

**Optical properties of ancient paper are governed by structural disorder of cellulose.**

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Ancient paper yellowing, inducing major esthetic damage, is mainly due to cellulose oxidation. The complexity of cellulose is an obstacle to the interpretation of optical spectra for the characterization and quantification of chemical damage induced by ageing in ancient paper. Here we report optical absorption measurements of paper samples obtained in a temperature range from 14 to 300 K. Their interpretation by *abinitio* theoretical computational simulations revealed a dominant role of static disorder on oxidized cellulose optical response, compared to temperature effect. Our findings are of crucial importance to understand ancient paper degradation processes and to conceive new diagnostic methods.