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The Potential Applications of Raman Spectroscopy in Unravelling Complex Palaeowildfire Ecosystems

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Raman spectroscopy represents a novel methodology of characterising plant-fire interactions through geological history, with enormous potential. Applications of Raman spectroscopy to charcoal have shown that this is an effective method of understanding intensity changes across palaeofire regimes. Such analyses have relied on the determination of appropriate Raman parameters, given their relationship with temperature of formation and microstructural changes in reference charcoals. Quantitative assessments of charcoal microstructure have also been successfully applied to the assessment of carbonaceous maturation under alternate thermal regimes, such as pyroclastic volcanism. Palaeowildfire systems in association with volcanism may present a complex history of thermal maturation, given interactions between detrital charcoals and volcanogenic deposition. However, whilst palaeofire and volcanic maturation of carbonaceous material are well understood individually, their interaction has yet to be characterised. Here we present the first analysis of palaeofire charcoals derived from volcanic ignition utilising Raman spectroscopy. Our results indicate that complex interactions between volcanism and palaeofire systems may be better understood by the characterisation of charcoal microstructure, alongside palaeobotanical and ecosystem studies. Understanding the unique relationship between wildfires and volcanism, and the impact that this has on the fossil record, may better assist our understanding of wildfire systems in deep history. Further still, this highlights the potential for better understanding the socioecological impacts of modern and future wildfire systems closely associated with volcanic centres.