Thermal maturity and facies variations reflected in $\delta^{34}S$ values of dibenzothiophenes – case study from the Eagle Ford Formation

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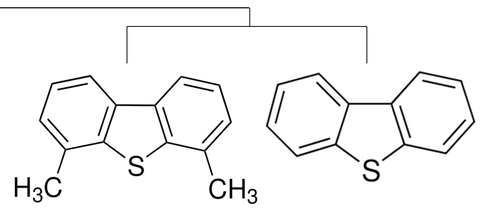
Introduction

Source rock

$\Delta^{34}S_{kerogen\text{-}DBTs} \approx \pm 2‰$ in the lab [1]

Thermal maturation

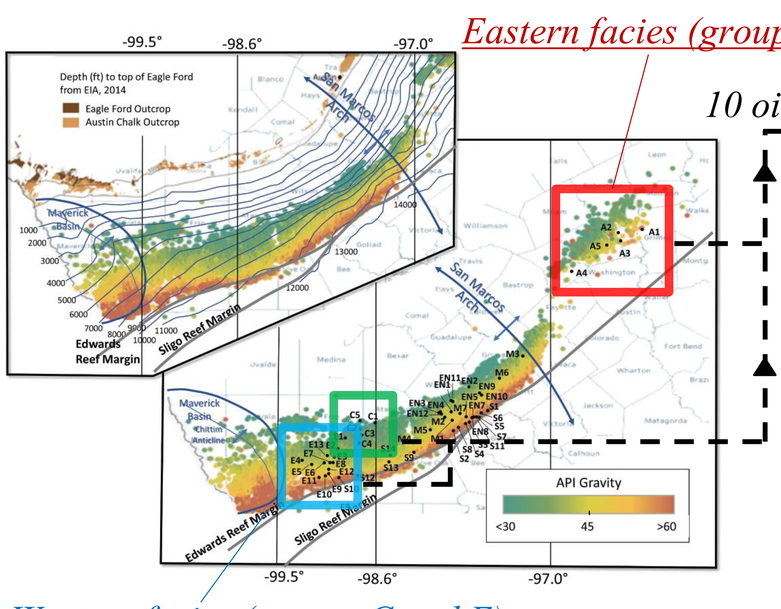


Dibenzothiophenes (DBTs)

Research questions:

1. Could the magnitude of $\Delta^{34}S_{kerogen\text{-}DBTs}$ with progressing thermal maturity, under natural conditions, be different from that observed in the lab?
2. Does facies variability have an influence on $\Delta^{34}S_{kerogen\text{-}DBTs}$?

Materials and methods



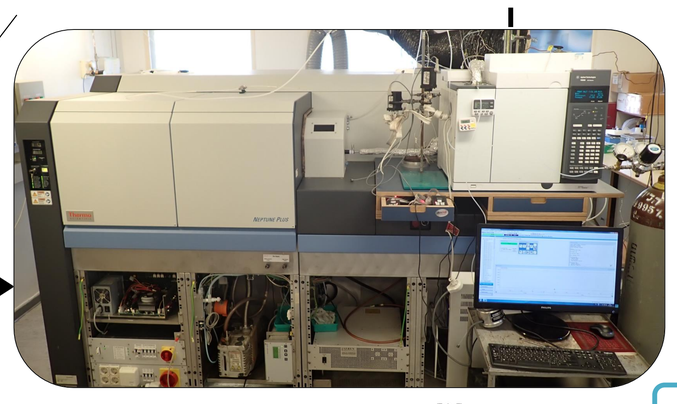
Eastern facies (group A)

Western facies (groups C and E)

10 oil samples

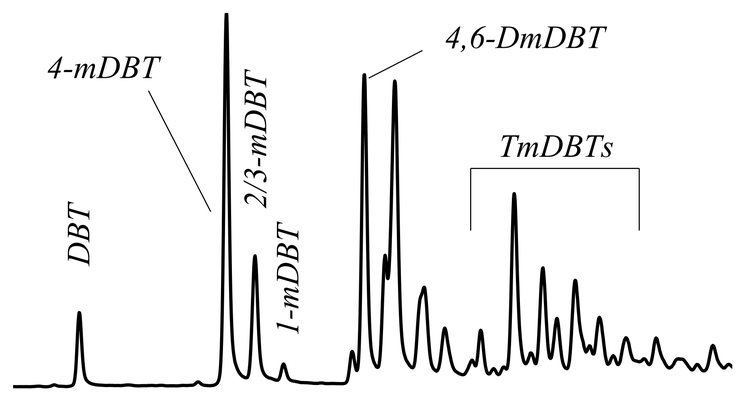
SiO_2/Al_2O_3 Column Chromatography

Aromatic fraction



GC/MC-ICPMS [2]

Compound specific $\delta^{34}S$ of dibenzothiophenes [3]



Geochemical correlations

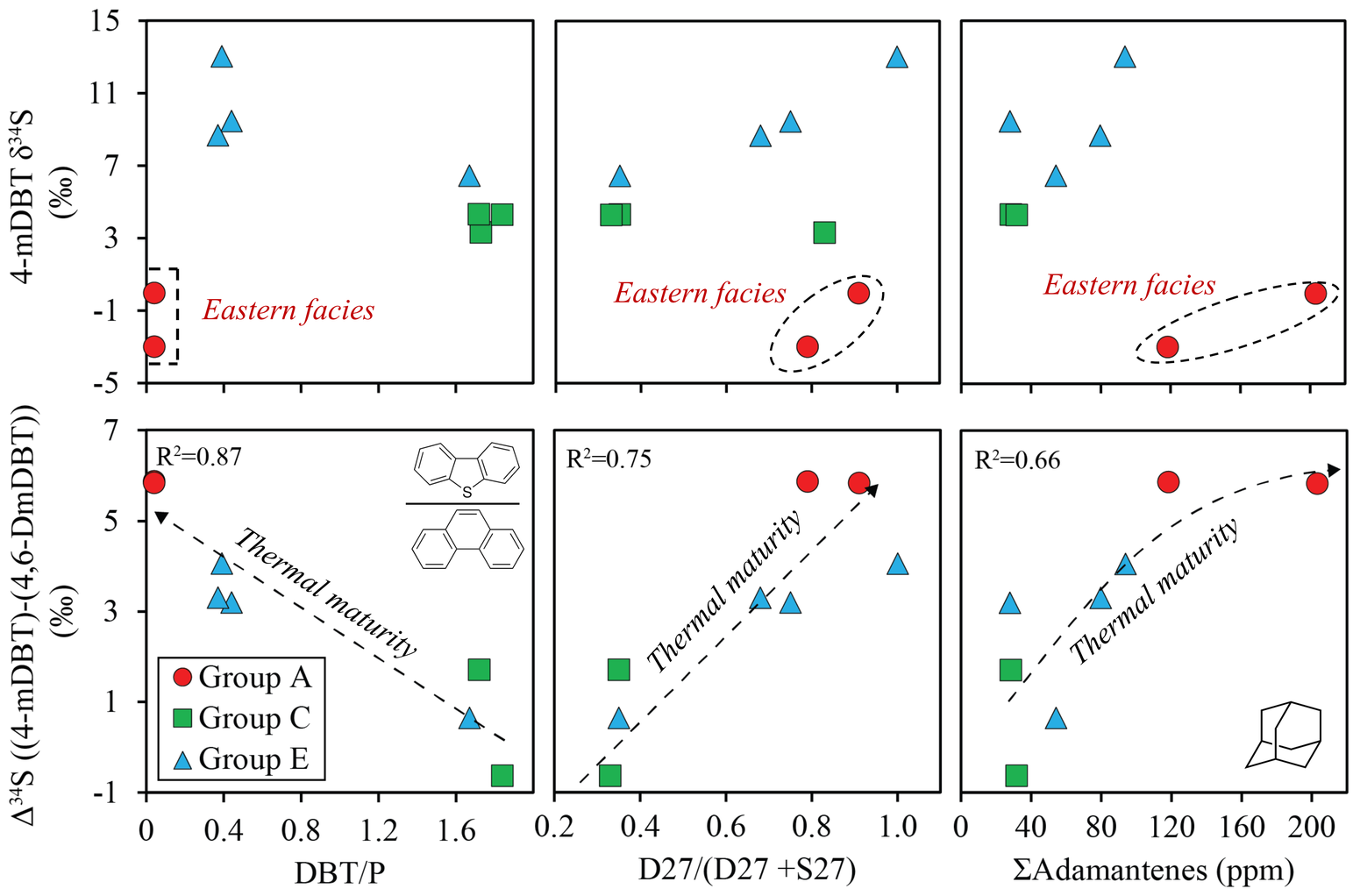
Biomarkers [4]

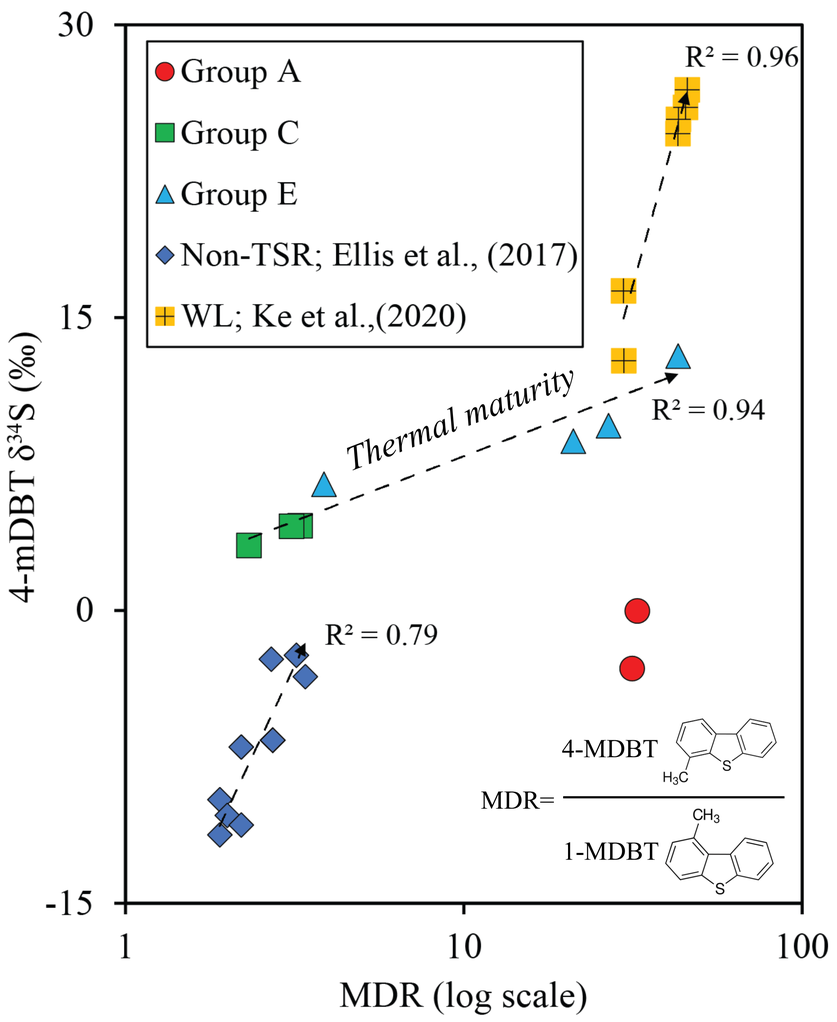
API°/ Sulfur % [4]

Thermal maturity indices [4]

Diamondoids [5]

Results





Take-home message

- $\delta^{34}S$ values of DBTs generated form a single source rock in a self-sourced petroleum system may vary by up to 10‰ with varying degree of maturation.
- $\delta^{34}S$ values of 4-mDBT increase with increasing thermal maturity yet are affected by facies variability of a given source rock.
- Isotopic difference ($\Delta^{34}S$) between 4-mDBT to 4,6-DmDBT in generated oils smoothens facies-effects and allows better assessment of molecular indices over different facies of a given source rock.

[1] Rosenberg et al., 2017; [2] Amrani et al., 2009; [3] Gvirtzman et al., 2015 [4] Sun et al., 2022 [5] Walters et al., 2023

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