# Pollen and spore chemistry as a long-term record of ultraviolet-B radiation flux

PHILLIP E. JARDINE[1]*, WESLEY T. FRASER[2], BARRY H. LOMAX[3] AND WILLIAM D. GOSLING[1]

[1]Department of Environment, Earth and Ecosystems, The Open University, Milton Keynes, UK (*correspondence: phillip.jardine@open.ac.uk; william.gosling@open.ac.uk)
[2]Geography, Department of Social Sciences, Oxford Brookes University, Oxford, UK (wfraser@brookes.ac.uk)
[3]Agriculture and Environmental Science, University of Nottingham, Sutton Bonington Campus, Leicestershire, UK (Barry.Lomax@nottingham.ac.uk)

Despite the importance of solar irradiance as a dominant control on the earth's energy budget, no proxy has been developed that can provide records on timescales of over $10^4$ years. No independent empirical record of solar irradiance therefore exists prior to the Holocene, limiting our understanding of the relationships between solar energy inputs, global climate and biotic change over longer timescales.

Here, we present a novel proxy based on the chemical composition of sporopollenin, the primary component of the outer walls of pollen and spores (sporomorphs). The chemical composition of sporopollenin is responsive to levels of ultraviolet-B (UV-B) radiation exposure, via a concomitant change in the concentration of phenolic compounds. This relationship offers the possibility of using fossil sporomorph chemistry as a proxy for past UV-B flux, and by extention total solar irradiance (TSI). Fourier Transform infrared (FTIR) spectroscopy provides an efficient, economical and non-destructive method for measuring phenolic compound concentration. The high preservation potential of sporomorphs in the geologic record, and the conservative nature of sporopollenin chemistry across the land plant phylogeny, means that this new proxy has the potential to reconstruct UV-B and TSI flux over much longer timescales than has previously been possible.

We demonstrate the capability of sporomorph chemistry to reconstruct accurately the modern latitudinal TSI gradient, and present preliminary TSI timeseries data from the late Pleistocene of Ghana. This proxy provides a new approach for quantifying and understanding the relationship between UV-B flux, solar insolation and past climate. The unpicking of this information offers the tantalising potential to determine how changes in solar irradiance have driven long-term changes in vegetation assemblages.