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ADSORPTION PROPERTIES OF CORK MATERIAL FOR WATER VAPOUR

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Introduction

Field research: white wine oxidation

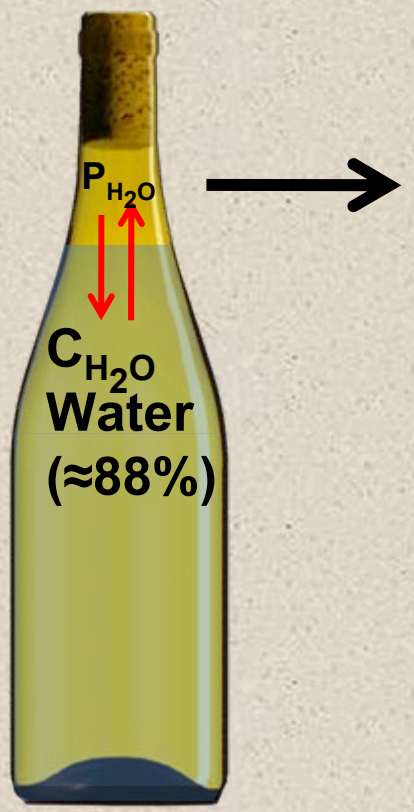
Polyphenols

Question:

What is the impact of the natural cork stopper on the wine oxidation?

Oxidation leading to sensory defaults and consumer refusing

Introduction



In case of upright position storage the head space between wine and cork stopper is saturated with water vapour

Water effect on cork structure?
Water as solvent of wine molecules (SO_2, O_2)

Objective

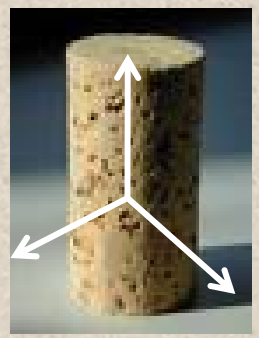
To perform a thermodynamic study of water vapour on cork in order to better understand the interactions of water with cork.

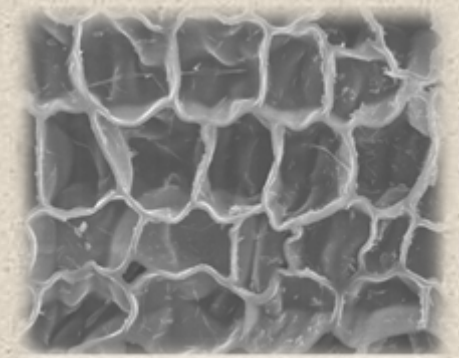
Material and methods

Cork material

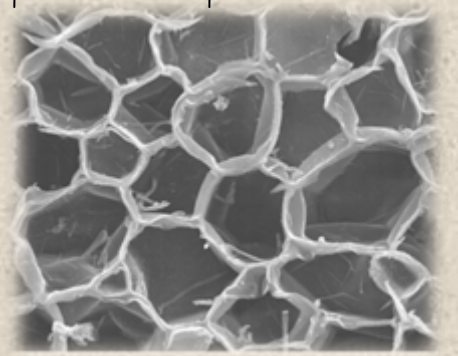
Virgin natural cork (*Quercus Suber* L.) from the bark of oak trees (Portugal).

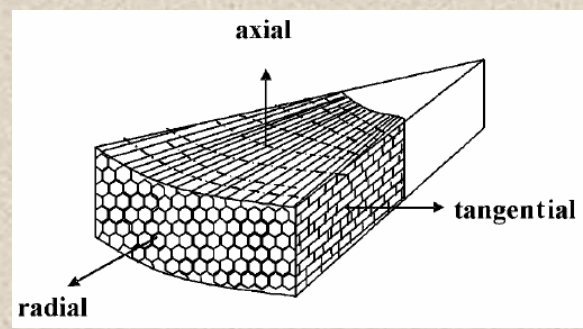
<u>Physical characterisation</u>:

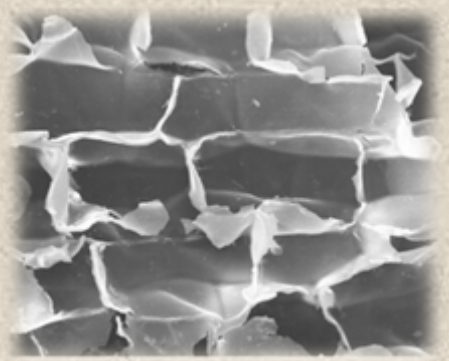




80 µm







Materials and methods

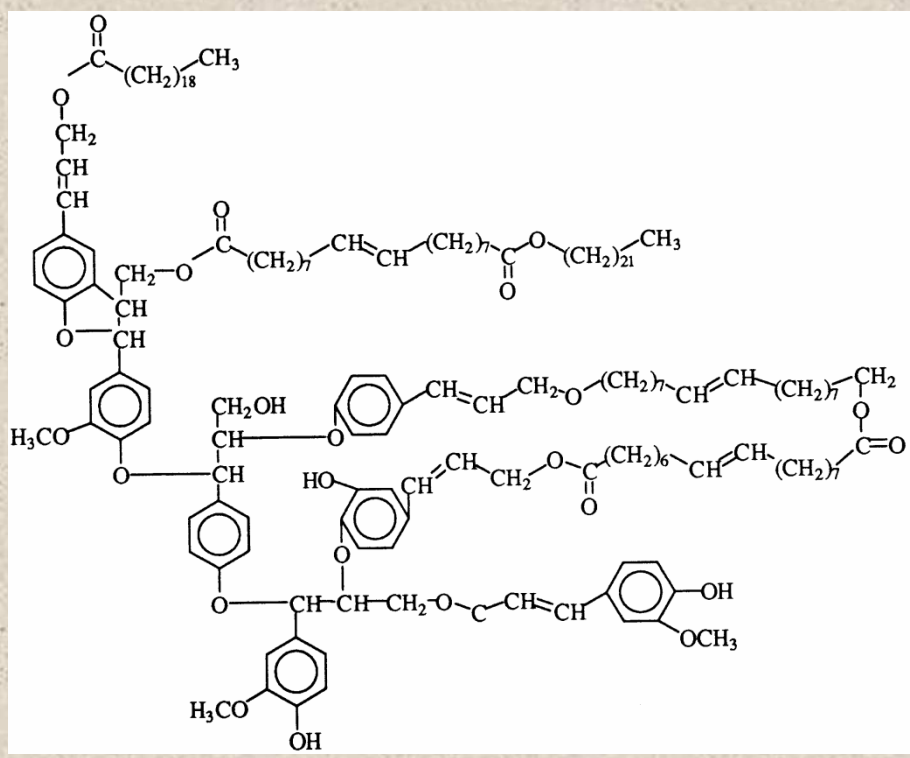
Cork material

Mechanical properties:

- Elasticity
- Compressibility

Chemical composition:

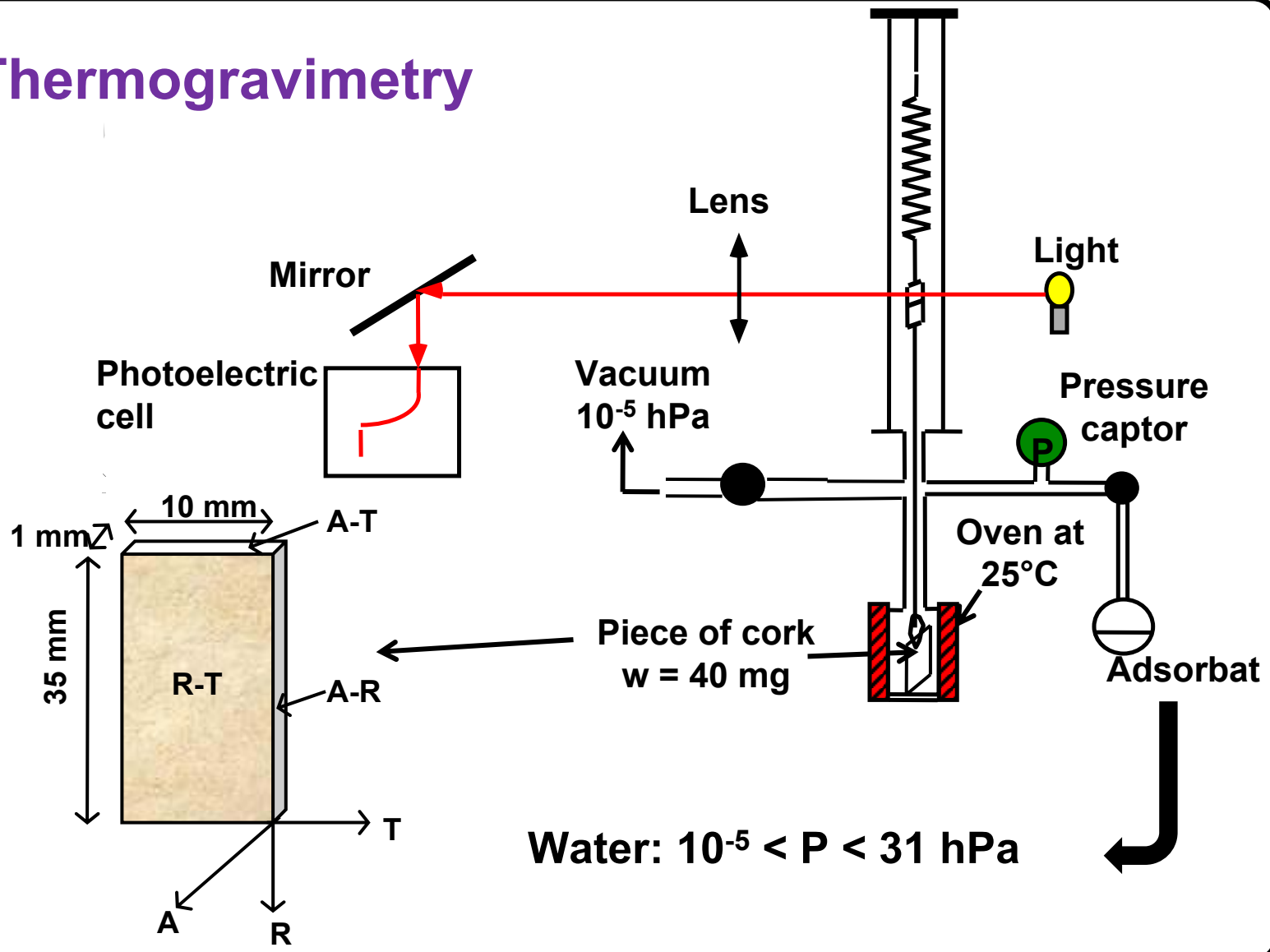
Suberin: ≈ 50%
lignin: ≈ 30%
polysaccharides: ≈ 10-20%
extractibles: ≈ 10-20%
ashes: ≈ 1-5%
others: ≈ 1-5%



The structure of suberin (Cordeiro *et al.*, 1998)

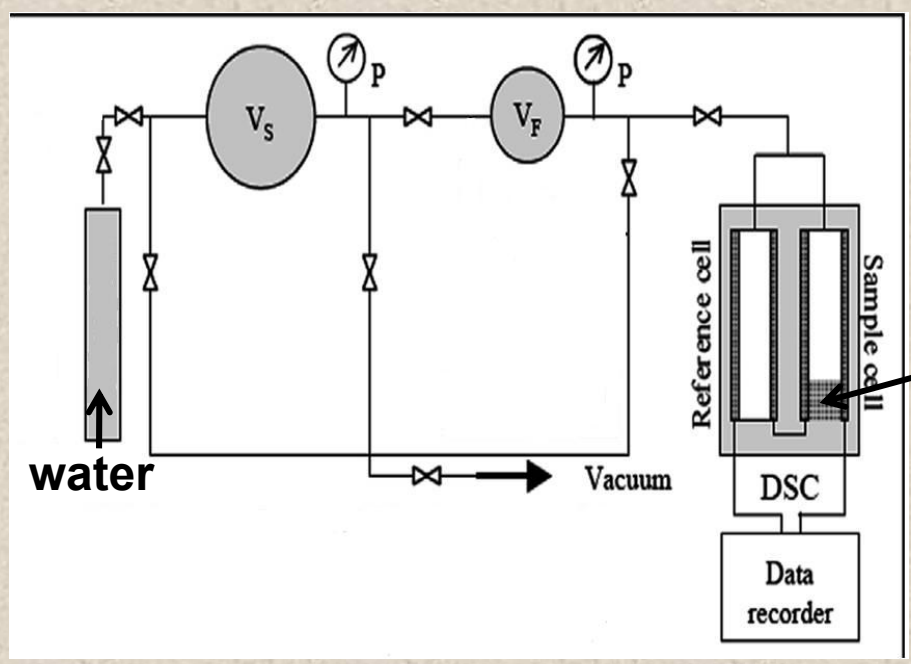
Materials and methods

Thermogravimetry



Materials and methods

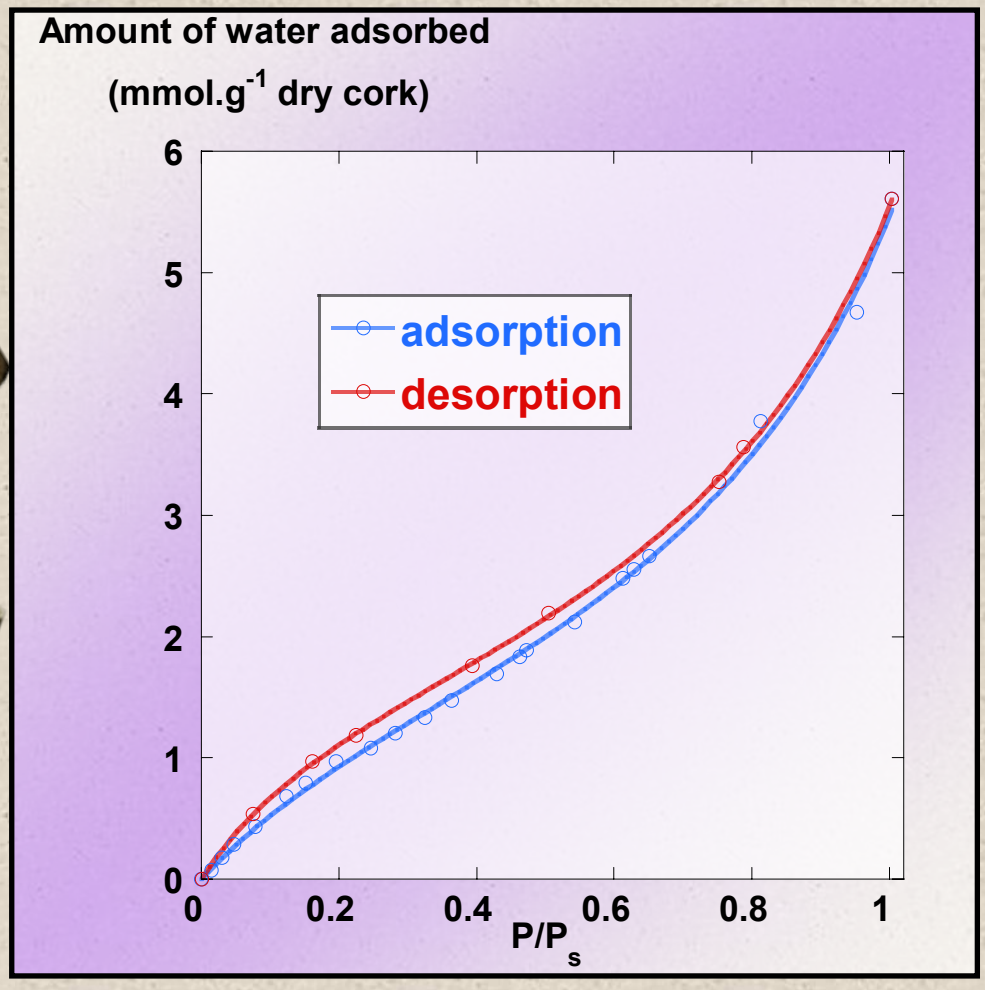
Differential calorimetry in isothermal condition, coupled with manometry



Heat released during gas adsorption process on cork powder w = 600 mg

Water: 10^{-5} < P < 31 hPa

Adsorption isotherm at 25°C



Type II isotherm: non porous or macroporous solid (IUPAC).

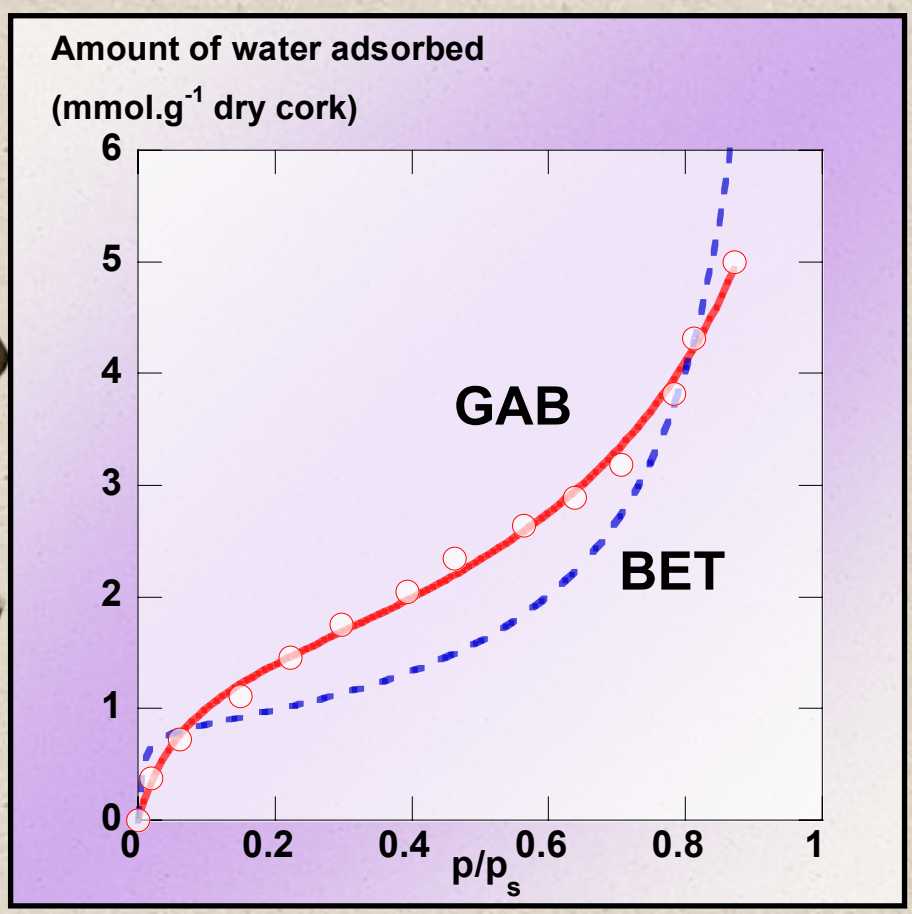
weak slope: low affinity

Maximum water adsorbed amount: ≈ 6 $mmol.g^{-1}$ as 10%

Low hysteresis during desorption: irreversible process, structural change (swelling)

Total water desorption under vacuum: physisorption phenomenon, weak bonds

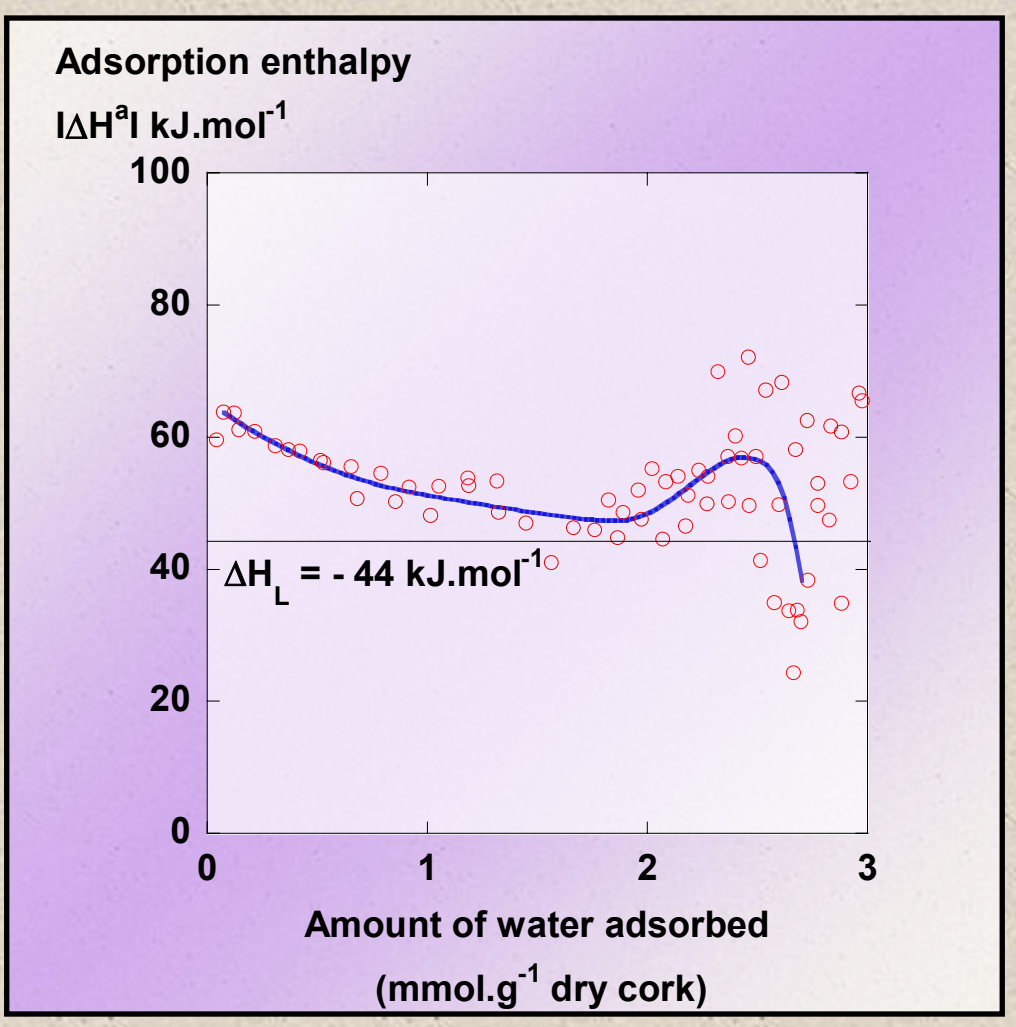
Adsorption isotherm at 25°C



Best fit with the GAB model

adsorption process by clusters formation around localized adsorption sites

Adsorption heat released during adsorption on cork at 25°C

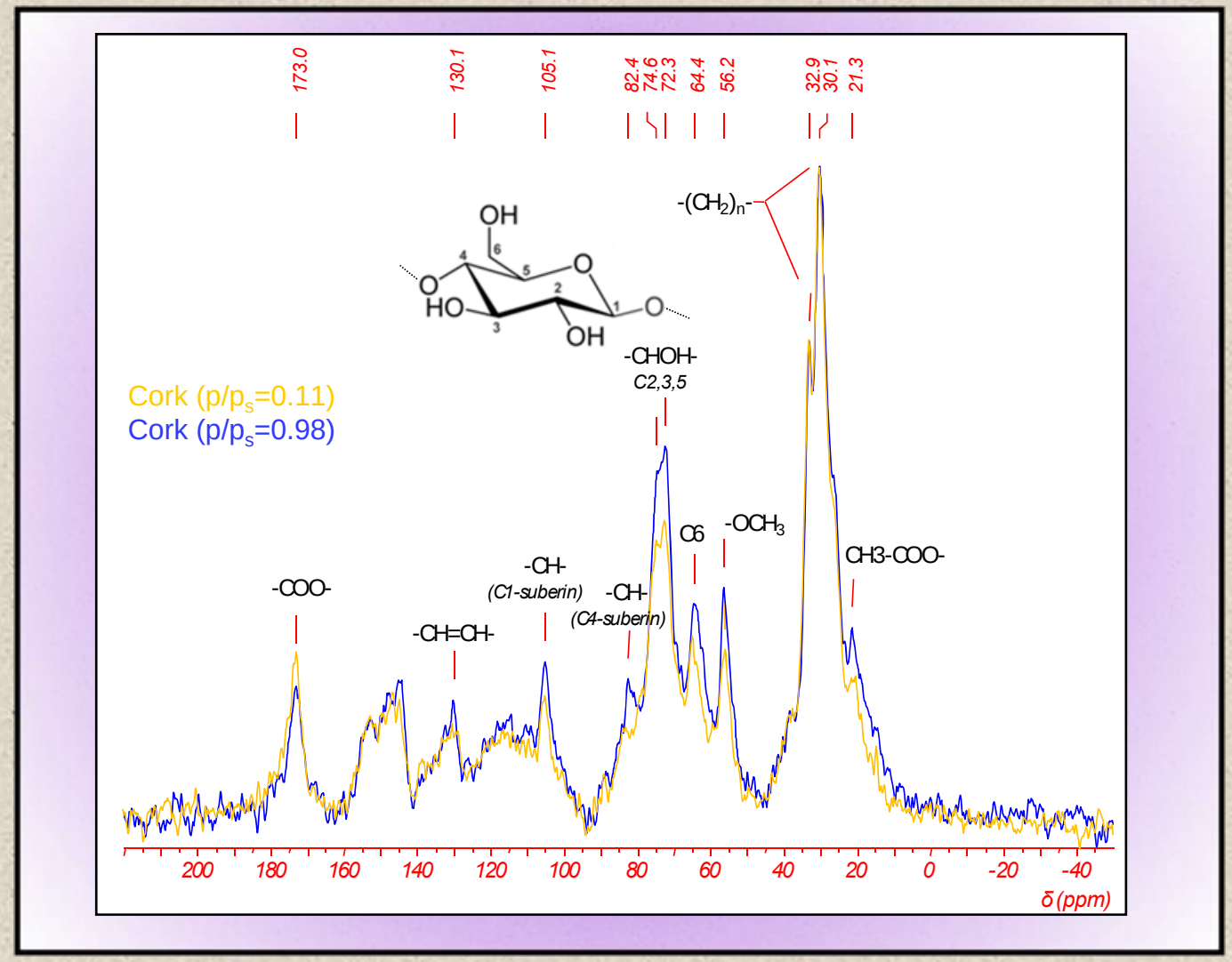


Exothermic phenomenon

Low heat of adsorption:
≈ 60 kJ·mol^{-1}

→ **Physisorption**

NMR



Water is mainly adsorbed on hydrophilic sites constituted by hydroxyl and methoxyl groups.

Conclusion and perspectives

Adsorption mechanism of water vapour on cork is in two steps.
(i) First, water adsorbs on hydrophilic sites constituted by hydroxyl and methoxyl groups. (ii) Then water adsorption continues by clusters formation around the hydrophilic sites.

Thermodynamic study of gaseous ethanol
Co-adsorption studies of:

- water / SO_2
- water / O_2

Gas (oxygene, SO_2) permeability studies of cork will be lead through the cork

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Thank you for your attention

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