

Introduction

A set of 10 oils and gas condensates has been investigated by standardised molecular organic-geochemical methods to assess oil quality, source and maturity and to verify previous interpretations (e.g., Killips 1996). The samples are from the Great South (Kawau-1A), Canterbury (Galleon-1), South Westland (Madagascar Beach), Grey River (Niagara-1, Petroleum Creek-3, Kotuku), Murchison (Blackwater-1) and East Coast (Rotokautuku, Totangi, Waitangi) Basins. They include five seep oils and range from yellow gas condensates to black, waxy oils. Detailed comparison is also made to Taranaki oils and gas condensates recently analysed using identical analytical protocols (Manzano-Kareah & Sykes 2008). The results are reported in Zink & Sykes (2008), available on CD-ROM or by download from www.gns.cri.nz.

Objectives

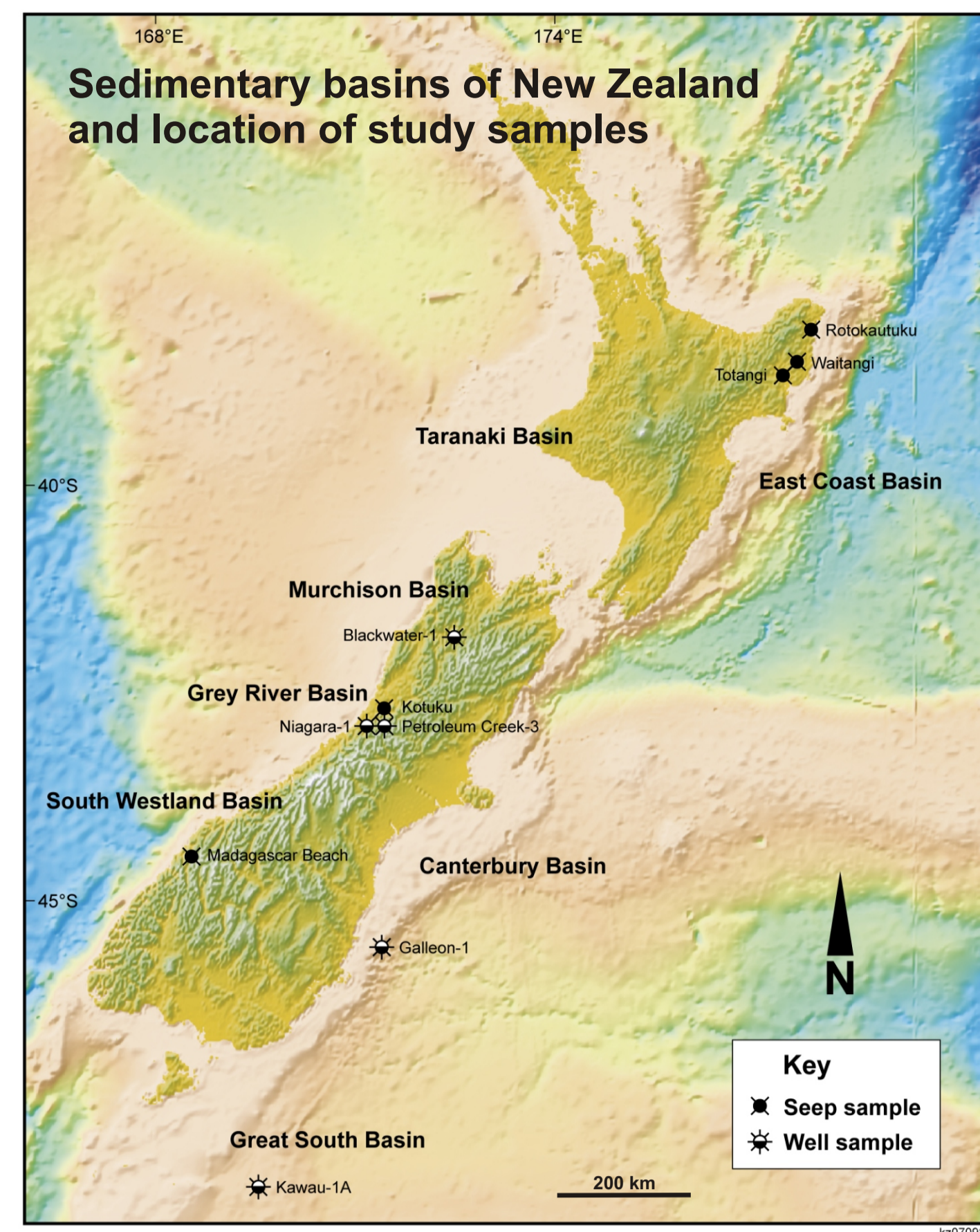
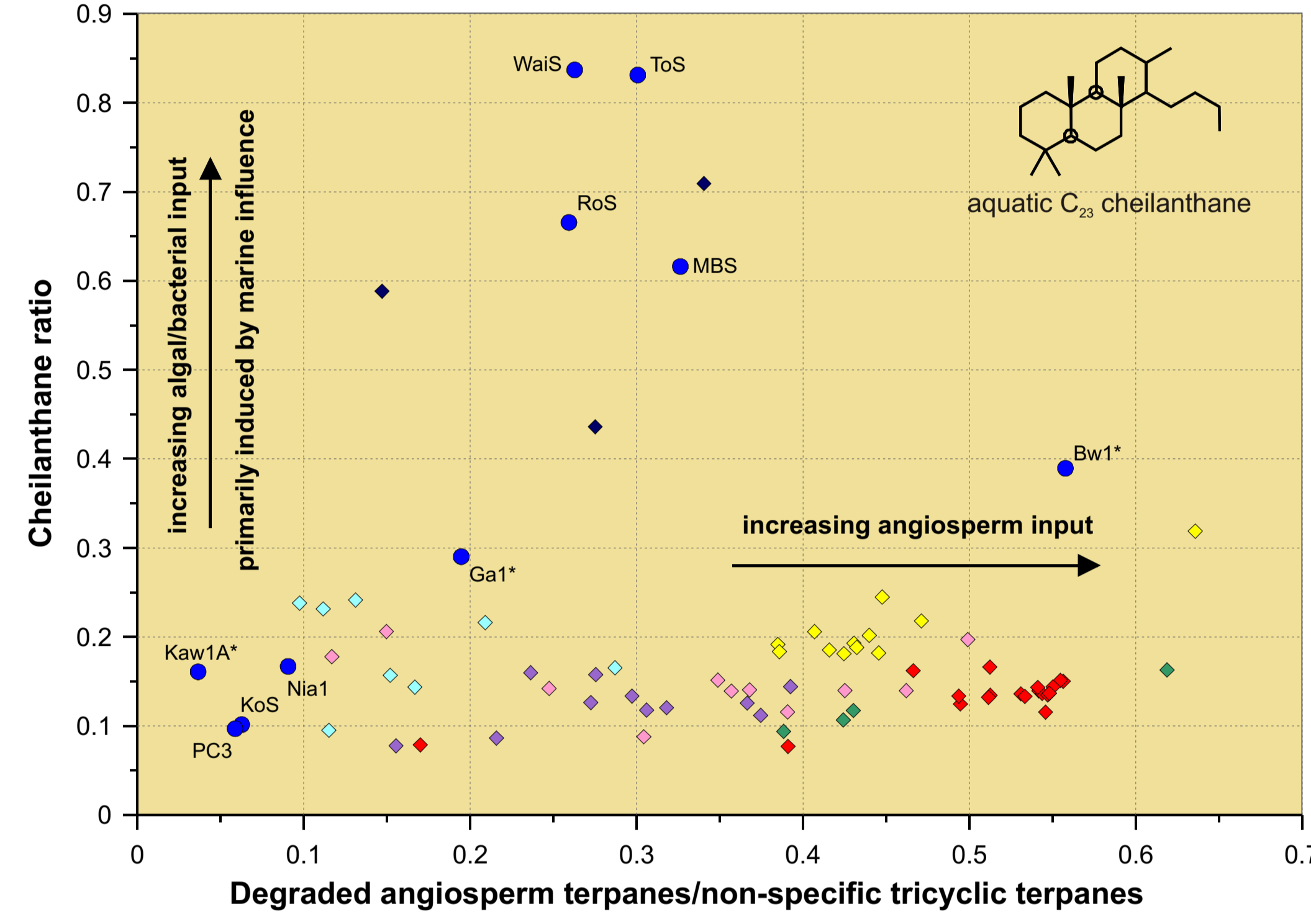
- Assess source organofacies and age
- Determine relative maturities
- Assess oil quality including waxiness and the effects of any alteration processes (e.g., evaporation, water-washing, and/or biodegradation)

Methods

- Gas chromatography (GC-FID) of whole oils/condensates
- Asphaltene precipitation, latroscan, and middle pressure liquid chromatography (MPLC) for separation
- Gas chromatography-mass spectrometry (GC-MS) of aliphatic and aromatic hydrocarbons including biomarkers
- Carbon isotope analysis of saturated and aromatic hydrocarbon fractions

Source organofacies and oil-oil correlation

Plot 2 Aquatic vs. terrestrial biomarkers



Symbols and abbreviations used in plots:

- 10 New Zealand oils (in this study)**
 - Bw1*: Blackwater-1
 - Ga1*: Galleon-1
 - Kaw1A*: Kawau-1
 - Nia1: Niagara-1
 - PC3: Petroleum Creek-3
 - KoS: Kotuku
 - MBS: Madagascar Beach
 - ToS: Totangi
 - WaiS: Waitangi
 - RoS: Rotokautuku
 - (* = gas condensate, S = oil seep)
- 7 Taranaki oil families - main oil fields, wells - inferred source(s)** (previously analysed samples in GNS database)
 - Maui - Maui, Maari, Moki - Late Cretaceous Rakopi Fm
 - Moturoa/Pohokura - Moturoa, Pohokura, Mangaheva - Eocene Mangaheva/Kaimiro/Turi Fms
 - Kaimiro/Ngatoro - Kaimiro, Ngatoro, Ahuroa - Eocene Mangaheva/Kaimiro Fms
 - Manaiia Trend - Kupe South, Kapuni, Toru - Paleocene Farewell Fm
 - Northern Tarata Thrust - McKee, Tariki - Eocene Mangaheva Fm
 - Southern Tarata Thrust - Stratford, Ngaere, Waihapa - Tertiary terrestrial
 - Northern Graben - Kora, Pukearuru - Paleocene Waipawa Fm equiv. + Tertiary terrestrial

Results and Conclusions

Results and interpretations are mostly consistent with previous studies (e.g., Killips 1996); current findings and interpretations are:

Source organofacies

- A wide range of terrestrial to marine source rocks is inferred (plots 2, 3, 5), a first indication of a high diversity within formation facies
- Four of the seep oils, from the East Coast (WaiS, ToS, RoS) and South Westland (MBS) Basins, have biomarker distributions consistent with marine oils with minor terrestrial input, with the East Coast oils showing even higher input of certain marine biomass (plots 2, 5)
- Gas condensates from the Canterbury (Ga1*) and Murchison (Bw1*) Basins are derived from predominantly terrestrial source rocks, but with significant marine influence and increased anoxicity during deposition and/or early diagenesis. In contrast, samples from the Grey River (KoS, PC3, Nia1) and Great South (Kaw1A*) Basins are even more terrestrial, with the oils from PC3 and KoS in particular having negligible marine influence (plots 2, 3, 5A, 6)

Comparison to Taranaki oil families

- East Coast seep oils are similar to the Northern Graben family (plots 5A, 6), but $\delta^{13}C$ isotope signatures are consistent with derivation from the Late Cretaceous Whangai Formation rather than Paleocene Waipawa Formation (plot 4)
- For East Coast oil RoS, a slightly different source, possibly the Upper Calcareous Member (Late Cretaceous–Paleocene), could be inferred on the basis of C_{29} steranes and cheilanthanes (plot 2, 5B)

⇒ An East Coast oil family is suggested

- Grey River (Nia1, PC3, KoS) and Canterbury (Ga1*) Basin samples are dominated by gymnosperm organic matter and show some analogies to the Rakopi Formation-sourced Late Cretaceous Maui family (plots 3) but particular the Ga1* condensate reflect more aquatic depositional conditions (plot 6)

- The gas condensate from the Great South Basin (Kaw1A*) shows no clear analogy to Taranaki oil families (plots 3, 6); a source rock older than the Rakopi Formation or changes in land plant vegetation seem conceivable

- The gas condensate from Murchison Basin (Bw1*) is separated in most biomarker plots, showing e.g. elevated amounts of angiosperm biomarkers indicating a Tertiary age (plots 2, 3) and specific aquatic depositional conditions (plots 4, 6)

⇒ A preliminary own oil family is suggested

Maturity levels at time of expulsion from source rocks (plots 7, 8)

- Different molecular parameters give different indications of maturities
- Range of relative maturities indicated, with Galleon-1 the lowest
- Need for improved calibration of molecular maturity parameters from analysis of source rock extracts

Oil quality

- Non-waxy to high wax oils and gas condensates (plot 1)
- Only MBS is heavily biodegraded to level 4–5 (plot 1) but also PC3 and KoS show slight biodegradation of level 2–3 (plot 9)
- Evaporation (plot 1) and water-washing (plot 10) have affected most samples to decrease oil quality

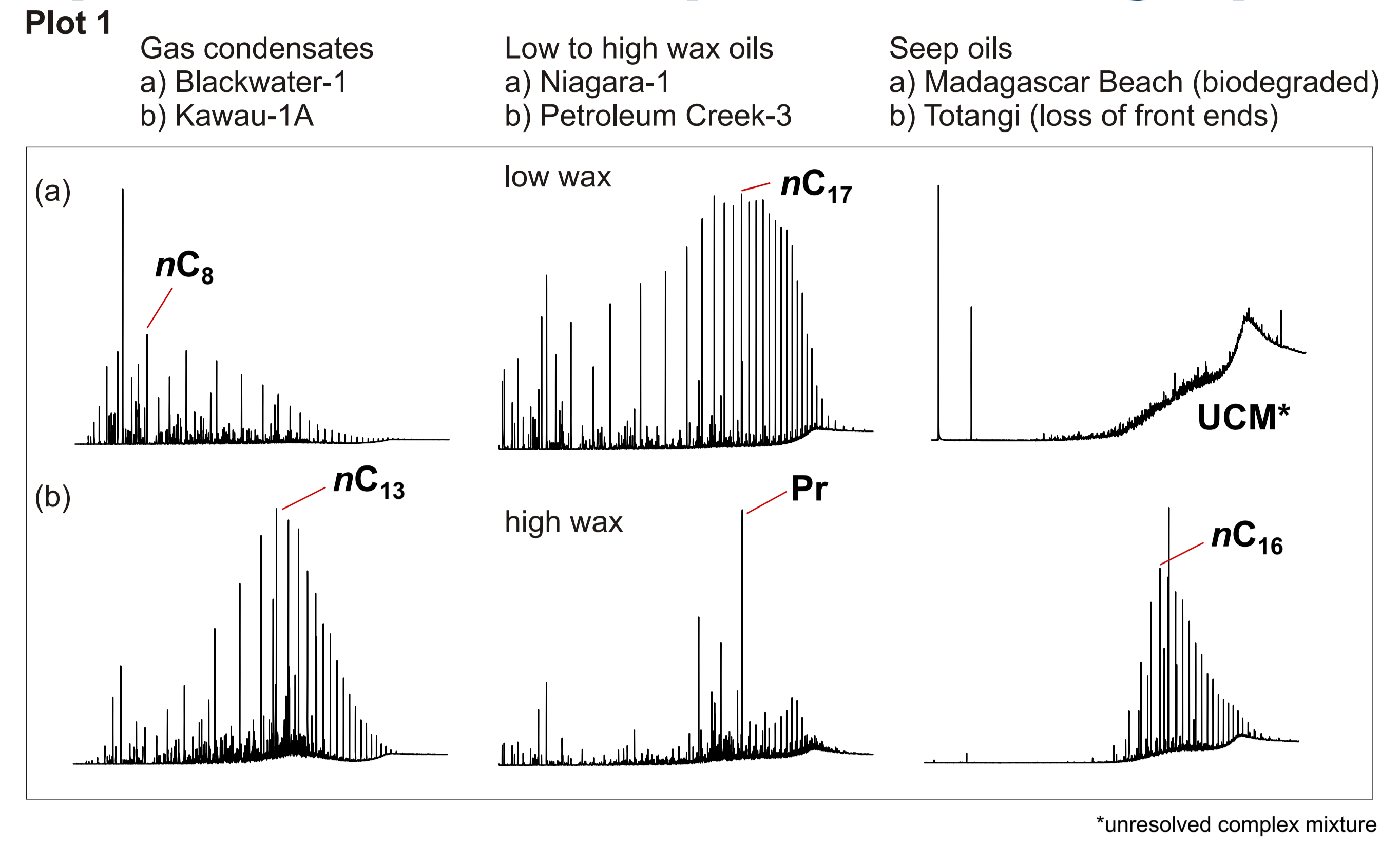
References

- Killips, S. 1996. A geochemical perspective of oil generation in New Zealand basins. Proceedings of the 1996 New Zealand Petroleum Conference, pp. 179–187.
- Manzano-Kareah, K., Sykes, R. 2008. Geochemical database and interpretations of Taranaki oils and condensates—Non-exclusive final report. GNS Science Consultancy Report 2008/16.
- Rogers, K.M., Collen, J.D., Johnston, J.H., Elgar, N.E. 1999. A geochemical appraisal of oil seeps from the East Coast Basin, New Zealand. Organic Geochemistry 30: 593–605.
- Zink K.-G., Sykes R. 2008. Geochemical database and interpretation of 10 oils from several New Zealand basins. GNS Science Report 2007/22.

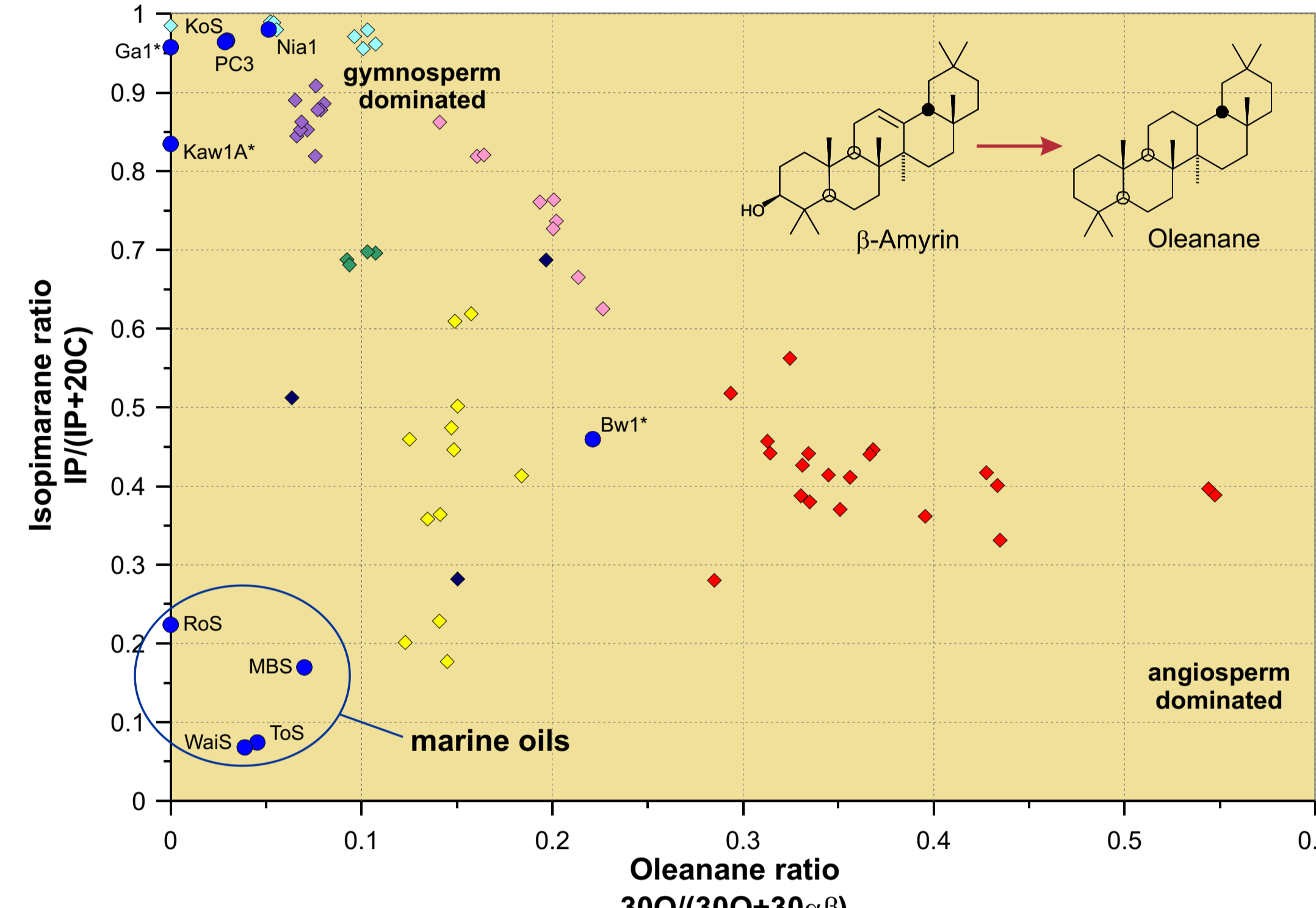
Acknowledgement

Sample analyses were undertaken by Applied Petroleum Technology (APT) AS, Norway.

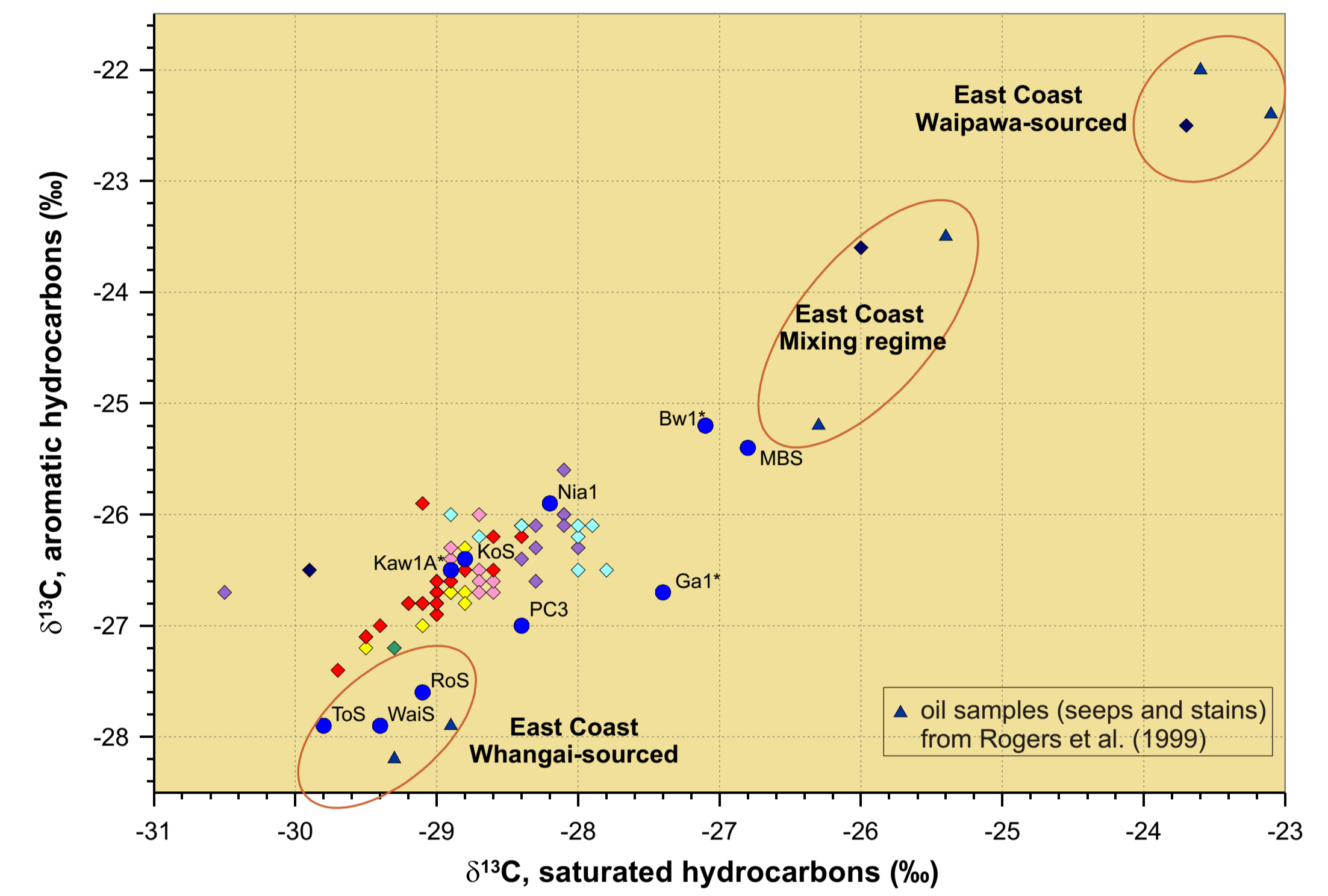
Representative examples of GC fingerprints



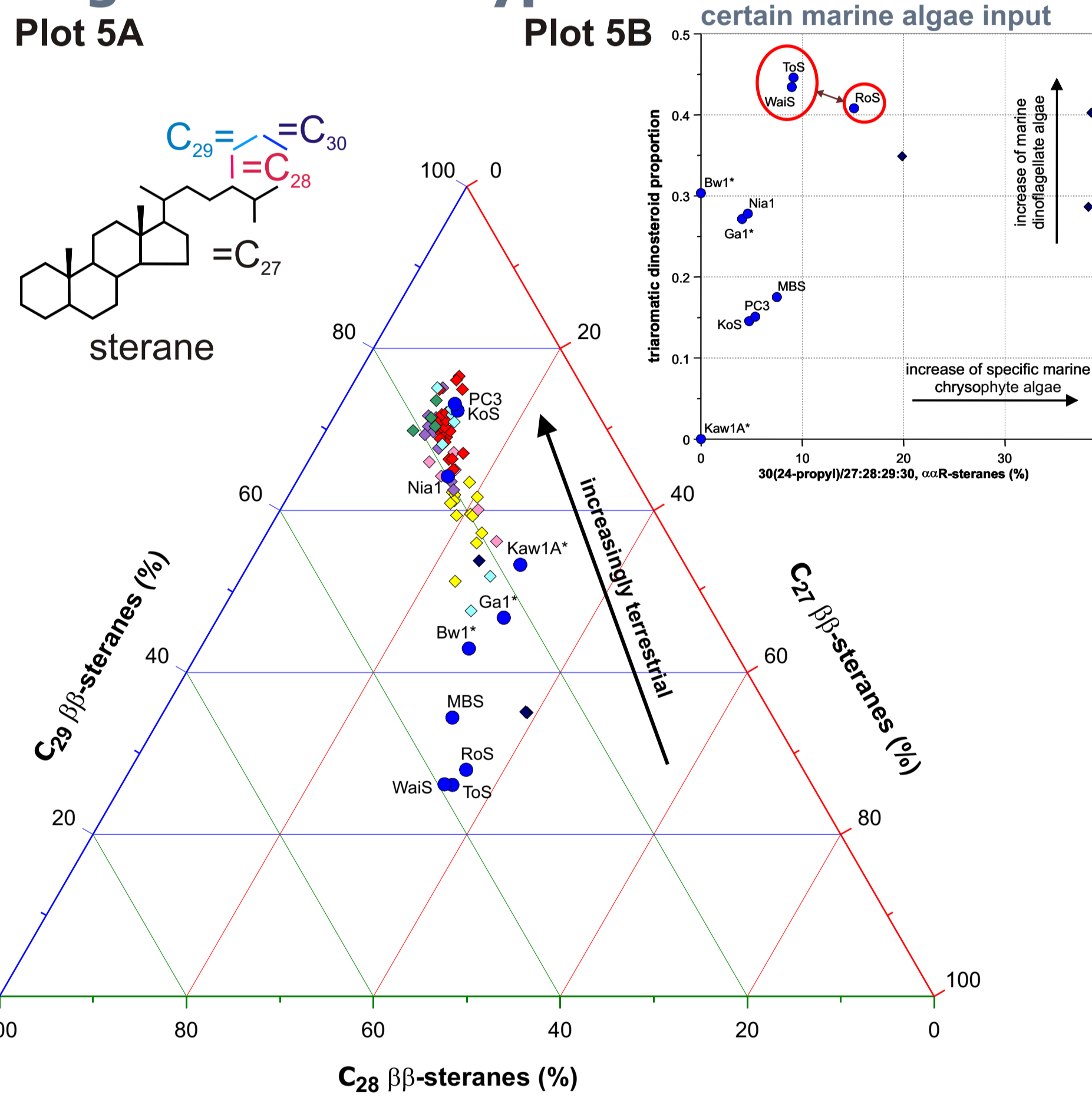
Plot 3 Woody plant biomarkers



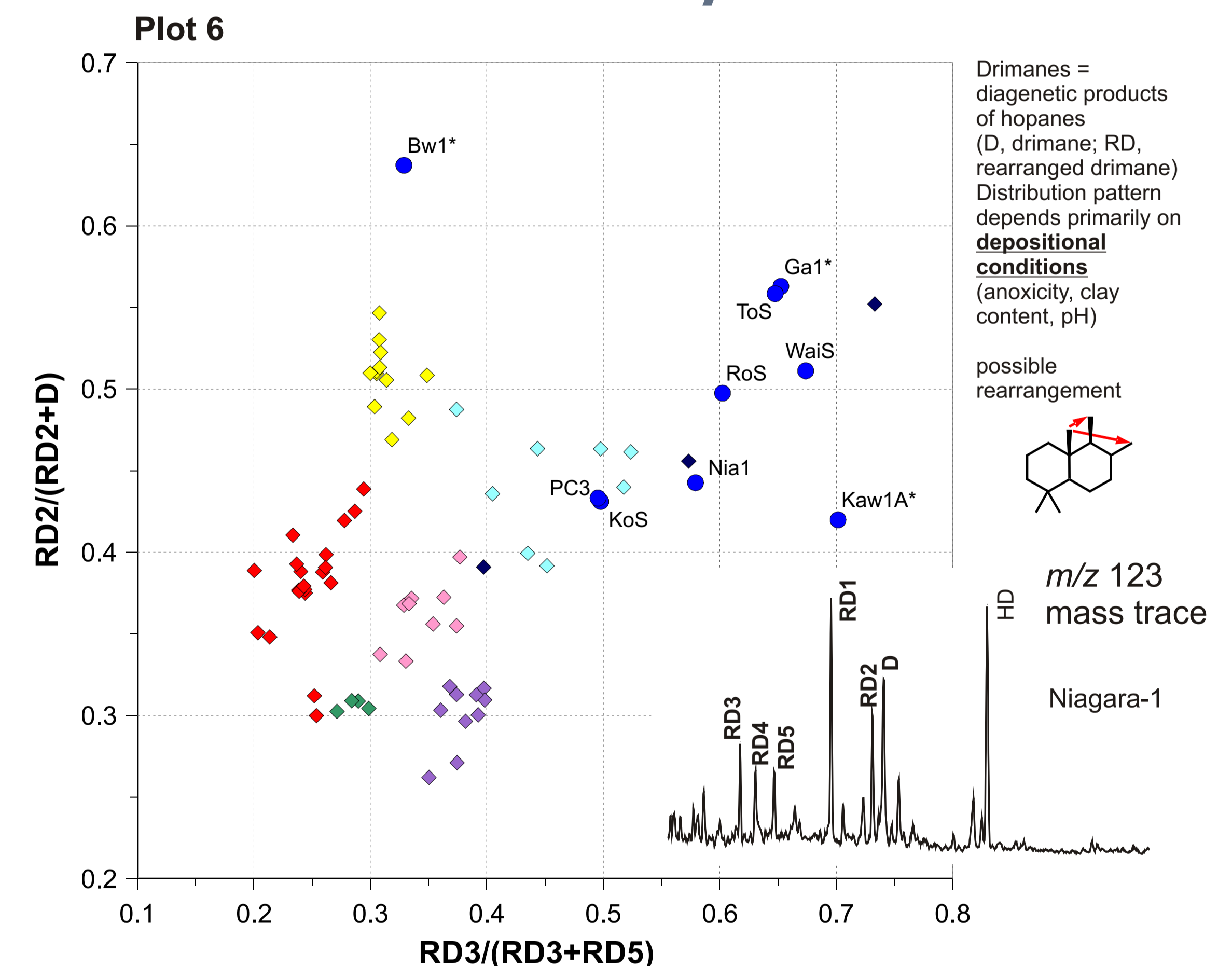
Plot 4 Carbon isotope signature



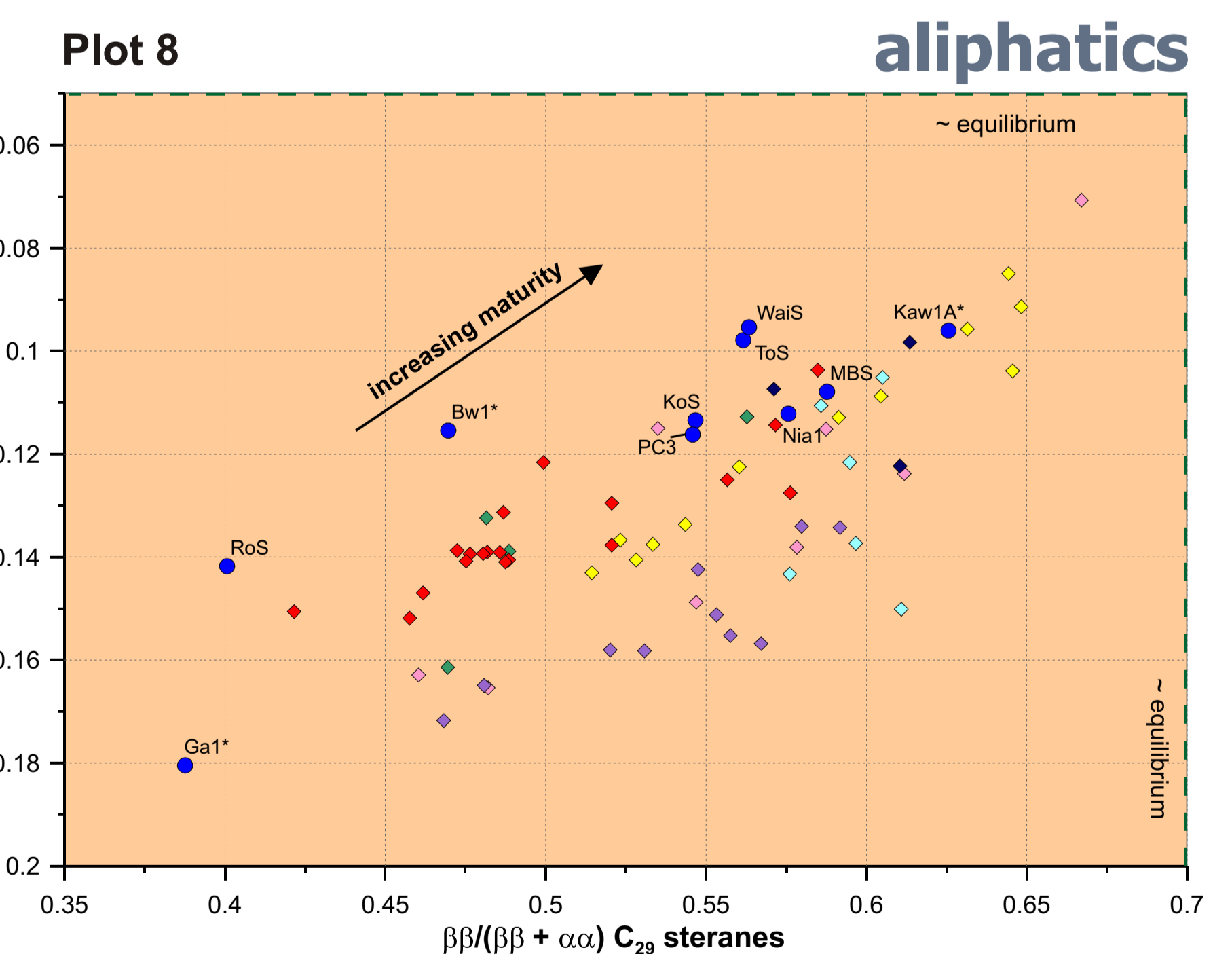
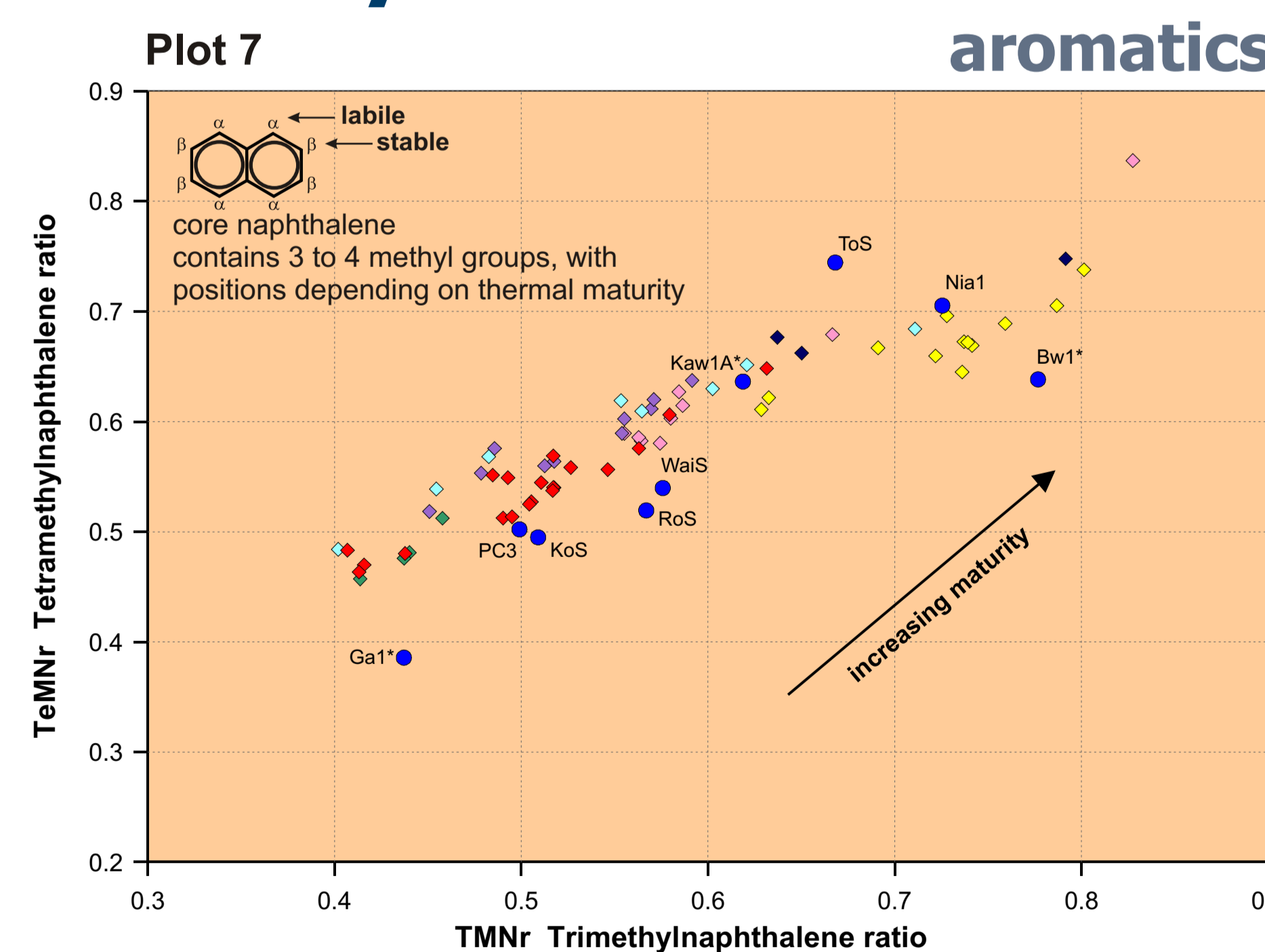
Organic matter type



Oil families reflected by drimanes



Maturity



Oil quality: Alteration processes

