Applying Raman Spectroscopy to Modern– and Palaeo–charcoals Associated with Wildfire Activity

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Calluna vulgaris (Heather)

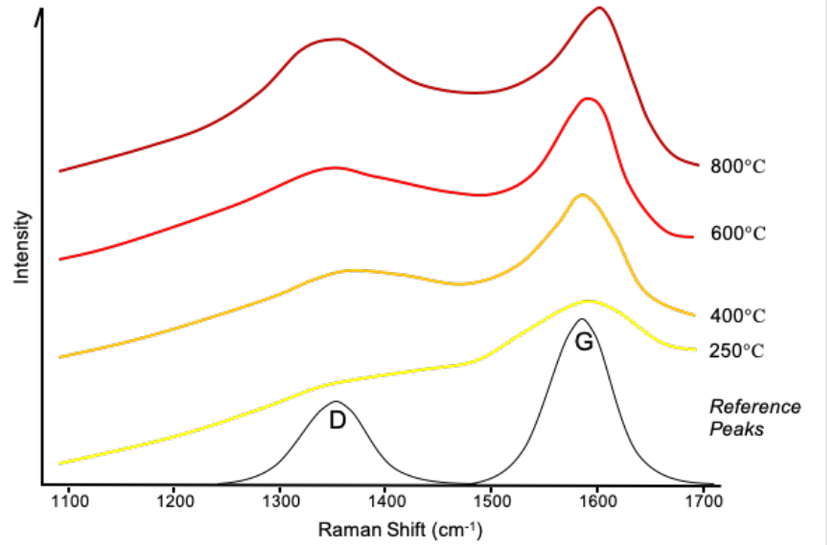
INTRODUCTION

- Raman spectroscopy has been used widely to characterize the thermal maturation of organic matter (1) – yet the relationship between Raman parameters, wildfire–derived charcoals, and their geothermometry is undiscussed.
- Here we display the creation of a Raman geothermometer (RamChar) from *Calluna vulgaris* charcoal, and its application to wildfire–derived charcoals isolated from the Boltysh Impact Crater, Ukraine.

BACKGROUND

- Raman spectroscopy of organic carbon relies on the characterization of the relationship between two spectral peaks – D and G (*see Fig. 1.*). Changes to the peak width (FWHM), ratios of intensity (ID/IG) and area (AD/AG), and distance between peaks (G–D) offer an insight into sample thermal maturity.
- The Boltysh Core represents Danian lacustrine infill and subsequent ecosystem recovery following a meteorite impact, occurring a few thousand years prior to Chicxilub. Significant isotopic and palynological research has revealed a period of climatic warming (Dan–C2 hyperthermal) across the centre of the core (2,3).

Fig. 1; Raman spectra of charcoal produced at varying temperatures.



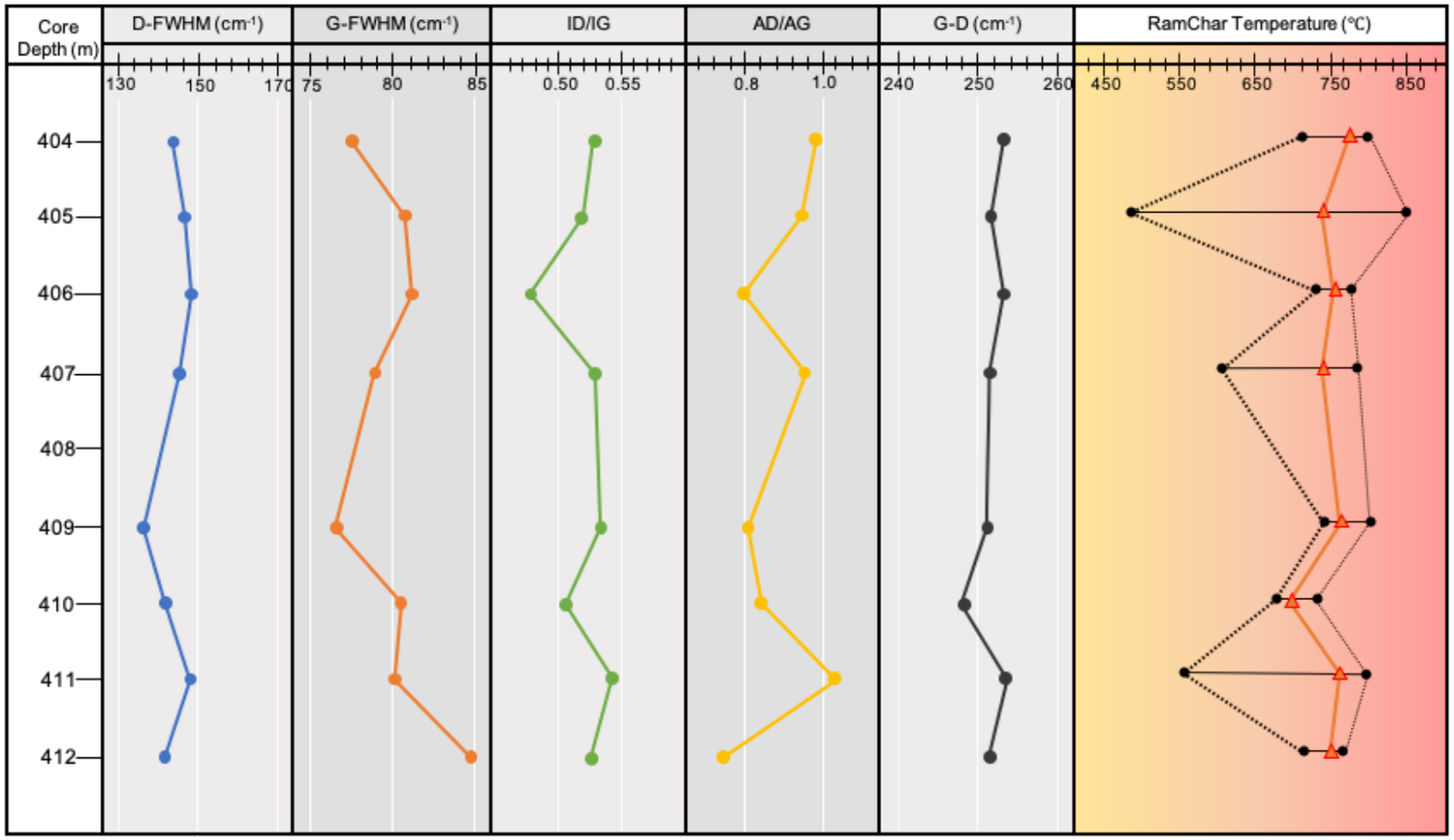


Fig. 2; Changes in Raman parameters with depth in a section of Boltysh core, and relation to the calculated wildfire temperatures.

RESULTS

Geothermometer

- Raising formation temperature:
  - Increases intensity of the D–peak.
  - Reduces the width of both peaks.
  - Increases the distance between both peaks (G–D).
- D–FWHM and G–D remain the best fit parameters for multiple–linear regression against temperature (RamChar).
- Trends for each parameter are very similar, but there are variations depending on the origin material (i.e. root).

Boltysh Application (Fig. 2.)

- Small variation in temperature across depth, with a median temperature of 752°C – typical of crown–fire systems.
- Temperature variation at depths 405, 407 and 411m show evidence of both surface (400–600°C) and crown (>600°C) wildfire systems.
- Crown fires are consistent with palynological data at this depth, indicating a presence of arboreal angiosperm species (2,3).

REFERENCES

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