A Technique for Microscopical Soil Examinations

Skip Palenik

Microtrace
Elgin, IL USA

www.microtracescientific.com
50001-85 D.L. Mapes
Boots from Suspect
Preliminary Separation

- Color (dry)
- Low Power Microscopy
- Seeds, Leaf Fragments
  - Paint, Glass, etc.
- Sonication in Water
  - Sinks
  - Suspended
    - Does not settle in 10 min.
  - Sinks in < 10 min.
  - Clean Sand and Silt
    - Fraction 1
    - Fraction 2
    - Fraction 3
Color
Fraction 1

Sand and Silt

Sieve
>90 < 180

Floats

Light Minerals
Mount in 1.540

Heavy Mineral Separation
$\rho < 2.89$

Identify and Quantitate by Polarized Light Microscopy

Sinks

Heavy Minerals
Mount in 1.660
Heavy Mineral Separation

Cleaned Silt
> 90 < 180 μm

Bromoform
$\rho = 2.84$
Mineral Separation in Heavy Liquids
Freezing Heavy Minerals in Tip of Tube with LN2
Isolation of Mineral Separates

1. Frozen Bromoform
2. LN$_2$
3. Oven Dry
4. Microtrace
Heavies Frozen in Bottom of Microcentrifuge Tube
Light Mineral Fraction
Washed from Tube
Light and Heavy Fractions Ready for Mounting
PLM Study of Density Fractions
Light Mineral Fraction in 1.540 Cargille Liquid
Plagioclase Feldspars
Crossed Polars
Rock Fragments
Heavy Mineral Suite
Plane Polarized Light
Mineral Suite Varies by Provenance of Source Rocks

Bottom. Crossed polars.
Birefringence

- Top. Kyanite in 1.660 index of refraction oil.
- Bottom. Crossed polars
Pleochroism

- Top. Glaucophane
  1.660 refractive index oil. N-S polarizer.

- Bottom. E-W polarizer.
Pleochroism

- Top. Euhedral tourmaline in 1.660 index of refraction oil. N-S polars

- Bottom. E-W polars.

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Pleochroism

- Top. Subhedral tourmaline in 1.660 refractive index oil.

- Bottom. E-W polars.

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Mineral Varieties

- Hypersthene from Mount St. Helens eruption collected from Yakima, WA days after the event. 1.660 index of refraction oil.
  Top. N-S polars.
  Bottom. E-W polars.
Mineral Varieties

- Hypersthene from Africa. 1.660 refractive index oil.
  Top. N-S polars.
  Bottom. E-W polars.
Mineral Varieties

- Hypersthene from Martinique. 1.660 refractive index oil.
  Top. E-W polars.
  Bottom. N-S polars.
Coarse Mineral Fractions

- Examination for identification and surface texture.
- Stereomicroscopy
- Scanning Electron Microscopy
- Cathodoluminescence
Monahan Sand Dunes in West Texas. Mounted in 1.660 refractive index oil for contrast.
Sahara sand stained with methylene blue to show distribution of amorphous silica (silicic acid) on grain surfaces.
SEM/EDS
SEM of Grain Surfaces

- Rounded quartz grain from Monahan Dunes in Texas showing surface coating.
Indicators on Quartz Grain Surfaces
Diatoms on Marine Quartz Grain Surface
Detail of Diatom on Quartz Grain Surface
“Silica Flowers” Deposited on Quartz Grain Surface
Etching and Dissolution of Silica on Quartz Surface
Deep Etching on Quartz Grain Surface
Fresh Quartz Grain from Glacier in Canada

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Cathodoluminescence
Fraction 2

Check for Diatoms or Plant Opal

Absent
- Heat with HF in Plastic Tube
- Acetolysis in Glass Tube
- Wash, Mount in Glycerine - Water

Present
- Split Sediment
- 30% H₂O₂ + heat
- Density Separation $\rho < 2.3$
Acetolysis in 1.5 mL Glass Microcentrifuge Tube
Fraction 2
Identification of Isolates

Optical Microscopy

- Pollen and spores
- Resistant plant tissue
- Tire rubber
- Combustion soot
- Diatoms and plant opal
Pollen Fraction after Acetolysis and Staining
Study of Internal Structure at High Magnification
Pollen Fraction without Staining

- Top. Charcoal particle.
- Bottom. Difficultly identified plant tissue.
Pollen Fraction without Staining
Opal Phytoliths

- Distinctive morphology.
Plant Opal
Fraction 3 (clays)

Centrifuge and Filtration

- XRD
- Microscopy
- Thermal Analysis
- FTIR

- Staining Tests
- Phase Contrast – Oil Immersion on Oriented Platelets
X-Ray Diffraction
Murder Scene Outside Disneyland in California

Victim’s Body Found Here
Concrete Block Substituted for Computers
Heavies Isolated from Concrete Block