

Abstract

Silicified woods belonging to the three-dimensional permineralised plants are thoroughly studied by palaeobotanists. Their importance is usually underestimated in other scientific disciplines, their mineralogy/geochemistry is poorly known in close relation to other known scientific data. Stone-like appearance and nature of silicified wood is valued mainly in mineralogical markets. Only a complex analytical view can reveal more about their taphonomic past, palaeoenvironments and mechanisms of their formation and preservation.

This PhD thesis aims to uncover the potential of instrumental analyses of permineralised woods and design remarkable procedures of observing the wood samples. I have performed petrographical and geochemical analyses and comparison of samples of the Pennsylvanian (Carboniferous) to the Late Triassic age from several localities in the Czech Republic, Germany, Brazil, Sultanate of Oman, Mongolia, USA – Arizona, France, and Antarctica.

The selected samples, in most cases taxonomically determined, were observed in qualitative and quantitative way by instrumental imaging and analytical tools. Bulk (XRD) and detailed point analyses were performed. As the samples are very old, the crystallinity of SiO_2 was high (α -quartz was their main constituent according to XRD). A rather rare metastable SiO_2 polymorph, moganite, was detected at concentration up to 20%; its presence seems to have a connection with volcanic settings or evaporitic environment.

Hot cathodoluminescence (CL) visualised most effectively the heterogeneities within the samples, distinguished different phases of silicification, secondary overprints, uncommon mineral admixtures, partial calcification or phosphatisation, and allochthonous rock/mineral grains. CL spectroscopy enabled identification of distinct CL emissions and gave precision to spectra assignment. CL has become a springboard for other instrumental point analyses (SEM/EMPA, Raman spectroscopy, LA-ICP-MS), which then led to more detailed analyses under higher magnifications. Finally, such a combination of distinct analytical techniques led to an identification of wakefieldite, a rare vanadate mineral, described in fossil wood for the first time. It was detected in a sample from the Eastern Bohemia, from a field site affected by volcanism and abundantly occurring local ore deposits. Neighbouring silicified matter with the wood structure was geochemically heterogeneous and witnessed REE's and V migration during multistep diagenetic evolution.

The unconventional approach to fossil-wood analysis allows us to distinguish alluvial and volcanic modes of silicification. It might be used as a starting point for further research worldwide that could produce a comprehensive database of materials signatures of such permineralisations. Simultaneously, the database of CL shades of mineral mass might be created to better understand the process of fossil wood silicification under distinct past environments and varying duration.