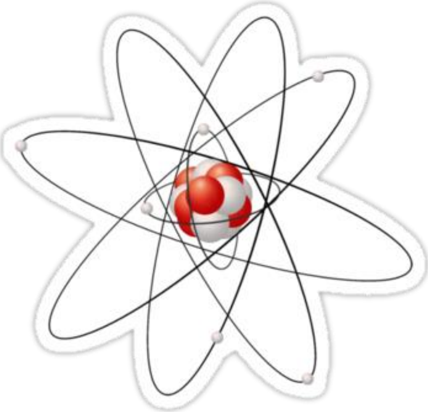
LIÈGE université
Animal systematics and diversity

CBE7

The place of chemosynthesis in marine food webs: towards a global perspective



Loïc N. MICHEL

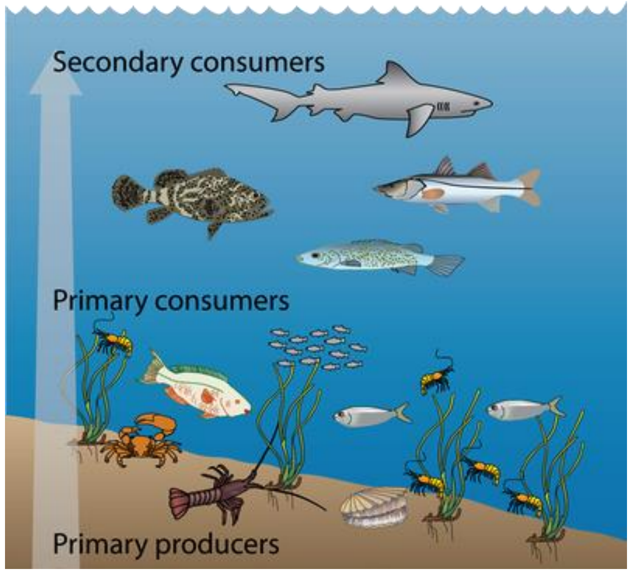
University of Liège, Belgium - Contact: loic.michel@uliege.be

@loicnmichel

7th International Symposium on Chemosynthesis-Based Ecosystems – São Paulo, Brazil, 17/08/2023

Food webs

Food webs: networks formed by entirety of trophic interactions found in a given ecosystem.



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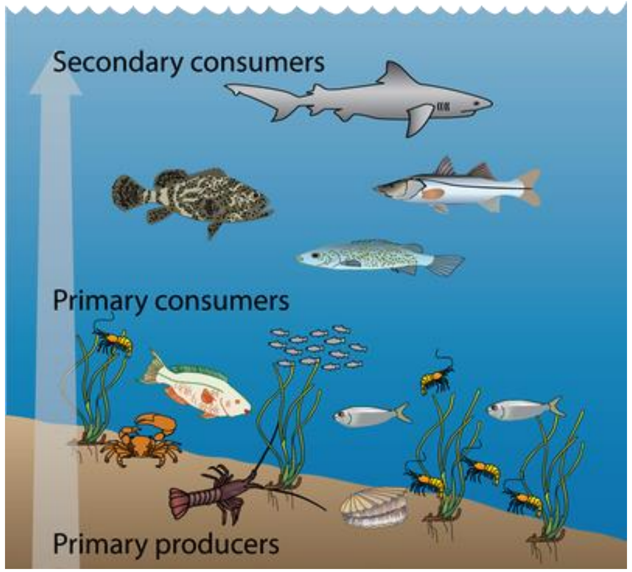
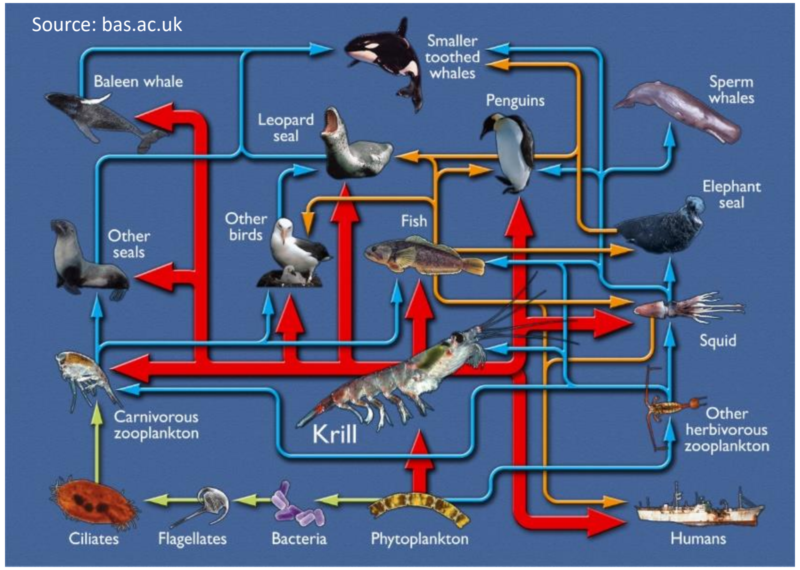


◀ In theory

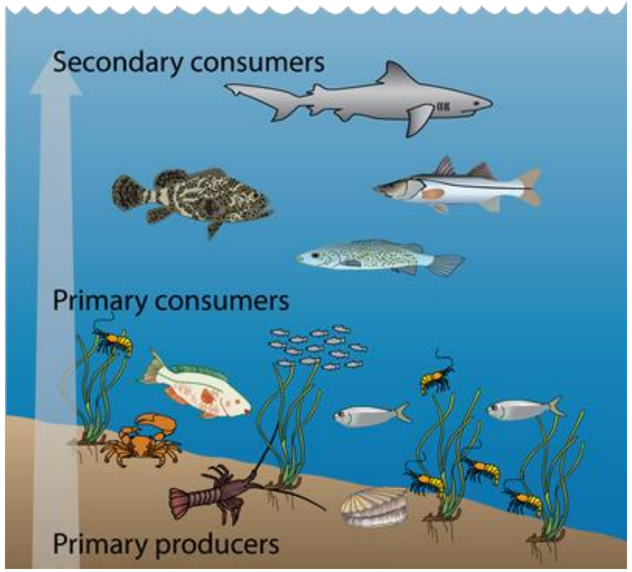
In the real world ▶



Trophic interactions are numerous and dynamic, leading to complex ecological networks

Food webs

Food webs: networks formed by entirety of trophic interactions found in a given ecosystem.



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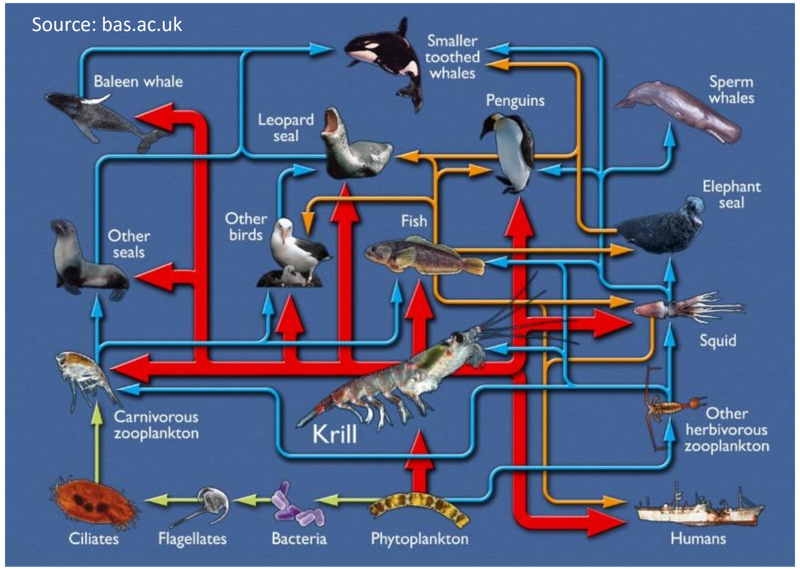
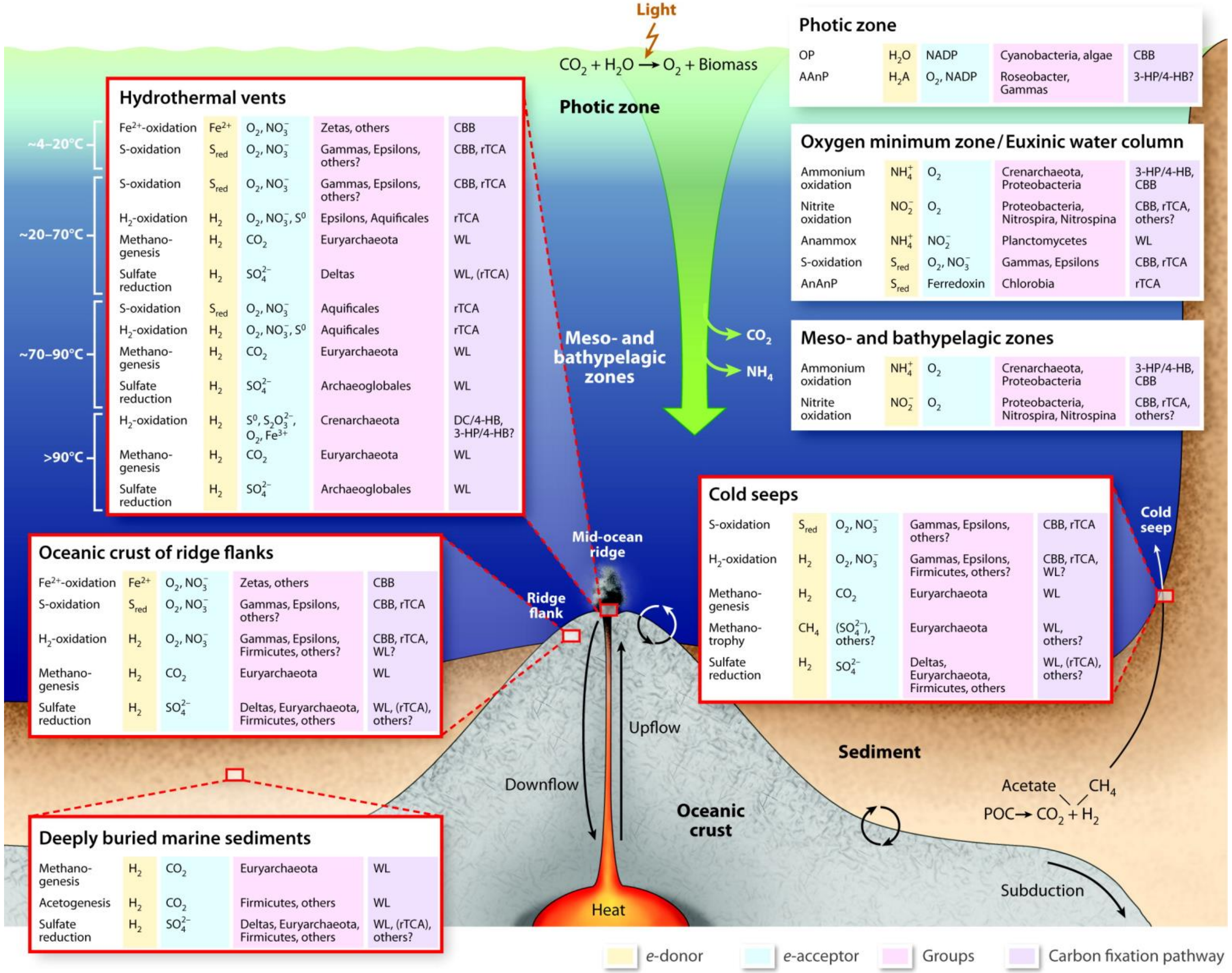


Trophic interactions are numerous and dynamic, leading to complex ecological networks

Since food webs link all organisms living in a given ecosystem together, their structure conditions system functioning and reaction to environmental fluctuations (natural or anthropogenic)

They can act as vectors, through which ecological changes can propagate across ecosystem compartments, or even across ecosystems

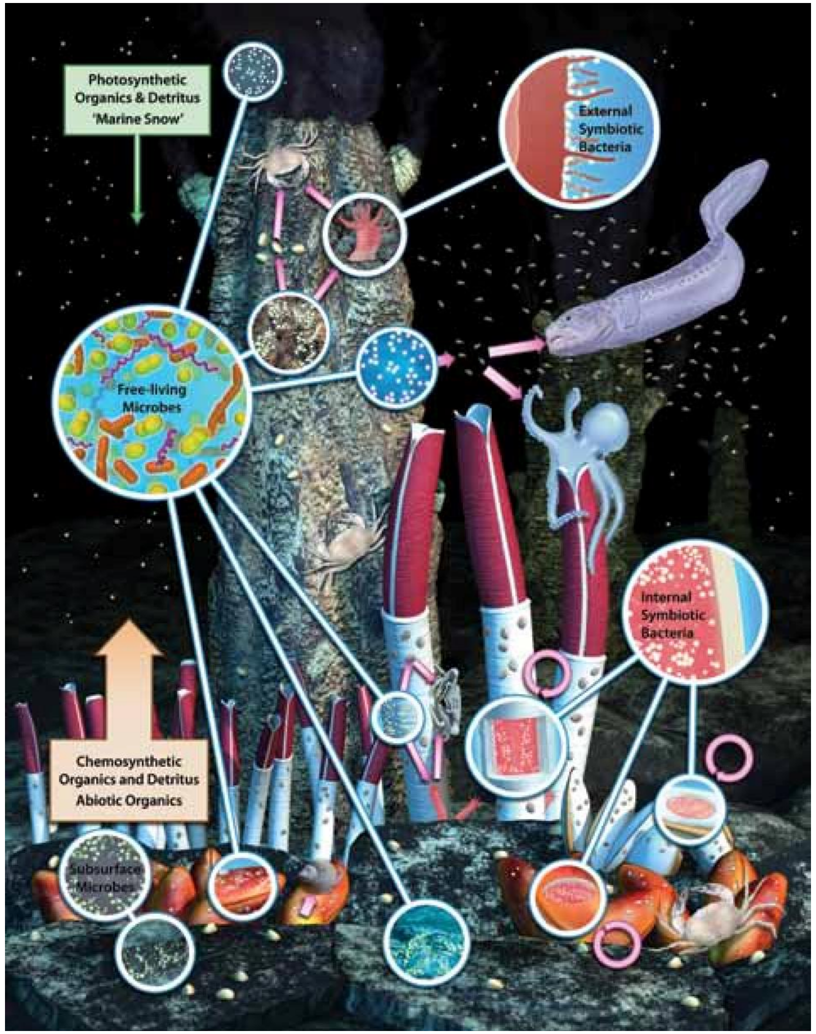
Chemosynthesis



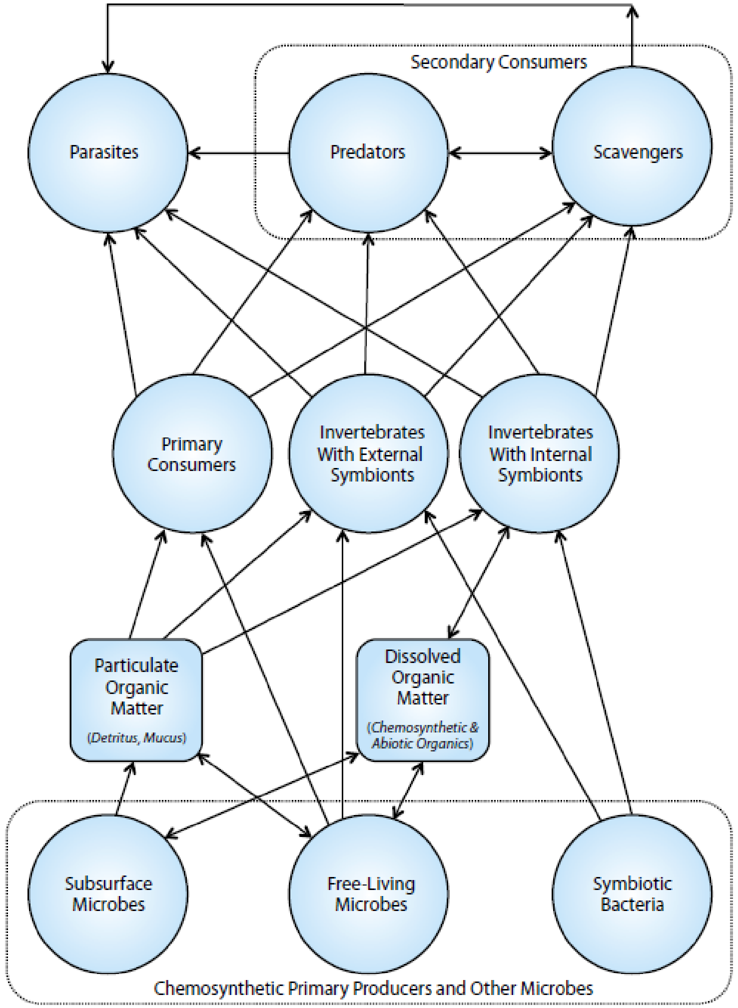
Hügler M, Sievert SM. 2011.
Annu. Rev. Mar. Sci. 3:261–89

While initially depicted as a rather anecdotic carbon fixation pathway, chemosynthesis has proven to be a major mechanism supporting food webs in multiple marine ecosystems, including hydrothermal vents

Hydrothermal vent food webs

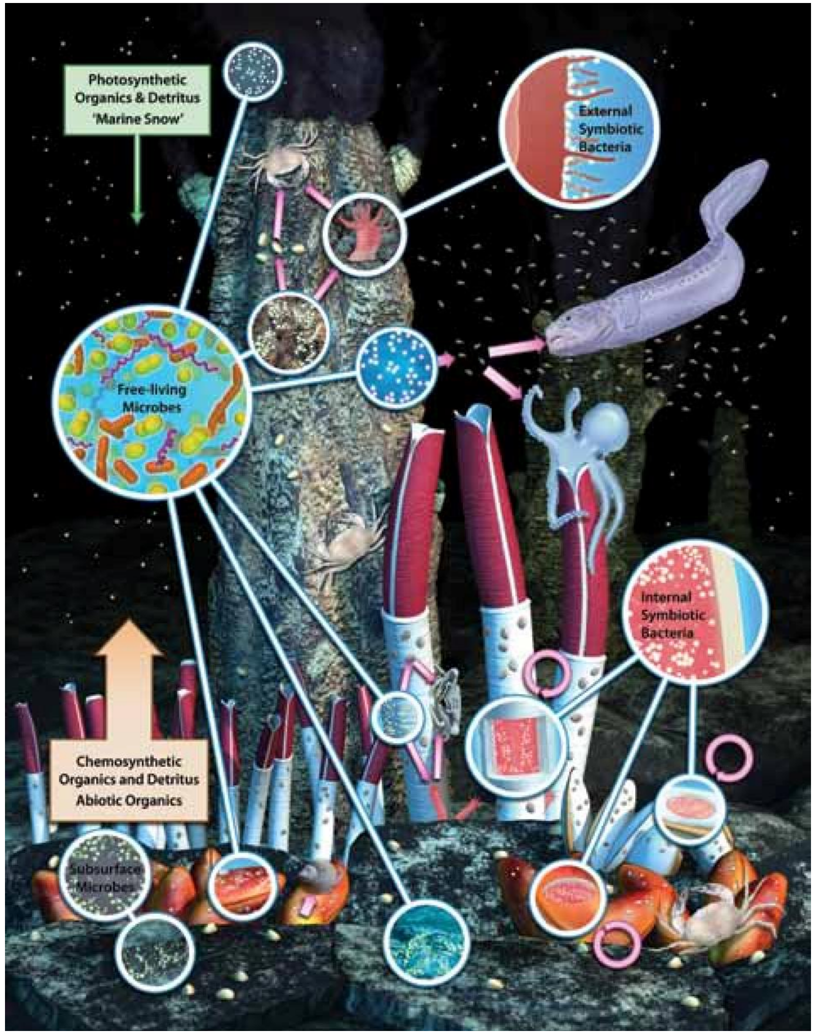


Decades of intensive research led to many discoveries regarding hydrothermal vent food webs…



Diagrams from Govenar 2012

Hydrothermal vent food webs



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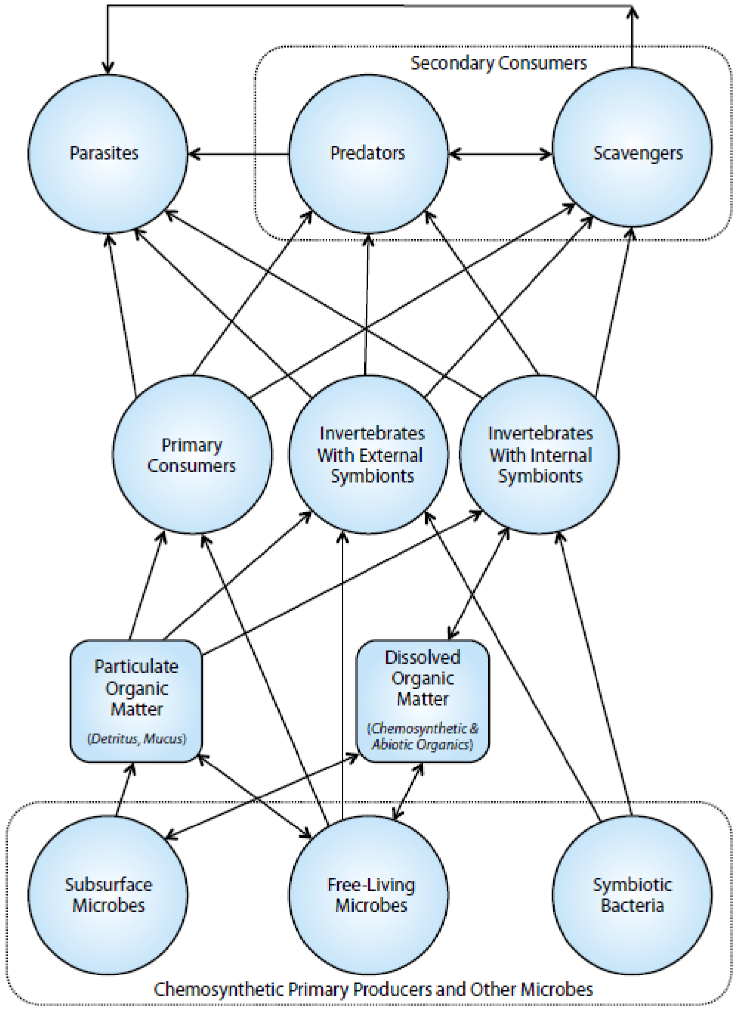
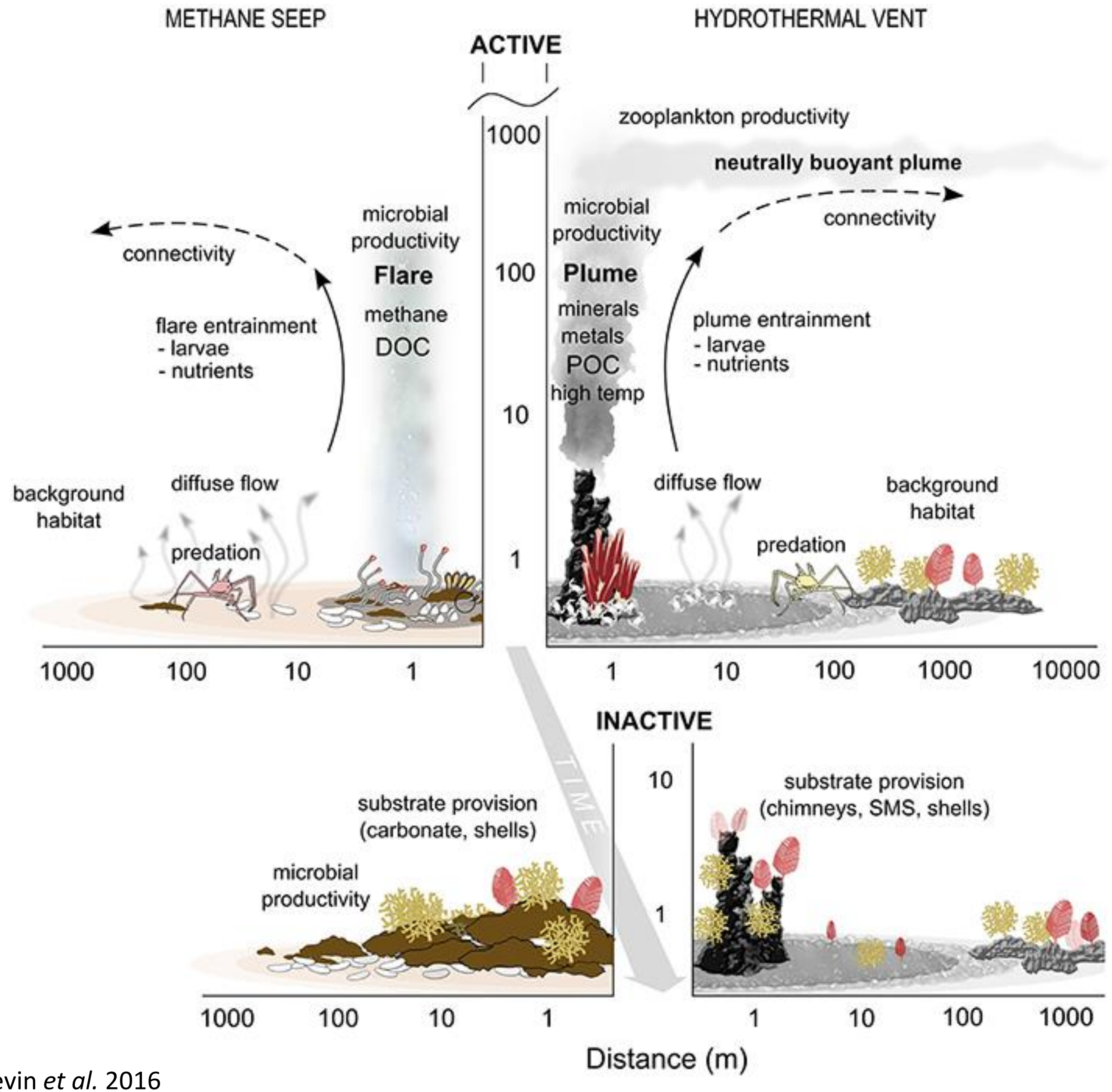


Diagrams from Govenar 2012

… and yet, trophic ecology of deep-sea vents remain, by many aspects, in its infancy when compared with other systems. Many questions about food web structure, trophic interactions and how they condition vent ecosystem functioning remain open, and new ones keep arising!

Deep-sea chemosynthetic subsidies

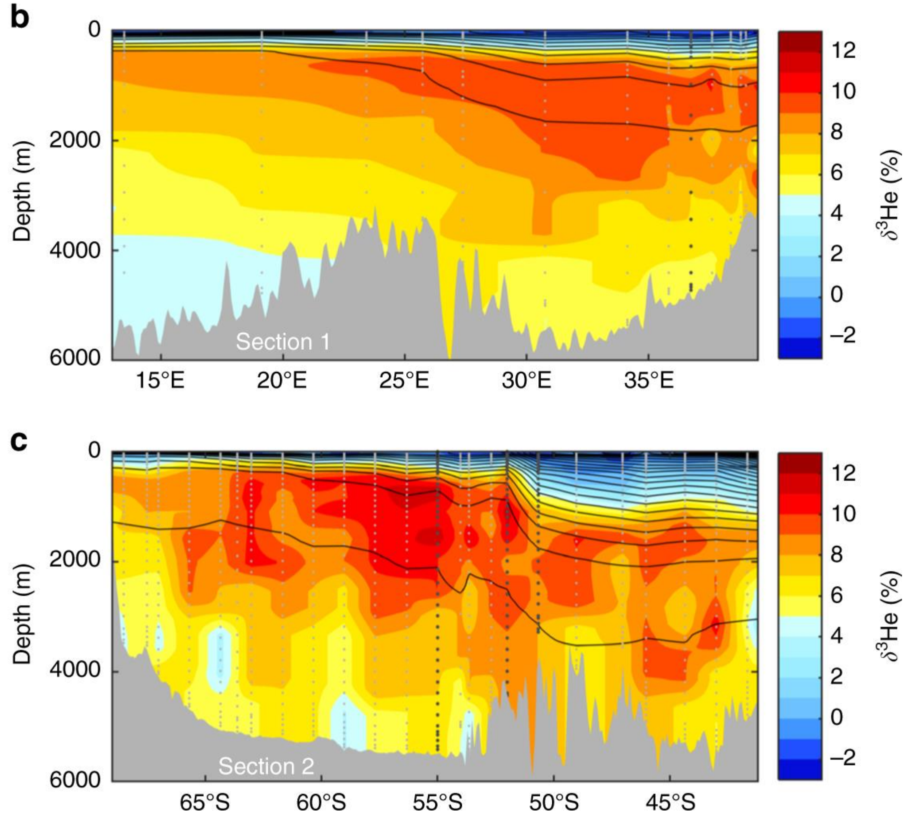


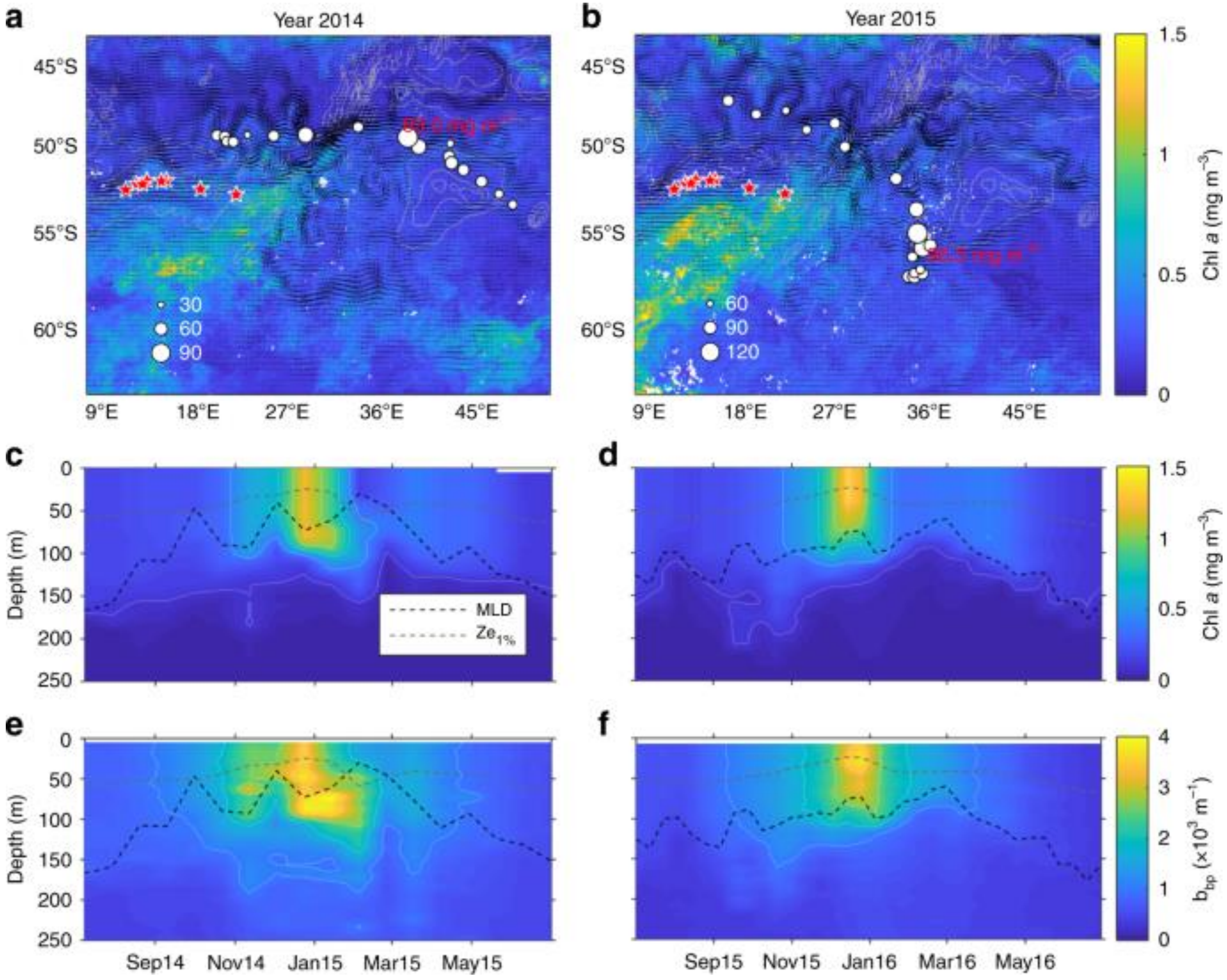
Levin *et al.* 2016

Chemosynthetic habitats are not only, as initially thought, "oases within a barren deep ocean"

There is increasing evidence that they are strongly connected to surrounding ecosystems

Deep-sea chemosynthetic subsidies



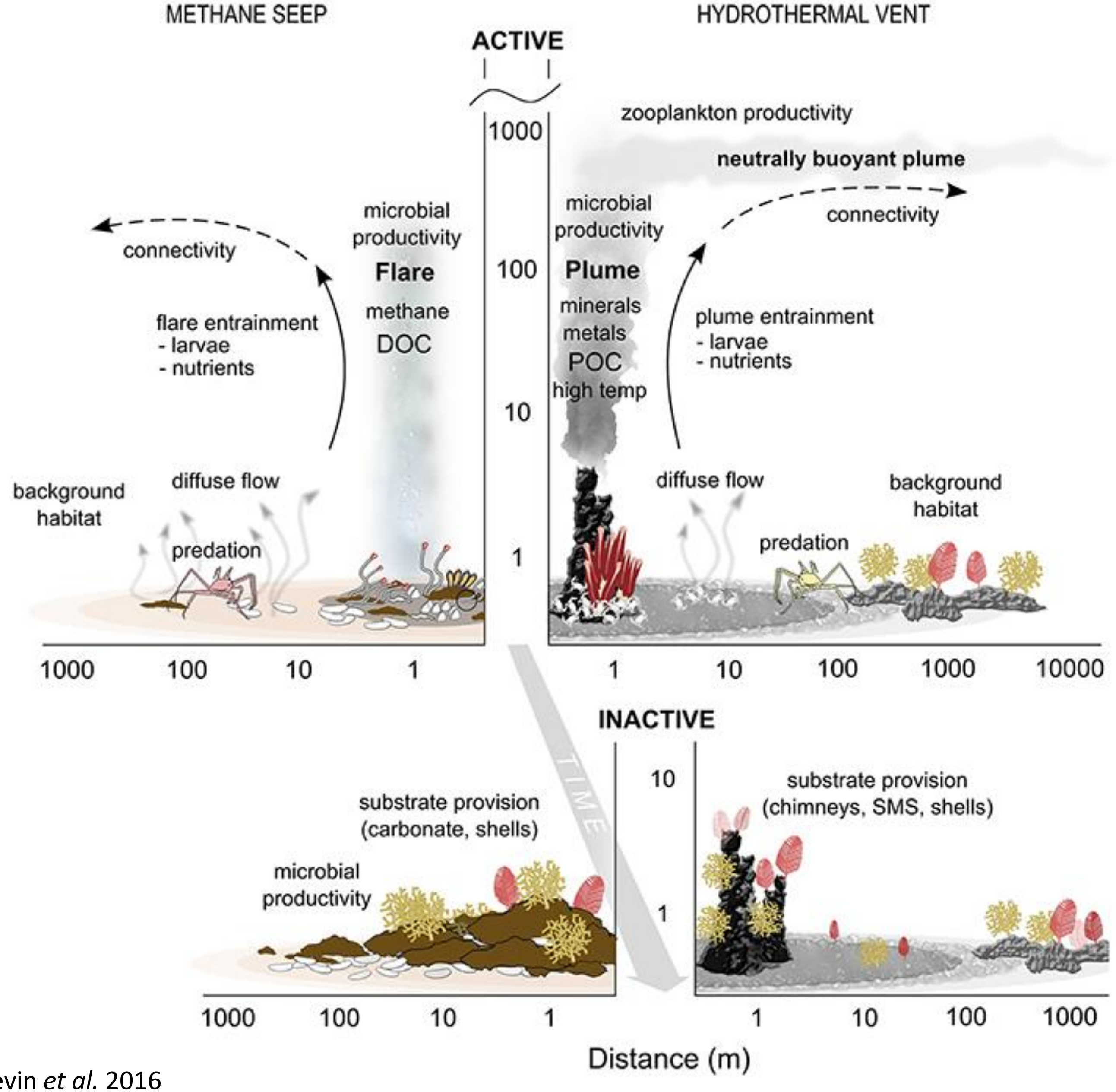


Ardyna *et al.* 2019

Hydrothermally-sourced iron triggers massive phytoplankton blooms in shallower layers of the Southern Ocean

Influence extending to hundreds of km

Deep-sea chemosynthetic subsidies



Levin *et al.* 2016

Chemosynthetic OM can be exported through particle advection + active movement of predators and scavengers

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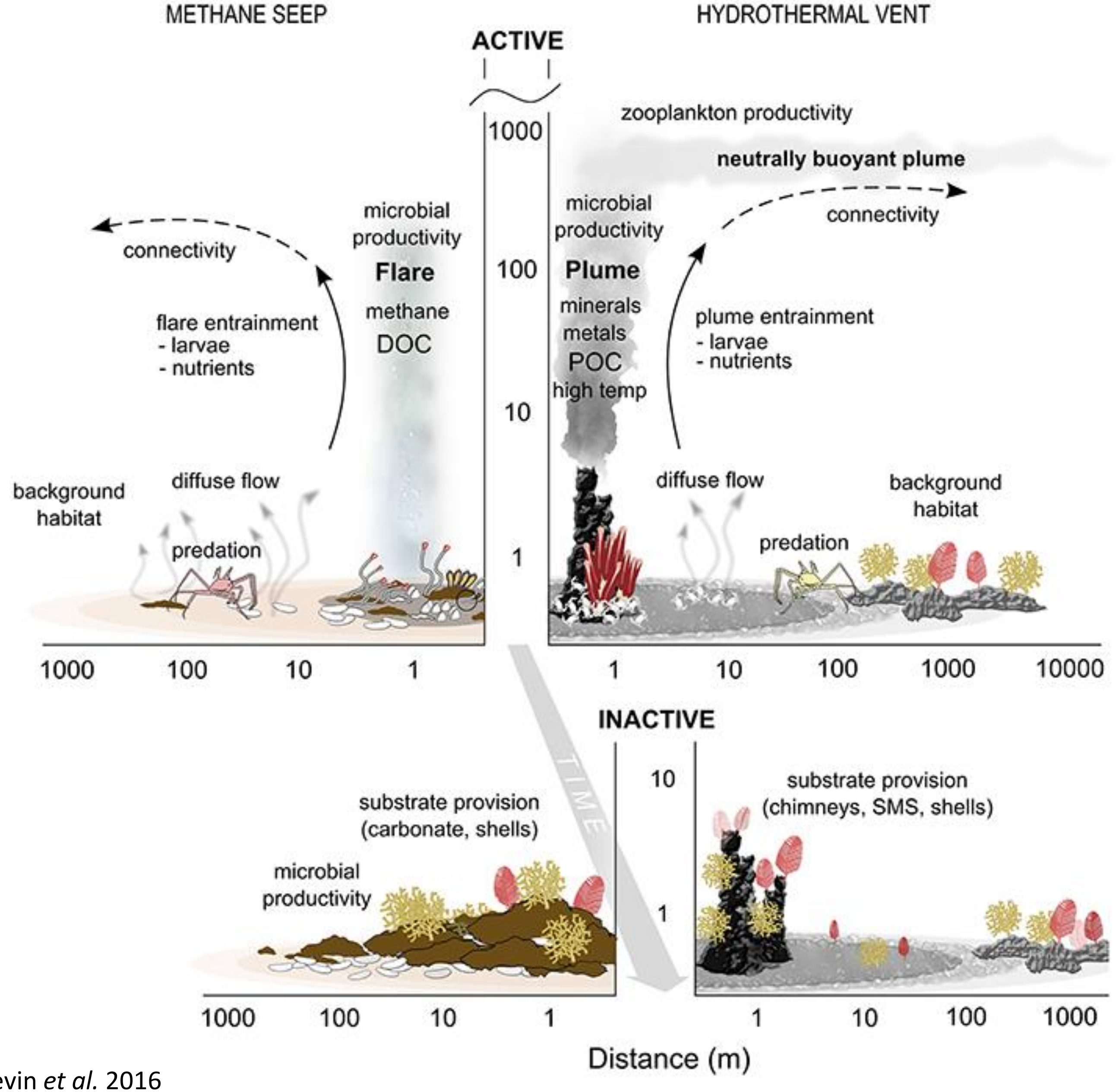

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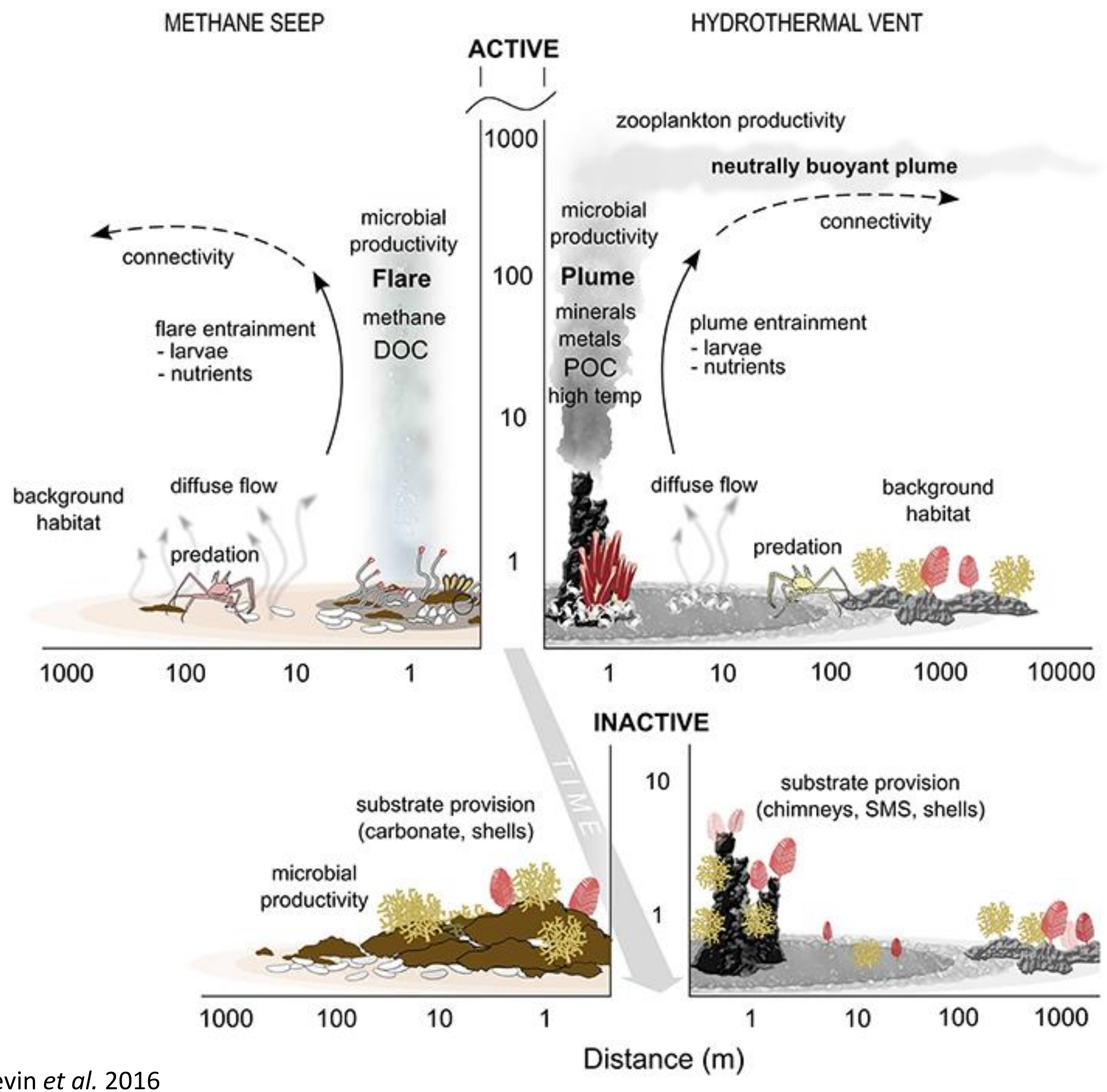
Overall: >10% of deep-sea benthic carbon flux could be derived from chemosynthesis

Mostly cold seeps (less intense production than vents, but more widespread)

Deep-sea chemosynthetic subsidies



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Overall: >10% of deep-sea benthic carbon flux could be derived from chemosynthesis

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Many things about the nature, occurrence or intensity of those subsidies are still unadequately understood…

About me

2022 - Present: Assistant professor at University of Liège, Belgium

2017 - 2022: Research scientist at Ifremer Brittany, Brest, France

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Research interests:

- How do food web structure and trophic interactions influence marine ecosystem functioning and biodiversity?
- How do natural or anthropogenic environmental variations impact animal feeding?
- How does ecological plasticity mediates marine consumers' response to change?

I mostly tackle those issues by using polar and deep-sea benthic invertebrates as ecological models, and by developing approaches based on trophic markers, notably stable isotopes.

Stable isotopes & hydrothermal vents: a long-lasting love story


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by Robert D. Ballard

Oceanus Vol. 20, No. 3, Summer 1977

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Influence of diet on the distribution of nitrogen isotopes in animals*

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Bacterial symbionts and low $^{13}C/^{12}C$ ratios in tissues of Pogonophora indicate unusual nutrition and metabolism

A. J. Southward*, Eve C. Southward*, P. R. Dando*, G. H. Rau†, H. Felbeck‡ & H. Flügel§

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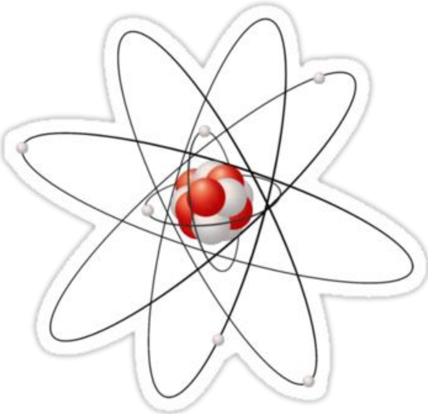
For 4 decades, stable isotopes have been instrumental to many findings about vent ecology… And still have much potential to offer!

Stable isotopes: you are what you eat

Stable isotope ratios in animals can be used as integrative trophic markers (indirect info on animal diet)



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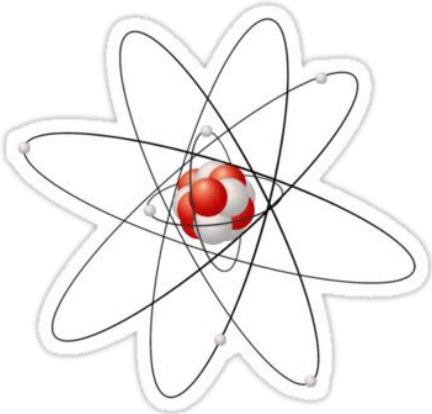
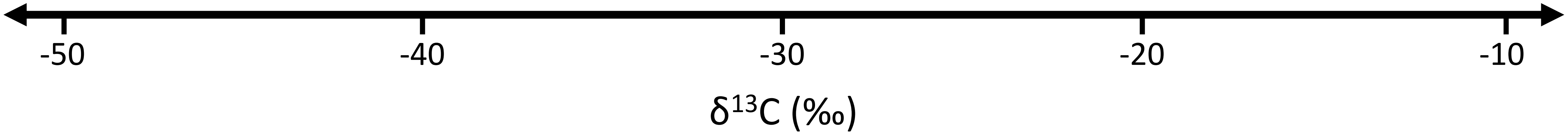


Mixing law: stable isotope composition of an animal is a proportional mix of its food sources' isotopic compositions

↓

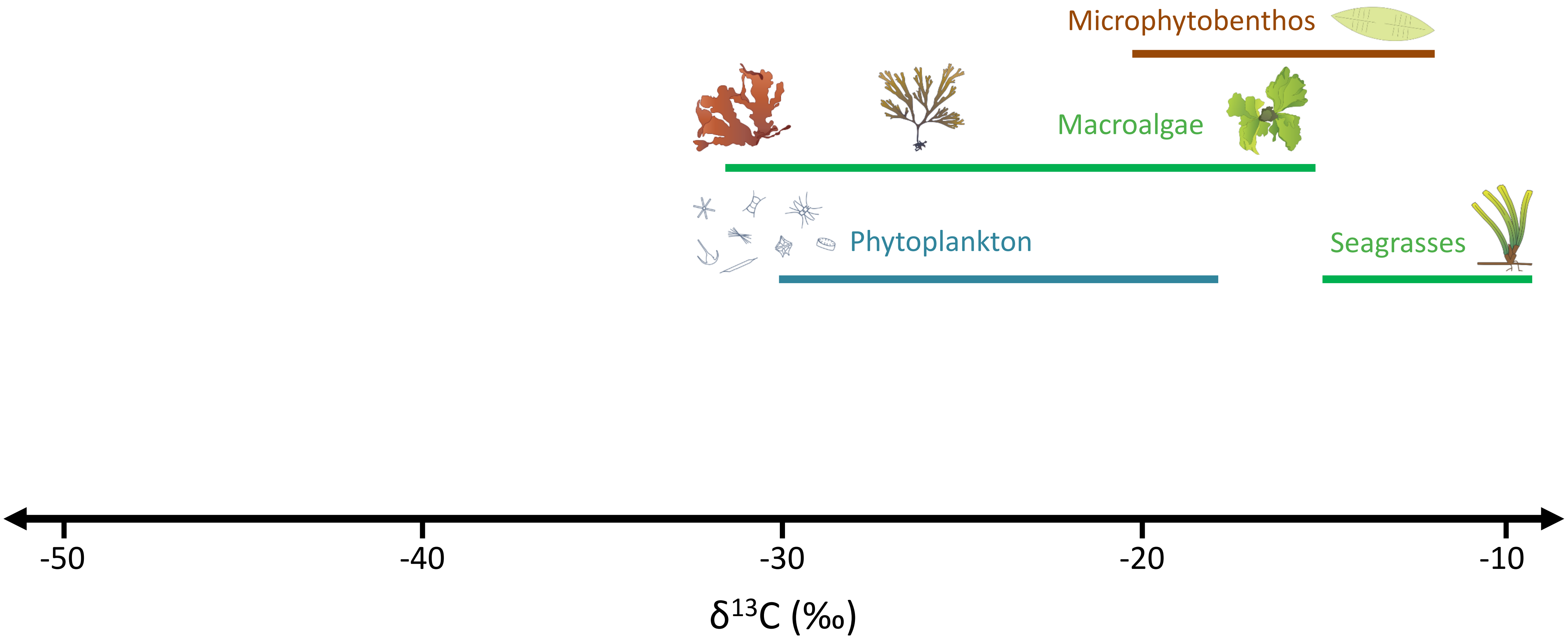
By measuring the isotopic compositions of an animal and those of its food sources, it is possible to estimate the contribution of each food source to the animal's diet

Carbon stable isotopes



$\delta^{13}C$ of marine producers is variable and mostly conserved throughout the food web

Carbon stable isotopes



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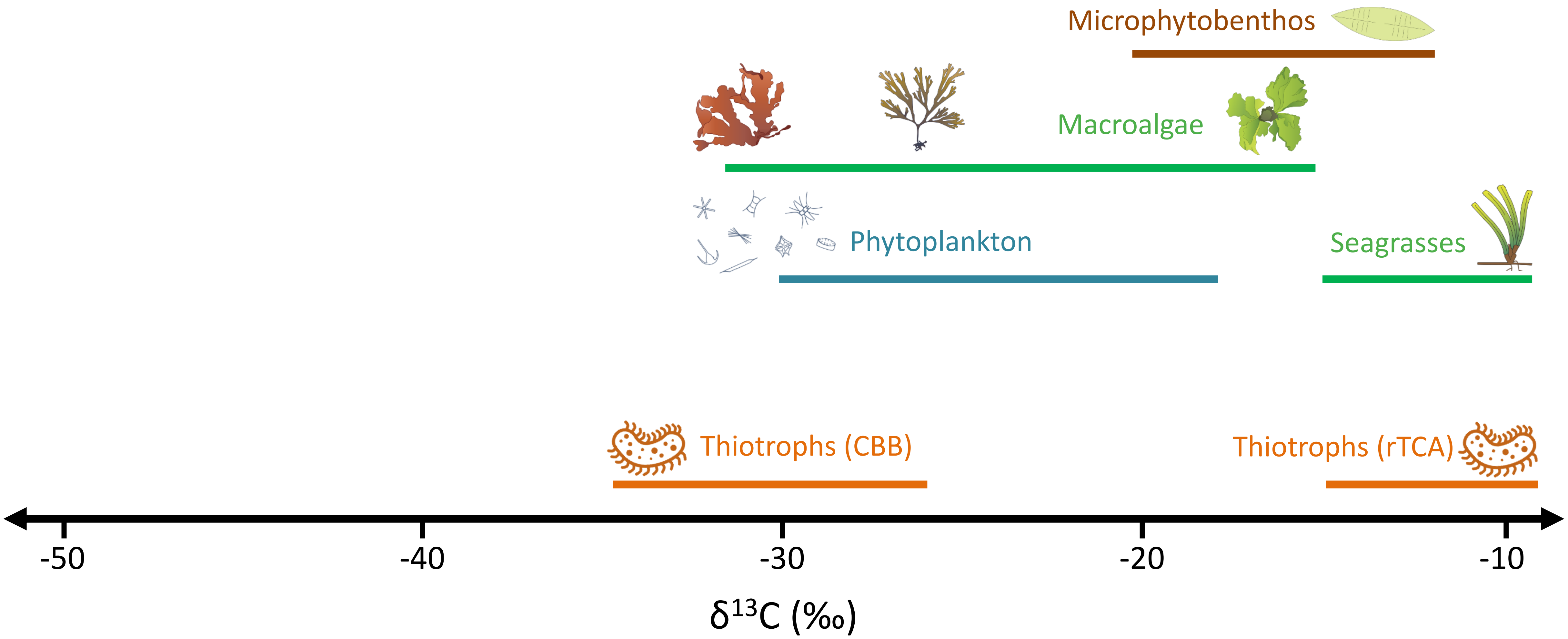

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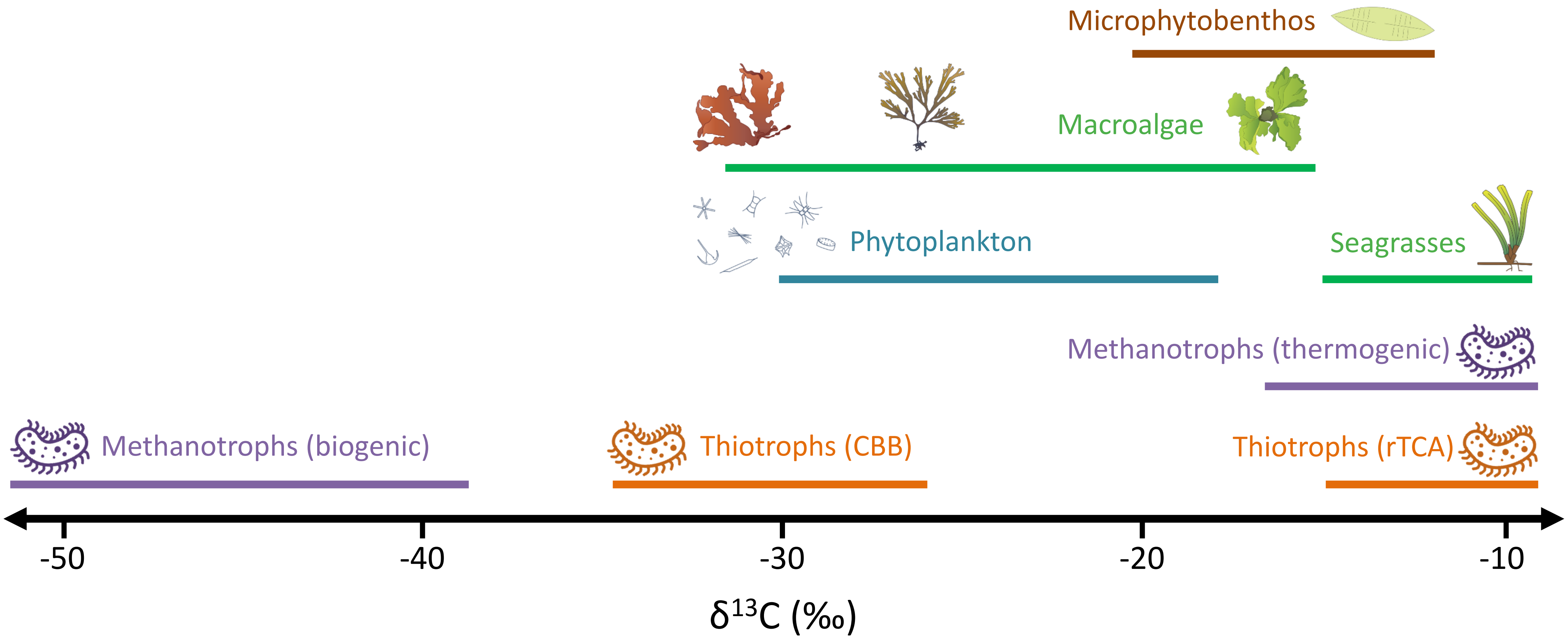

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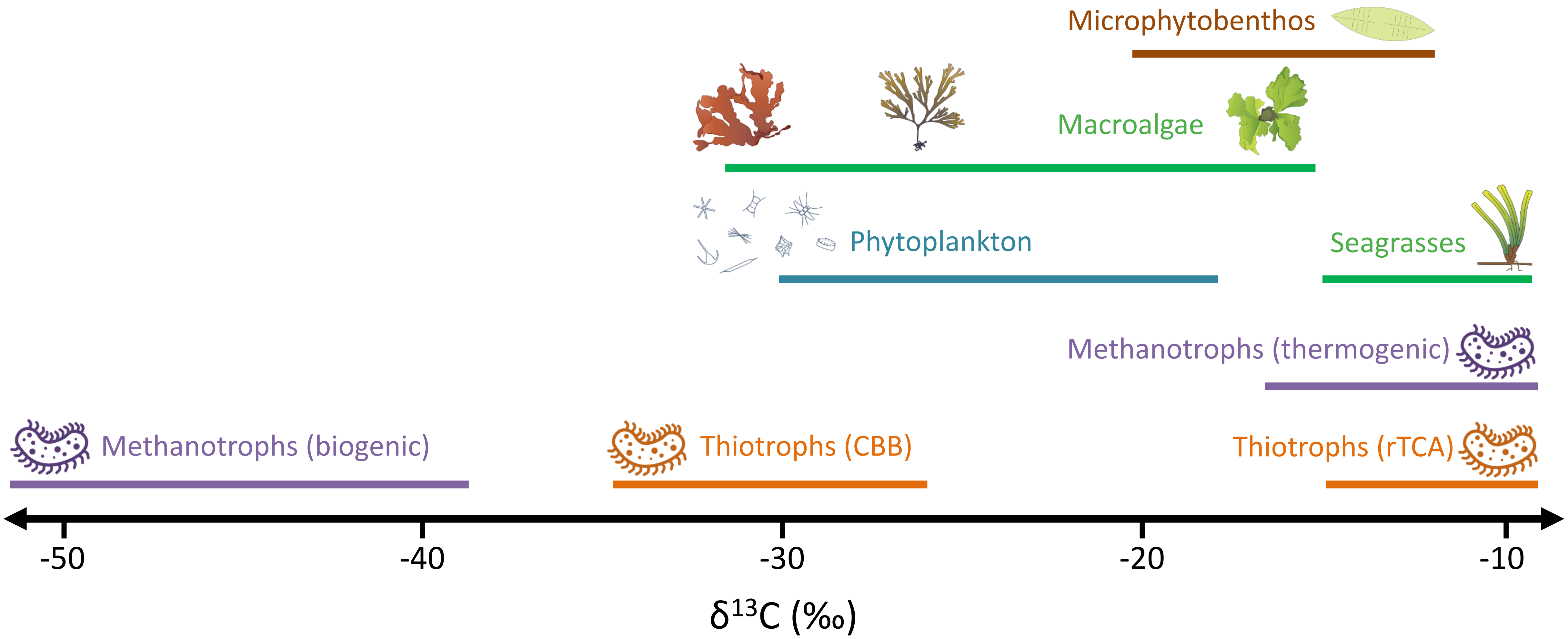


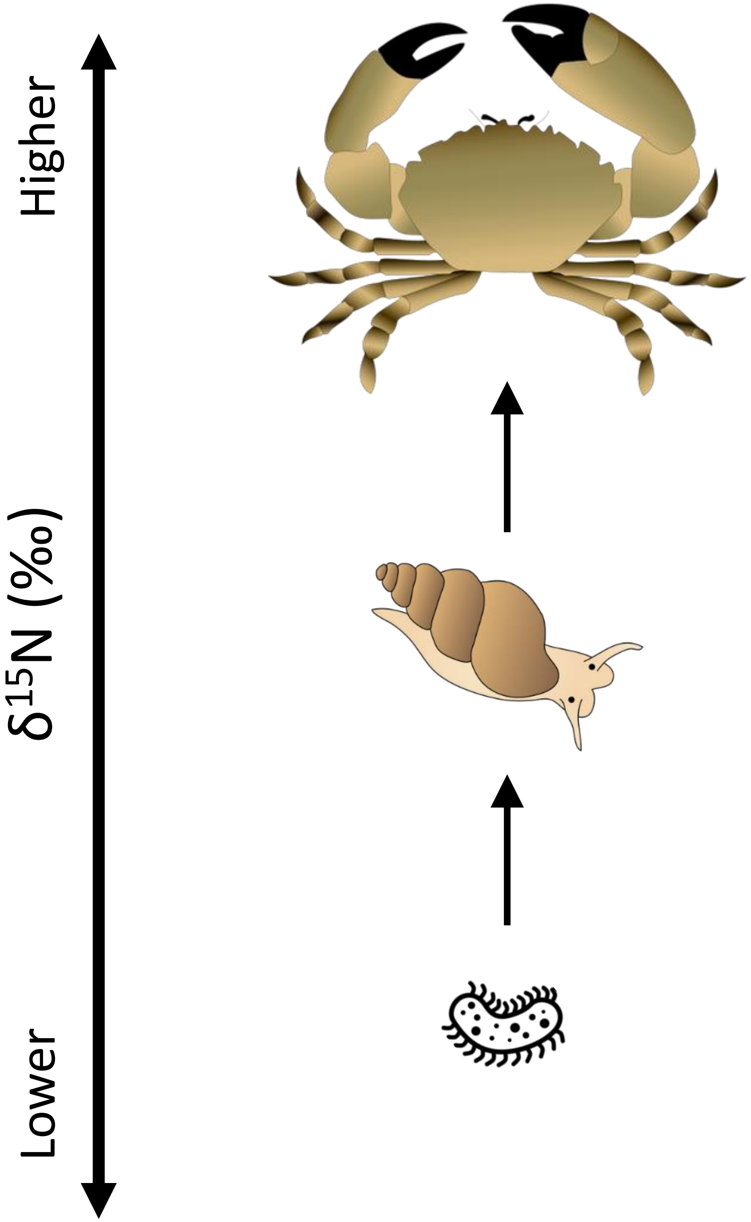
$\delta^{13}C$ of marine producers is variable and mostly conserved throughout the food web

$\delta^{13}C$ can be used to identify and quantify relative contributions of production mechanisms supporting animal populations in marine ecosystems

Nitrogen stable isotopes

Higher trophic position

Lower trophic position



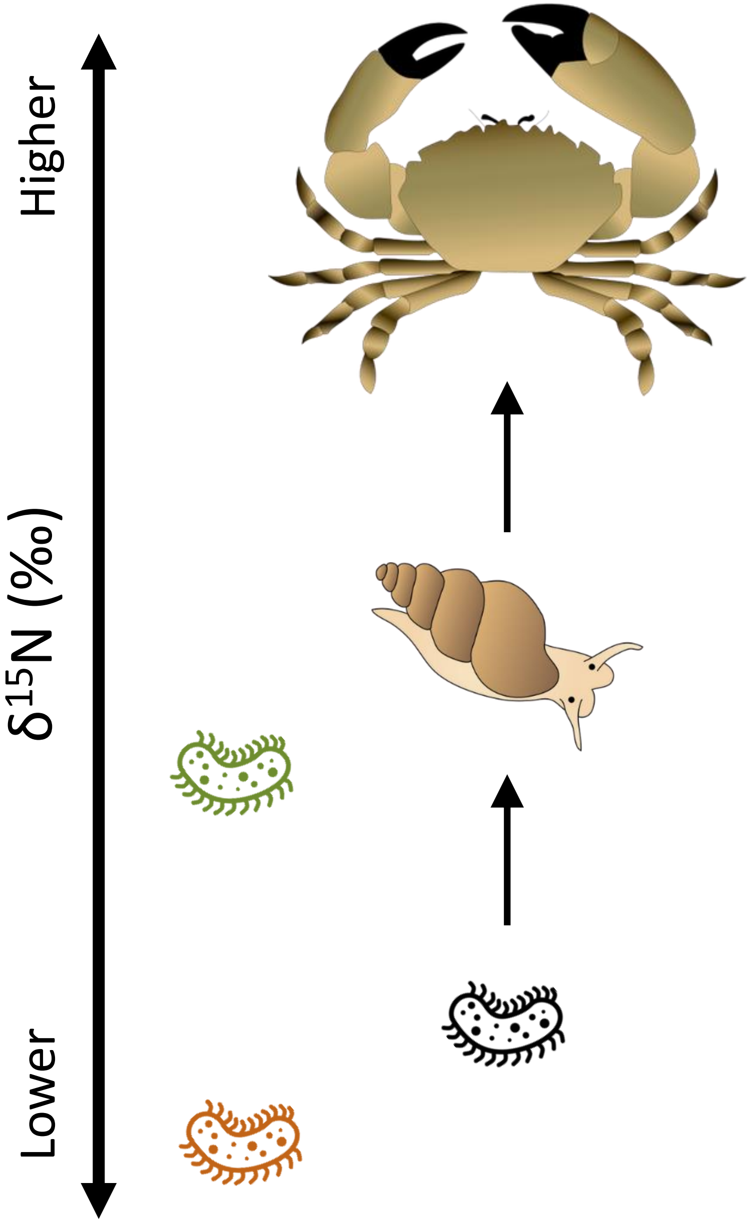
Nitrogen stable isotopes

Higher trophic position

Producers using NO_3^-

Lower trophic position

Producers using NH_4^+



Nitrogen stable isotopes

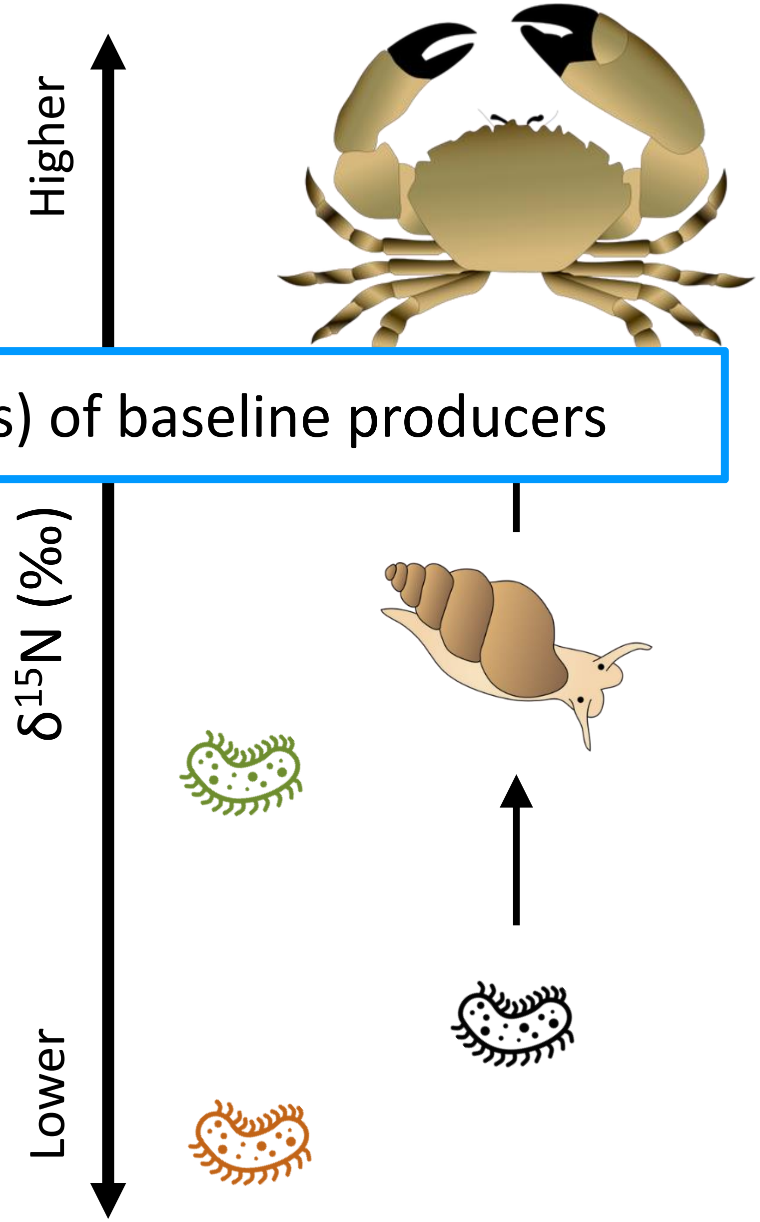
Higher trophic position

$\delta^{15}N$: tracer of trophic position + inorganic nitrogen source(s) of baseline producers

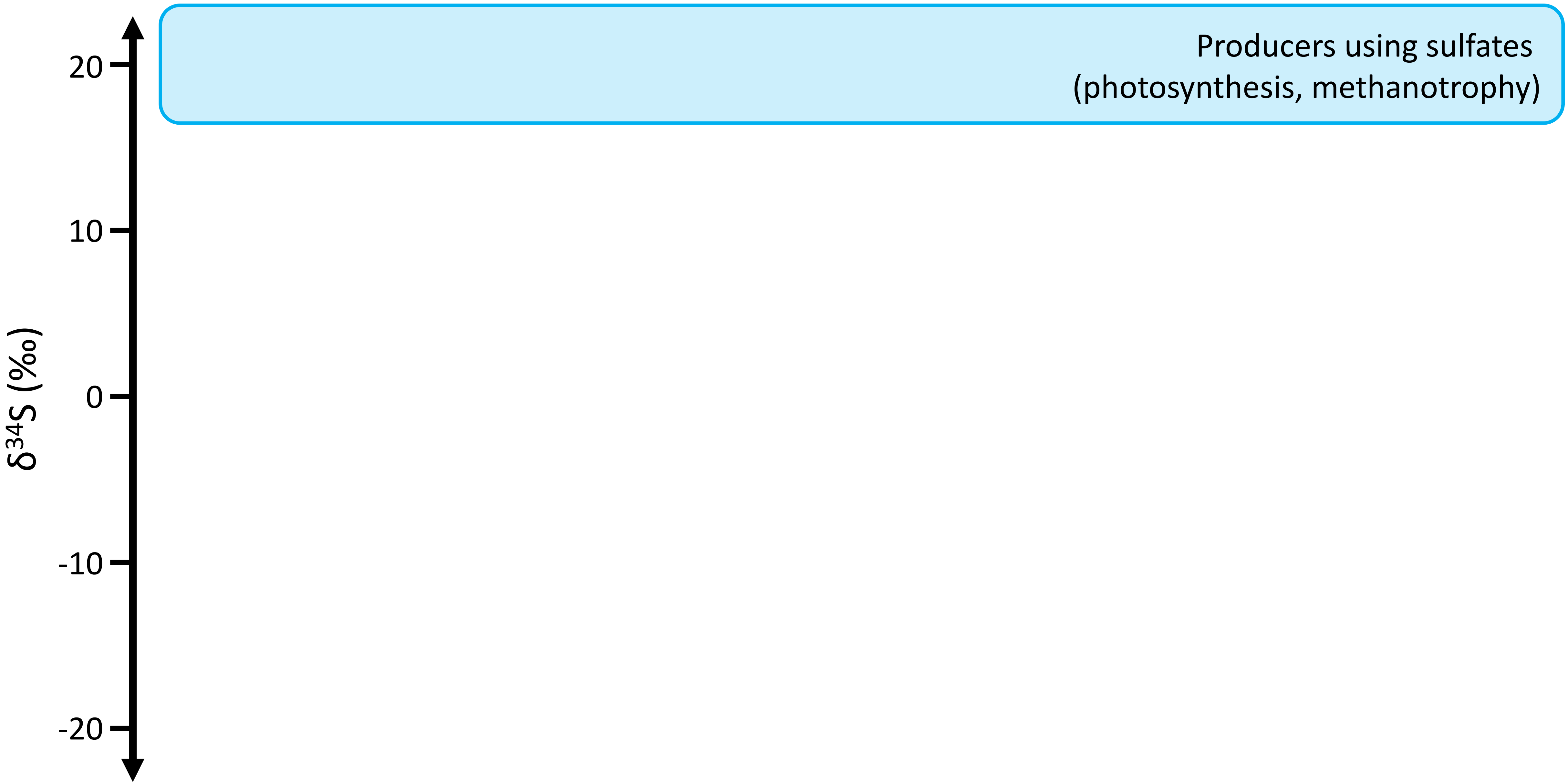
Producers using NO_3^-

Lower trophic position

Producers using NH_4^+



Sulfur stable isotopes



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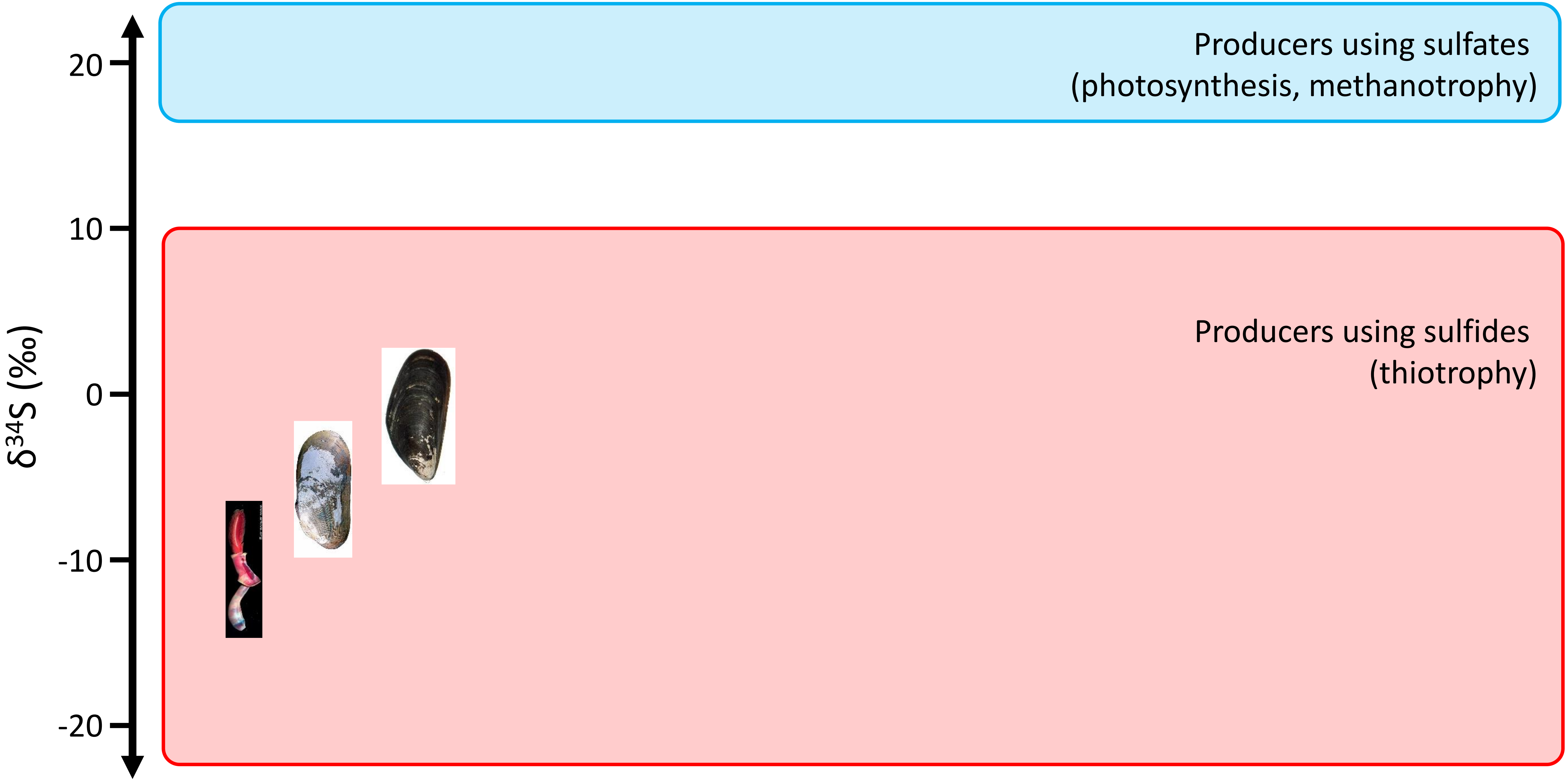

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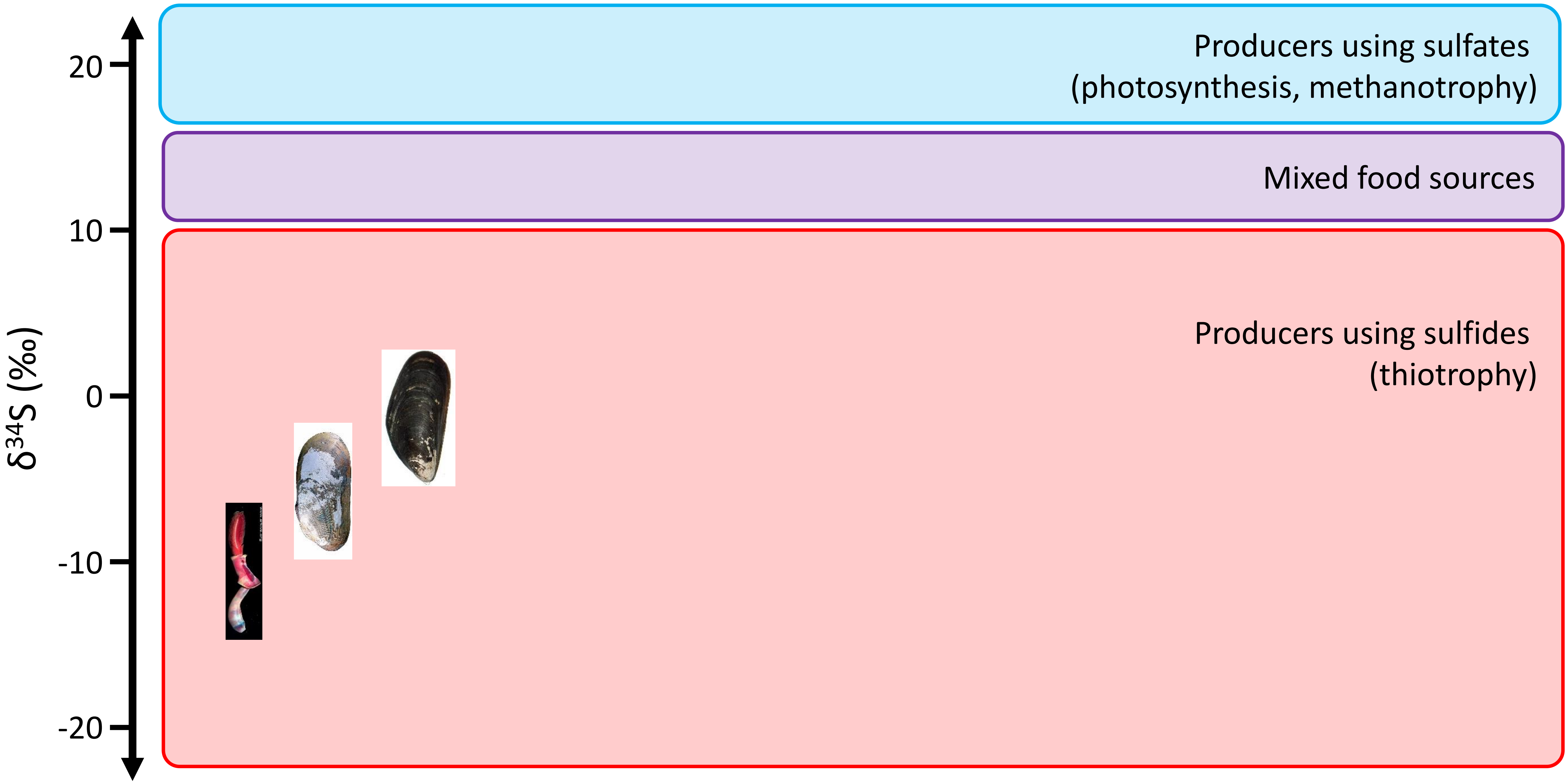

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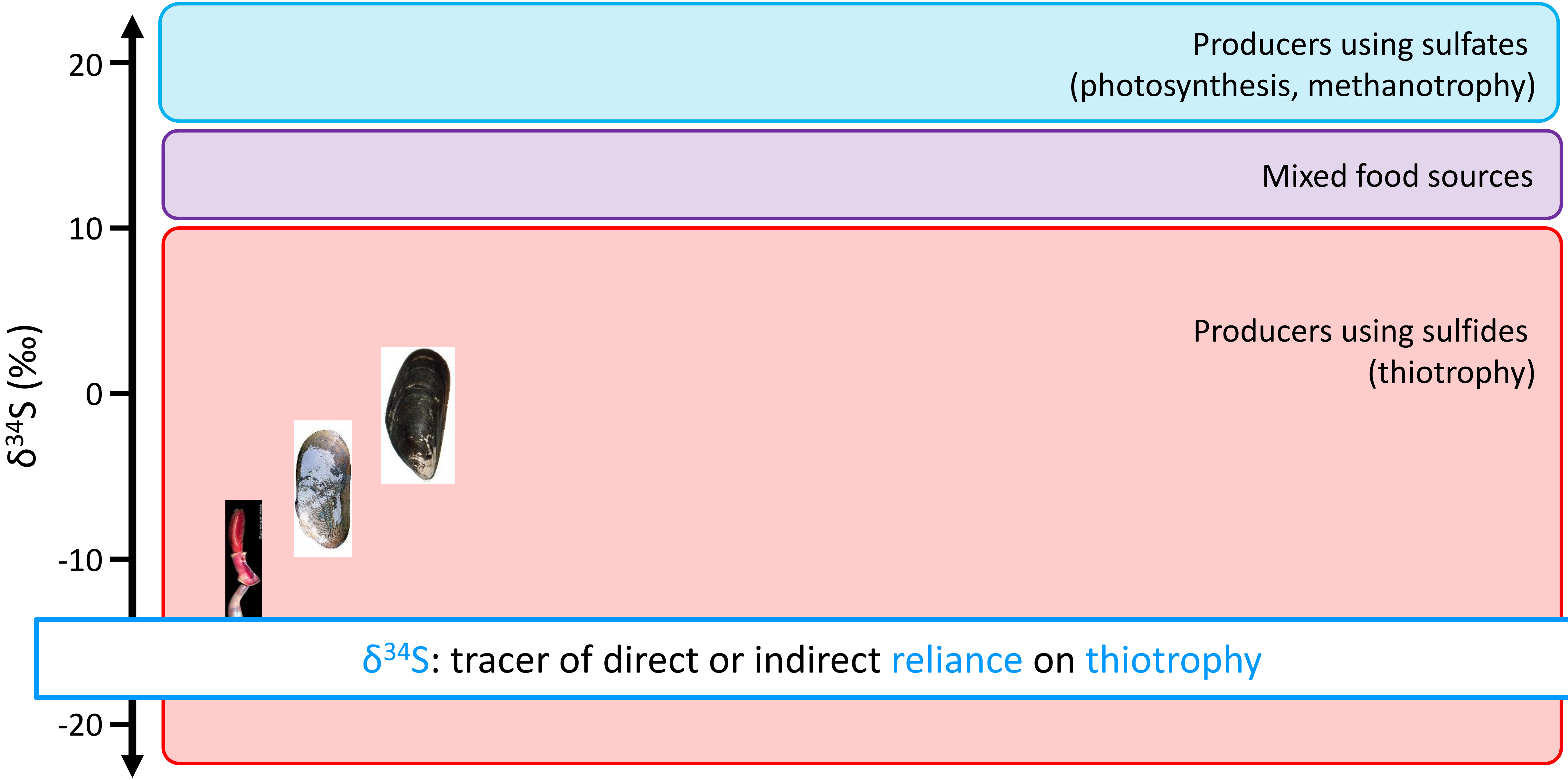
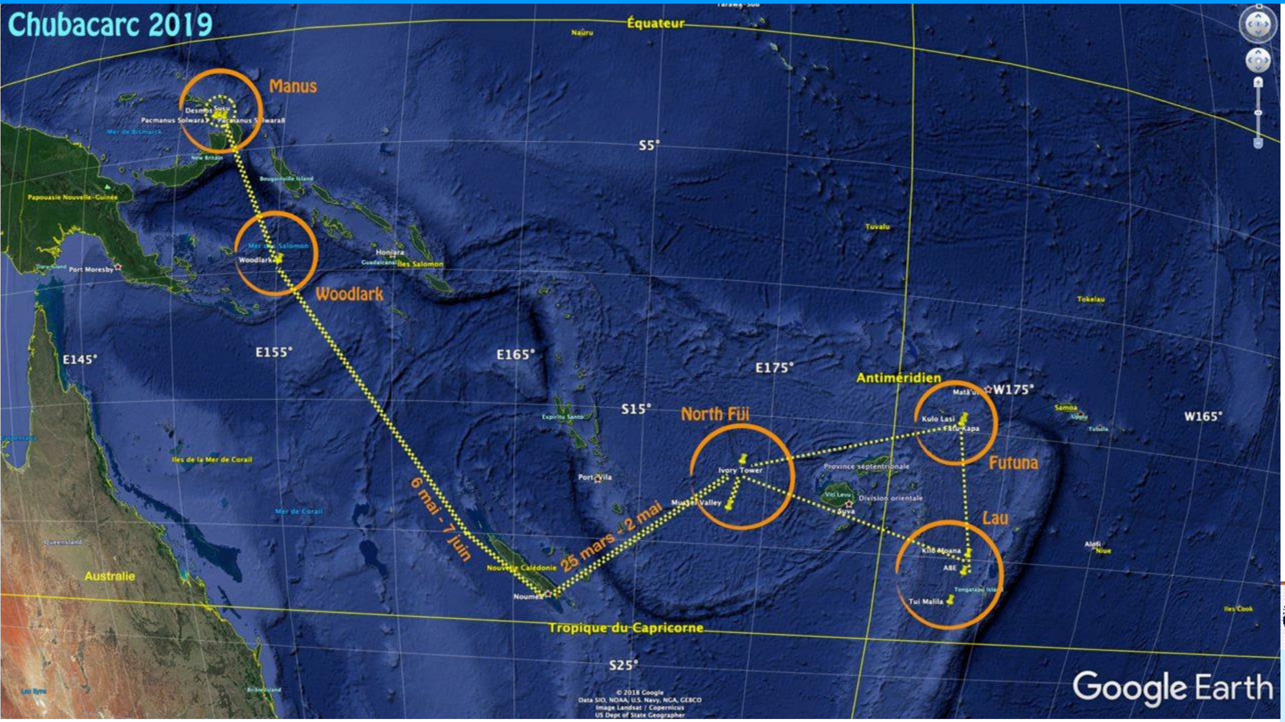


$\delta^{34}S$: tracer of direct or indirect reliance on thiotrophy

A food web example : Woodlark Basin



Chubacarc cruise: connectivity and regional patterns of biodiversity in back-arc basins of Western Pacific

Hourdez & Jollivet (2019): https://doi.org/10.17600/18001111

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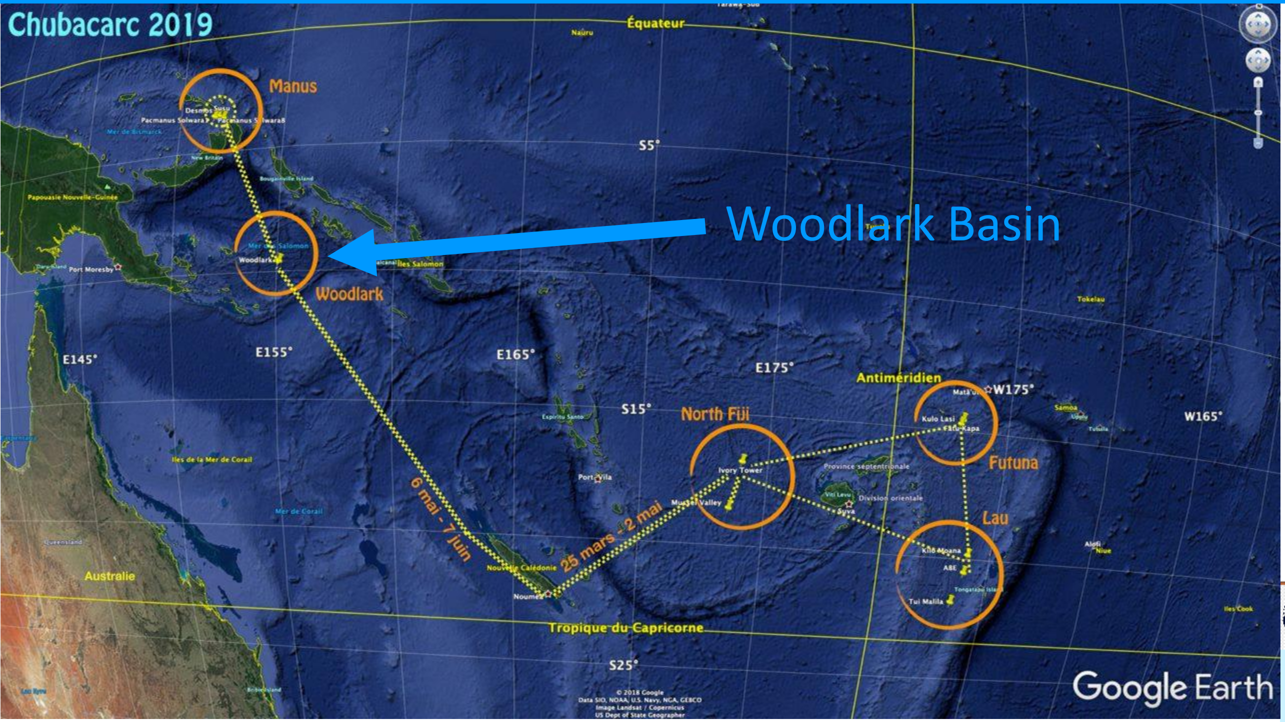

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La Scala vent field, Woodlark Basin

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earth & environment

ARTICLE

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https://doi.org/10.1038/s43247-022-00387-9 OPEN

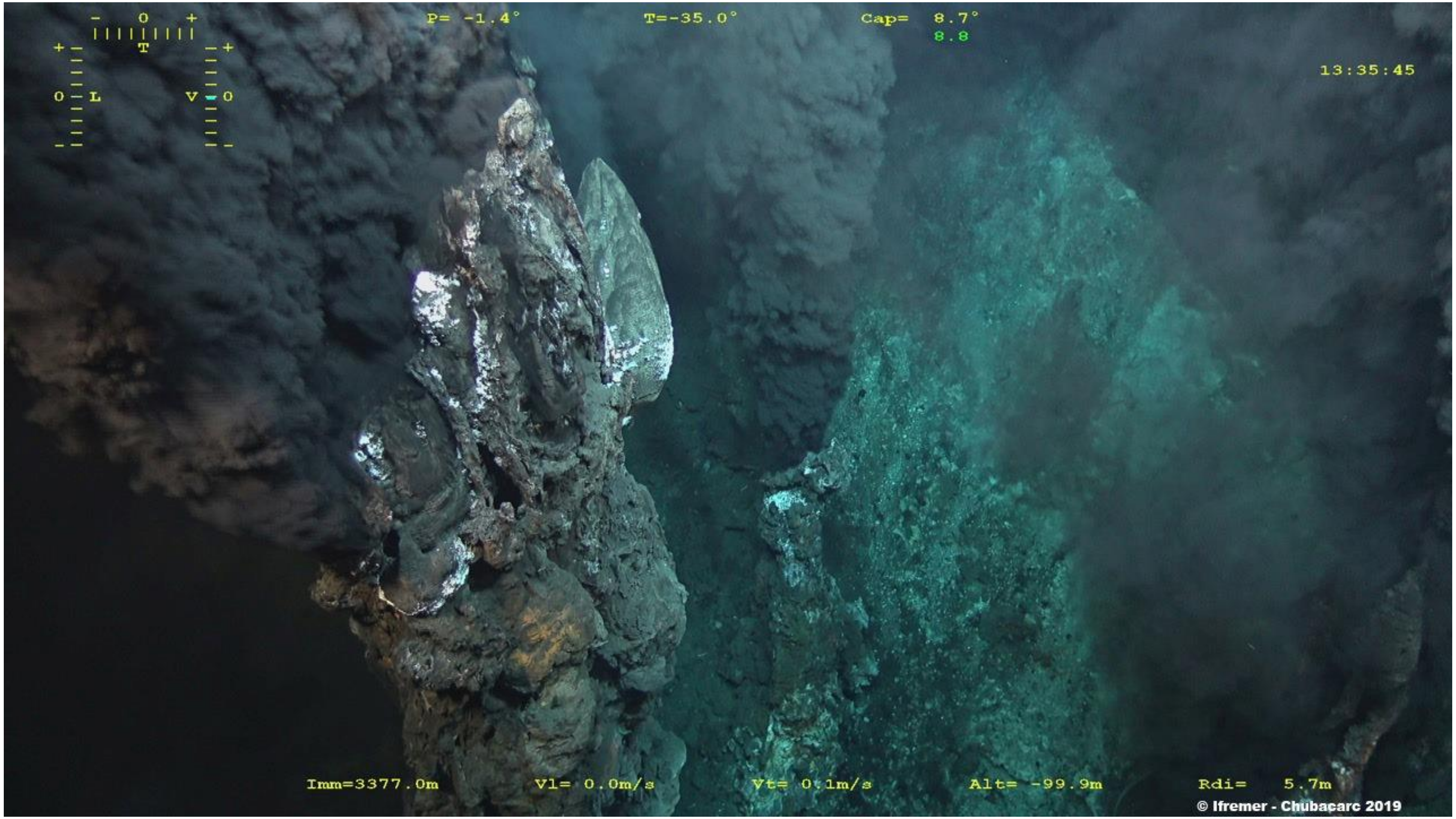
Active hydrothermal vents in the Woodlark Basin may act as dispersing centres for hydrothermal fauna

Cédric Boulart[1✉], Olivier Rouxel[2], Carla Scalabrin[2], Pierre Le Meur[3], Ewan Pelleter[2], Camille Poitrimol[1,4], Eric Thiébaut[1], Marjolaine Matabos[4], Jade Castel[1], Adrien Tran Lu Y[5,6], Loic N. Michel[4], Cécile Cathalot[2], Sandrine Chéron[2], Audrey Boissier[2], Yoan Germain[2], Vivien Guyader[2], Sophie Arnaud-Haond[7], François Bonhomme[5], Thomas Broquet[1], Valérie Cueff-Gauchard[8], Victor Le Layec[1,6], Stéphane L'Haridon[8], Jean Mary[1], Anne-Sophie Le Port[1], Aurélie Tasiemski[9], Darren C. Kuama[10], Stéphane Hourdez[6] & Didier Jollivet[1]

Open access paper: https://doi.org/10.1038/s43247-022-00387-9

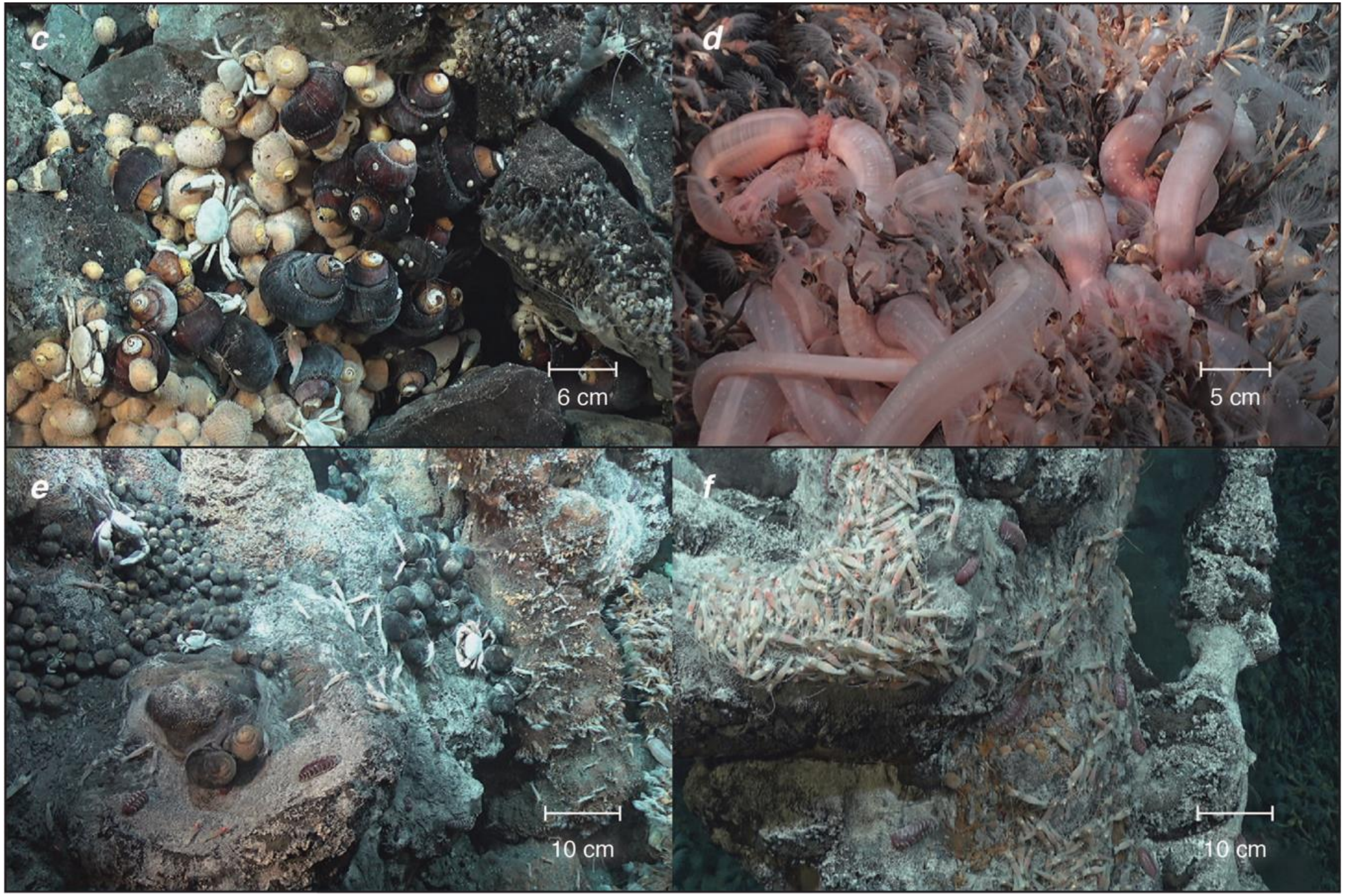
La Scala vent field, Woodlark Basin

Discovery of several active smokers, depth ≈ 3400 m

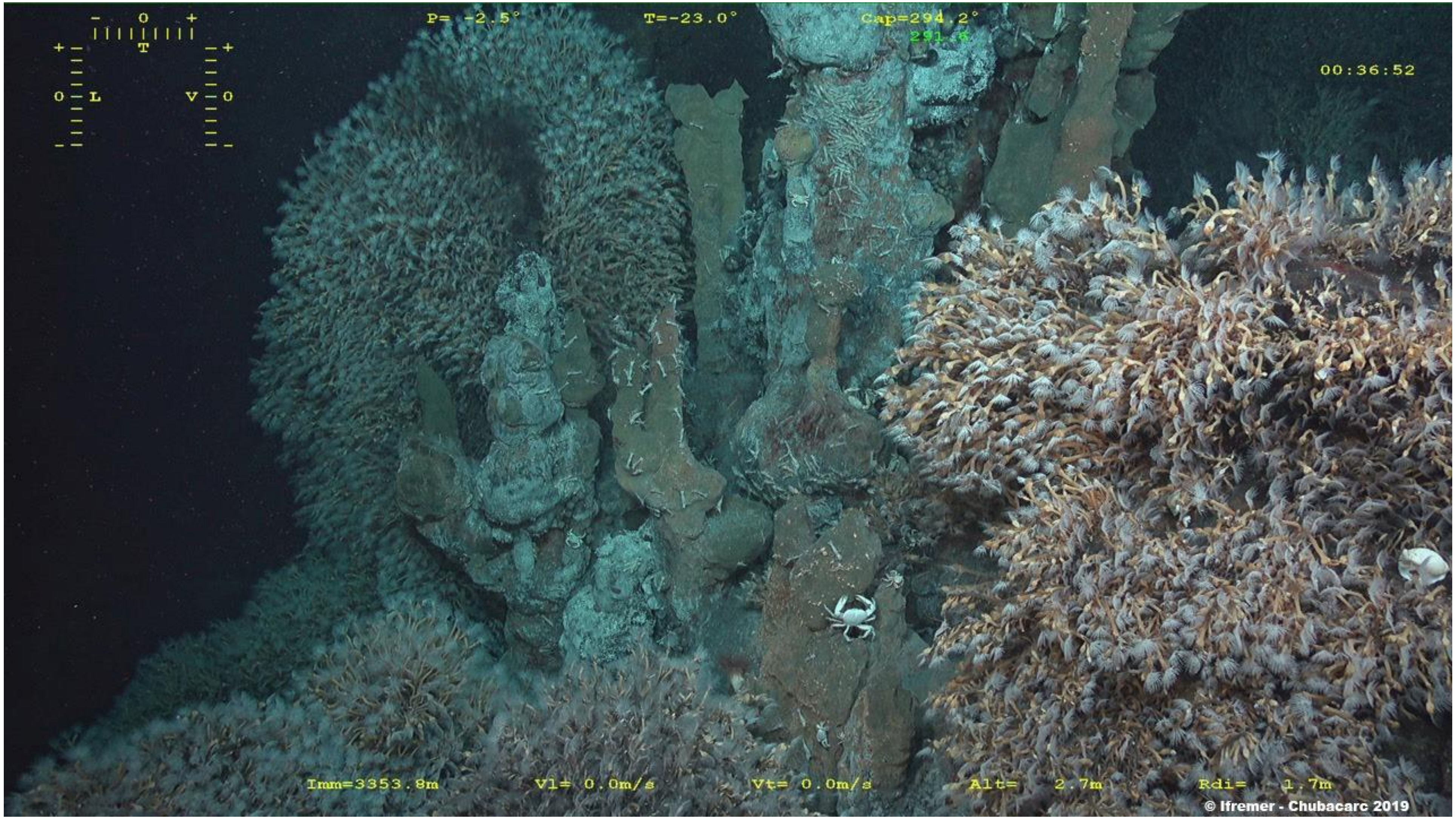


La Scala vent field, Woodlark Basin

Close to active chimneys: communities dominated by symbiont-bearing gastropods that act as foundation species



La Scala vent field, Woodlark Basin

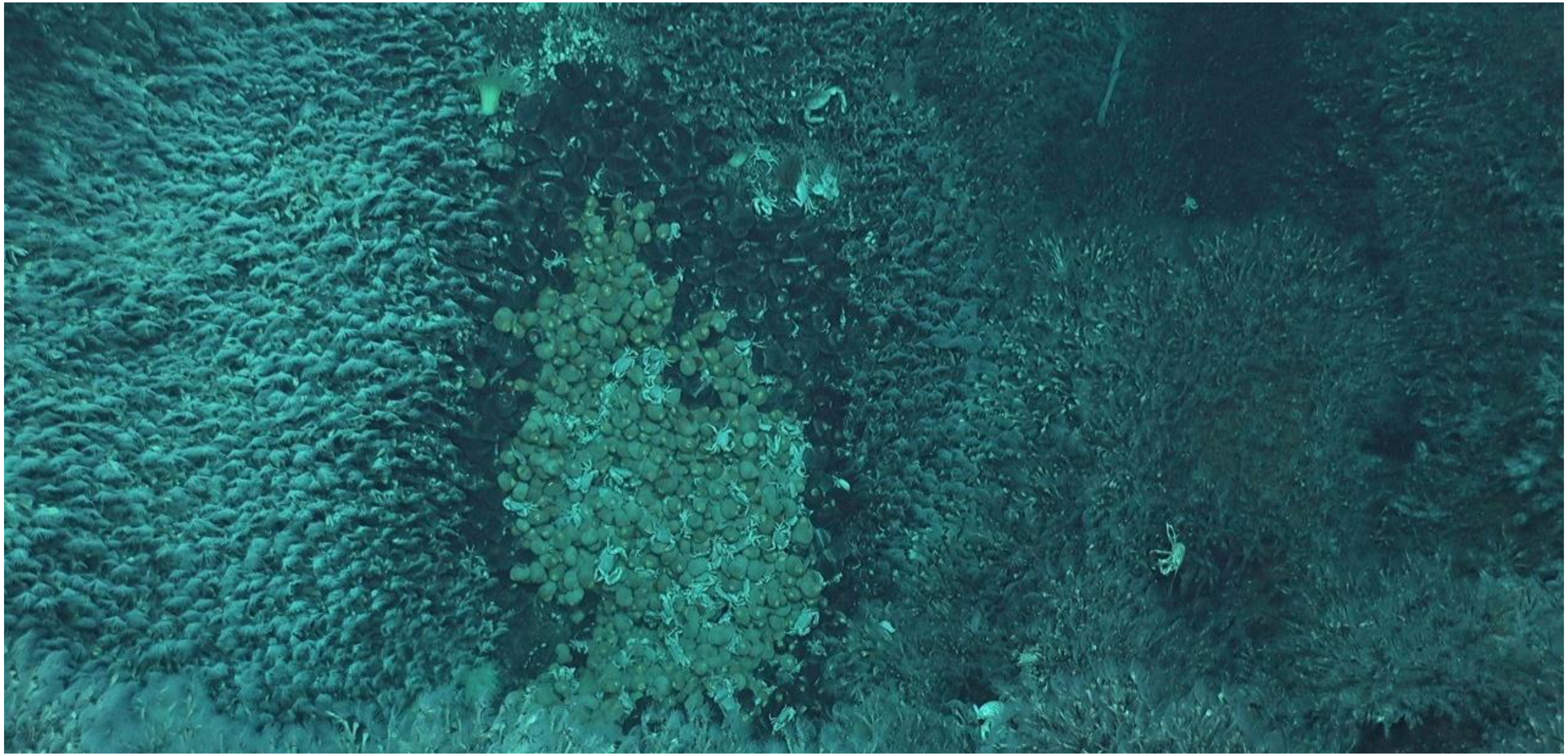


On inactive chimneys and peripheral zones: dense cirriped bushes

Not typical of SW Pacific hydrothermal vents, but described in nearby oceanic trenches (e.g. Tonga)

La Scala vent field, Woodlark Basin

Document functional ecology of this newly discovered system



La Scala vent field, Woodlark Basin

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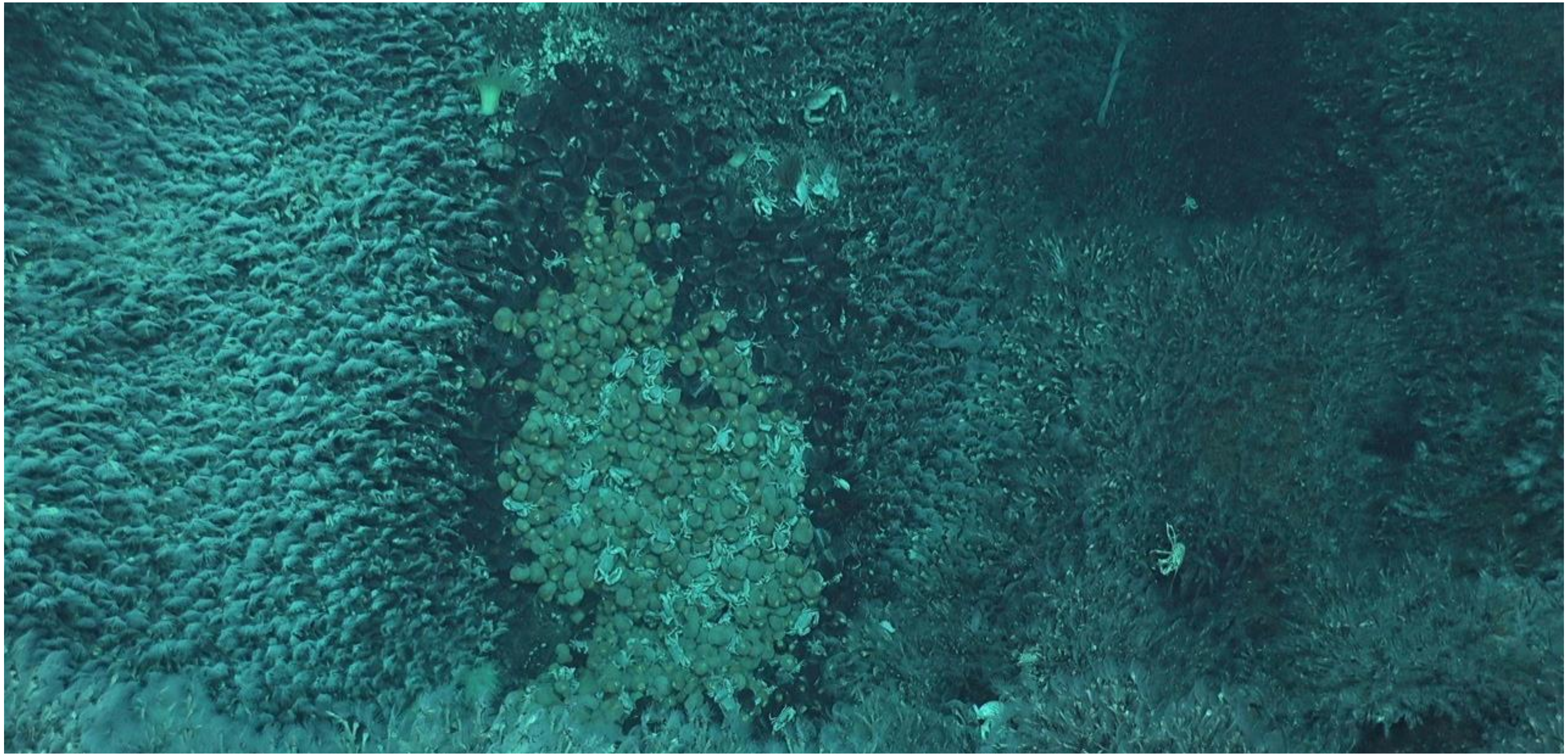
Identify main production pathways supporting animal populations

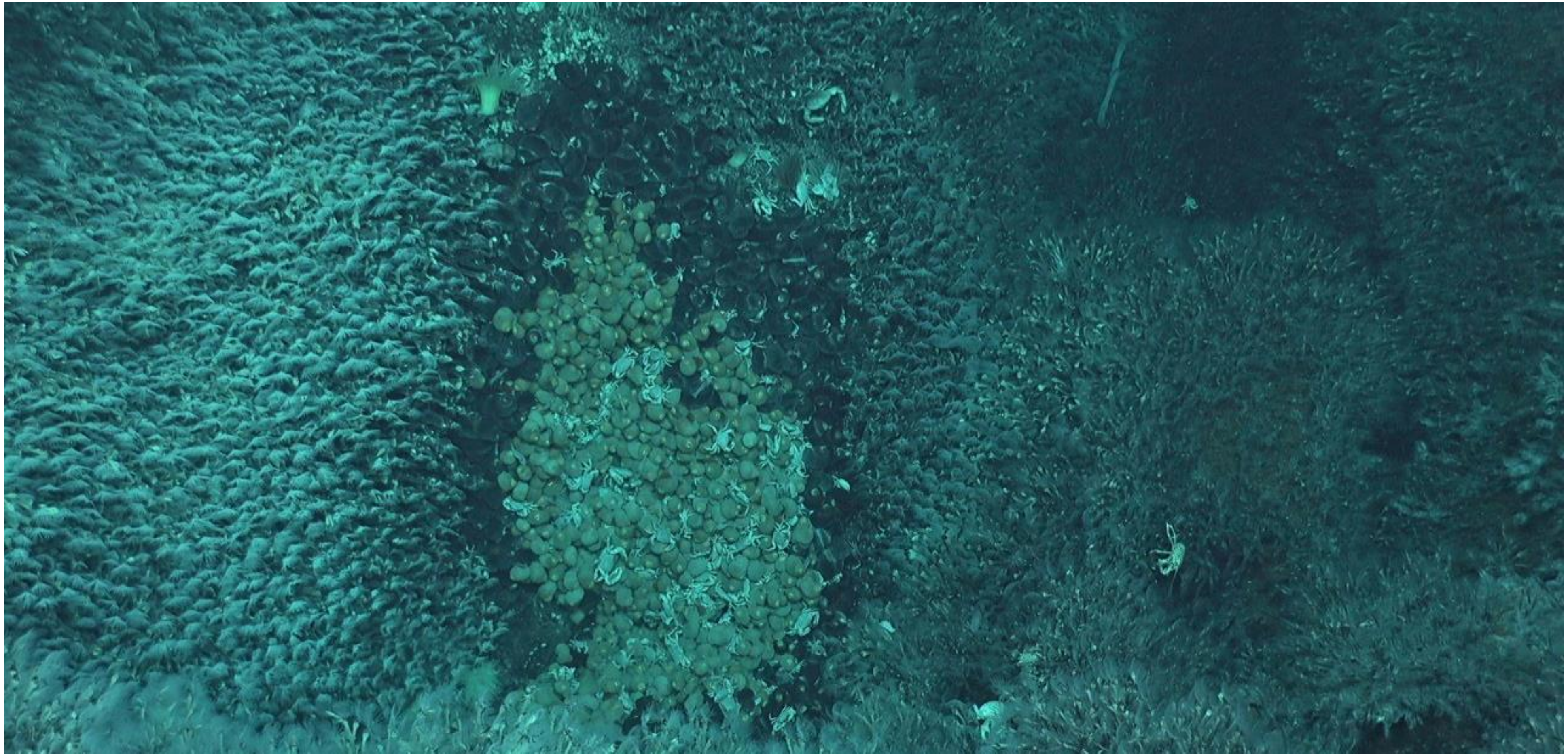


La Scala vent field, Woodlark Basin

Document functional ecology of this newly discovered system

Identify main production pathways supporting animal populations

Assess potential energy fluxes between active sites and inactive, peripheral habitats



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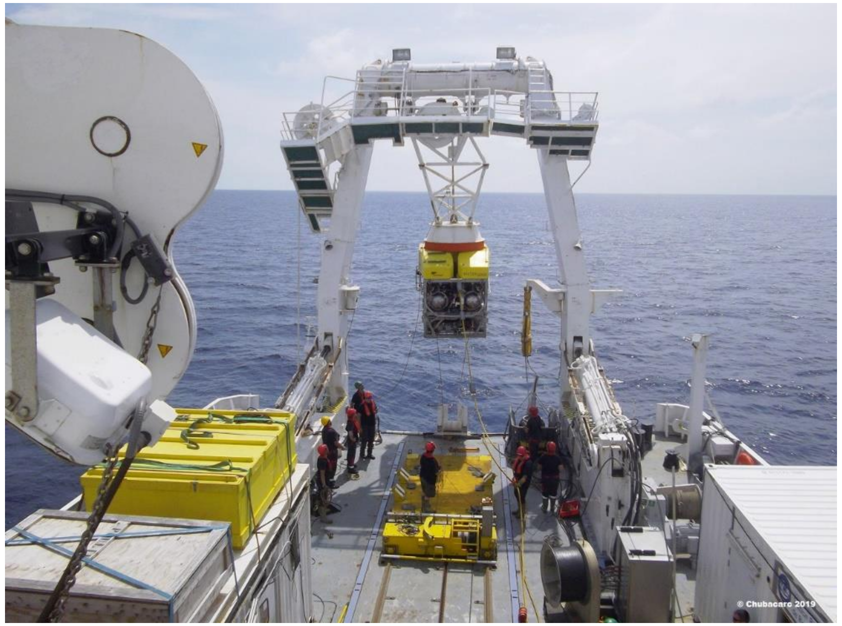

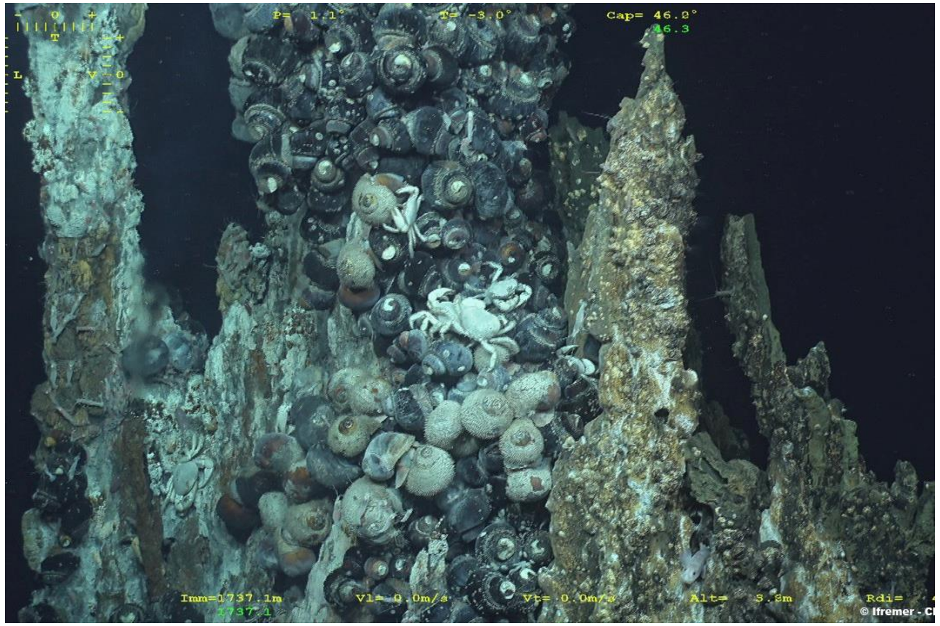

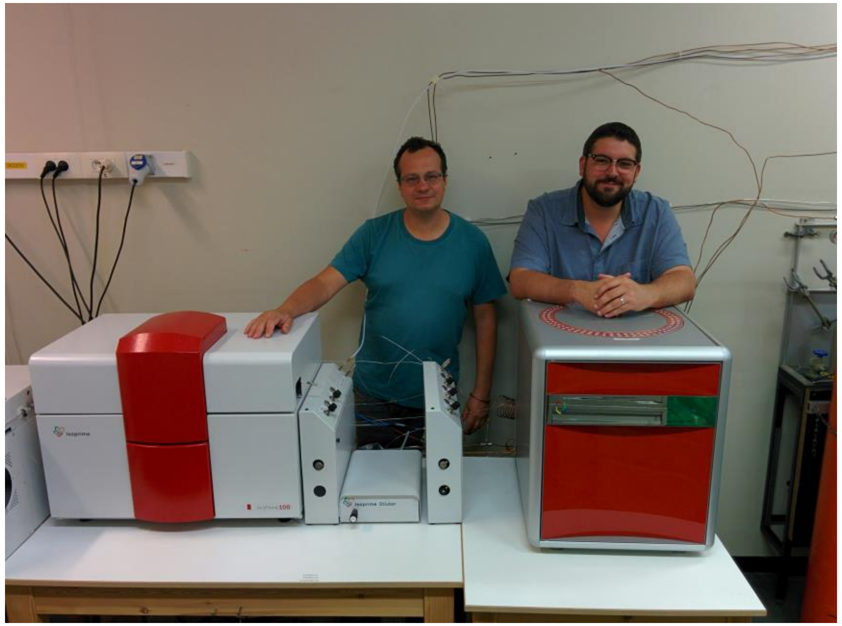

ROV sampling of biomass-dominant benthic fauna

Dissection and extraction of relevant tissues

Use of stable isotope ratios of C, N and S

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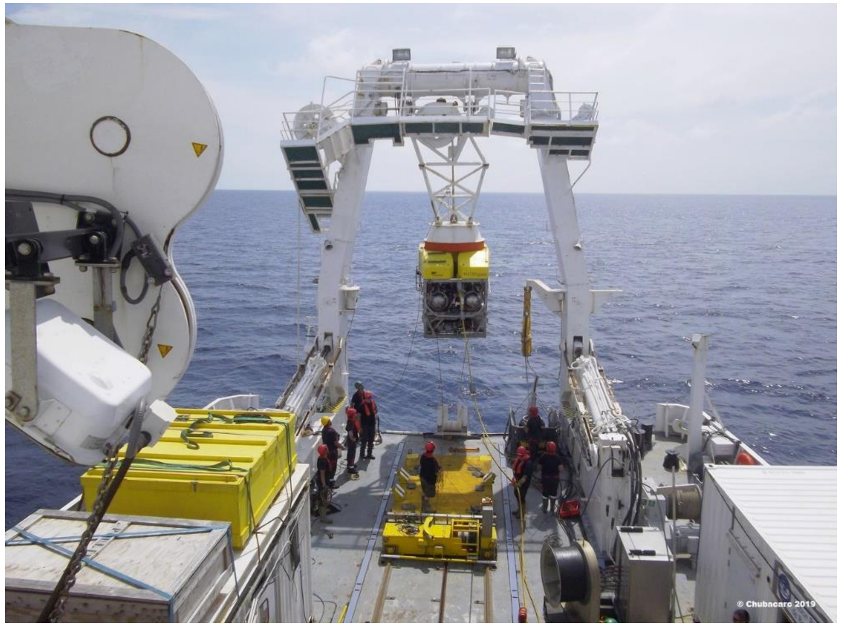

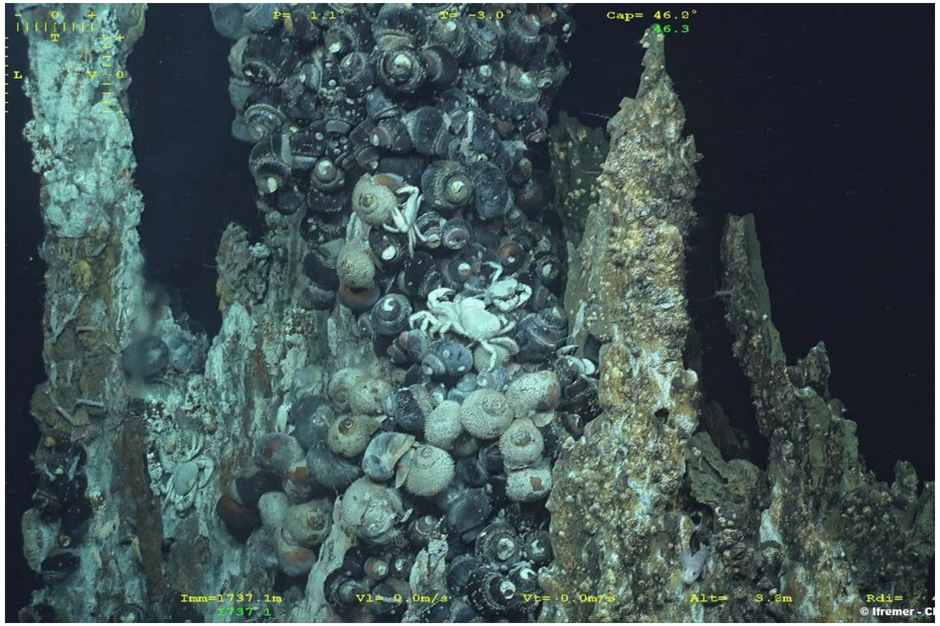

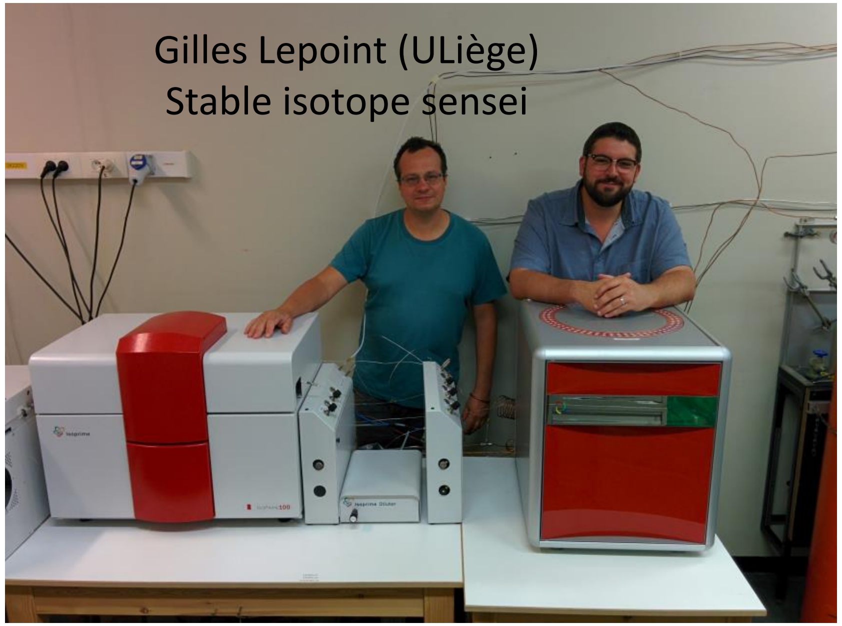

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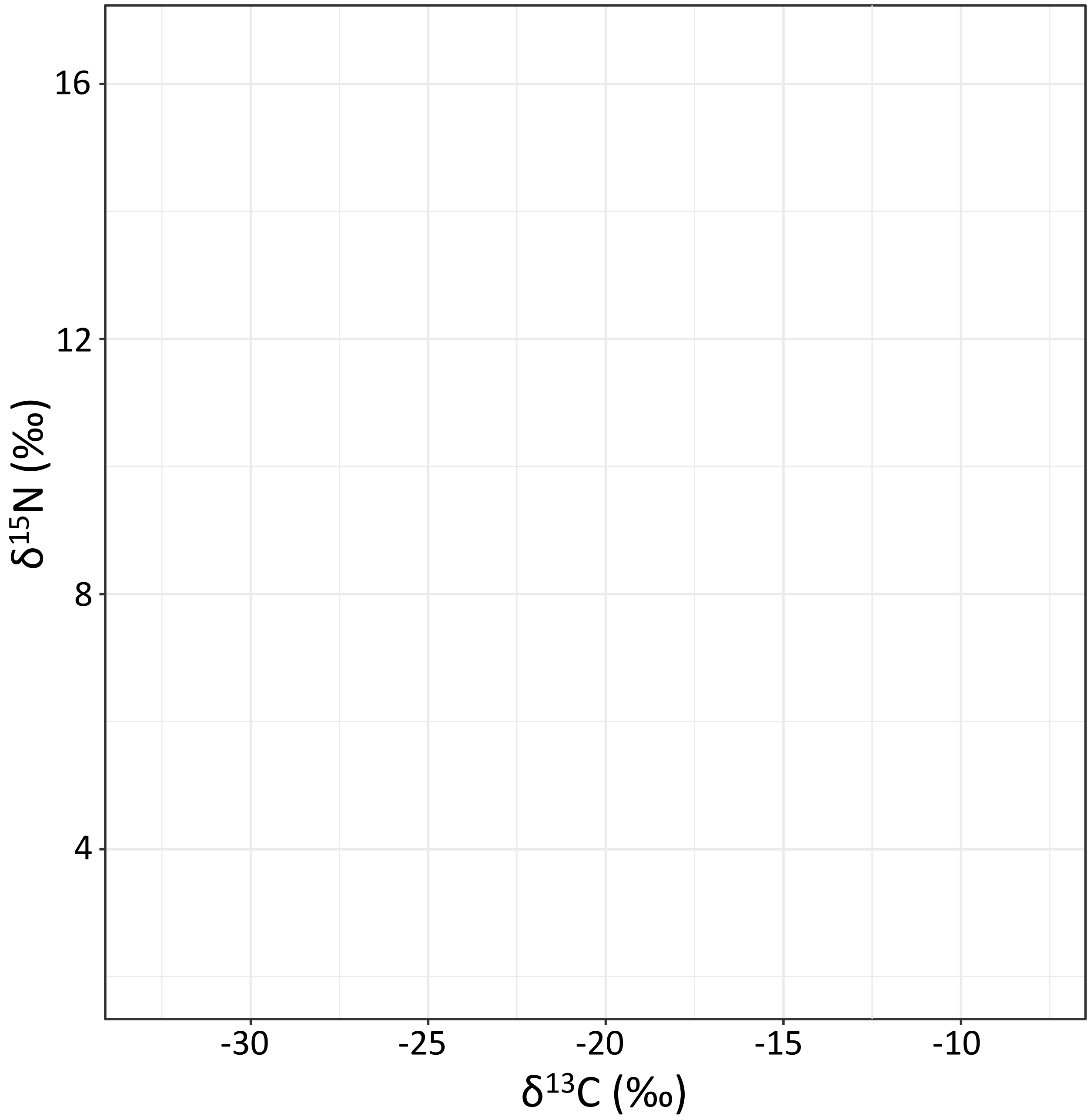
Food web structure: La Scala (Woodlark basin)



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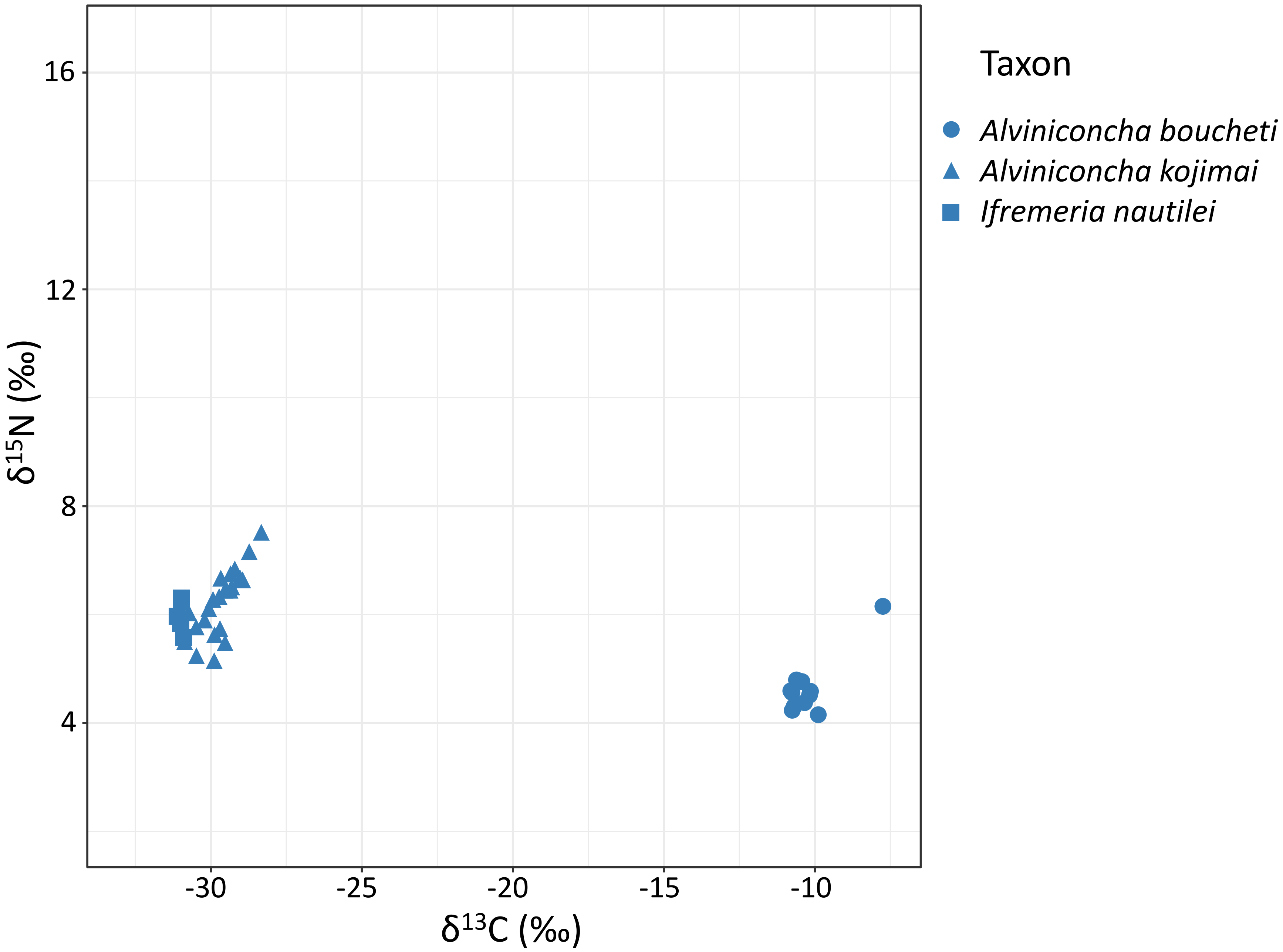
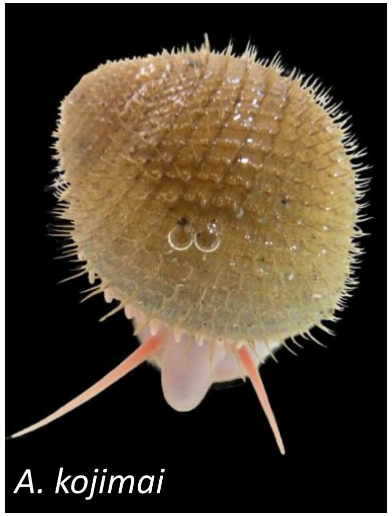
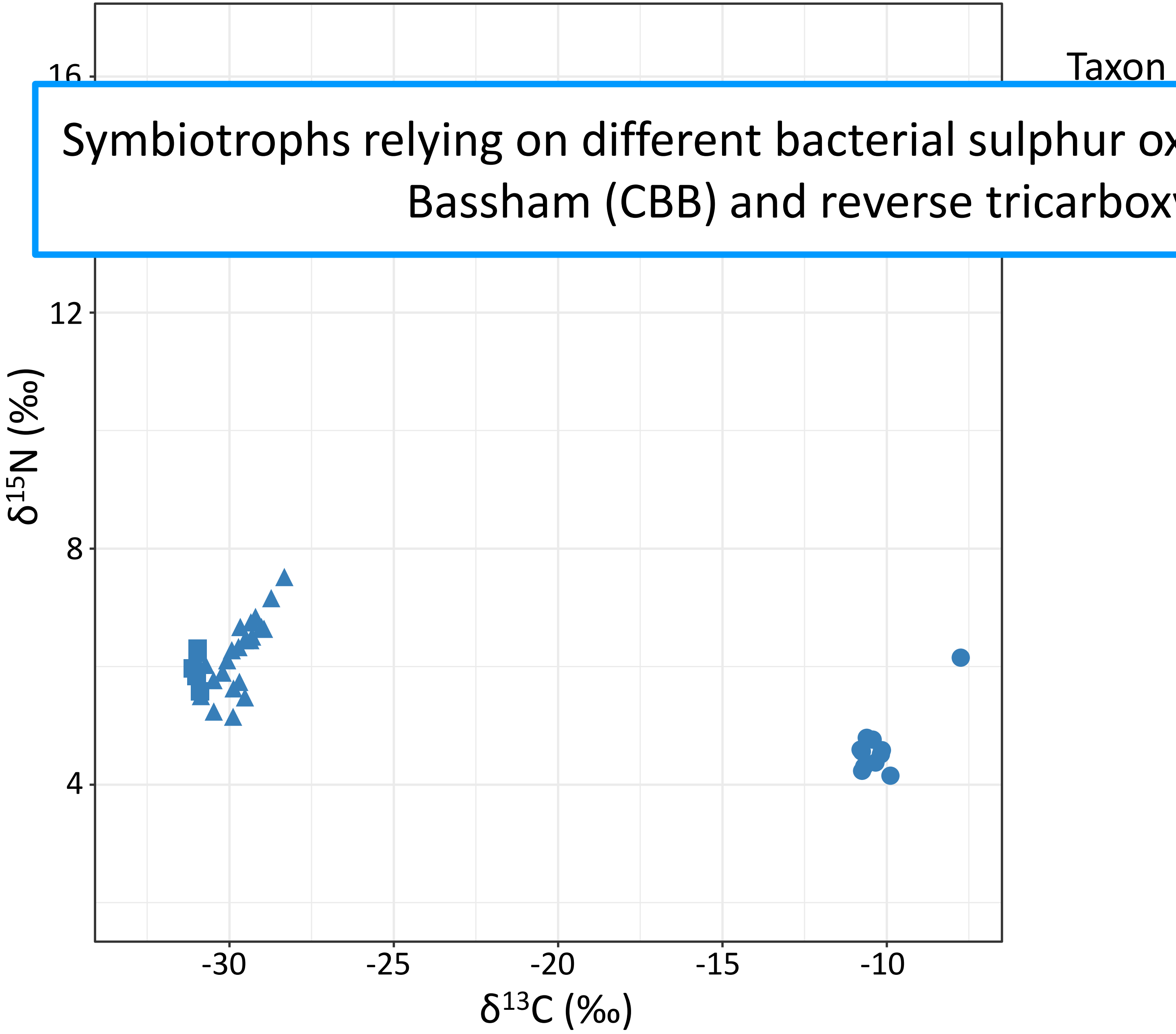
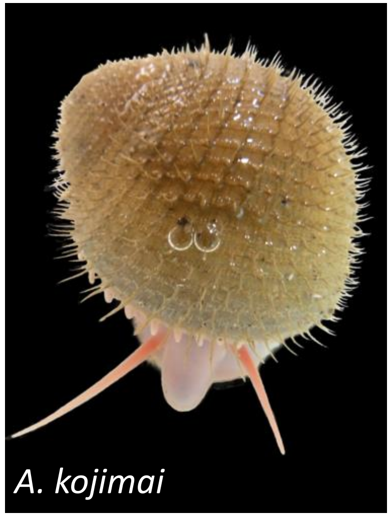




Food web structure: La Scala (Woodlark basin)

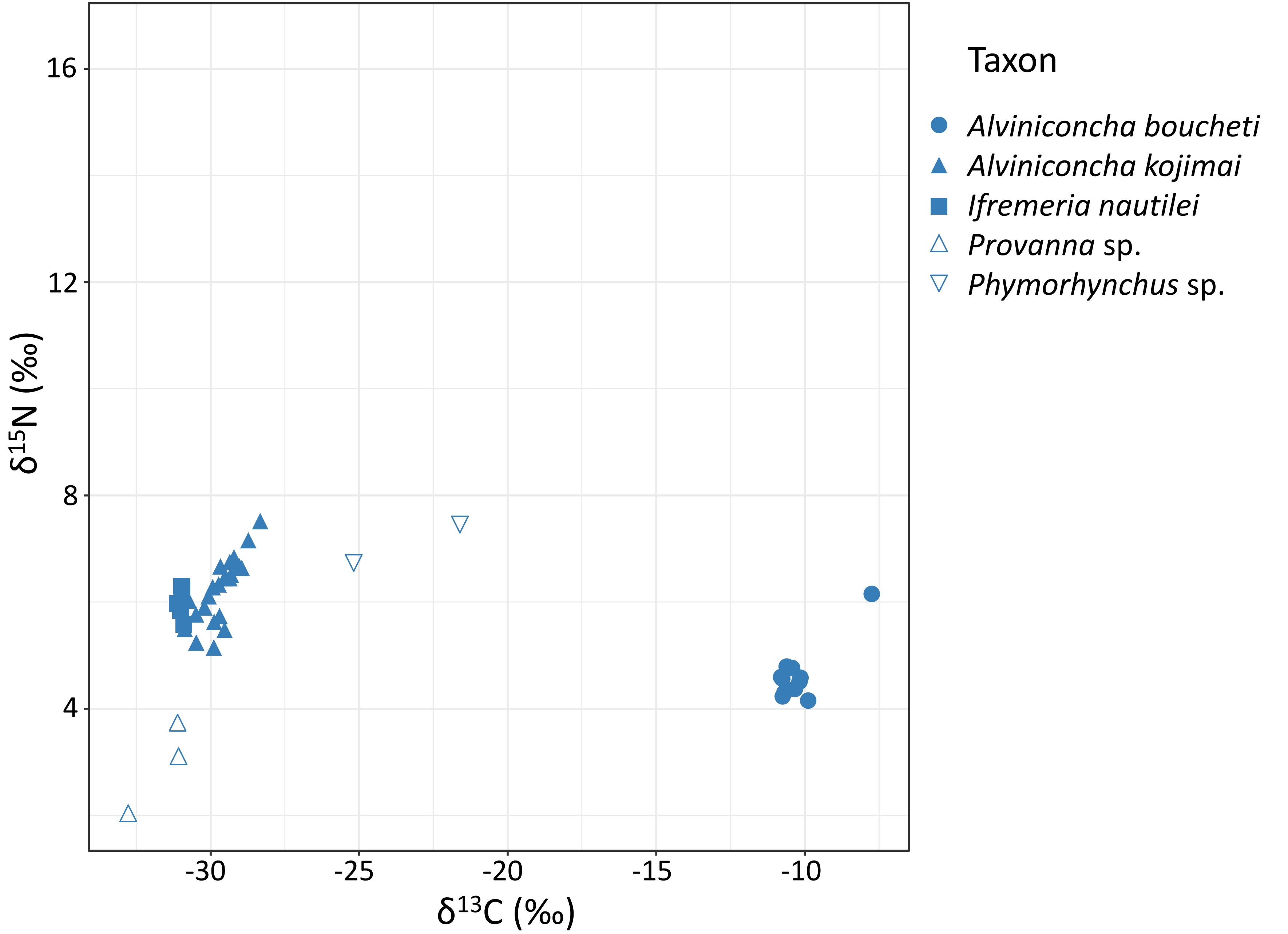
Symbiotrophs relying on different bacterial sulphur oxydation metabolisms: Calvin-Benson-Bassham (CBB) and reverse tricarboxylic acid (rTCA) cycles




A. kojimai


I. nautilei

Food web structure: La Scala (Woodlark basin)



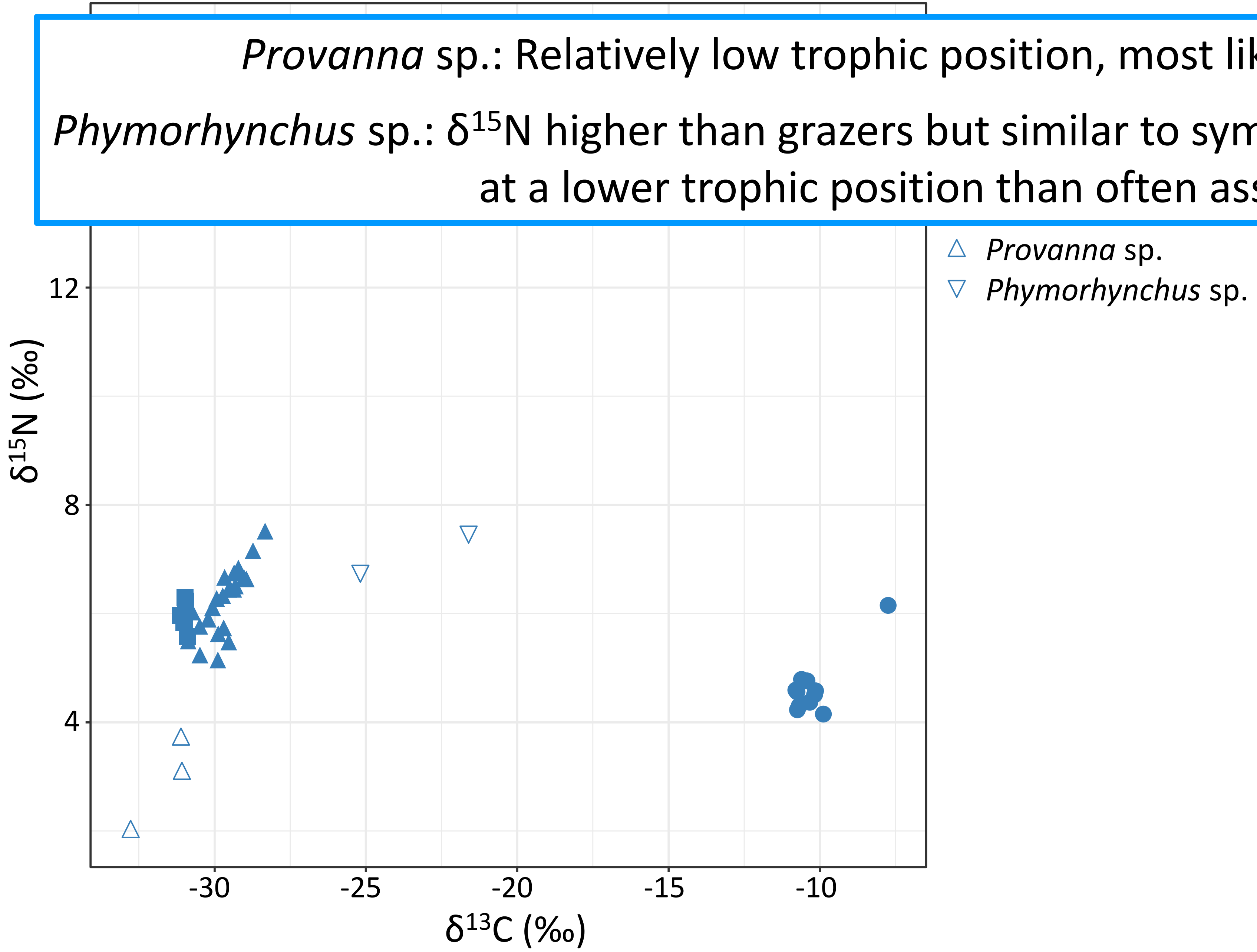
Provanna sp.

Phymorhynchus sp.

Food web structure: La Scala (Woodlark basin)

Provanna sp.: Relatively low trophic position, most likely bacterial grazer

Phymorhynchus sp.: $\delta^{15}N$ higher than grazers but similar to symbiont feeders. Seems to feed at a lower trophic position than often assumed.



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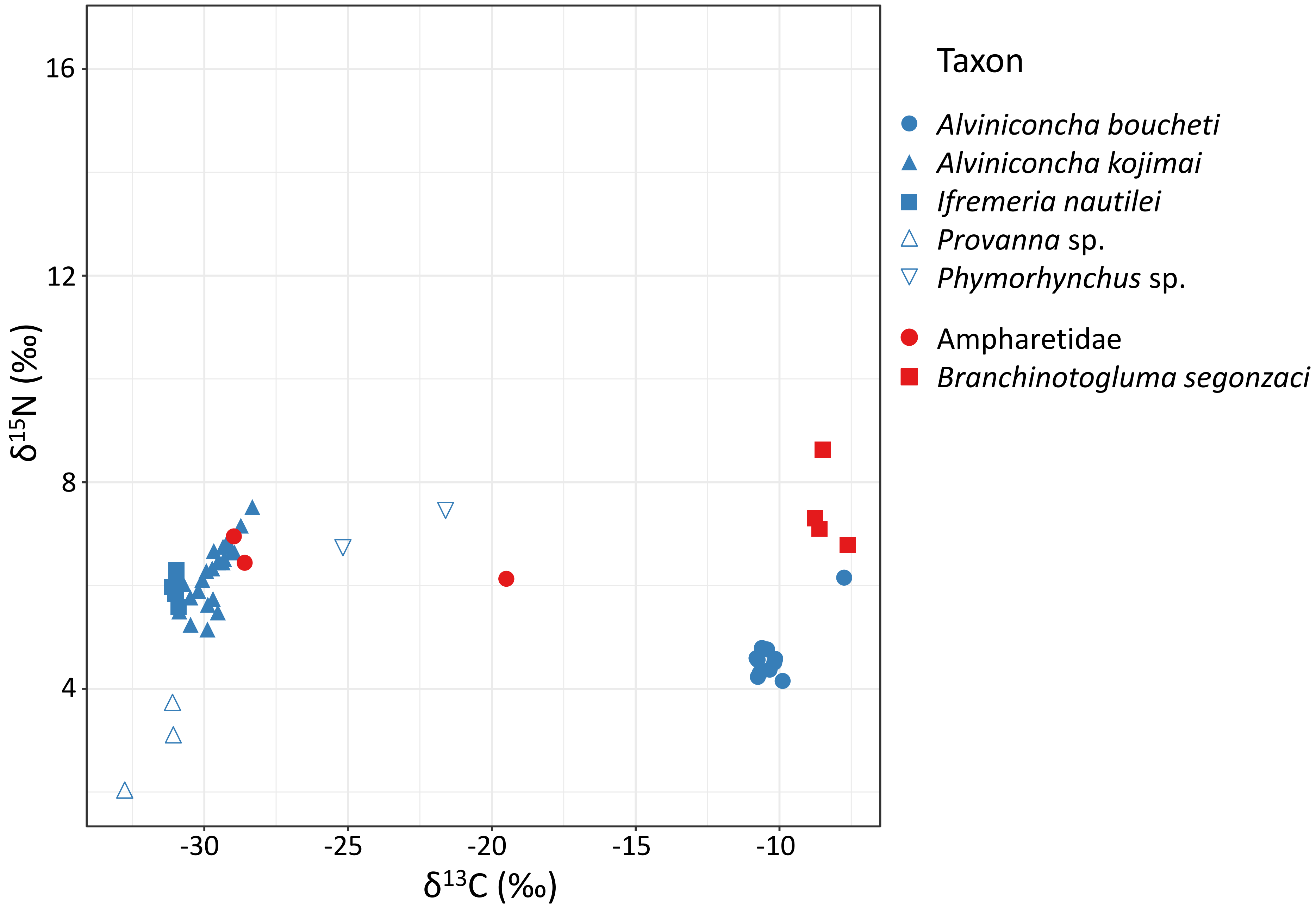
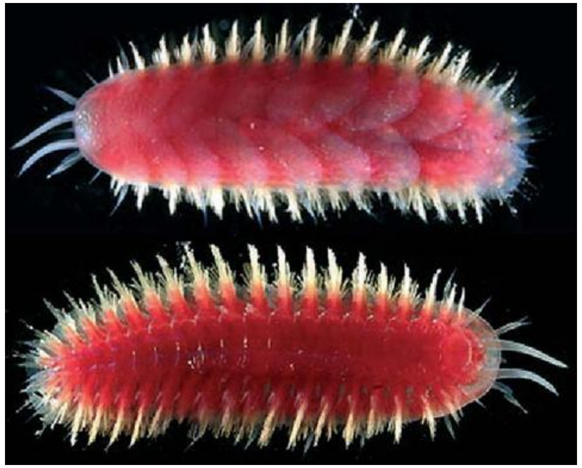
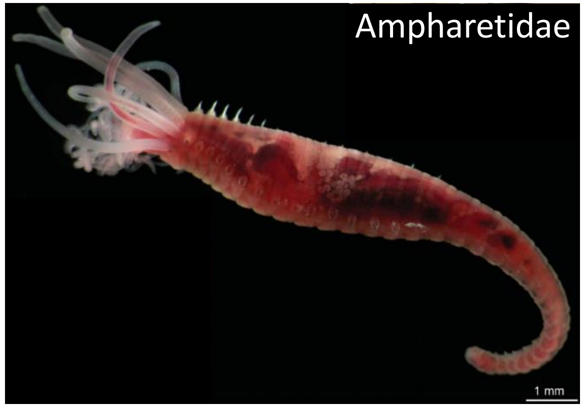


B. segonzaci





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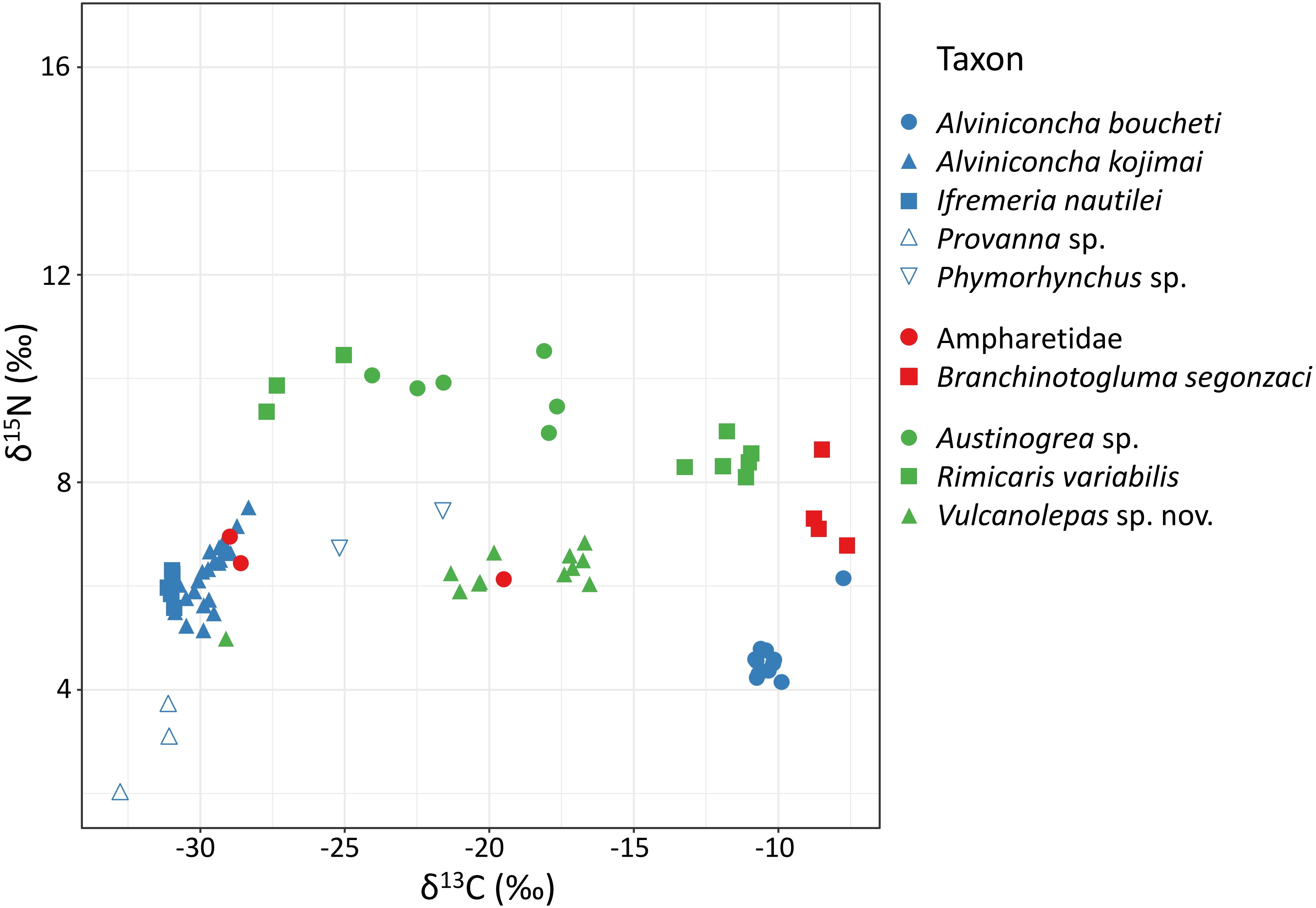


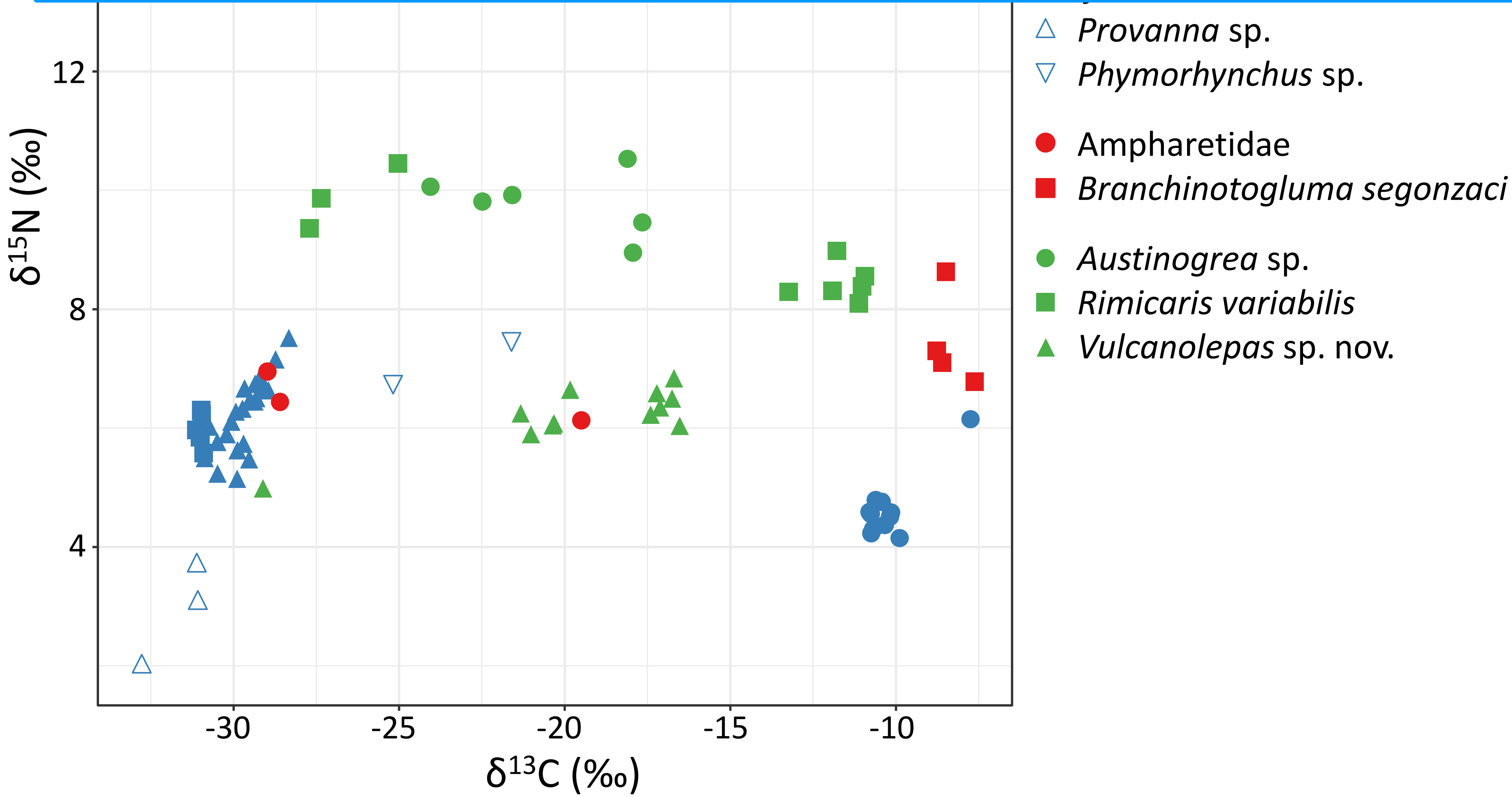
Austinogrea sp.

Vulcanolepas sp. nov.

Food web structure: La Scala (Woodlark basin)

$\delta^{15}N$ of crabs and shrimps higher, yet similar. Both omnivores? Differences in trophic position masked by baseline differences?

Marked $\delta^{13}C$ differences among shrimps: high intraspecific trophic diversity



Austinogrea sp.

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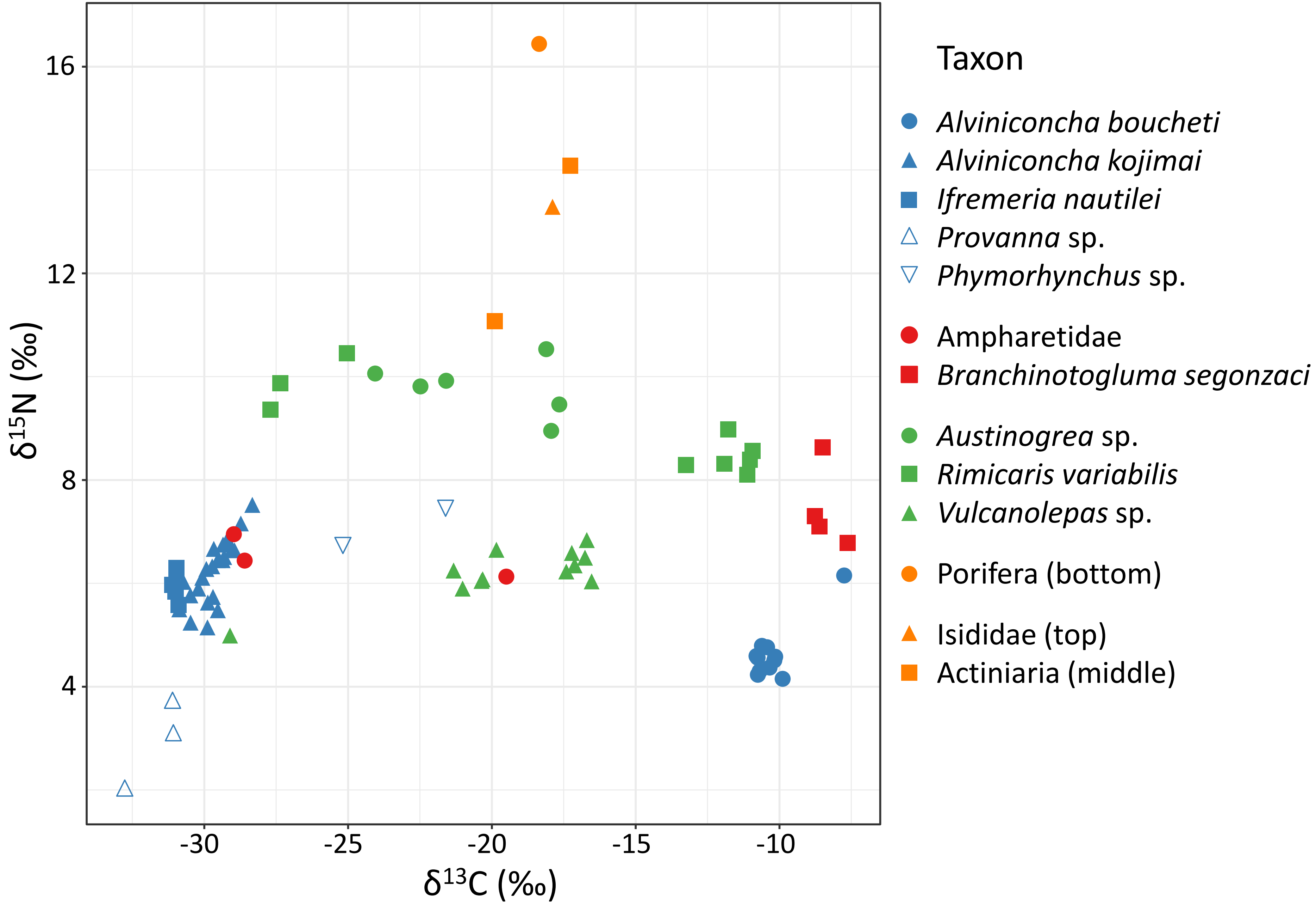

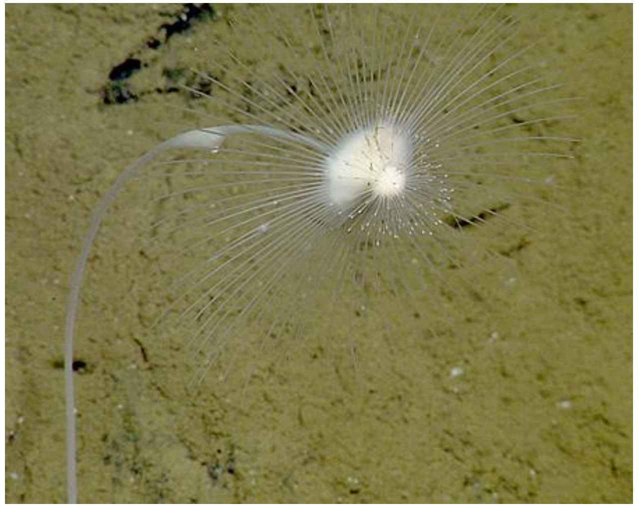

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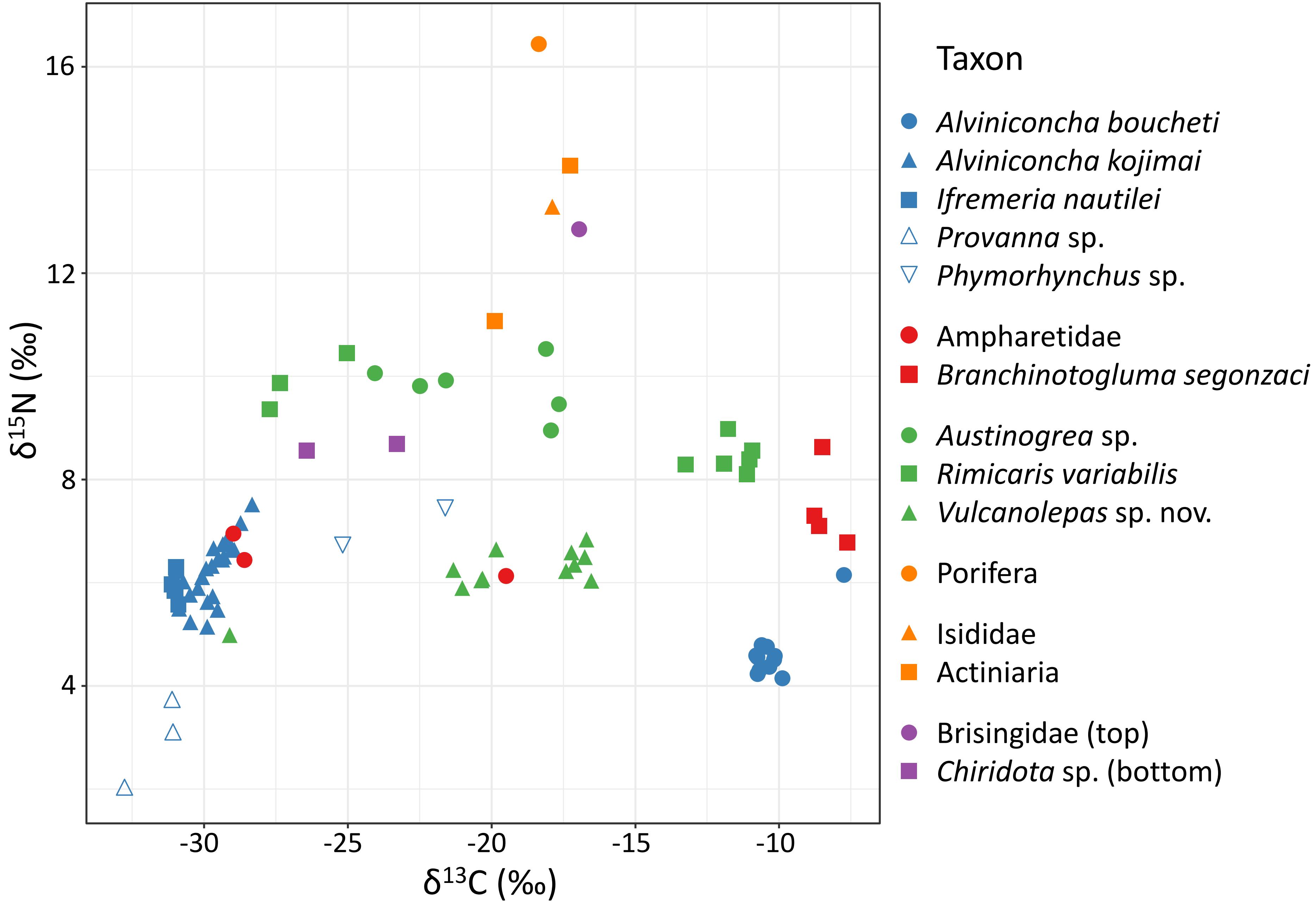

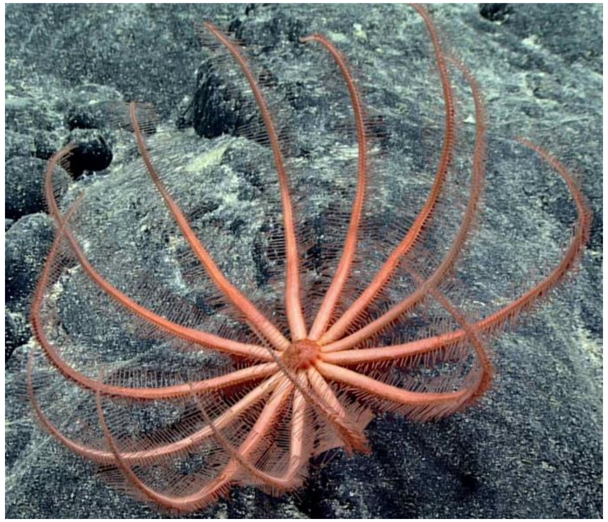

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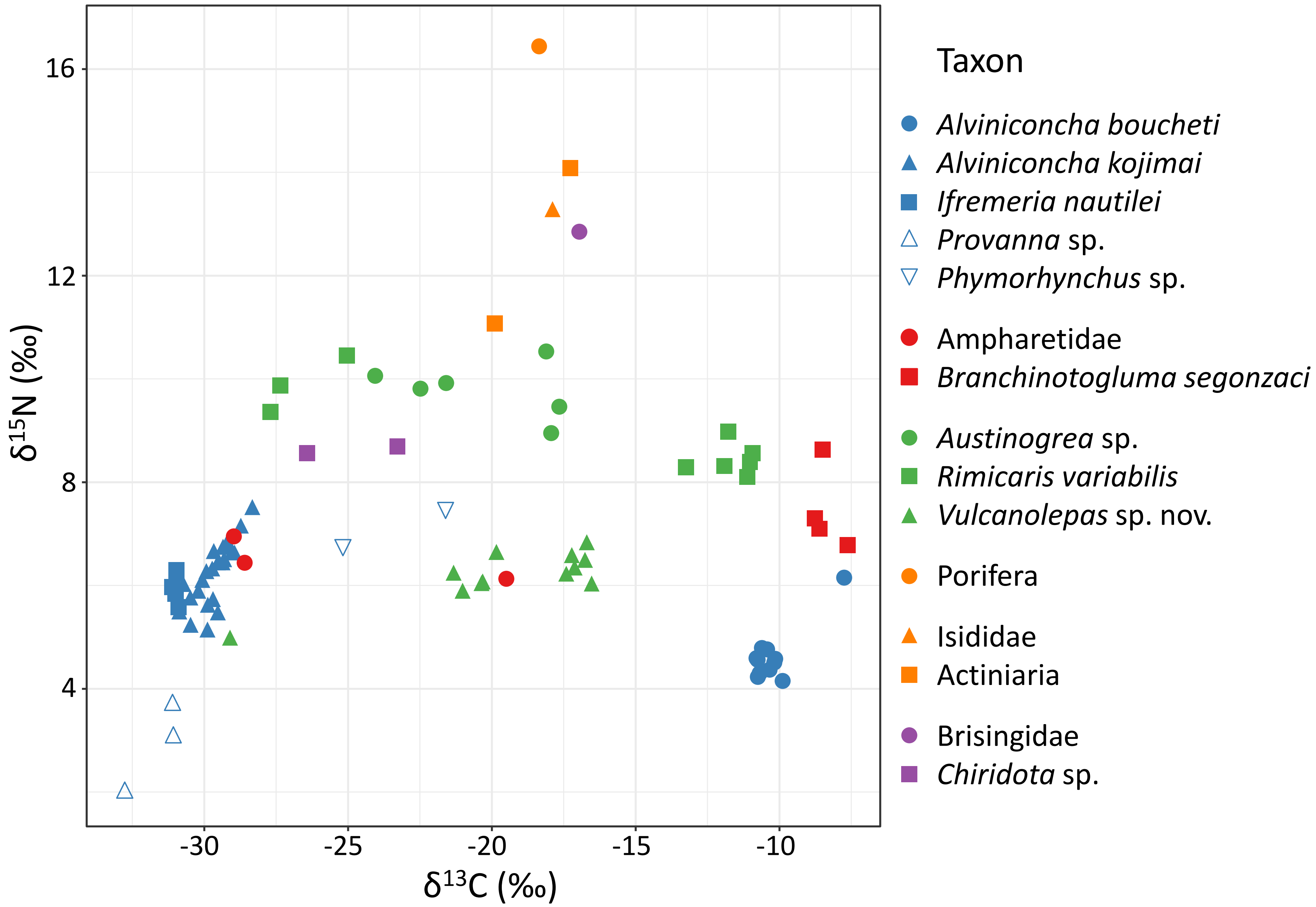

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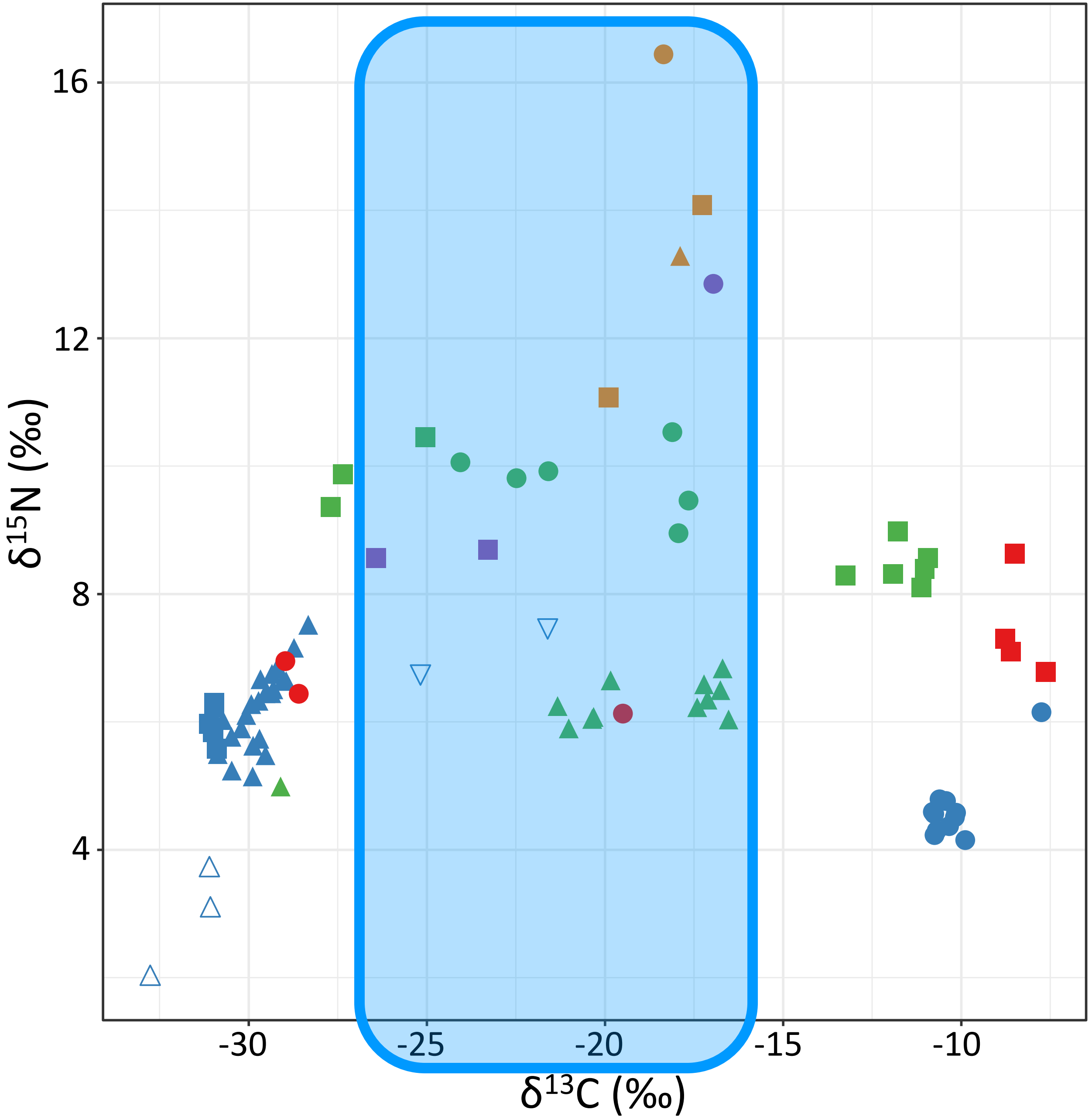
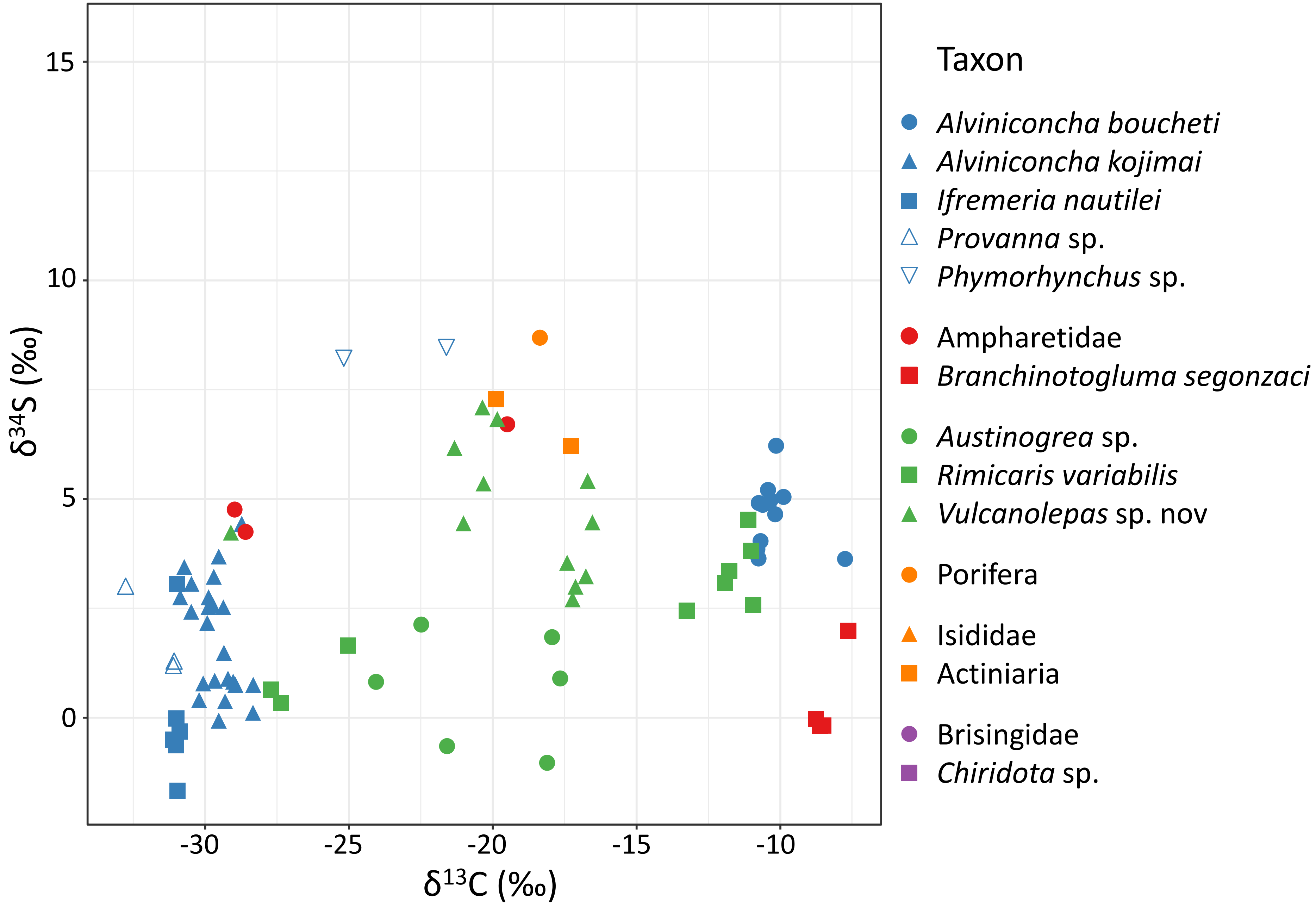


What do these animals with intermediate $\delta^{13}C$ feed on?

Exported photosynthetic production?

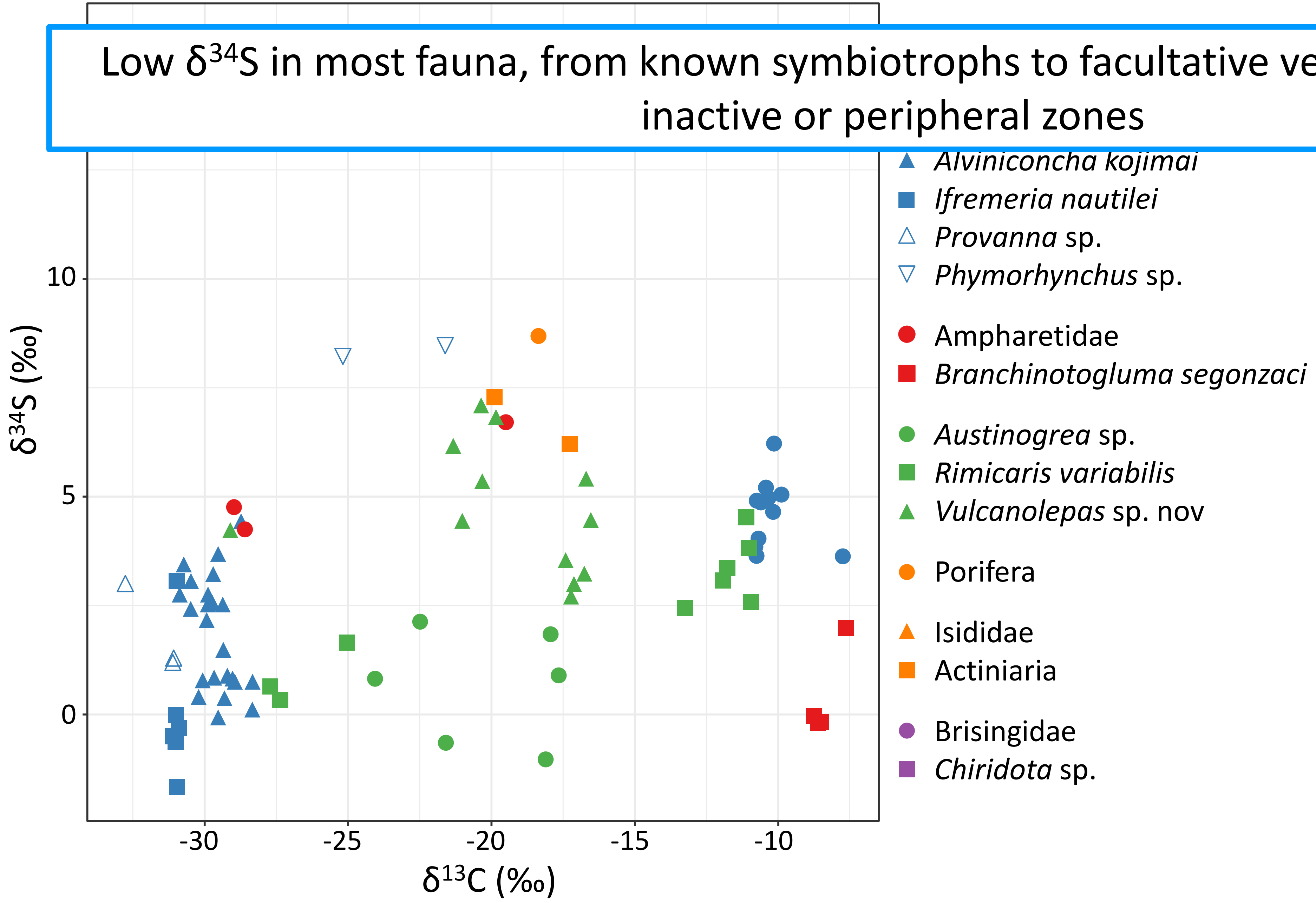
Mix of chemosynthesis-derived OM produced through multiple pathways?

Food web structure: La Scala (Woodlark basin)

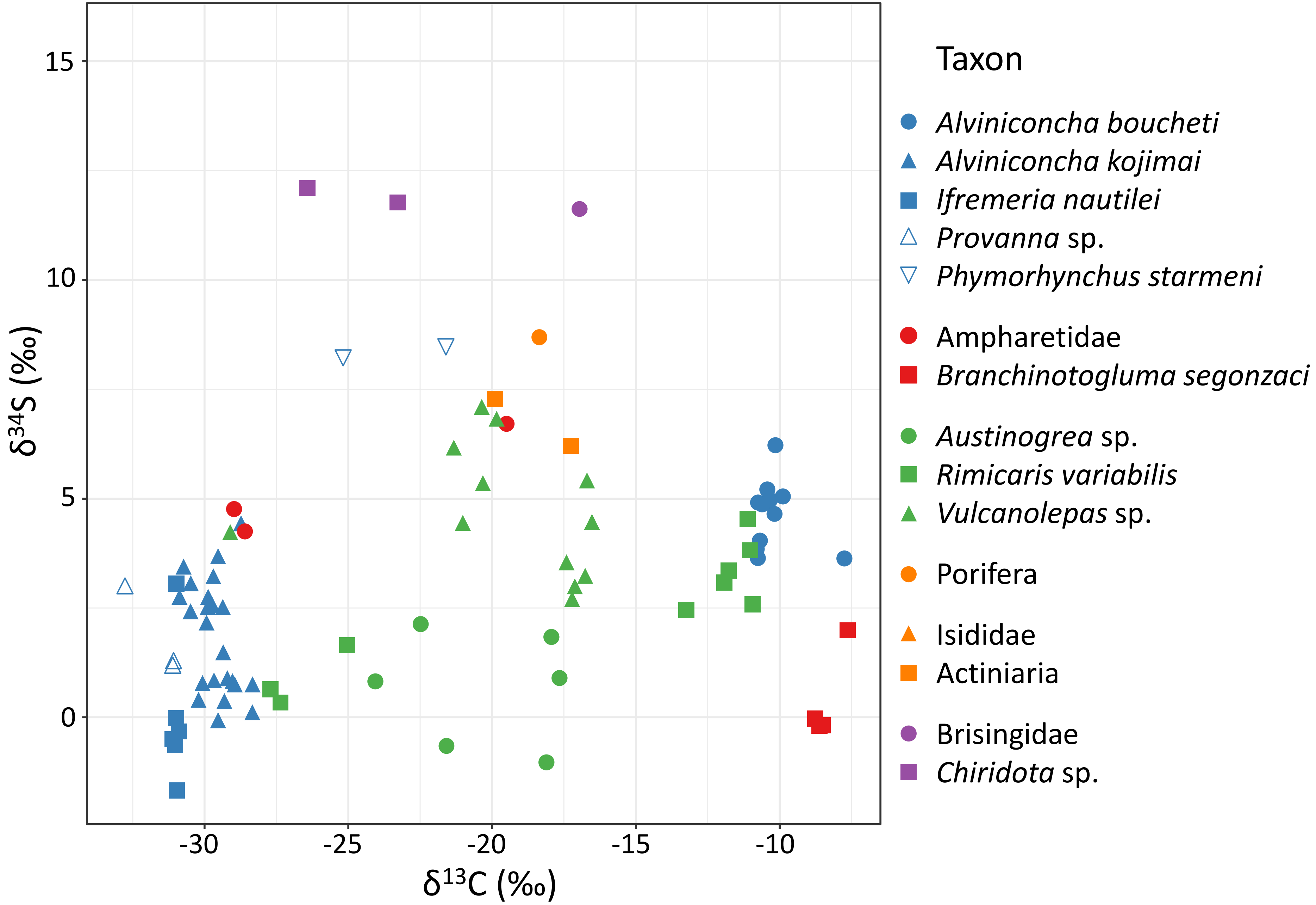


Food web structure: La Scala (Woodlark basin)

Low $\delta^{34}S$ in most fauna, from known symbiotrophs to facultative vent dwellers found in inactive or peripheral zones

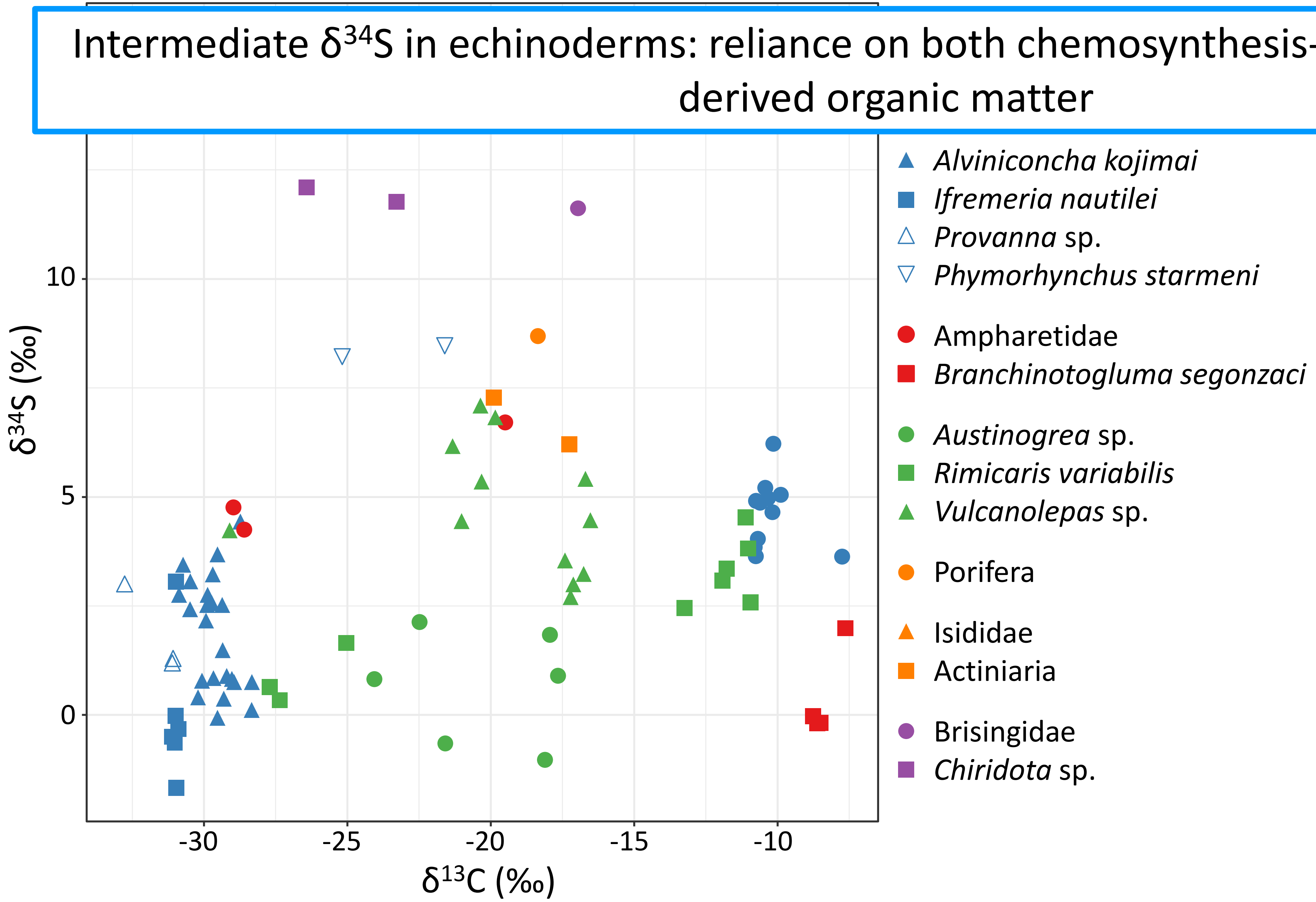


Food web structure: La Scala (Woodlark basin)

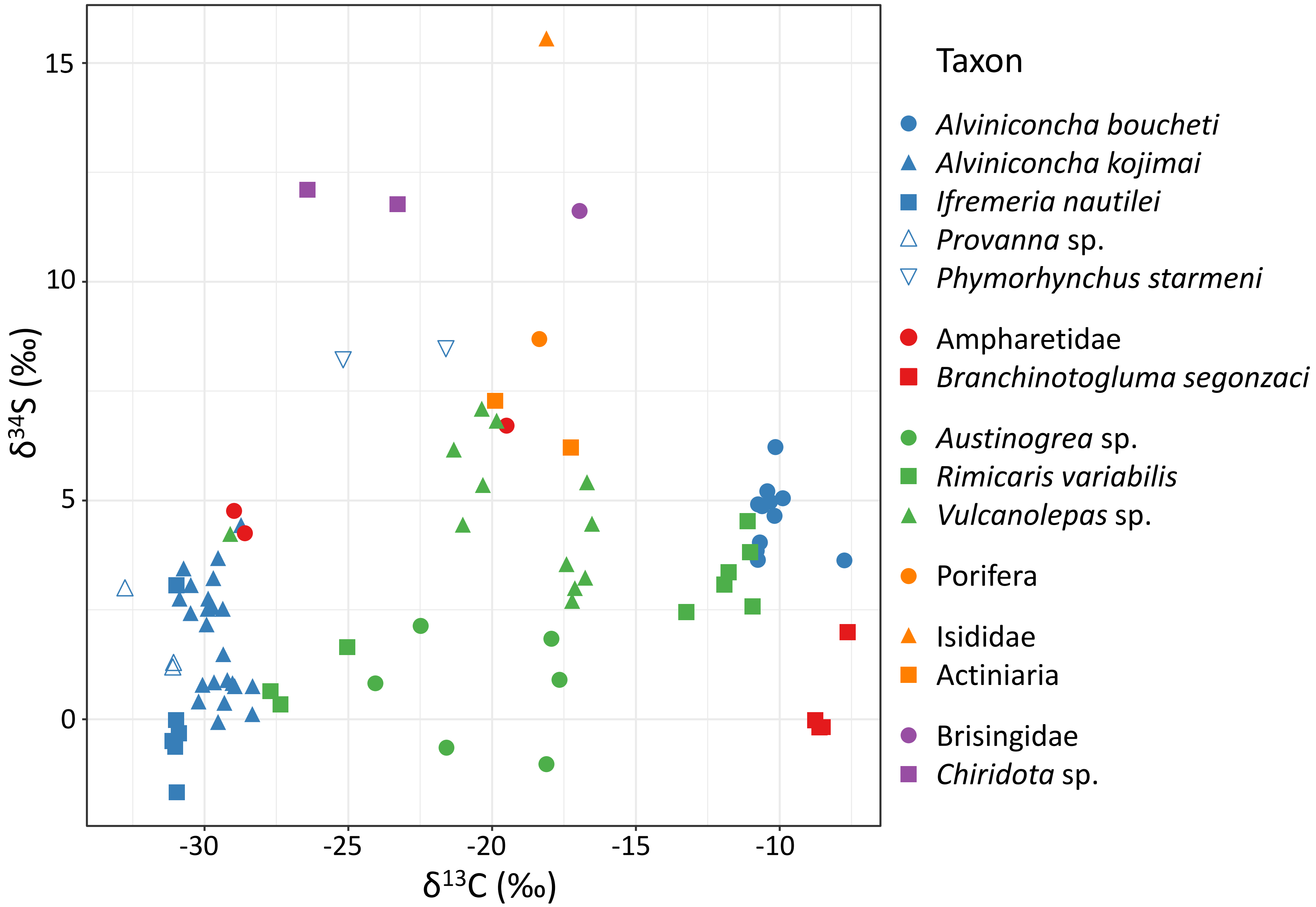


Food web structure: La Scala (Woodlark basin)

Intermediate $\delta^{34}S$ in echinoderms: reliance on both chemosynthesis- and photosynthesis-derived organic matter



Food web structure: La Scala (Woodlark basin)



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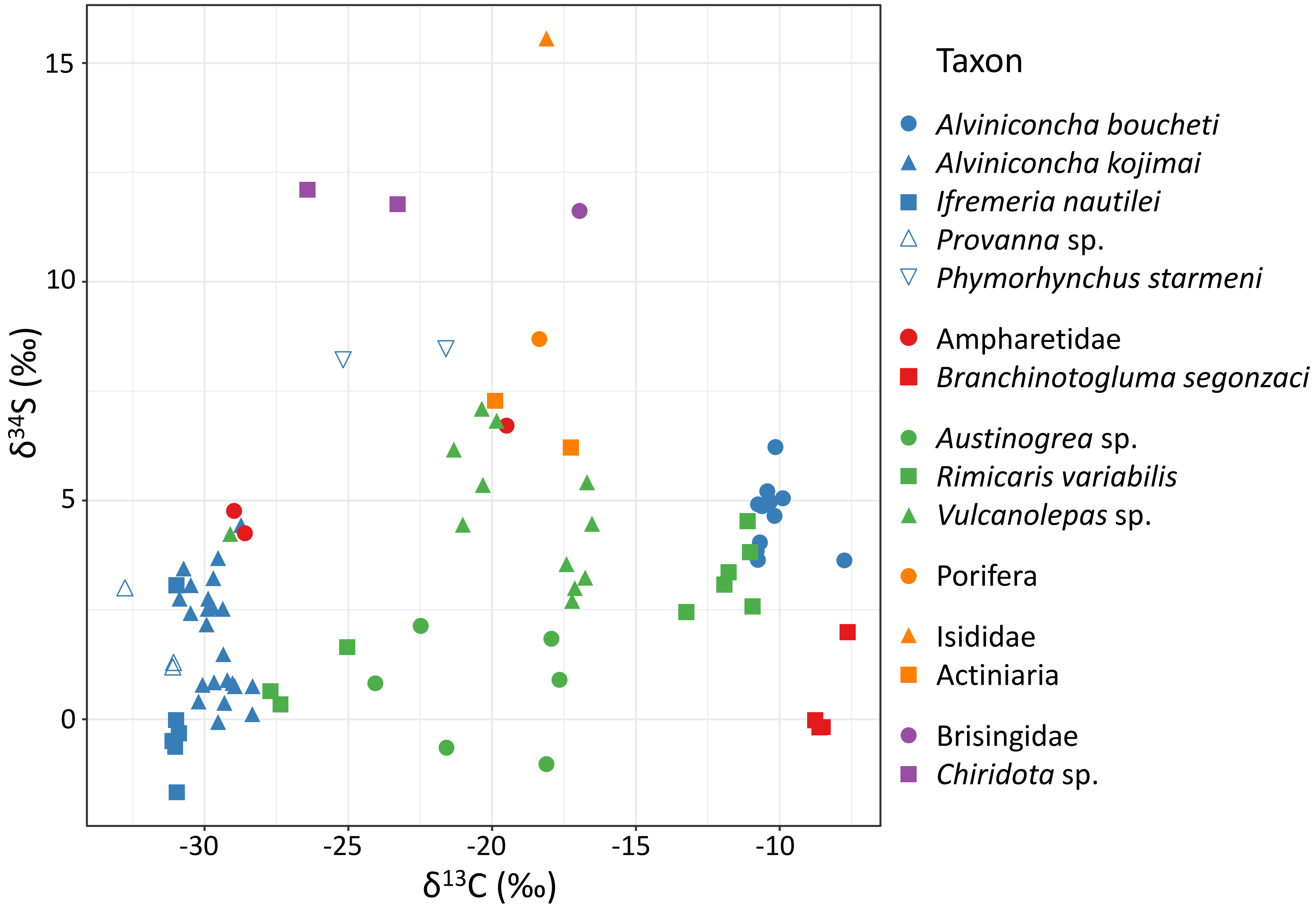
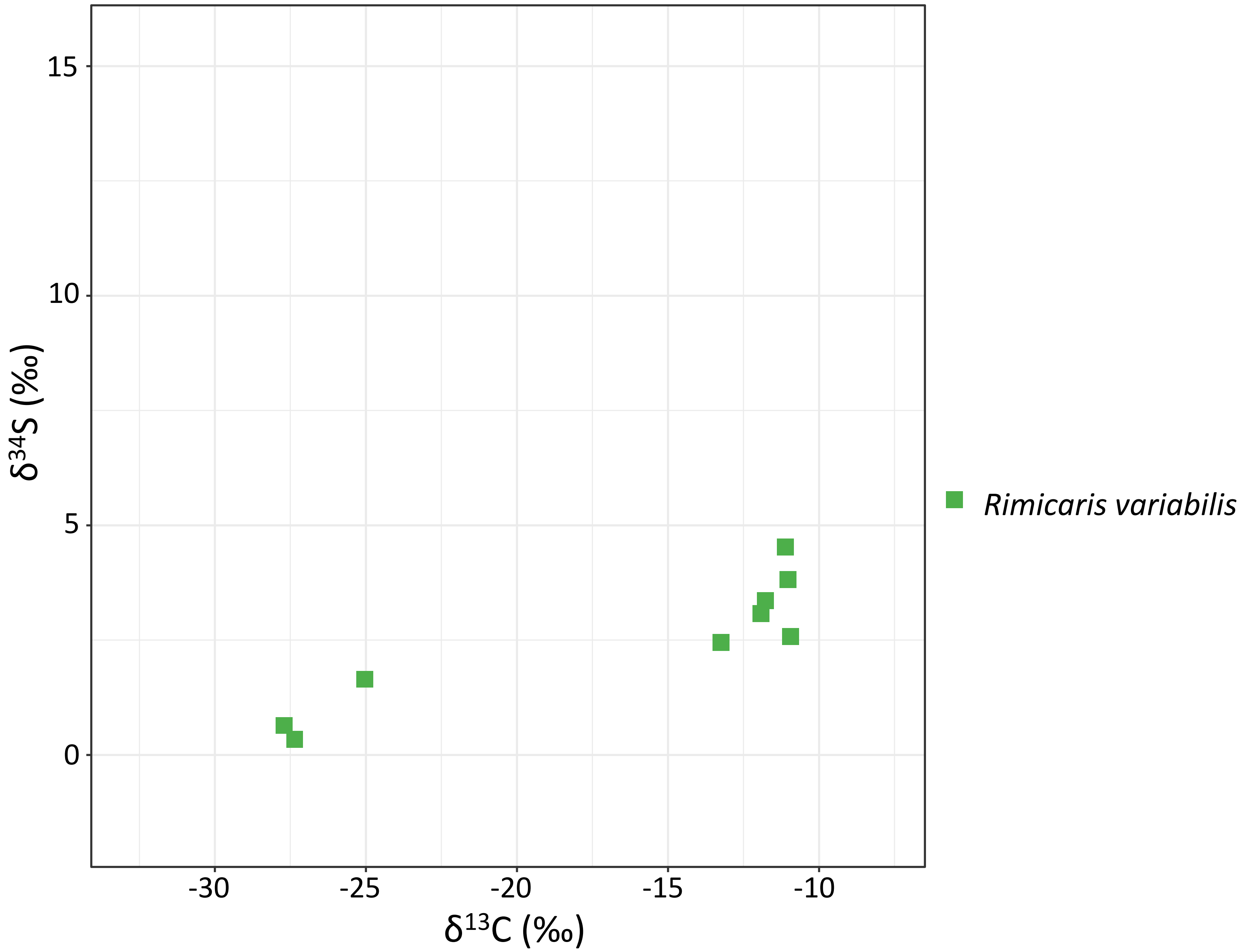


Community mostly fueled by thiotrophy in active emission zones, but also in peripheral habitats. Photosynthetic inputs limited.

Continuum of $\delta^{13}C$ values: co-reliance on CBB and rTCA cycles, with inter- and intraspecific differences in feeding habits

Food web structure: La Scala (Woodlark basin)



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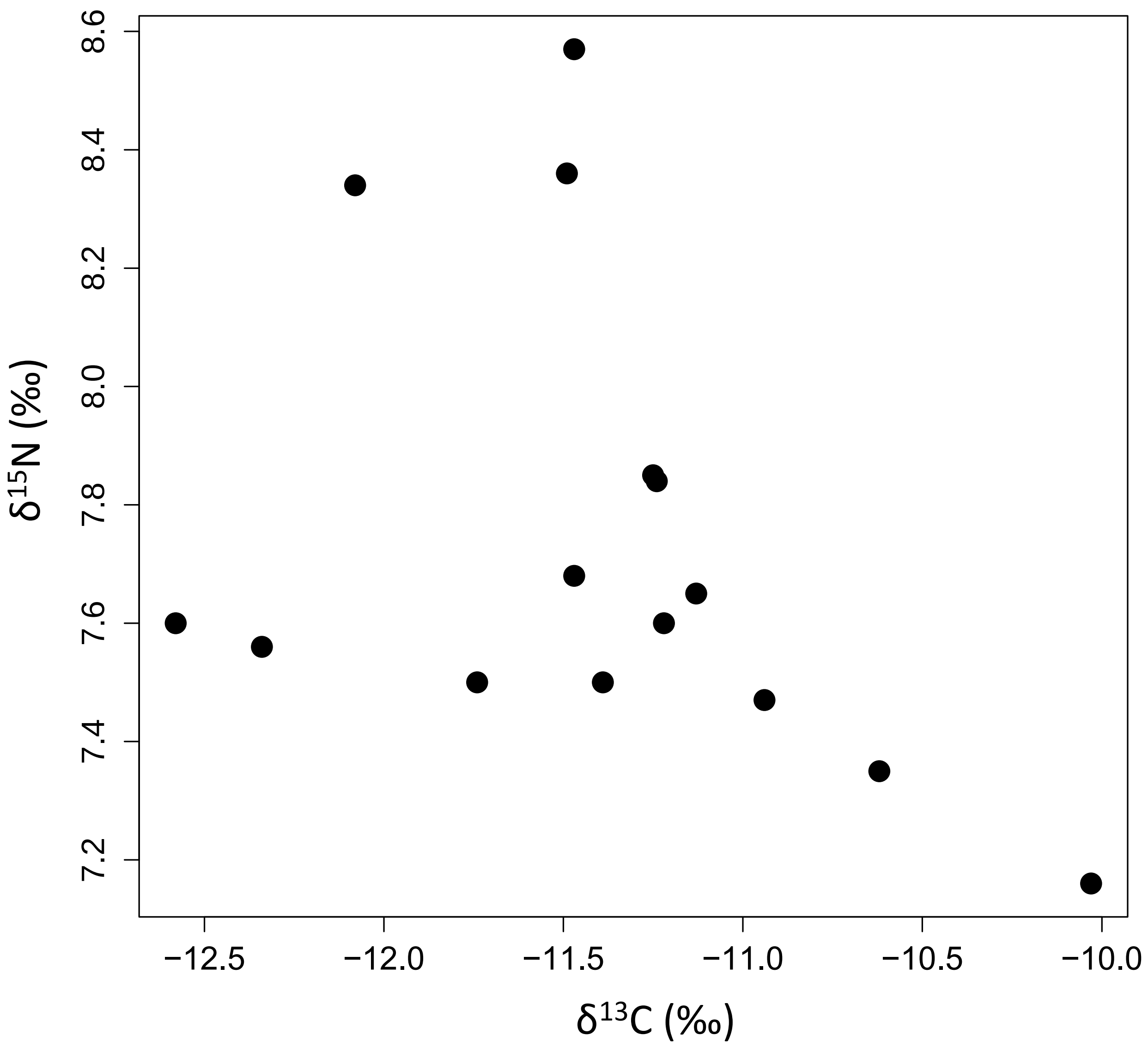
Isotopic variability: what ecological info does it hold?

Typical SI analysis output : points in "isospace"



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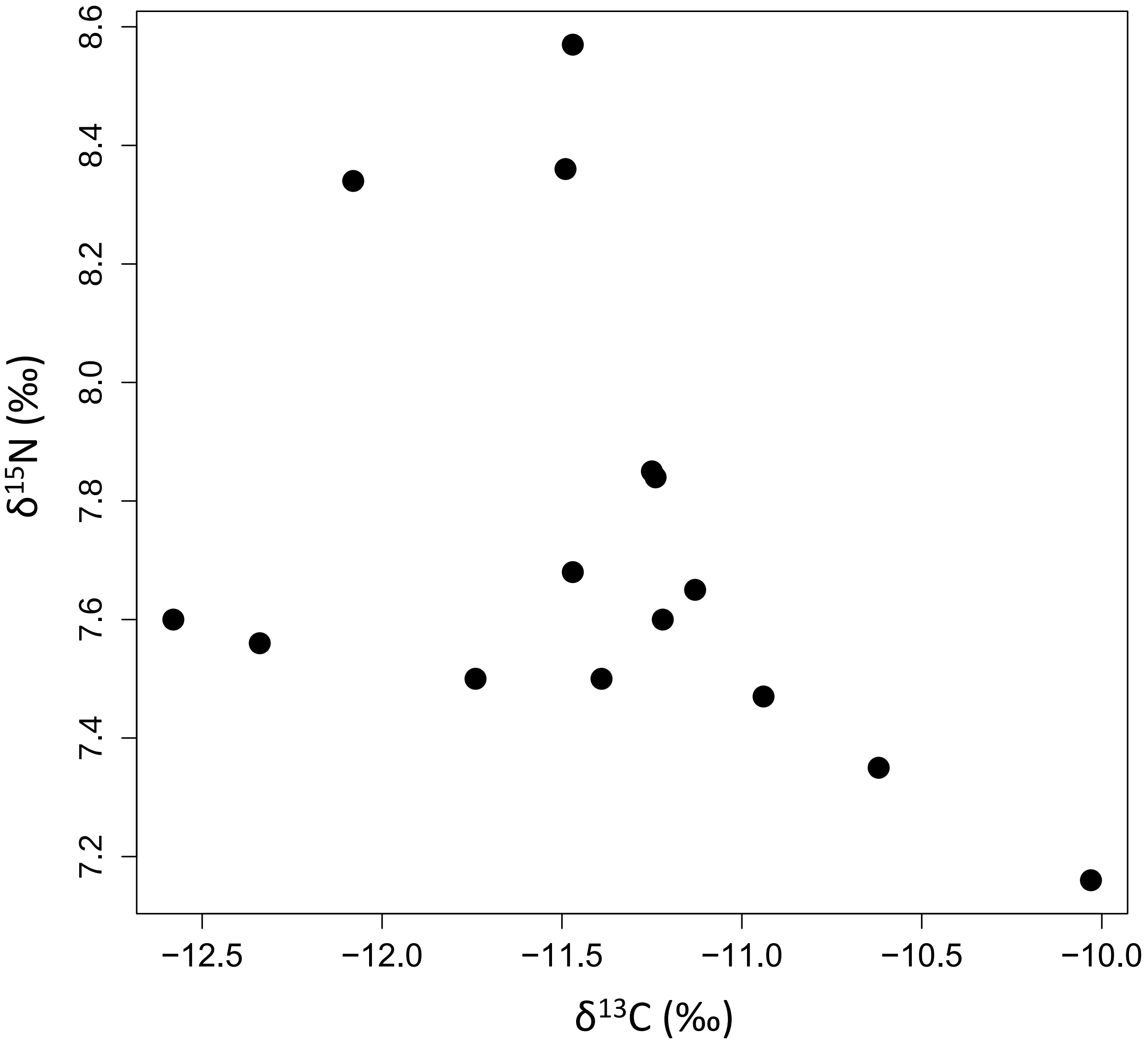

Position of consumers in the isospace is driven by

1) Differences in consumed resources (different preys can have different isotopic compositions)

Isotopic variability: what ecological info does it hold?

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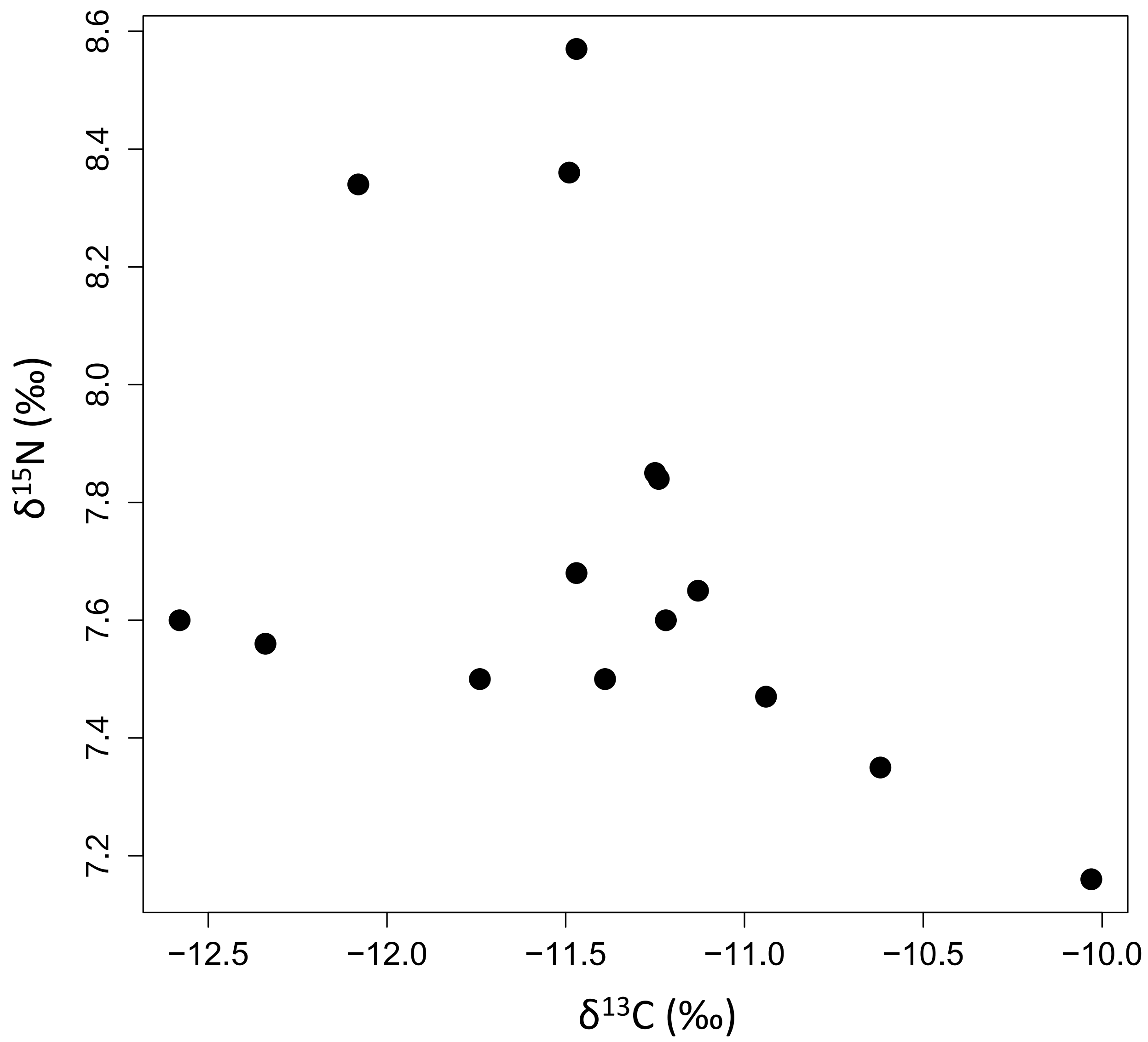


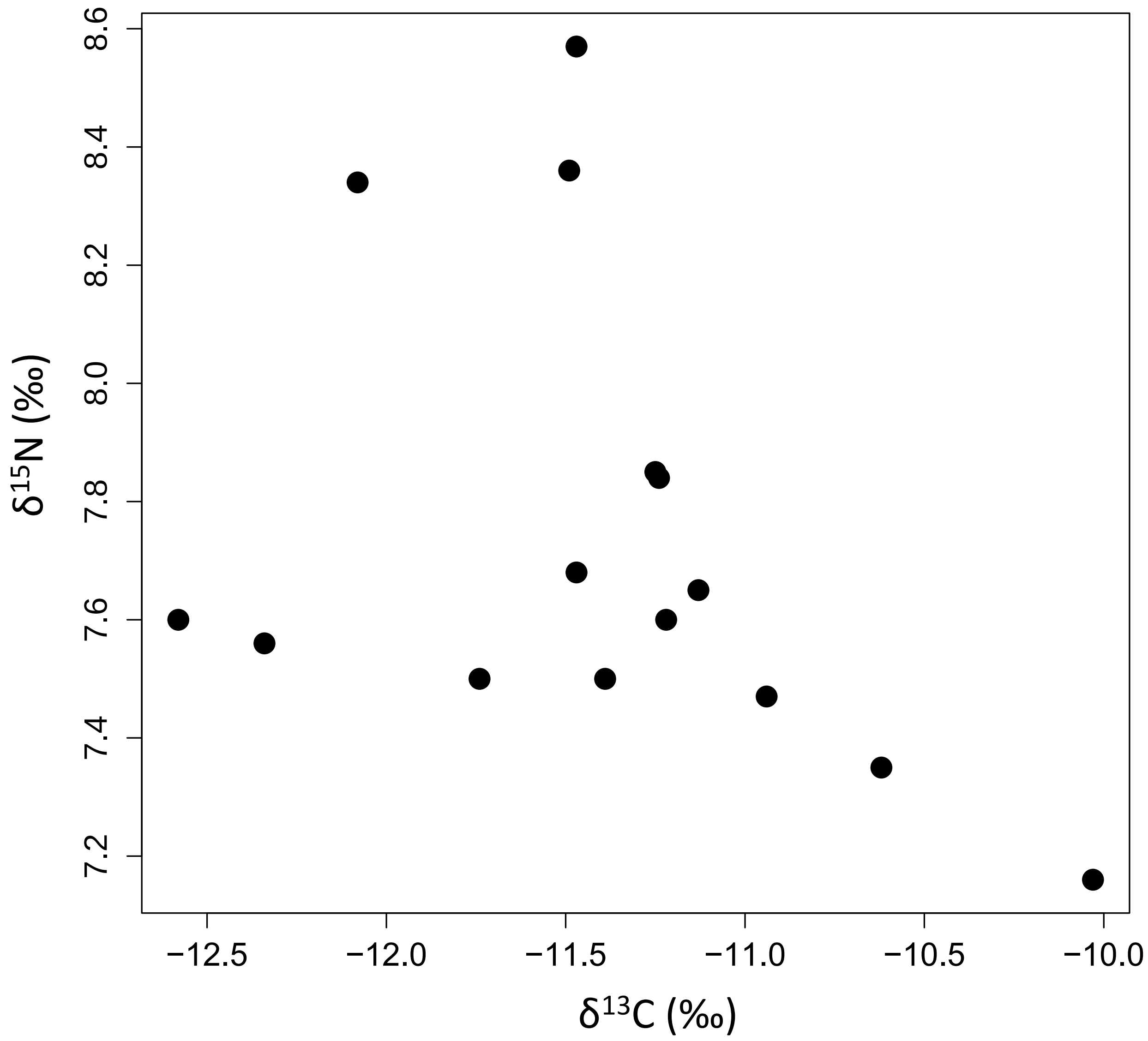
Position of consumers in the isospace is driven by

1) Differences in consumed resources
(different preys can have different isotopic compositions)

2) Differences in foraging habitat
(the same prey can have different isotopic compositions in different habitats)

Isotopic variability: what ecological info does it hold?

Geometric approach (Layman *et al.* 2007):



CAN STABLE ISOTOPE RATIOS PROVIDE FOR COMMUNITY-WIDE MEASURES OF TROPHIC STRUCTURE?

Craig A. Layman,[1,5] D. Albrey Arrington,[2] Carmen G. Montaña,[3] and David M. Post[4]

Ecology, 88(1), 2007, pp. 42–48

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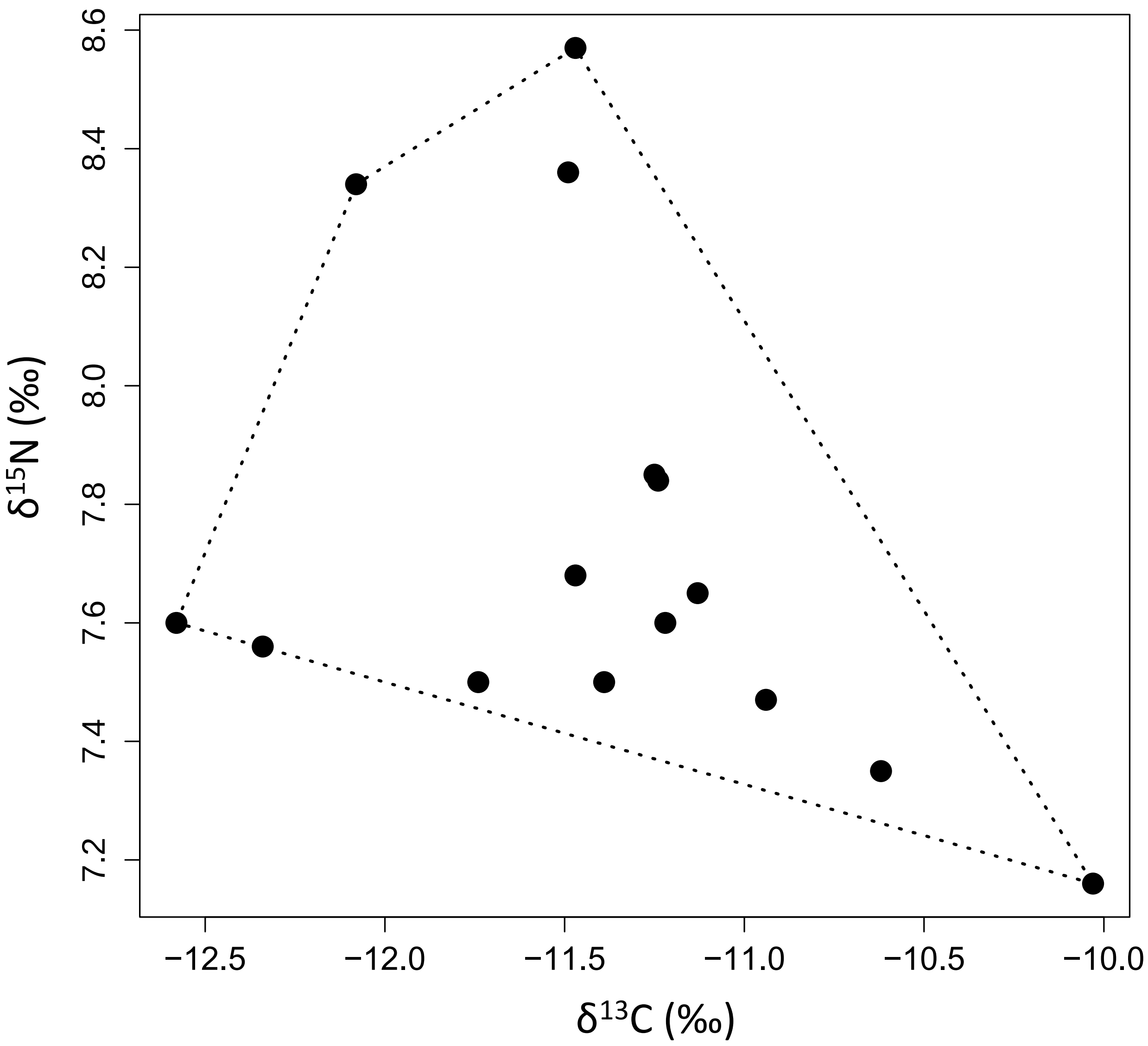
Geometric approach (Layman *et al.* 2007):

Fit a convex hull (i.e., the smallest possible surface that encompasses all points) to the data

This convex hull represents the isotopic niche of the group of consumers (proxy for their realized ecological niche)



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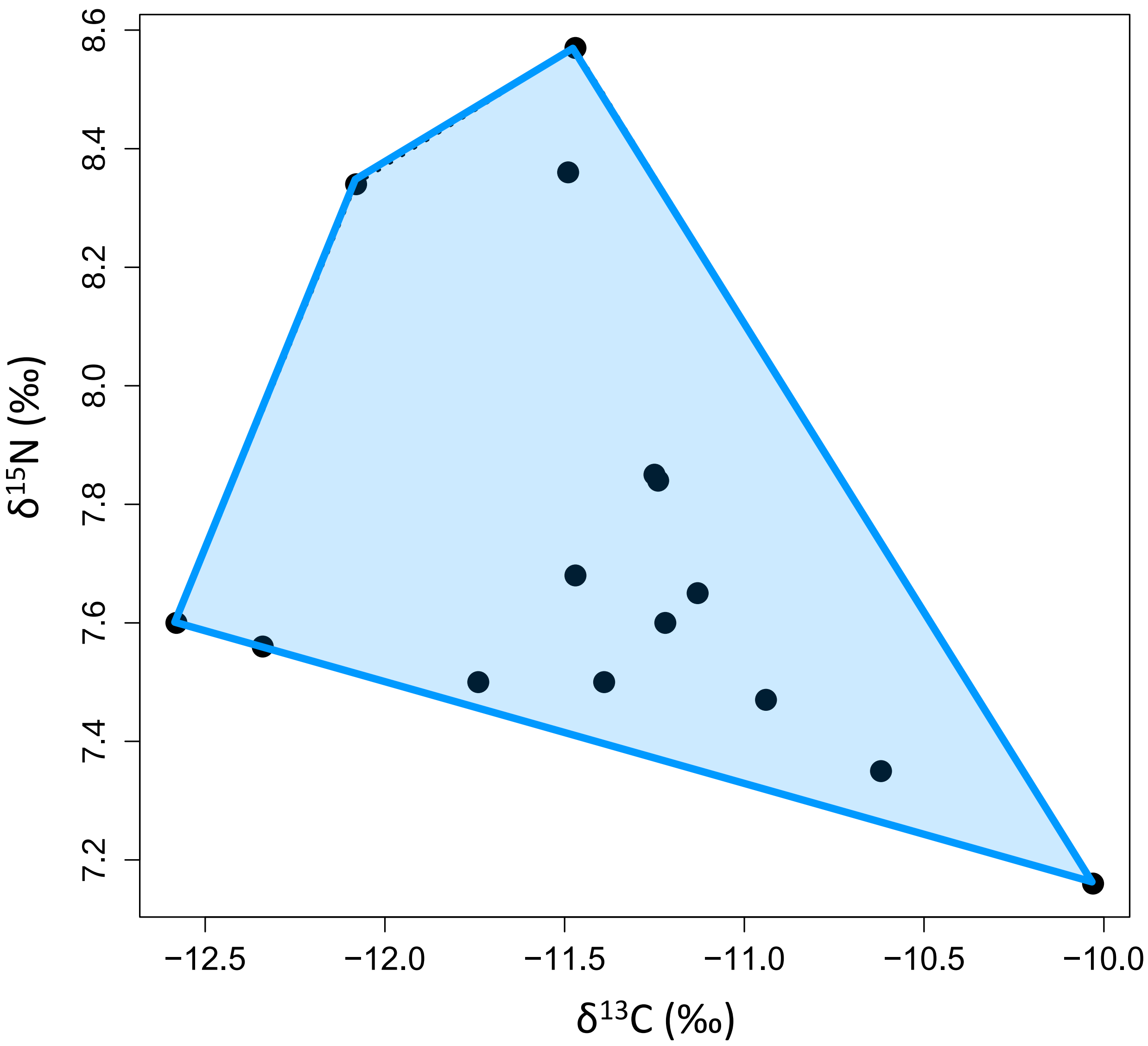
Set of complementary metrics including total area of the convex hull: proxy of the total resource diversity used by the organisms



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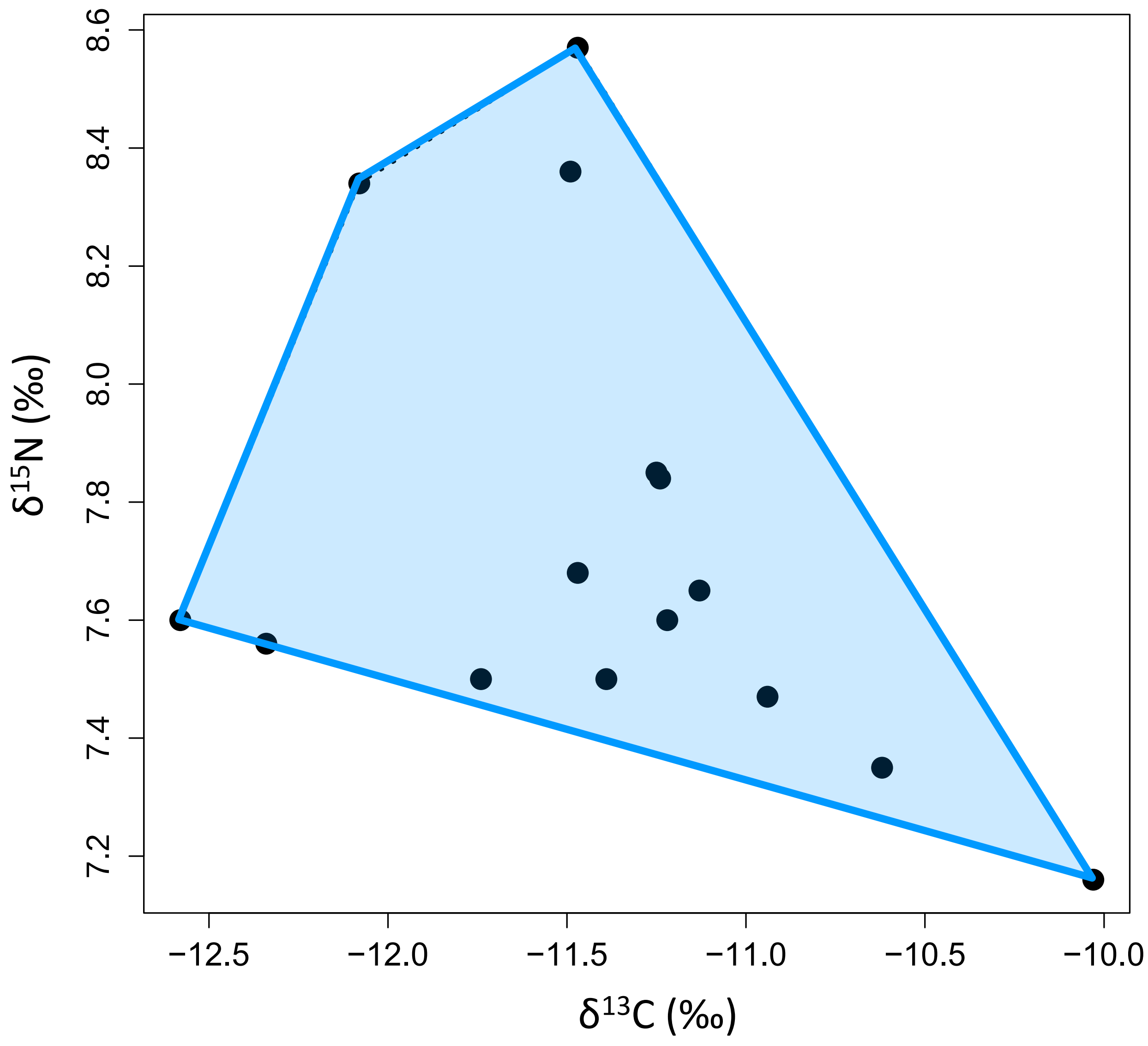
Isotopic variability: what ecological info does it hold?

Some hull-based metrics (including its total area) are highly sensitive to the presence of extreme points

According to your research question, it can be a good or a bad thing…



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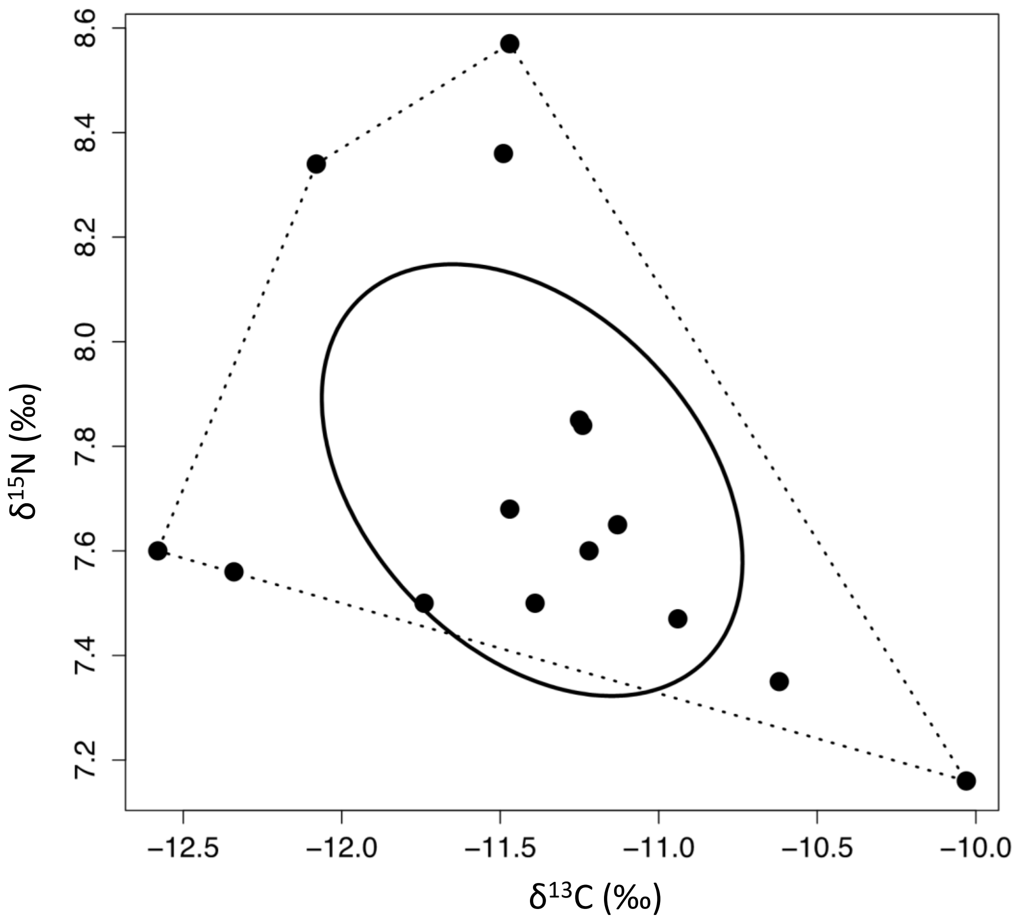

Journal of Animal Ecology
British Ecological Society
Journal of Animal Ecology 2011
doi: 10.1111/j.1365-2656.2011.01806.x

Comparing isotopic niche widths among and within communities: SIBER – Stable Isotope Bayesian Ellipses in R

Andrew L. Jackson[1]*, Richard Inger[2], Andrew C. Parnell[3] and Stuart Bearhop[2]

Standard ellipse vs. convex hull
(SD vs. full range)

Represents "core isotopic niche" of the group of consumers

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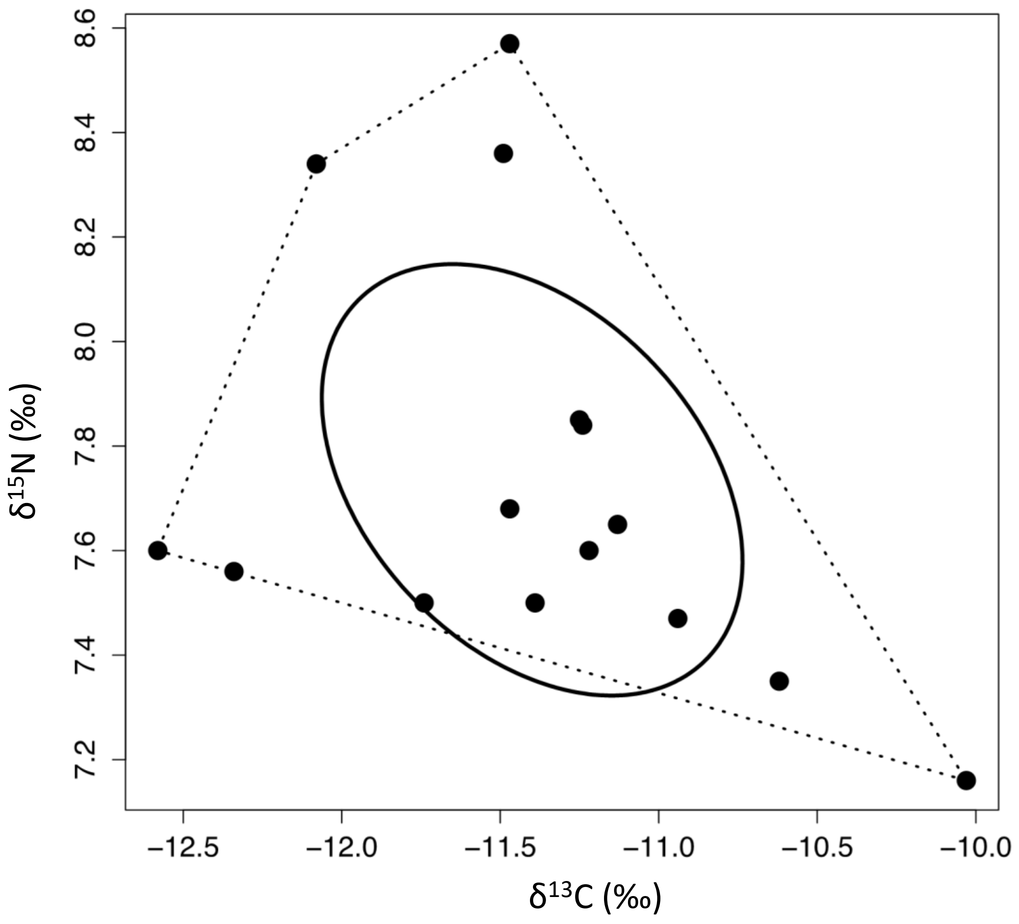

Standard ellipse vs. convex hull
(SD vs. full range)

Represents "core isotopic niche" of the group of consumers

Main metric: standard ellipse area (SEA), proxy for the diversity of most commonly used ecological resources

More robust and less sensitive to extreme values and small sample size

Ellipses and hulls can be complementary

Journal of Animal Ecology

British Ecological Society

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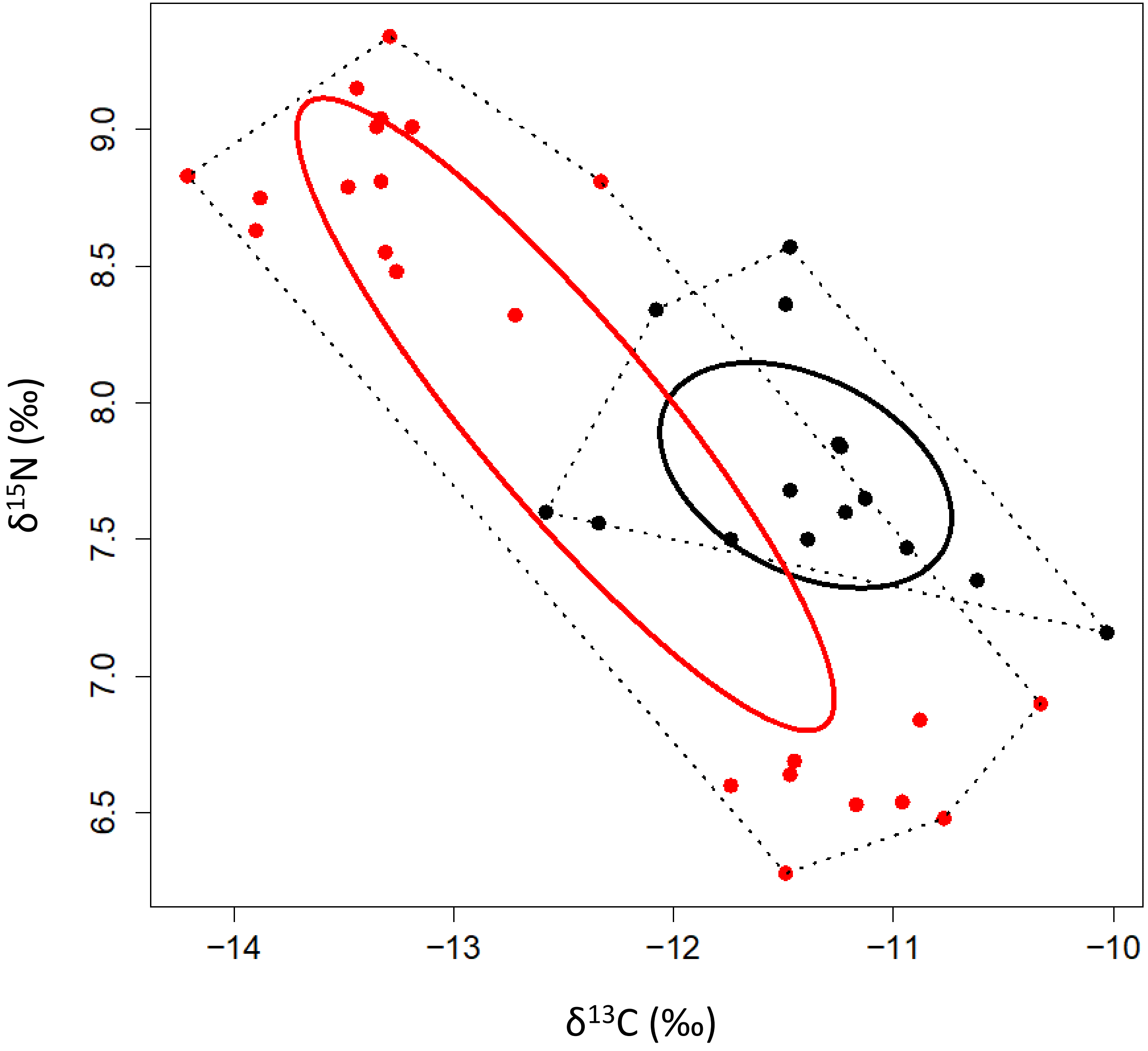
Stable isotopes as niche proxies

Comparison of groups :

Hull or ellipse size



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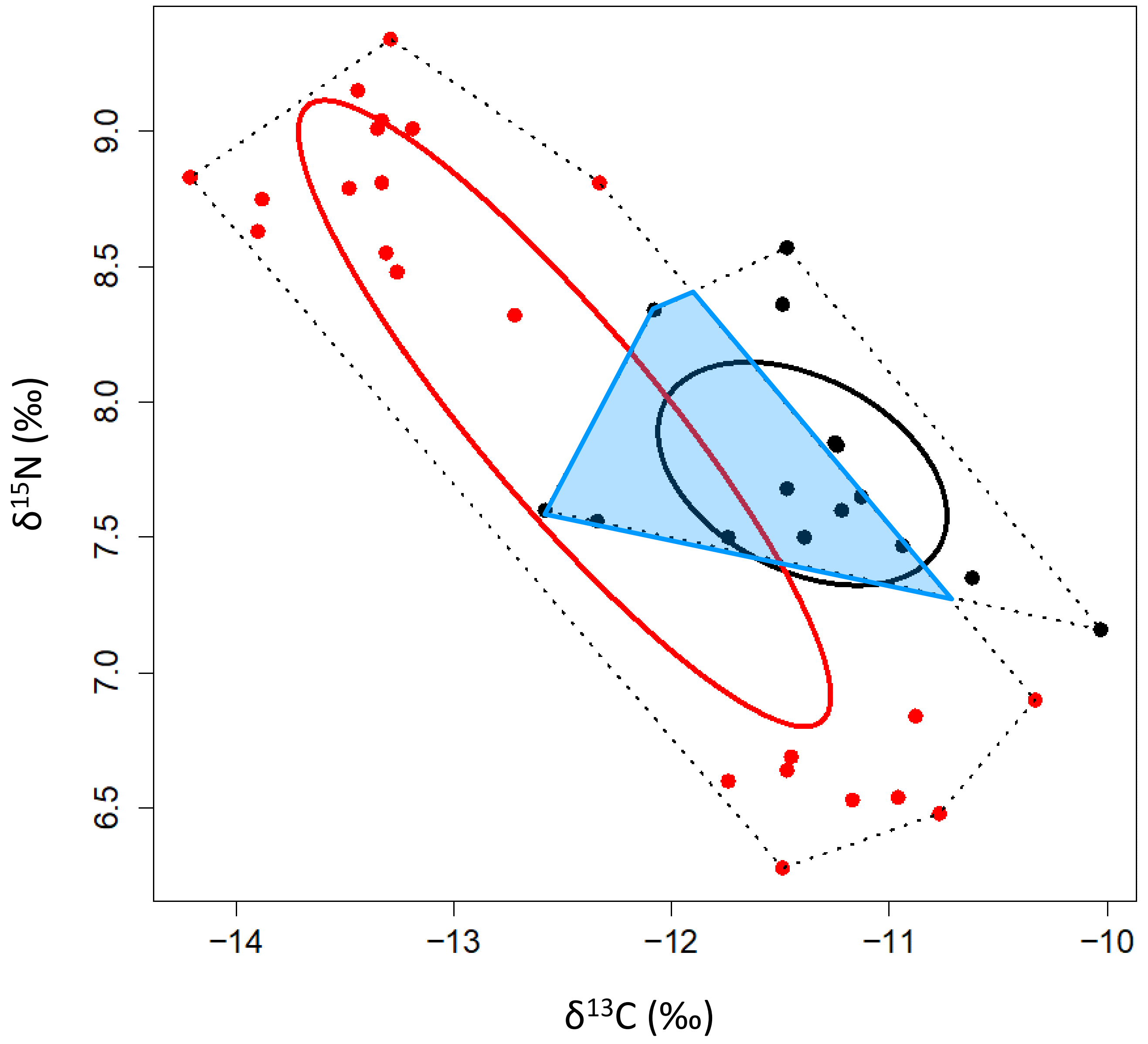
Hull or ellipse overlap: the greater the overlap, the more the organism groups are likely to rely on shared resources



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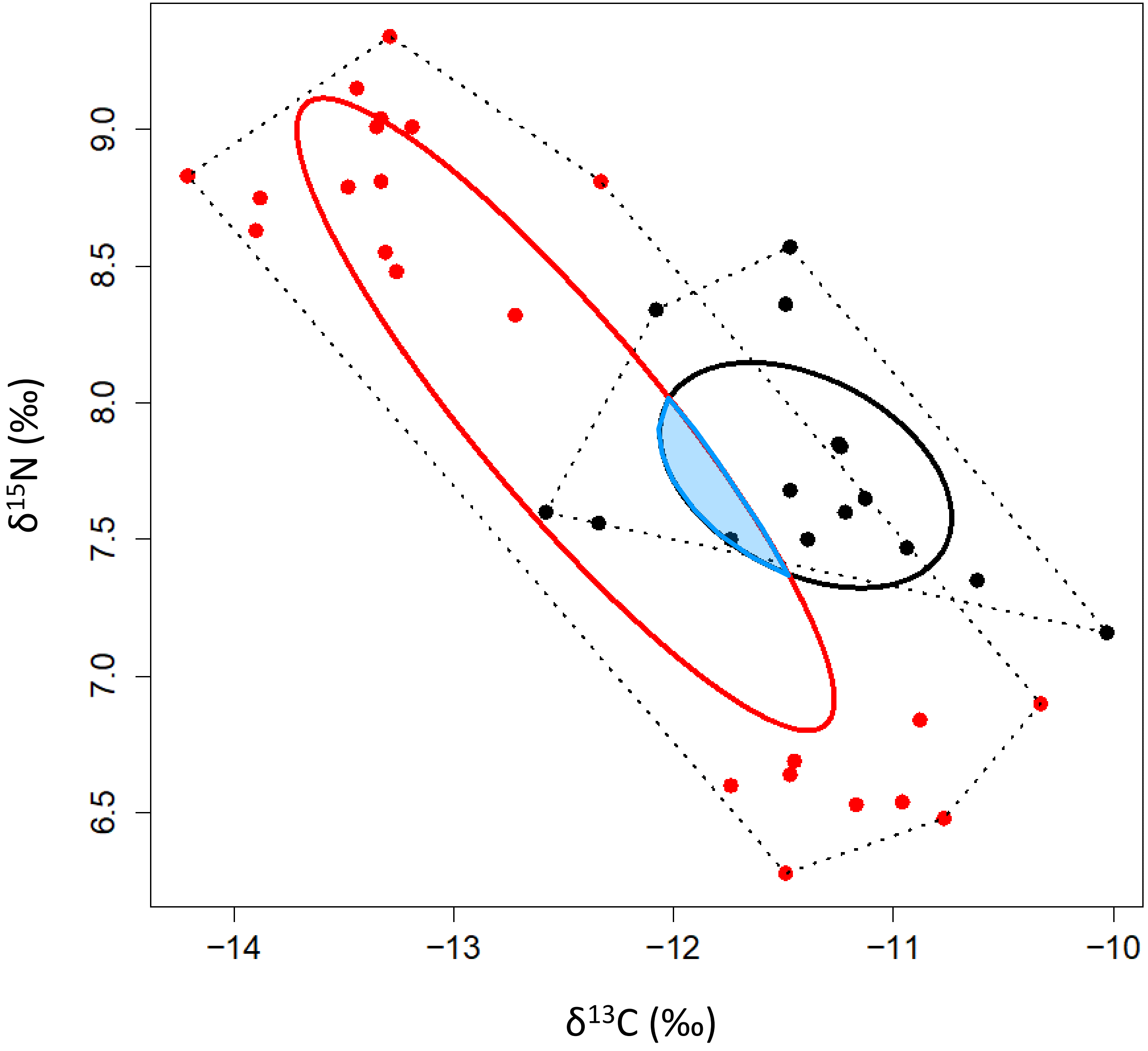
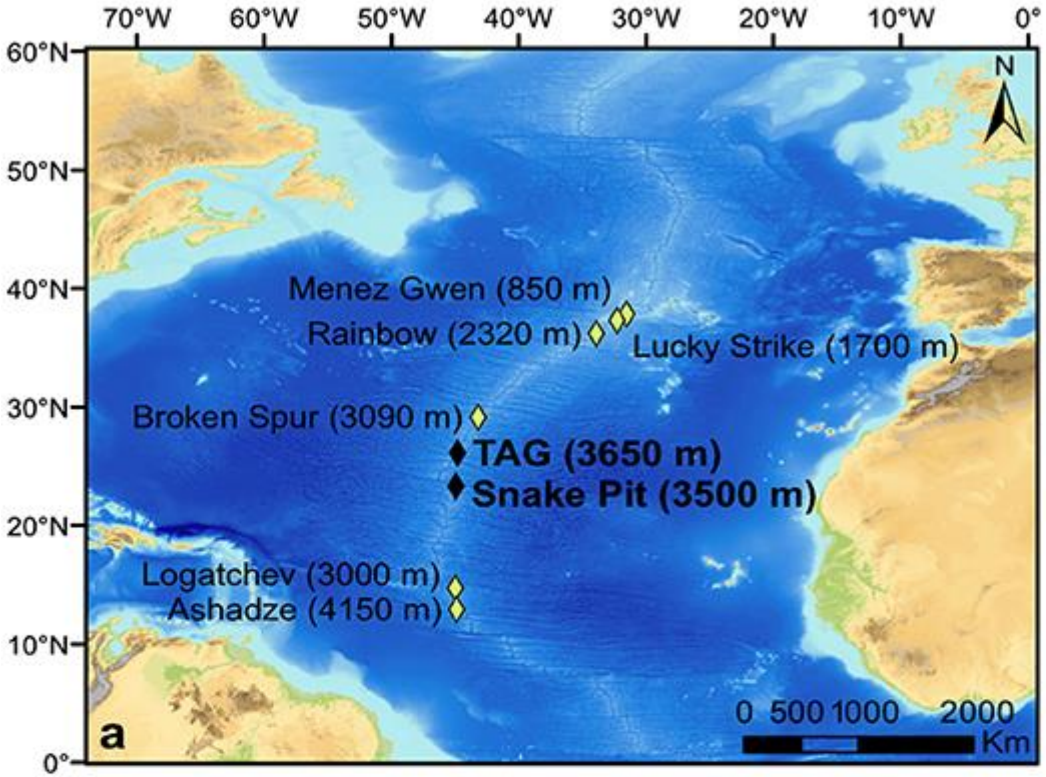


Isotopic niches – Snake Pit shrimps



Spedicato *et al*. 2020

Snake Pit hydrothermal field (Mid-Atlantic Ridge)

Pierre Methou
(Then Ifremer, now JAMSTEC)

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Research

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Cite this article: Methou P, Michel LN, Segonzac M, Cambon-Bonavita M-A, Pradillon F. 2020 Integrative taxonomy revisits the ontogeny and trophic niches of *Rimicaris* vent shrimps. *R. Soc. Open Sci.* **7**: 200837. http://dx.doi.org/10.1098/rsos.200837

Integrative taxonomy revisits the ontogeny and trophic niches of *Rimicaris* vent shrimps

Pierre Methou[1,2], Loïc N. Michel[2], Michel Segonzac[3], Marie-Anne Cambon-Bonavita[1] and Florence Pradillon[2]

Isotopic niches – Snake Pit shrimps

Shrimp swarms notably containing two congeneric species in variable densities and proportions

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Rimicaris exoculata: enlarged cephalothoracic cavity hosting abundant episymbiotic communities on which they depend for their nutrition

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Shrimp swarms notably containing two congeneric species in variable densities and proportions

Rimicaris exoculata: enlarged cephalothoracic cavity hosting abundant episymbiotic communities on which they depend for their nutrition

Rimicaris chacei: smaller, no obvious morphological adaptations to symbiosis, mixotrophic species (depend both on symbiotic associations and "classical" feeding)

Isotopic niches – Snake Pit shrimps

Not only adults, but also juveniles / immature individuals

R. exoculata

Juvenile stade A

Juvenile stade B

Juvenile stade C
(Subadult)

R. chacei

Juvenile stade A

Juvenile stade B
(Subadult)

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Juvenile stade A

Juvenile stade B

Juvenile stade C
(Subadult)

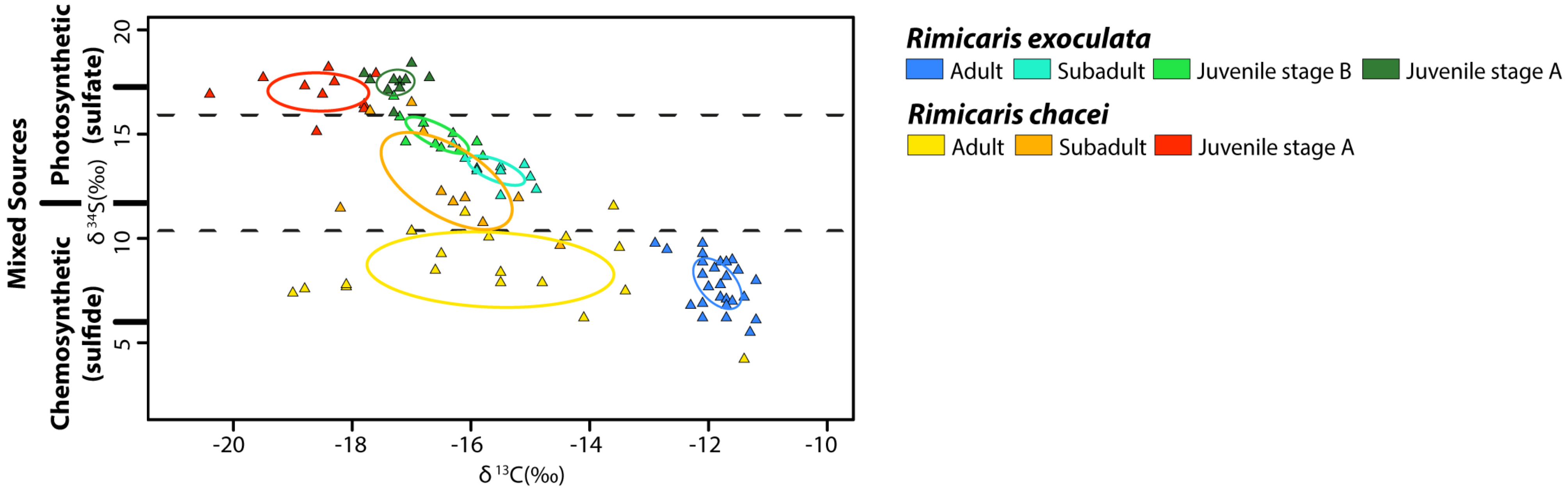
R. chacei

Juvenile stade A

Juvenile stade B
(Subadult)

What do these species rely on throughout their life cycle stages occuring in vent ecosystems? Are there ontogenetic niche shifts?

Isotopic niches – Snake Pit shrimps



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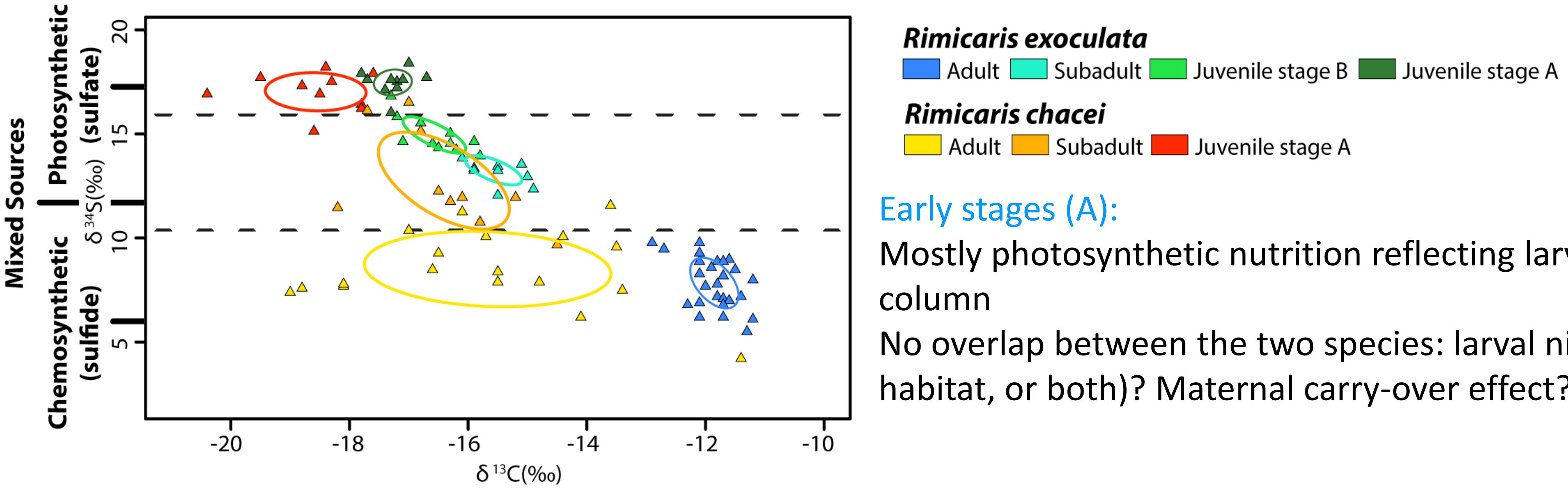
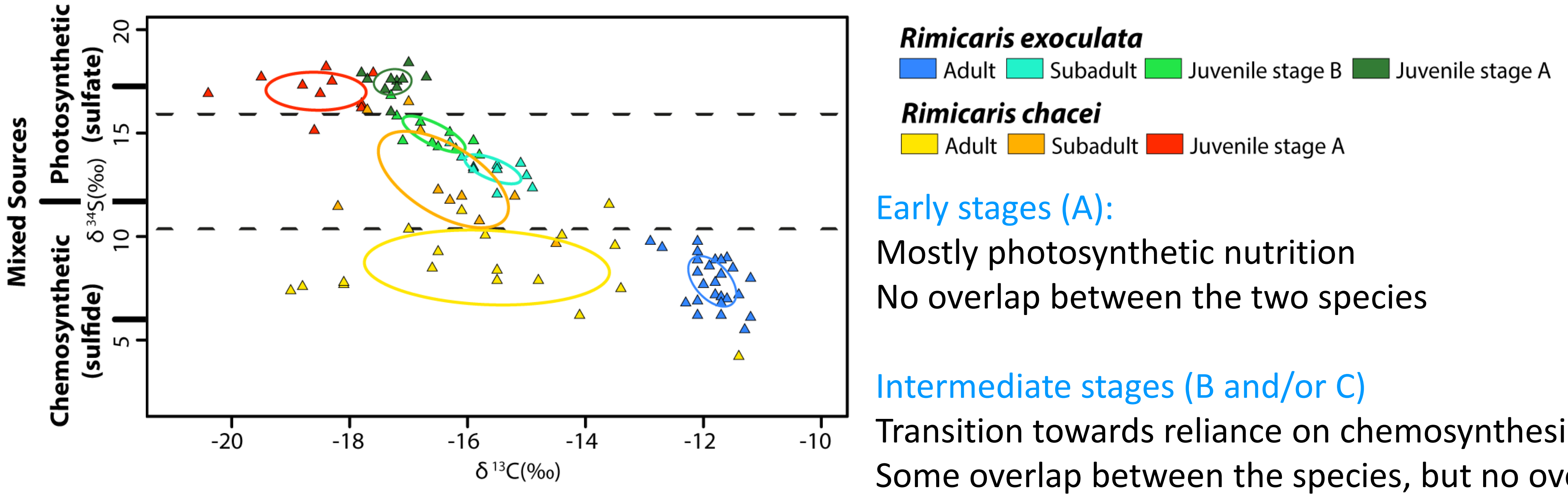


Early stages (A):

Mostly photosynthetic nutrition reflecting larval stages in the water column

No overlap between the two species: larval niche segregation (trophic, habitat, or both)? Maternal carry-over effect?

Isotopic niches – Snake Pit shrimps



Early stages (A):

Mostly photosynthetic nutrition

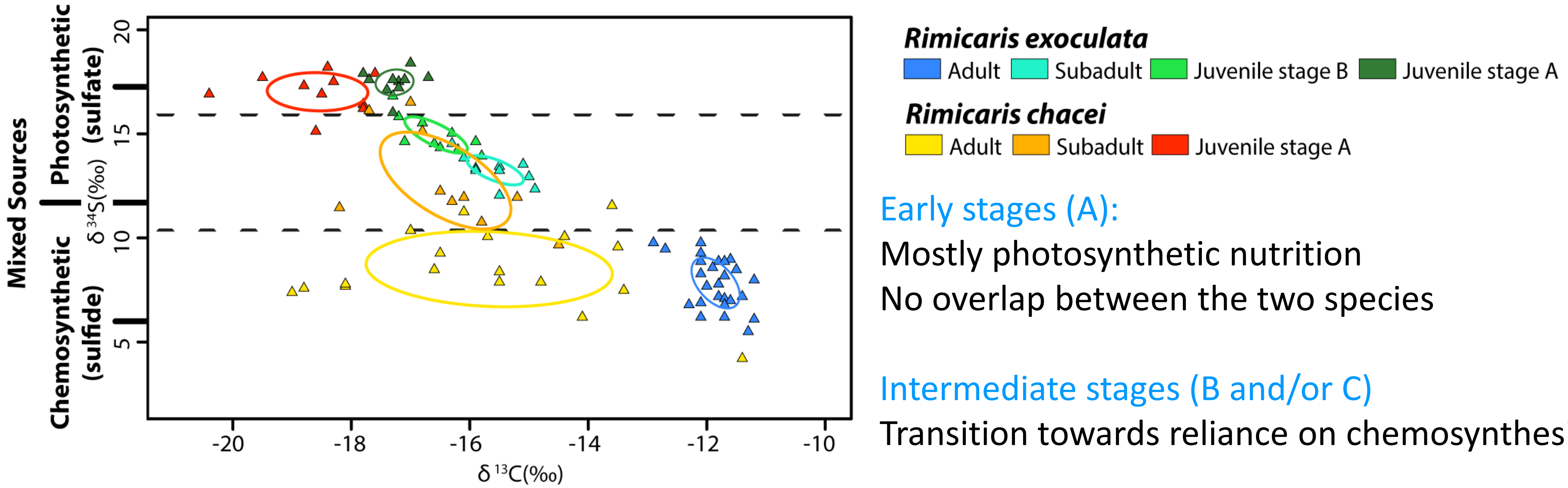
No overlap between the two species

Intermediate stages (B and/or C)

Transition towards reliance on chemosynthesis

Some overlap between the species, but no overlap between successive stages in *R. exoculata*

Isotopic niches – Snake Pit shrimps



Early stages (A):

Mostly photosynthetic nutrition

No overlap between the two species

Intermediate stages (B and/or C)

Transition towards reliance on chemosynthesis

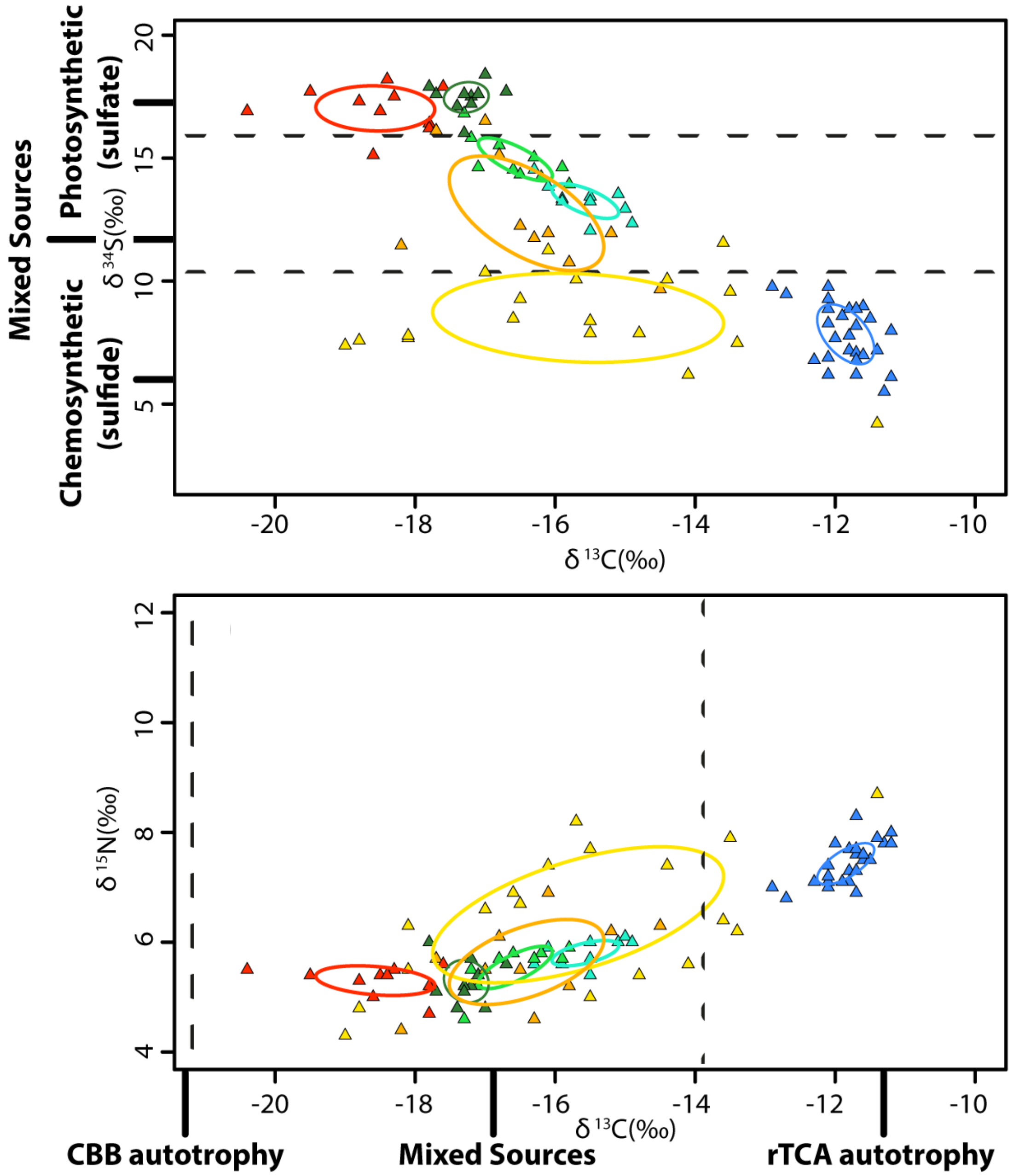
Adult stages

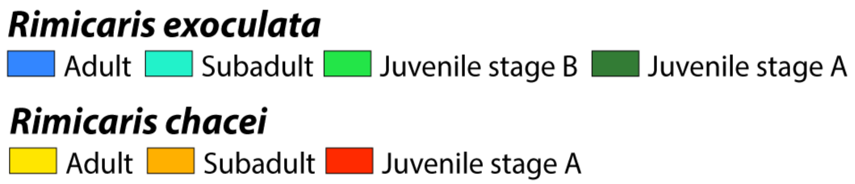
Chemosynthetic nutrition and marked niche separation

R. exoculata: narrow niche consistent with sole reliance on their symbionts. Big gap between subadults and adults linked with strong ecological and morphological changes

R. chacei: much wider niche (greater trophic diversity): mixotrophy and/or reliance on multiple symbiotic partners

Isotopic niches – Snake Pit shrimps





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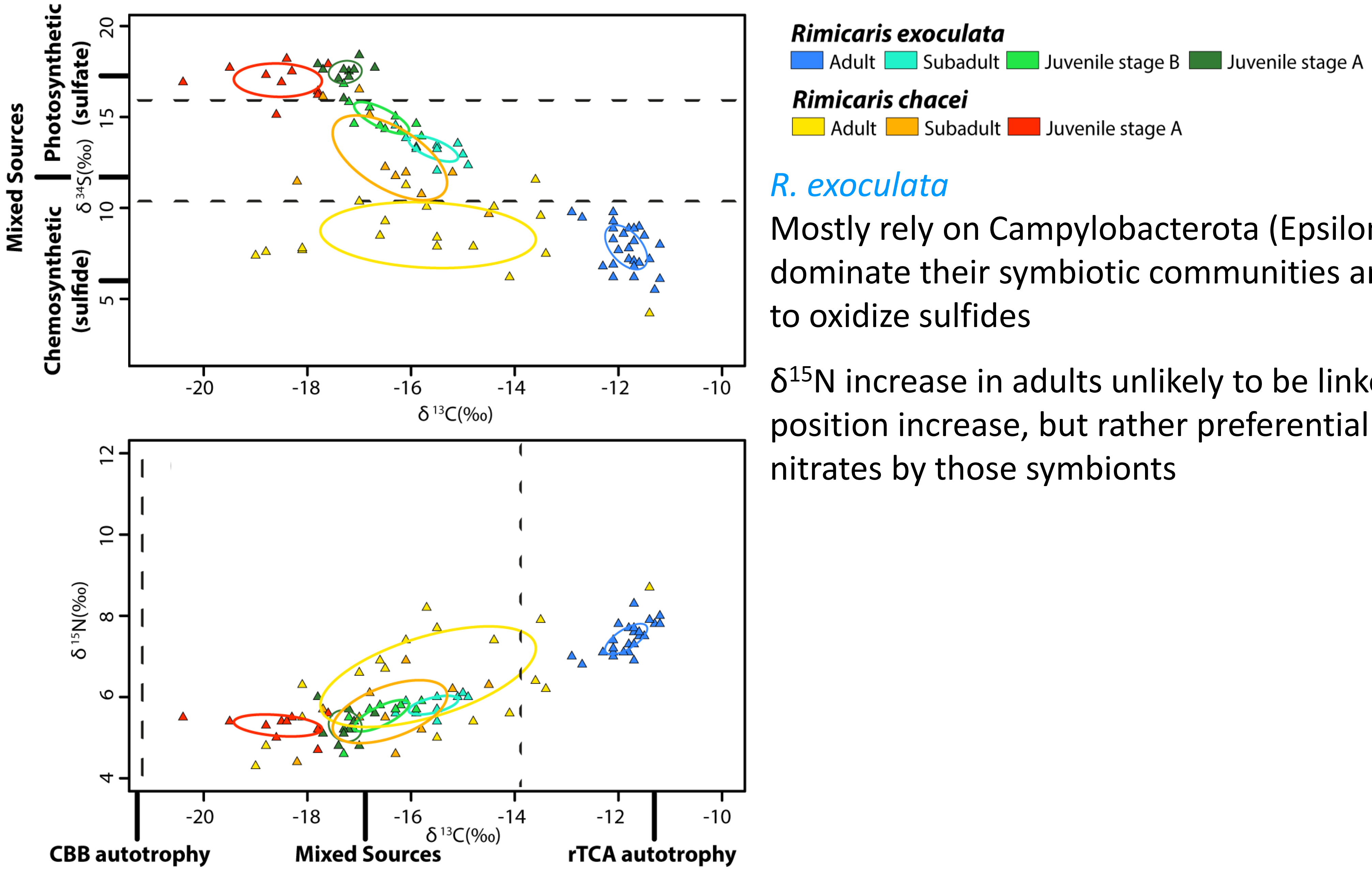
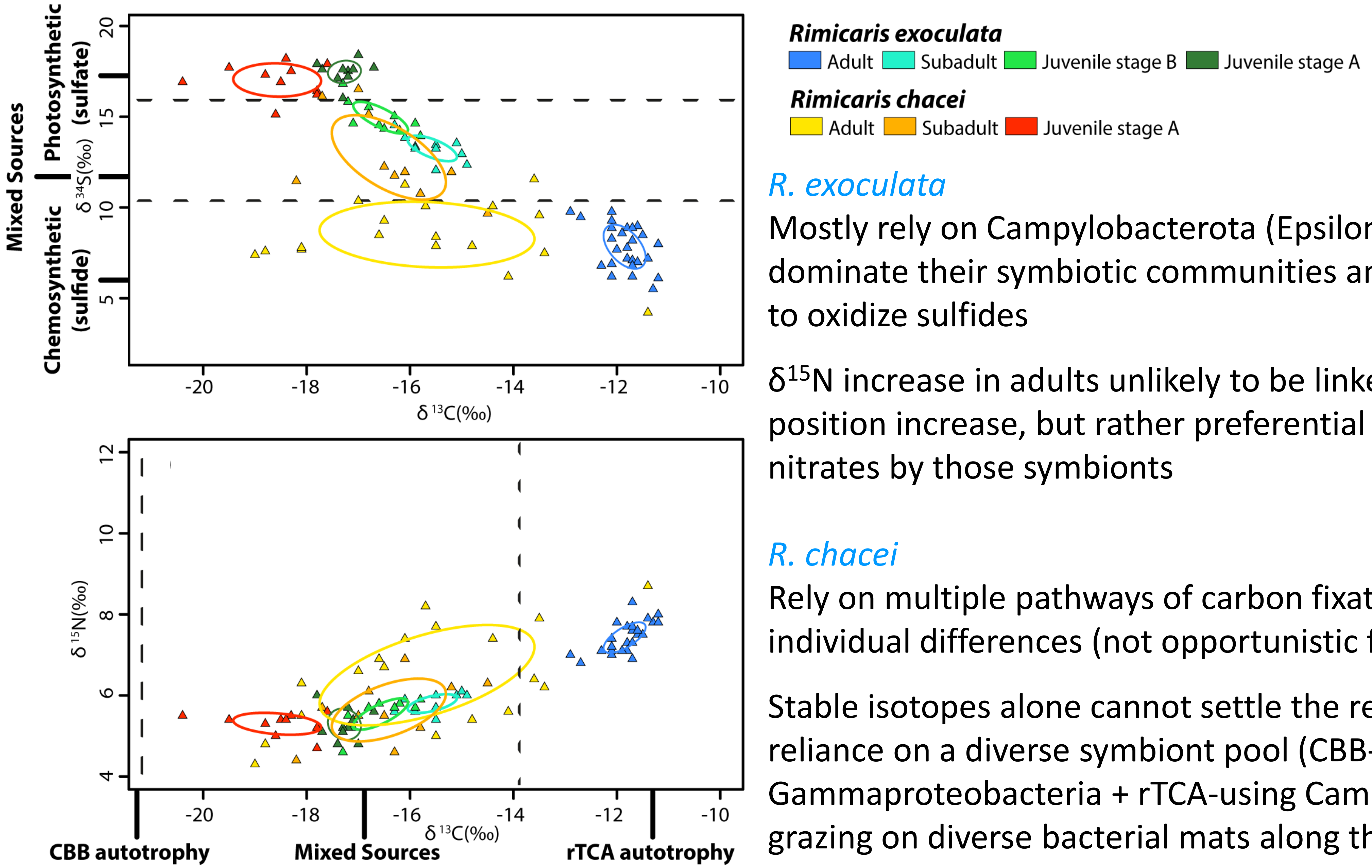


R. exoculata

Mostly rely on Campylobacterota (Epsilonproteobacteria) that dominate their symbiotic communities and use the rTCA cycle to oxidize sulfides

$\delta^{15}N$ increase in adults unlikely to be linked with trophic position increase, but rather preferential assimilation of nitrates by those symbionts

Isotopic niches – Snake Pit shrimps



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R. chacei

Rely on multiple pathways of carbon fixation, with large inter-individual differences (not opportunistic feeding!)

Stable isotopes alone cannot settle the relative importance of reliance on a diverse symbiont pool (CBB-using Gammaproteobacteria + rTCA-using Campylobacterota) vs. grazing on diverse bacterial mats along the vent gradient

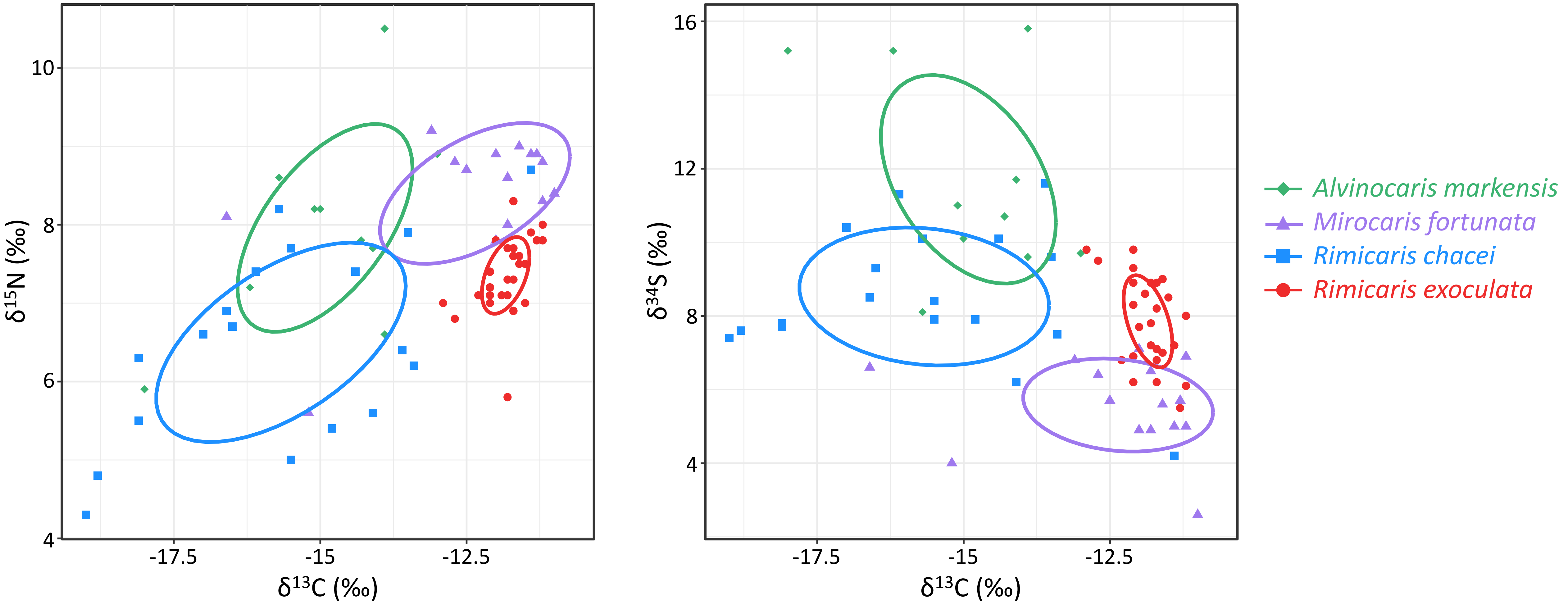
Isotopic niches – Snake Pit shrimps

Symbiotrophic
Rimicaris exoculata

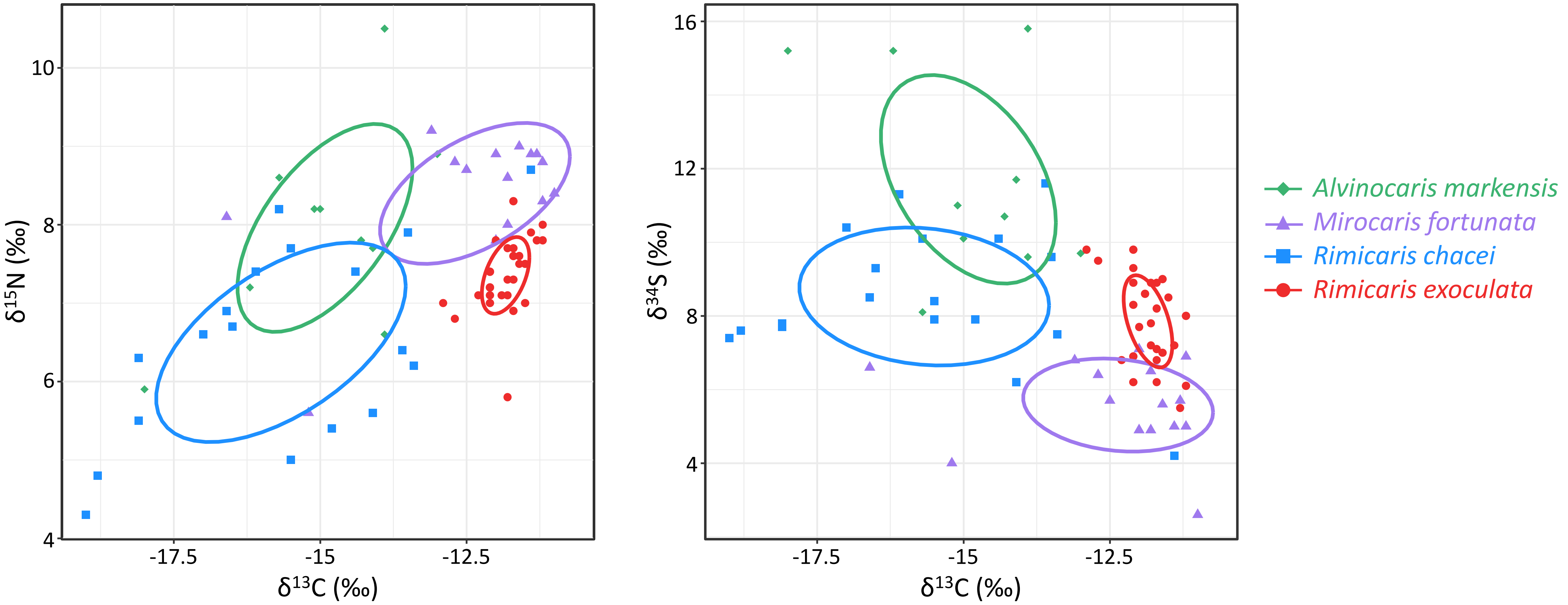
Mixotrophic
Rimicaris chacei

Phagotrophic
Mirocaris fortunata
Alvinocaris markensis

Isotopic niches – Snake Pit shrimps

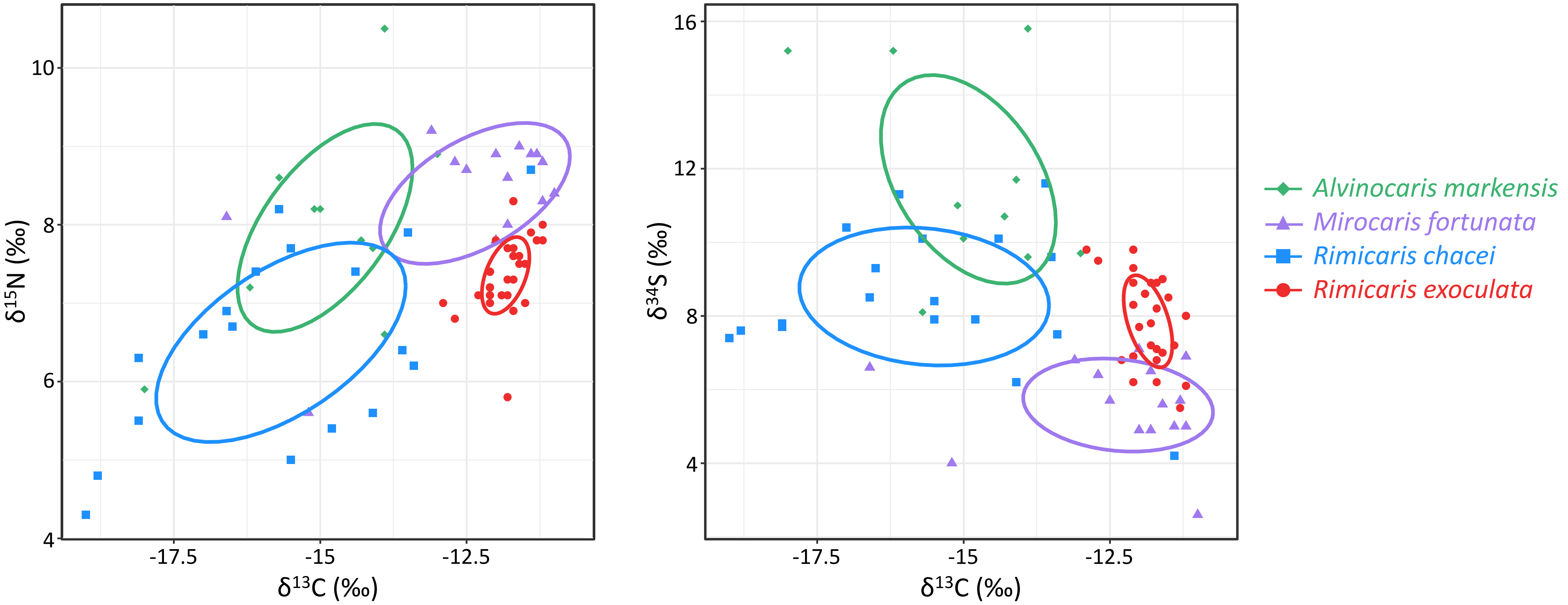


Isotopic niches – Snake Pit shrimps



Both phagotrophic species have higher $\delta^{15}N$: omnivory?

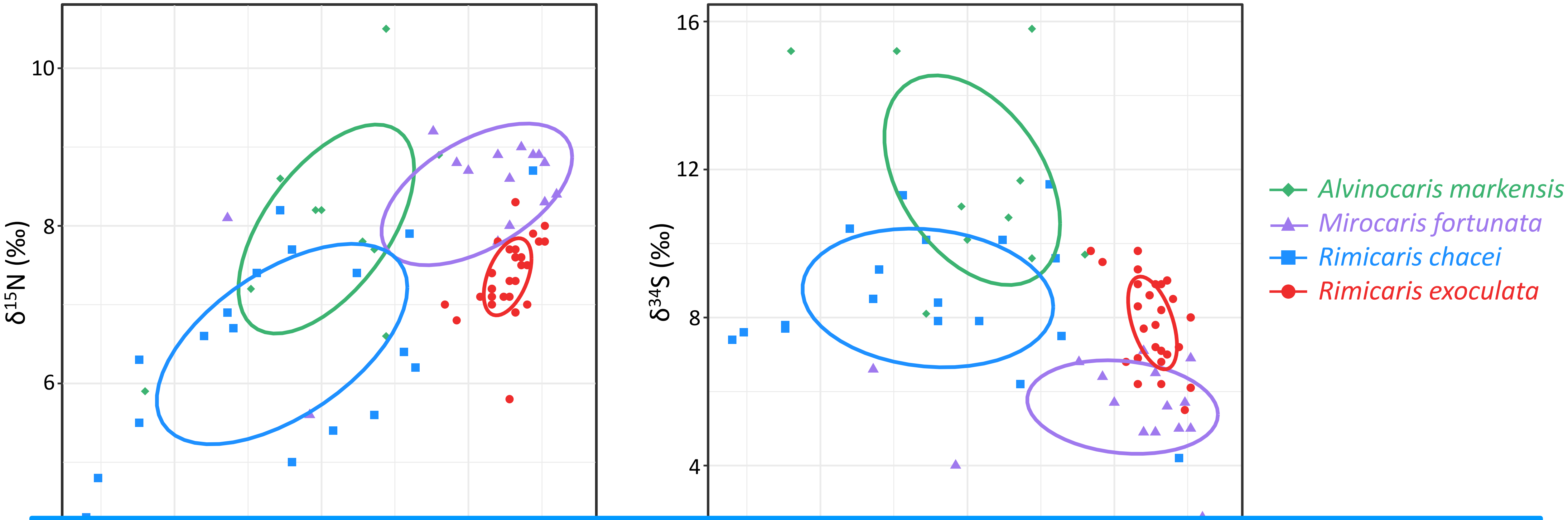
Isotopic niches – Snake Pit shrimps



Both phagotrophic species have higher $\delta^{15}N$: omnivory?

M. fortunata only relies on endogenous vent production, but *A. markensis*' niche is very wide and this species apparently feeds on a mix of photosynthesis- and chemosynthesis-derived items

Isotopic niches – Snake Pit shrimps

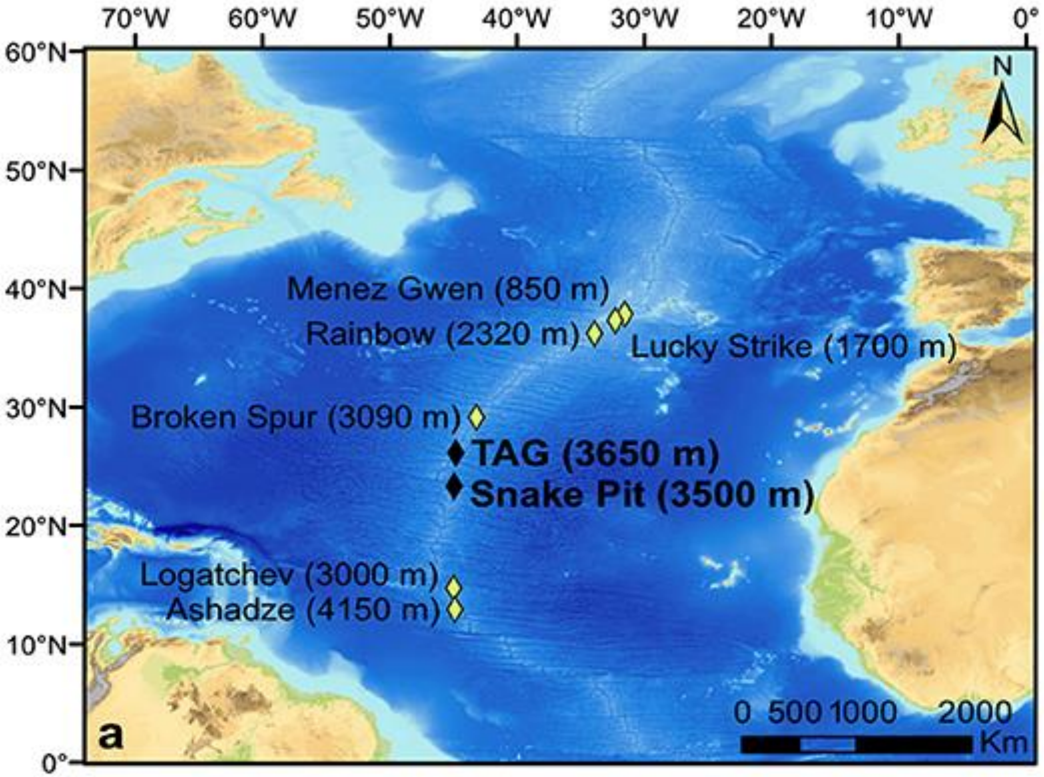


Stable isotopes allow tracing organic matter fluxes between ecosystems… Both ways!

Both phagotrophic species have higher $\delta^{15}N$: omnivory?

M. fortunata only relies on endogenous vent production, but *A. markensis*’ niche is very wide and this species apparently feeds on a mix of photosynthesis- and chemosynthesis-derived items

Links between vents and peripheral habitats



Spedicato *et al*. 2020

Joan Alfaro-Lucas
(Then Ifremer, now U Victoria)

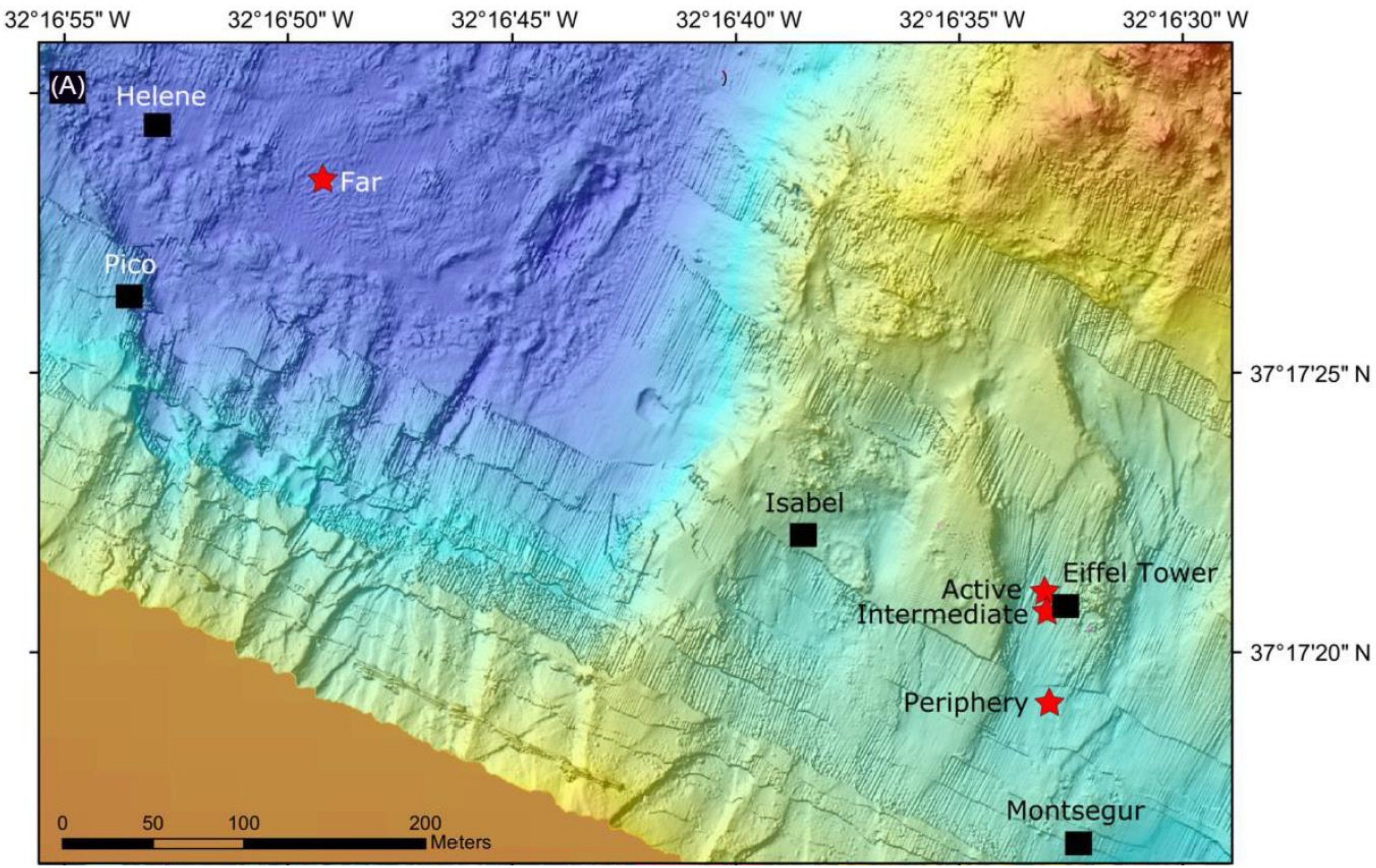
High environmental stress and productivity increase functional diversity along a deep-sea hydrothermal vent gradient

J. M. Alfaro-Lucas,[1,4] F. Pradillon,[1] D. Zeppilli,[1] L. N. Michel,[1] P. Martinez-Arbizu,[2] H. Tanaka,[3] M. Foviaux,[1] and J. Sarrazin[1]

Ecology, 101(11), 2020, e03144

Lucky Strike hydrothermal field (Mid-Atlantic Ridge)

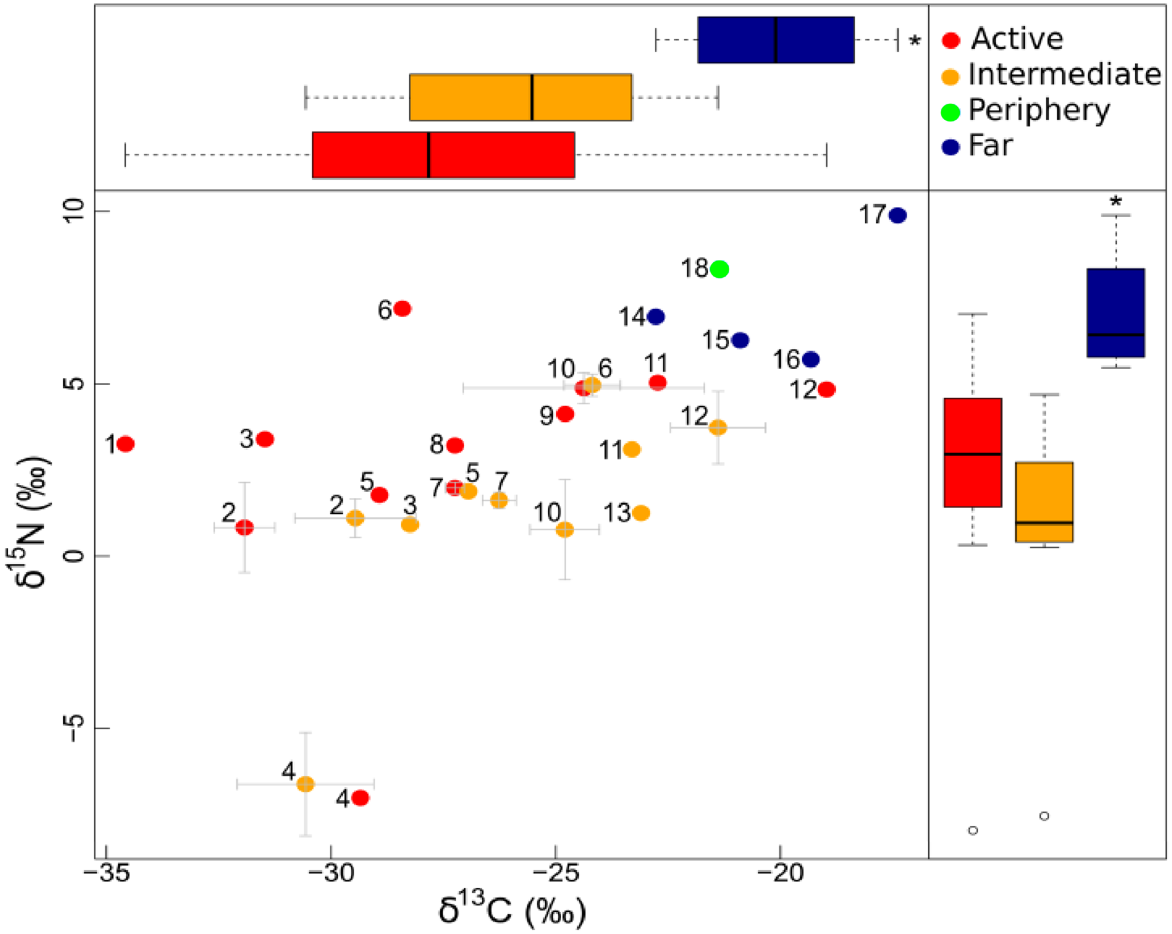
Links between vents and peripheral habitats



Deployment of artificial substrates along a vent proximity gradient for 2 years

Analysis of settled communities in terms of taxonomic, functional and isotopic diversity

Links between vents and peripheral habitats



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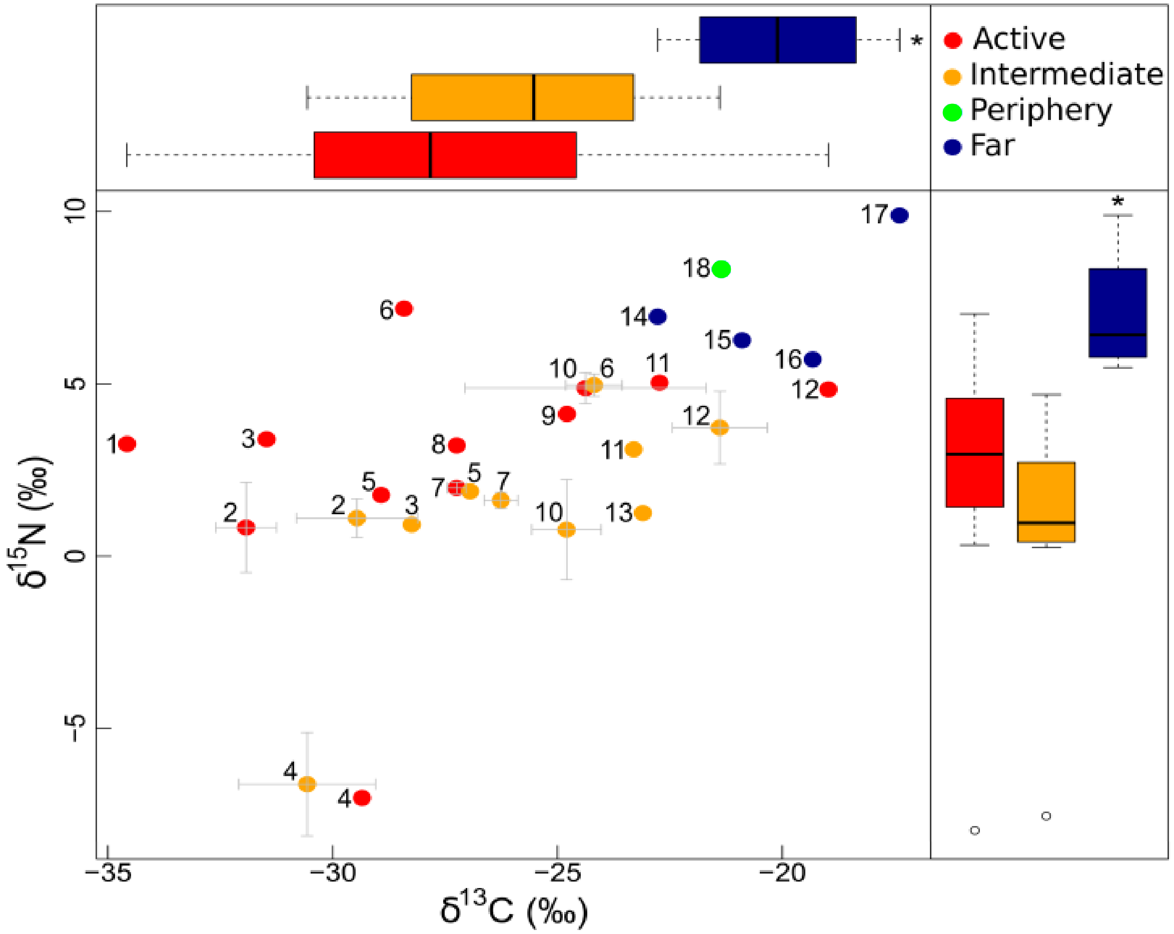

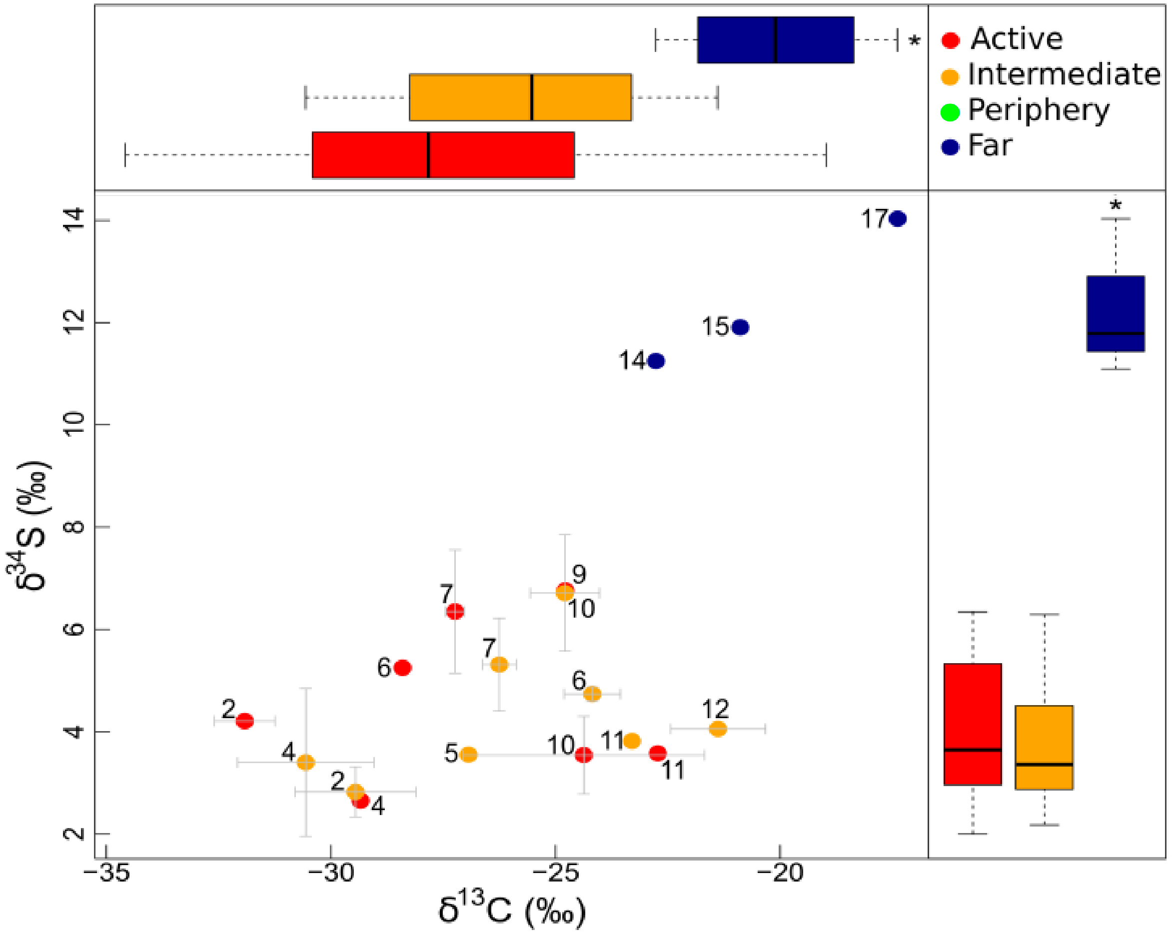

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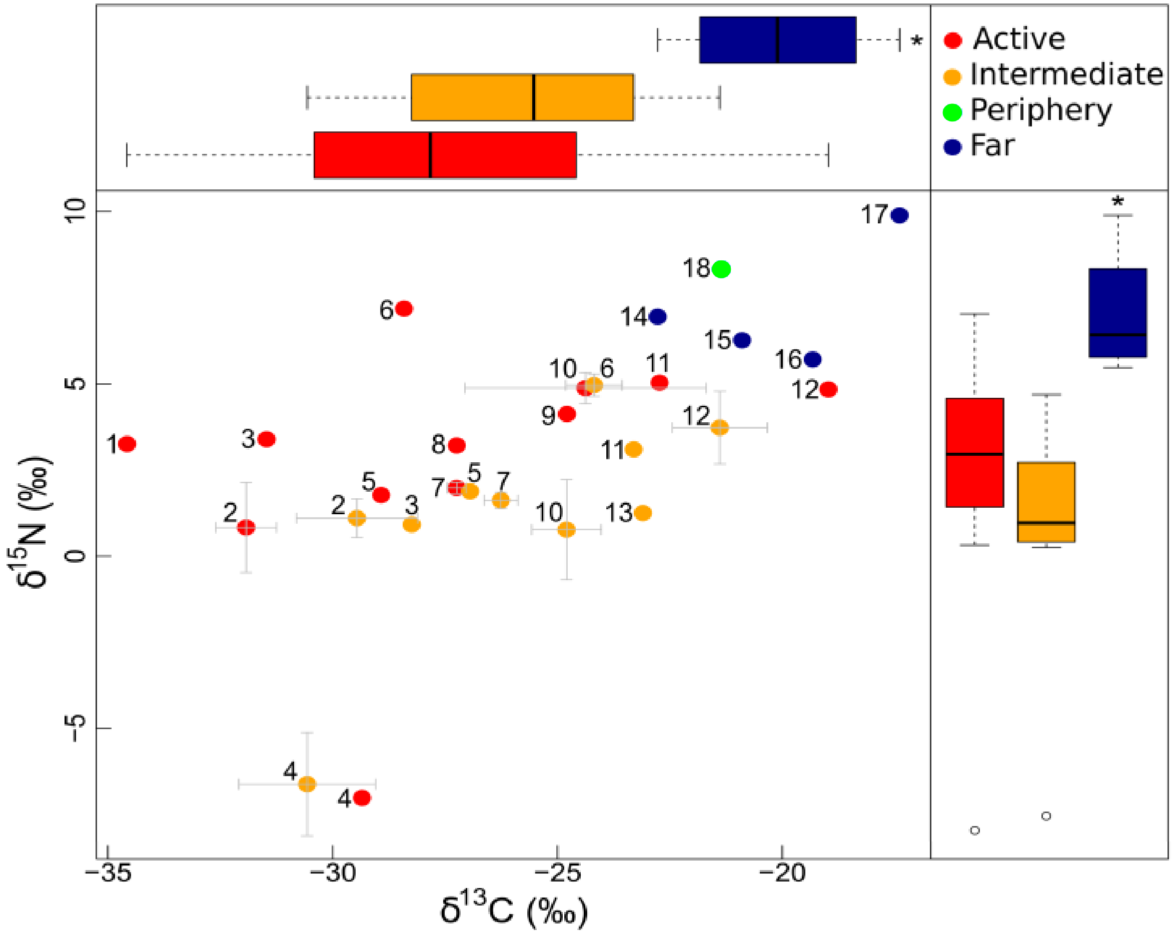
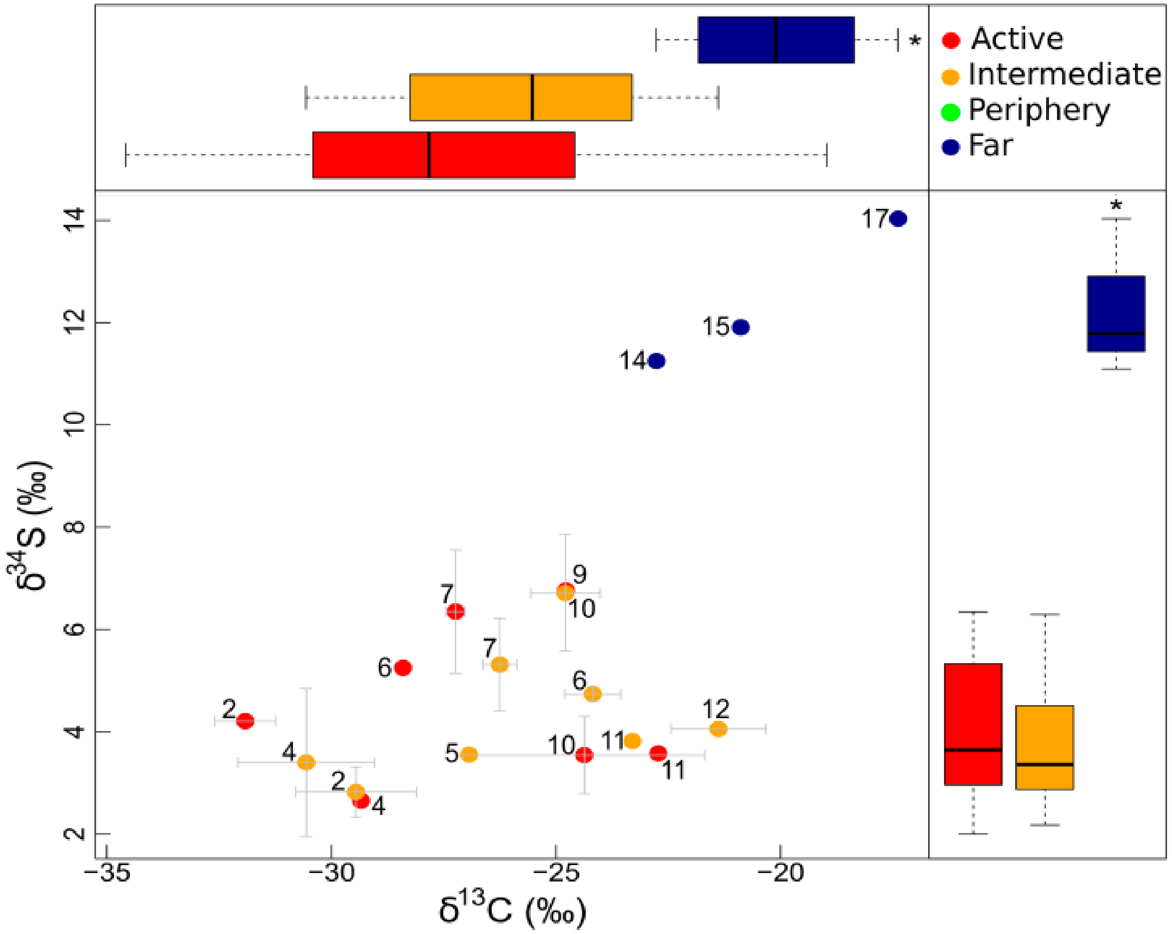
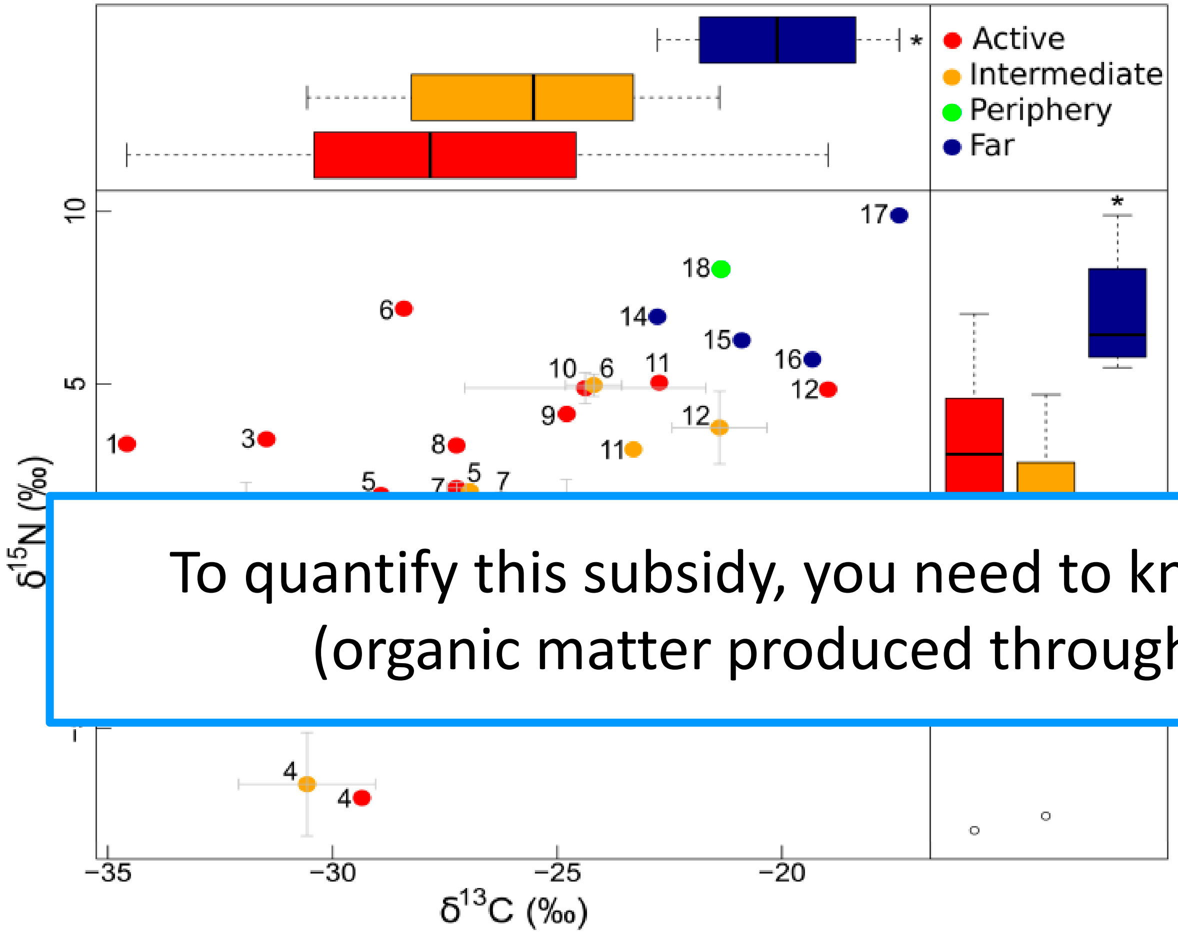
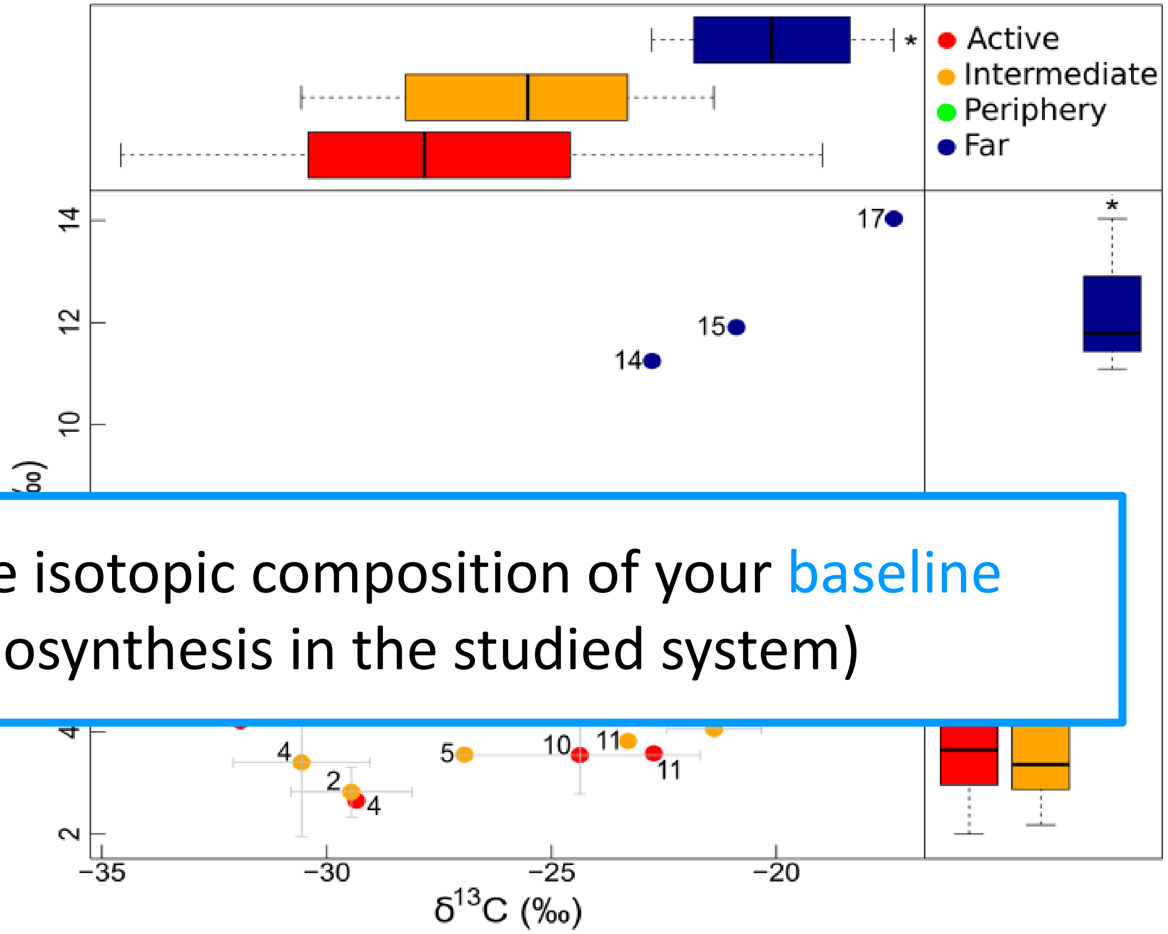




Partial reliance on chemosynthesis at the far site (100 m from any active vent): spatial subsidy extends way beyond areas under direct venting influence

Links between vents and peripheral habitats

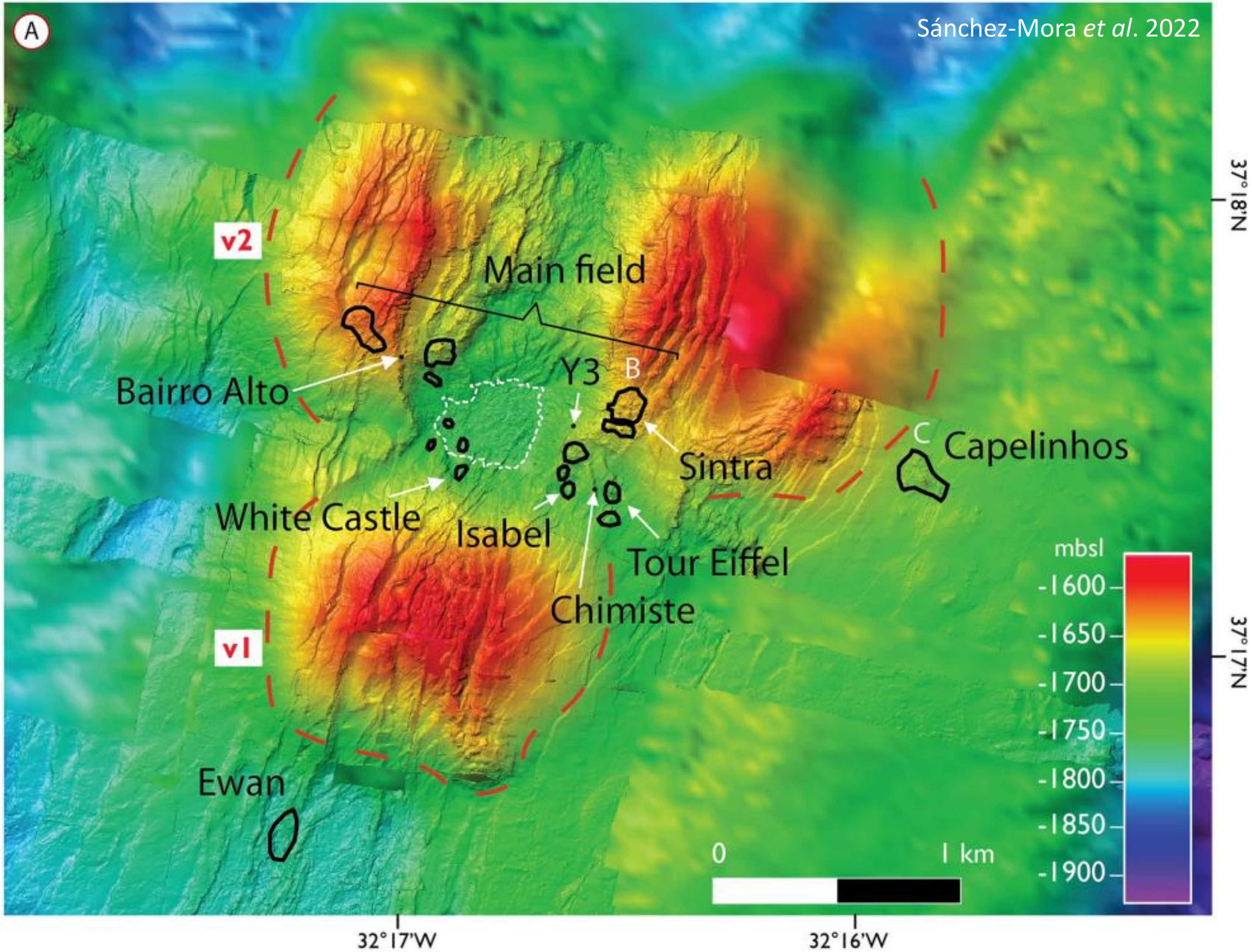




To quantify this subsidy, you need to know the isotopic composition of your baseline (organic matter produced through chemosynthesis in the studied system)

Partial reliance on chemosynthesis at the far site (100 m from any active vent): spatial subsidy extends way beyond areas under direct venting influence

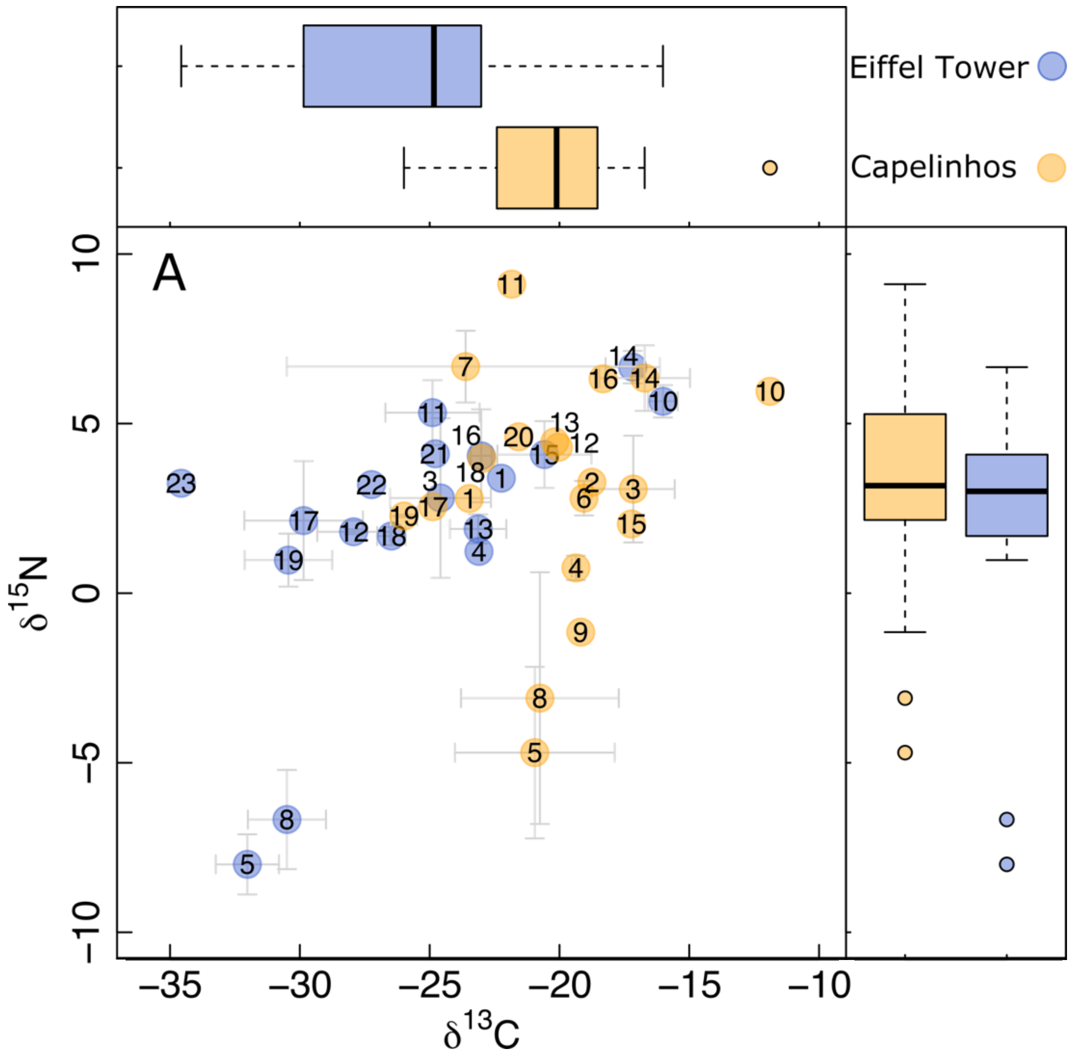
Baseline variability inside a vent field



Lucky Strike vent field

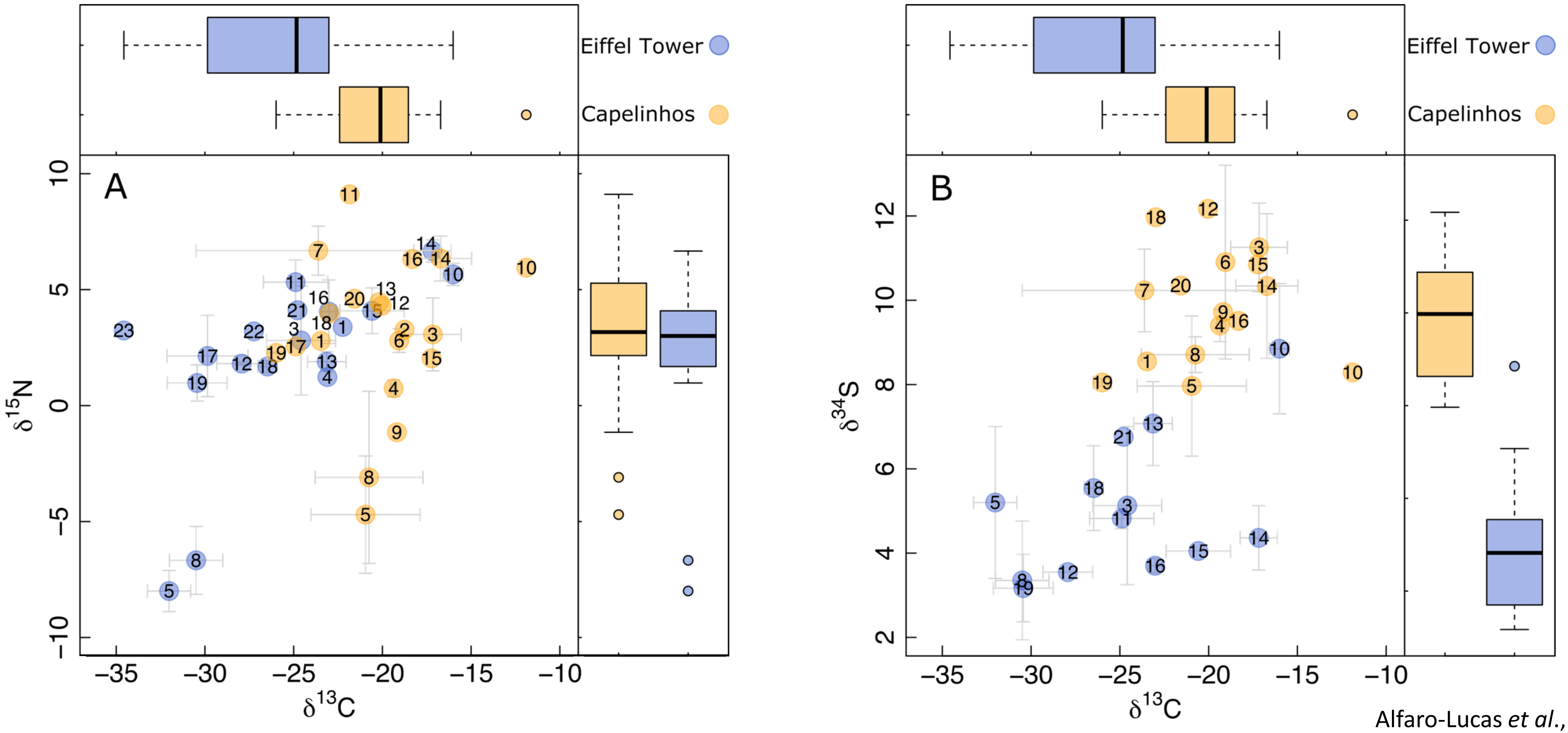
Eiffel Tower & Capelinhos (~ 1.5 km apart)

Baseline variability inside a vent field



Alfaro-Lucas *et al.*, In review

Baseline variability inside a vent field



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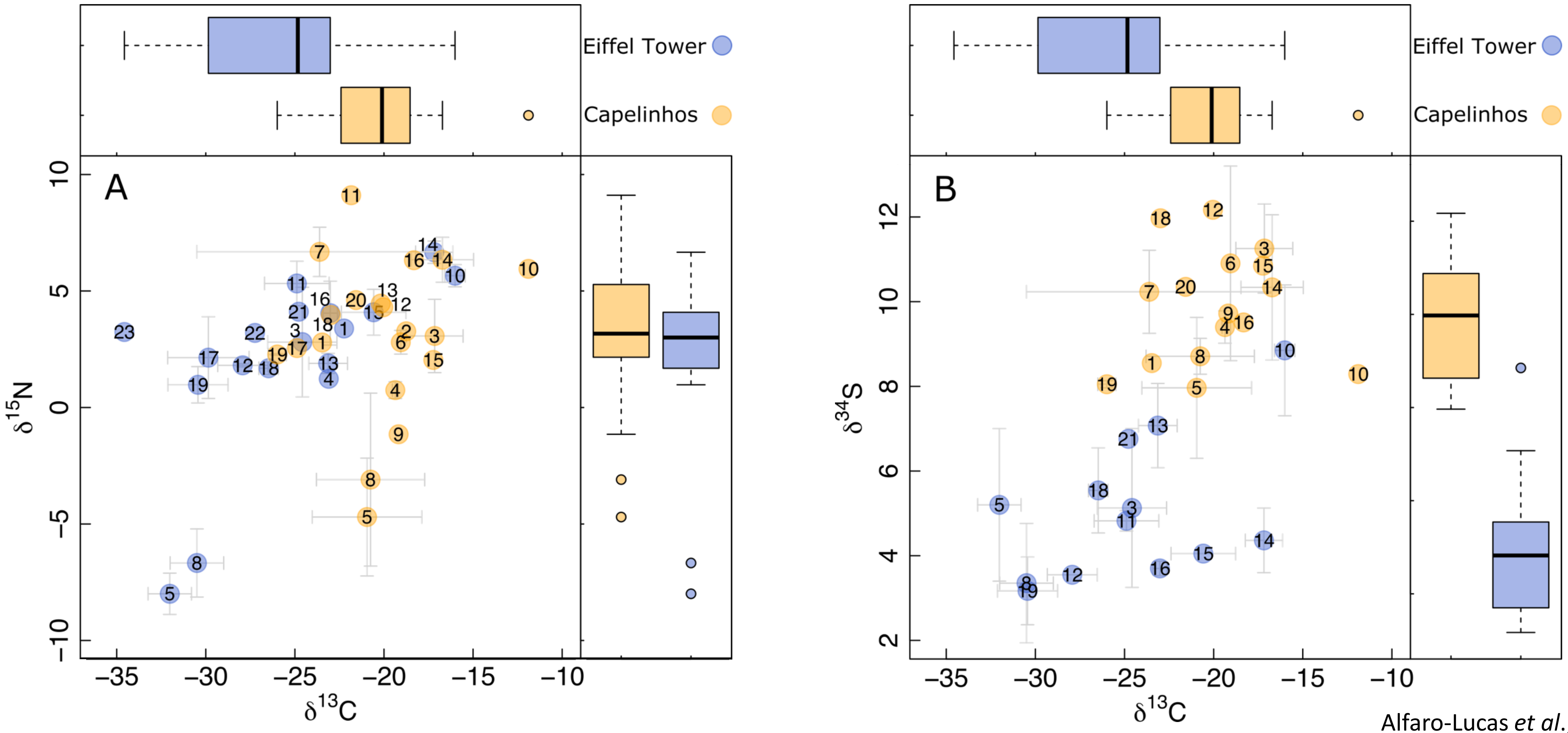
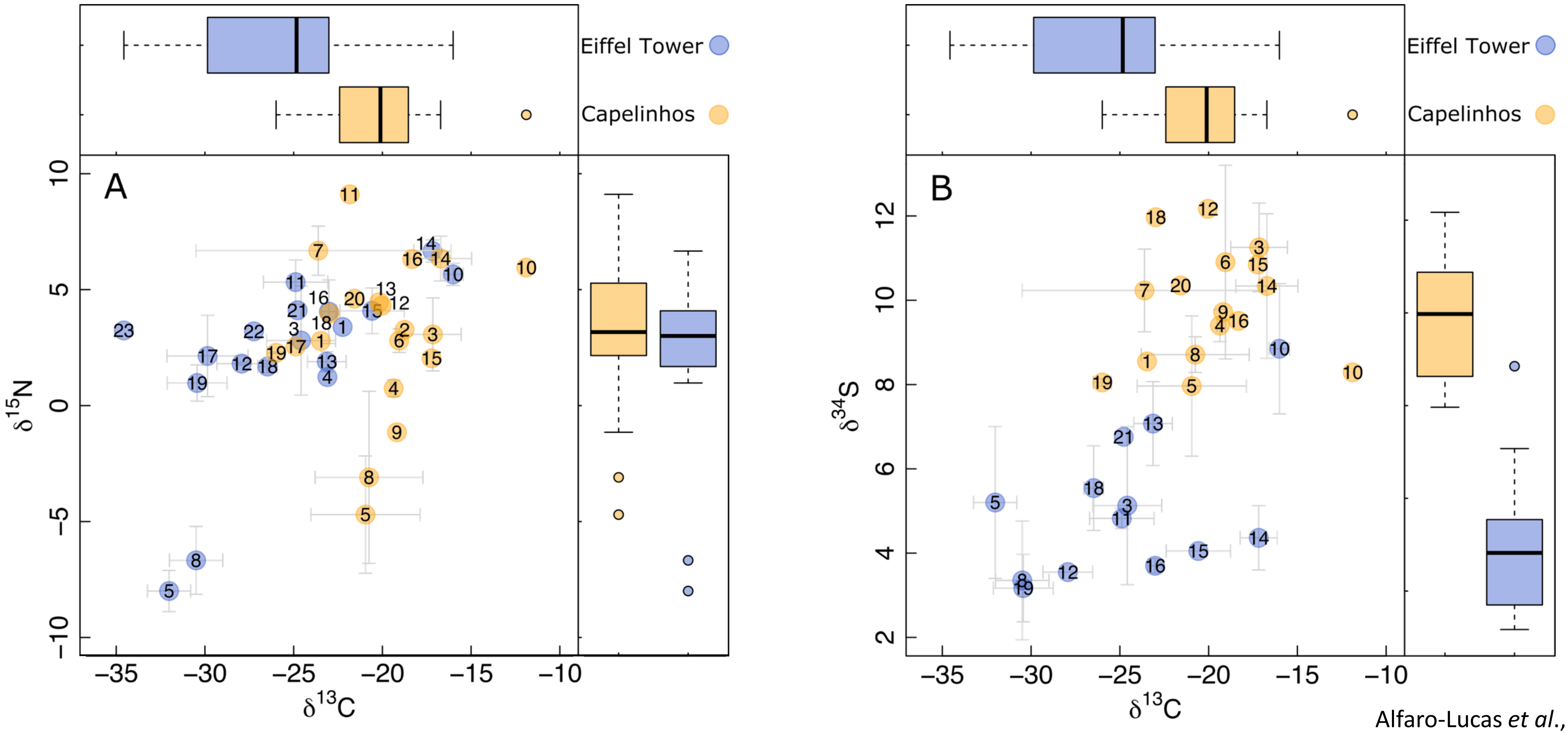


Alfaro-Lucas *et al.*, In review

General shift towards more positive $\delta^{13}C$, particularly marked in the foundation species *Bathymodiolus azoricus* (5)

Strong shift of the whole community towards higher $\delta^{34}S$

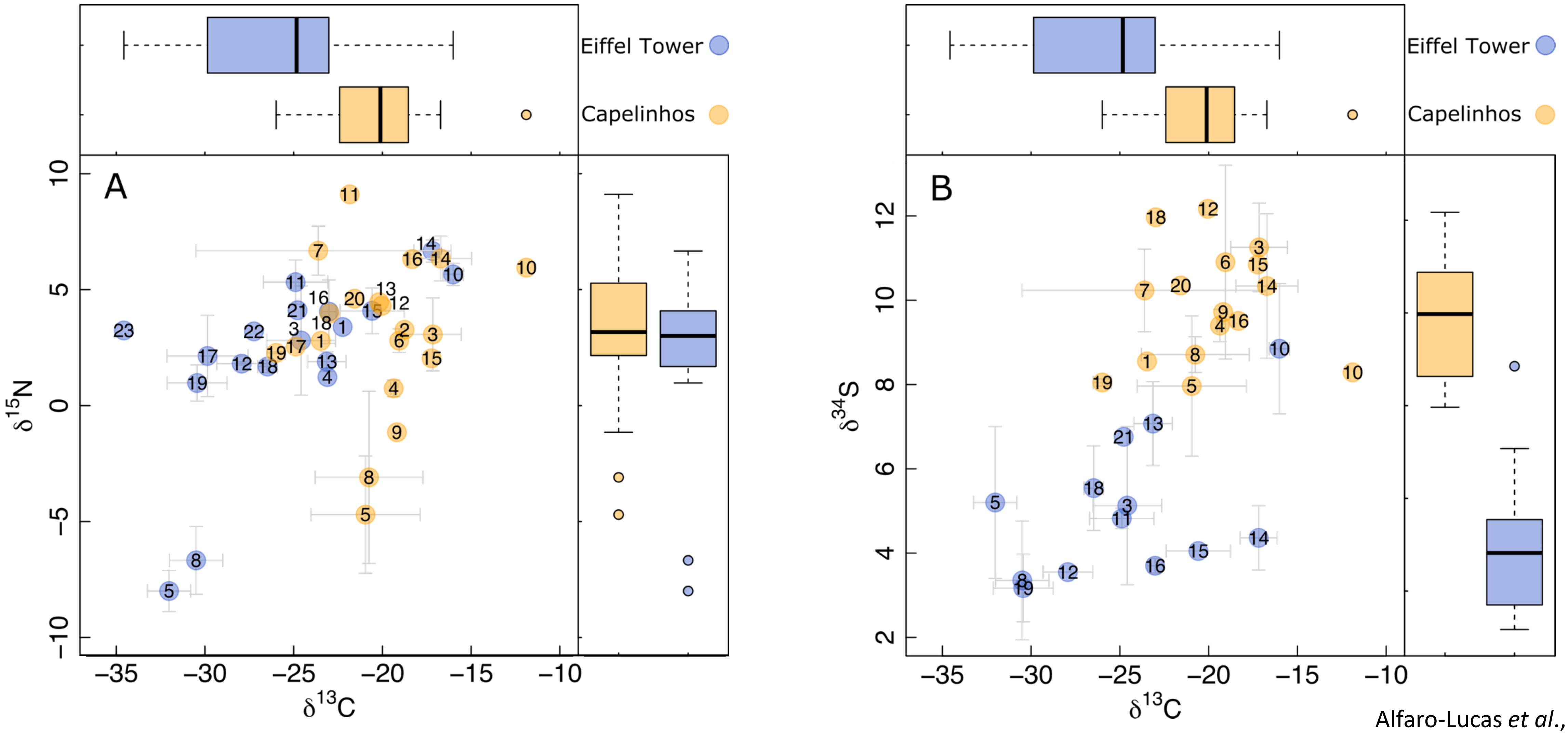
Baseline variability inside a vent field



Alfaro-Lucas *et al.*, In review

Higher contribution of photosynthetic OM? Unlikely: overall low $\delta^{15}N$ + similar depth and oceanographic features as other LS vents where export of photosynthetic OM is considered low to negligible

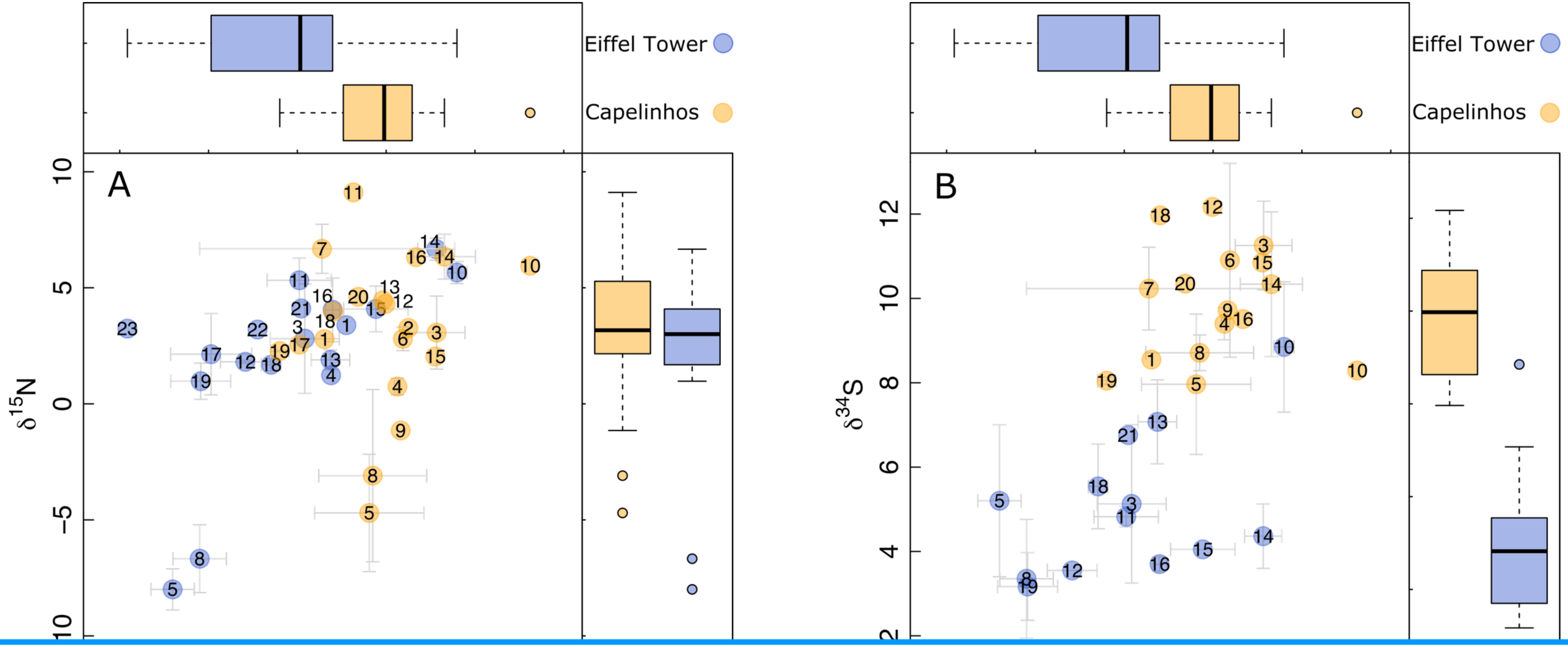
Baseline variability inside a vent field



Alfaro-Lucas *et al.*, In review

Local differences in geochemistry: different rock/fluid interactions leading to isotopically heavy sulfides and/or co-reliance of the vent community on CBB thiotrophy and methanotrophy (seen in other MAR vents like Rainbow)

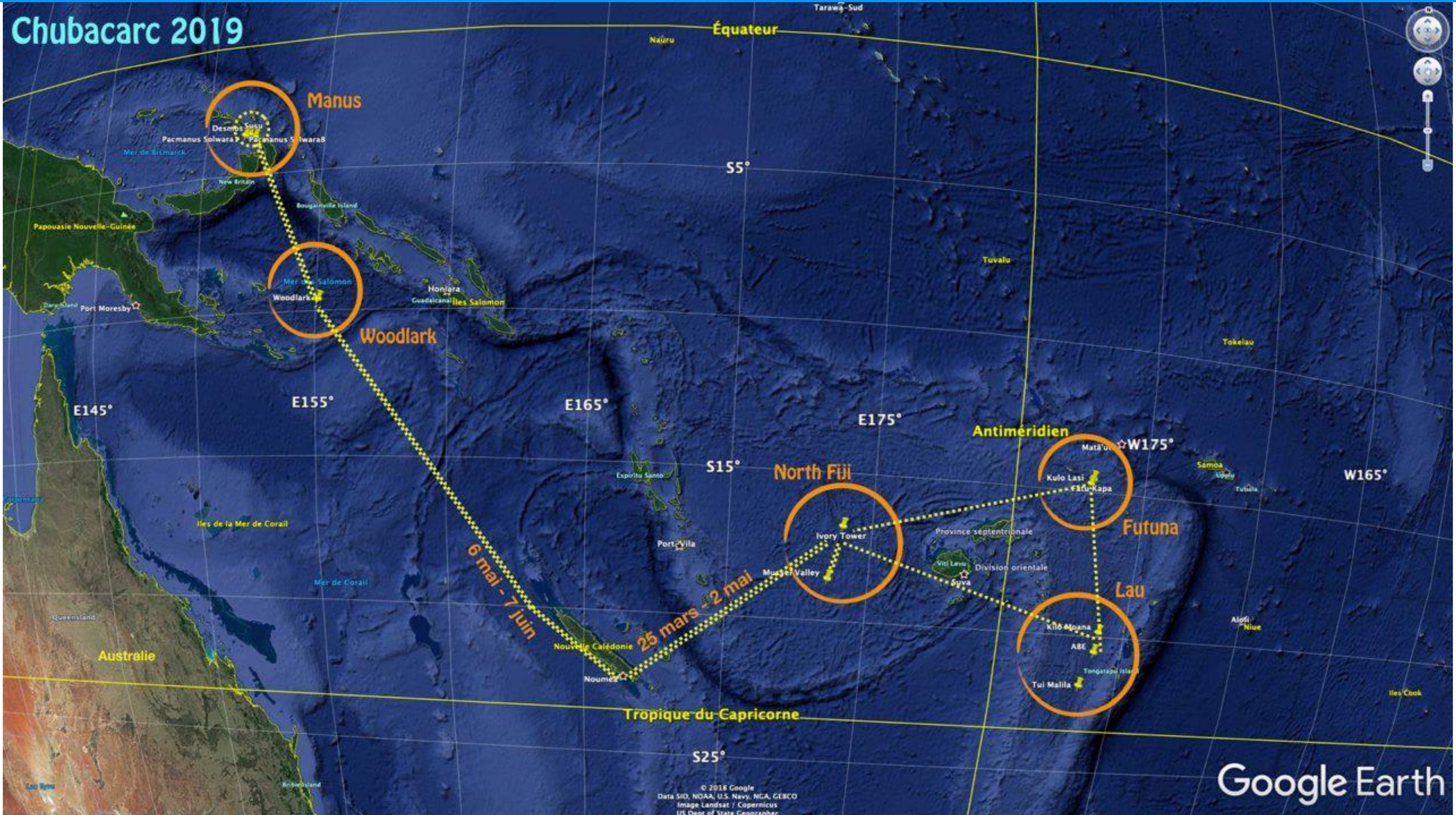
Baseline variability inside a vent field



The absence of baseline data complicates the interpretation of trophic interactions inside a system or across systems

Baseline variation exists at multiple spatial scales

Baseline variation at large spatial scale



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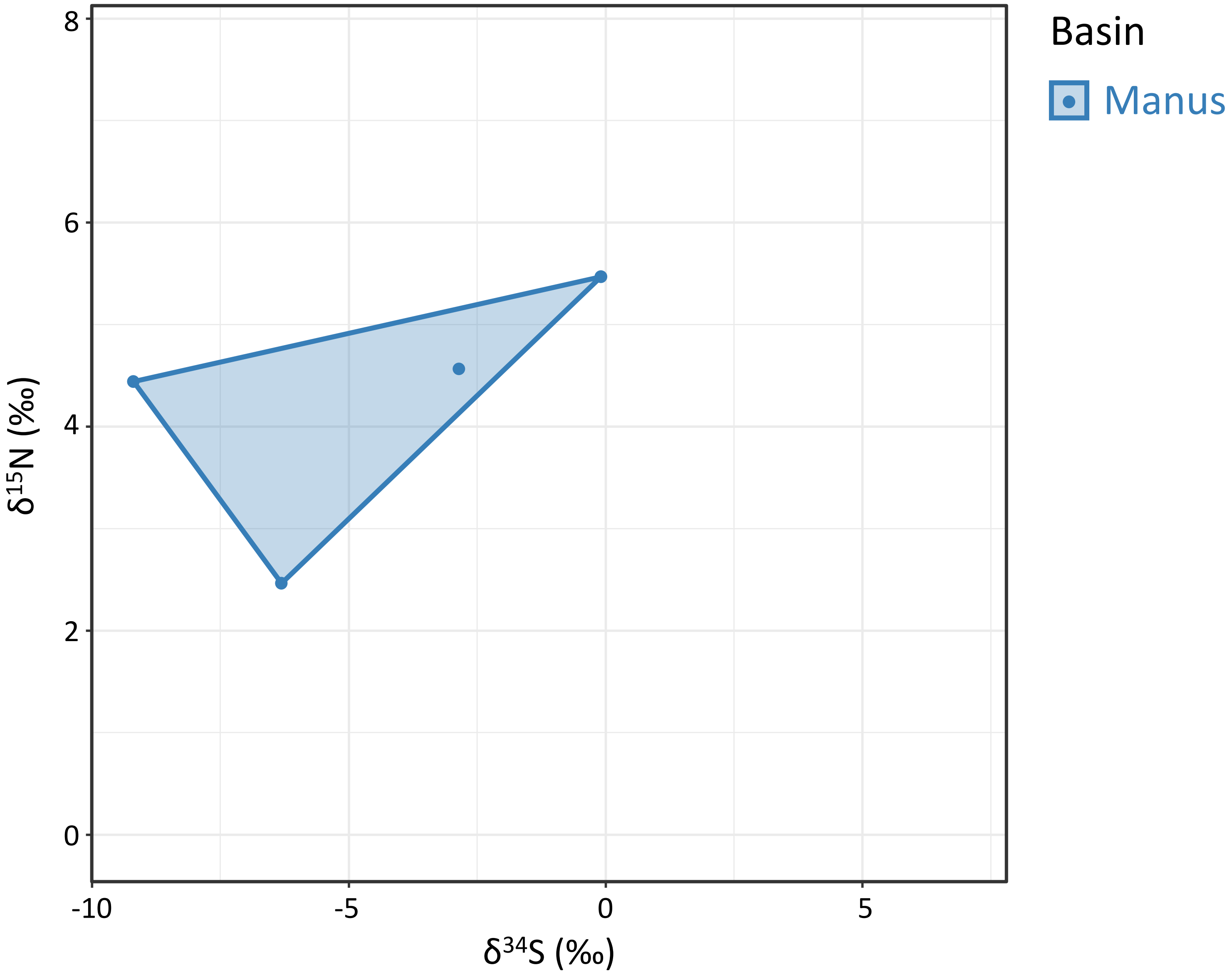
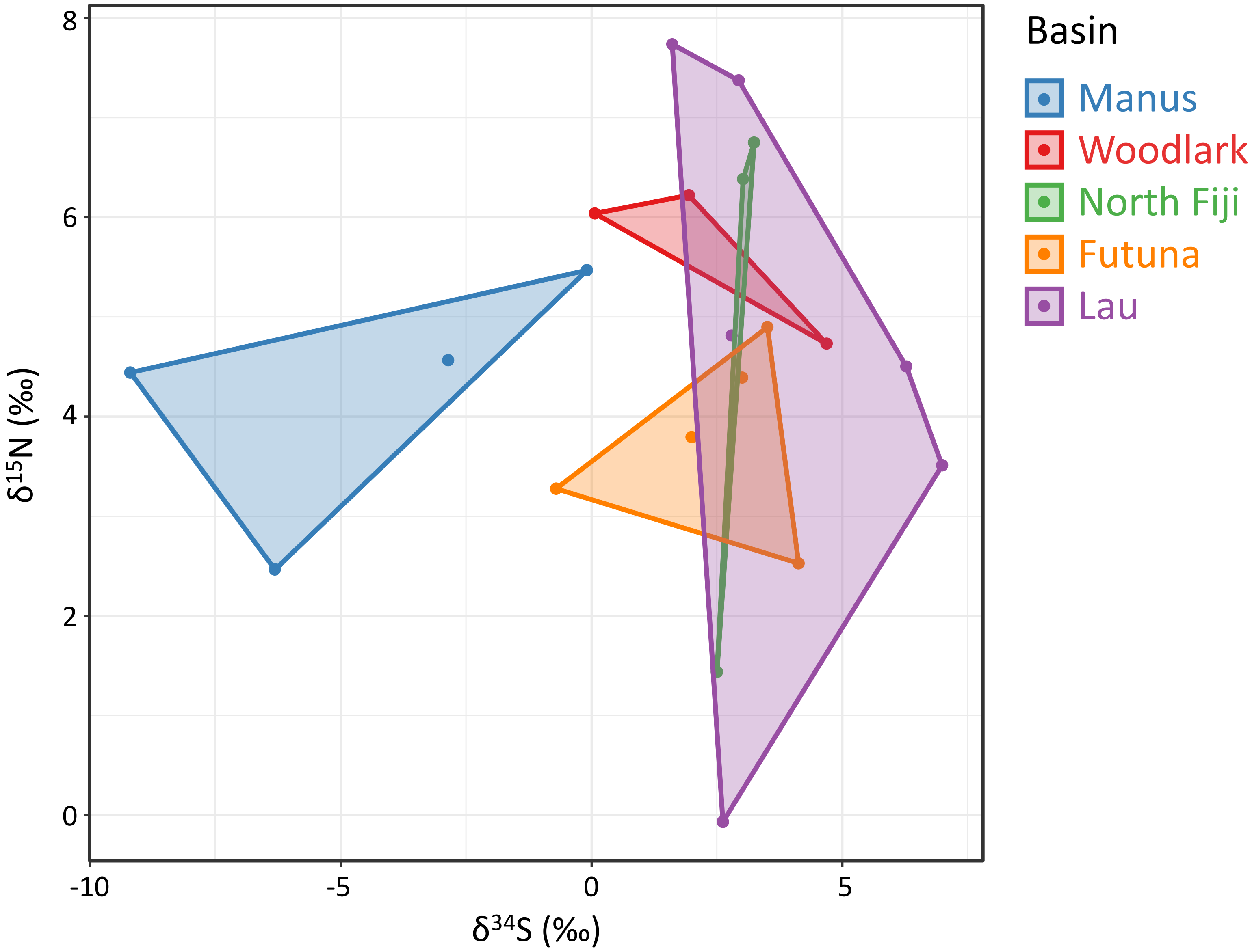


Hulls built using isotopic compositions of symbiotrophic foundation species (*Alviniconcha* spp., *Ifremeria nautilei*, *Bathymodiolus* spp.)

Baseline variation at large spatial scale



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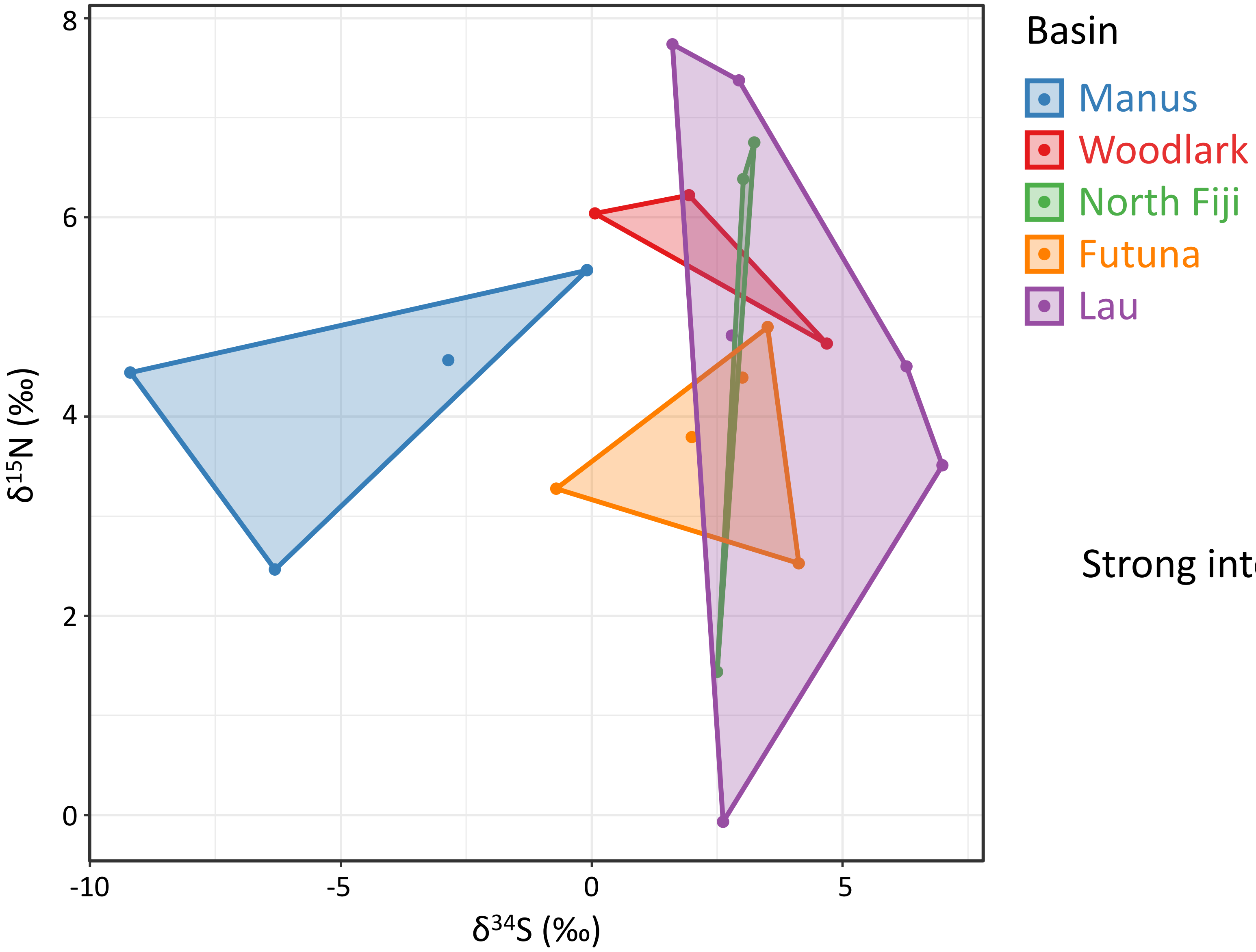
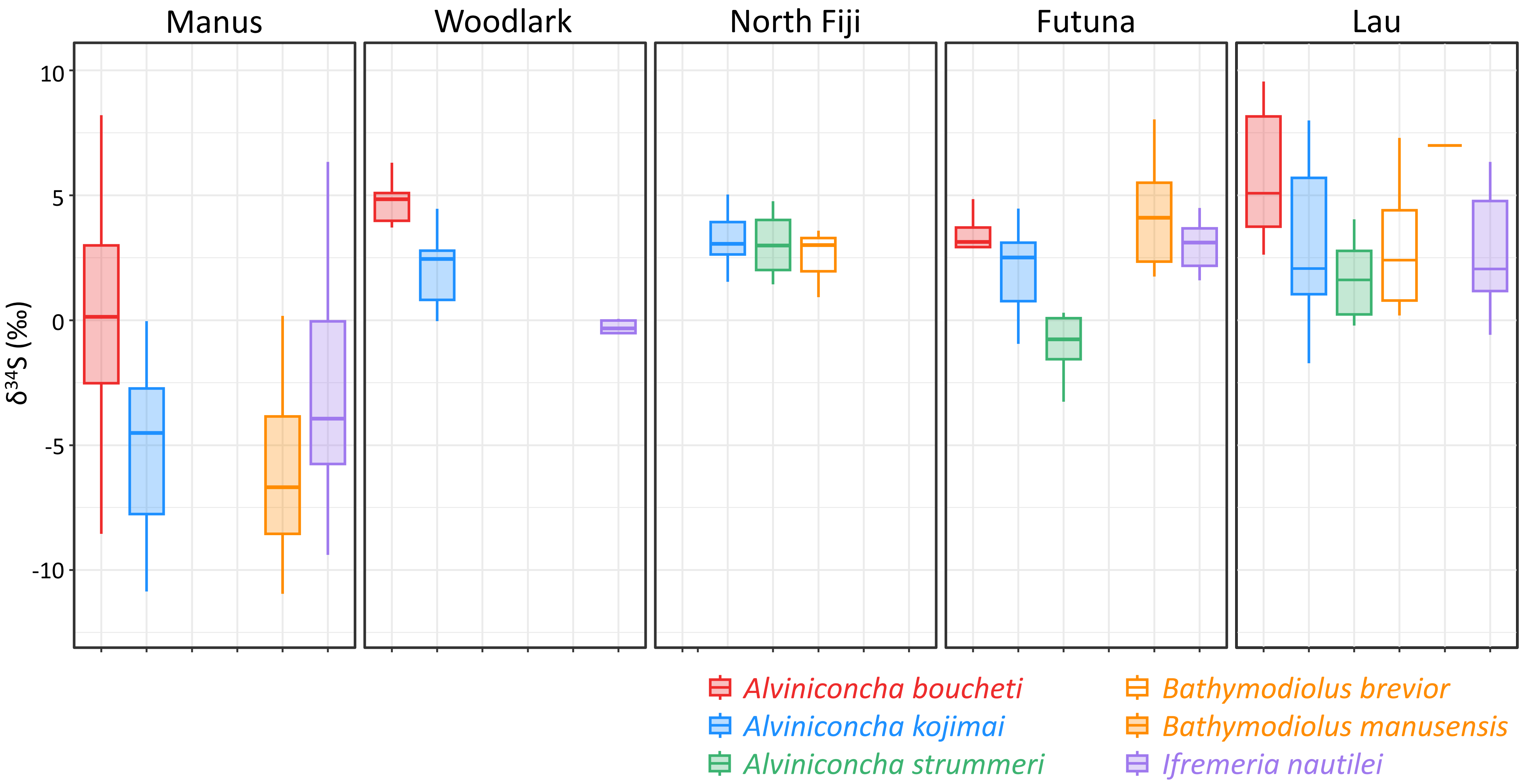


Strong inter-basin differences in hull shape and size

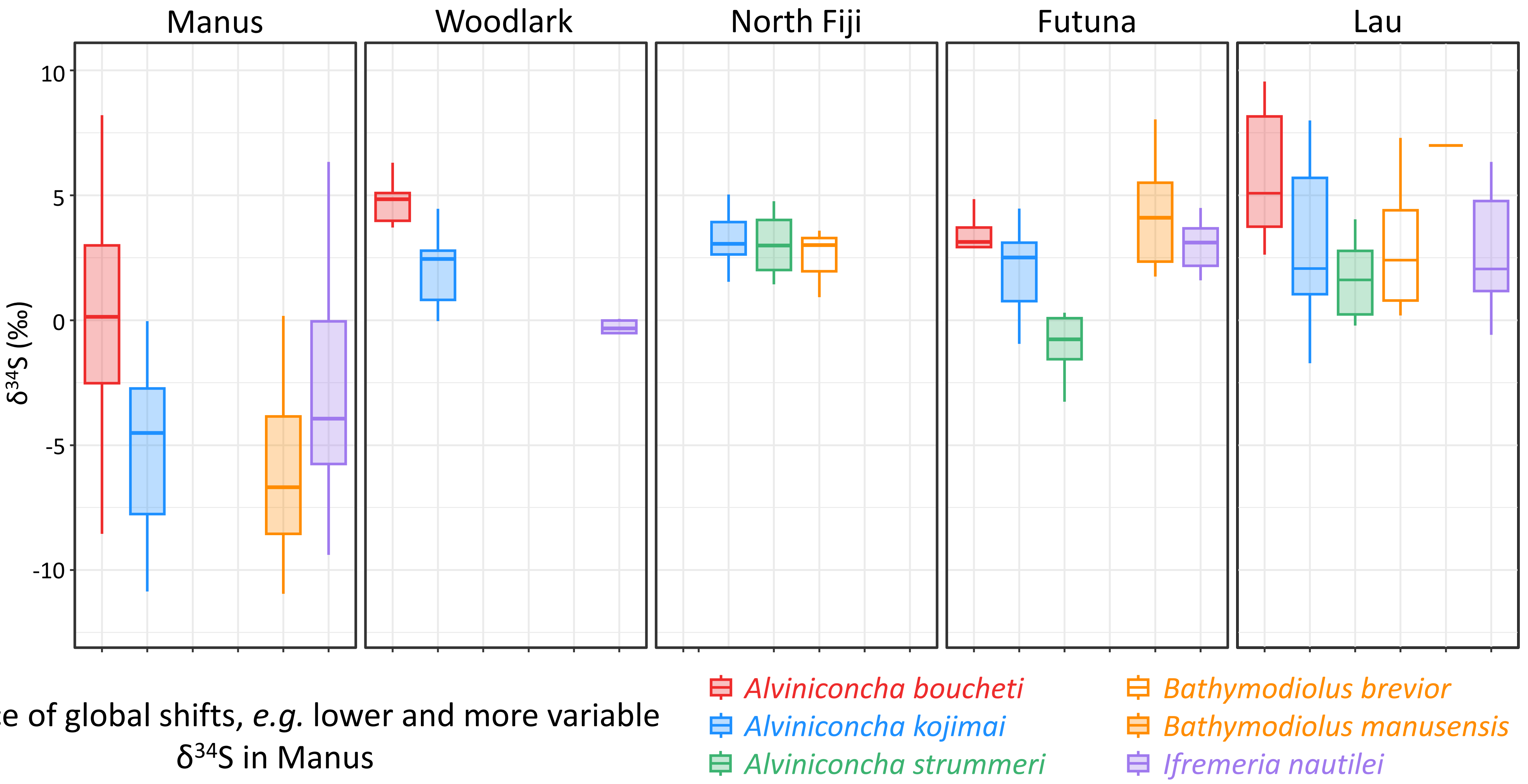
No clear longitudinal effect…

Hulls built using isotopic compositions of symbiotrophic foundation species (*Alviniconcha* spp., *Ifremeria nautilei*, *Bathymodiolus* spp.)

Baseline variations: $\delta^{34}S$

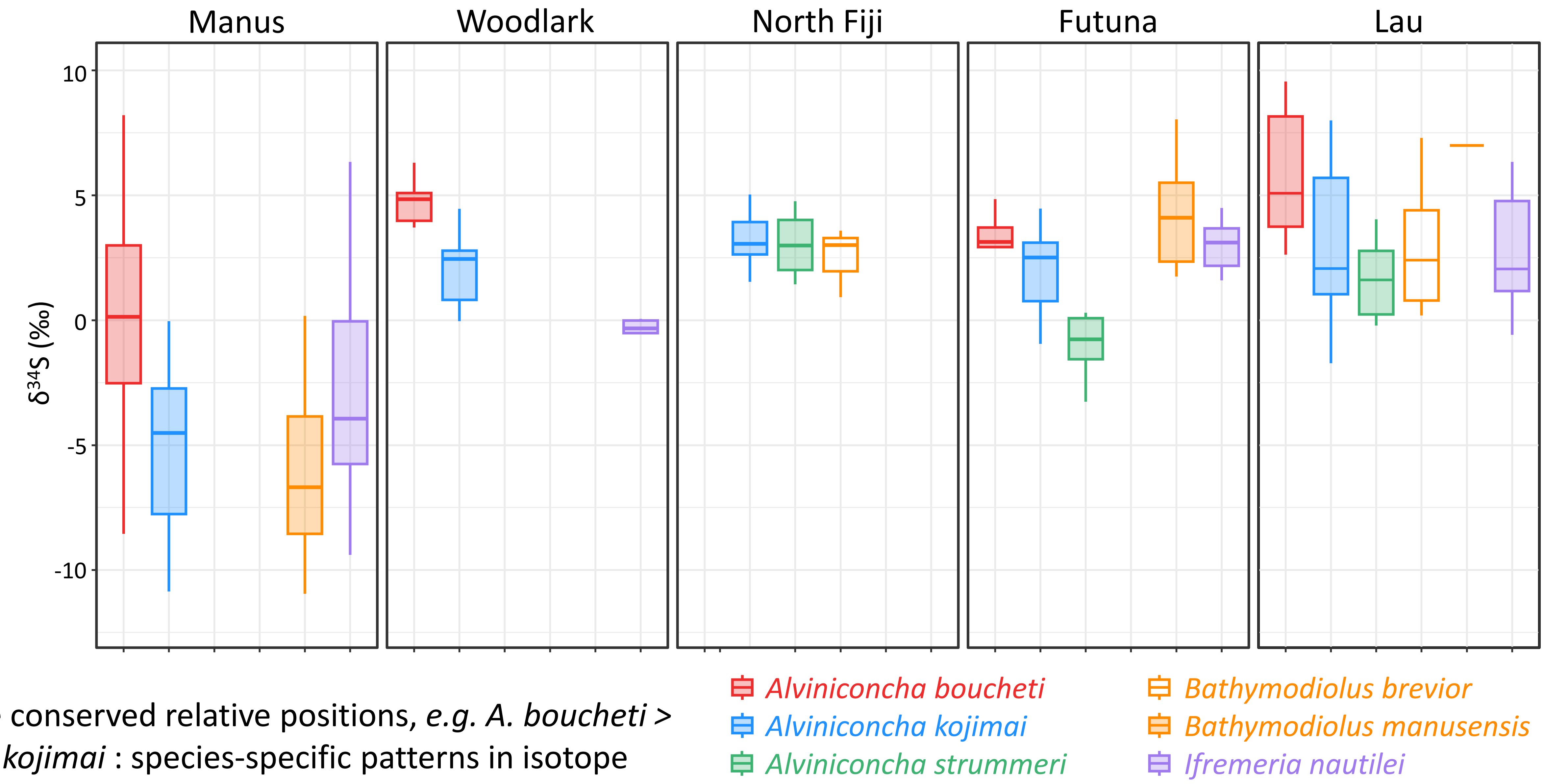


Baseline variations: δ^{34}S



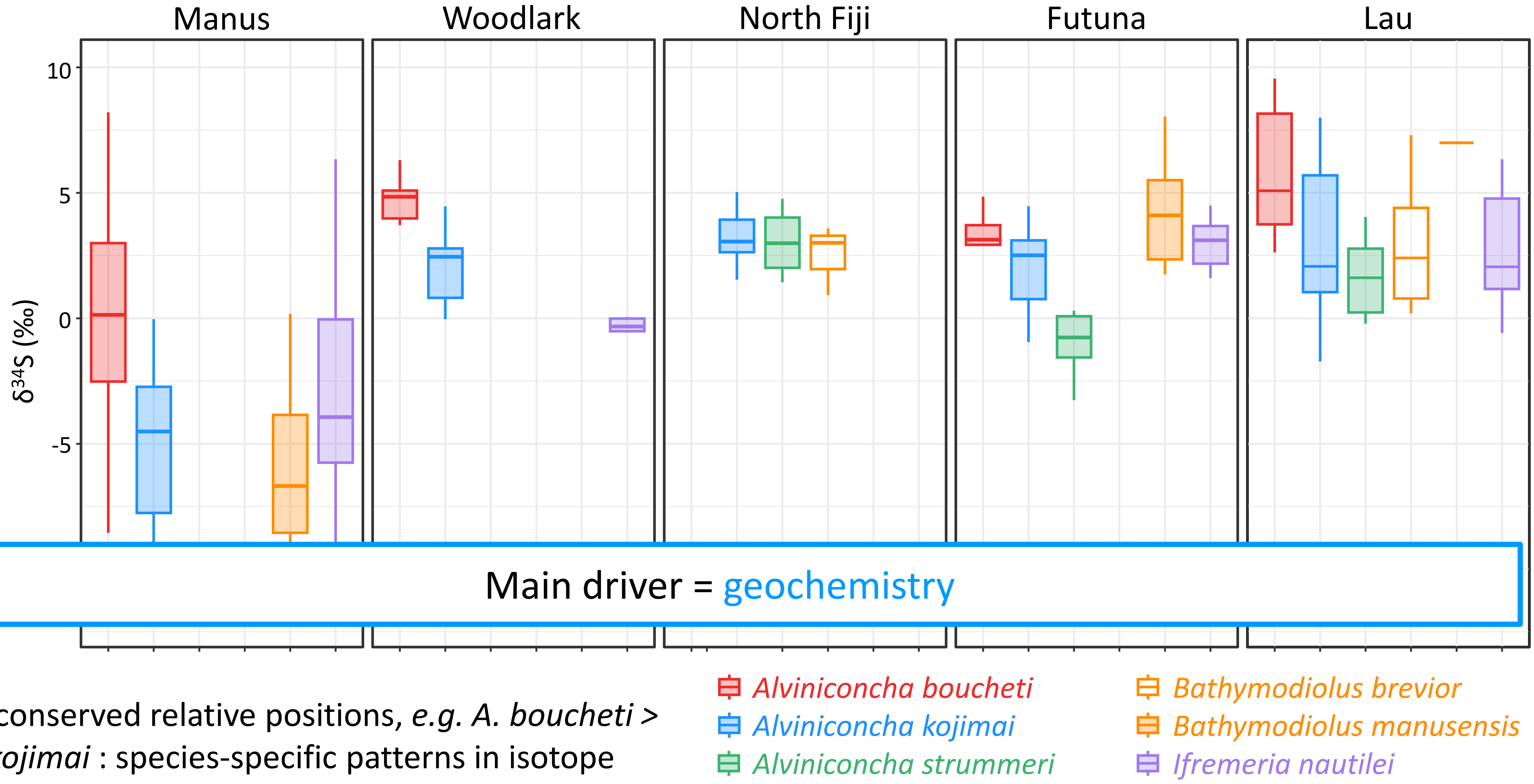
Presence of global shifts, *e.g.* lower and more variable δ^{34}S in Manus

Baseline variations: δ34S



Some conserved relative positions, *e.g. A. boucheti* > *A. kojimai* : species-specific patterns in isotope fractionation during sulfide uptake by symbionts?

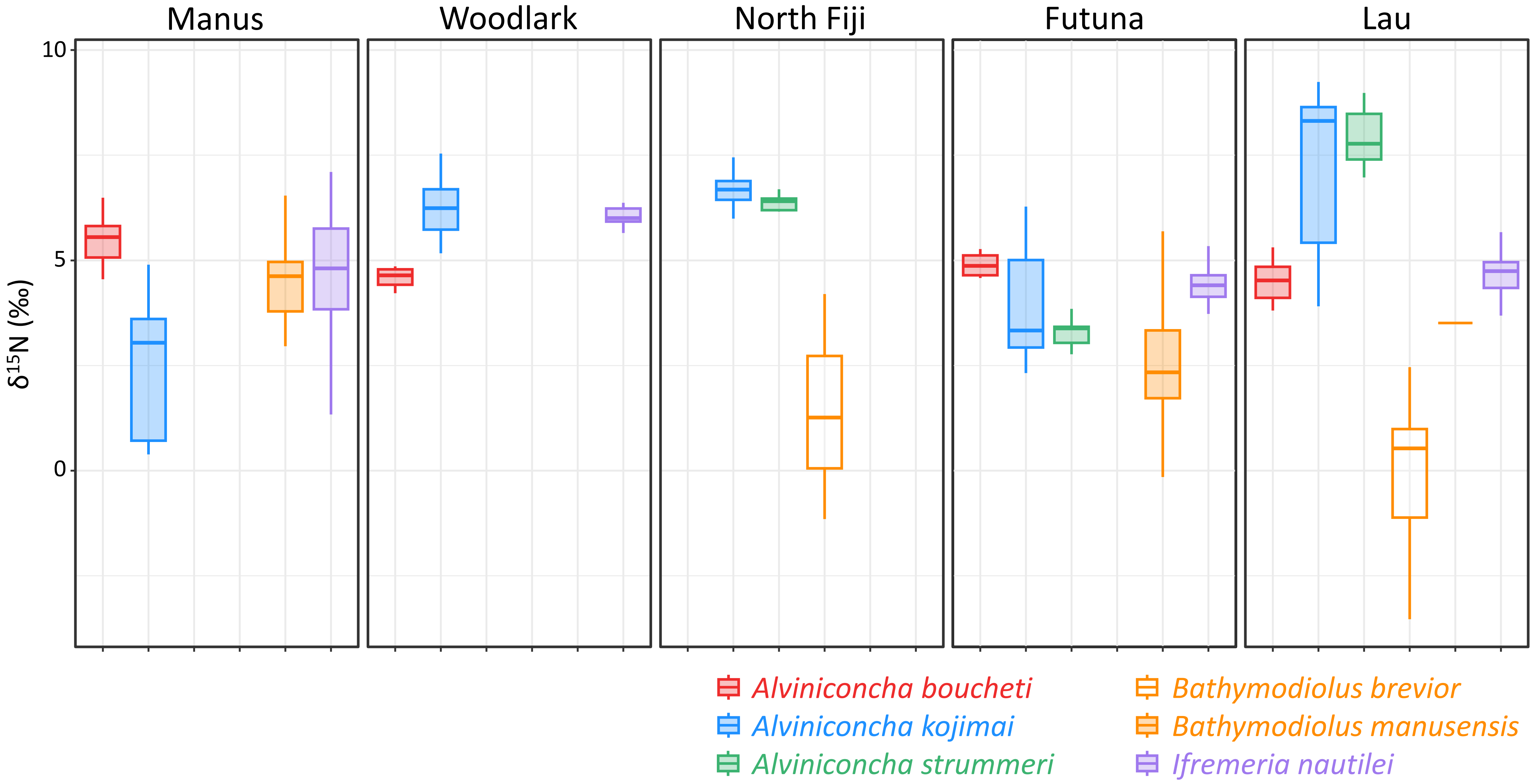
Baseline variations: δ^{34}S



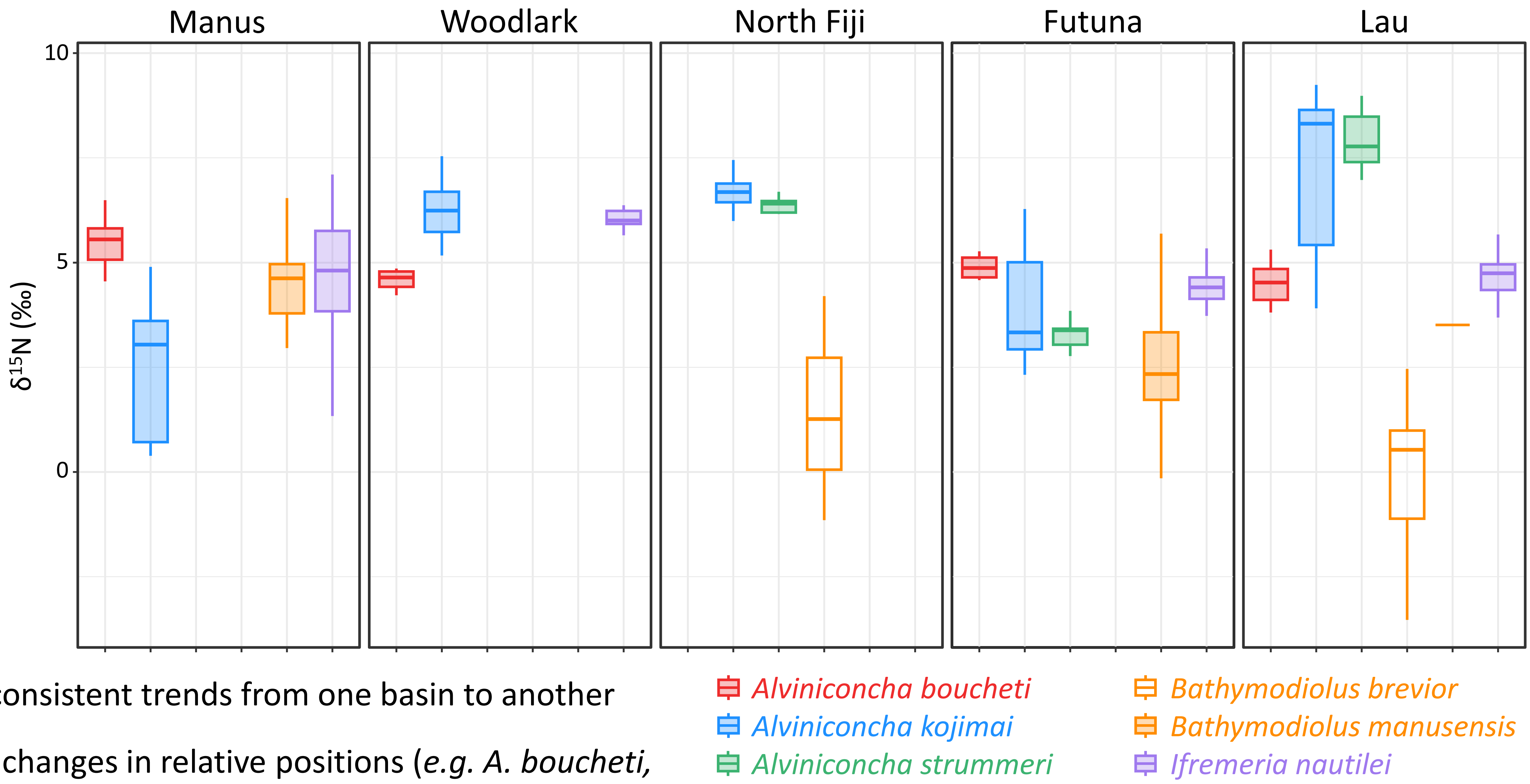
Main driver = geochemistry

Some conserved relative positions, *e.g. A. boucheti* > *A. kojimai* : species-specific patterns in isotope fractionation during sulfide uptake by symbionts?

Baseline variations: δ^{15}N



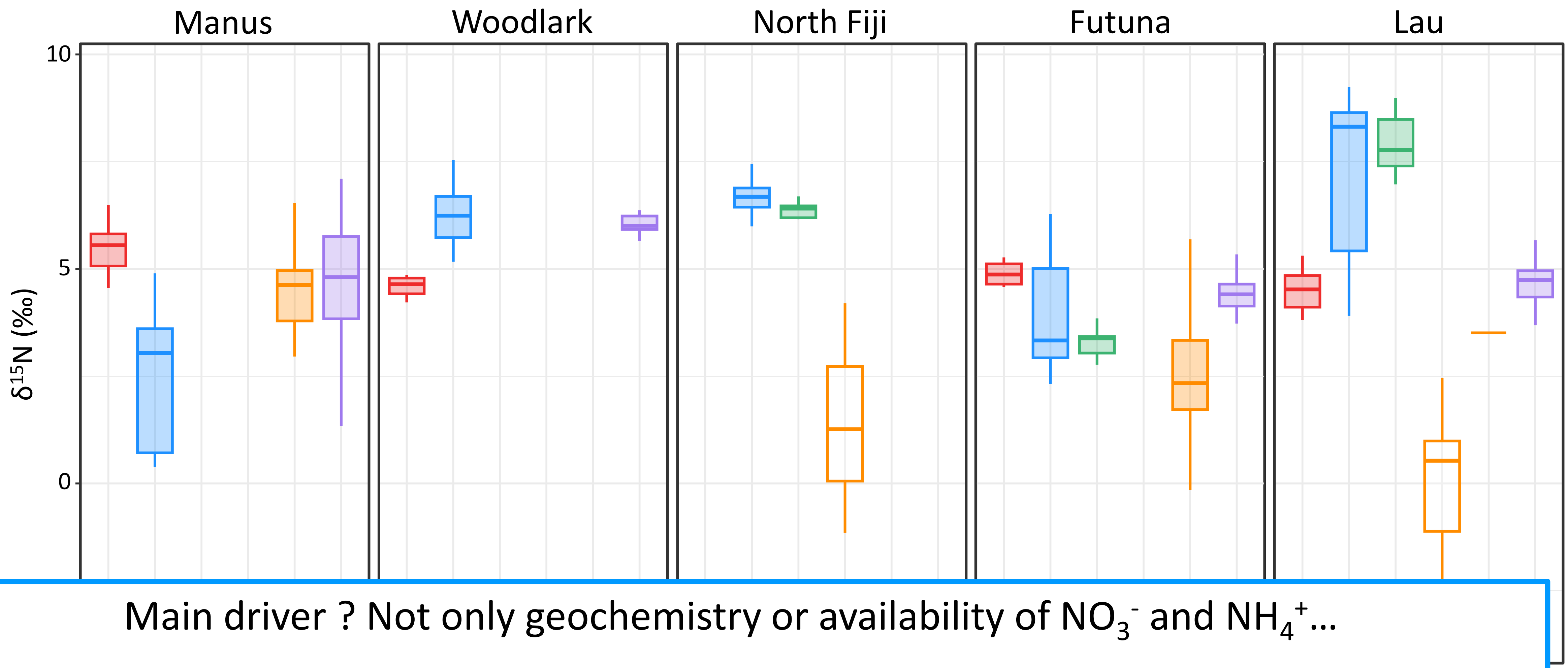
Baseline variations: $\delta^{15}N$



No consistent trends from one basin to another

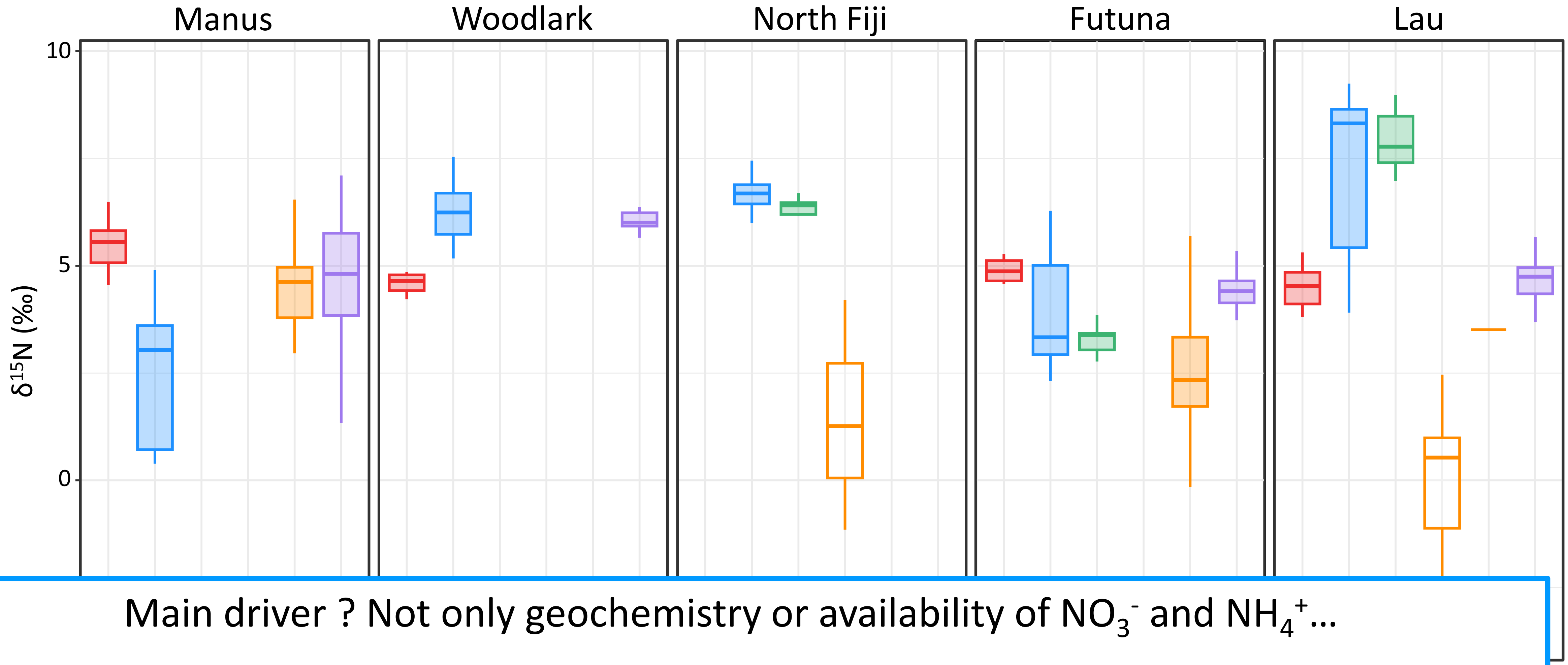
Strong changes in relative positions (*e.g. A. boucheti, A. kojimai* and *I. nautilei*)

Baseline variations: $\delta^{15}N$



Main driver ? Not only geochemistry or availability of NO_3^- and NH_4^+…

Baseline variations: $\delta^{15}N$



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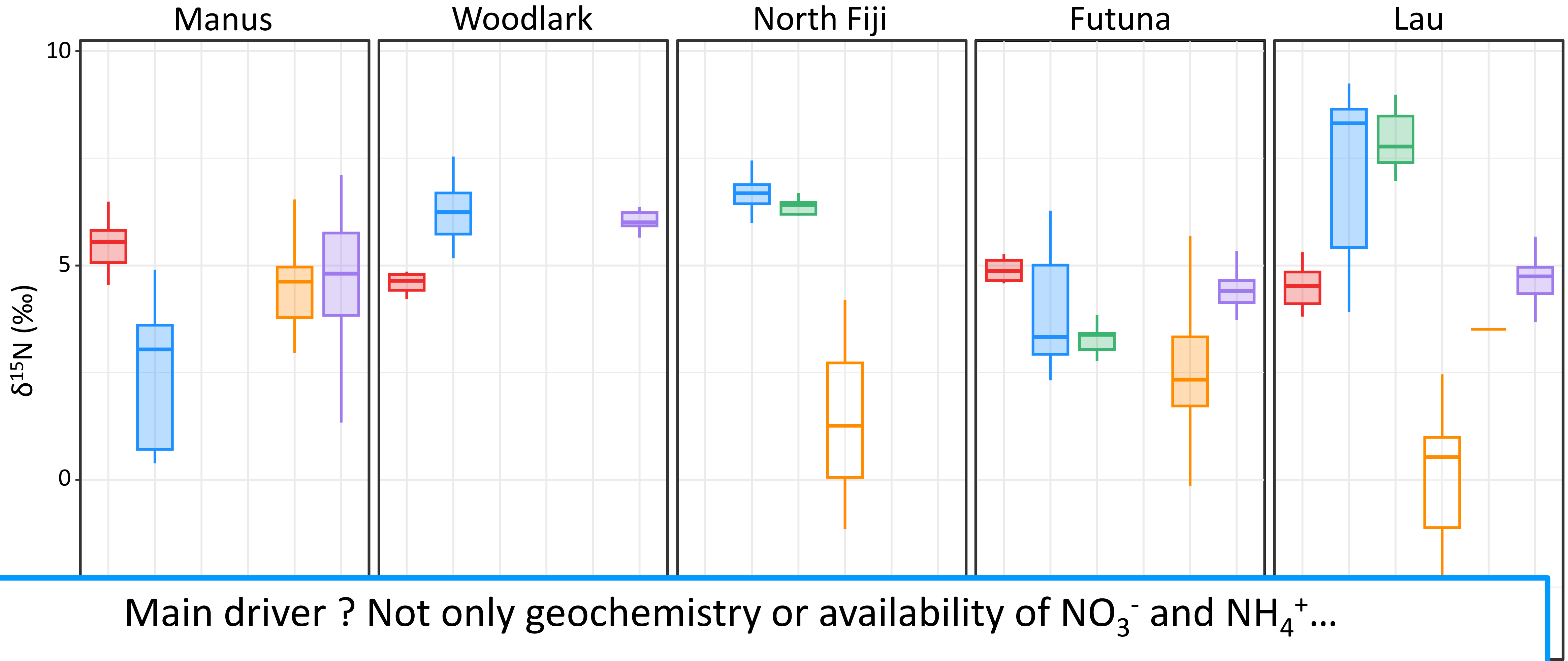

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Changes in identity or metabolism of symbiotic partners, resulting in different isotopic composition of the holobionts?

S

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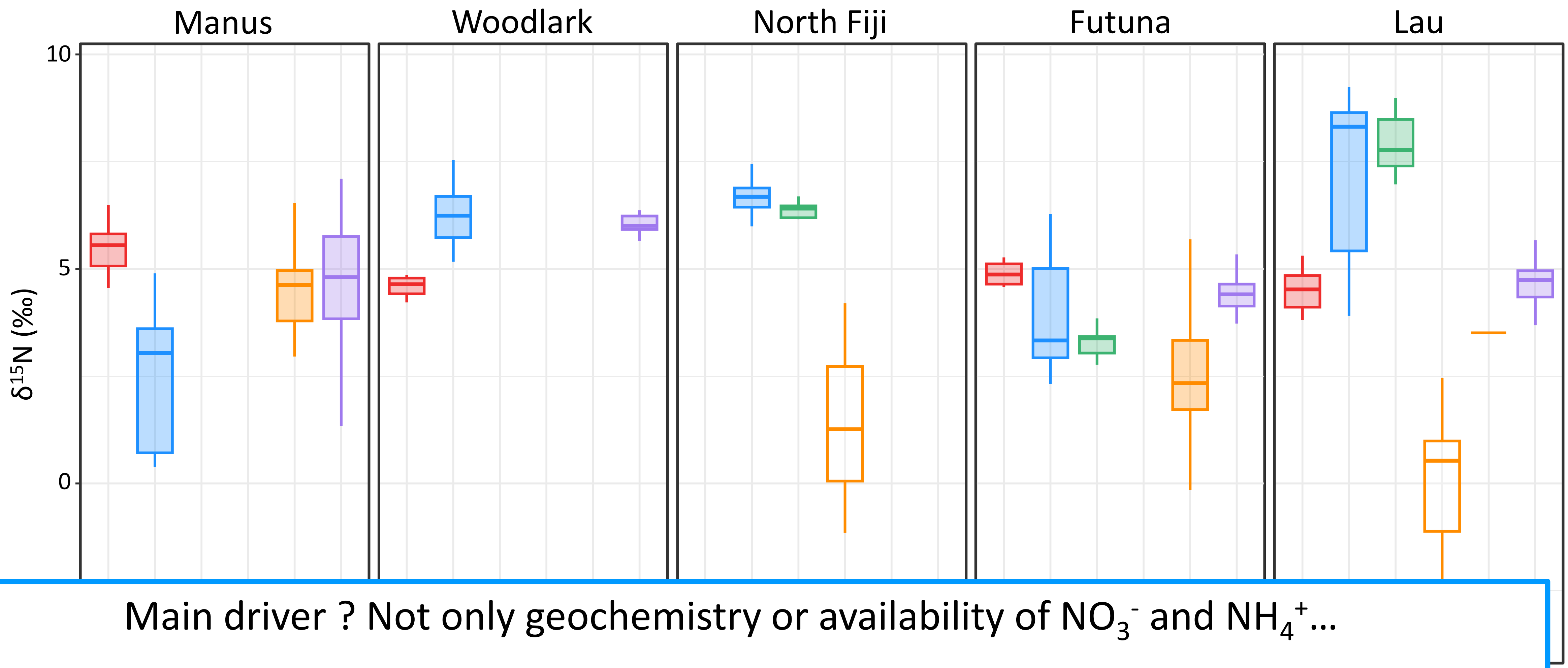

S

Main driver ? Not only geochemistry or availability of NO_3^- and NH_4^+…

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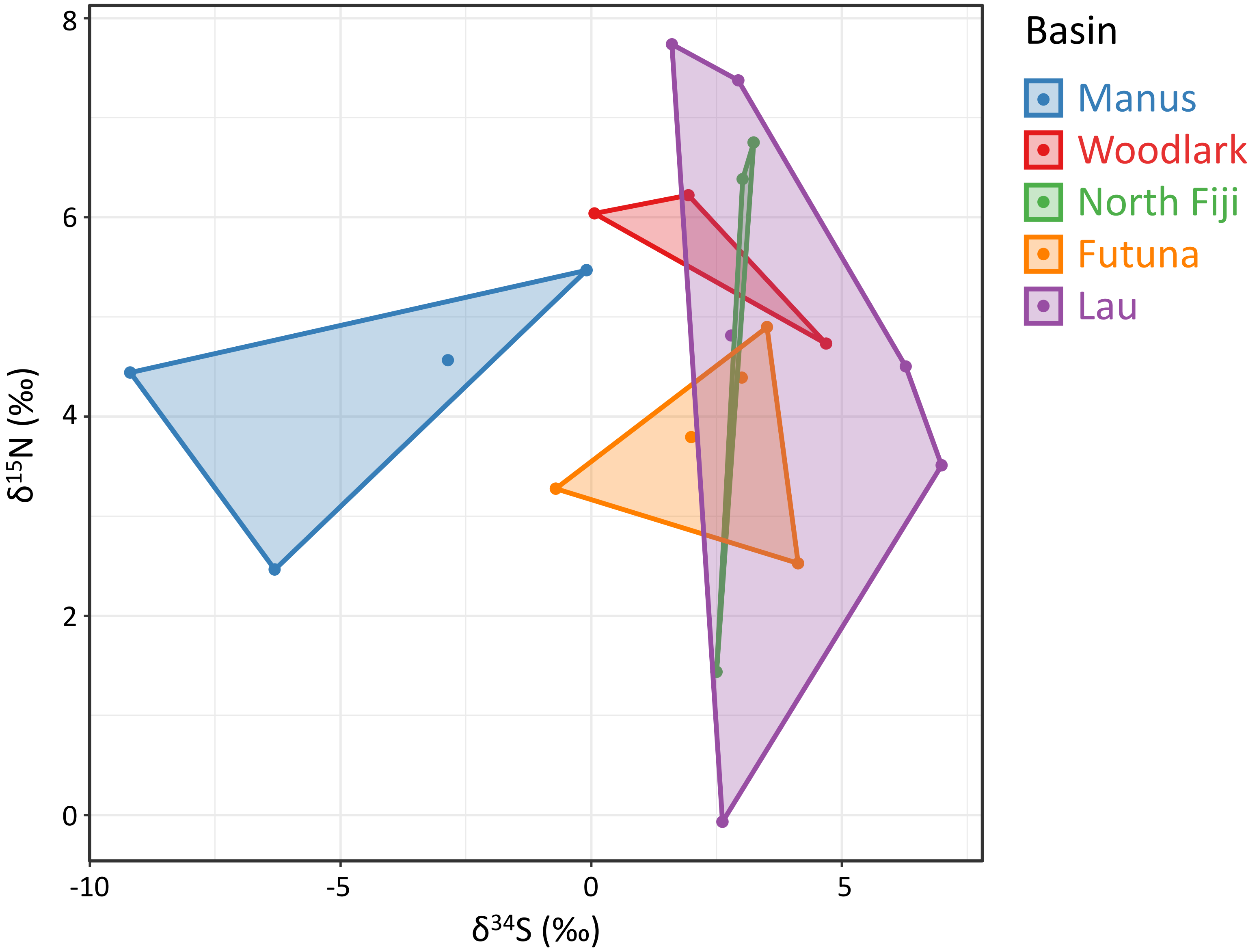
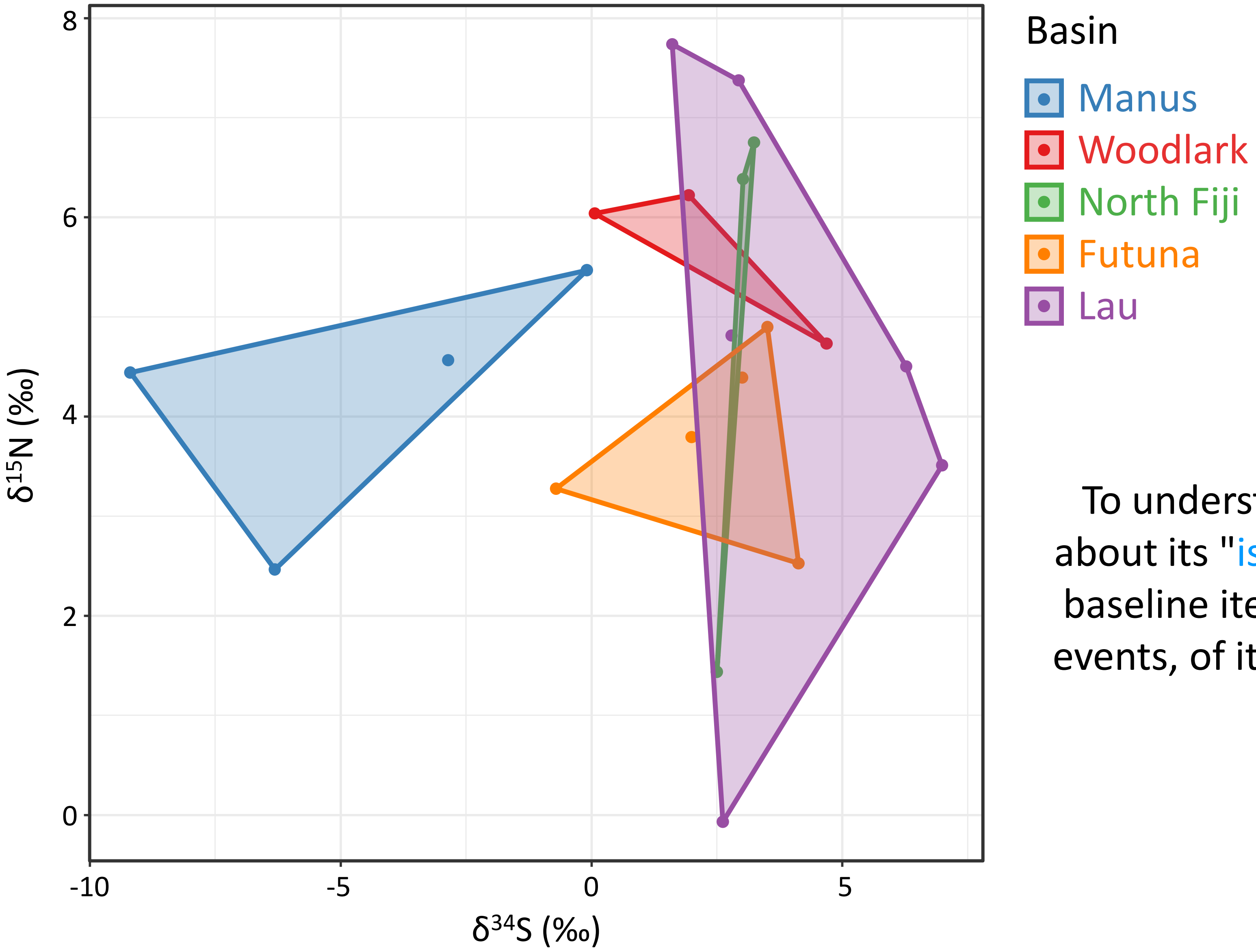
Changes in trophic position: unlikely as symbiotrophic species…

Baseline variation at large spatial scale



Baseline variation at large spatial scale



To understand the trophic ecology of a species, info about its "isotopic landscape" (isotopic composition of baseline items, of other species, of previous sampling events, of its place in other comparable systems, etc…) highly desirable…

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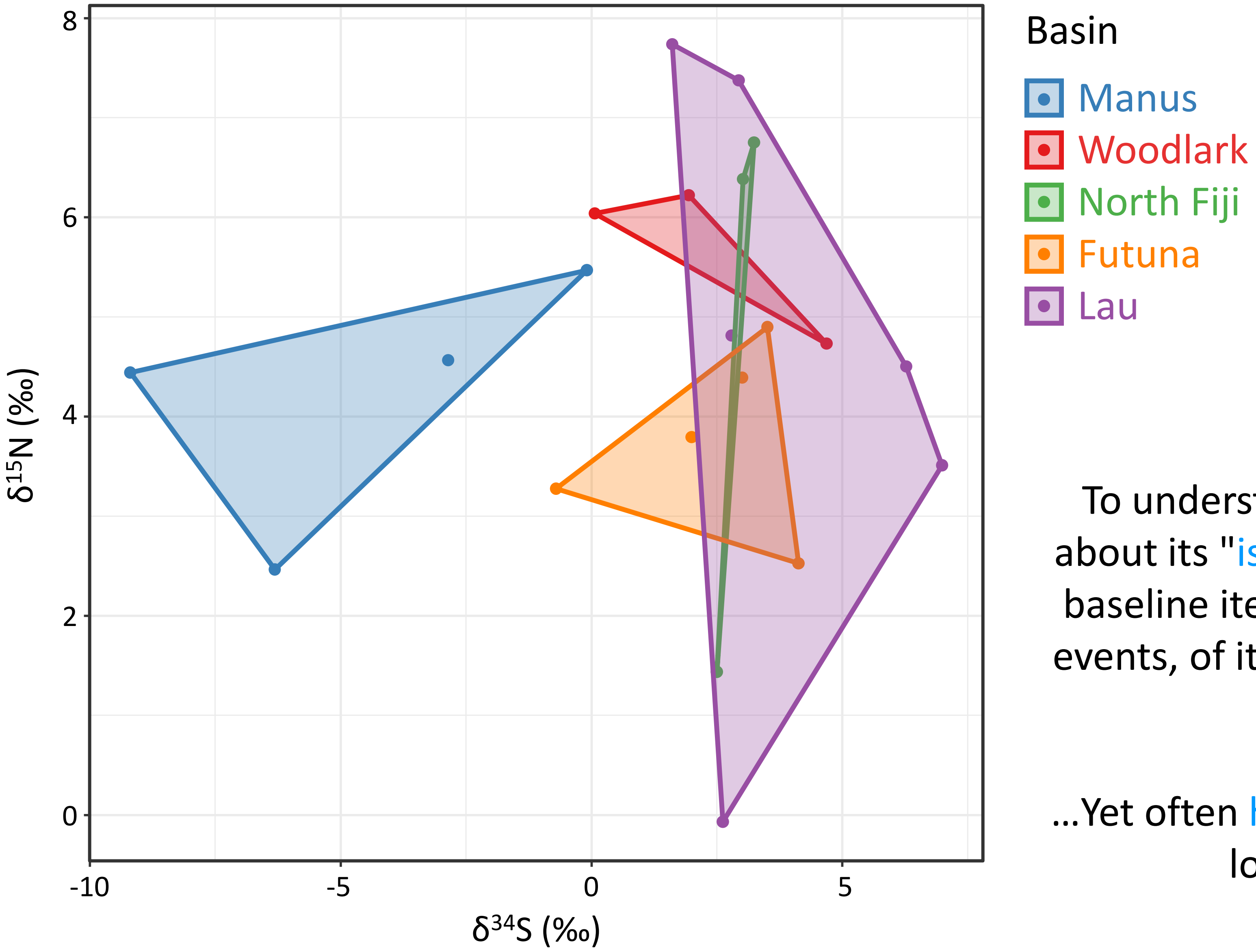

To understand the trophic ecology of a species, info about its "isotopic landscape" (isotopic composition of baseline items, of other species, of previous sampling events, of its place in other comparable systems, etc…) highly desirable…

…Yet often hard to obtain due to constraining sampling logistics, analytical limitations, etc.

DeepIso

SEANOE Sea scientific open data edition

DeepIso - a global open database of stable isotope ratios and elemental contents for deep-sea ecosystems

Date	2021-08-17
Temporal extent	1985 -2018

Author(s): Michel Loïc N.[1], Bell James B.[2], Dubois Stanislas F.[3], Le Pans Mathilde[1], Lepoint Gilles[4], Olu Karine[1], Reid William D. K.[5], Sarrazin Jozee[1], Schaal Gauthier[6], Hayden Brian[7]

Contributor(s): Carlier Antoine, Demopoulos Amanda W. J., Marticorena Julien, McClain-Counts Jennifer P., Methou Pierre, Parzanini Camilla, Pradillon Florence, Puccinelli Eleonora, Riekenberg Philip M., Van Audenhaege Loic, Van Dover Cindy Lee, Van Oevelen Dick, Woulds Clare, Cresson Pierre, Alfaro Lucas Joan Manel, Le Bourg Baptiste

Affiliation(s):
1 : Ifremer, REM/EEP, F-29280 Plouzané, France
2 : Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, United Kingdom
3 : Ifremer, ODE/DYNECO, F-29280 Plouzané, France
4 : Laboratory of Oceanology, Freshwater and Oceanic Sciences Unit of reSearch (FOCUS), University of Liège, Liège, Belgium

Click to download the data

DATA

Example of targeted taxa: tubeworms Escarpia southwardae and mussels Bathymodiolus aff. boomerang from cold seeps. Picture: Ifremer, WACS cruise, 2011 (depth: 3160 m).

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Click to download the data | DATA

Example of targeted taxa:

Goals:

Produce a global, easily discoverable, available and reusable compilation of stable isotope ratios and elemental contents in organisms from deep-sea ecosystems

Provide the deep-sea community with an open data analysis tool that can be used in the context of future ecological research, and to help deep-sea researchers to use stable isotope markers at their full efficiency.

Freely available at https://doi.org/10.17882/76595 under CC-BY licence

DeepIso: core working group

James B. Bell
CEFAS (UK)

Stanislas F. Dubois
Ifremer (FR)

Gilles Lepoint
ULiège (BE)

Karine Olu
Ifremer (FR)

William D. K. Reid
Newcastle U (UK)

Jozée Sarrazin
Ifremer (FR)

Gauthier Schaal
UBO (FR)

Brian Hayden
UNB (CA)

DeepIso: data contributors

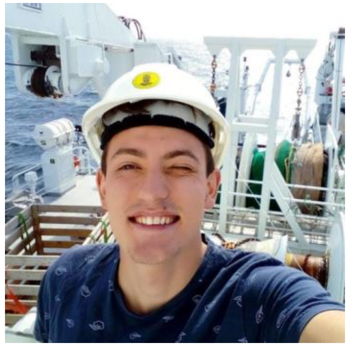




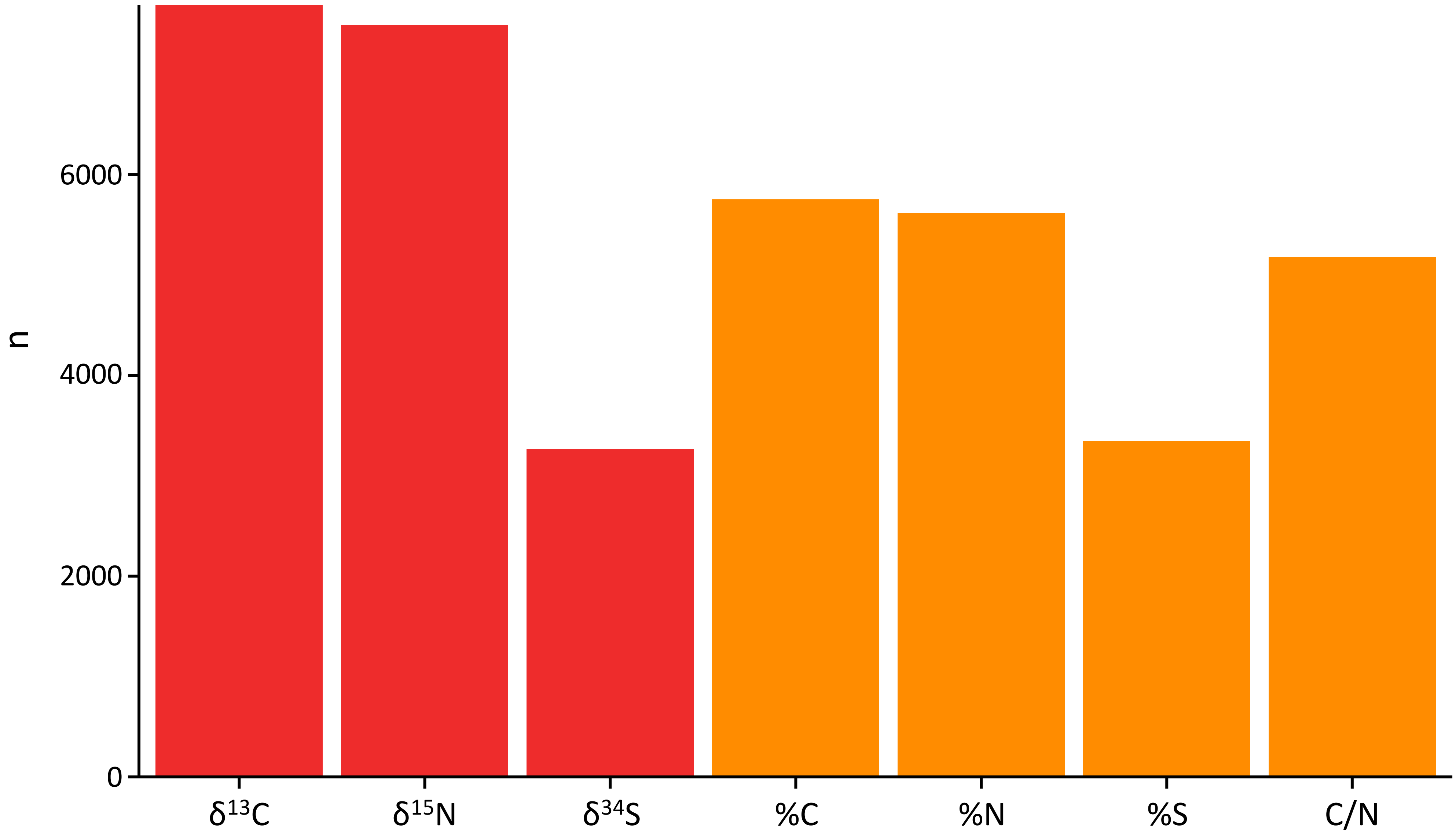






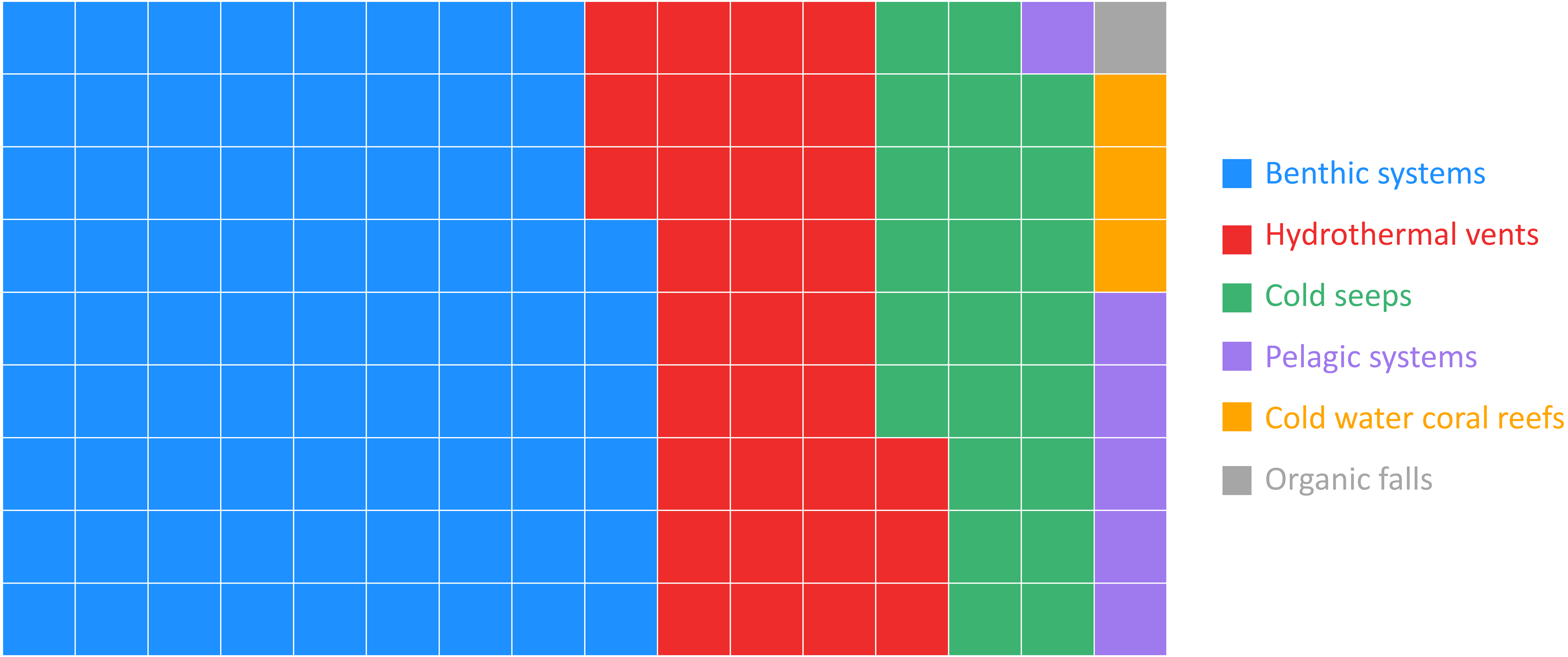




DeepIso



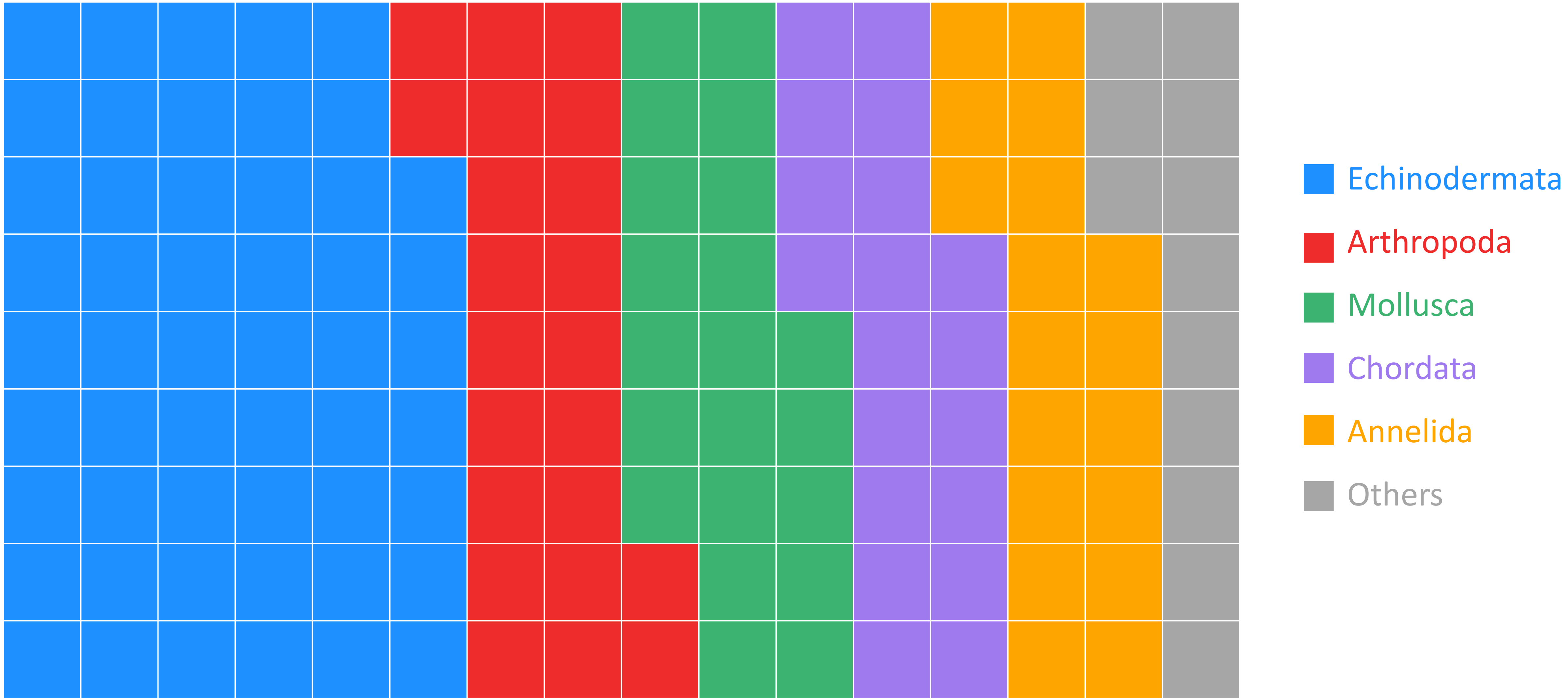
38335 measurements of 7 parameters

DeepIso



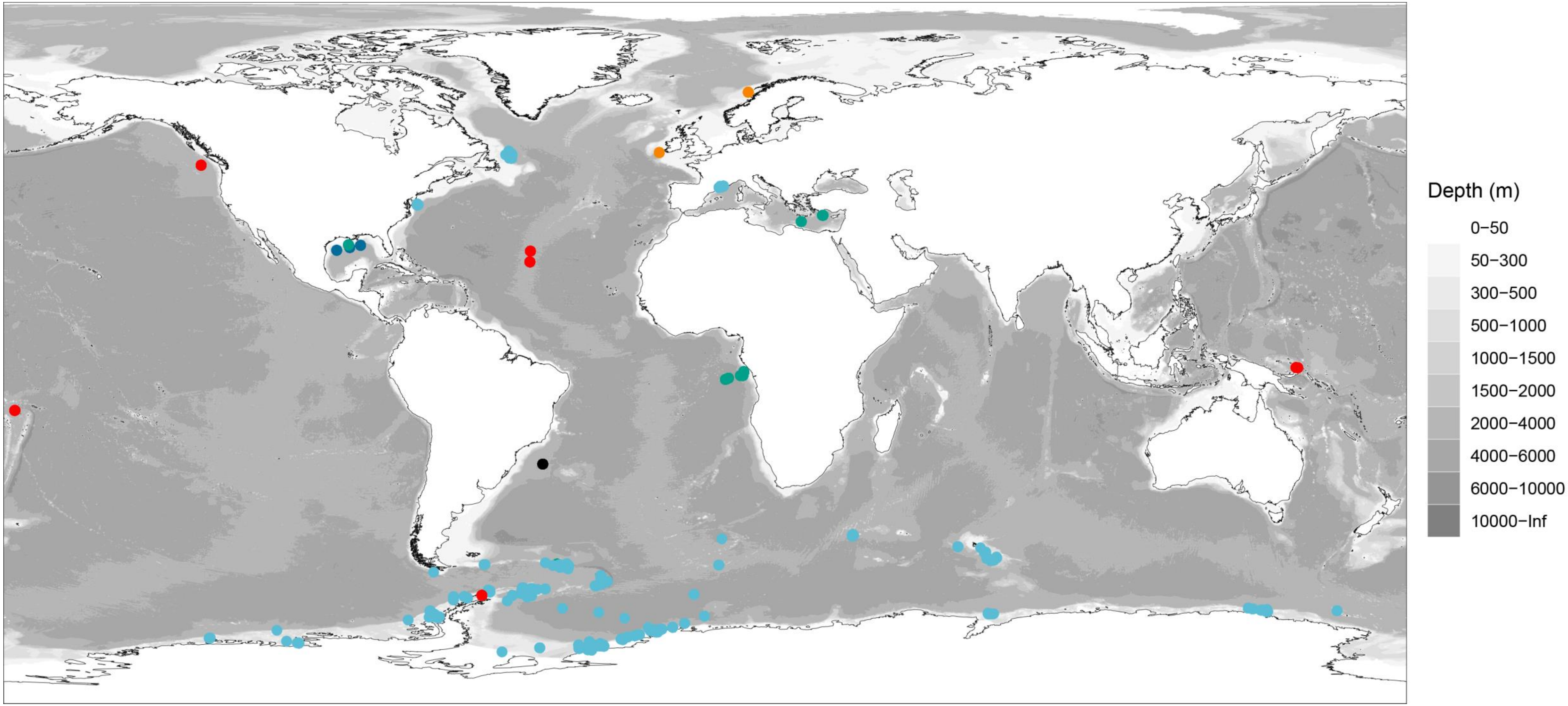
7248 distinct samples from multiple ecosystems, including 3164 (44%) from chemosynthesis-based ecosystems

DeepIso



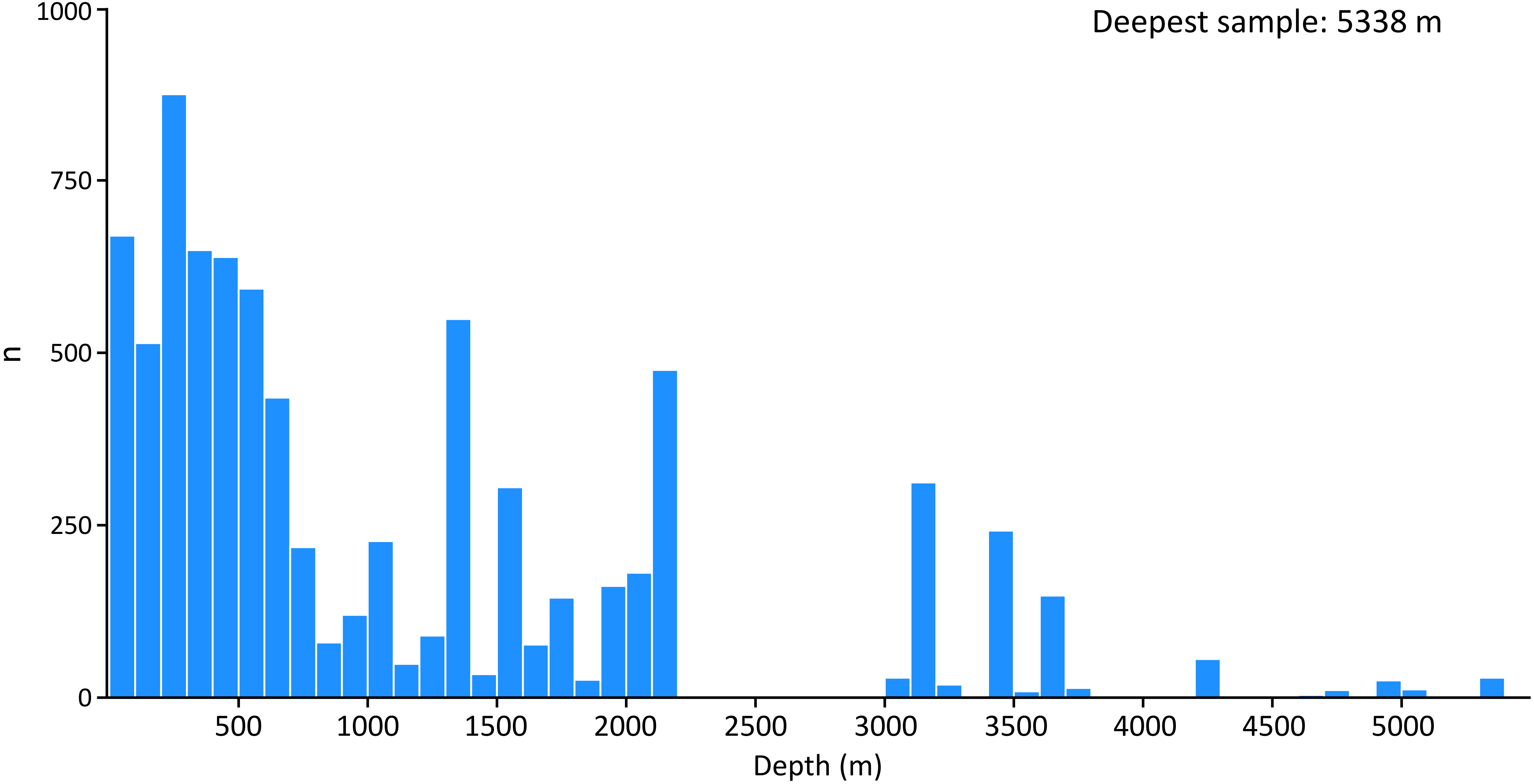
881 distinct taxa (+ sediment, detritus, suspended particulate organic matter, bulk plancton, etc.)

DeepIso



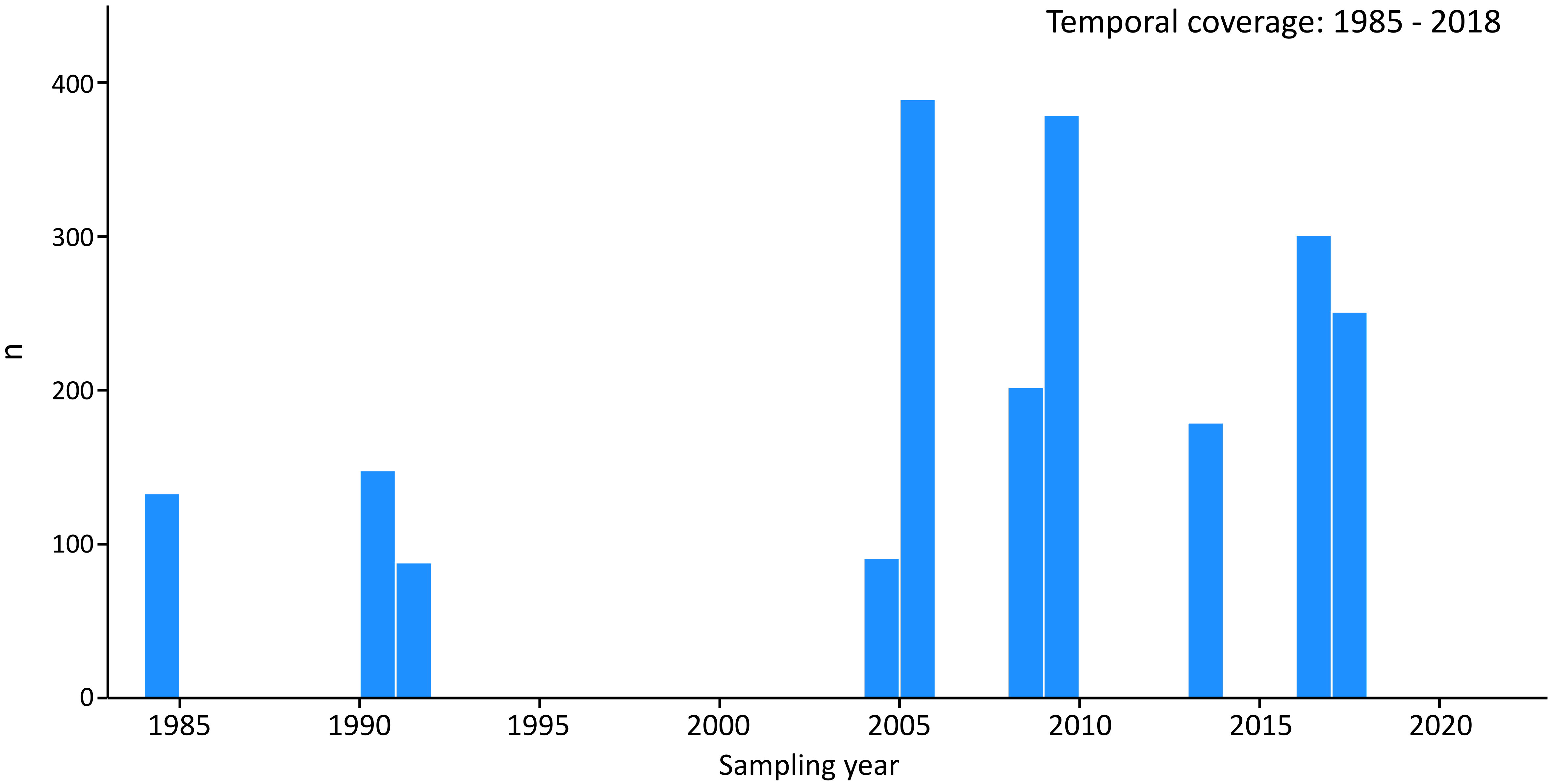
Worldwide spatial coverage

DeepIso



Deepest sample: 5338 m
1000
750
500
250
0
n
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Depth (m)

DeepIso



Temporal coverage: 1985 - 2018
400
300
200
100
0
n
1985
1990
1995
2000
2005
2010
2015
2020
Sampling year

DeepIso: what's next?

- Integrate DeepIso with larger scale initiatives such as IsoBank

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ISOBANK

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- We are looking for people willing to share data, either underlying published articles, grey literature or even unpublished
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ISOBANK

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Feeling like contributing? Questions? Feedback?
Get in touch!

Take home message




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- Consider archiving your data openly – you'll likely benefit from it and so will the rest of the scientific community

Acknowledgements

Many friends and colleagues that helped me, directly or indirectly, to perform this research

Ifremer and the French Oceanographic Fleet for providing sampling and research infrastructure

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