Scattering matrices of mineral aerosol particles at 441.6 nm and 632.8 nm

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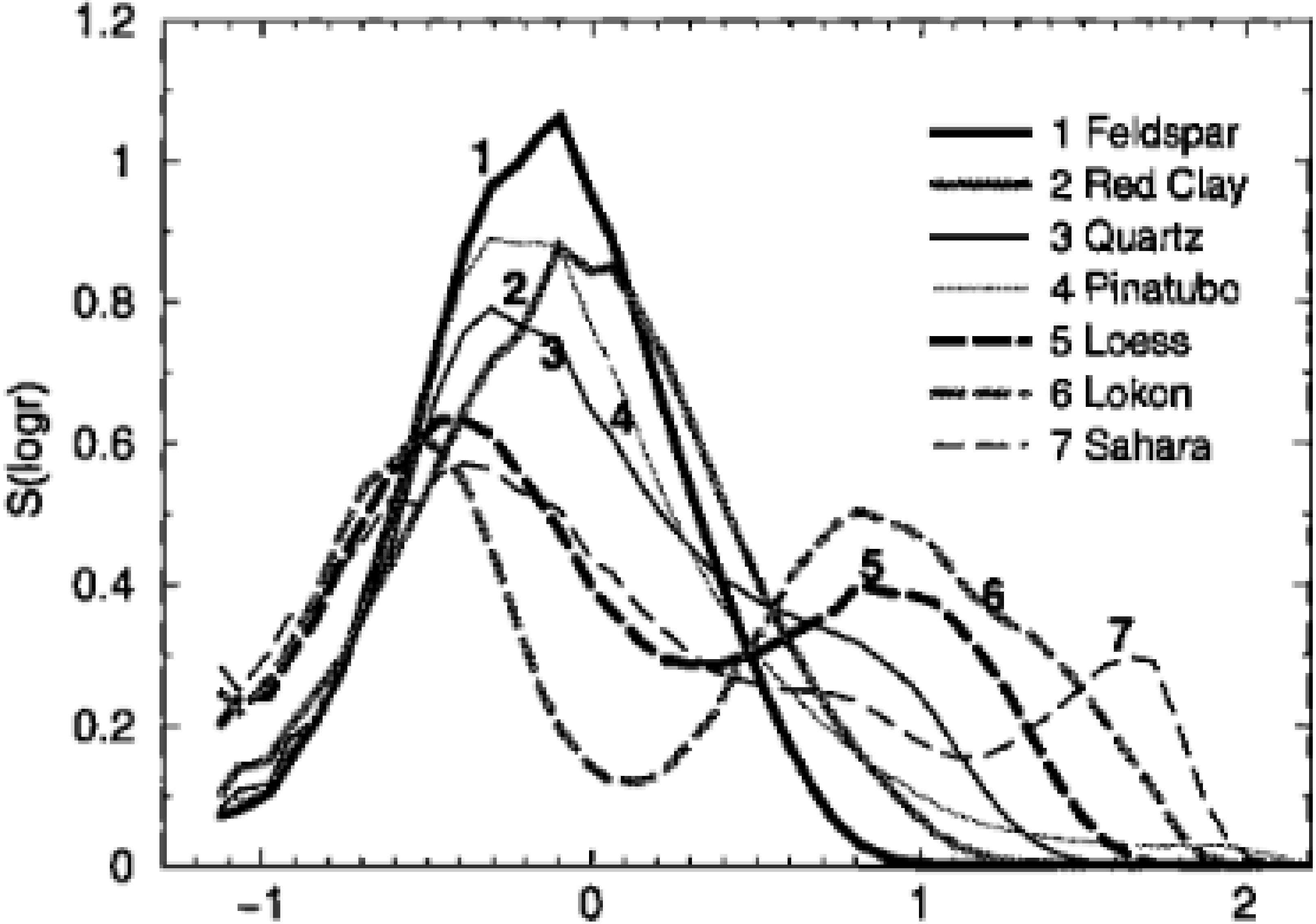
Briefly

- Seven distinct irregular shaped mineral aerosol samples
  - Found in the earth's atmosphere
- Do measurements at wavelength 441.6 nm and 632.8 nm
- Try to model these samples with Siris (I don't know version)

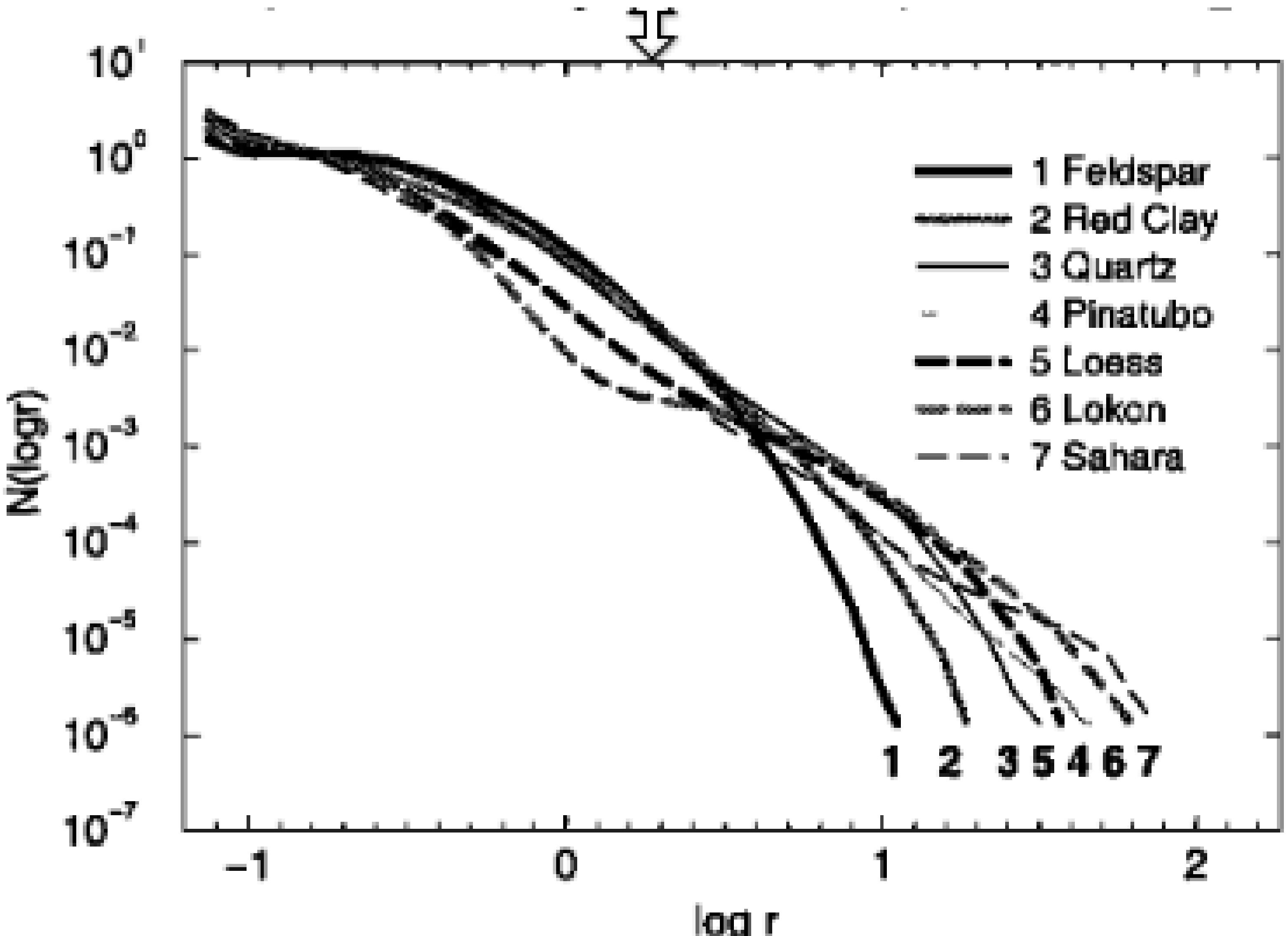
Samples

- Required a lot
  - Hard to obtain from the air
- Not “real” aerosols
  - Soil
  - Fine powder
- Still should be quite good

Size distribution



number distribution



Samples

Table 1. Overview of Properties of the Aerosol Samples Studied

Sample	Main Constituents (Mineral or Mineral group)	r_{eff} (μm)	σ_{eff}	$Re(m)$	Color
Feldspar	K-feldspar, plagioclase, quartz	1.0	1.0	1.5-1.6	light pink
Red clay	biotite, illite, quartz	1.5	1.3	1.5-1.7	red brown
Quartz	quartz	2.3	1.5	1.54	white
Pinatubo volcanic ash	silica glass, plagioclase, amphibole, magnetite	3.0	3.5	1.5-1.7 2.1	light grey
Loess	K-feldspar, illite, quartz, calcite, chlorite, albite	3.9	1.6	1.5-1.7	yellow brown
Lokon volcanic ash	silica glass, plagioclase, magnetite	7.1	1.6	1.5-1.6 2.1	dark brown
Sahara sand	quartz, clay minerals, calcium carbonate	8.2	2.0	1.5-1.7	yellow brown

$$r_{\text{eff}} = \frac{\int_0^\infty r \pi r^2 n(r) dr}{\int_0^\infty \pi r^2 n(r) dr}, \qquad \sigma_{\text{eff}} = \sqrt{\frac{\int_0^\infty (r - r_{\text{eff}})^2 \pi r^2 n(r) dr}{r_{\text{eff}}^2 \int_0^\infty \pi r^2 n(r) dr}}.$$

Refractive index

- Electron microprobe
- Not “real” refractive index
  - Inhomogeneous
  - Irregularities
- Refractive index does not change that much at the visual spectrum
- Variations small
  - Except when the sample contains iron
- Imaginary part is mostly handwavium :(

Particle shapes

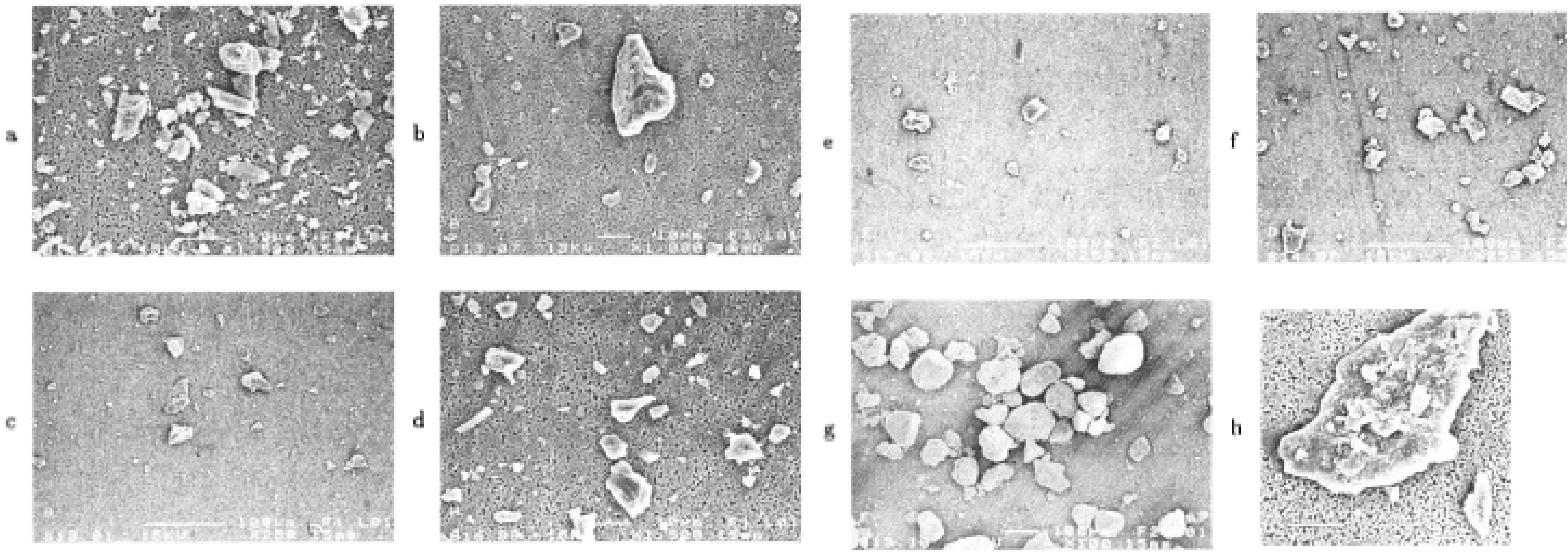


Figure 2. Scanning electron microscope (SEM) photographs of the aerosol samples studied: (a) feldspar, (b) red clay, (c) quartz, (d) Pinatubo ash, (e) loess, (f) Lokon ash, and (g) Sahara sand. An example of irregularity of a single (quartz) particle is shown in photograph Figure 2h. White bars in Figures 2a, 2b, 2d, and 2h denote 10 μm but in the remaining photographs, 100 μm.

Experimental setup

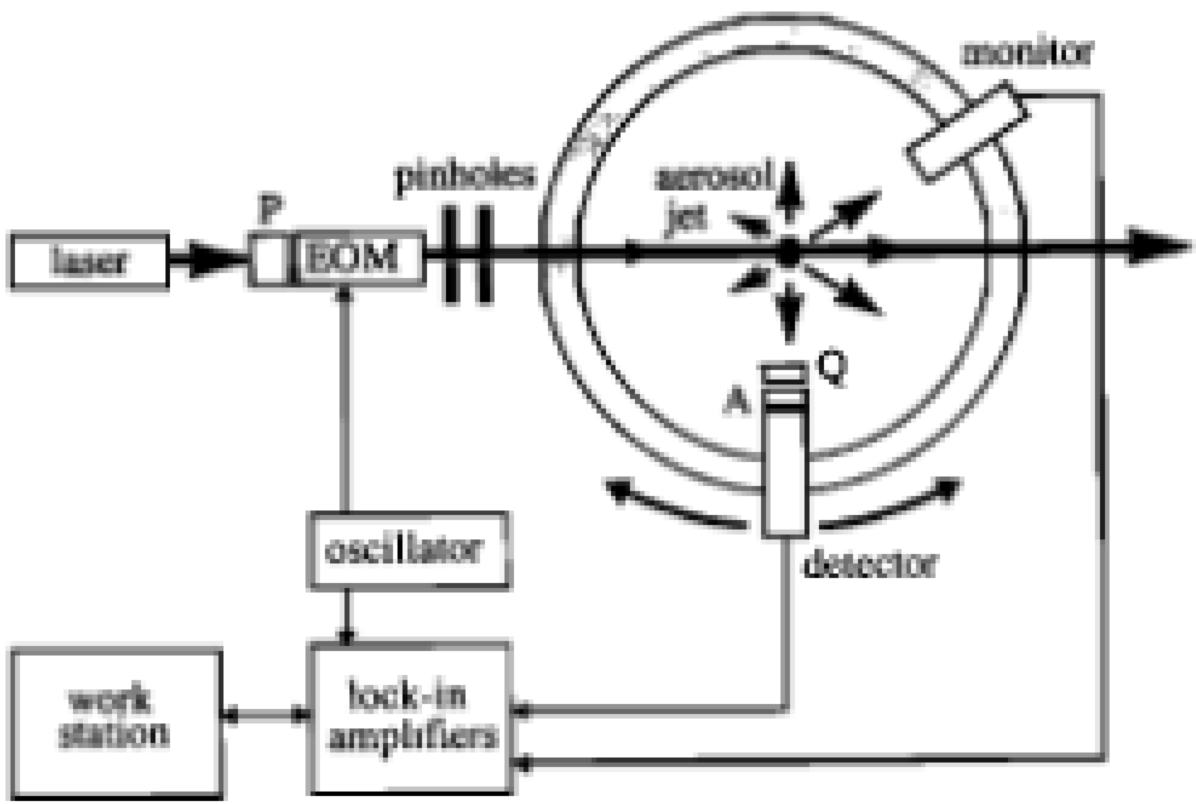
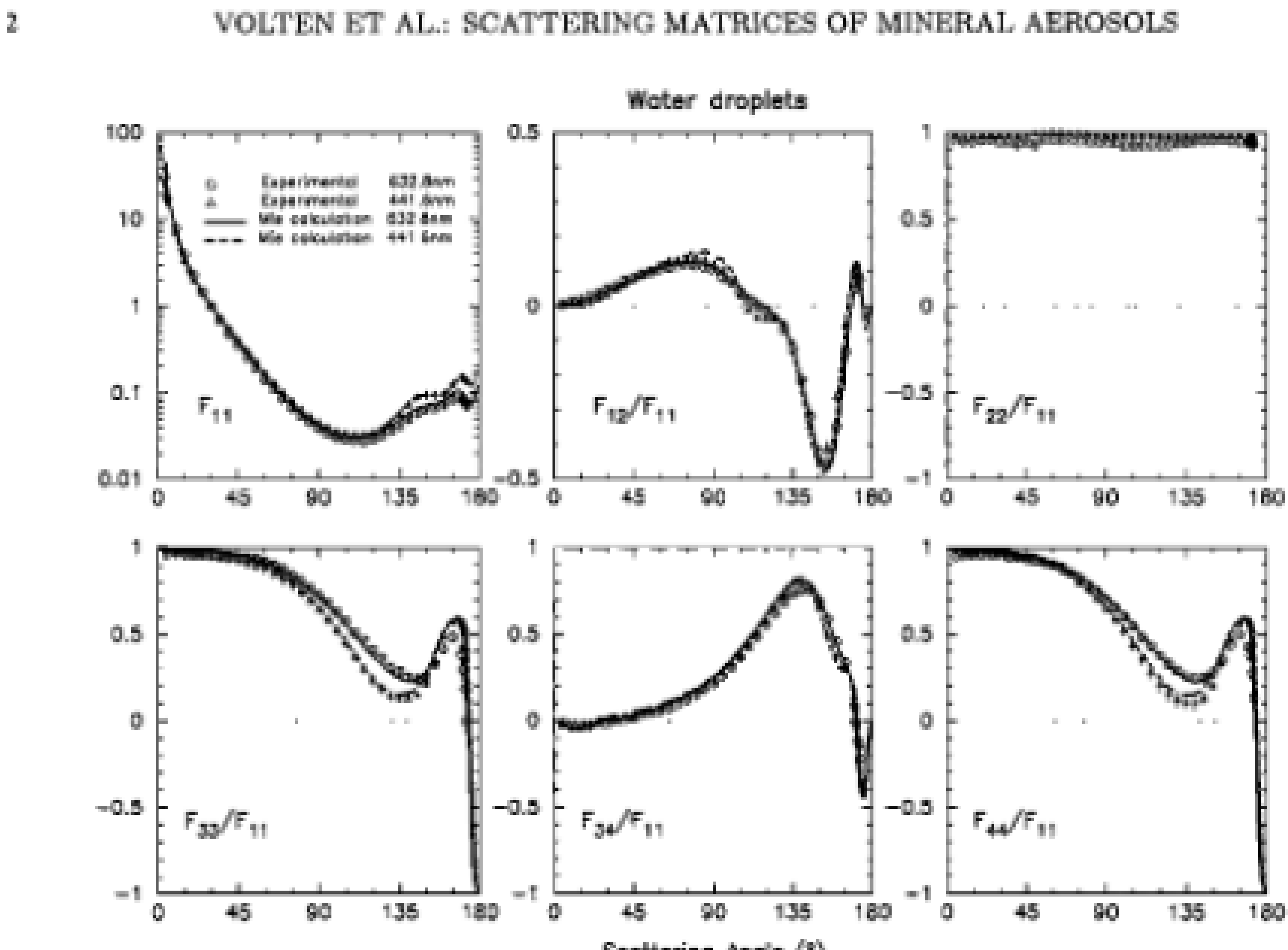


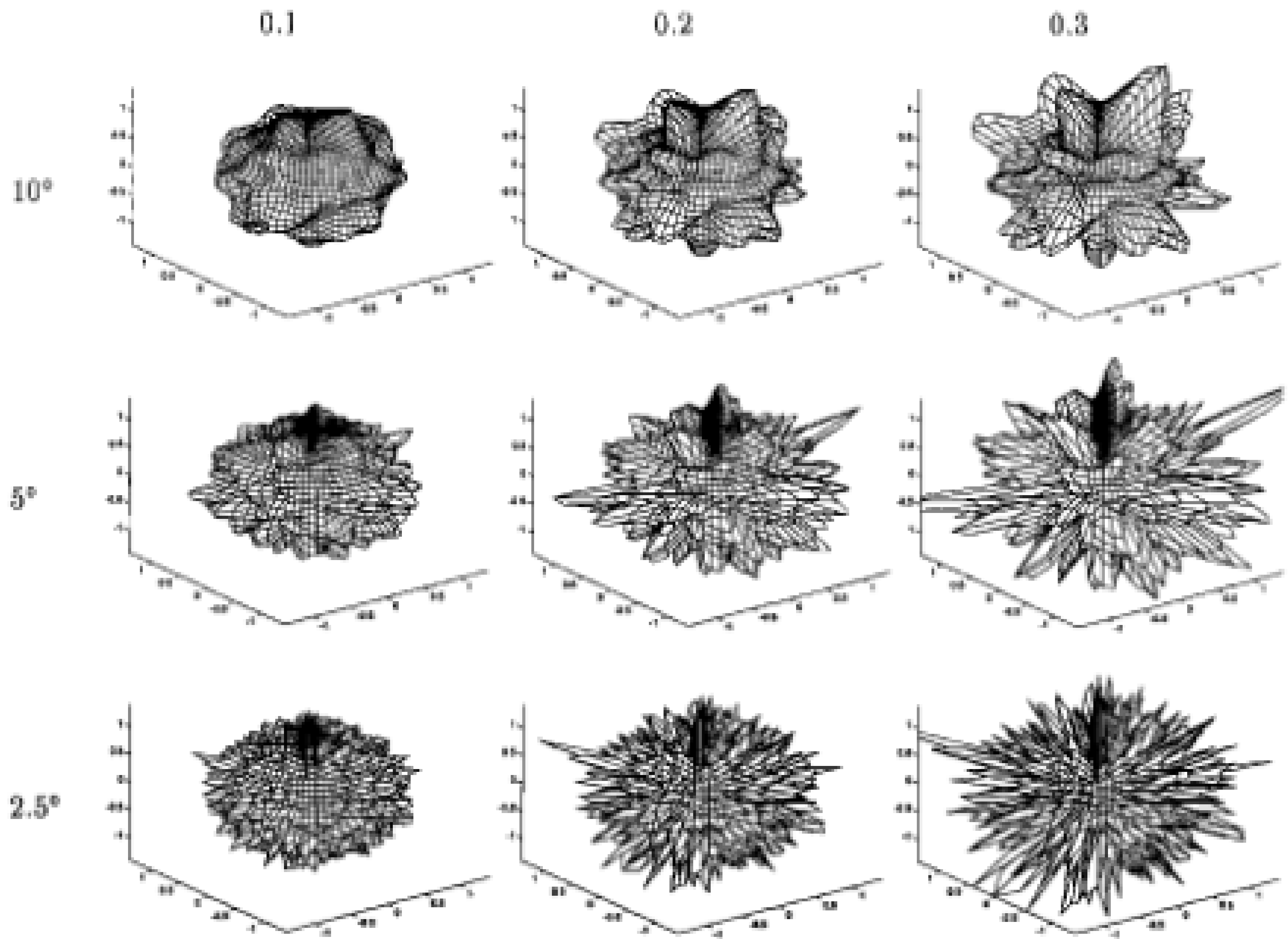
Figure 3. Schematic picture of the experimental setup; P, polarizer; A, polarization analyzer; Q, quarter-wave plate; EOM, electro-optic modulator.

Waterdroplet test



Numerical studies

- Made with siris


0.1
0.2
0.3
10°
5°
2.5°

During this slide Timo shows results from the paper due to pure laziness

How parameters affected the results

- The standard deviation not that much: fix to 0.2
- Variation in the correlation angle: 5
- Refractive index is the strongest factor
  - Real part does not affect that much to the DLP

MORE slides please, Timo

Summary

- Good agreement (experimental and numerical)
- Can tweak parameters
- Check all parameters
- Bad: Feldspar and red clay
- Loess, Sahara and Lokon might have iron oxides