GEOSCIENCE CENTER GÖTTINGEN

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN IN PUBLICA COMMODA SEIT 1737

# Long-term alteration of natural and technical silicious glass fibres

**Lena Knüpfer**, Kirsten Techmer, Georg-August Universität Göttingen, Geoscience Center, Dept of Mineralogy, Goldschmidtstraße 1, 37077 Göttingen, email: lena.knuepfer@stud.uni-goettingen.de

## Introduction

To understand the long-term durability of silicious glass fibres, the microstructural and chemical alteration along the surfaces of $H_2SO_4$ altered and unaltered stone wool was optically investigated with the electron microscope after 25 years. The present study used altered silicious glass fibres used in the thesis by D. Gödecke (Gödecke, 1998: Experimental studies on the corrosion of glass fibres at low temperatures, EUG 1998).

## Material and methods

Stone wool are technical glass fibres and insulating material comparable to a basaltic composition of natural glass fibres. It is manufactured using the cascade spinning process.

Two stone wool samples and natrural glass fibres (Pele´s hair) were considered. In the course of the study by Gödecke (1998), one of the stone wool samples was altered with 0.0025 mol/l $H_2SO_4$ for 7 days in 1998. The second stone wool sample is an unaltered specimen. Both samples were stored for 25 years without external influences.

The electron optical investigations were made with the JSM-IT500 from JEOL, using SED and electron mapping.

Table 1. Stone wool composition, measured by electron microprobe

| | wt.-% | σ |
|---|---|---|
| $SiO_2$ | 45.96 | 0.37 |
| $TiO_2$ | 2.87 | 0.09 |
| $Al_2O_3$ | 13.17 | 0.15 |
| $FeO_{tot}$ | 6.07 | 0.29 |
| MgO | 9.70 | 0.17 |
| MnO | 0.14 | 0.10 |
| CaO | 16.82 | 0.10 |
| BaO | 0.05 | 0.04 |
| $Na_2O$ | 2.83 | 0.07 |
| $K_2O$ | 1.27 | 0.06 |
| $Cr_2O_3$ | 0.05 | 0.06 |
| total | 98.94 | 0.63 |

(Gödecke, 1998)

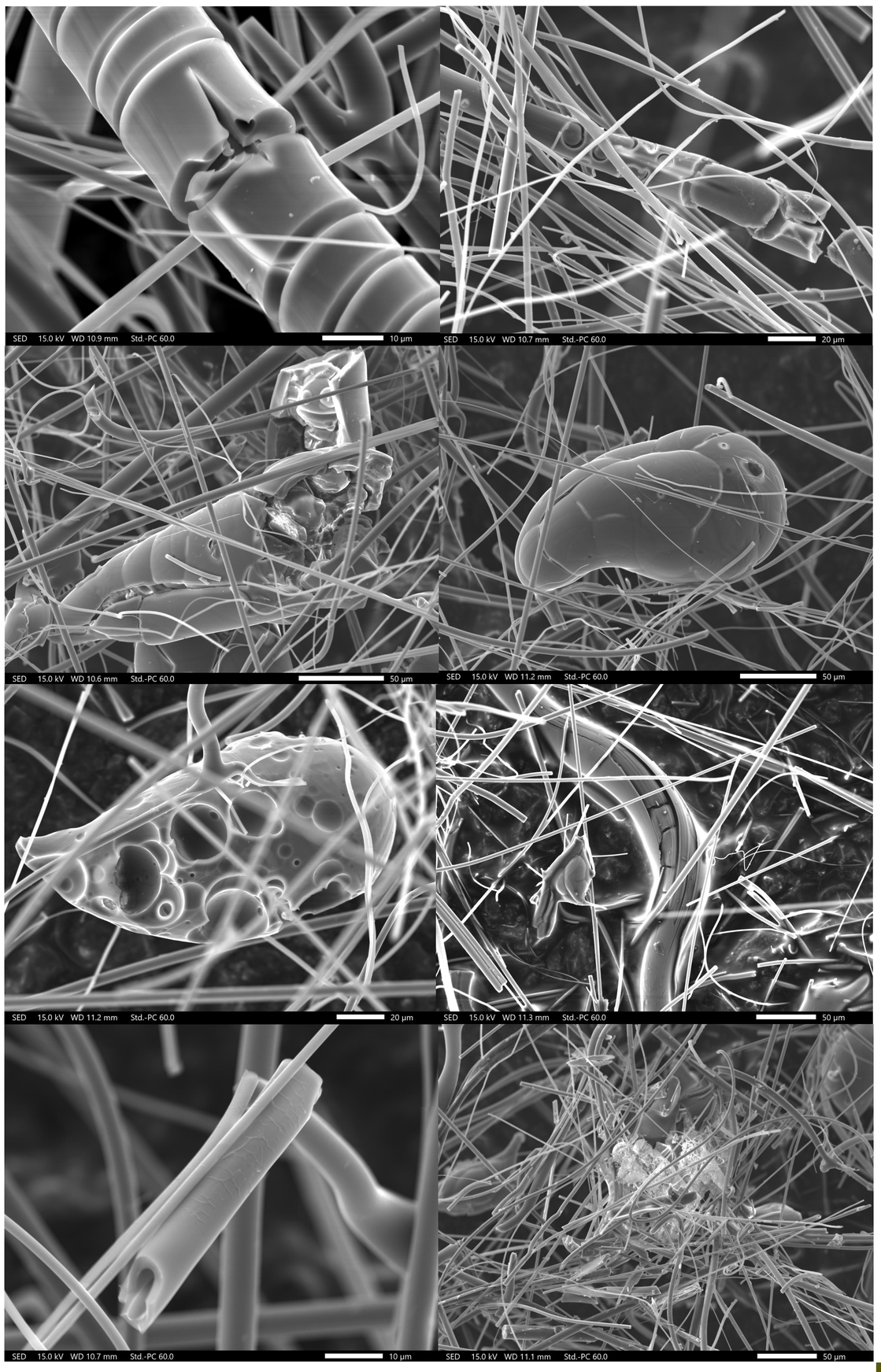


Figure 1. SEM image of the $H_2SO_4$ altered stone wool after 25 years.




Figure 3. SEM images of Pele´s hair.

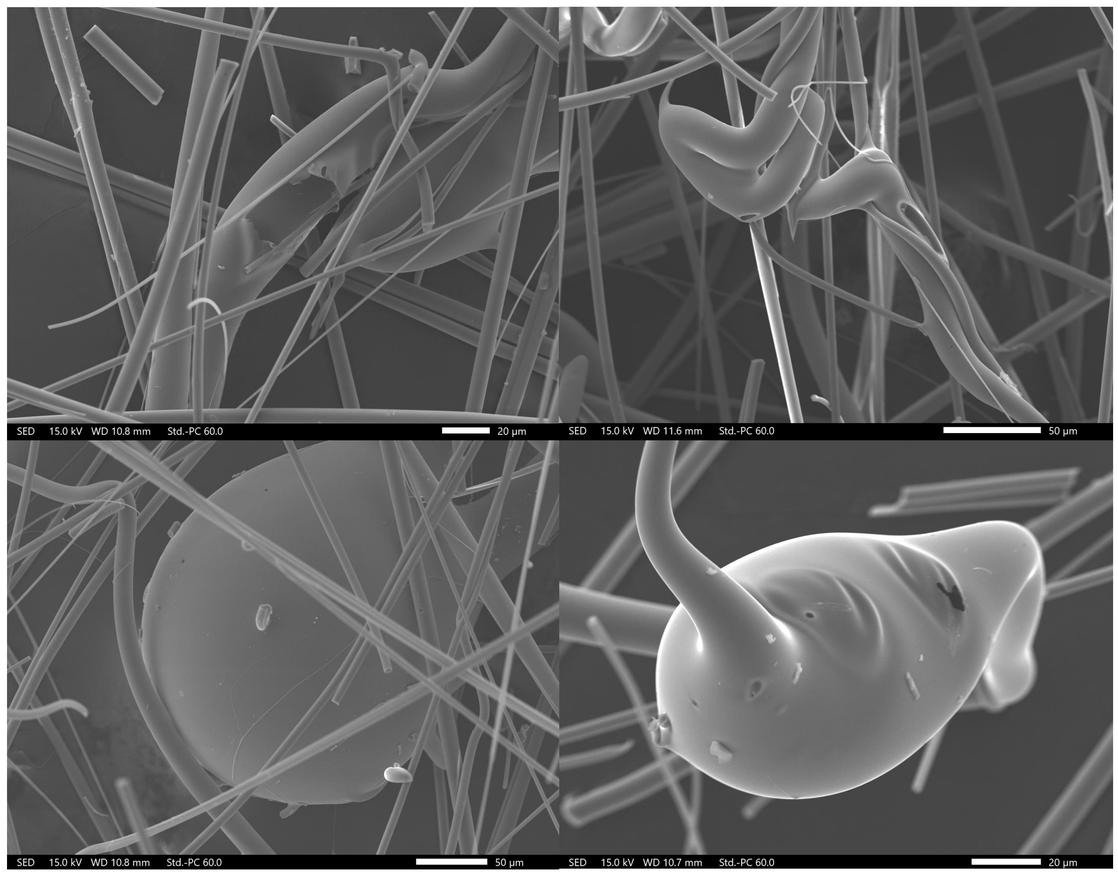


Figure 2. SEM images of the unaltered stone wool after 25 years.

## Main results

After 25 years of storage, $H_2SO_4$ induced alteration lead to fracturing along the fibre axes resulting in intense fragmentation down to the nanometer scale. The fragments are of several tens of nanometers up to some micrometres in sizes. Single fibres show the formation of ring-shaped cracks perpenticular to the fibre axes. Along these cracks, the beginning of fragmentation can be observed as a splitting along the fibre axes. In the unaltered samples the alteration lead to less intense fragmentation due to the 25 years of storage.

In both samples, corrosion pits can be seen as an alteration product in the obtained melting drops. In the $H_2SO_4$ altered samples the corrosion pits are up to several tens in nanometers, in the unaltered samples only up to a few nanometers in sizes.

Cl as well as Sulfur bearing minerals can be detected in both samples, the altered as well as the unaltered samples.

After 25 years storage, partly intense organic material can be observed along larger parts of glass fibres as well, resulting in a clumping of the fibres into larger mixtures of chunks.

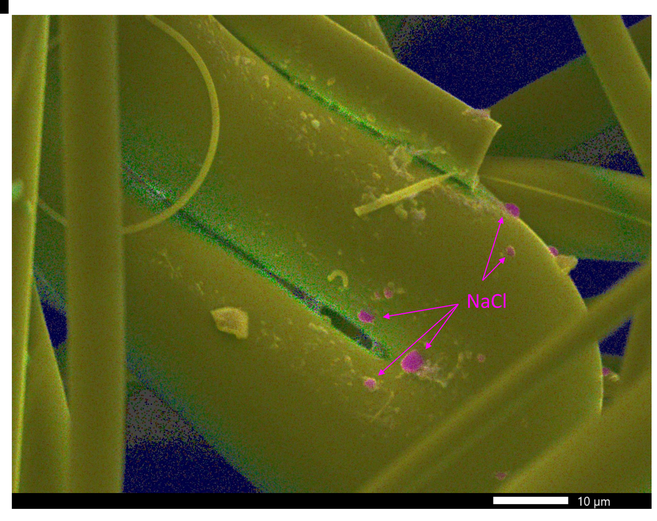


Figure 4. Electron mapping image of the unaltered stone wool after 25 years.

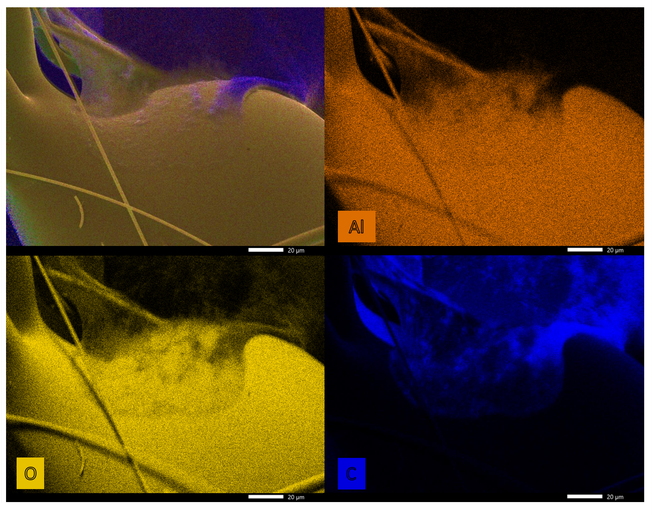


Figure 5. Electron mapping images of the unaltered stone wool after 25 years.

**References:** D. Gödecke (1998). ‘Experimental studies on the corrosion of glass fibres at low temperatures, EUG 1998‘

**Acknowledgments:** We greatly thank the GOELEM laboratory for the SEM studies!