Mono-, di- and anhydrosaccharides from the Mesozoic and Cenozoic lignites and fossil wood

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Mono-, di- and polysaccharides are common constituents of living organisms, but their occurrence and state of preservation in geological record have only rarely been considered. Here, we show the monosaccharide and for the first time the di- and anhydrosaccharide occurrence from the Middle Miocene lignite and Middle Jurassic fossil wood samples. From detritic lignites, fructose and glucose were detected as dominant monosaccharides, and sucrose and trehalose as important disaccharides. Xylites characterized by more complex composition, with monosaccharides (arabinose, arabinofuranose, glucose, and minor xylose and fructose), saccharols (erythritol, arabitol and mannitol), and also some disaccharides. The Middle Jurassic fossil wood samples contain glucose, glucofuranose and levoglucosan. The high content of holocellulose (up to 55 wt. %) and co-occurrence of such monosaccharides as arabinose, xylose and mannose in xylites suggest that probable not only cellulose but also hemicellulose was preserved in samples as old as 13 Ma. Compounds like trehalose and mannitol appear to be products of wood degrading fungi. Surprisingly, glucose, the most stable monosaccharide, and levoglucosan can occur in much older organic matter (c.a. 168 Ma) as products from cellulose degradation, and possibly a remnant from wildfire burning of wood, respectively. Our findings confirm that saccharides can be preserved under favorable conditions in sedimentary organic matter of the Mesozoic to the Cenozoic eras, and can be used as specific biomarkers of cellulose and maybe also hemicellulose degradation, fungal metabolism, and wildfire events.