Prebona DuraClean™

Fossilizing wood

mechanism and effect

Wooden deck fossilized with Prebona DuraClean.

Fossilizing wood with Prebona DuraClean

Prebona DuraClean is amorphous colloidal silica with a surface modification to optimize the function of making wood surfaces more durable and soil repellent by applying Prebona DuraClean to the surface of outdoor and indoor wooden structures, typically building structures such as floors, façades, decks and fences. Prebona DuraClean has the effect of improving the physical properties of wood by a mechanism called fossilizing. For more information on how Prebona DuraClean can be used to make surfaces durable and soil repellent, please visit www.prebona.com.

To use silica to improve properties of wood is relatively new and contributes to long term durability of wood. Silica comes in different forms and Prebona DuraClean represents the latest, third generation, and most advanced form of silica for treatment of wood. Silica can either be used to treat surfaces of wooden structures or be added to timber, which is then used as building material. The focus of this brochure is the use of silica to treat surfaces of wood structures such as wooden decks, wood facades etc. In recent years, treatment of wood with silica has attracted intense attention among researchers and consumers alike as it provides an attractive means to improve properties of wood.

Prebona DuraClean represents the third generation silica treatment for wood. The main differences between Prebona DuraClean and conventional silica treatments for wood based on water-glass is that Prebona DuraClean is not corrosive due to moderate pH of PrebonaDuraClean and that Prebona DuraClean water-fast after treatment and drying. Silica treatments based on water-glass is soluble in water and will be removed from the wood over time.

Prebona DuraClean

Prebona DuraClean is colloidal silica and consists of very small (5 - 100nm) particles of amorphous silica (SiO_2) in water. Silica is the second most common substance in the earth's crust and is what sand is made of. Silica is non-organic material and hence not sensitive to UV from the sun or heat and is very resistant to mechanical abrasion. This is one reason why colloidal silica is a suitable material to treat wood with in order to extend the life time of wood structures. Another reason for the suitability of colloidal silica is that it will penetrate easily into wood because of its small particle size. Once the colloidal silica has penetrated into the wood, it will form a very strong three dimensional network. Colloidal silica has been demonstrated to be beneficial to wood in many ways, all stemming from its ability to fill pores and capillaries of the wood.

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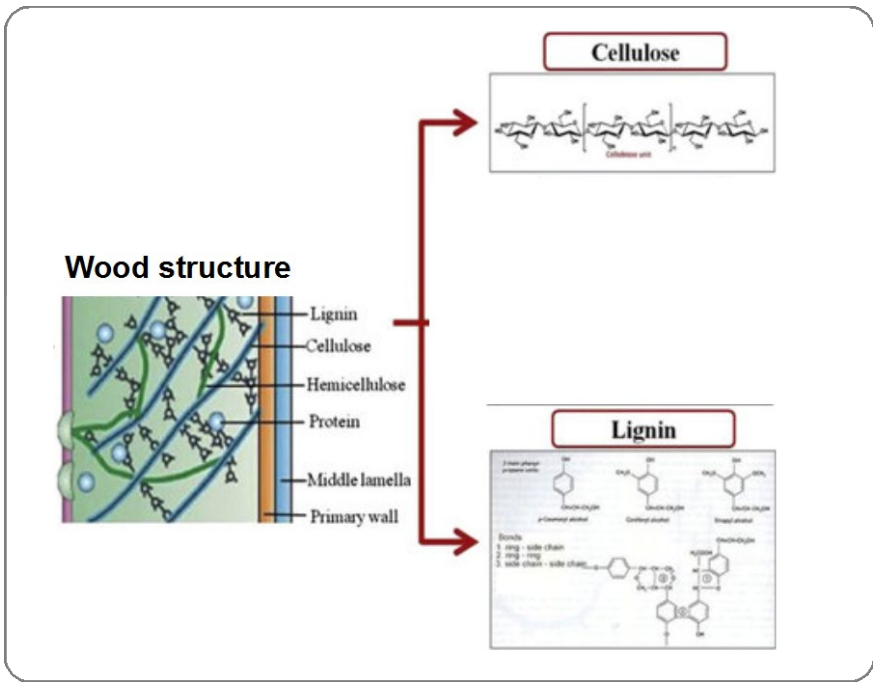
Wood

Wood is a composite material consisting of cellulose fibers bound together by a natural resin called lignin. It is the composite structure that provide strength and flexibility of wood. Both cellulose and lignin are organic materials based on carbon and hence subject to deterioration by UV from the sun, heat and mechanical abrasion. Once the lignin is disintegrated due to UV exposure, wood will lose its strength and appear like paper. The process of fossilizing wood include replacement of lignin with a non-organic mineral such as silica. The silica will act as a glue in the wood structure and provide strength and durability as it is not sensitive to UV from the sun or heat and is very resistant to mechanical abrasion. As silica in the form of Prebona DuraClean is not water soluble after drying, the treatment will be very long-lasting.



Wood structure.

How to foissilize wood with Prebona DuraClean

Prebona DuraClean is used to treat the surface of wood structures with the main purpose of making the surface resistant and soil repellent. Before treating a wood surface with Prebona DuraClean, the surface should be clean and dry.

Treatment of a wood surface with Prebona DuraClean is typically done with a low pressure sprayer. The amount of Prebona DuraClean needed depends on the condition of the wood. A wood surface that is heavily deteriorated due to UV, id much of the lignin is gone, will require more Prebona DuraClean compared to a newer wood surface. It is often good to treat a surface twice to make sure that enough silica has penetrated into the wood. Typically, 1 liter will cover 5 m2 of wood surface. Avoid treating wood surface in direct sun light or when there is risk of rain. Once Prebona DuraClean has dried, it is resistant to water and ready to be used.

Prebona DuraClean effect on properties of wood

Strength

When wood is treated with colloidal silica, strength improves. The reason is due to filling of pores, cracks and capillaries with silica, replacing deteriorated lignin, which makes the wood stronger. Both flexural and compressive strength of wood improves after treatment with Prebona DuraClean.

Abrasion resistance

When a wood surface is treated with colloidal silica, abrasion resistance improves. Abrasion is defined as surface wear that causes progressive loss of material from a wood surface. Abrasion results from dynamic forces and displacements that are cycled many times. The reason for an improved abrasion resistance of a wood surface treated with colloidal silica is that pores and capillaries have been filled with silica, which improves surface hardness and therefore improves abrasion resistance.

Resistance to water absorption

A wood surface treated with Prebona DuraClean will be denser and therefore less absorbing. When a wood surface treated with Prewbona DuraClean is subjected to water, e.g. rain, the water will form a water film that runs off the surface, cleaning the surface and making the surface dry faster compared to a non-treated wood surface.

Thermal properties and fire resistance

Treatment of wood with colloidal silica improves thermal properties and fire resistance of the wood.

Soil repellant properties

Wood treated with Prebona DuraClean is soil repellent because the surface is dense and hence less prone to adhere dust and other dirt particles. Treatment of wood with Prebona DuraClean makes the surface hydrophilic, i.e. when surface is exposed to rain, a water film forms and washes dirt off the surface to keep it clean and make the surface dry faster, which makes it less attractive a surface for growth of algae and moss providing for less usage of biocides.

Prebona DuraClean effect on expected life time of wood

Durability of wood is the ability to resist weathering action, including UV exposure and abrasion. Durable wood is economical and helps the environment by conserving resources and reducing wastes. The best for economy and environment is to extend the life of a wood structure instead of replacing it with a new structure. We make it possible to extend the life of wood by fossilizing it with Prebona DuraClean.

Prebona report on formulations for fossilizing effect on wood (excerpt)

Aim

This report summarizes results obtained from wooden decks that have been treated with Prebona DuraClean. The report provides images taken with scanning electron microscopy (SEM) of wood treated with Prebona DuraClean as well as untreated reference samples.

Method/setup

Two types of pressure impregnated pine wood have been used, one that originates from 1979, and one newer from approximately 2000. All wood decks were first scrubbed clean using Grumme Grönsåpa before treatment with Prebona DuraClean. SEM images were taken of small splinters from the wooden decks. The images were captured directly from the samples without sputtering in variable pressure mode (vpSEM) at 10 Pa, at 20.10 kV with an I probe of 1000 pA and 8.5-9.5 mm working distance, using a backscattering detector.

Results and Discussion

The backscattering detector used for SEM imaging and analysis gives a contrast coupled to the molecular density. This means that organic (carbon based) materials such as wood give lower contrast than inorganic silica, which therefore lights up as brighter parts in the images.

In the first round of SEM images depict wood treated with Prebona DuraClean. The wood splinters were cut with a knife to make a fresh cross-section, which was imaged at an angle of 15-35°. As can be seen in Figure 1.b, Prebona DuraClean has penetrated into the surface of the wood being well integrated with the top layer of fibers and also filling some structures below the surface. Roughly one month after the decks had been cleaned, treated and put outside for weather exposure, new splinters were taken and imaged with SEM. This time we compared untreated reference with wood samples treated with Prebona DuraClean. This time the splinters were cut at a lower angle and the samples are imaged looking straight down at the wooden surface.

Looking at the older wood from 1979 (see Figure 2.a, b and c), we can see that even the untreated samples have some inorganic material in the surface layer (naturally occurring fossilization), although not as much as the samples treated with Prebona DuraClean (instant or boosted fossilization). This difference is more striking when looking at the newer wood from 2000 seen in Figure 3.a, b and c, where very limited amount of inorganic material is seen on the surface of the untreated sample.

Interestingly, the pore structure further in to the wood also seems to have been impregnated with Prebona DuraClean. This is seen both in the older wood (Figure 2.a, b and c) and in the newer wood (Figure 3.a, b and c), where closeups at 1000x magnifications have been made roughly 100 µm below the surface. This suggests that Prebona DuraClean treatment has penetrated far beneath the surface and partly fossilized the fibers. We can also see some brighter spots in these images and in the 100x image (Figure 3.a) silica filled pores can be seen far below the surface. The results also suggest that Prebona DuraClean remains in the wood after outdoor exposure.

Conclusions

Using SEM imagining with a backscattering detector, Prebona DuraClean can be seen to not only coat the surface of wood, but also to penetrate and affect (fossilize) the wood structure further into the material. It is difficult to say how far the treatment penetrates, but certainly several micrometers, and potentially hundreds of micrometers. The results also indicates that fossilizing effect from Prebona DuraClean is durable.

Images

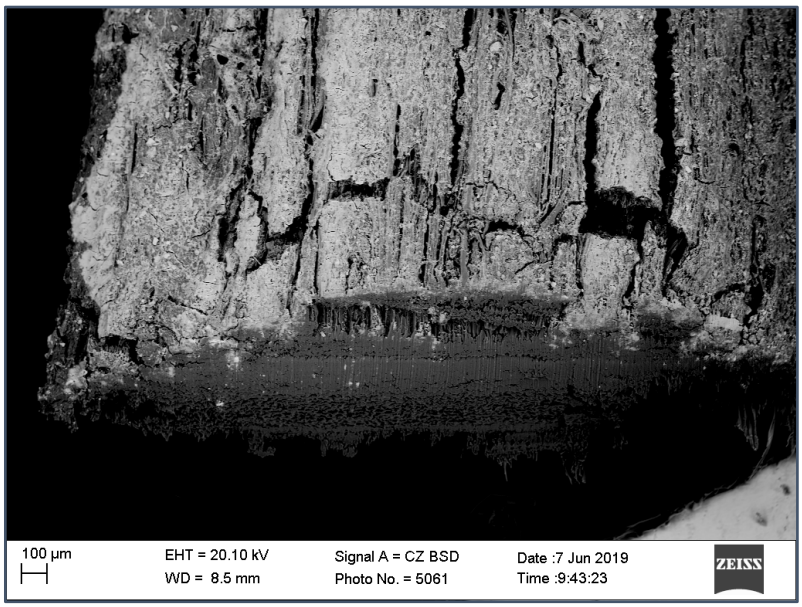


Figure 1.a. *SEM image (100X) of older wood (1979) freshly treated with Prebona DuraClean.*

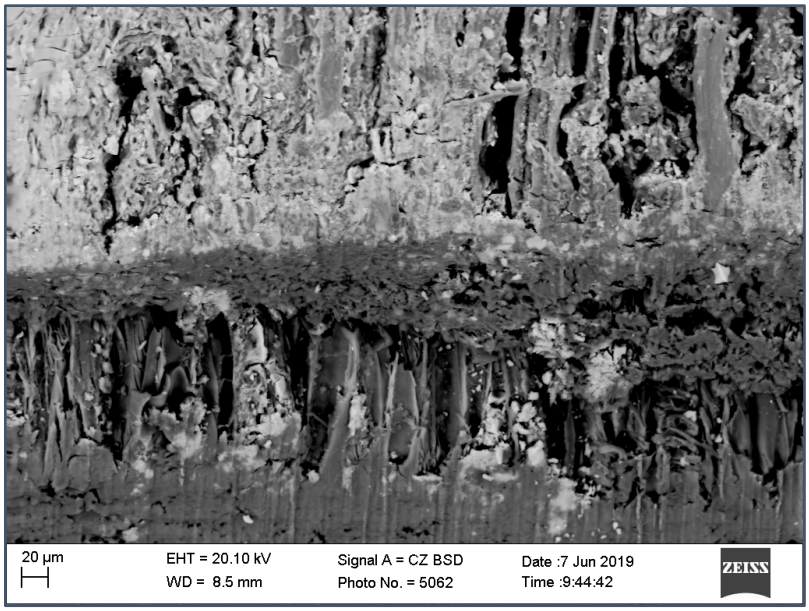


Figure 1.b. *SEM image (500X) of older wood (1979) freshly treated with Prebona DuraClean.*

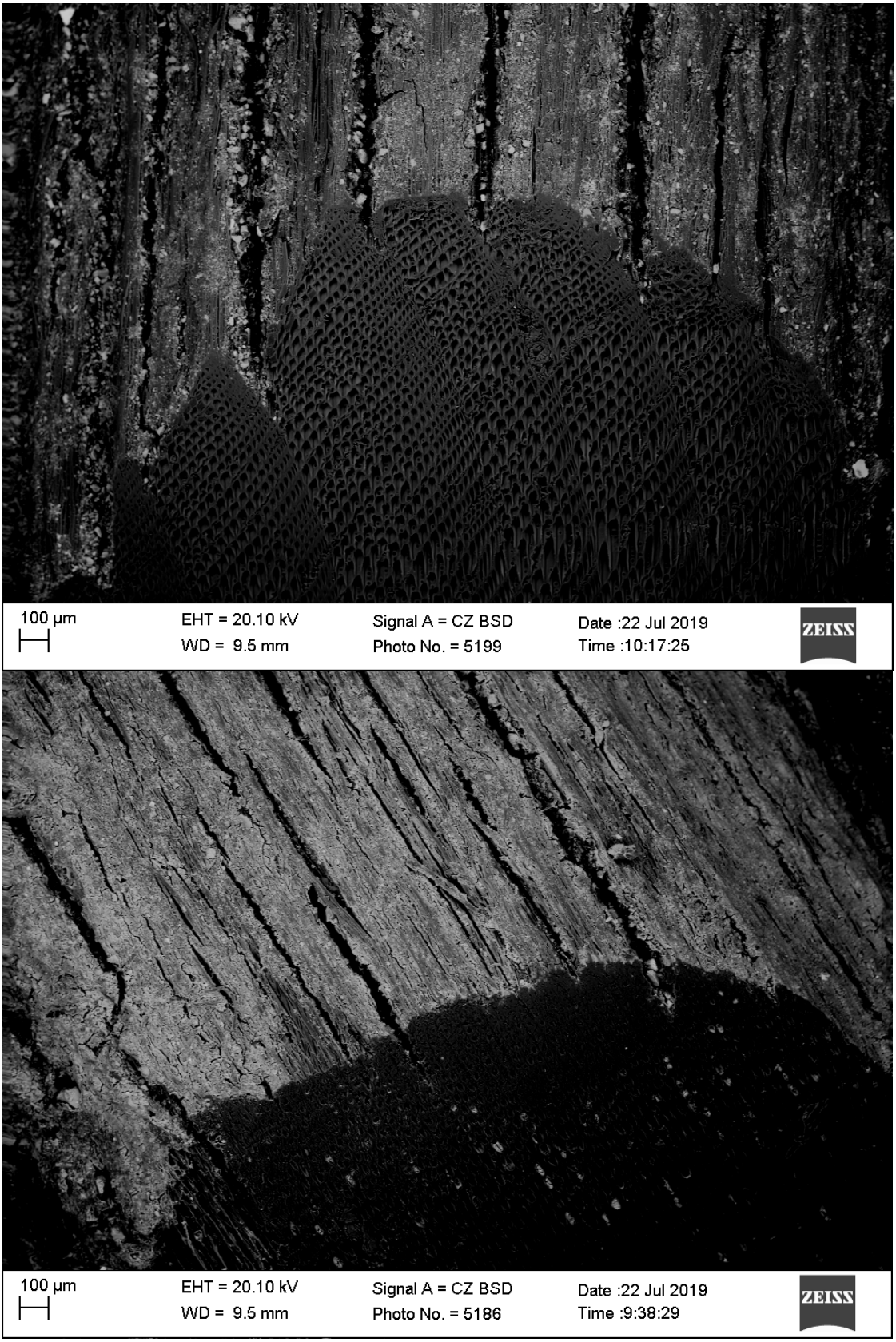


Figure 2.a. *SEM images (100X) of old wood (1979) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*

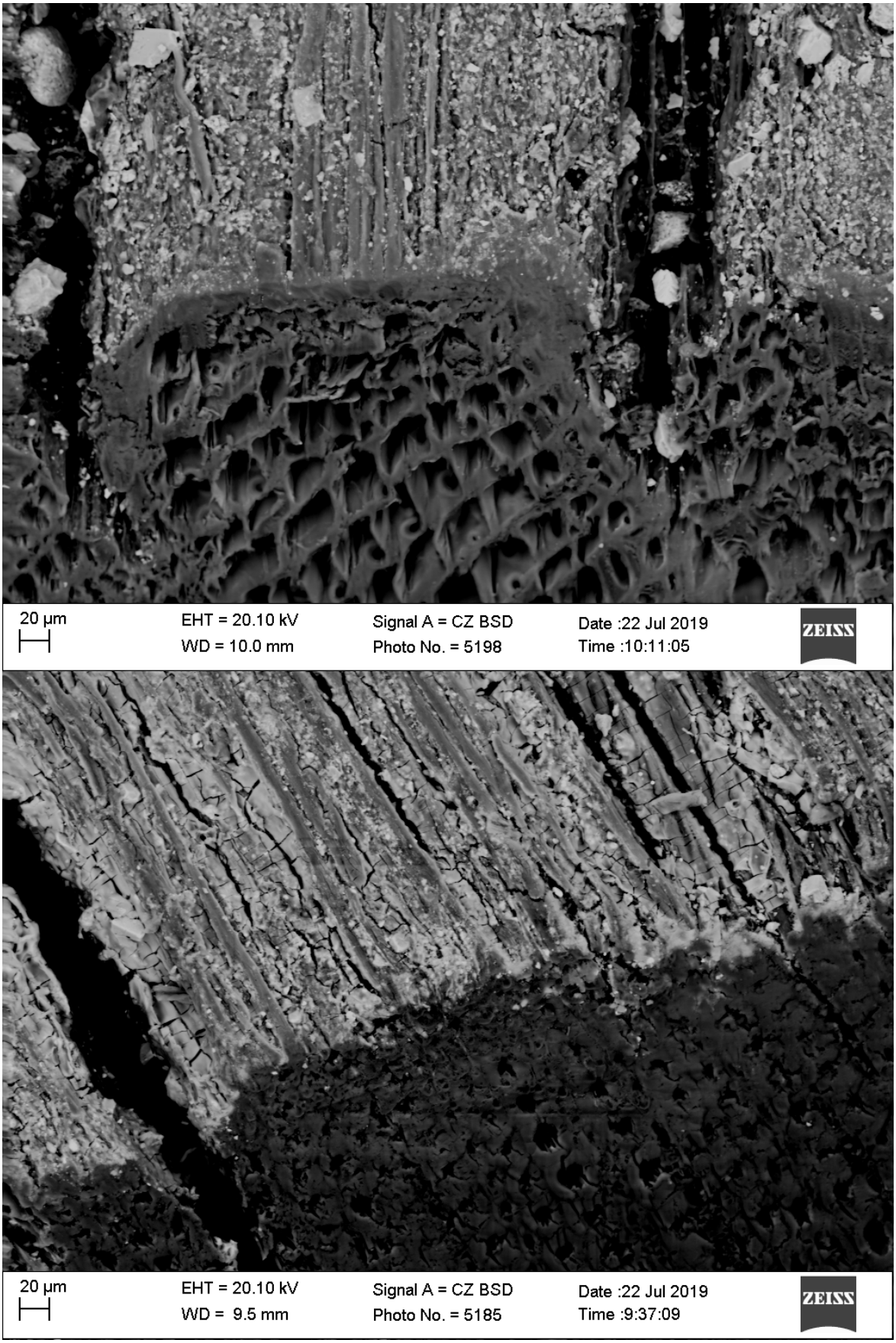


Figure 2.b. *SEM images (500X) of old wood (1979) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*

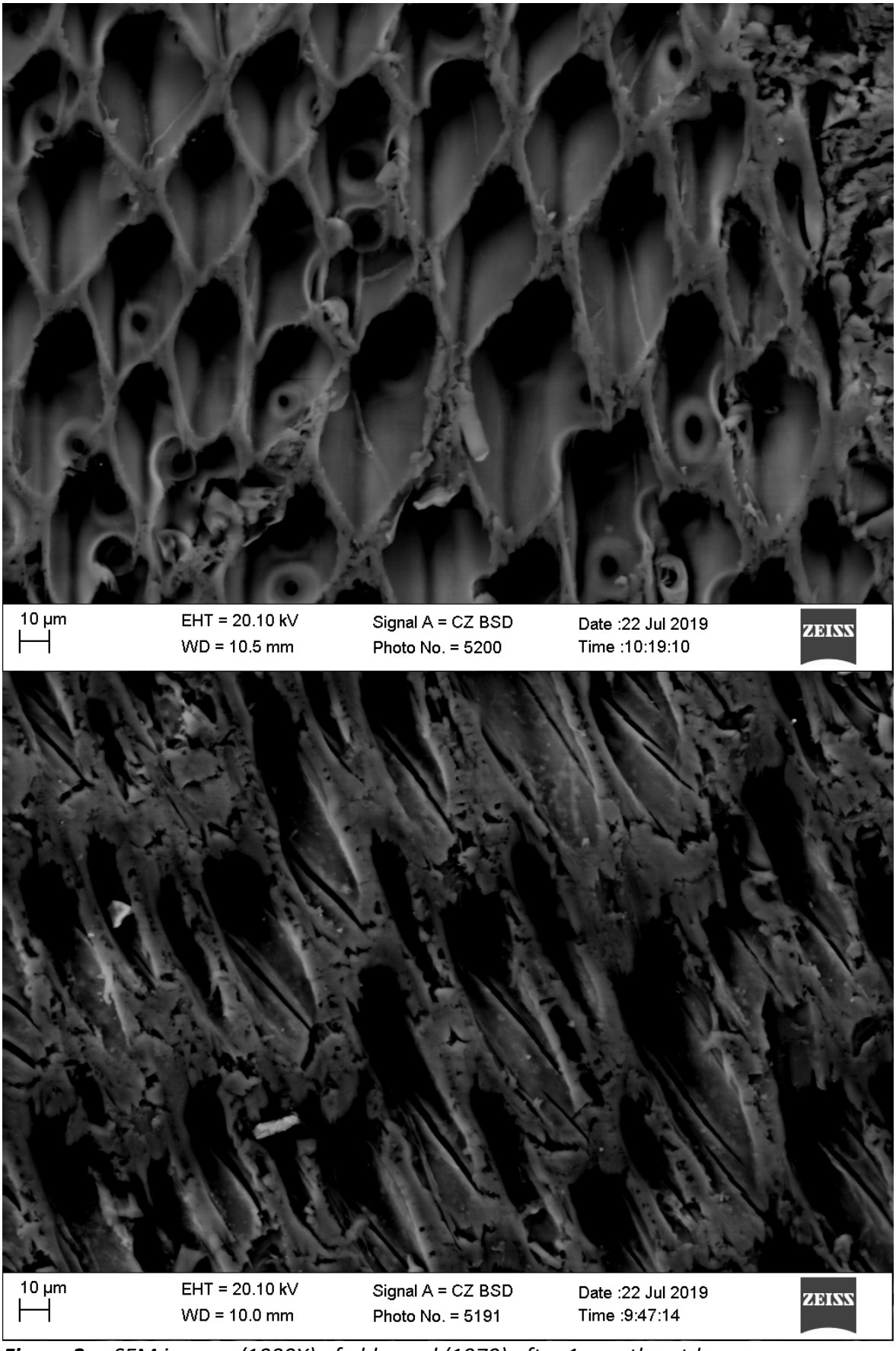


Figure 2.c. *SEM images (1000X) of old wood (1979) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*

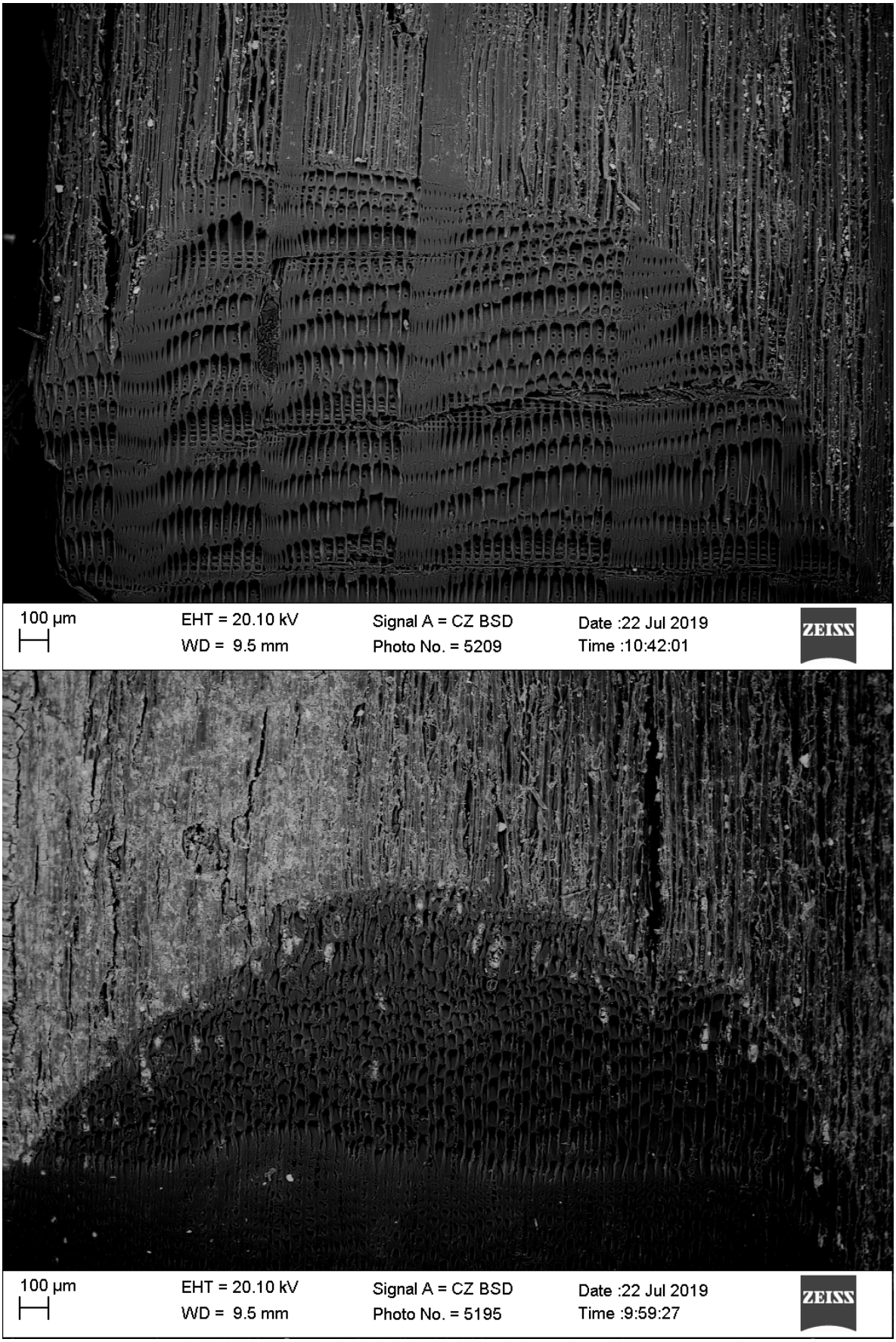


Figure 3.a. *SEM images (100X) of newer wood (2000) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*

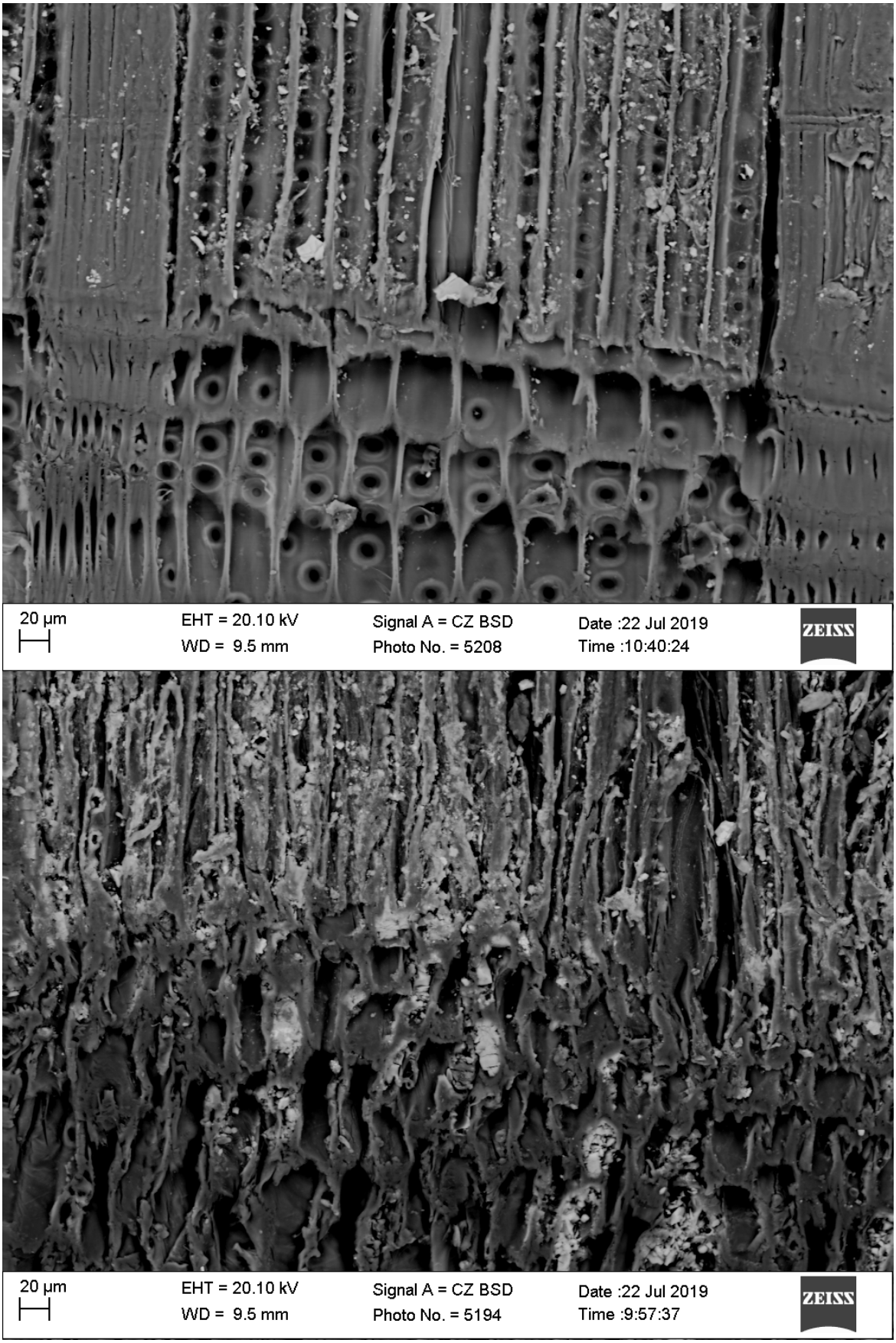


Figure 3.b. *SEM images (500X) of newer wood (2000) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*

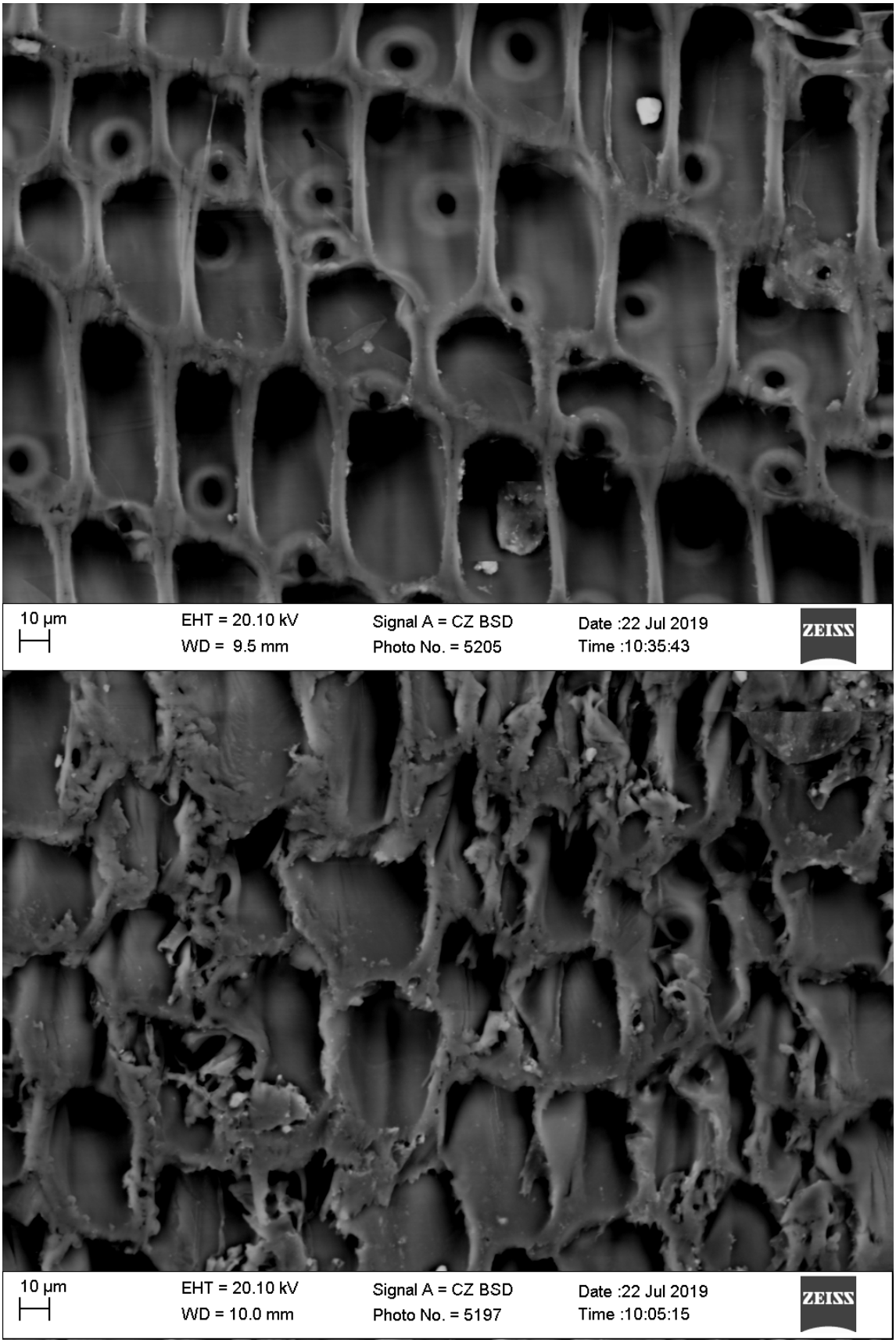


Figure 3.b. *SEM images (1000X) of newer wood (2000) after 1 month outdoor exposure. Top: untreated sample. Bottom: sample treated with Prebona DuraClean.*