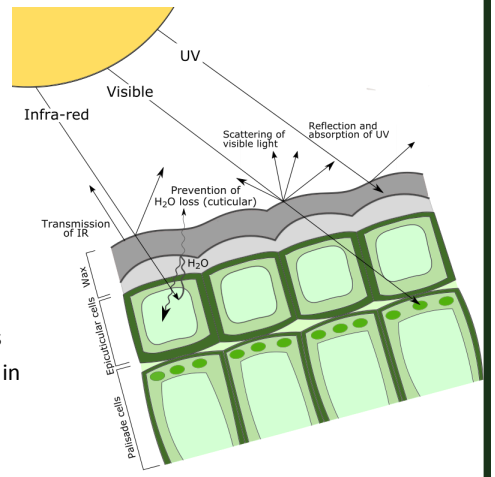
Leaf waxes: tracking past climate and plant metabolism

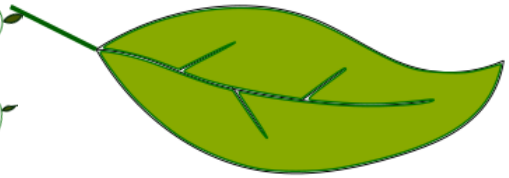
Bridget Warren[1*], Yvette Eley[1], James Bendle[1]

[1]School of Geography, Earth and Environmental Sciences, University of Birmingham [*]baw888@student.bham.ac.uk

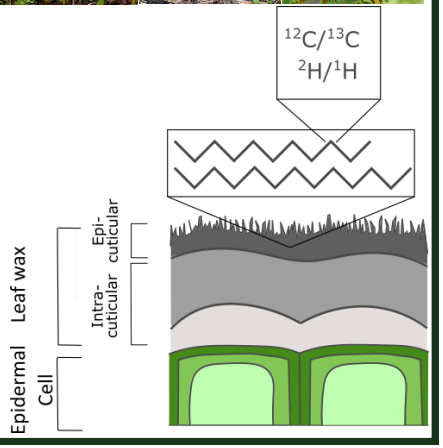
What are plant waxes?

- Forms a shiny, impermeable layer on leaf surfaces
- Found in all land plants
- Used for
  - Preventing water loss
  - Preventing radiation damage
  - Controlling leaf temperature
  - Interactions with the environment
- Chemical composition of leaf wax changes with environment leaves were grown in—e.g. in warmer conditions, plants alter chemical composition to raise wax melting point



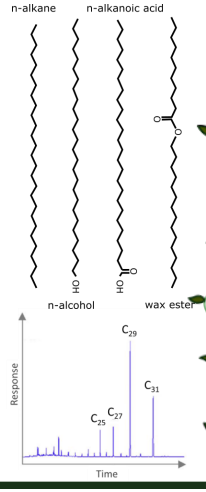


- Leaf waxes contain organic molecules, polymers
- 2 main layers of wax, epicuticular (mostly straight chained organic compounds, e.g. alkanes, aldehydes) and intracuticular (organics embedded in a polymer matrix)
- Waxes formed in epidermal cells are transported to leaf surface
- My research focusses on *n*-alkanes; simple chains of carbon and hydrogen atoms
- I am looking at isotopes of carbon and hydrogen ($^{13}C/^{12}C$, $^{2}H/^{1}H$), chain length, and carbon preference index (ratio of odd to even numbered alkanes)



Plant waxes and the geologic record

- Leaf wax alkanes do not decay on leaf death, and enter the sediment, become part of the geological record
- Easily identifiable in sediment as plant waxes— more chains with odd than even numbers of carbon atoms
- Waxes can preserve information on:
  - Temperature
  - Local habitat changes (grassland/forest cover)
  - Water supply/rainfall
  - Plant metabolism/nutritional information
  - Past atmospheric CO_2 concentration (potentially)
- Leaf waxes in geologic record therefore preserve information on the conditions of their formation



My research

- Use the highly controlled BIFoR leaf samples to look at the influences of metabolism and climate on chemical characteristics of leaf wax *n*-alkanes
- Carbon isotope composition of plants theoretically decreases with higher CO_2 concentration—can use this to look at past CO_2 concentrations
- Applications in the geologic record—apply any new palaeoclimate calibrations to the geologic record for environmental and climatic reconstruction
- Current work—what do carnivorous plants get out of their prey?

Images: commons.wikimedia.org/wiki/File:Lycopodiella_inundata_001.jpg, commons.wikimedia.org/wiki/File:Equisetopsida.jpg, commons.wikimedia.org/wiki/File:Tree_Fern_Spores.jpg, commons.wikimedia.org/wiki/File:Ginkgo_Biloba_Leaves_-_Black_Background.jpg, commons.wikimedia.org/wiki/File:Araucaria_araucana_cones.jpg,commons.wikimedia.org/wiki/File:Nepenthes_in_the_Southern_Western_Ghats.jpg,commons.wikimedia.org/wiki/File:Fagus_sylvatica_pliocenica_MHNT.PAL.VEG.2002.31.jpg,commons.wikimedia.org/wiki/File:Drawing_of_Venus_Flytrap.jpgcommons.wikimedia.org/wiki/File:CeratophyllumSubmersum.jpg, commons.wikimedia.org/wiki/File:CeratophyllumSubmersum.jpg, Eley, Y. L., & Hren, M. T. (2018). Reconstructing vapor pressure