

PAHs AND BIOCHAR – INSEPARABLE?

Tom Holm

Mike Machesky

John Scott



ILLINOIS STATE
WATER SURVEY
PRAIRIE RESEARCH INSTITUTE

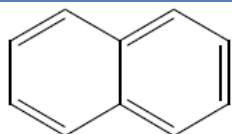


ILLINOIS SUSTAINABLE
TECHNOLOGY CENTER
PRAIRIE RESEARCH INSTITUTE

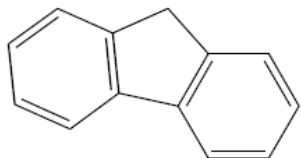


ILLINOIS

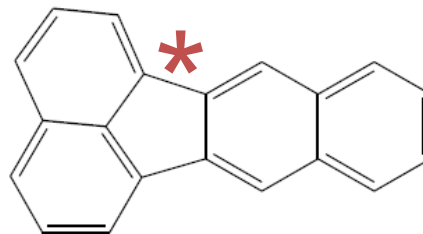
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) USEPA PRIORITY POLLUTANTS



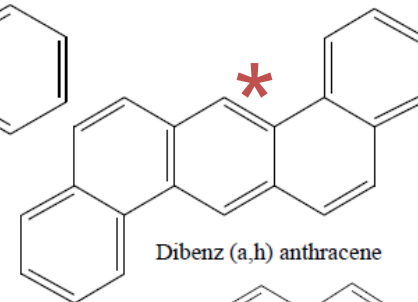
Naphthalene



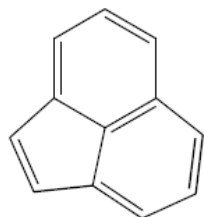
Fluorene



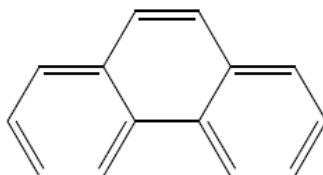
Benzo k fluoranthene



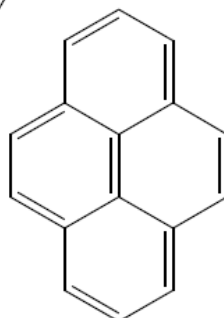
Dibenz (a,h) anthracene



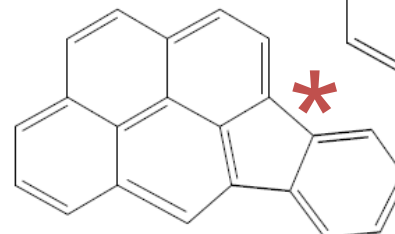
Acenaphthylene



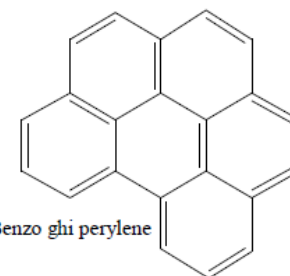
Phenanthrene



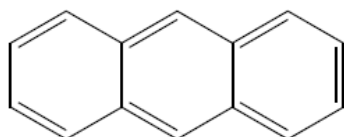
Pyrene



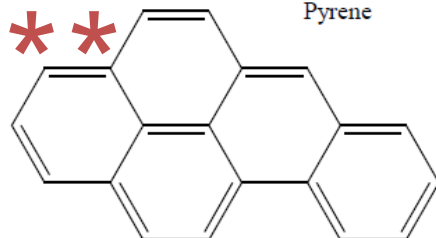
Indeno (1,2,3,c,d) perylene



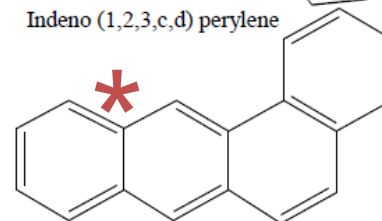
Benzo ghi perylene



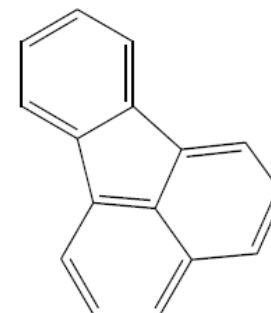
Anthracene



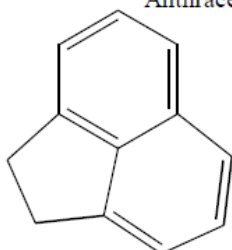
Benzo (a) pyrene



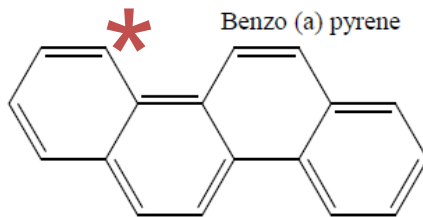
Benzo (a) anthracene



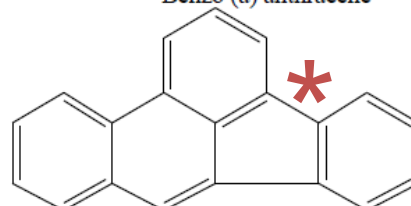
Fluoranthene



Acenaphthene



Chrysene



Benzo (b) fluoroanthene

CORN STOVER BIOCHAR

- **Slow pyrolysis, N₂**

- 450 °C
- 550 °C
- 750 °C

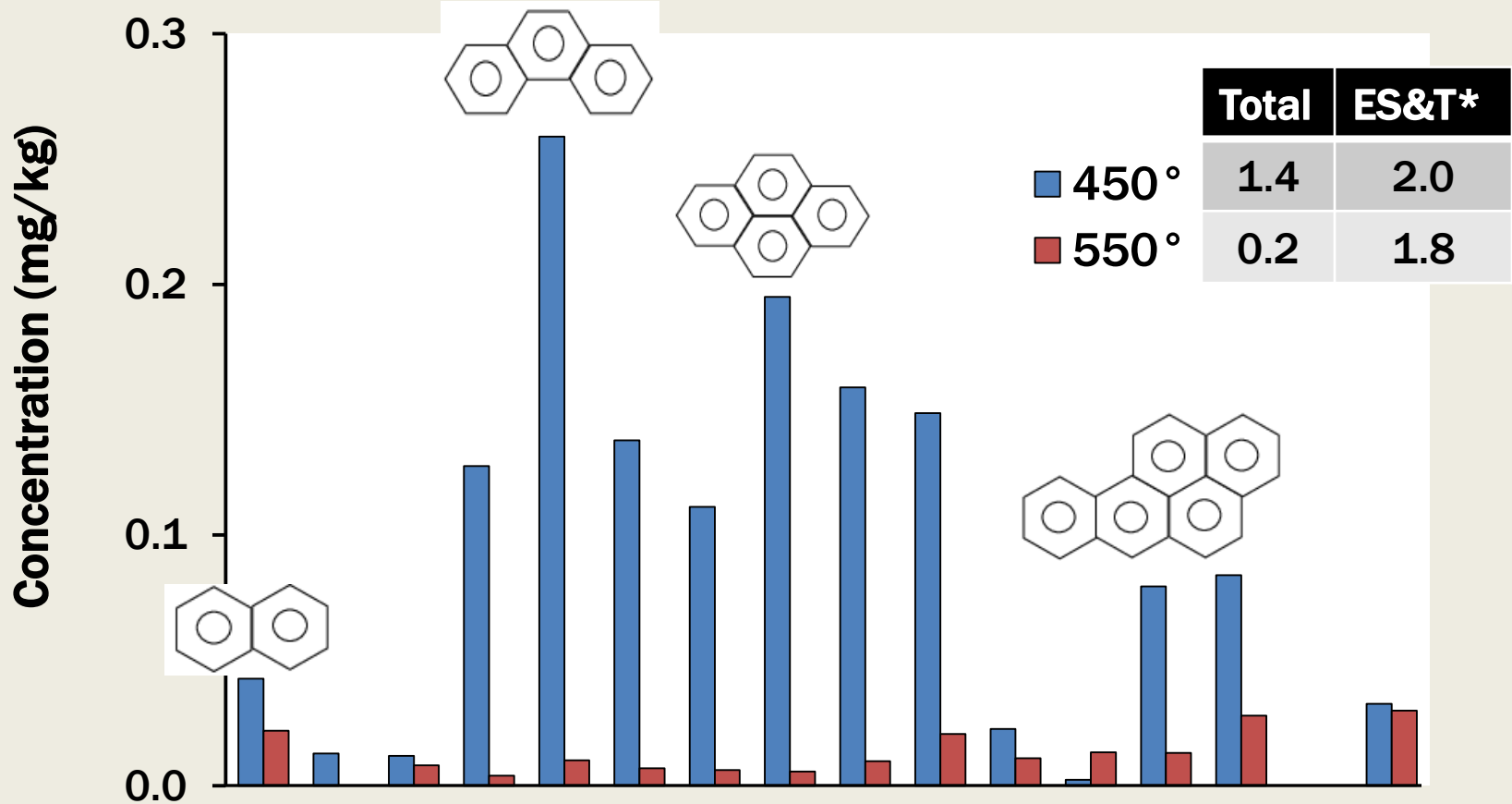
- **Artificial aging**

- Freeze-thaw
- 60 °C
- 110 °C



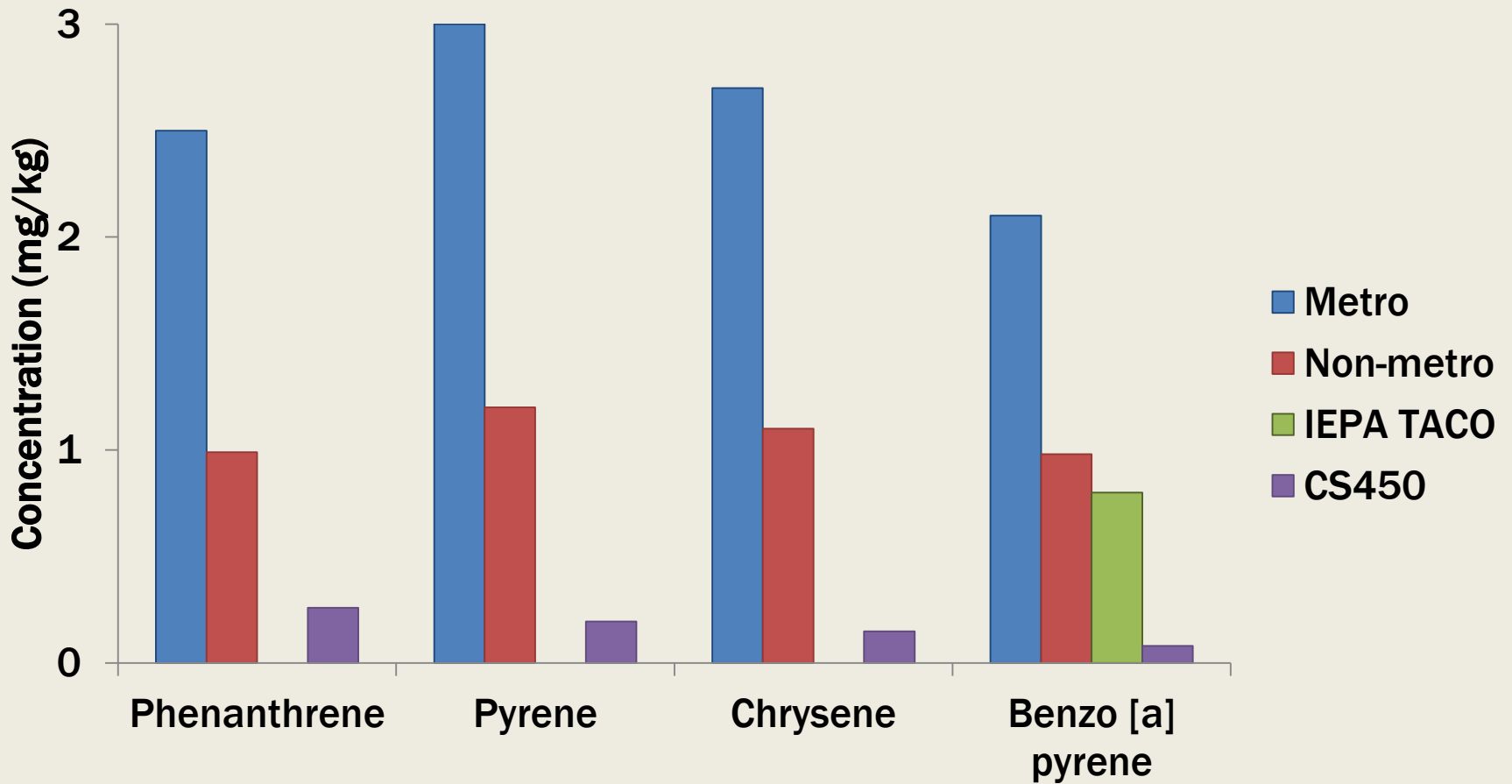
Hale et al. (2011)

PAH PROFILES



*Hale et al. (2012)

ILLINOIS SOIL, TACO, BIOCHAR



Observation: Based on 14 MGP soils and soots, and 43 MGP sediments, acute toxicity to soil and benthic organisms from PAHs has virtually NO relationship to total PAH concentrations.

Soil	Total PAH (mg/kg soil)	% Worm mortality
OG10	42100	0 (all lived)
CG3	4100	100 (all died)

Hawthorne et al.



BIOAVAILABILITY

- **Definition: Freely available to cross an organism's cellular membrane.**
- **Operational definition: Water-soluble**

Semple et al. (2004)

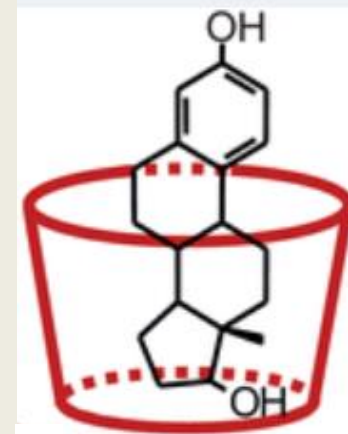
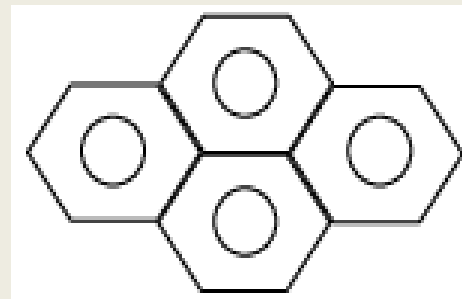
BIOACCESSIBILITY

- **Definition: Includes what is actually bioavailable now plus what is potentially bioavailable.**
- **Operational definition: Mild extraction**

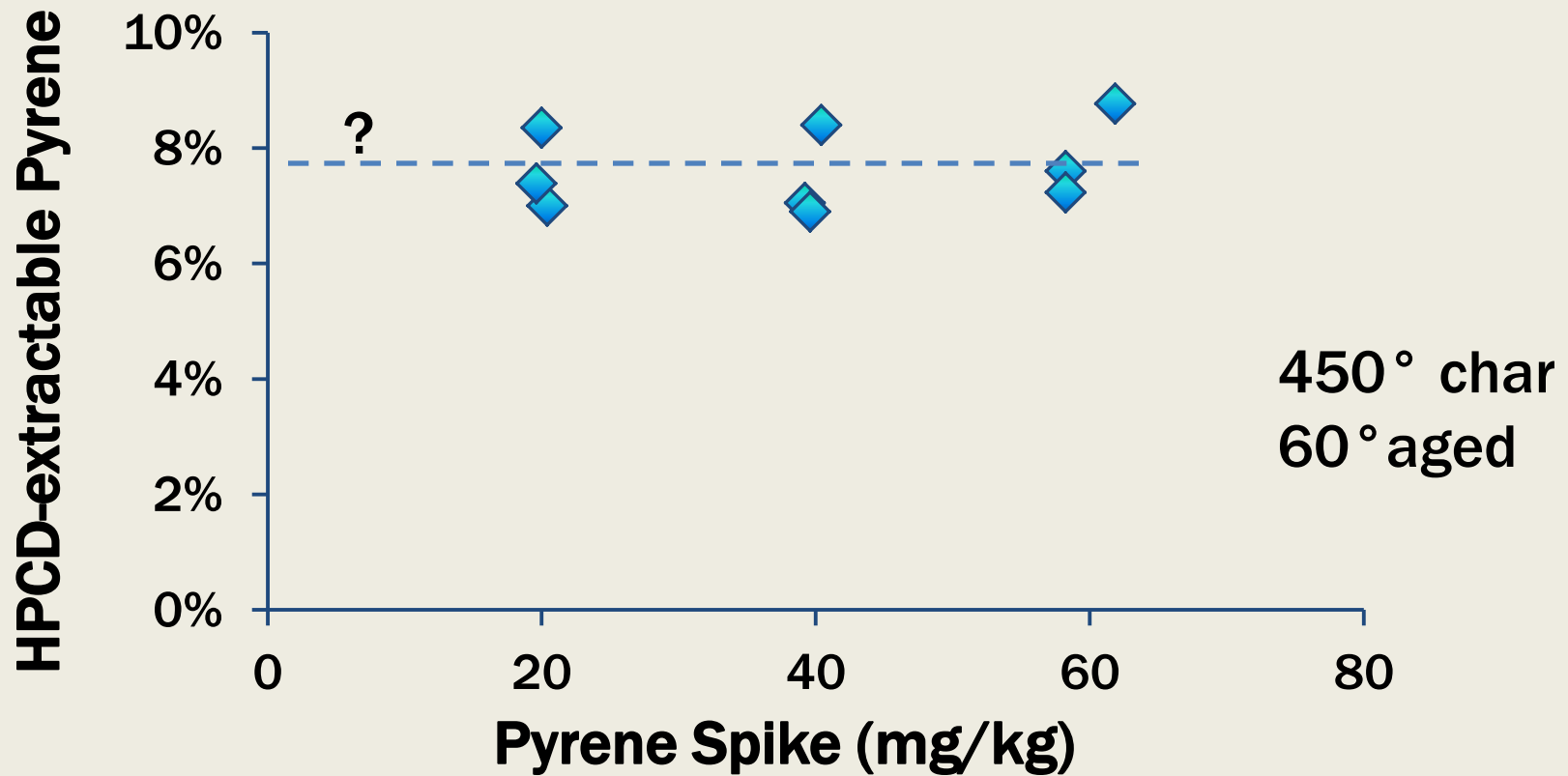
Semple et al. (2004)

BIOACCESSIBILITY EXPERIMENTS

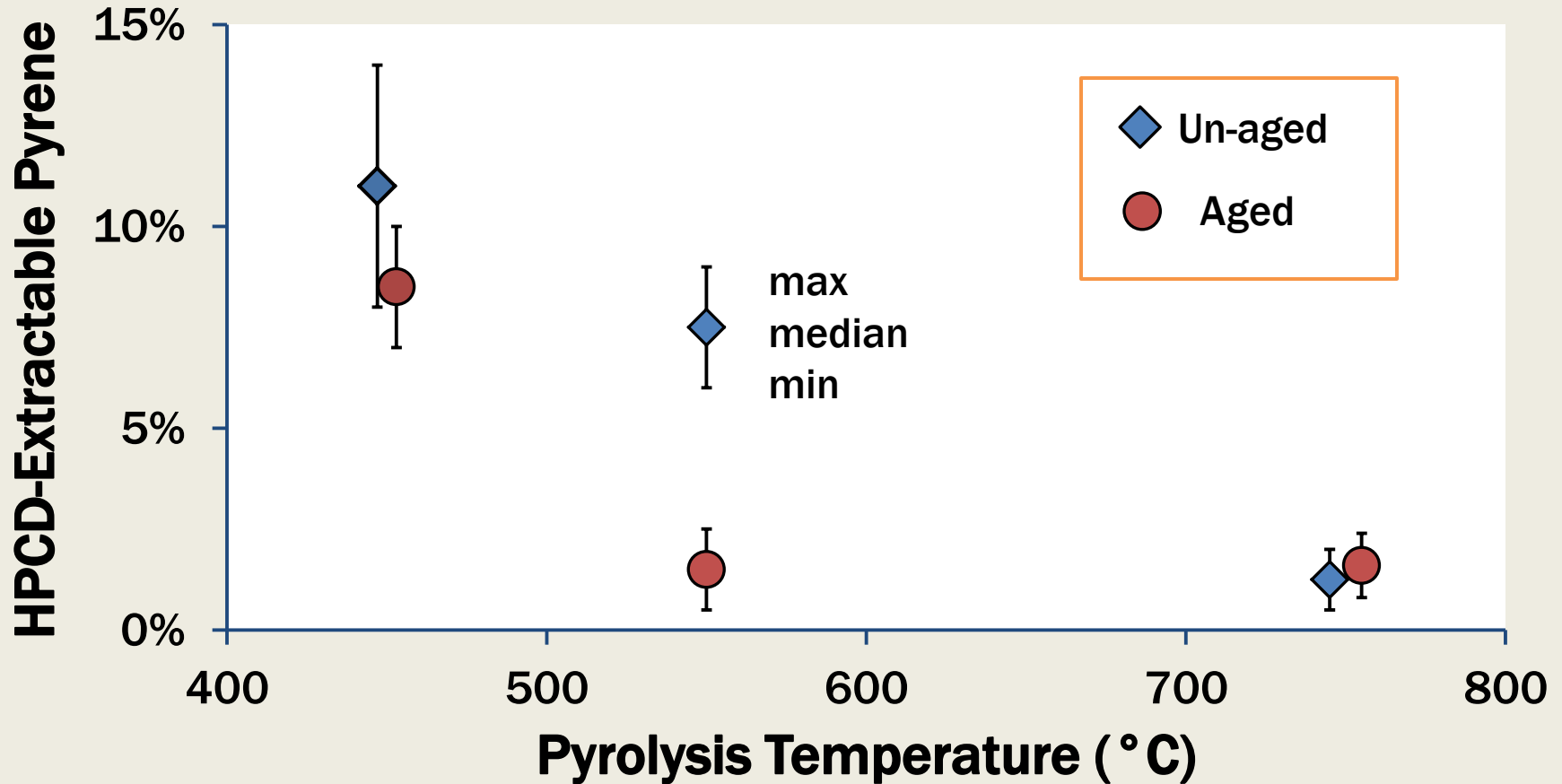
- Pyrene probe compound
- Extract with 2-hydroxypropyl- β -cyclodextrin (HPCD)



HPCD EXTRACTION

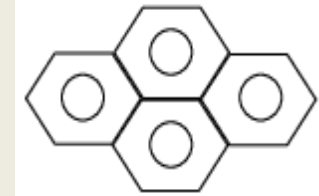


PYRENE BIOACCESSIBILITY



ADSORPTION EXPERIMENTS

- **Pyrene probe compound**
- **Competing sorption and passive sampling**
- **Adsorption (surface) vs partitioning (bulk)**



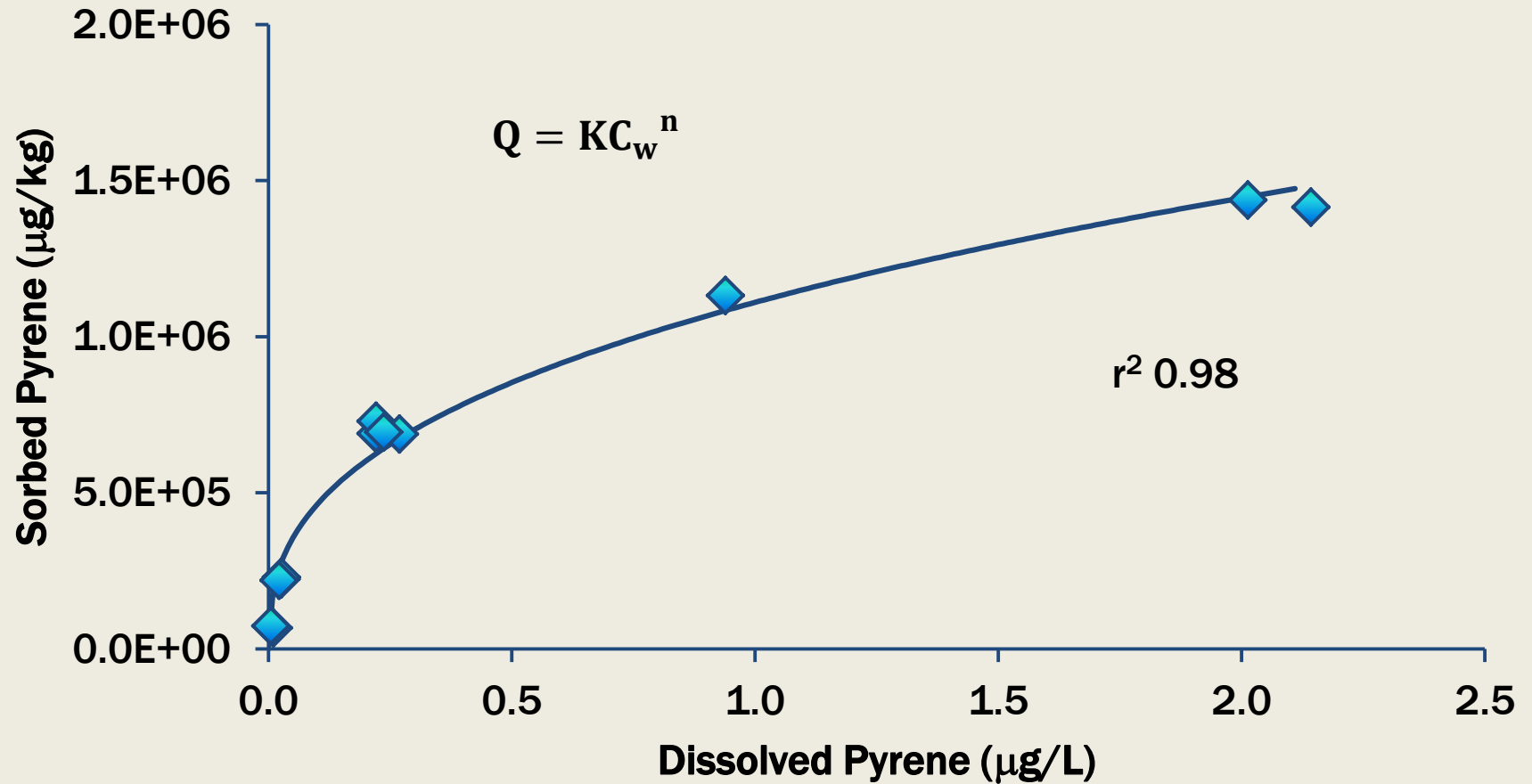
Absorption



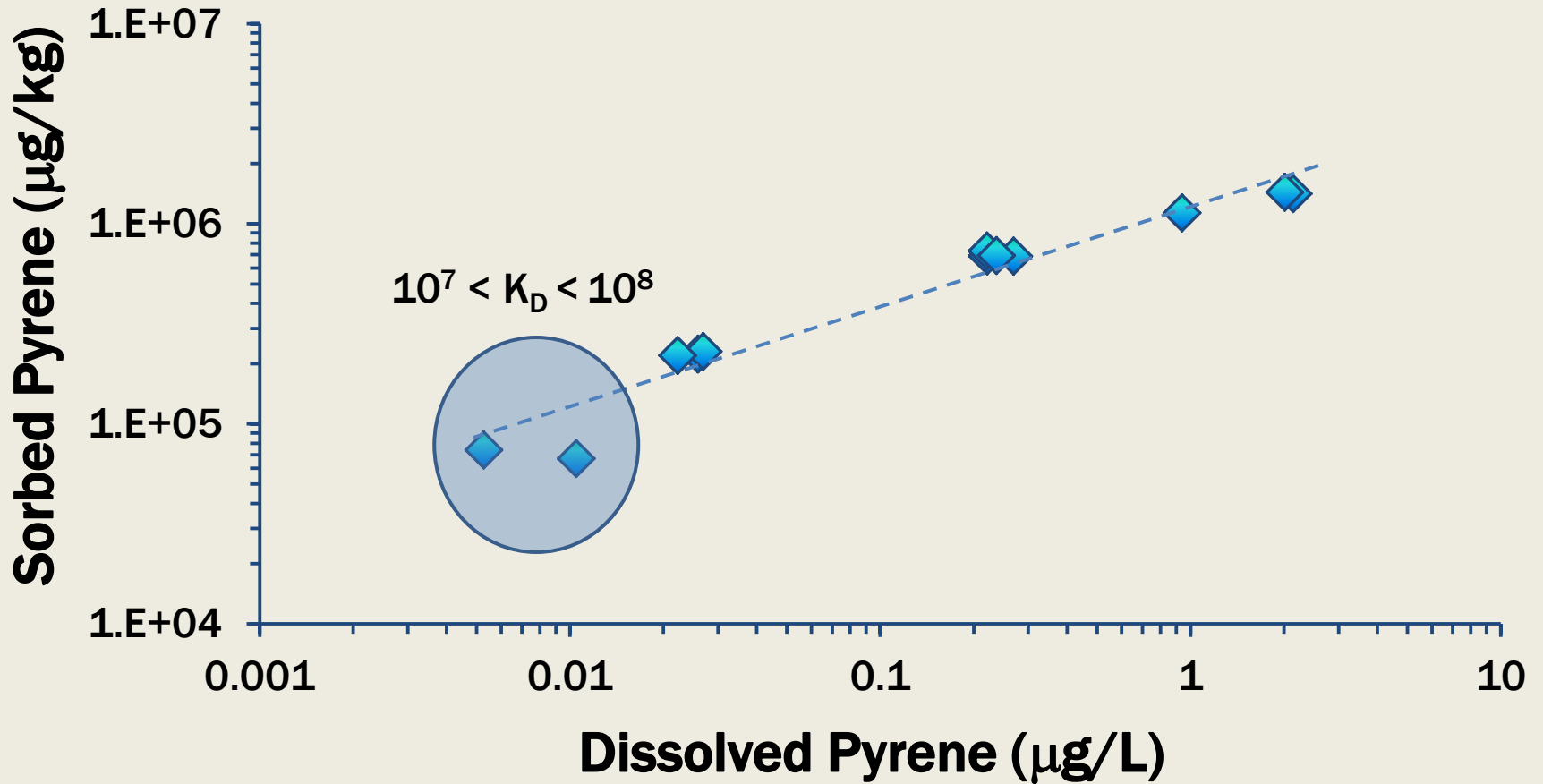
Adsorption



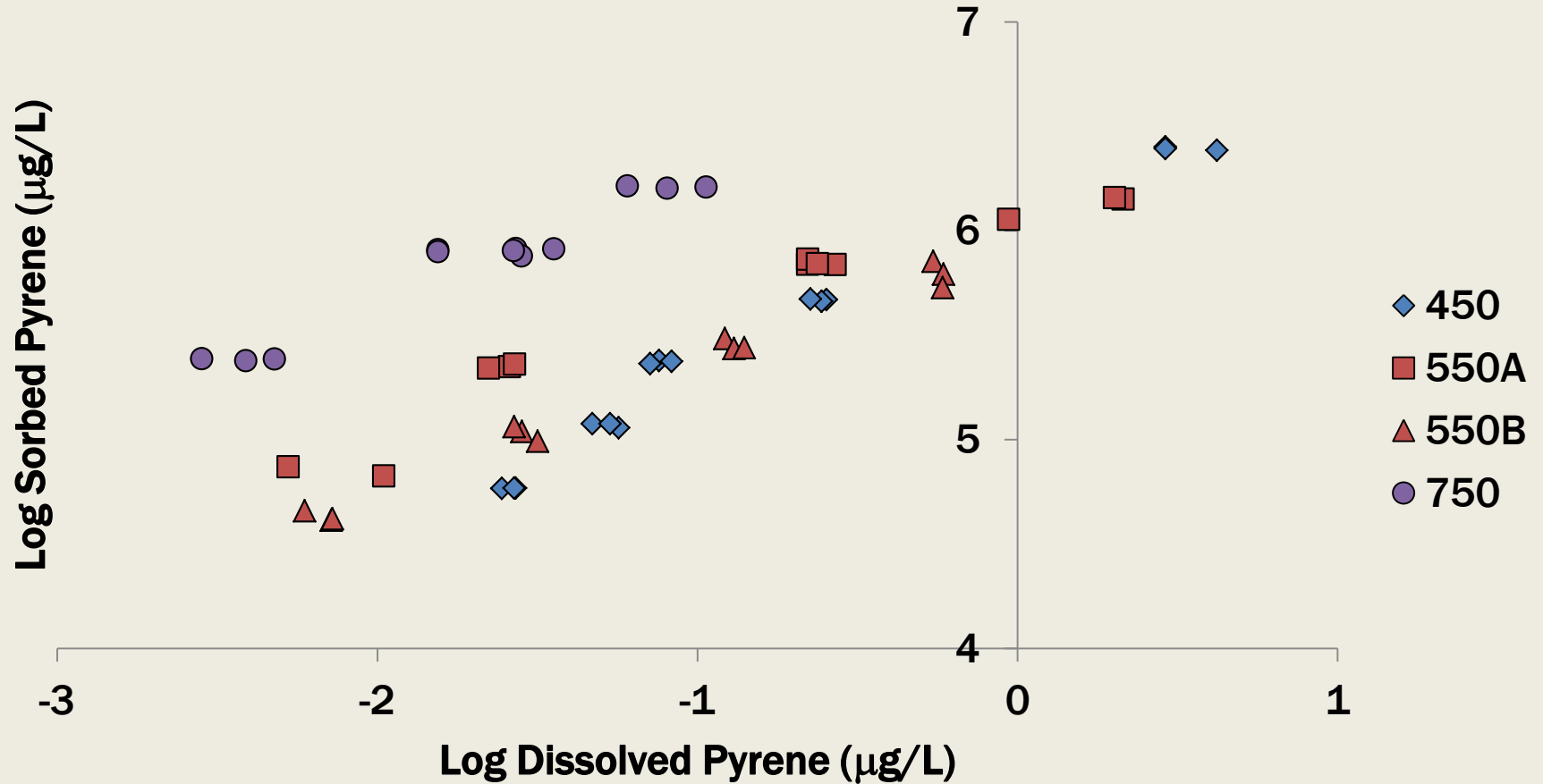
ADSORPTION ISOTHERM, CS550



ISOTHERM, LOG-LOG



UN-AGED CHARS



AGING, 750 ° CHAR

