WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Via Email and U.S. Mail

17 August 2007

Mr. Chal A. Martin
Public Works Director / City Engineer
City of Burlington
900 East Fairhaven Avenue
Burlington, WA 98233

Re: City of Hamilton
Historic Flood Investigation
WJE No. 2006.5898

Dear Mr. Martin:

At your request, Wiss, Janney, Elstner Associates, Inc. (WJE) investigated evidence of historic flood levels in the City of Hamilton, Washington, by removing silt samples from the Smith and Slipper Houses and subjecting them to microscopical studies. It was our understanding that there were questions as to whether or not the Smith House, located in Hamilton, flooded during historic flood events in the early 1900's. The purpose of our work was to identify, if possible, to what extent the Smith House flooded during the events of the early 1900's.

Investigation

We met with you at the Smith House on 11 April 2007 to locate areas for investigative openings. On 19 April 2007, we met again at the site with you and a contractor to open the areas selected for investigative openings. A total of four investigative openings were made. Openings 1 through 4 were at the Smith House. Opening 5 was at the Slipper House located approximately 3 blocks south of the Smith House. Investigative openings were made at the following locations:

- Opening No. 1: Interior opening of north exterior wall in upstairs bedroom, near base of wall (Figure 1)
- Opening No. 2: Interior opening of east exterior wall adjacent to front door, at base of wall (Figure 2)
- Opening No. 3: Opening of south surface of interior wall intersecting east exterior wall near front door, at base of wall (Figure 3)
- Opening No. 4: North exterior wall, behind exterior siding (Figure 4)
- Opening No. 5: Opening of interior office wall at Slipper House (Figure 5)

Silt samples were removed from each of the five openings. Silt samples were also removed from within the crawlspace of the Smith House.

During the 19 April investigation, Mr. Richard A. Dethlefs, P.E., S.E. of WJE and Mr. Chal Martin of City of Burlington crawled through the crawlspace of the Smith House. Five silt samples were removed from various locations throughout the crawlspace for microscopical studies. A total of eleven silt samples were sent to the WJE laboratory in Northbrook, Illinois, for microscopical studies.

Findings and Observations

Building Description

The Smith House, built in 1908, is a two-story, wood frame structure supported on perimeter concrete foundation walls and post-and-pier foundations. The west end of the house has a full height basement. The basement walls and floors are concrete. The east end of the house, approximately 30 feet in length, has a crawlspace with post-and-pier interior foundations (Figure 6). The first floor framing is generally 6x6 beams spaced at approximately 6 feet on center supporting 2x8 joists at 2 feet on center with 1x shiplap subflooring. The beams are supported by 6x6 posts set on concrete piers at approximately 8 feet on center. The finish floors are 1x4 tongue-and-groove Doug-Fir flooring.

Crawlspace

In the crawlspace, there did not appear to be any attachment of the perimeter beams and rim joists to the concrete foundation walls. Along the east wall, gaps were generally observed between the perimeter beam and the concrete foundation wall. Shims of 1x material were used to periodically shim the gap between the perimeter beam and the top of the foundation wall. Generally, no positive attachment was provided between the 6x6 posts and the beams or concrete piers.

Extensive framing repairs were observed along the south wall at the east end of the house. Reportedly, the repairs were initiated to address damage resulting from a flood that occurred in 1995. The south end of the 2x8 floor joists were cut along most of the length of the south wall. The joists were extended with sistered 2x8 joists, which were supported on stacked 2x plates on top of the foundation wall (Figure 7). The 6x6 beam located approximately 6-1/2 feet inward from the south wall reportedly rolled as a result of the flood. The beam was realigned and supported by side gussets. The subflooring in this area was replaced by plywood.

There is a black plastic vapor retarder on top of the ground surface throughout the crawlspace. The vapor retarder was generally overlain by a layer of fine silt (Figure 6). At the northwest corner of the crawlspace, a layer of silt was observed on the top surface of a floor beam located 2 feet 8 inches above the ground surface.

Basement

There is an interior concrete foundation wall between two adjacent rooms of the basement in the southwest corner of the house. Between the two rooms is a framed wood door. Flood lines from recent floods were observed on both sides of the concrete foundation wall. The flood line on the west side of the wall is located 11-5/8 inches from the ceiling. The flood line on the east side of the wall is located 13-1/2 inches from the ceiling.

Opening No. 1

Opening No. 1 was located in the upper floor, north bedroom. The opening was made in the interior surface of the north, exterior wall. The wall finish was the original wood lath-and-plaster. No apparent flood lines or debris were observed within the wall cavity. The lath nails exhibited minor rust staining on the 2x4 wall studs.

Opening Nos. 2 and 3

Opening Nos. 2 and 3 were located on the main floor level. Opening No. 2 was made in the interior surface of the east, exterior wall adjacent to the front door (Figure 8). Opening No. 3 was made in the south surface of the interior wall adjacent to the east exterior wall. Both openings were located at the base of the wall. No apparent flood debris or flood lines were observed within the wall cavities. Framing nails visible in the wall cavities were corroded. The lath nails exhibited minor rust staining on the 2x4 wall studs.

Opening No. 4

Opening No. 4 was an exterior opening located on the north wall, just below the dining room bay window. At this location, the wood lap siding was removed to reveal the wood wall sheathing. Seven courses of lap siding, approximately 2-1/2 feet in height, were removed below the window.

There was a discoloration line located on the 1x shiplap sheathing boards approximately 2 feet below the window. The line appeared to be a flood line and corresponded with the approximate elevation of the interior finish floor (Figure 9). Lesser discolorations, light staining, of the wood sheathing were observed above this line. If the line is a flood line, as it appears to be, the fainter discolorations above this line are likely due to wicking of water behind the siding.

Slipper House

The Slipper House, reportedly built around the same era as the Smith House, has reportedly been relocated and elevated from its original location. One opening, Opening No. 5, was made within the Slipper House. The opening was located at the base of the interior, west wall of the office. The office side of the wall was sheathed with 1x shiplap sheathing with gypsum wallboard interior finish. The back side of the wall was sheathed with wood shiplap siding boards. The boards had paint on them and were shaped like siding boards. Some of the boards were installed upside down indicating that the backside of the wall was sheathed with re-used materials.

Grey colored deposits were observed on the top edge of the 1x shiplap sheathing boards on the office side of the wall (Figure 10). The deposits were primarily located on the top of the boards near the base of the wall. The bottom three boards removed from the opening and provided to the lab for microscopical examination.

Lab Analysis and Findings

The grey colored deposits found within the wall at the Slipper House appear to be mortar, not flood silt.

Two debris samples from the crawlspace contained clay particles, which were likely water-borne sediment. One of the two samples was taken from the top of a floor beam approximately 2 feet 8 inches above the crawlspace floor. The other sample was taken from the surface of the vapor retarder near the

center of the crawlspace. The rest of the crawlspace deposit samples, samples 4, 6, and 9, contained primarily fine angular fragments of quartz and feldspar with smaller amounts of mica, hornblende, opaque grains, and others.

No visual indication of flooding was found within the interior wall cavities of the Smith House. The microscopical studies of the debris from Opening 2 consisted mainly of gypsum, which was likely the dust deposited from cutting the opening through the plaster wall finish. The debris from Opening 3 was found to contain many of the same components as were observed in the deposits found within the crawlspace, i.e. angular volcanic rock fragments (basalt, brown volcanic glass, colorless volcanic glass) and mineral grains (quartz, chert, feldspar, hornblende, biotite mica, pyroxene, hematite, and opaque grains), but did not appear to have been deposited due to flood waters.

Debris samples removed from the vertical wall surface and sill behind the lap siding at the north exterior opening contained angular volcanic rock fragments and mineral grains (quartz, feldspar, pyroxene, hornblende, mica, hematite, apatite, and opaque grains) similar to the silt samples removed from the crawlspace. The water line observed behind the siding boards indicate that the silt was likely deposited by flood water. No silt samples were removed from above the water line for comparison because the boards above the water line were clean.

The WJE laboratory debris studies report is provided in the Appendix.

Conclusions

The deposit sample removed from inside the wall of the Slipper House appeared to be a mortar material, not flood silt. As a result, the limited sampling of the Slipper House was inconclusive regarding determination of past flood levels within the house and determination of flood silt materials that can be transferred into an interior wall cavity during a flood event.

At the Smith House, WJE did not observe any evidence to indicate that flood water elevations ever exceeded the finish floor elevation of the house. The debris samples removed from Opening 3 were similar in constituency to the debris found within the crawlspace, but there was no visual evidence to indicate the material was deposited by flooding. In addition, none of the same materials were found in Opening 2, which was immediately adjacent to Opening 3 in an exterior wall. The debris in Opening 3 is likely from soils deposited in the wall at the time of construction and from fragments of the plaster deposited in the space while cutting the opening.

The silt debris found within the crawlspace on top of the vapor retarder is believed to have been primarily deposited by flooding. There was generally a thick layer of the silt observed throughout the crawlspace on top of the vapor retarder and on top of floor beams elevated approximately 2 feet 8 inches above the level of the crawlspace floor.

The water line observed behind the north, exterior wall opening behind the lap siding, was approximately equal in elevation to the finish floor elevation. No silt debris was observed above the water line at this location. Both silt samples removed from behind the siding contained many of the same constituents as the silt samples found on top of the vapor retarder within the crawlspace. It is likely that the silt debris found behind the lap siding at this location was deposited by flood water.

It is our understanding that the repairs at the southeast corner of the house were performed as a result of damage from the 1995 flood. Based on the repairs that were performed, it appears that buoyancy effects from the 1995 flood caused the wood floor framing to lift off of the south foundation wall leaving the south end of the floor joists unsupported and one 6x6 floor beam rotated. Because there were no positive connections found between the wood framing and the concrete foundations, it is not surprising that the flood waters were able to float a portion of the house. While in the crawlspace, we did not observe any evidence of similar historic repairs to indicate that the house had been subjected to buoyancy effects during earlier area floods.

The highest water mark and/or indication of flood silt deposits found at the Smith House were at Opening 4, behind the wood lap siding on the north side of the house. The elevation of the flood markings and silt deposits at this location were approximately equal in elevation to the finish floor elevation. We are unable to determine from the debris samples when the approximate date of this highest flood level occurred; however, based on the damage and repairs that occurred as a result of the 1995 flood, it appears that this flood may have been close to, if not the highest elevation of flood water that the house ever experienced.

We are unable to explain the nearly 2 inch difference in elevation of the flood lines on either side of the concrete foundation wall in the basement. Since both sides of the wall appear able to readily receive flood waters and the drainage characteristics of the rooms on either side of the wall appear similar, we were unable to develop a logical explanation for why one side of the wall would be marked nearly 2 inches higher than the other side of the wall. Both of the observed marks were lower in elevation than the mark observed at the north exterior opening behind the lap siding.

Please call if you have any questions.

Very truly yours,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Richard A. Dethlefs, P.E., S.E.
Consultant

Enclosures:
Figures
Appendix

FIGURES

Figure 1. Smith House, Opening No. 1. Upstairs bedroom, north exterior wall.

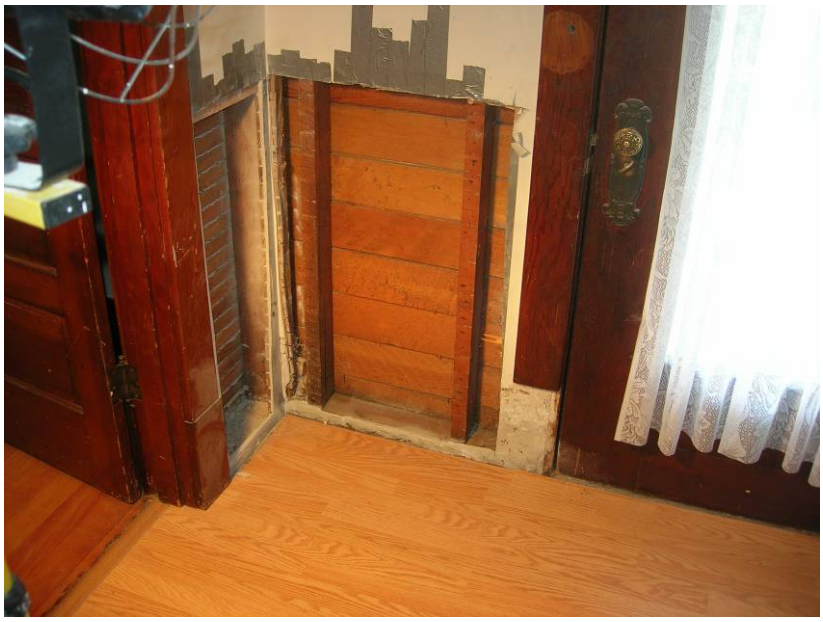

Figure 2. Smith House, Opening No. 2. Interior opening of east exterior wall adjacent to front door.

Figure 3. Smith House, Opening No. 3. Opening at south side of interior wall adjacent to Opening No. 2.

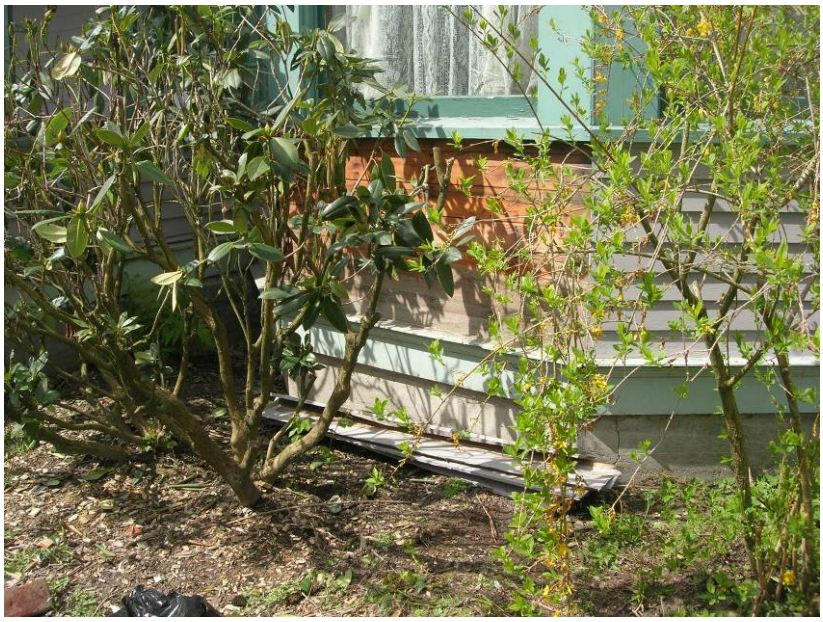

Figure 4. Smith House, Opening No. 4. North exterior wall behind siding.

Figure 5. Slipper House, Opening No. 5. Opening at interior office wall.

Figure 6. Smith House crawlspace.

Figure 7. Repairs at south end of Smith House foundation.

Figure 8. Close-up view of Opening No. 2. No water lines present.

Figure 9. Smith House, Opening No. 4. Water line at approximately same elevation as finish floor line behind lap siding.

Figure 10. Grey deposits on top of sheathing boards at Slipper House interior wall opening.

APPENDIX

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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INTEROFFICE MEMORANDUM

Via: email

To: Richard Dethlefs

From: Laura J. Powers

Date: 17 August 2007

Project: Hamilton, Washington Flood Mark Investigation
WJE No. 2006.5898

Subject: Debris Studies

As requested, microscopical studies have been conducted to compare samples of silty deposits removed from various locations of the Smith House and samples removed from one location of the Slipper House. The purpose of the microscopical studies was to establish the likelihood that the various silt deposits in the Smith House were deposited by a flood. Reportedly, the Slipper House was documented as having experienced the same flooding event that is suspected of depositing debris at the Smith House. The Slipper House has reportedly been moved since the flooding event. The Smith House has not been moved since its original construction in 1908.

The samples received for study are listed below.

Table 1 – Samples and Locations

WJE Sample No.	Sample Identification	Location and Field Description	Date Collected
1	Slipper House	Slipper House - 2nd sheathing board from floor, office wall opening.	4/19/07
2	Smith House crawlspace, NW Corner	Silt sample from top of floor beam, approximately 2 feet 8 inches above grade	4/19/07
3	Smith House. Opening No. 3	Dust / Debris from top of sill plate. Interior wall intersecting east exterior wall near front door.	4/19/07
4	Smith House crawlspace, NE Corner	Crawl space NE corner - silt brushed from surface of boiler pipes ~2ft below floor	4/19/07
5	Smith House, Exterior Opening, North Wall, Sill	Silt from sill behind exterior lap siding.	4/19/07
6	Smith House crawlspace, Top Layer Visqueen	Silt sample from top layer of plastic sheeting in crawlspace.	4/19/07
7	Smith House, Exterior Opening, North Wall, Wall	Silt sample from vertical wall surface, approximately 5 inches below finish floor elevation.	4/19/07
8	Smith House crawlspace, Center	Silt sample from crawlspace near center of house	4/19/07
9	Smith House, crawlspace, East	Silt sample from crawlspace, sample from underlying plastic, near east mid-crawl space	4/19/07

WJE Sample No.	Sample Identification	Location and Field Description	Date Collected
10	Smtih House, Opening No. 2	Bottom four lath pieces. Interior of east exterior wall near front door, interior finish removed.	4/19/07
11	Smith House, Opening No. 3	Interior wall near entry	4/19/07

Microscopical Studies

The samples were examined in general accordance with the procedures outlined in ASTM C 856, *Standard Practice for Petrographic Examination of Hardened Concrete*, which is applicable to a wide variety of other materials used in construction, and provides guidance for conducting systematic microscopical investigations. The samples were examined visually, and with the aid of a stereomicroscope using magnifications up to 60X. Materials chosen for more detailed studies were removed either by gently scraping the surface with a scalpel or by applying clear tape to the surface. The material collected was passed through a 75-micron sieve (No. 200). Particles retained on the 75-micron sieve were examined directly using the stereomicroscope. A sample of the particles retained on the 45-micron sieve (No. 325) was immersed in a drop of refractive index liquid on a glass microscope slide, and then covered with a thin glass cover slip. Particles collected on clear tape were placed on a glass microscope slide. Refractive index liquid was infiltrated under the tape, and a thin glass cover slip was mounted over the tape also using refractive index liquid. These preparations were examined at magnifications up to 500X using a polarized-light microscope. Representative features were photographed.

Sample Descriptions

Sample 1 Slipper House: The sample is a saw-cut section of wood sheathing, approximately 12 inches long, 3.2 inches high, and about 0.6 inches thick. One side of the sample is marked with an arrow and a notation 9 inches up. Insect webs are observed on the unlabeled side. Gray, buff, and beige deposits are observed on both sides and on the top and bottom surfaces. Deposits are also observed in the longitudinal cracks (Figures 1 and 2). The heaviest deposits are observed on the top surface, where nearly the entire surface is covered with beige, fine-grained material (Figure 3). Mounds up to 0.1 inch thick occur in several spots. The smooth surfaces of the clumps suggests that the deposits have been influenced by water; either deposited or molded by water later. The deposits are firmly ‘cemented’ to the wood. Microscopical examination reveals that the deposits contain a variety of siliceous mineral grains and carbonated paste that contains frequent portland cement relics. Small fine-grained nodules, possibly carbonated lime, are also observed in the carbonated paste. The sand grains include quartz, feldspar, mica, hornblende, volcanic rocks, chert, hematite, opaque oxides, and epidote.

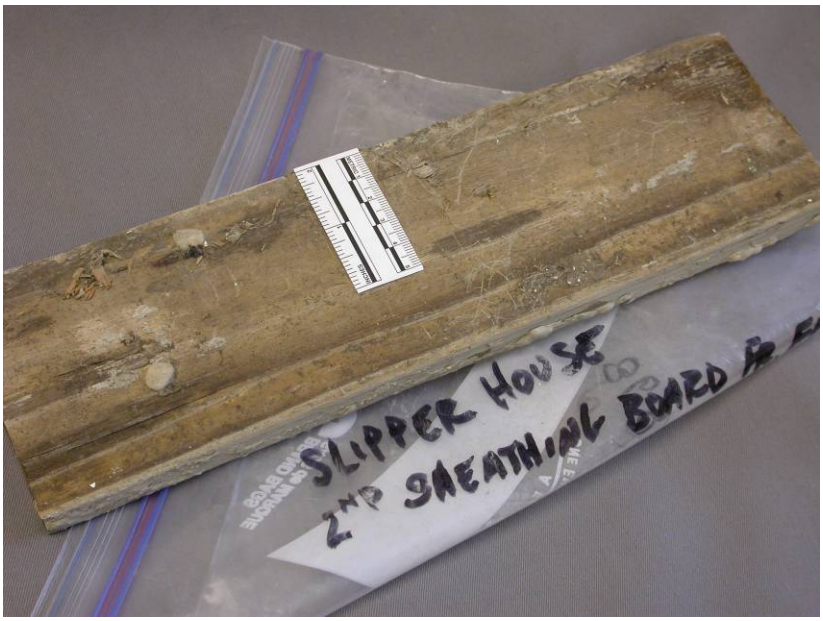

Figure 1. Slipper House Sheathing Board back surface.

Figure 2. Front surface of Slipper House sheathing sample.

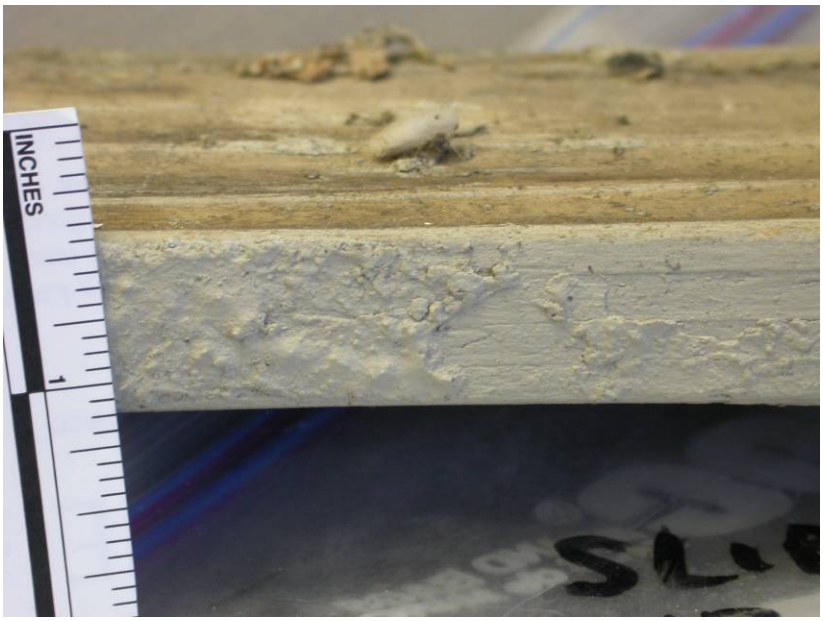

Figure 3. Closer view of deposits on top surface of sheathing.

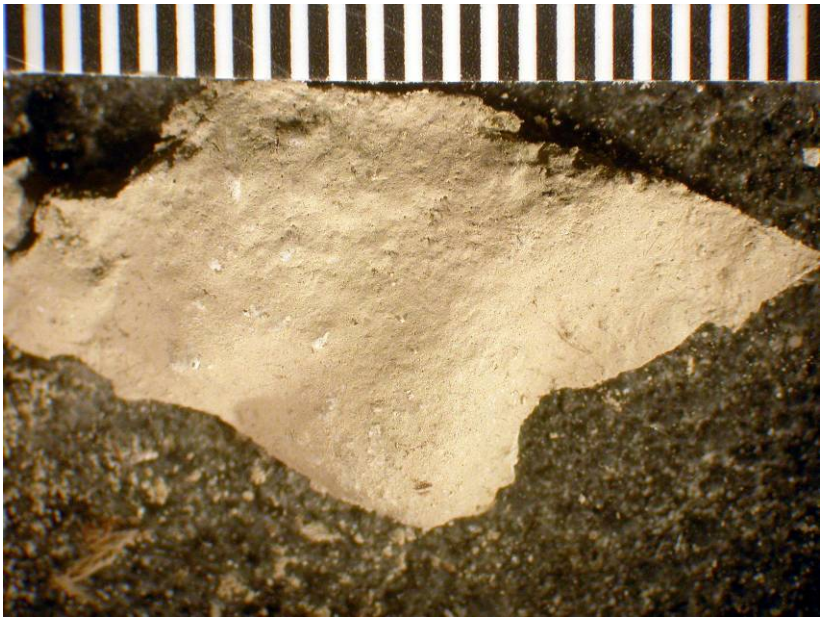

Figure 4. Close view of deposits removed for study. Millimeter scale.

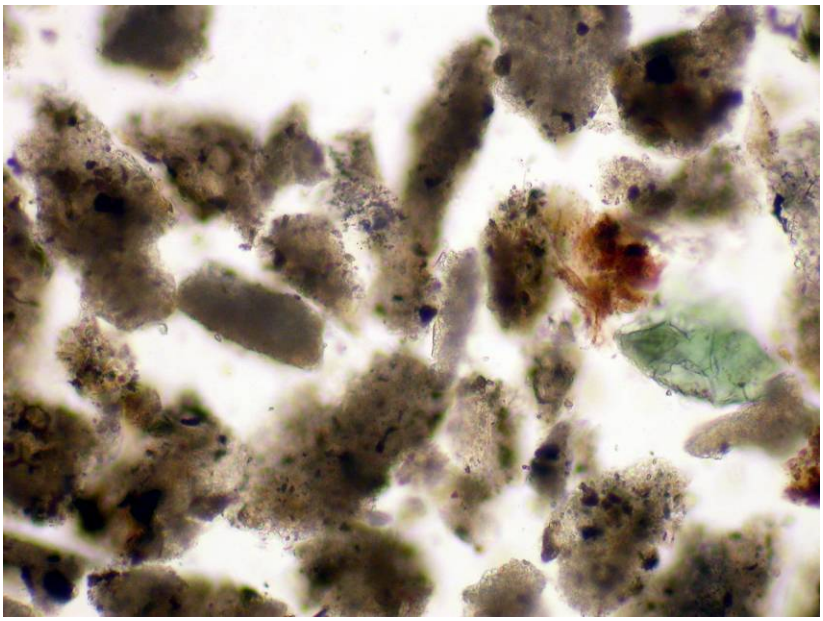

Figure 5. Fragments of carbonated cementitious paste and mineral grains. Plane-polarized light.

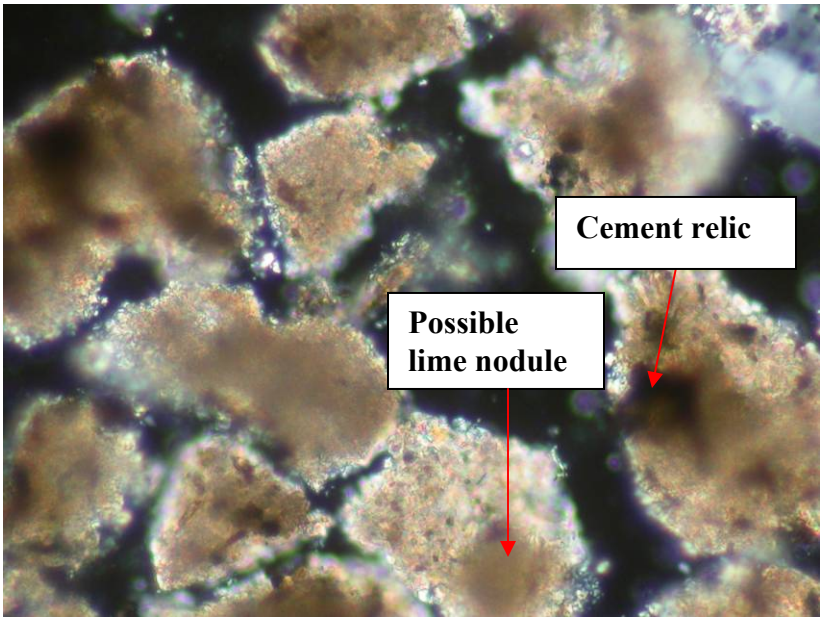

Figure 6. Magnified view of carbonated paste. Cross-polarized light.

Sample 2 Smith House crawlspace, NW Corner. Silt Sample from Top of Beam (2 feet 8 inches above grade): The sample contains approximately 10 grams of beige, fine-grained, material that consists mostly of loose powder, and a smaller amount of slightly harder flakes up to about 0.05 inch across. The sample mainly consists of clay or clay-like minerals (platy habit and less than 30 micrometers long), reddish lumps of soil, mineral grains up to 50 micrometers in diameter, and small amounts of rootlets, wood fiber, and hair.

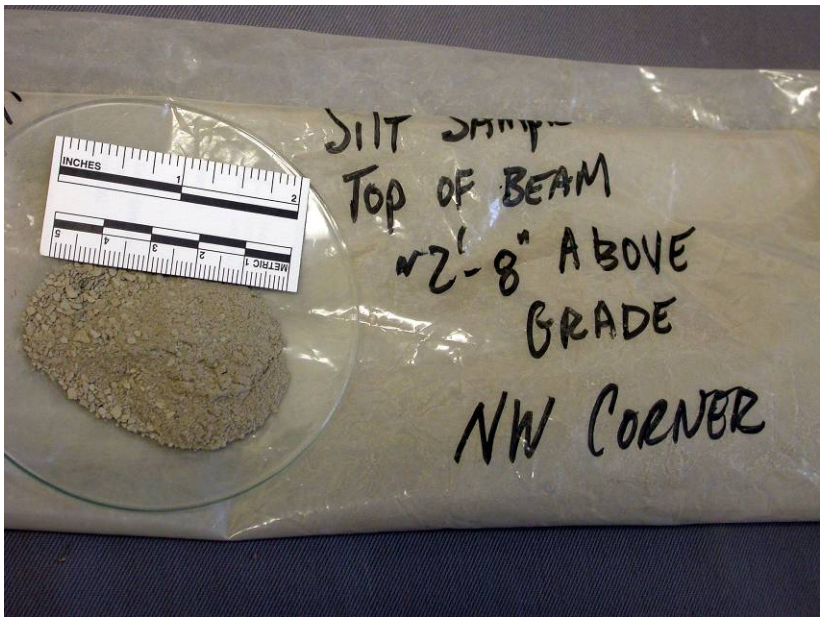

Figure 7. NW Corner Silt Sample from top of beam.

Figure 8. Closer view of silt sample.

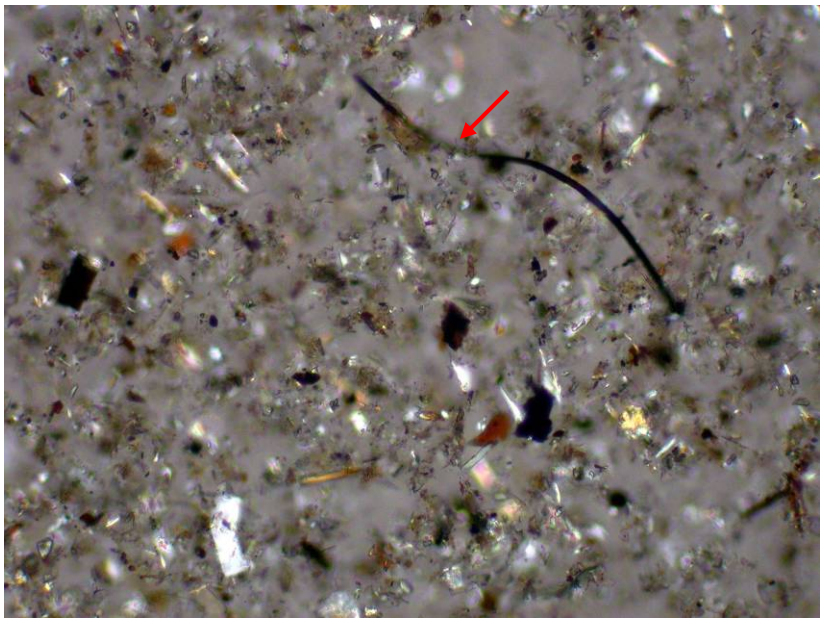

Figure 9. Cross-polarized light view of fine-grained silt showing mineral fragments (bright), soil (reddish brown), and hair or rootlet (arrow). Upper filter slightly uncrossed.

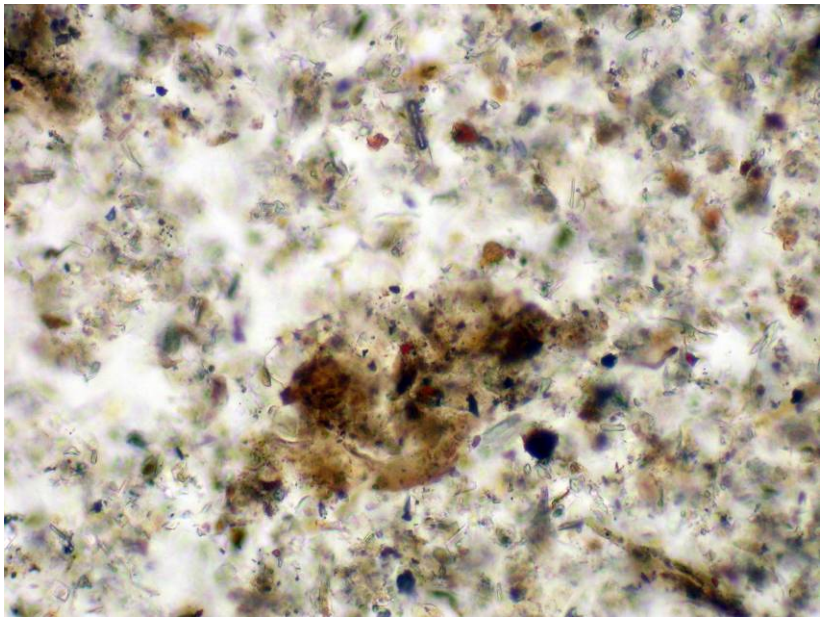

Figure 10. Plane-polarized light view of fine-grained silt particles. Reddish brown particles are soil. Platy mineral grains are less than 30 micrometers long.

Sample 3 Smith House Opening No.3. Dust / Debris from Top of Sill Plate: The sample contains approximately 6 grams of beige, fine-grained, powdery material, gray mortar fragments up to 0.8 inch long, brown wood splinters up to 0.5 inch long, and a dark brown clump of fibrous material approximately 0.4 inch across. The powdery loose material mainly consists of angular volcanic rock fragments (including basalt that contains brown glass and pumice that contain colorless glass) and angular mineral grains (including quartz, chert, feldspar, hornblende, biotite mica, pyroxene, hematite, and opaque grains. The material identified as chert is microcrystalline and may be felsite (intergrown quartz and feldspar matrix in a siliceous volcanic rock). The loose material contains abundant wood fibers, and small amounts of reddish soil particles.

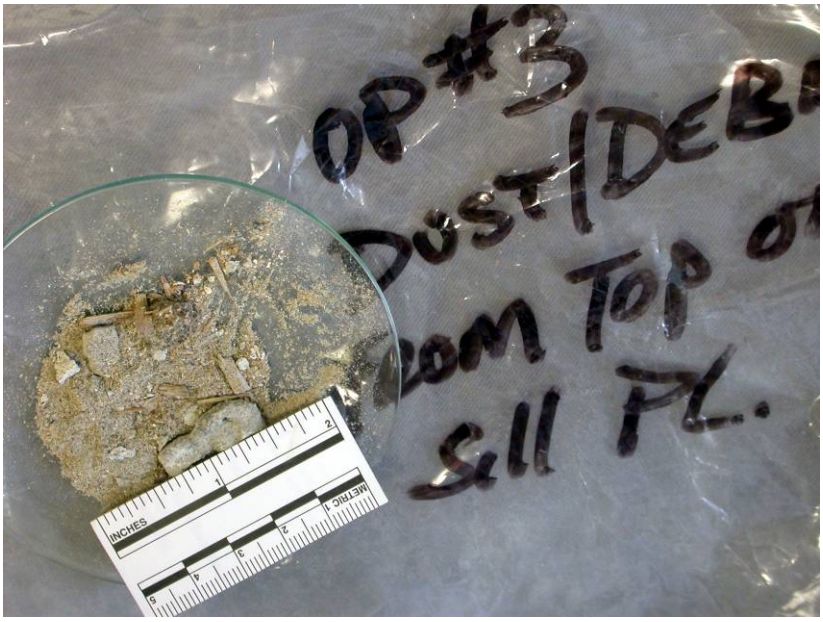

Figure 11. Opening No. 3 Dust/Debris Sample.

Figure 12. Closer view of sample. Millimeter scale.

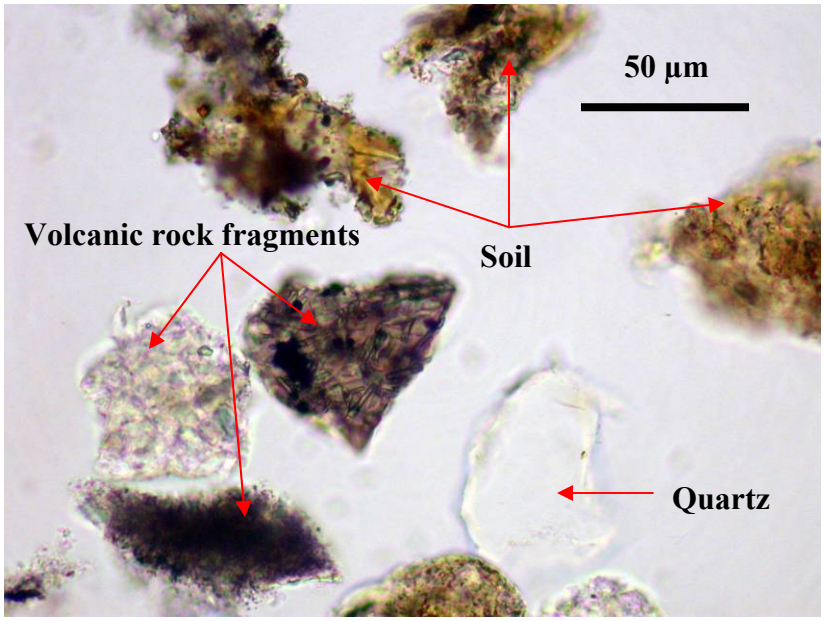

Figure 13. Representative particles in the sample. Plane-polarized light.

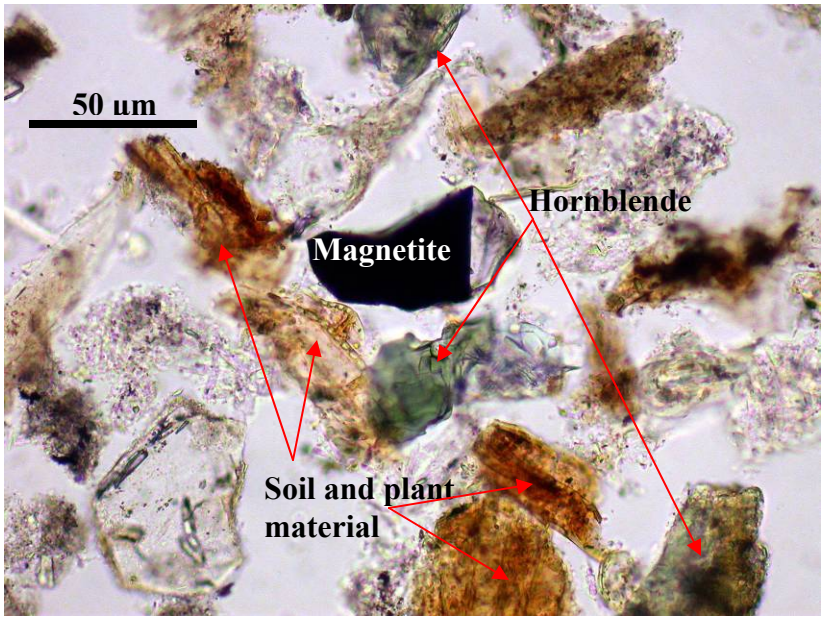

Figure 14. Representative particles in the sample. Unlabeled particles are quartz and feldspar. Plane-polarized light.

Sample 4 Smith House Crawl Space NE Corner: The sample contains approximately 36 grams of beige, exceptionally fine-grained, powdery material that consists mainly of angular mineral grains and rock fragments, and small amounts of reddish soil particles and plant material (stems and rootlets). The rock fragments and mineral grains include: basalt, natural glass, quartz, feldspar, pyroxene, hornblende, mica, hematite, apatite, and opaque grains. Mineral grains are more abundant than rock fragments.

Figure 15. Close view of Crawl Space NE Corner Sample. Millimeter scale.

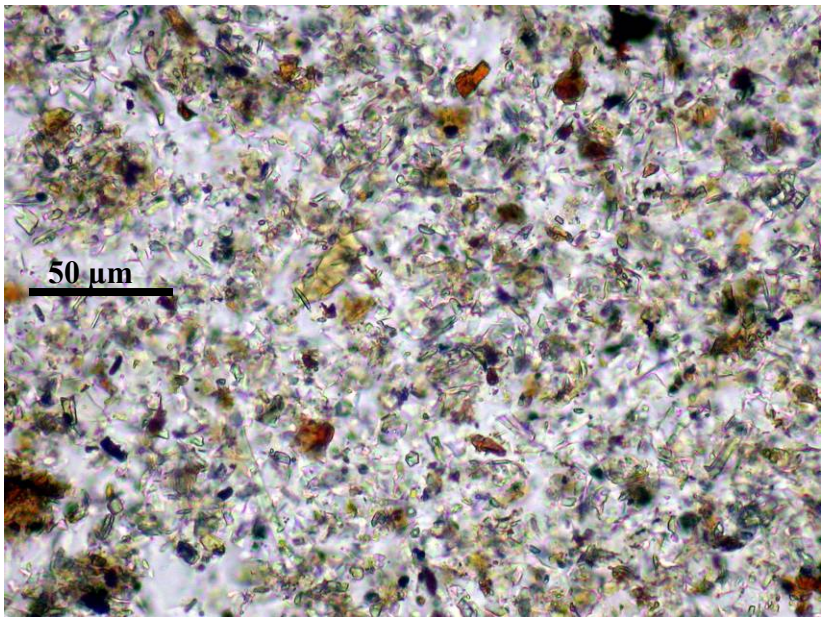

Figure 16. Representative particles shown in plane-polarized light.

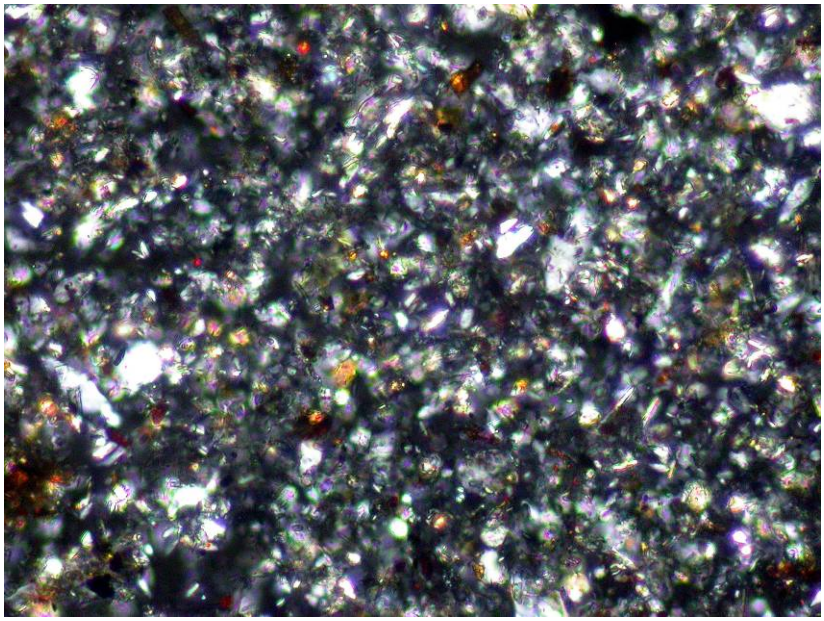

Figure 17. Cross-polarized light view of the field shown above. Bright particles are mostly quartz and feldspar. Reddish particles are soil and hematite. Upper filter is slightly uncrossed.

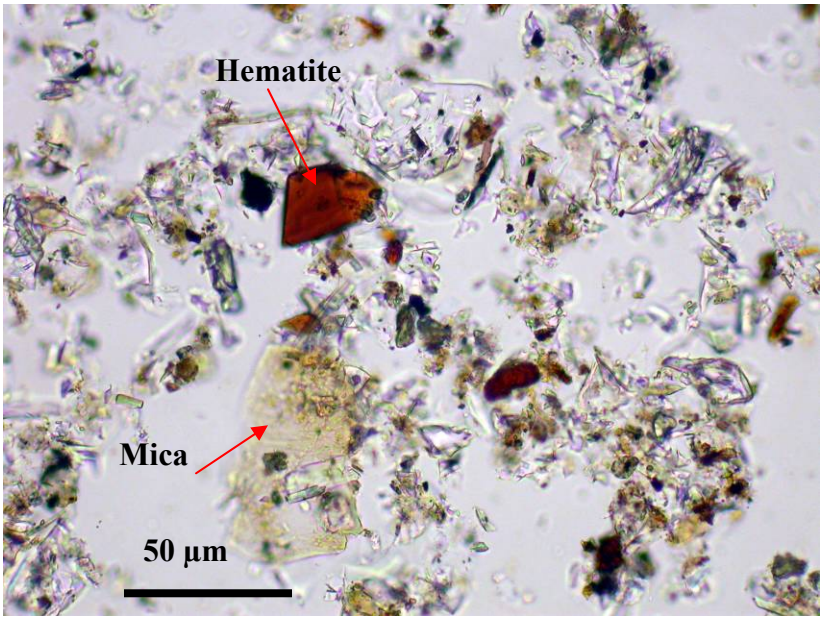

Figure 18. Magnified view of representative particles. Quartz and feldspar are colorless and exhibit low relief.

Sample 5 Smith House Exterior Opening, North Wall, Sill: The sample contains approximately 3 grams of beige powdery material, plant material (wood, stems, and rootlets), insect parts, paint flakes, and rodent droppings. The powdery material (less than 50 micrometers in diameter) mainly consists of angular fragments of volcanic rocks (basalt and volcanic glass) and angular mineral grains. Smaller amounts of soil and plant material are observed. The mineral grains include quartz, feldspar, pyroxene, hornblende, mica, hematite, apatite, and opaque grains (largely magnetite).

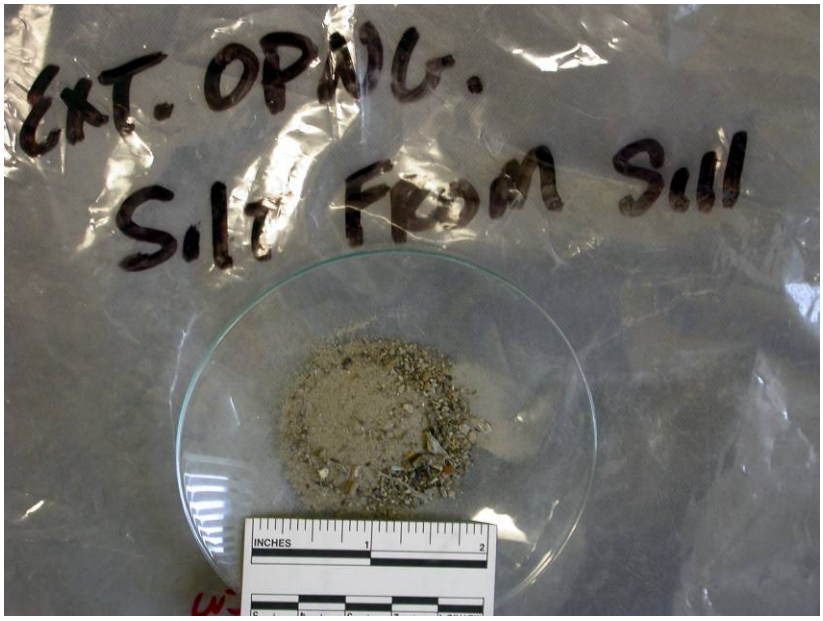

Figure 19. Exterior Opening Silt from Sill Sample.

Figure 20. Closer view of sample. Millimeter scale.

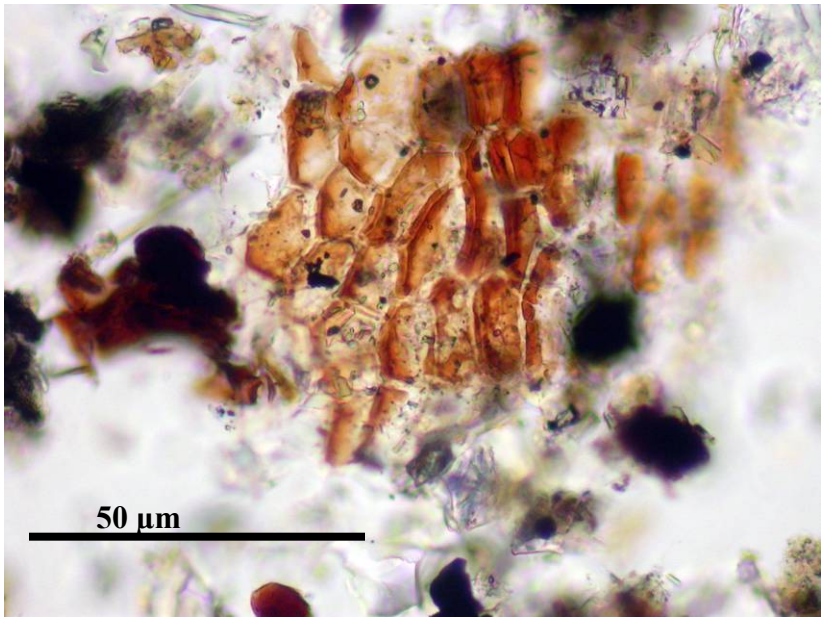

Figure 21. Cellular structure in plant material. Plane-polarized light.

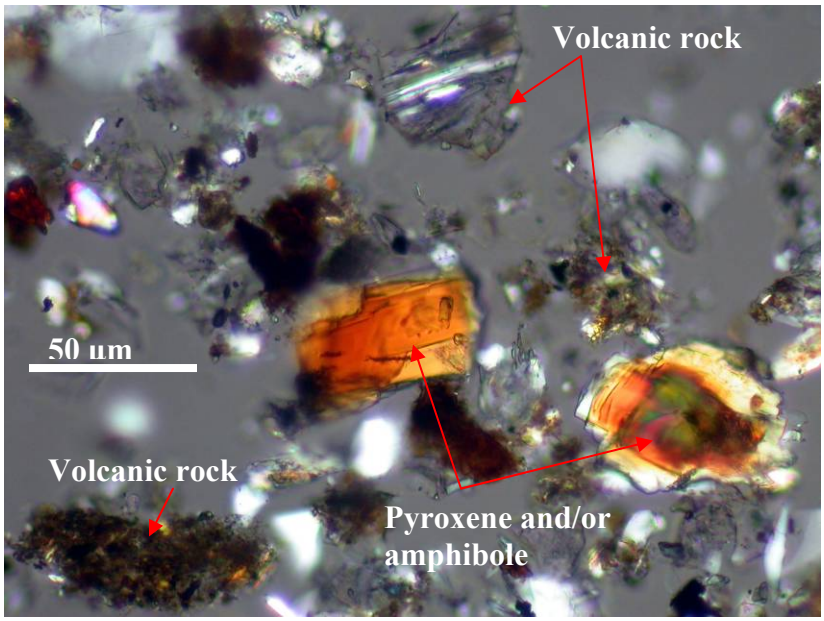

Figure 22. Representative particles in the sample. Cross-polarized light with upper filter slightly uncrossed.

Sample 6 Smith House Crawlspace, Top Layer of Visqueen: The sample contains approximately 25 grams of beige powdery material that exhibits a slight tendency to form small clumps up to a few millimeters in diameter. The powdery material (less than 50 micrometers in diameter) mainly consists of angular fragments of quartz and feldspar, flakes of mica (biotite and chlorite), acicular minerals, fragments of opaque oxides and hornblendes, and smaller amounts of volcanic rocks (basalt and volcanic glass), reddish soil, and plant material (stems fragments and rootlets).

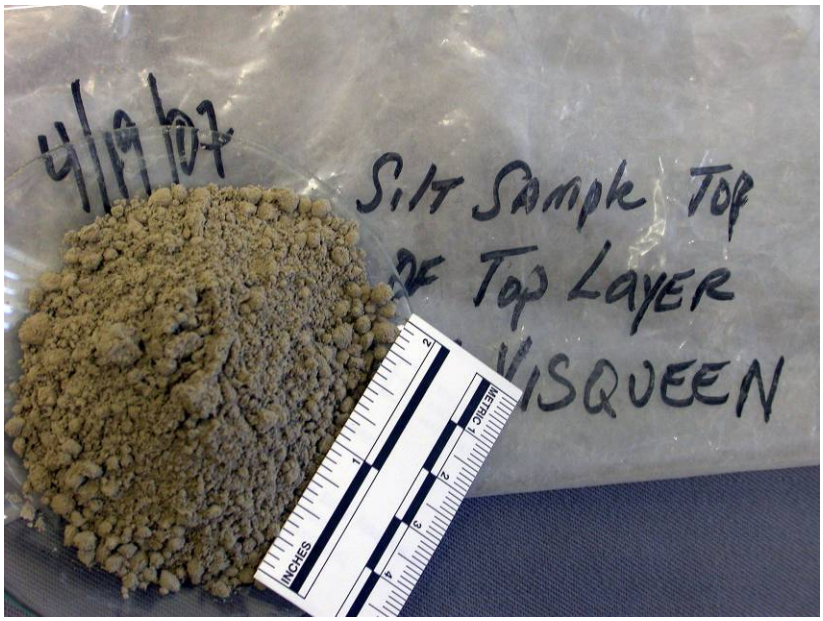

Figure 23. Sample from top of top layer of visqueen.

Figure 24. Closer view of sample. Millimeter scale.

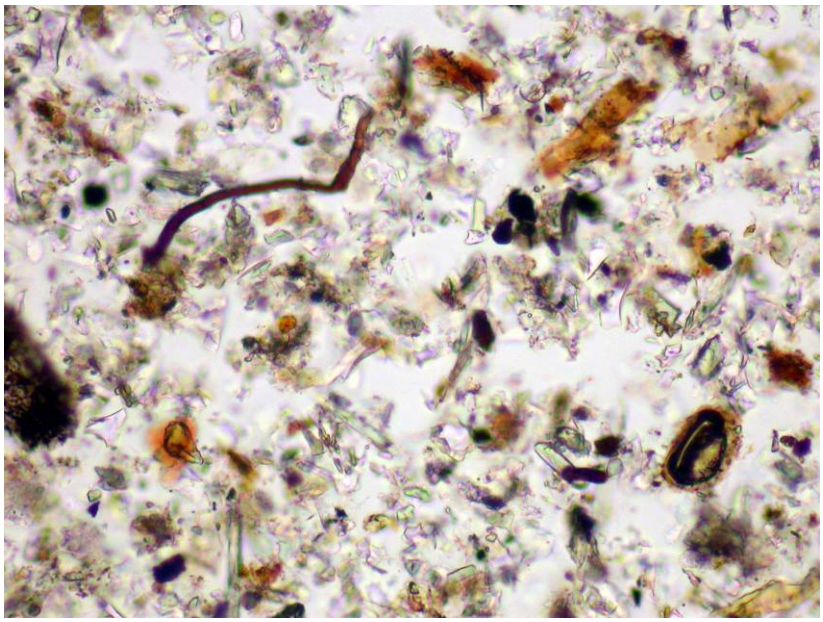

Figure 25. Angular, almost colorless, fragments are mineral grains. Reddish material is mostly soil and plant material. Plane-polarized light.

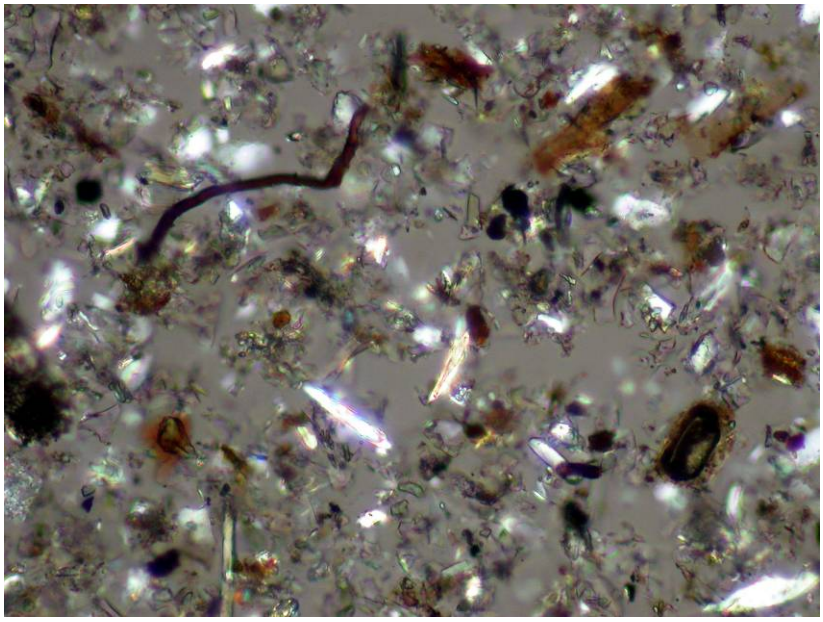

Figure 26. Cross-polarized light view of field above showing mineral grains (bright) and soil and plant material (reddish brown). Upper filter slightly uncrossed.

Sample 7 Smith House, Exterior Opening, North Wall, Vertical Wall Surface: The sample contains approximately 4 grams of wood fragments, insect parts, and beige powdery material. The sample was passed through a No. 200 sieve (75-micrometer openings) and the powdery material was collected and examined. This material consists of angular fragments of quartz and feldspar, flakes of mica (biotite and chlorite), acicular minerals, fragments of opaque oxides and hornblende, and smaller amounts of volcanic rocks (basalt and volcanic glass), reddish soil, and plant material (stems fragments and rootlets).

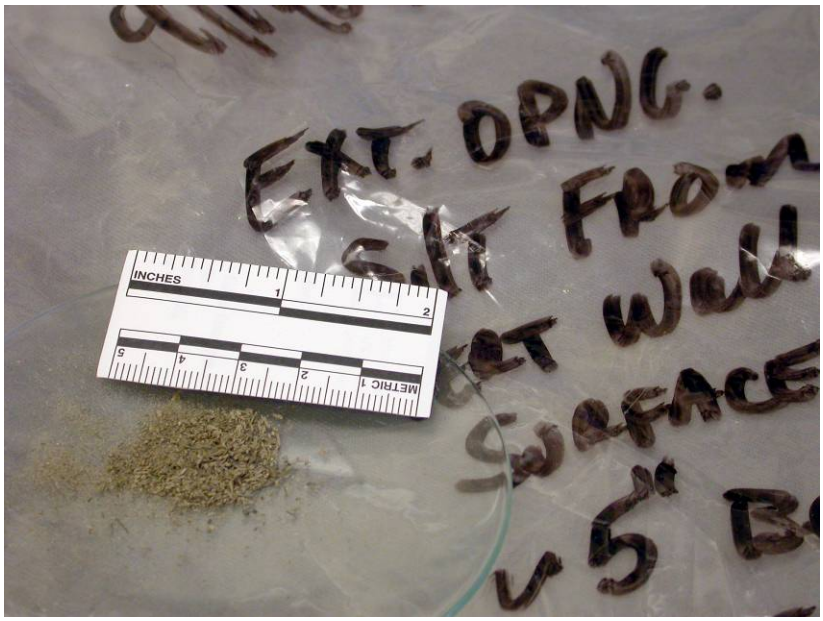

Figure 27. Silt sample from Exterior Opening Vertical Wall Surface.

Figure 28. Closer view of sample. Millimeter scale.

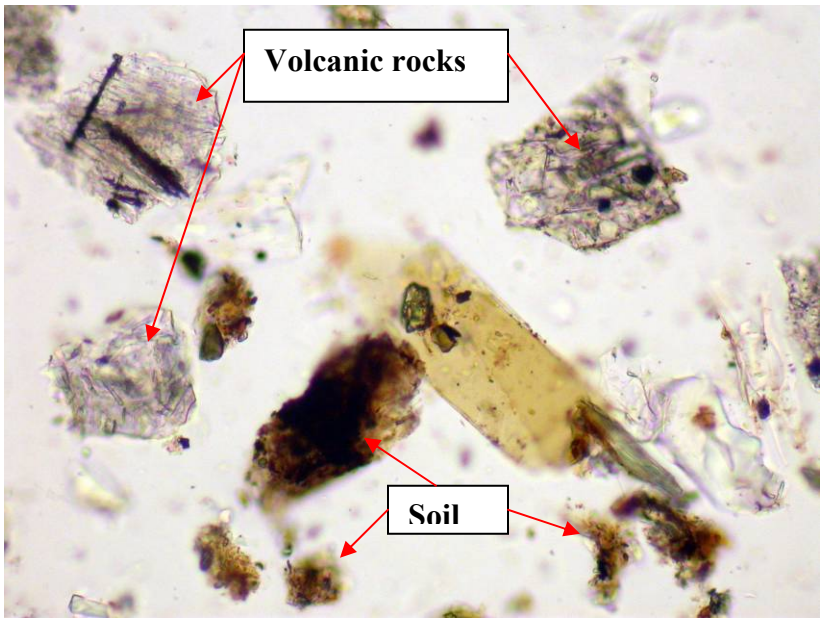

Figure 29. Rock fragments (labeled), and soil particles passing the No. 200 sieve. Plane-polarized light.

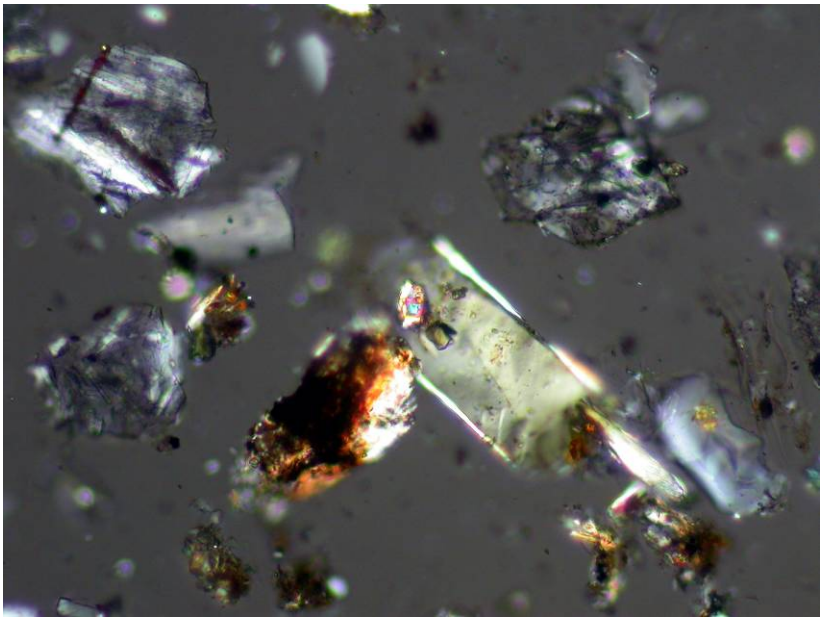

Figure 30. Cross-polarized light view of field above showing rock fragments and mineral grains (bright) and soil (reddish brown). Upper filter slightly uncrossed.

Sample 8 Smith House, Crawl Space Center: The sample consists of beige powder, a piece of fabric, and a piece of thin black plastic. The fabric and plastic are coated with beige powder. The total mass of the sample is approximately 17 grams. The loose powder and the powdery material collected from the fabric and plastic were examined as one sample. The powder consists of particles that are mostly less than 30 micrometers in diameter. The major constituents are platy clay or clay-like minerals, angular fragments of quartz and feldspar, flakes of mica (biotite and chlorite), acicular minerals, fragments of opaque oxides and hornblendes, and volcanic rock fragments, reddish soil, and plant material (rootlets).

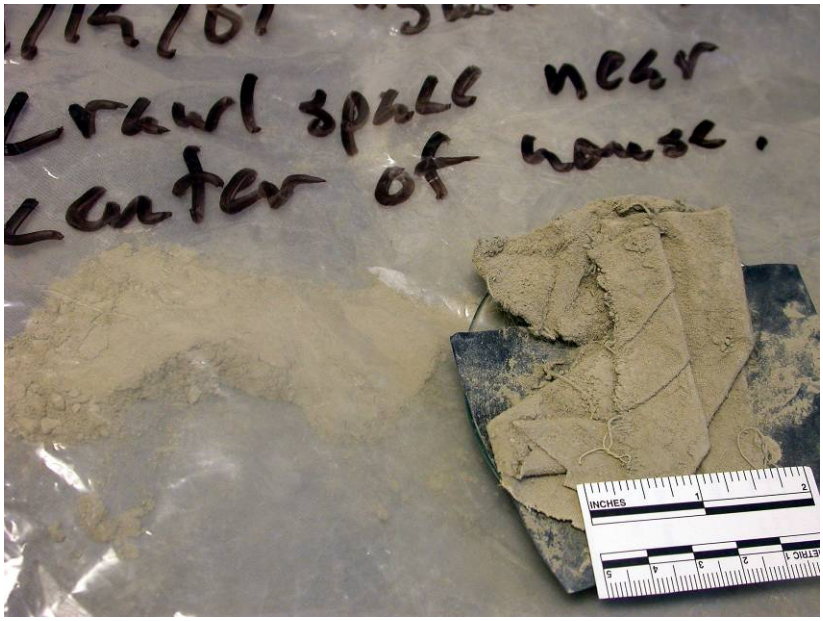

Figure 31. Sample from Crawl Space Near Center of House.

Figure 32. Closer view of fine-grained deposits on fabric. Millimeter scale.

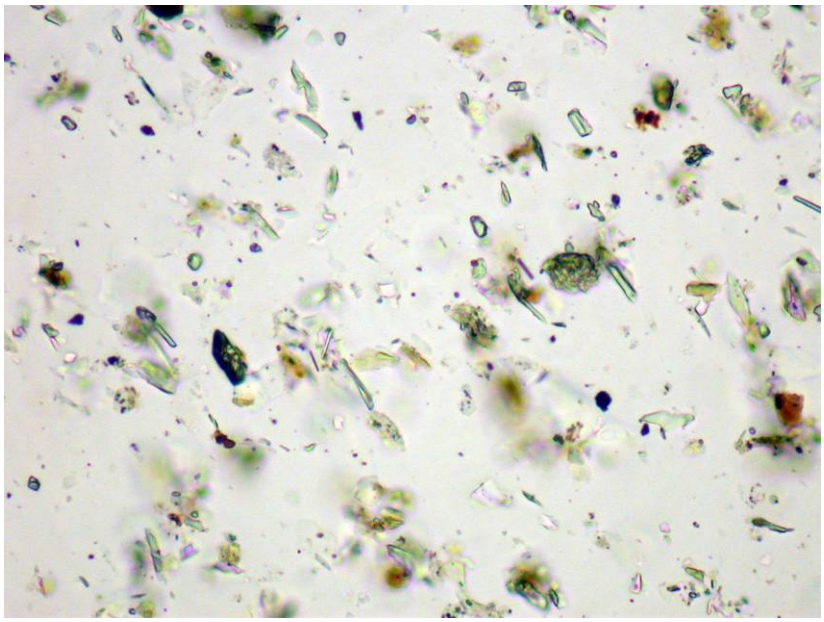

Figure 33. Platy and acicular minerals (aligned diagonally) less than 30 micrometers in the longest dimension. Plane-polarized light.

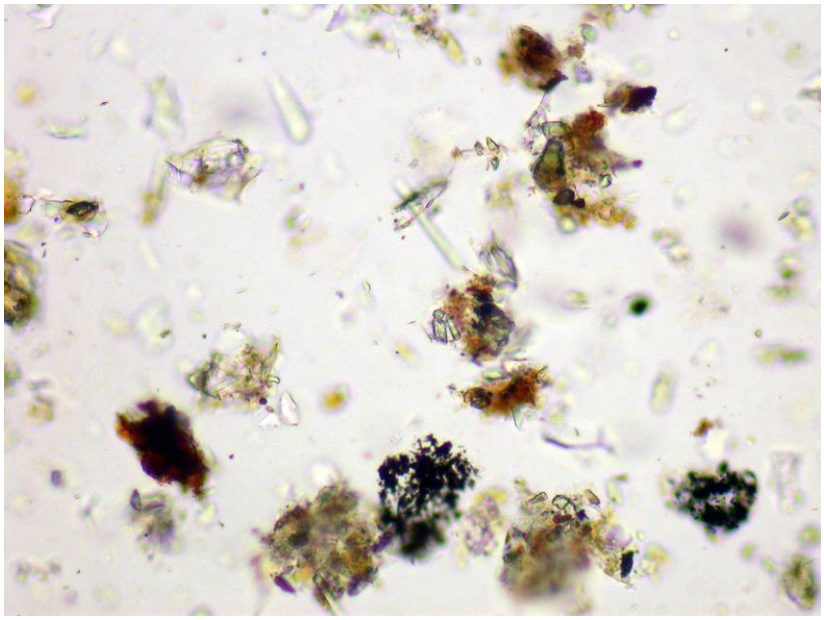

Figure 34. Larger rock and mineral fragments and soil particles (reddish brown). Plane-polarized light.

Sample 9 Smith House, Crawl Space Under Plastic, East: The sample was moist when received. The sample consists of black plastic and beige-brown lumps. The plastic is coated on both sides with beige to brown deposits. The total mass of the sample is approximately 55 grams. A sample of the deposits was collected from the surface of the plastic, dried, and then mounted in immersion oil. The deposits mainly consist of angular particles of quartz and feldspar. The particles are mostly less than 30 micrometers in diameter. Smaller amounts of mica, hornblendes, acicular minerals, fragments of opaque oxides, volcanic rock fragments, epidote, and pyroxene are observed. The sample also contains traces of reddish soil.

Figure 35. Sample from Crawl Space Under Plastic, East Mid Crawl Space.

Figure 36. Closer view of deposits on plastic. Millimeter scale.

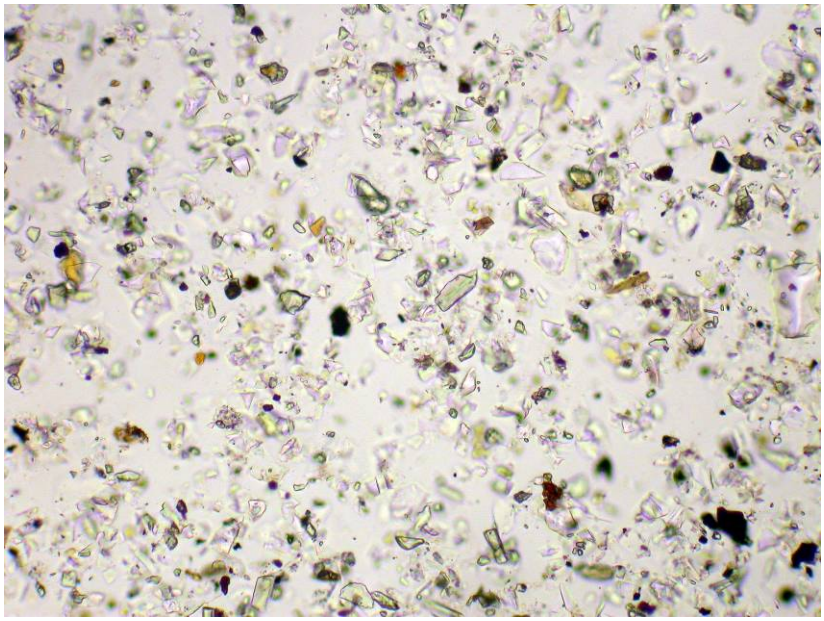

Figure 37. Deposits on the plastic consist of small, angular fragments of minerals. The largest particles are 30 micrometers long. Plane-polarized light.

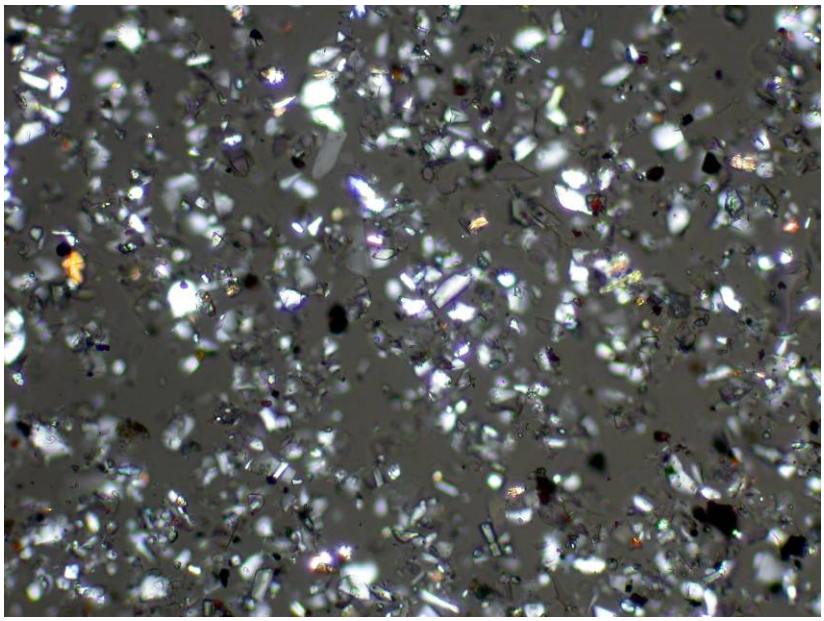

Figure 38. Cross-polarized light view of field shown above. The sample consists mainly of quartz and feldspars (shades of gray). Upper filter slightly uncrossed.

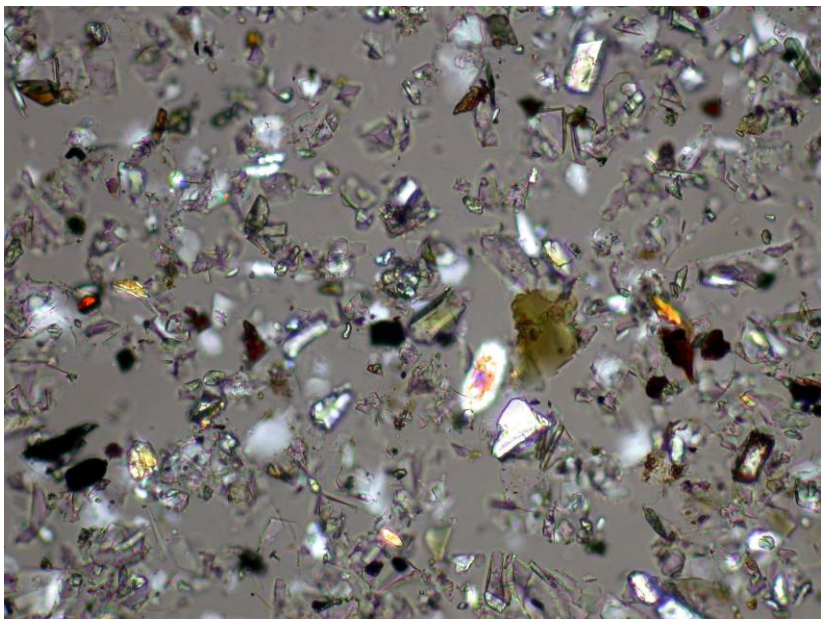

Figure 39. Magnified view showing quartz and feldspar (shades of gray), opaque grains (black), hematite (red), hornblende and pyroxene (yellow) and biotite mica (greenish brown). Cross-polarized light with upper filter slightly uncrossed.

Sample 10 Smith House, Opening No. 2, Interior of East Exterior Wall: The sample consists of four, 22.5 inch long, sections of wood lath. One side of each slat (side with protruding nails) is marked with the number (position) of the lath and an arrow indicating the 'up' direction. Dark patches of fungal growth and several light-colored patches are observed on this side of the lath. Patches of deposits are more common on the opposite side of the lath (nail head side), and on the top surface of lath slats 2 and 3. Deposits were collected from these surfaces, and were found to consist of gypsum (plaster) and quartz sand grains.

Figure 40. Opening No. 2 East Exterior Wall, back surface.

Figure 41. Opening No. 2, front surface of lath slats.

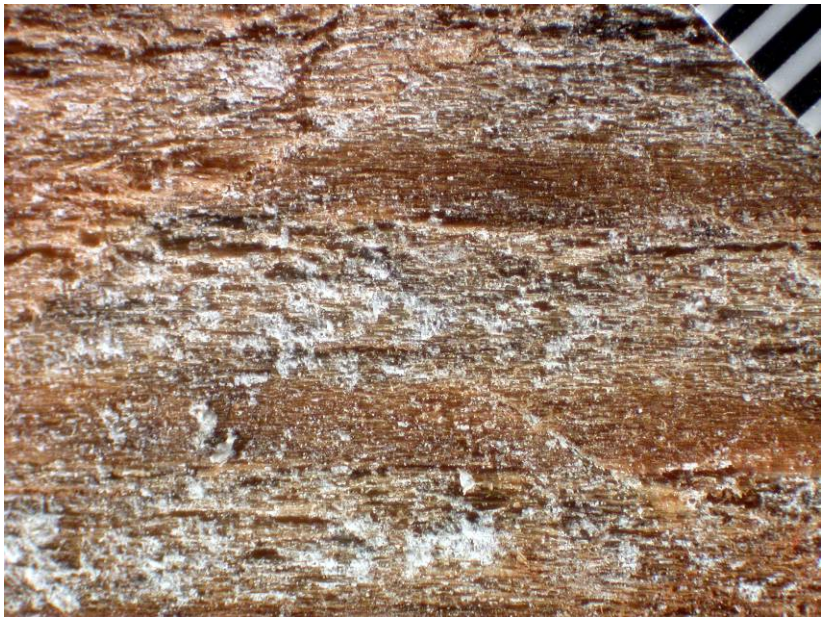

Figure 42. Closer view of deposits on lath. Millimeter scale.

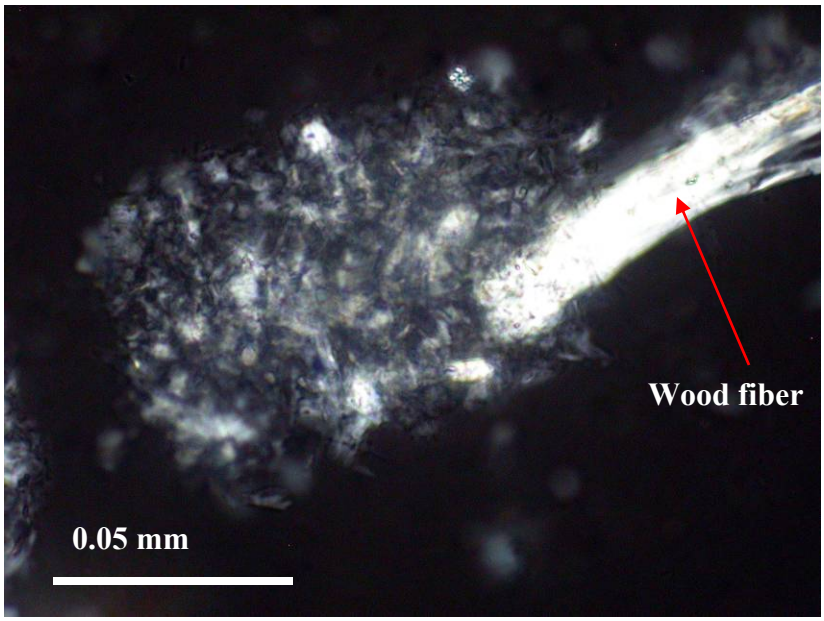

Figure 43. Gypsum plaster and embedded wood fiber. Cross-polarized light.

Sample 11 Smith House, Opening No. 3 Interior Wall: The sample is a saw-cut section of plaster, 9 inches wide, 7.5 inches high, and 0.25 to 0.45 inch thick. The front surface is nearly covered with tape. Four pieces of wood lath, 1.4 inches wide and 0.3 inch thick, are loosely attached to the back surface. Each slat is marked with a number (1 through 4) and an arrow indicating the 'up' direction. The back surface of the plaster is 'dusty' but is otherwise fairly clean. The back surfaces of the two upper pieces of lath are generally free of deposits, except for dust and adhered gypsum plaster. Patches of fine-grained deposits (debris) are observed on the back and top surfaces of the two bottom slats. The deposits, which were removed using tape, mainly consist of quartz, feldspar, volcanic rocks (including brown and colorless volcanic glass), hornblende, micas, epidote, and opaque grains. Small amounts of wood fibers were also collected with the deposits.

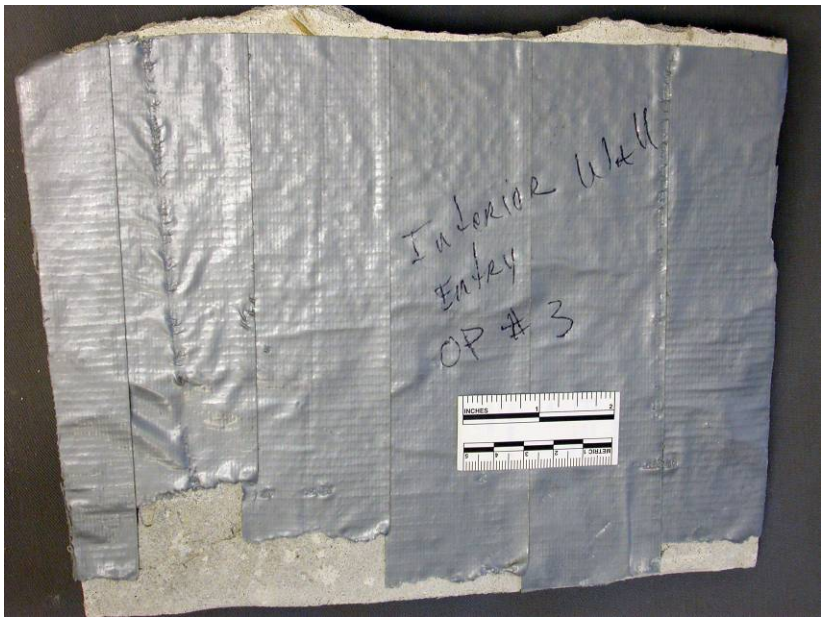

Figure 44. Front side of the samples from Opening No. 3 Interior Wall Entry.

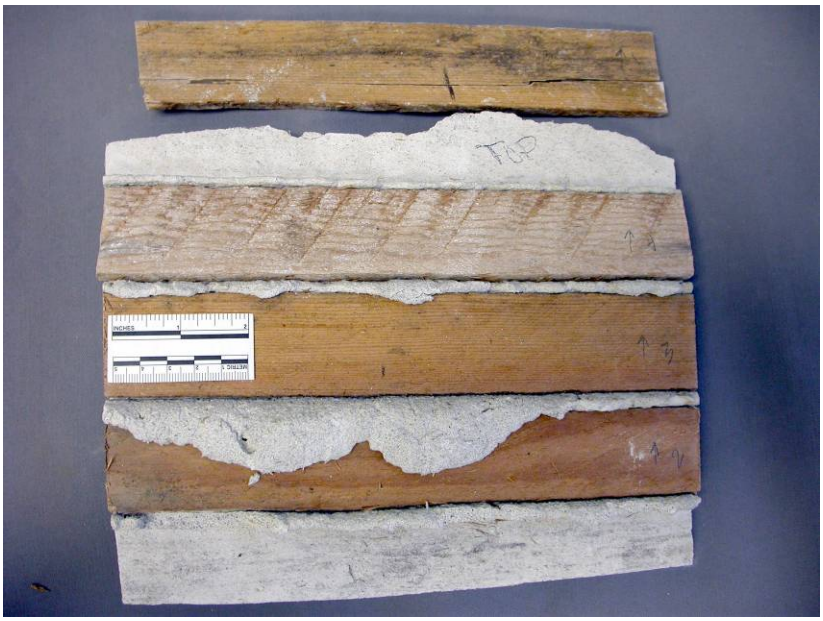

Figure 45. Back side of the sample. Lath No. 1 is above the sample.

Figure 46. Fine-grained debris on the back surface of lath No. 2. Millimeter scale.

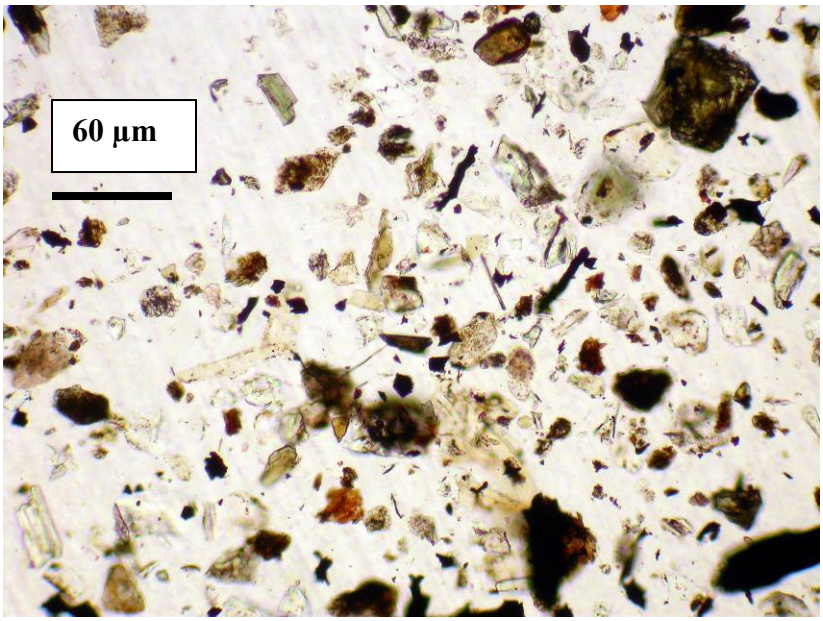

Figure 47. Plane-polarized light view of mineral debris collected from lath using tape.

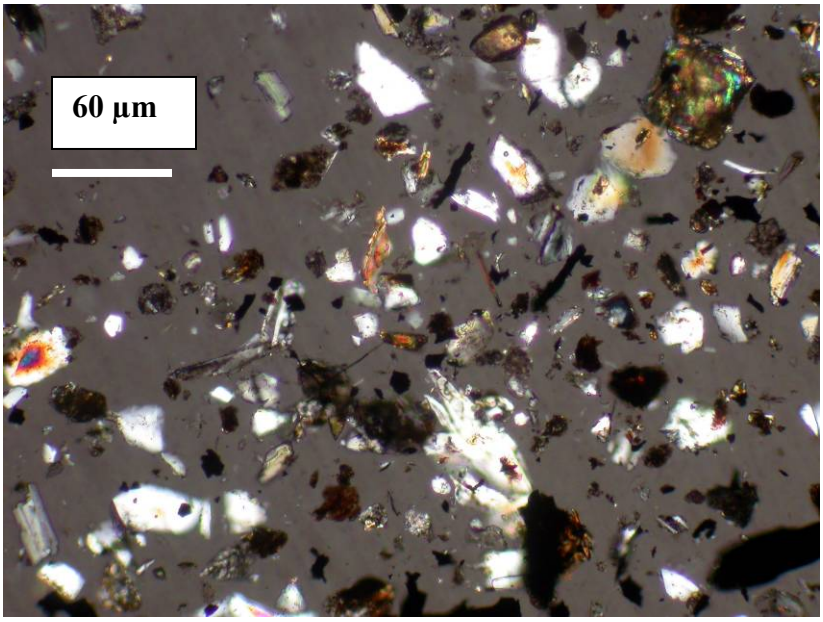

Figure 48. Cross-polarized light view of the field shown above. Most of the particles are quartz and feldspar. A multi-colored epidote grain is shown in the upper right. Upper filter is slightly uncrossed.

SUMMARY AND DISCUSSION

The results of the analyses are discussed herein and summarized in Table 2.

Two samples from the Smith House mainly consist of clay or clay-size platy mineral grains; Sample 2, crawlspace NW corner top of beam, and Sample 8 crawlspace center.

The deposits collected from the Slipper House are composed of carbonated portland cement and lime paste containing siliceous sand grains, and appear to be mortar residue. The sand was presumably locally derived, as would be typical at the time of construction of this house. The main constituents of the sand are quartz, feldspar, mica, hornblende, volcanic rocks, chert, hematite, opaque oxides, and epidote and these could possibly be constituents of the local soil. These rocks and minerals are the same constituents found in the majority of the debris samples. The volcanic rock fragments are particularly distinctive as these include brown volcanic glass containing acicular crystals, and colorless volcanic glass containing stretched air bubbles. The volcanic rock fragments are particularly abundant in the Smith House Samples 3 (Opening 3 Sill Plate), 7 (Exterior Opening Vertical Wall Surface), and 11 (Opening 3 Interior Wall).

Table 2 – Description of Deposits

WJE No.	Identification	Major Components	Minor Components
1	Slipper House	Carbonated portland cement paste, siliceous sand grains (quartz, feldspar, mica, hornblende, volcanic rocks, chert, hematite, opaque oxides, and epidote)	Possibly carbonated lime nodules, fungal material
2	NW Corner Top of Beam	Platy clay or clay-like minerals, soil, relatively larger angular mineral grains (as above)	Rootlets, wood and woody plant fibers, hair.
3	Opening No. 3	Angular volcanic rock fragments (basalt, brown volcanic glass, colorless volcanic glass) and mineral grains (quartz, chert, feldspar, hornblende, biotite mica, pyroxene, hematite, and opaque grains), wood fibers	Soil, rootlets, hair, insect parts
4	NE Corner Crawl Space	Very fine, angular fragments of quartz, feldspar, pyroxene, hornblende, mica, hematite, apatite, and opaque grains, basalt and natural volcanic glass.	Soil and plant material
5	Exterior Opening-Sill	Angular volcanic rock fragments and mineral grains (quartz, feldspar, pyroxene, hornblende, mica, hematite, apatite, and opaque grains), wood fibers	Soil, plant material, paint, and insect parts
6	Top Layer Visqueen	Very fine, angular, acicular, and platy mineral grains (mostly quartz, feldspar, micas, hornblende, and opaque grains)	Volcanic rock fragments, soil, plant material
7	Exterior Opening-Vert. Wall Surface	Wood fragments, volcanic rock fragments (crystalline and glassy), acicular, and platy mineral grains (mostly quartz, feldspar, micas, hornblende, and opaque grains)	Insect parts, soil, plant rootlets
8	Crawl Space Center	Platy clay or clay-like minerals, soil, relatively larger angular mineral grains (as above, with traces of epidote and prehnite)	Soil, plant rootlets
9	Crawl Space Under Plastic	Angular fragments of quartz and feldspar, smaller amounts of mica, hornblendes, acicular minerals, fragments of opaque oxides, volcanic rock fragments, epidote, and pyroxene	Soil
10	Opening No. 2 East Exterior Wall	Gypsum	Quartz
11	Opening No. 3 Interior Wall	Angular fragments of quartz, feldspar, basalt and natural volcanic glass, hornblende, mica, hematite, and opaque grains	Wood fragments