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Background

On September 23, 1933, a tusk was discovered in a gravel pit four miles south of Hampton, Iowa. After careful analysis, the tusk was determined to belong to a *Mastodon americanus*.[1] The University of Northern Iowa museum records note that the tusk was patched with a prepared patching plaster in the 1960's.[2] In the United States at the time Alvar was the most commonly used consolidate to form a plaster. It was either mixed with acetone, alcohol and other solvents, or asbestos.[3] The museum record notes indicate that the patching plaster was prepared in a can, like a spackling compound.[2] It is unclear whether this is a professionally mixed conservation material, or a product purchased from a hardware store. In either case, the chance that the plaster compound contained asbestos is extremely high.

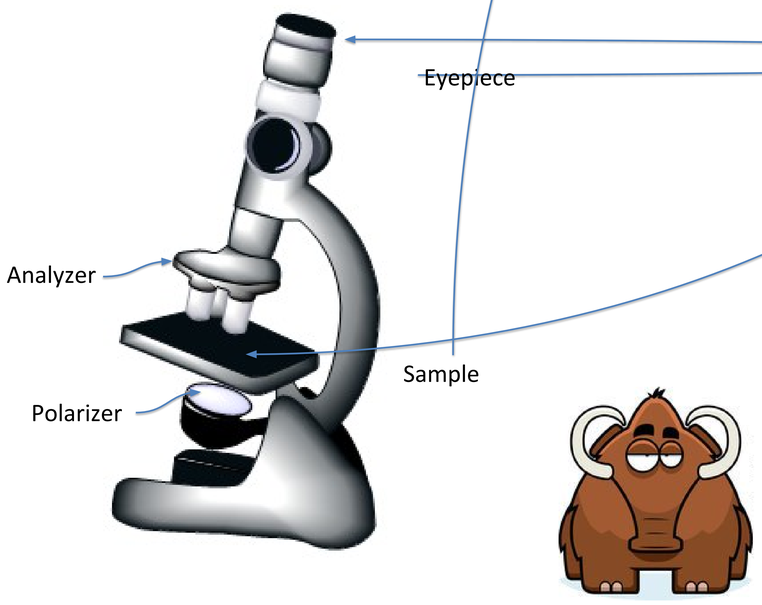
Asbestos is a term used for a naturally occurring fibrous mineral of many types. These crystalline minerals consist of atoms that are arranged in a long-range order and are antistrophic. Due to this, asbestos fibers are polarizable, and can be seen and counted using Polarized Light Microscopy (PLM). If the fibers are too small and not visible via PLM, a Scanning Electron Microscope (SEM) can be used to identify the smallest fibers.[4] The Occupational Safety and Health Administration (OSHA) has defined the Permissible Exposure Limit (PEL) for asbestos at 0.1 fiber per cubic centimeter of air per eight hours[5], and the OSHA content limit is 1.0% in a bulk matrix.[5]

Experimental

Polarized Light Microscopy (PLM)

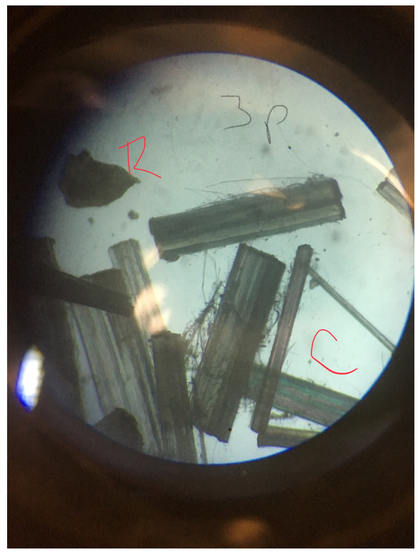
Polarized light microscopes are designed to observe samples that are visible due to their antistrophic nature. Two polarizing filters are positioned in the light path: one before the specimen (the polarizer) and one between the sample and the observation tubes (the analyzer). The light that passes through the polarizer is limited to the light waves vibrating along the polarizing axis to completely pass through. The analyzer then is inserted at a 90-degree angle to the axis of the polarizer, and no light passes through. When the filters are adjusted, light passes through and different aspects of the specimen will be shown. Antistrophic samples reflect the light making it appear brighter than isotropic samples. Antistrophic samples also have a range of refractive indices and act as beam splitters for light rays.[6]

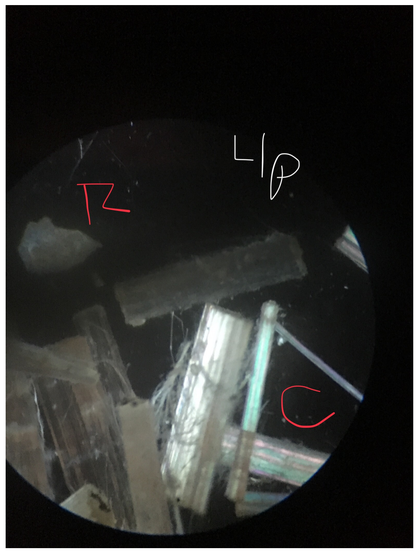
- PLM is an extremely classic method for analyzing asbestos.[7]



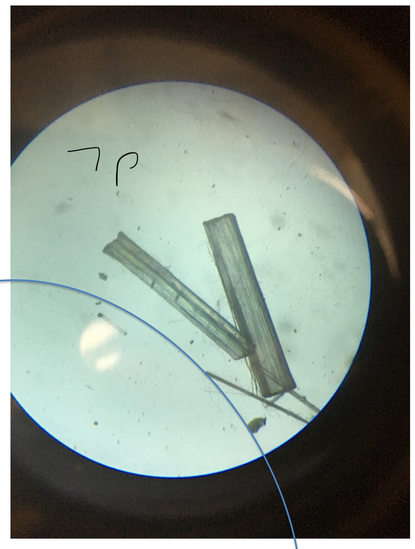
PLM Experimentation

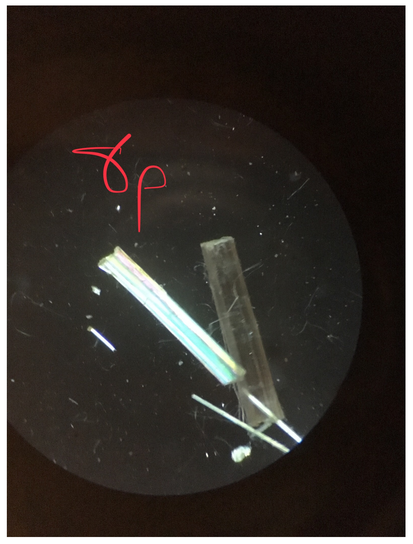
- Pure Asbestos crystals were analyzed by PLM



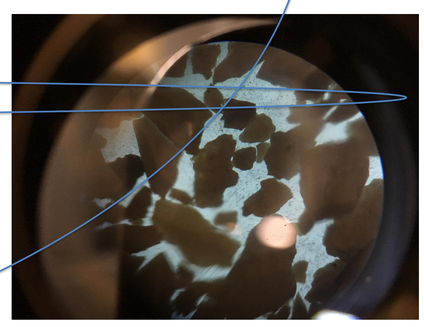


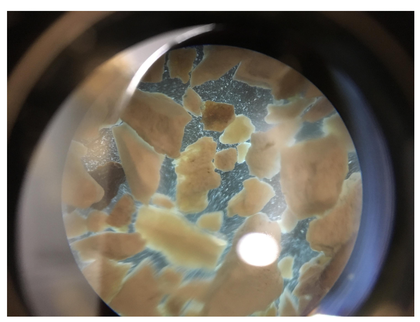
- Top left figure: crystal and rock samples under non-polarized light. Rock sample marked with an "R" and crystal sample marked with a "C"
- Top right figure: crystal and rock sample under polarized light. Rock sample marked with an "R" and crystal sample marked with a "C".
- Bottom left figure: crystal samples under non-polarized light
- Bottom right figure: crystal samples under polarized light

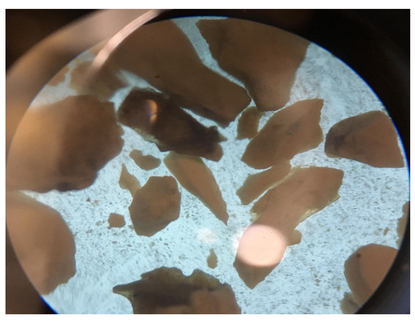


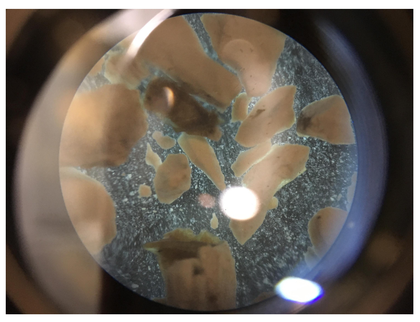


- After pure samples were analyzed, samples of tusk plaster were analyzed using the same setup. Three separate samples were analyzed to comply with OSHA guidelines
- Below: samples analyzed from plaster. Left is not polarized, and right is polarized



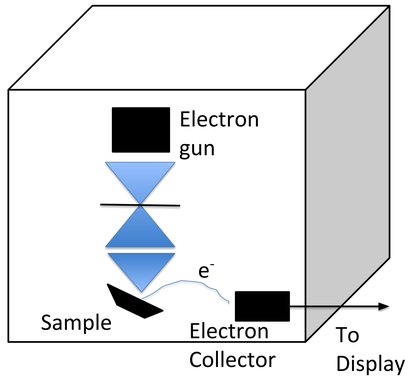


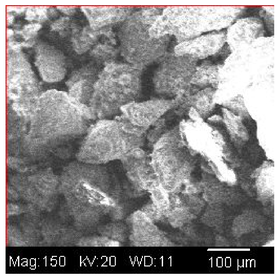


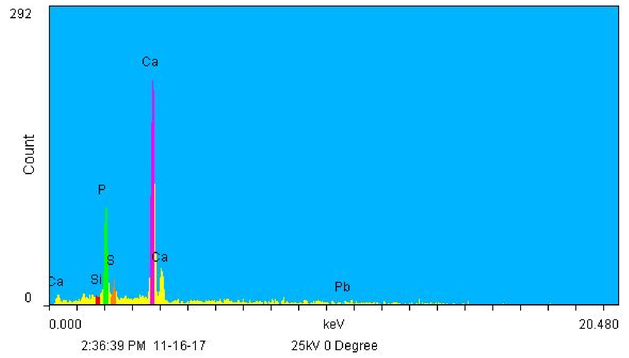


SEM/EDX

- To confirm our negative findings, the sample was run on the SEM.







- No silicon was detected on the EDX (spectrum above), confirming the negativity of the results

Conclusions

Due to the lack of asbestos in the PLM samples, and the lack of detected silicone from the SEM experiments, it can be concluded that our tusk is asbestos free.

Acknowledgements

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- Dr. Colin Weeks – for the use of his PLM setup. Being asbestos free is a good feeling and we wouldn't be sure without you!

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