Comparison of Oil Generation Kinetics for Oil Shales as Determined by Rock-Eval and Hydrous Pyrolysis

Michael D. Lewan
U. S. Geological Survey, Denver, CO

Ronald J. Hill
Western State College, Gunnison, CO

Tim E. Ruble
Humble Geochemical Services, Humble, TX

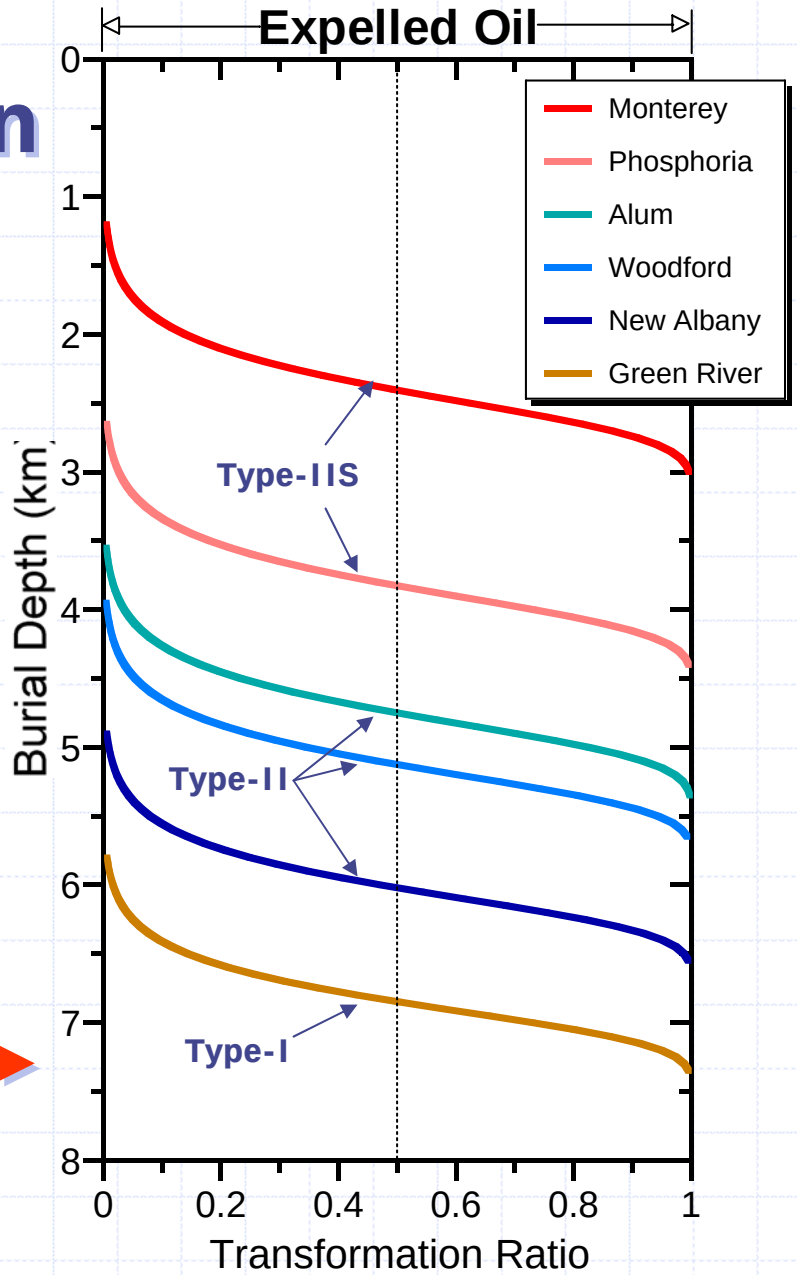
Objective

Determine whether oil-generation kinetics derived by different pyrolysis methods are critical to determining timing and extent of oil generation in surface and *in situ* retorting.

Natural Oil Generation

The laboratory pyrolysis method used to derive oil generation kinetics can have a **significant** effect on determining **timing** and **extent** of **natural** oil generation from source rocks in sedimentary basins

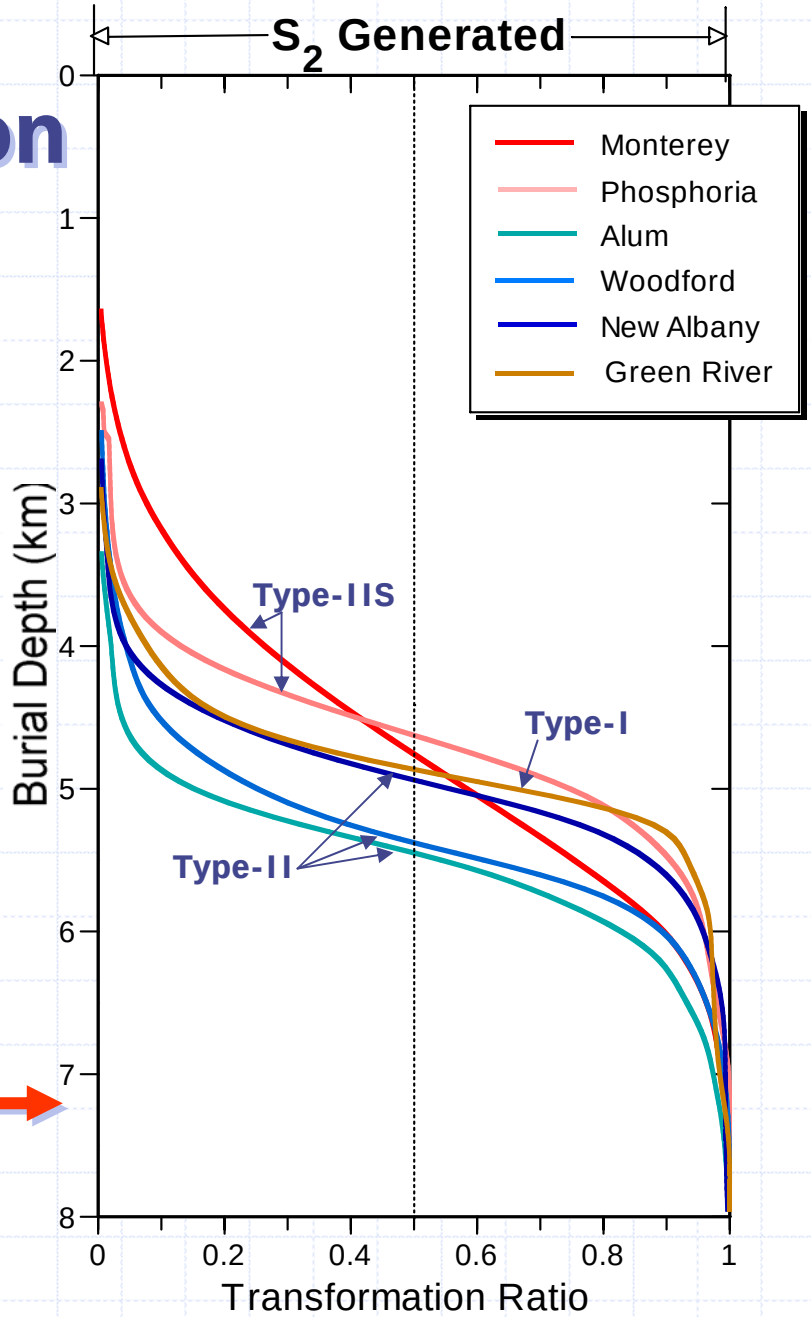
Hydrous Pyrolysis (HP) kinetics for an 80-Ma source rock in a sedimentary basin with a heating rate of 2.5°C/m.y.



Natural Oil Generation

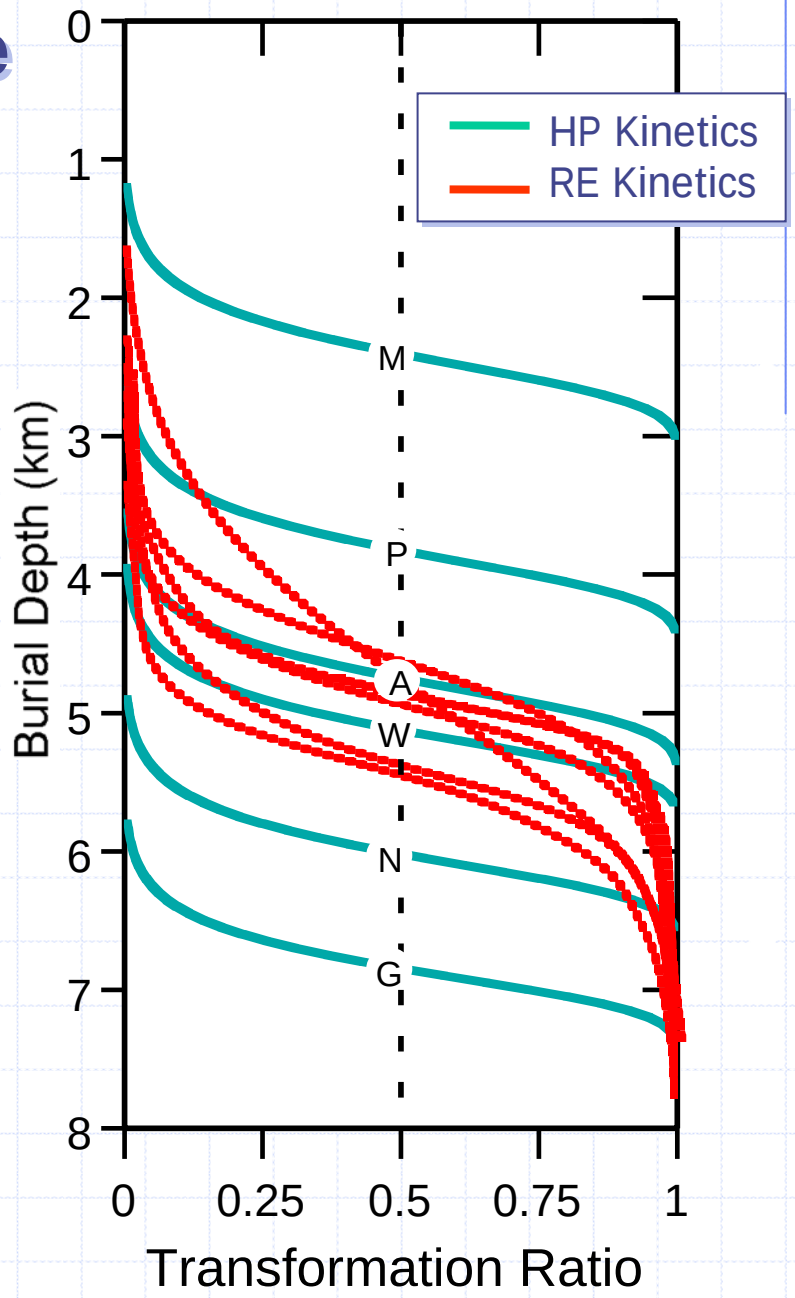
The laboratory pyrolysis method used to derive oil generation kinetics can have a **significant** effect on determining **timing** and **extent** of **natural** oil generation from source rocks in sedimentary basins

Rock Eval Pyrolysis (RE) kinetics for an 80-Ma source rock in a sedimentary basin with a heating rate of 2.5°C/m.y.



Does the same hold true for oil shale retorting?

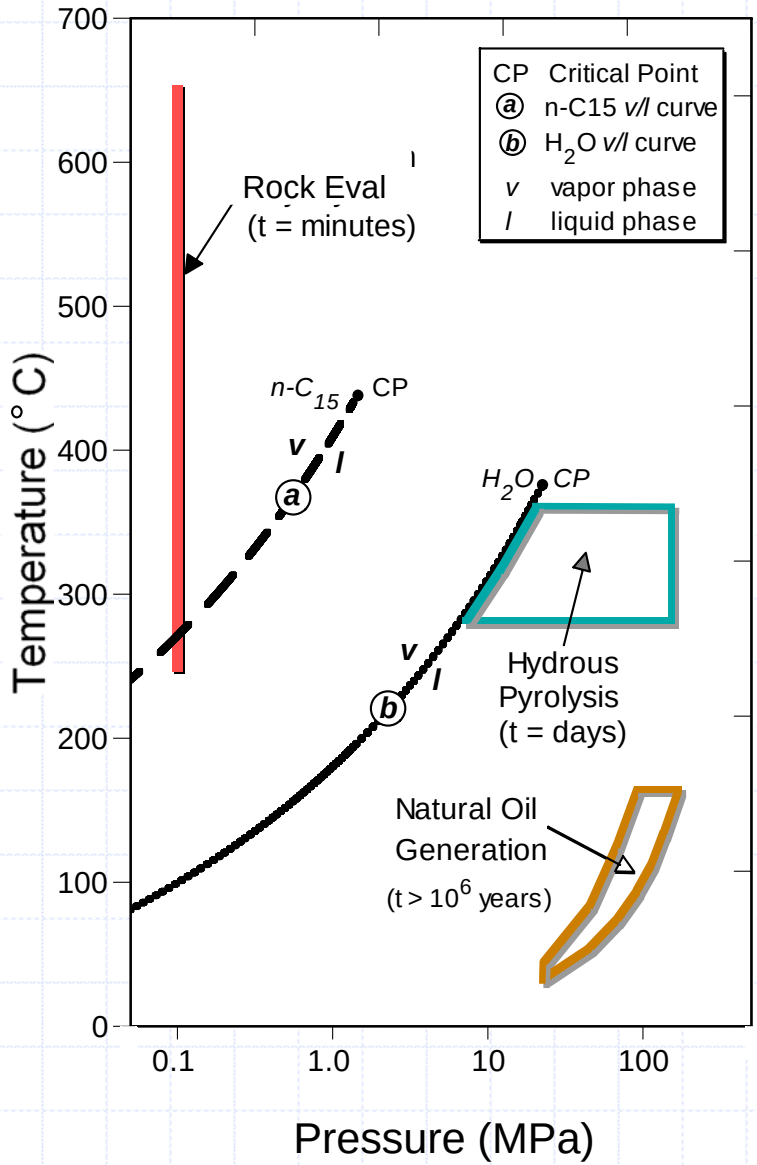
Does the laboratory pyrolysis method used to derive kinetics have a **significant** effect on determining **timing** and **extent** of oil generation in oil-shale **retorting**?



Pyrolysis Methods

Rock-Eval (RE) Kinetics
- Bulk (REb)
- Compositional (REc)

Hydrous Pyrolysis (HP) Kinetics



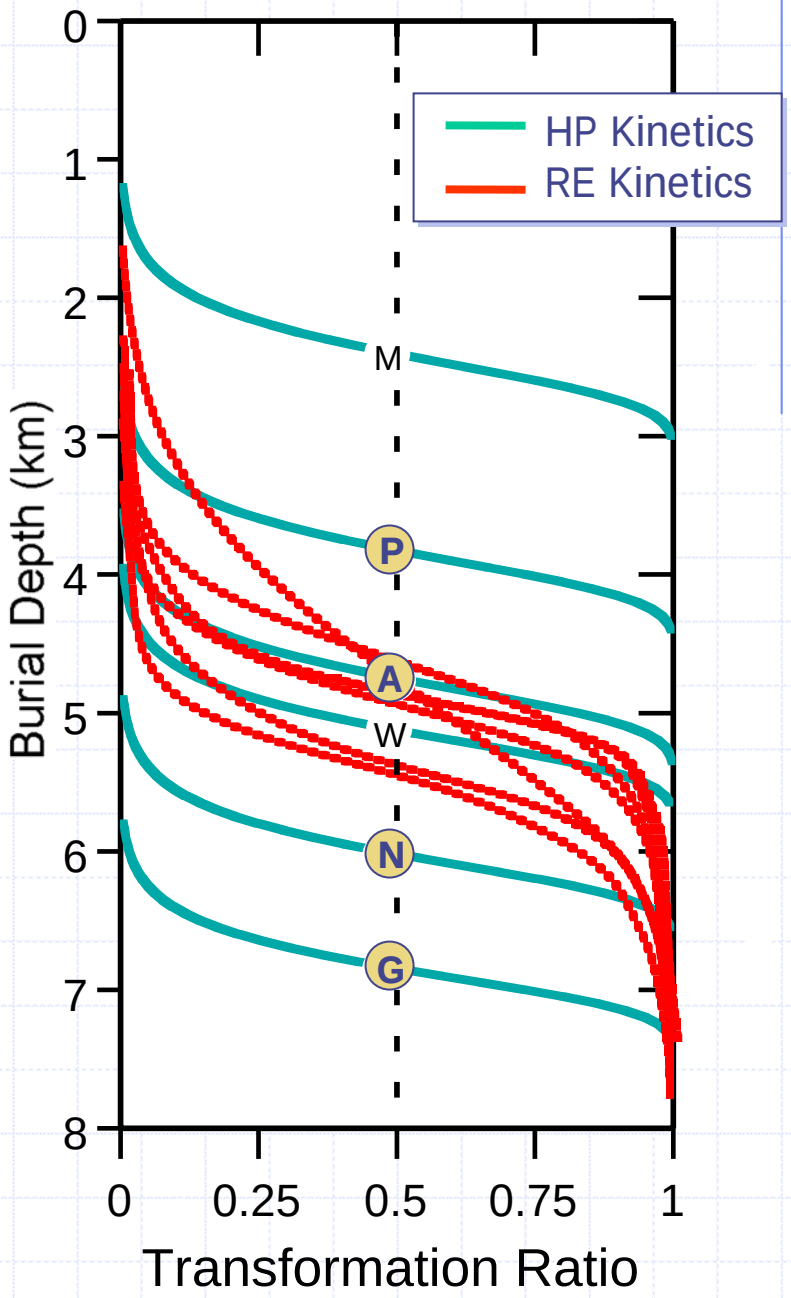
Samples

Ⓟ Phosphoria Retort Shale
23.6 wt%TOC of **Type-IIS**

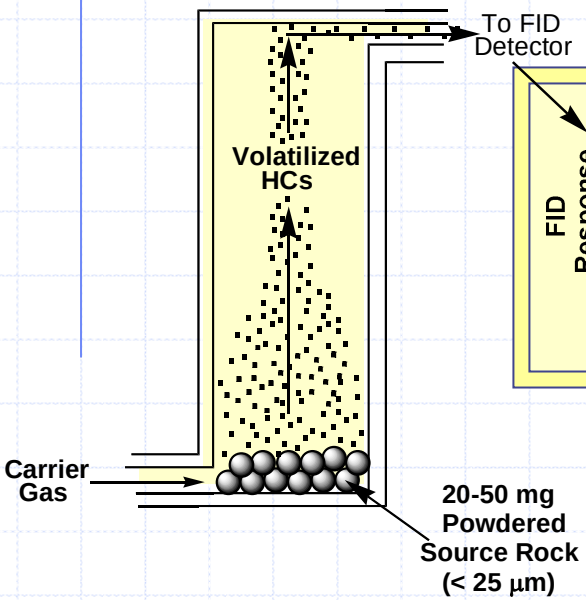
Ⓐ Alum Shale (Sweden)
13.2 wt%TOC of **Type-II**

Ⓝ New Albany Sh. (EOS)
14.3 wt%TOC of **Type-II**

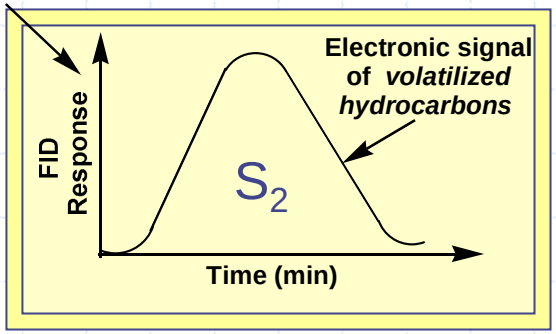
Ⓖ Green River (Mahogany)
15.2 wt%TOC of **Type-I**



Rock-Eval Pyrolysis Methods

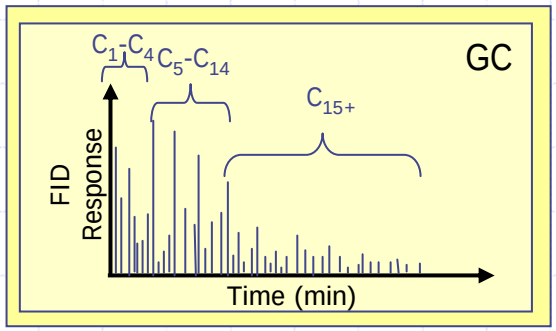


Bulk RE



or

Compositional RE



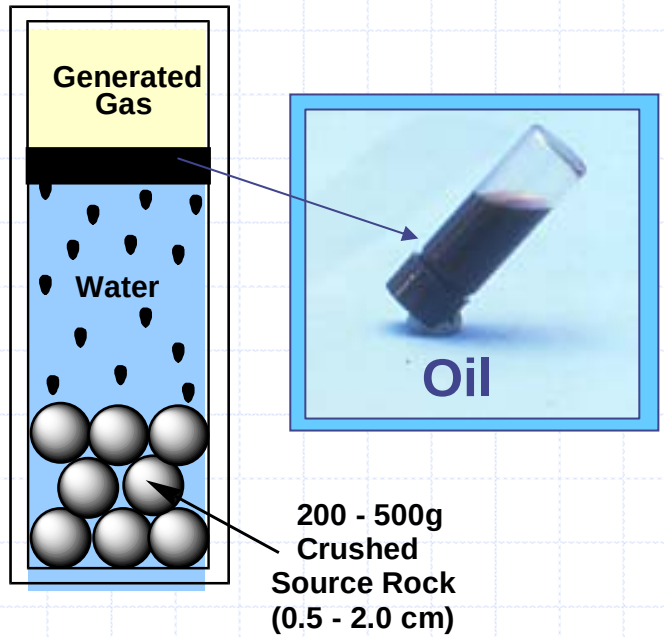
Temperature = 250 to 650°C

Pressure = ~1 atm

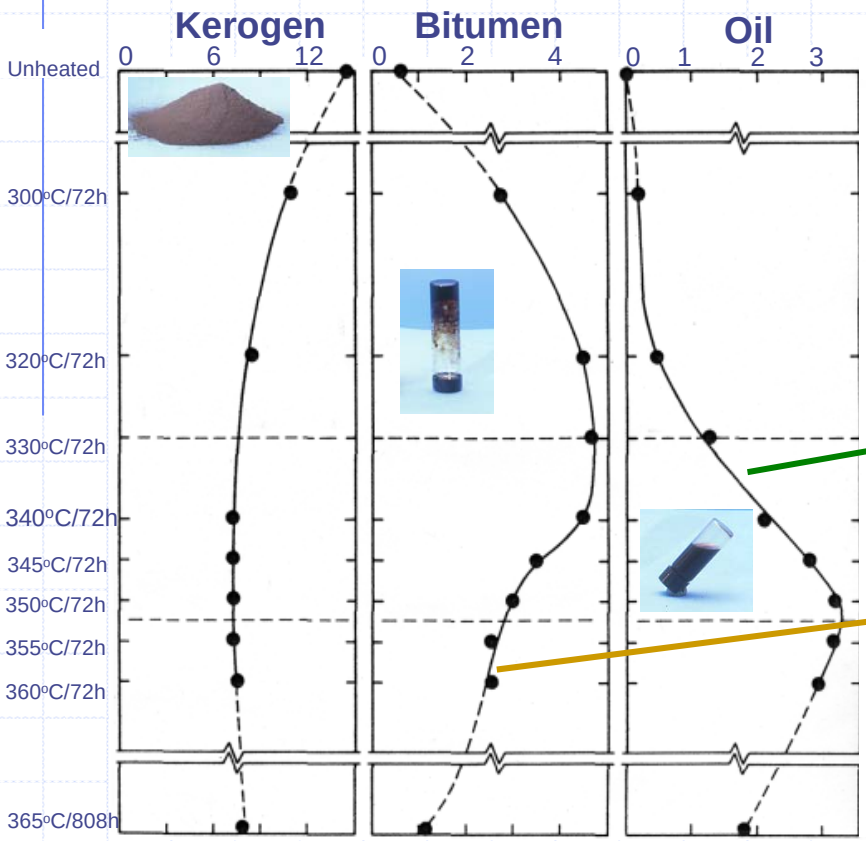
Heating Rates = 1, 5, 15, 30, and 50°C/min

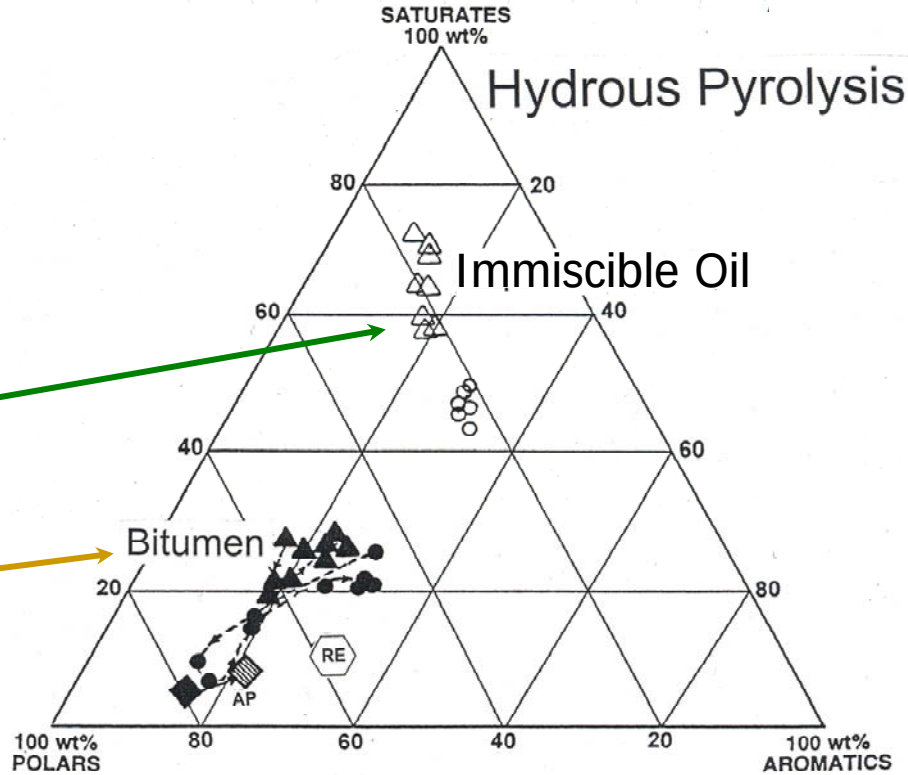
Hydrous Pyrolysis Methods

Isothermal Heating at
Temperatures = 250 to 365°C
Times = 12 to 120 hours
Pressures = 600 to 3,000 psia

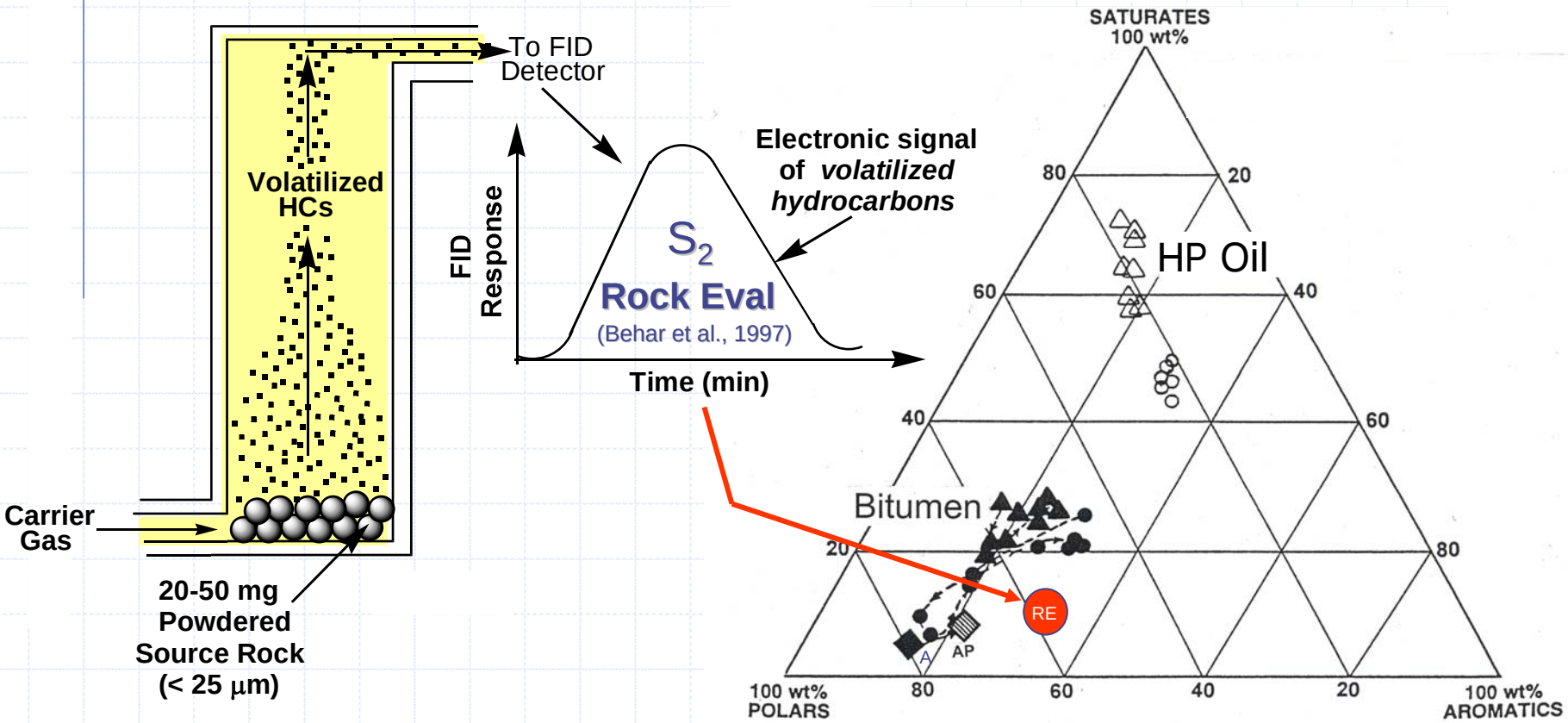


Hydrous Pyrolysis Products

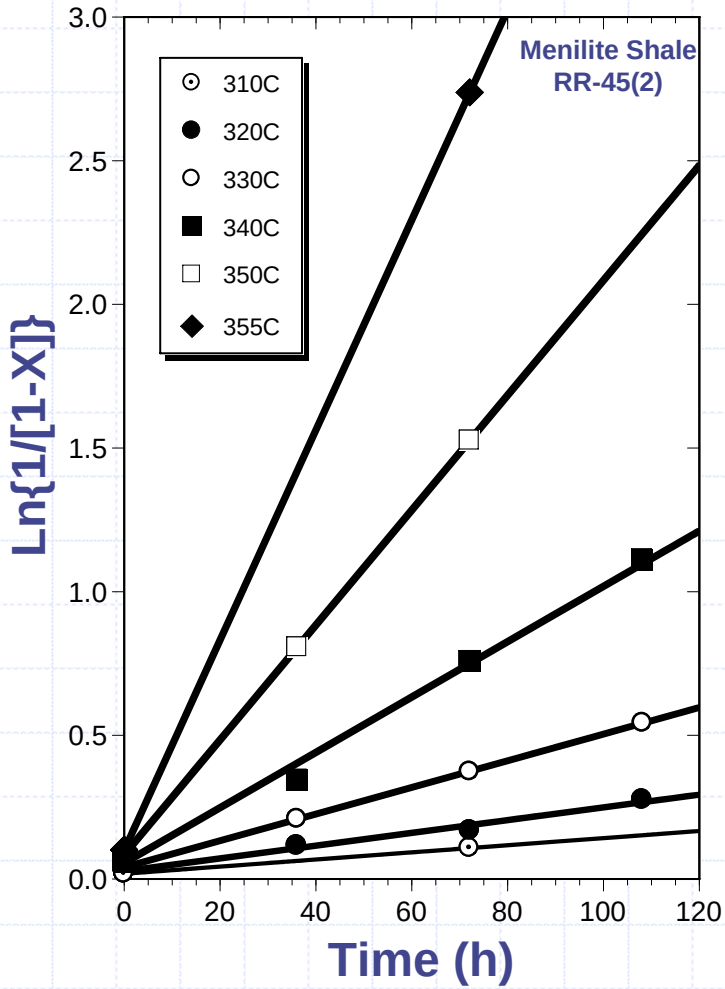


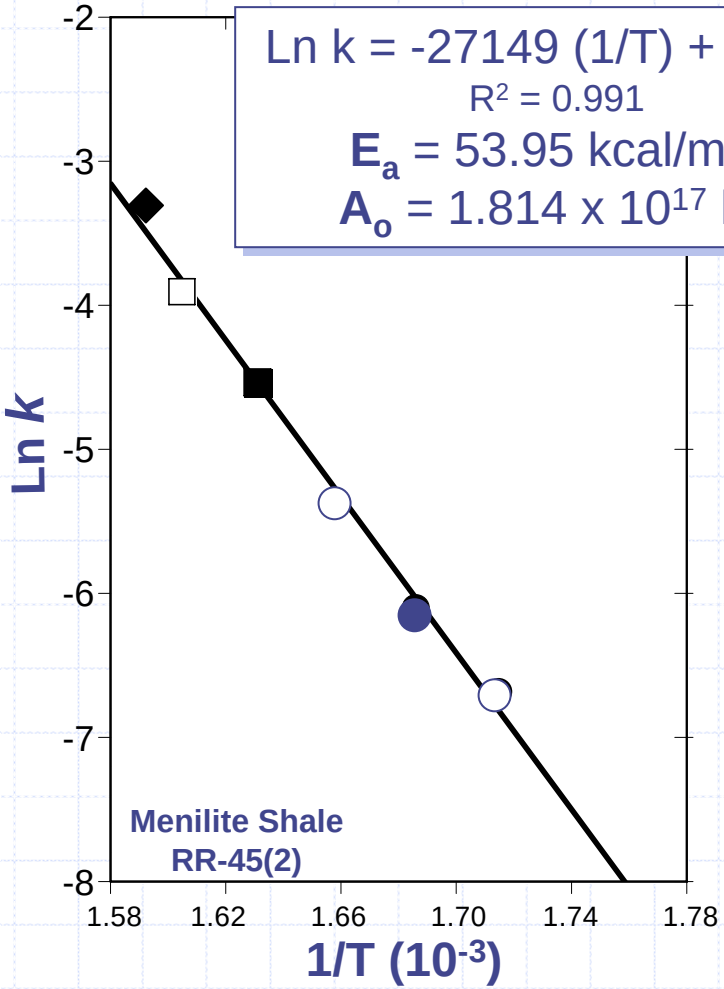


Rock-Eval Products

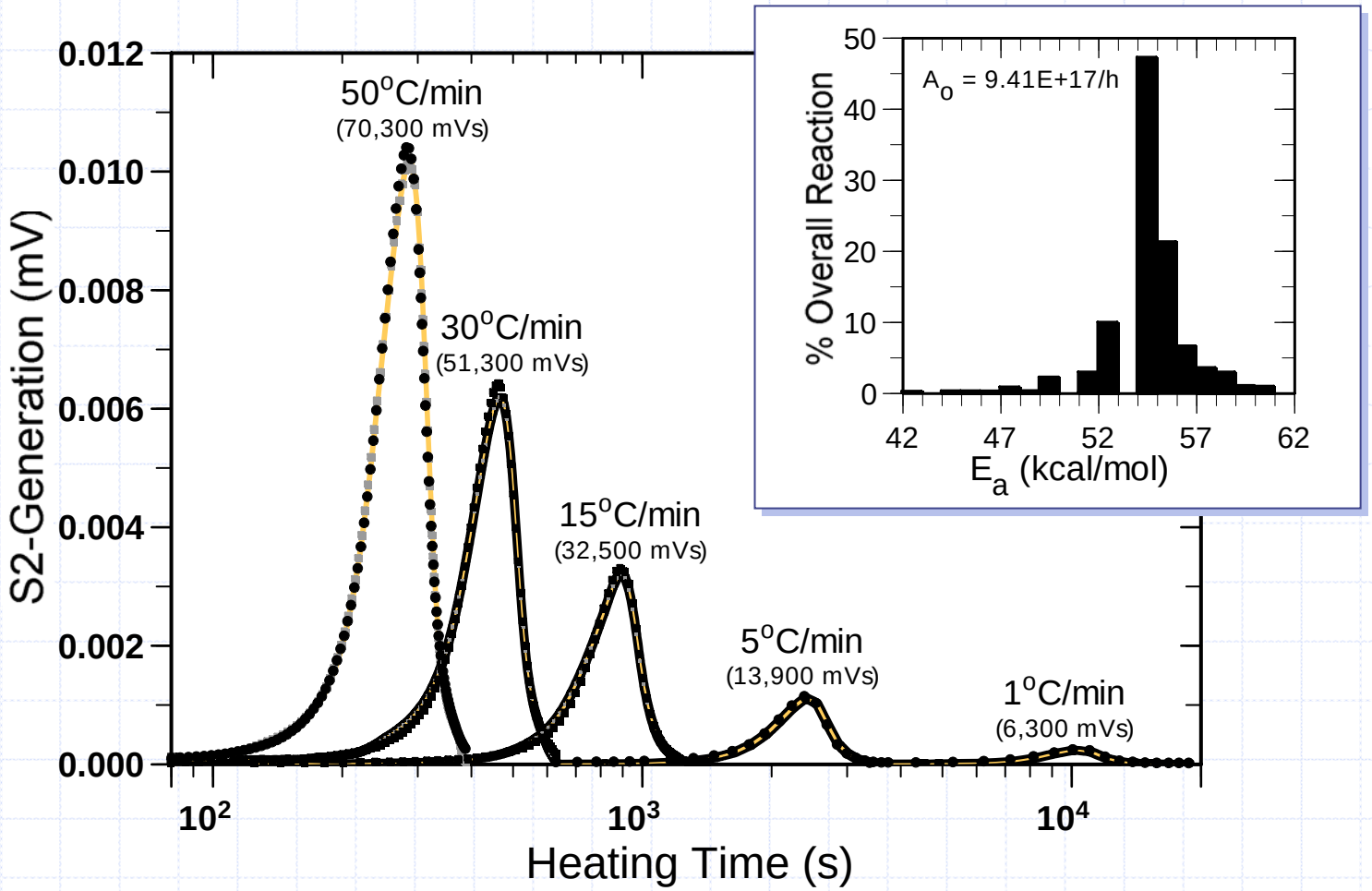


Hydrous Pyrolysis Isothermal Kinetics





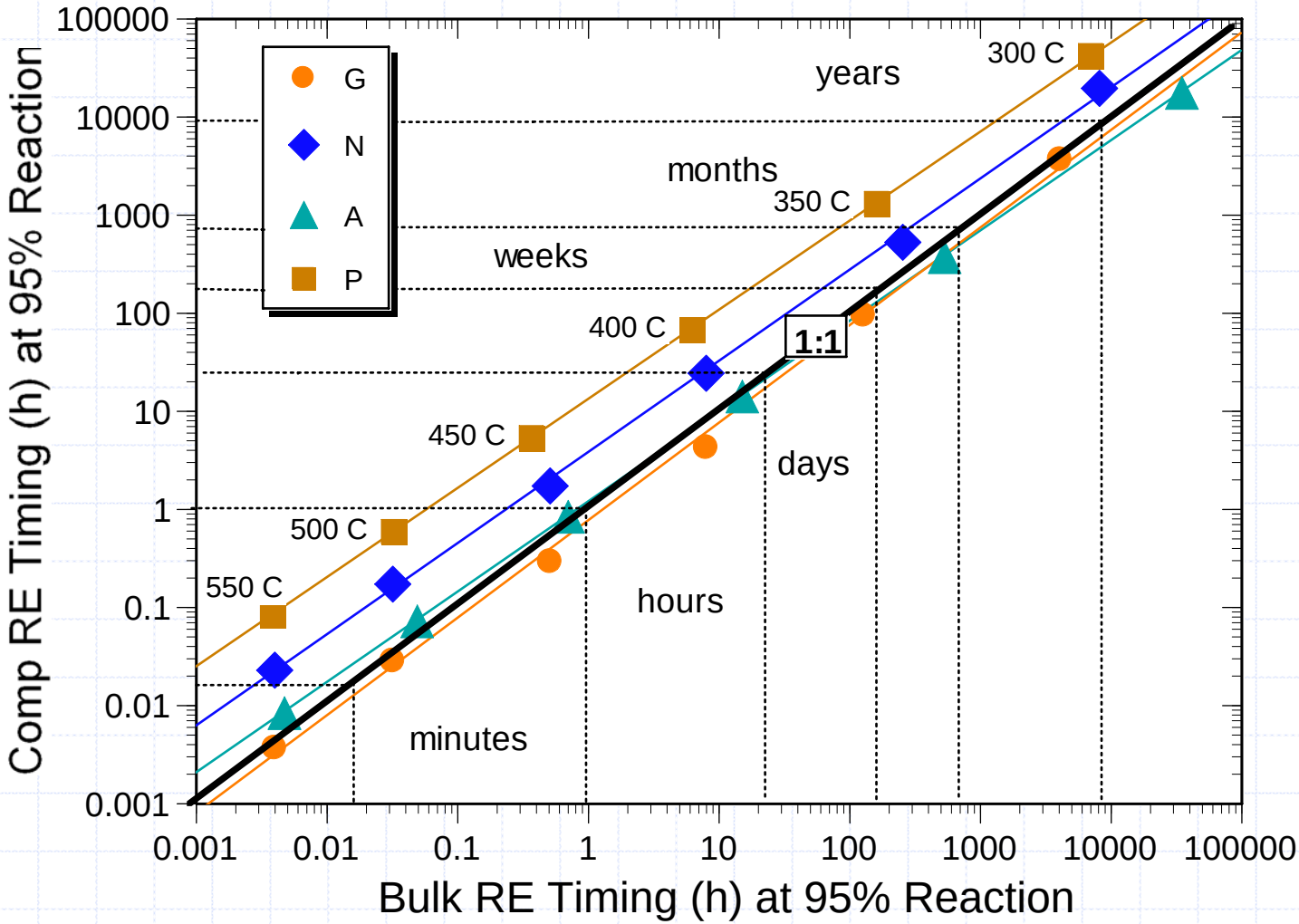
Rock-Eval
Non-isothermal Kinetics



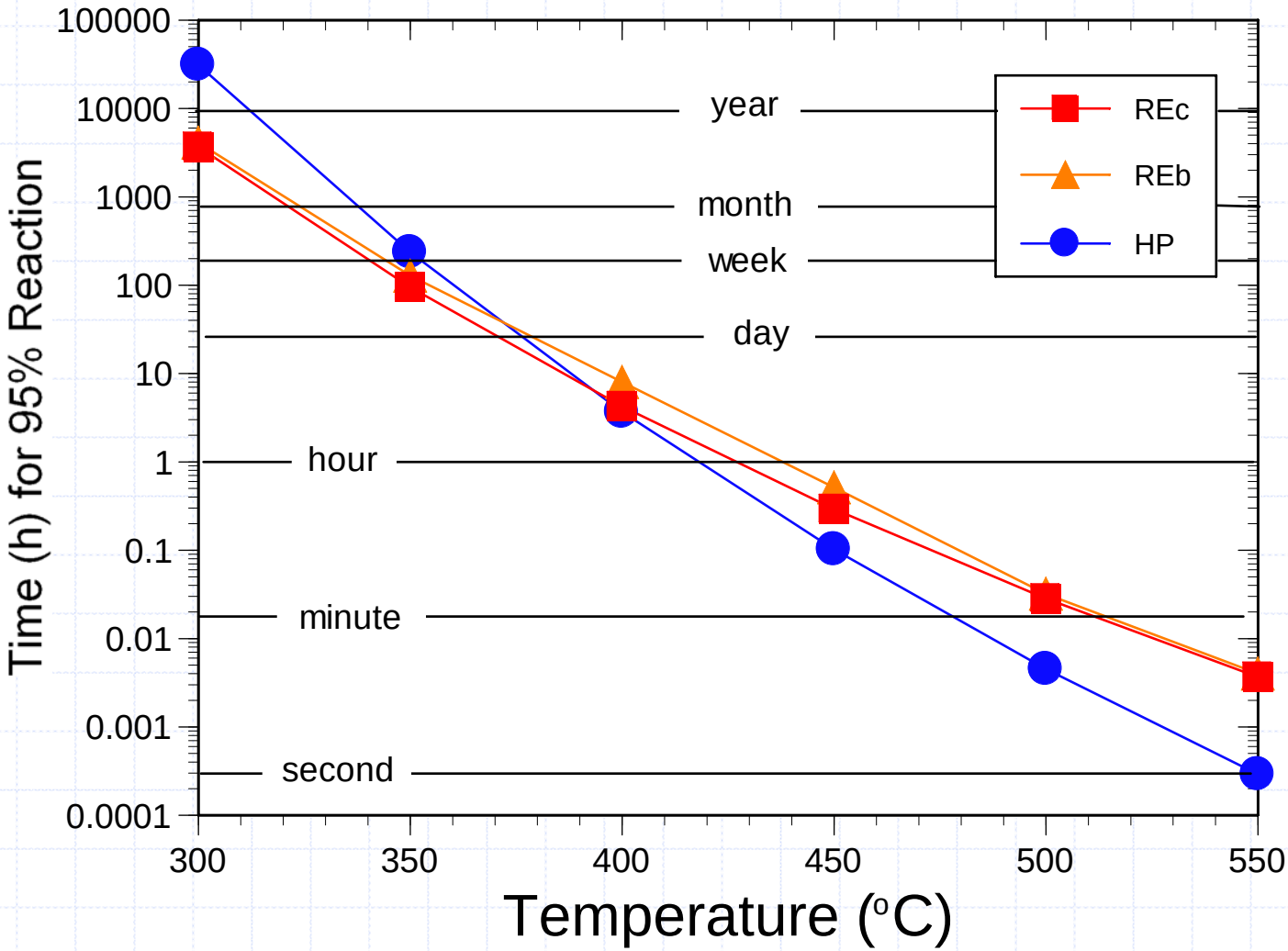
Comparison of Pyrolysis Methods For Deriving Oil Generation Kinetics

Attribute	HP	RE
Heating	Isothermal	Non-isothermal
Temperatures (°C)	250-365	250-650
Times (h)	12-120	0.5-7
Pressures (psia)	600-3000	~15
Products	HC-rich oil	Polar-rich bitumen

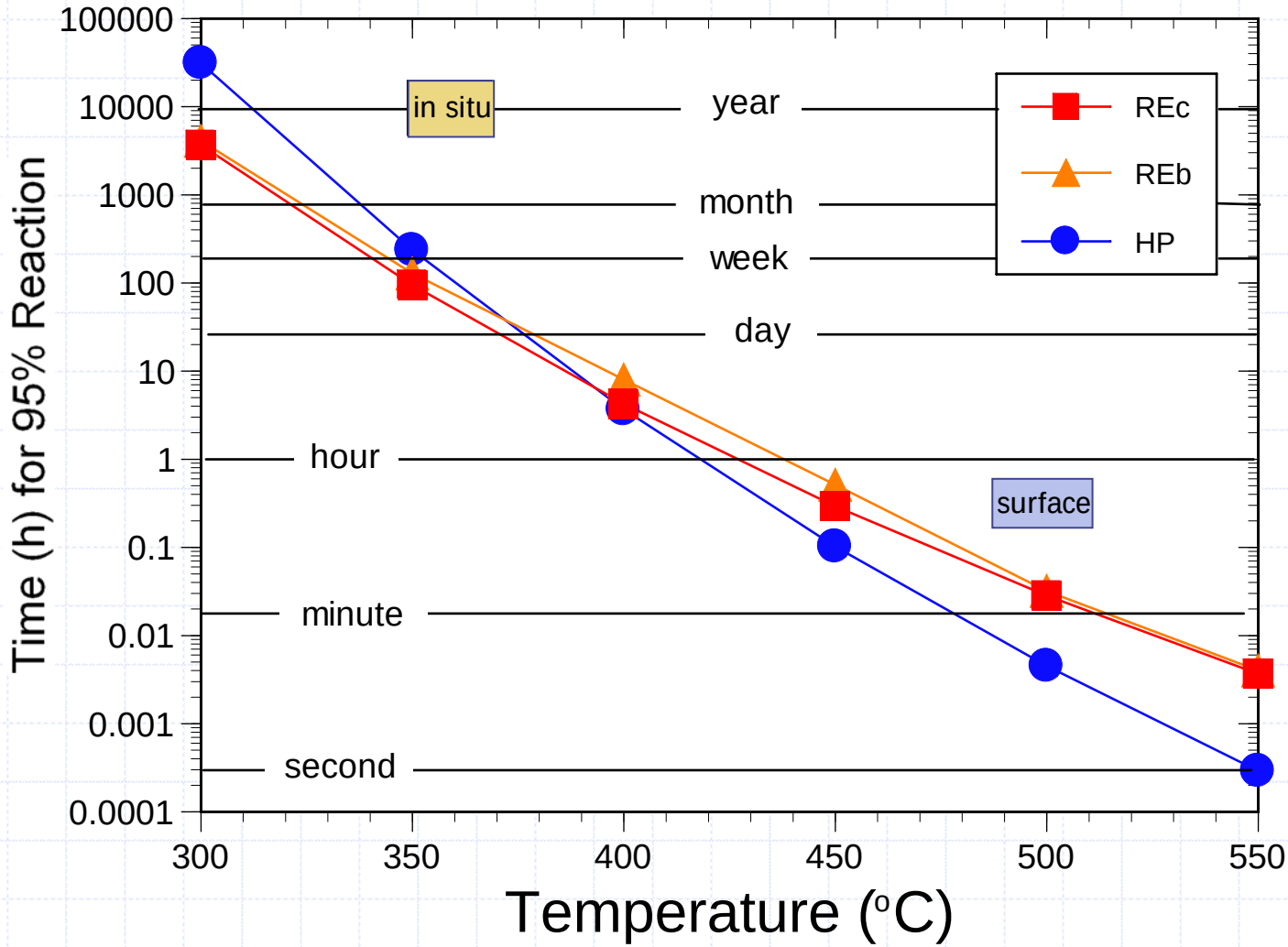
Bulk RE versus Comp RE Timing at 95% Generation



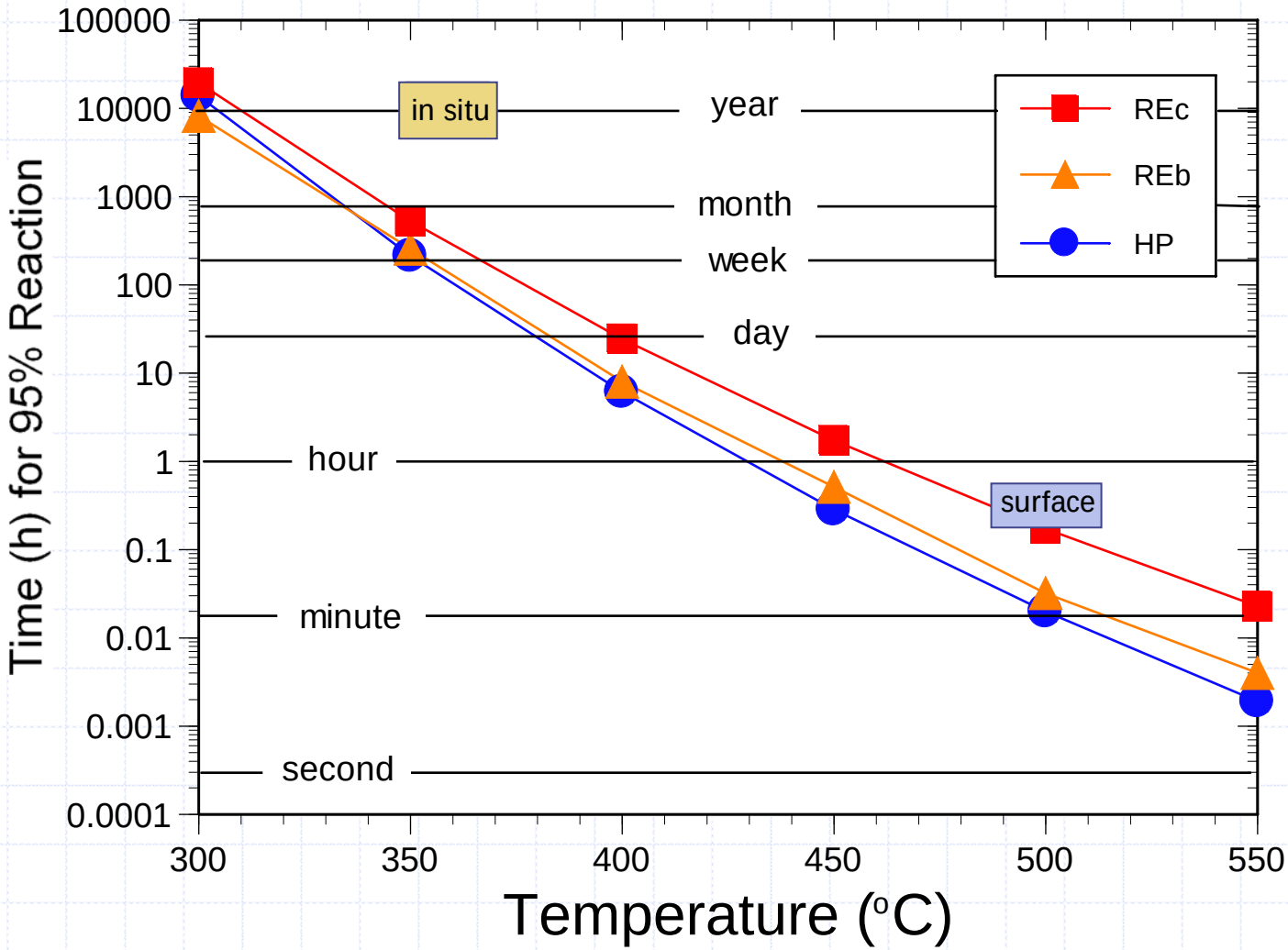
Comparison of Timing at 95% Generation of Green River Shale (Type-I)



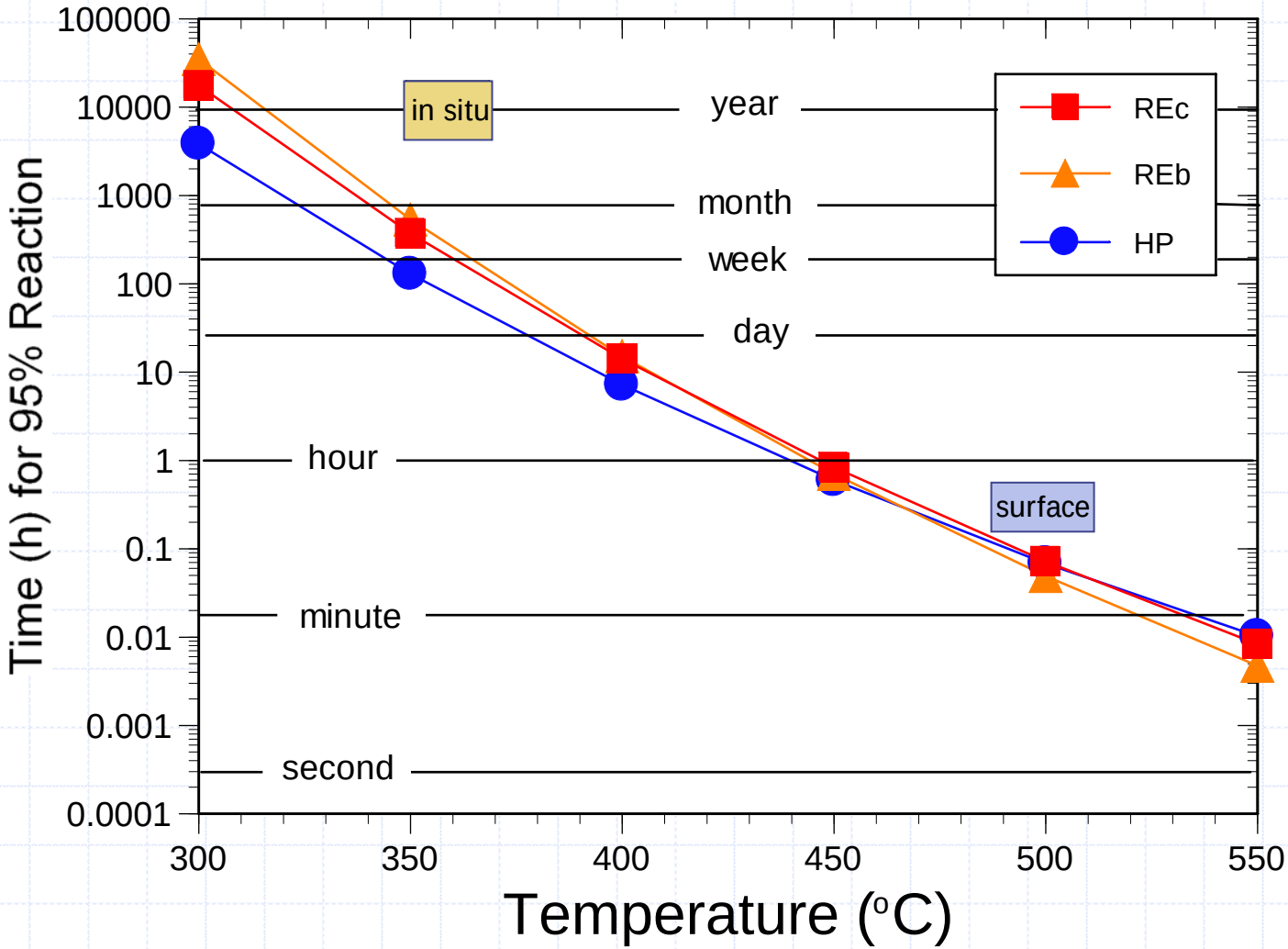
Comparison of Timing at 95% Generation of Green River Shale (Type-I)



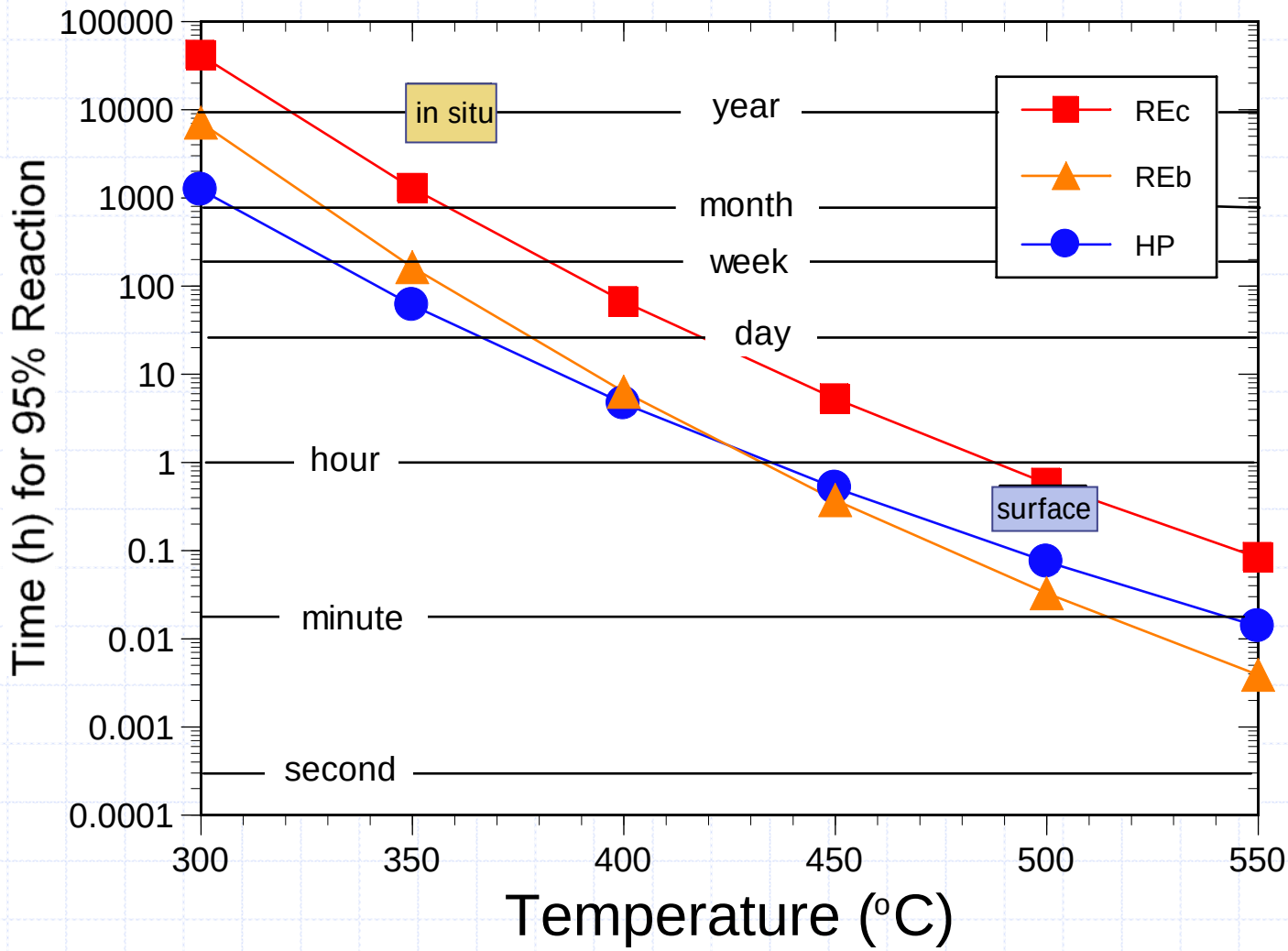
Comparison of Timing at 95% Generation of New Albany Shale (Type-II)



Comparison of Timing at 95% Generation of Alum Shale (Type-II)



Comparison of Timing at 95% Generation of Phosphoria Retort Shale (Type-IIS)



Conclusions

Pyrolysis Methods for determining oil generation

can make a significant difference in determining timing and extent of **natural** petroleum generation.

do not make a significant difference in determining timing and extent of ***in situ*** oil-shale retorting.

may make a significant difference in determining timing and extent of in **surface** oil-shale retorting (Type-IIS).