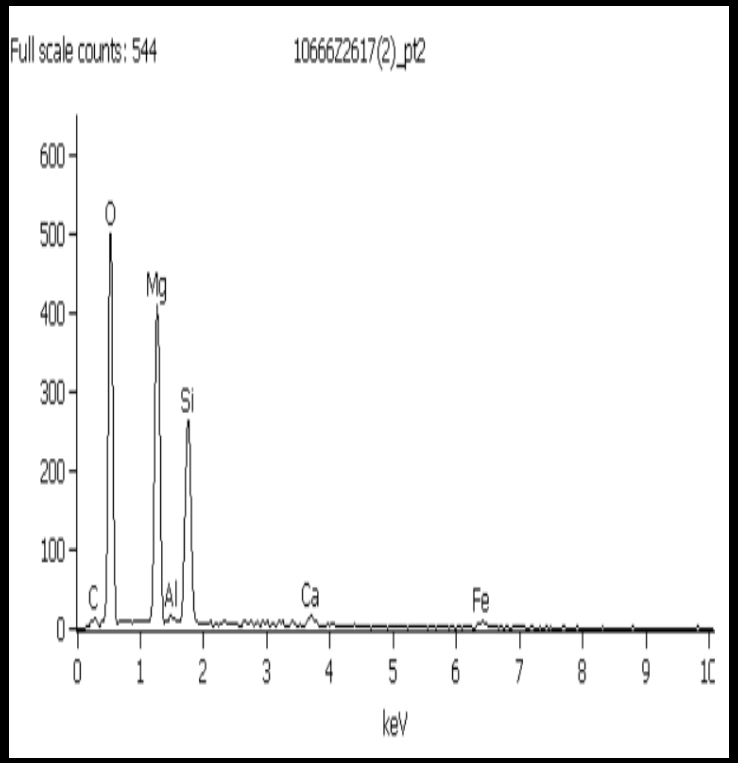
SEM images of fibrous serpentine (Chrysotile) mineral surface (right, area 2) and Lizardite (left, area 1). Areas 1 and 2 were shown in the previous slide.





EDS spectra of fibrous serpentine-Chrysotile mineral surface (right, area 2) and Lizardite (left, area 1).





An active quarry (Luis A. Gonzalez, quarry #17) located along route PR-121 Sector Cuatro Calles in Yauco. JCA and DRNA permits are posted at its entrance

- Dust sample was collected on the road at the entrance.
- **290,000,000** str/cm2
- Lizardite also Observed

Entrance to the Parking of “Centro Juvenil de Mayagüez Aguadilla”, Mayaguez

- Dust sample was collected on the road at the entrance to the parking.
- **75,000,000** str/cm2
- Lizardite also Observed

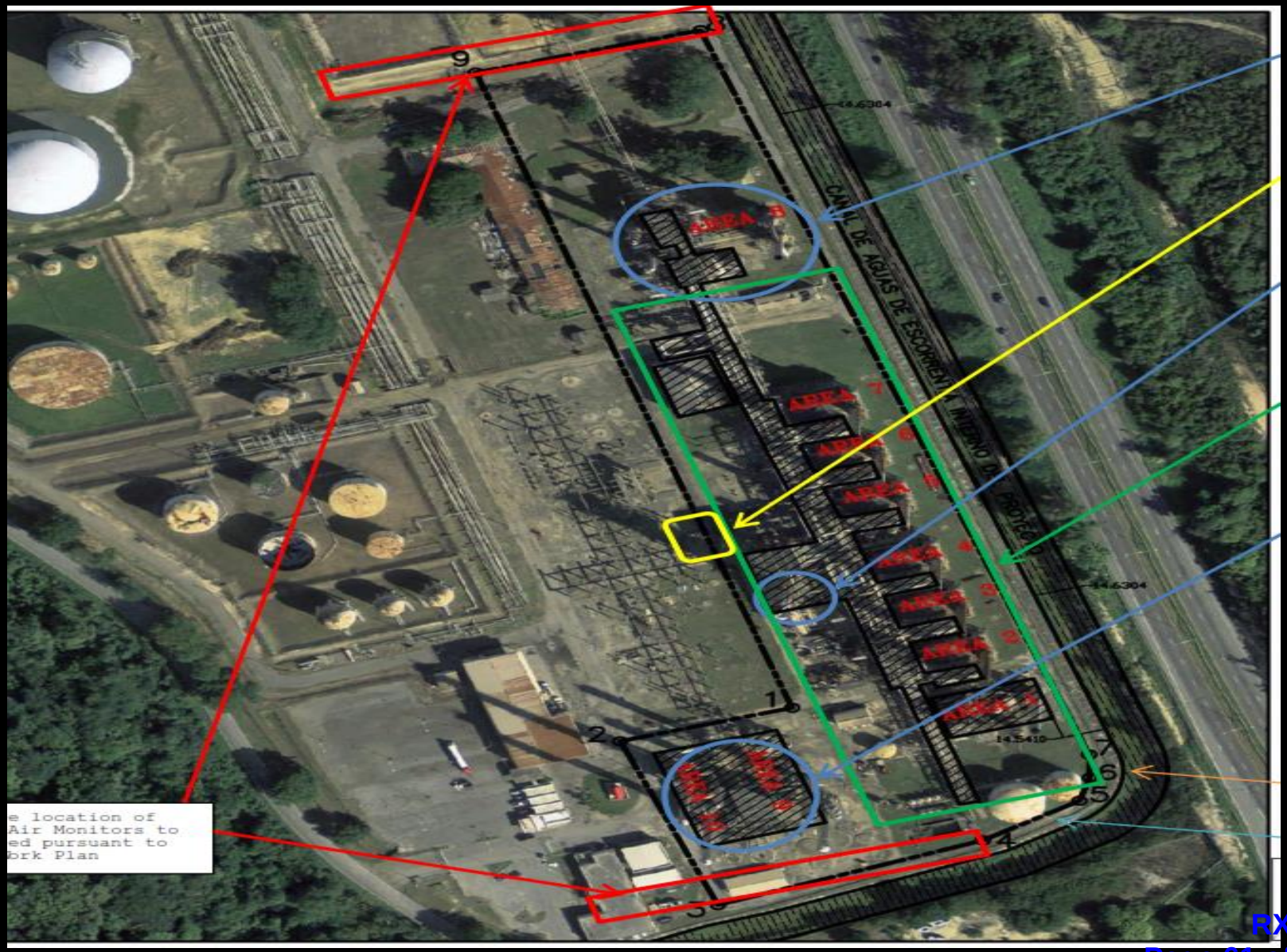
TSI FROM A HIGH DISTILLATION STACK

General Background

No complete ACM survey was conducted.

Initial EPA findings (as summarized by EPA)

- **Tall structures Stacks/Tanks**
  - Chrysotile concentration are up to 40%, Amosite is 5%
- **Low structures (ground level) Boilers**
  - Chrysotile concentrations up to 5%, Amosite 40%


e location of
Air Monitors to
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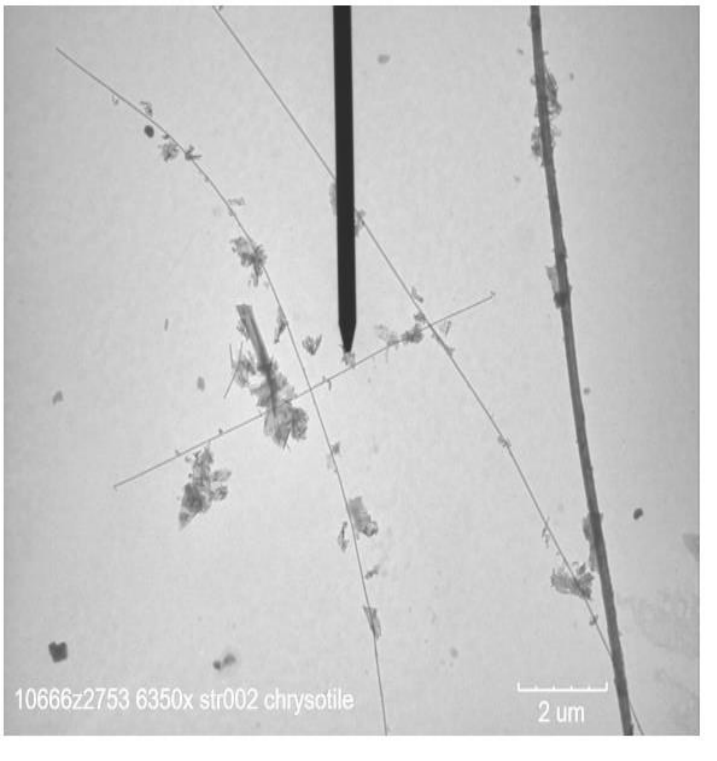
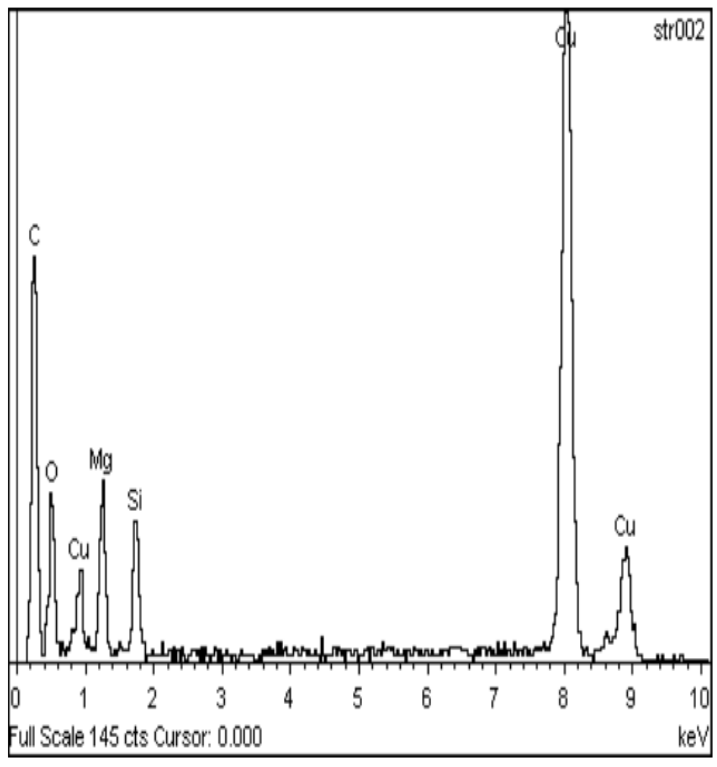
ork Plan

Bulk sample result of TSI on distillation tower

MVA #	PLM Analysis Results % Asbestos	Additional Materials Observed	TEM Analysis Results	Comments
Z2753	40-60% Chrysotile	Binder	Chrysotile Detected	Chrysotile with Calcium Silicate Binder Confirmed by SEM

TEM image (left) and EDS spectrum (right) of a representative Chrysotile fiber detected during analysis of insulation sample BULK-OL-CHM4-ER2 (MVA Z2753). No Aluminum or Iron peaks are visible.





TEM-EDS Characterization (Elemental Weight %) of Chrysotile Structures detected in insulation sample BULK-OL-CHM4-ER2 (MVA Z2753)

Structure	Mg	Si	Fe	Al
str001	26.2	24.9	0	0
str002	27.7	24.5	0	0
str003	28.0	24.4	0	0
str004	28.5	23.8	0	0
str005	26.0	25.5	0	0
str006	28.4	24.1	0	0
str007	26.9	24.9	1.67	0
str008	28.0	24.9	0	0
str009	27.3	24.8	0	0
str010	24.5	27.0	1.31	0
str011	28.9	23.3	0	0
str012	25.1	26.2	1.82	0
str013	28.2	23.9	1.55	0
str014	27.6	24.4	1.47	0
str015	27.6	24.5	1.45	0

CHEMICAL COMPOSITION

COMPOSITION OF THE SERPENTINES FOUND IN THE DUST SAMPLES

Table 5. EDS Characterization (atomic weight percent) of Chrysotile structures detected in settled dust samples collected from outside and inside Olefins facility.

MVA #	AES Sample I.D.	Mg	Al	Si	Fe	O
Z2124	D-EV-FP-ER1	28.6	0.7	22.6	2.3	45.8
		25.0	1.4	24.0	3.6	46.1
Z2125	D-HS-PG-ER2	27.4	0.0	25.1	0.8	46.8
		25.5	1.2	24.5	2.4	46.4
Z2127	D-JLPV-CR19-1F-H-ER4	27.2	1.0	24.1	1.2	46.6
Z2130	D-TEC-ARE-PO006-E-ER7	27.3	1.2	23.7	1.5	46.4
Z2131	D-TEC-GULF-GS-ER8	23.0	4.2	23.7	2.6	46.6
		28.2	1.1	23.1	1.3	46.3
Z2133	D-NOW-P0036-BS-ER10	27.5	0.9	22.6	3.4	45.6
Z2135	D-TEC-P0018-C2-ER12	22.2	1.8	26.7	2.2	47.2
		29.0	0.0	24.1	0.9	46.4
		19.7	1.5	26.1	6.8	45.9
		24.1	1.2	25.2	3.0	46.5
Z2377	D-OL-SM-ER6 (*sample inside Olefins)	27.1	1.0	23.9	1.7	46.4
		23.7	2.4	23.3	4.9	45.7
Ave		25.7	1.3	24.2	2.6	46.3
Std. Dev.		2.7	1.0	1.2	1.6	0.4
Max		29.0	4.2	26.7	6.8	47.2
Min		19.7	0.0	22.6	0.8	45.6

COMPOSITION OF THE AGGREGATES

Table 9. SEM/TEM-EDS Characterization (Elemental Weight %) of Serpentine Structures Detected in Aggregate Samples

	Mg	Al	Si	Fe	O	Ca	S	Type
Z2617	26.2	0.5	24.6	2.3	46.4	---	---	Chrysotile (TEM)
	25.0	1.1	21.9	4.3	45.2	2.5	---	Chrysotile (SEM)
	27.5	0.3	23.3	2.9	45.9	---	---	Lizardite (TEM)
	22.7	2.6	21.4	5.8	45.0	2.6	---	Lizardite (SEM)
Z2618	20.7	0.9	23.8	4.8	46.4	1.6	1.9	Chrysotile (TEM)
	27.9	1.2	23.2	1.5	46.3	---	---	Lizardite (TEM)
Z2754	28.4	---	23.3	2.5	45.9	---	---	Chrysotile (TEM)
	26.1	2.1	23.0	2.5	46.3	---	---	Chrysotile (SEM)
Z2755	27.7	---	25.3	---	47.0	---	---	Chrysotile (TEM)
	25.0	0.8	22.9	3.0	45.6	2.7	---	Chrysotile (SEM)
	25.0	0.7	23.4	2.5	45.8	2.6	---	Chrysotile (SEM)

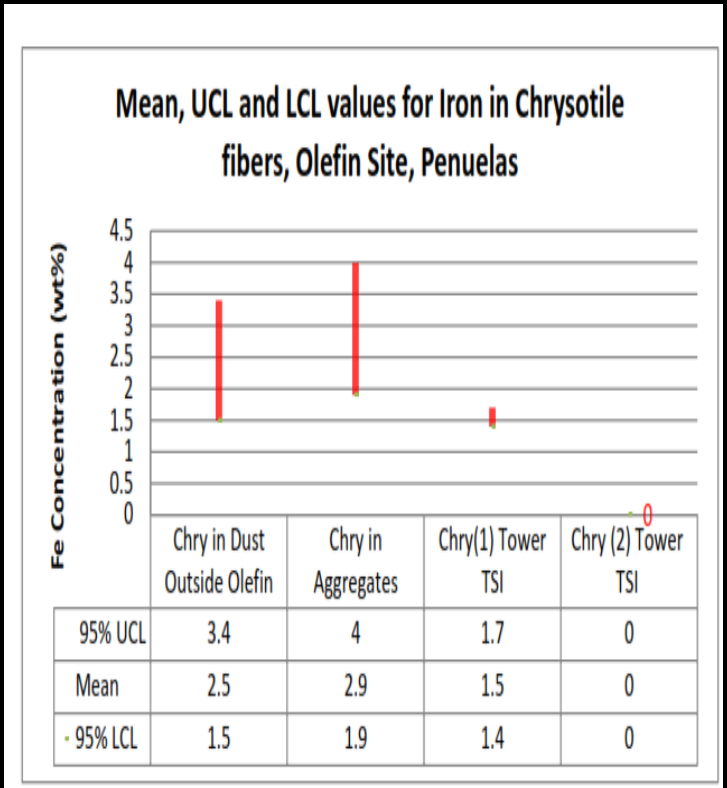
CHEMICAL COMPOSITION

COMPOSITION OF THE SERPENTINITES YAUCO/MEDIA QEJADA AREA

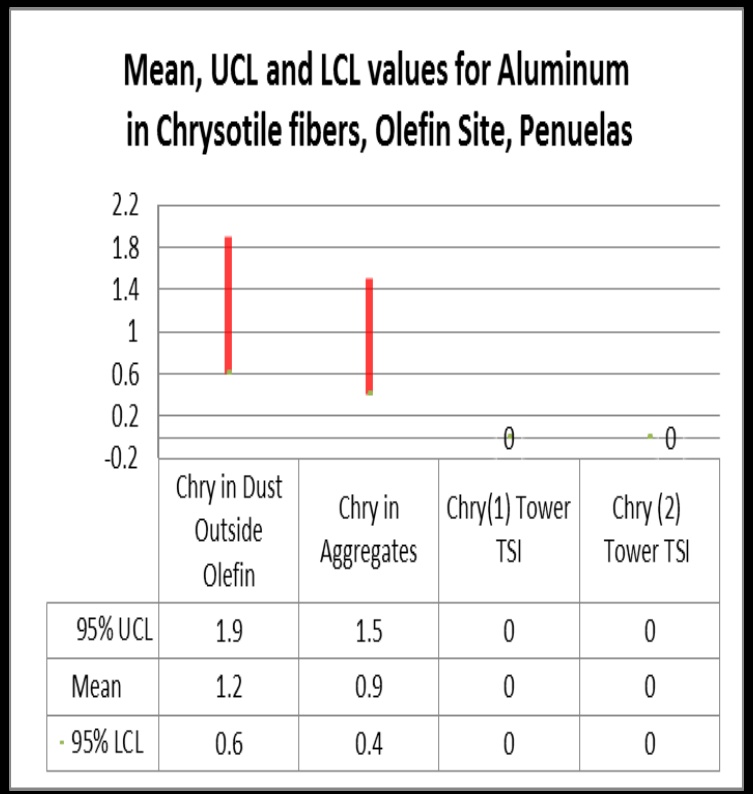
Table 7. EDS Characterization (Elemental Weight %) of Fibrous and Non-Fibrous Serpentine Structures Detected in Mineral Samples Z2284 (RM-MC-AP3) and Z2285 (R-Q1-AP4)

	Mg	Al	Si	Fe	O
TEM P001	28.7	0.0	22.8	3.0	45.6
TEM P002	25.4	1.4	22.4	5.7	45.1
TEM P003	24.9	0.0	25.1	2.9	46.4
TEM P004	25.8	1.1	23.4	3.9	45.8
TEM F001	30.5	0.0	19.6	5.4	44.2
TEM F002	27.1	0.0	22.8	4.1	45.5
TEM F003	25.6	0.6	22.2	7.1	44.6
SEM (3)_Pt1	26.1	0.8	23.7	2.4	47.0
SEM (3)_Pt2	25.2	0.8	20.5	2.8	50.7
SEM (3)_Pt3	25.9	0.8	24.3	3.2	45.8
SEM (4)_Pt1	25.7	0.7	21.3	2.9	49.4
SEM (4)_Pt2	26.5	0.9	26.8	6.4	39.4
Ave	26.4	0.6	22.9	4.1	45.8
Std. Dev.	1.6	0.5	2.0	1.6	2.8
Max	30.5	1.4	26.8	7.1	50.7
Min	24.9	0.0	19.6	2.4	39.4

Iron and Aluminum concentrations from Chrysotile containing dust and aggregate samples

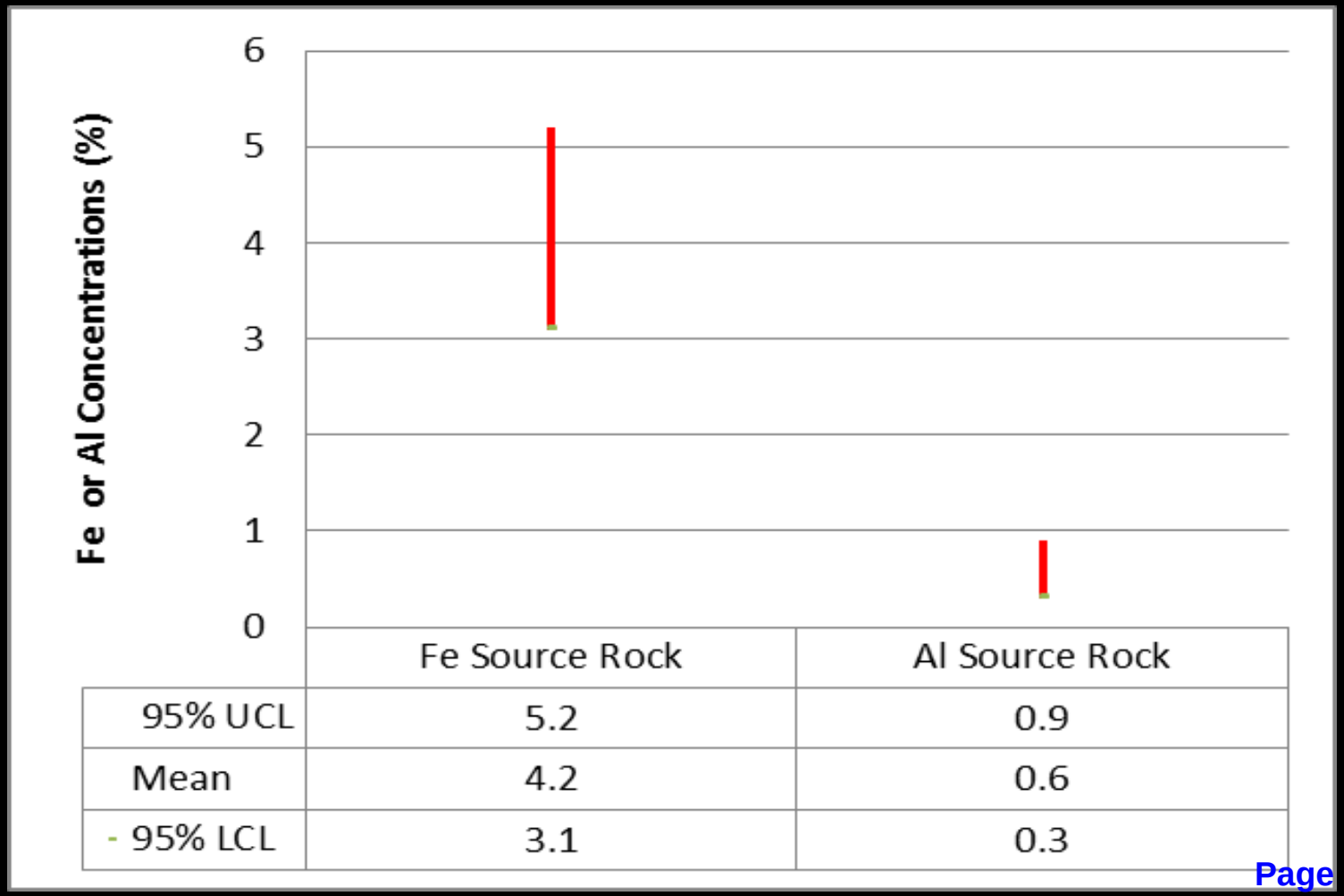


	Chry in Dust Outside Olefin	Chry in Aggregates	Chry(1) Tower TSI	Chry (2) Tower TSI
95% UCL	3.4	4	1.7	0
Mean	2.5	2.9	1.5	0
95% LCL	1.5	1.9	1.4	0



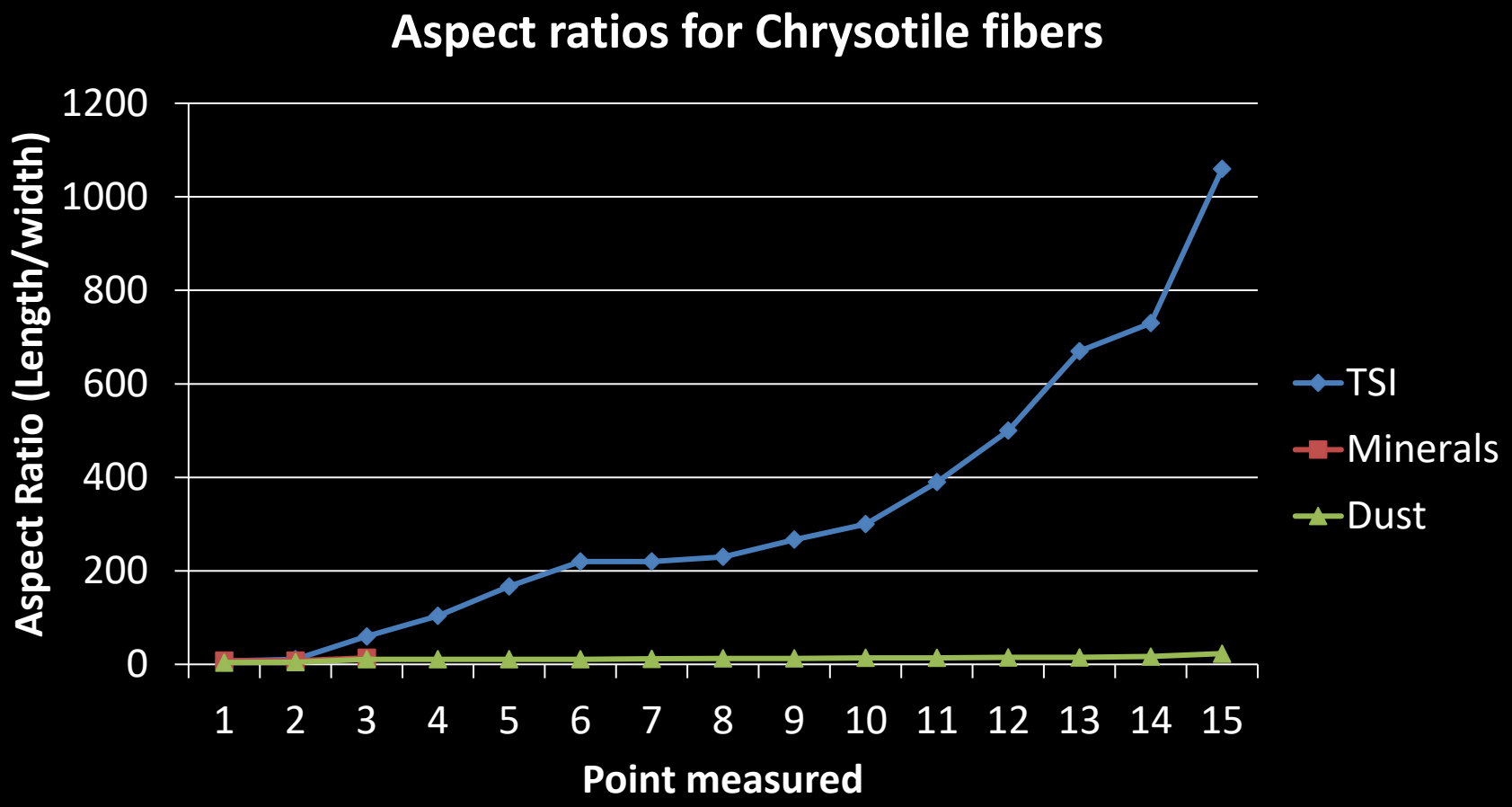
	Chry in Dust Outside Olefin	Chry in Aggregates	Chry(1) Tower TSI	Chry (2) Tower TSI
95% UCL	1.9	1.5	0	0
Mean	1.2	0.9	0	0
95% LCL	0.6	0.4	0	0

Iron and Aluminum concentrations of Chrysotile and Lizardite in the samples from the source rock



	Fe Source Rock	Al Source Rock
95% UCL	5.2	0.9
Mean	4.2	0.6
- 95% LCL	3.1	0.3

Aspect ratios for Chrysotile fibers present in TSI, NOA and dust. TSI is from a distillation tower.



ADDITIONAL SOURCES OF POTENTIAL CONTAMINATION

Property 0008-Encarnacion Community Tallaboa.

PACM Spray on Ceiling (stucco) on the first floor (exterior right/interior -left) ceiling-Property P0008 built in 1967. Second floor was under construction (Weston report Phase IV)

Church in Tallaboa Community, next to the schoool

Front View

Side View

Location of sampling points-Beach area

General View of asbestos transite panels mixed with trash.

Waste Pile #3

Waste pile # 9

CONCLUSIONS

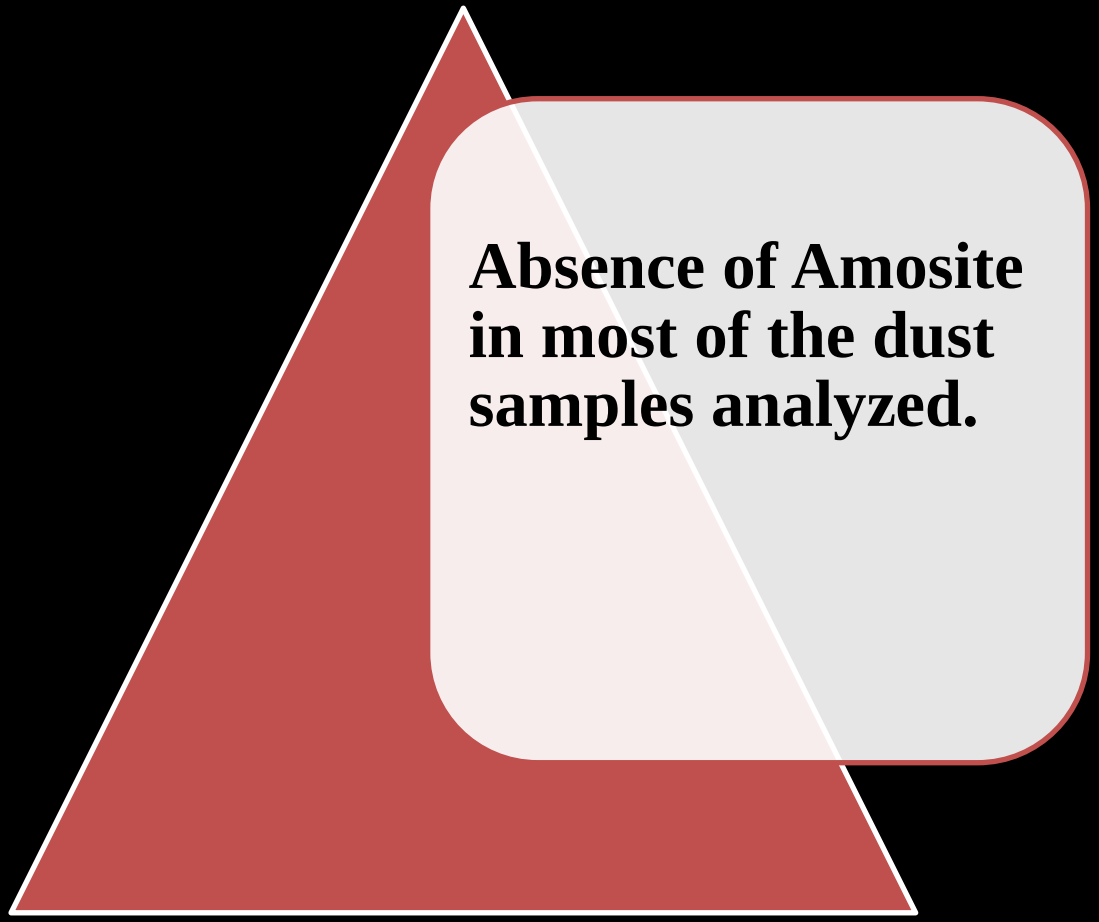
WHY THE CONTAMINATION OUTSIDE OLEFIN FACILITY CANNOT BE RELATED TO OLEFINS TSI ONLY?

Presence of non-fibrous (Lizardite) serpentine together with fibrous (Chrysotile) serpentine and Magnetite in some of the dust samples collected around Olefins facility. Same minerals association was observed in the NOA source rock mined from quarries located in SW of Puerto Rico .

WHY THE CONTAMINATION OUTSIDE OLEFIN FACILITY CANNOT BE RELATED TO OLEFINS TSI ONLY?

Presence of Lizardite, Magnetite and Fe/Al bearing Chrysotile in the aggregate samples collected from gravel. The source of the gravel is from the present/past quarries located in the SW of Puerto Rico. Both Lizardite and Chrysotile were observed to be present and closely intergrown.

WHY THE CONTAMINATION OUTSIDE OLEFIN FACILITY CANNOT BE RELATED TO OLEFINS ONLY?



WHY THE CONTAMINATION OUTSIDE OLEFIN FACILITY CANNOT BE RELATED TO OLEFINS ONLY?

The direct correlation between the Fe-Al content of Chrysotile in aggregates with the Fe-Al content of Chrysotile fibers present in the dust samples.

WHY THE CONTAMINATION OUTSIDE OLEFIN FACILITY CANNOT BE RELATED TO OLEFINS TSI ONLY?

The difference between Al-Fe content of Chrysotile from the aggregates/dust samples versus Chrysotile composition of insulation sample collected from a deteriorated TSI (Distillation Tower)

- AL-Fe Concentrations in Serpentines present in aggregates and dust samples-overlap
- Al-Fe in TSI insulation-low Fe, no Al.

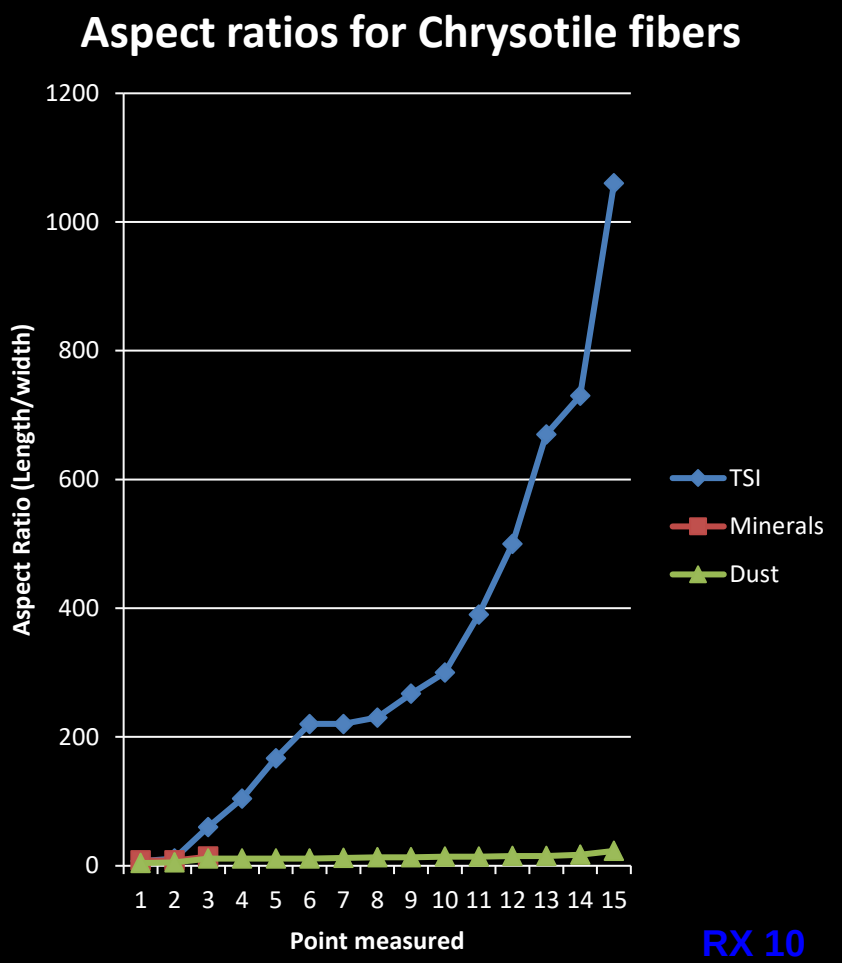
Aspect Ratio-Dust, TSI, minerals

Dust-Aspect ratios of Chrysotile fibers present in the dust samples were primarily less than 20:1

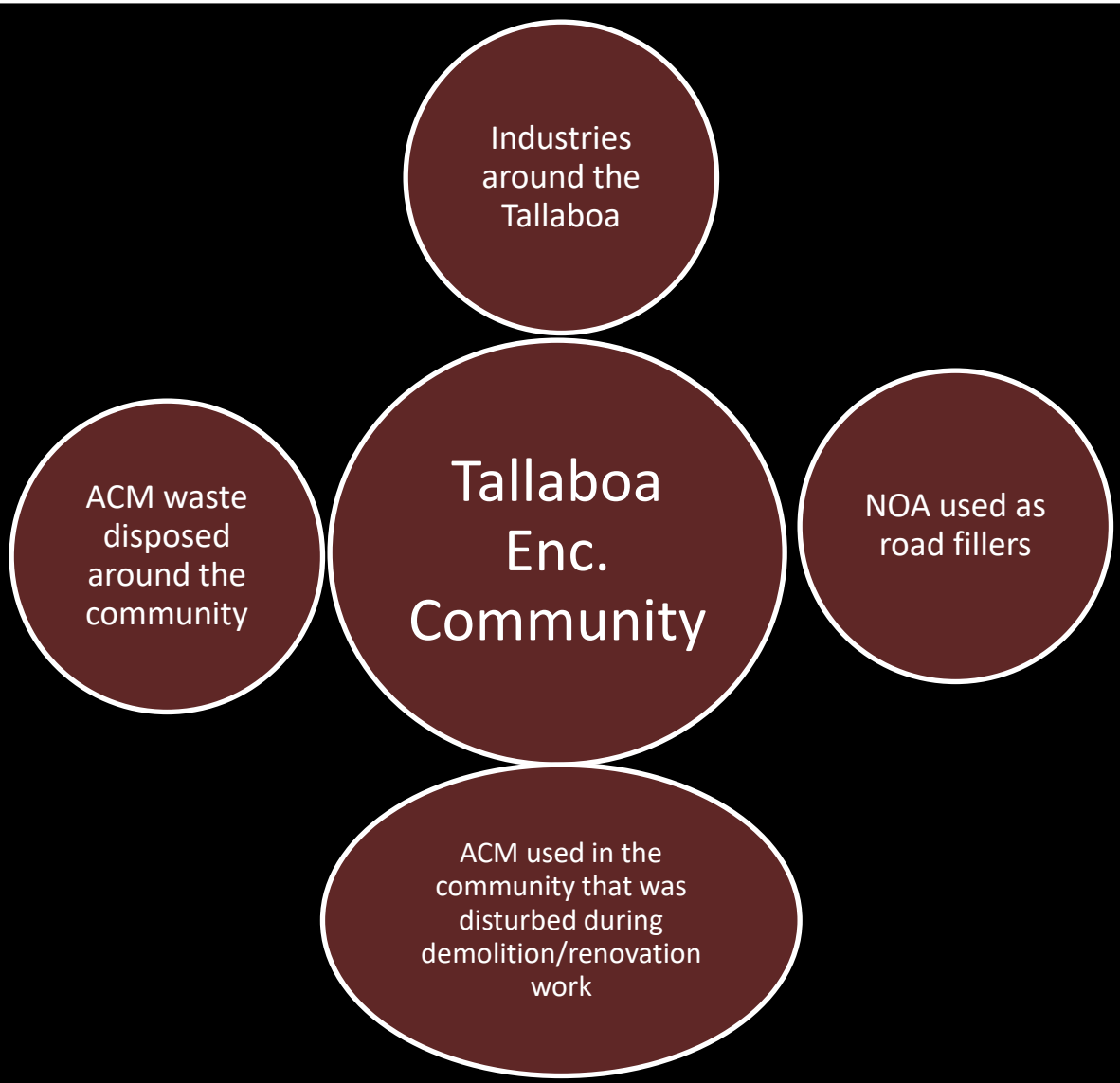
TSI-distillation tower . TSI fibers were found to have a much larger aspect ratios; the average aspect ratio of the fifteen fibers analyzed was greater than 100:1 (329).

Minerals-Serpentinite

Aspect ratios of 8:1, 8:1 and 14:1.



Potential Sources of Asbestos Contamination for Tallaboa Enc. Community



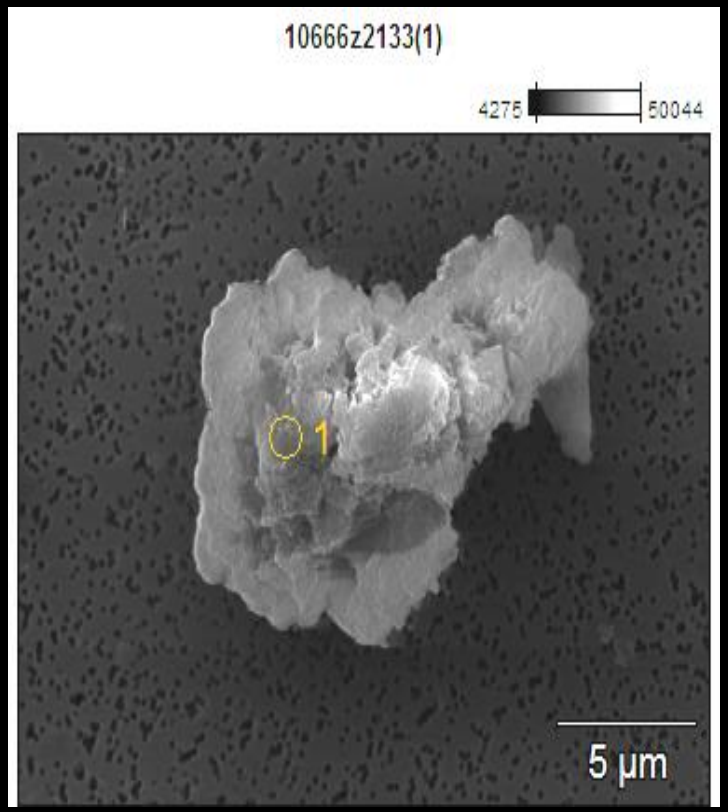
SERPENTINITES FORMATION

Serpentinization by Hydration at low temperature (Most Lizardites)-Identified by Bastite

MgFe olivine + H2O → MgFe serpentine + magnetite+H

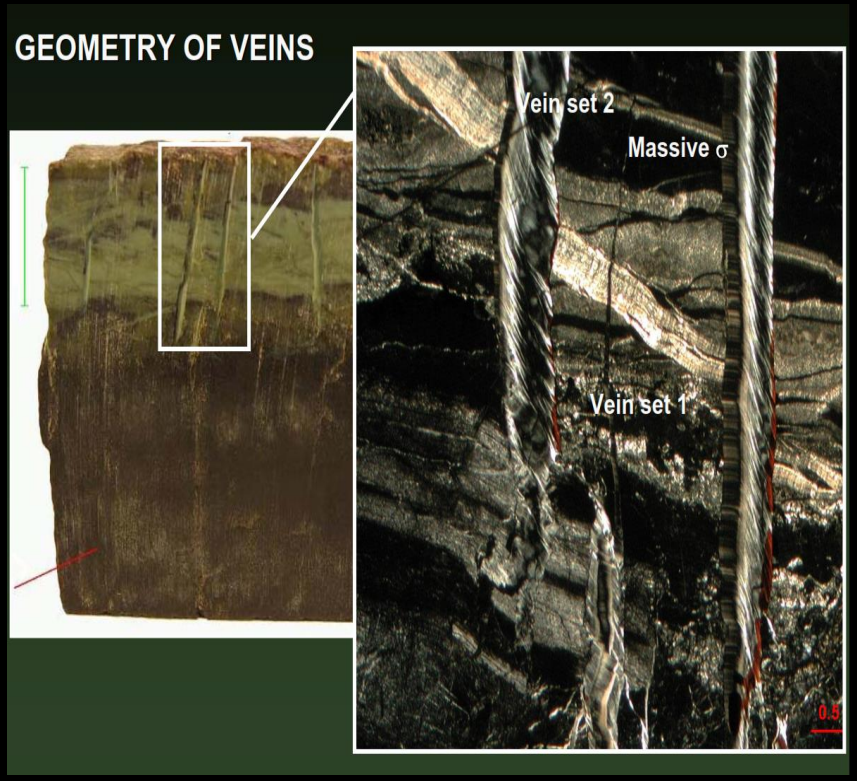
- (e.g. Ontario serpentinite from 100% Dunite)

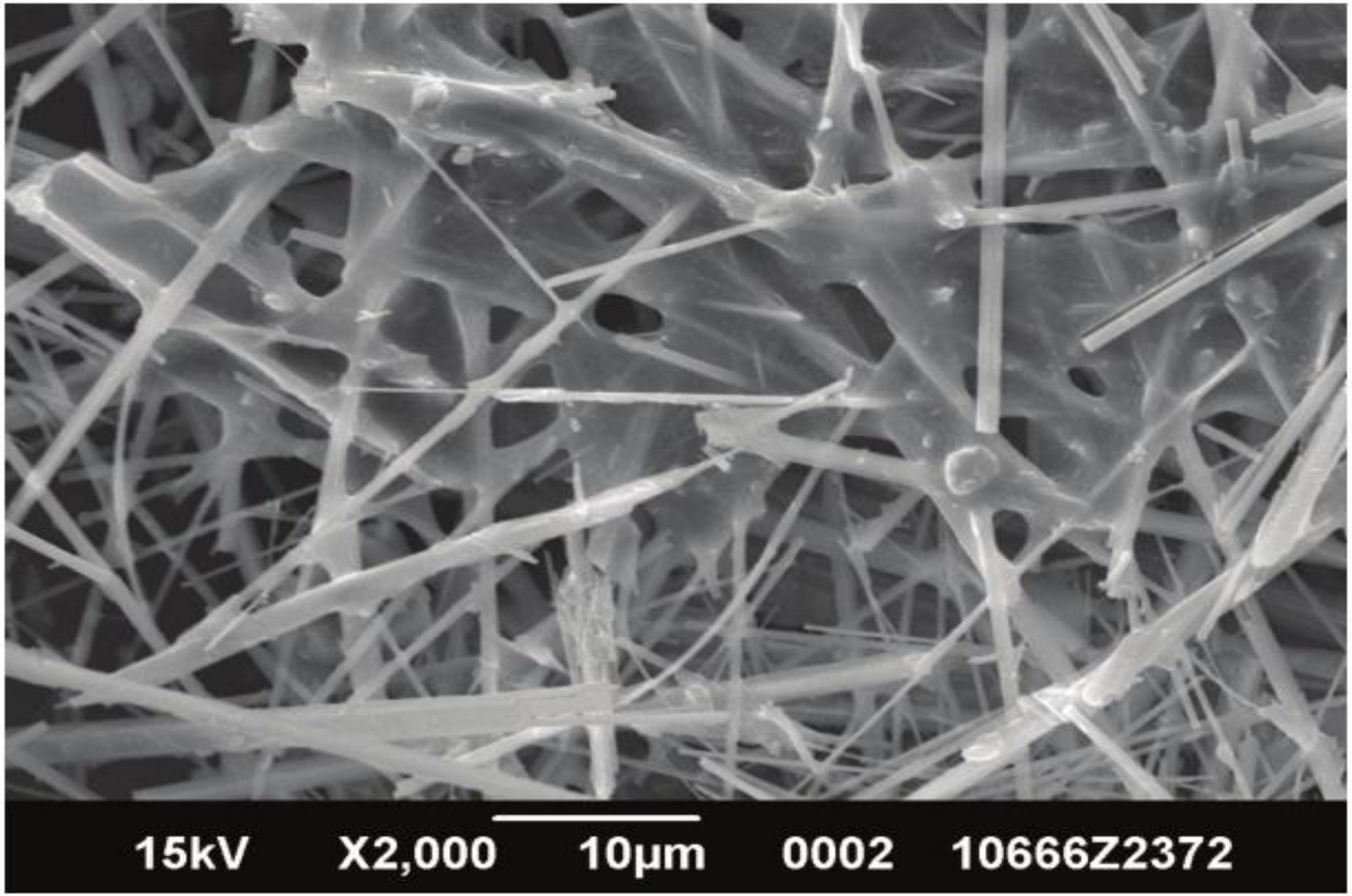
Pyroxyne+H2O →MgFe Serpentine+Silica



Serpentinization by Recrystallization (Mostly Chrysotiles in veins/cleavage)

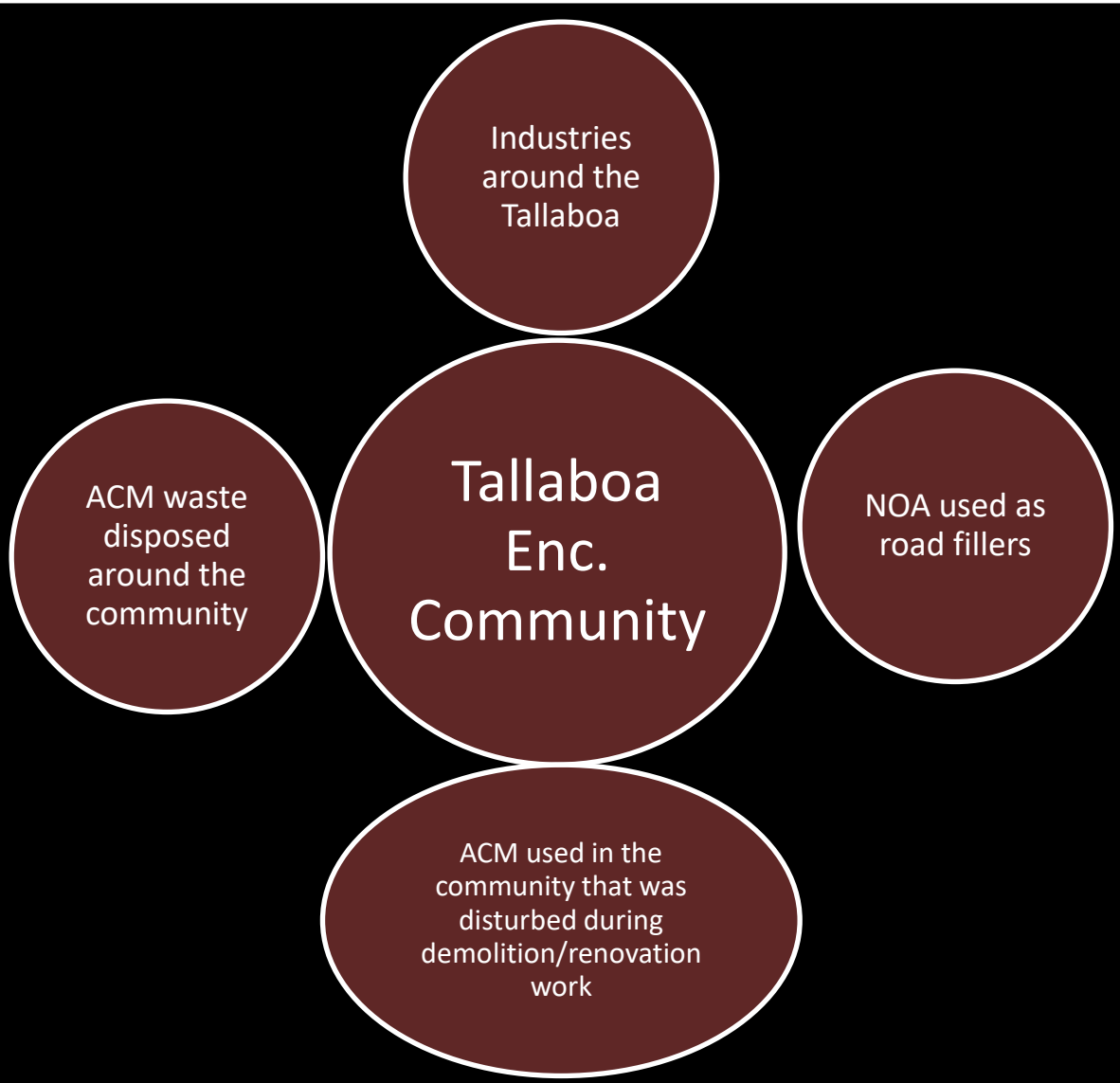
- Process of alteration in which the destabilization of primary minerals releases the iron and the other elements necessary for serpentine formation.





Insulation sample B-OL-PS408-ER5 (MVA Z2372). Numbers denote areas where EDS spectra were collected. Large bundles of amosite were identified in point1. Diatoms were identified in point 2. Smaller amosite fibers with silicon-rich binder material are present in point 3.

Potential Sources of Asbestos Contamination for Tallaboa Enc. Community



The Bus Stop Bench Sampling Experiment

Bus station is located at the intersection of state roads PR-385 and PR-384, about 1.6 miles north-west of site (see Appendix I for sampling points locations).

Table 1. Summary of Bus Stop Bench Samples. Unless otherwise specified results (str/cm^2) are Chrysotile fibers.

MVA #	Sample I. D.	Sample Description	Date Collected	TEM results [str/cm^2]
Z2133	D-NOW-P0036-BS-ER10	Dust, stop bus bench, rd. 385 int. with rd. 384, northwest of Olefins, between 1 and 2 miles	02 October 2014	6,300
Z2136	BLK-FB-ER13	Field blank	02 October 2014	NAD (A.S. 250)
Z2374	D-385-W-ER1	Wipe 10 cm x 10 cm from bench left side bus stop	23 October 2014	880,000
Z2375	D-FB-385-ER2	Field blank	23 October 2014	NAD (A.S. 250)
Z2619	D-NOW-P0036-BS-ER1	Dust on bench bus stop intersection Road 385/384	11 November 2014	NAD (A.S. 4,200)
Z2620	D-NOW-P0036-BS-ER2	Dust under bench bus stop intersection Road 385/384	11 November 2014	NA
Z2621	D-FB-NOW-P0036-BS-ER3	Field blank	11 November 2014	NAD (A.S. 250)
Z2622	W-NOW-P0036-BS-ER1	Wipe on bench bus stop intersection Road 385/384	11 November 2014	880,000
Z2623	W-NOW-P0036-BS-ER2	Wipe under bench bus stop intersection Road 385/384	11 November 2014	NA
Z2624	W-FB-NOW-P0036-BS-ER3	Field blank	11 November 2014	NAD (A.S. 250)
Z2710	D-NOW-P0036-BS-ER1	Dust on bench bus stop intersection Road 385/384	18 November 2014	10,000
Z2711	D-NOW-P0036-BS-ER2	Dust under bench bus stop intersection Road 385/384	18 November 2014	NA
Z2712	D-FB-NOW-P0036-BS-ER3	Field blank	18 November 2014	NAD (A.S. 250)
Z2713	W-NOW-P0036-BS-ER1	Wipe on bench bus stop intersection Road 385/384	18 November 2014	13,000 total chrysotile-8,400 tremolite-4,200
Z2714	W-NOW-P0036-BS-ER2	Wipe under bench bus stop intersection Road 385/384	18 November 2014	NA
Z2715	W-FB-NOW-P0036-BS-ER3	Field blank	18 November 2014	NAD (A.S. 250)

NA = Not analyzed. NAD = No Asbestos Detected (A.S. = Analytical Sensitivity)