THE NON-VENT BENTHIC FAUNA OF THE MID-ATLANTIC RIDGE

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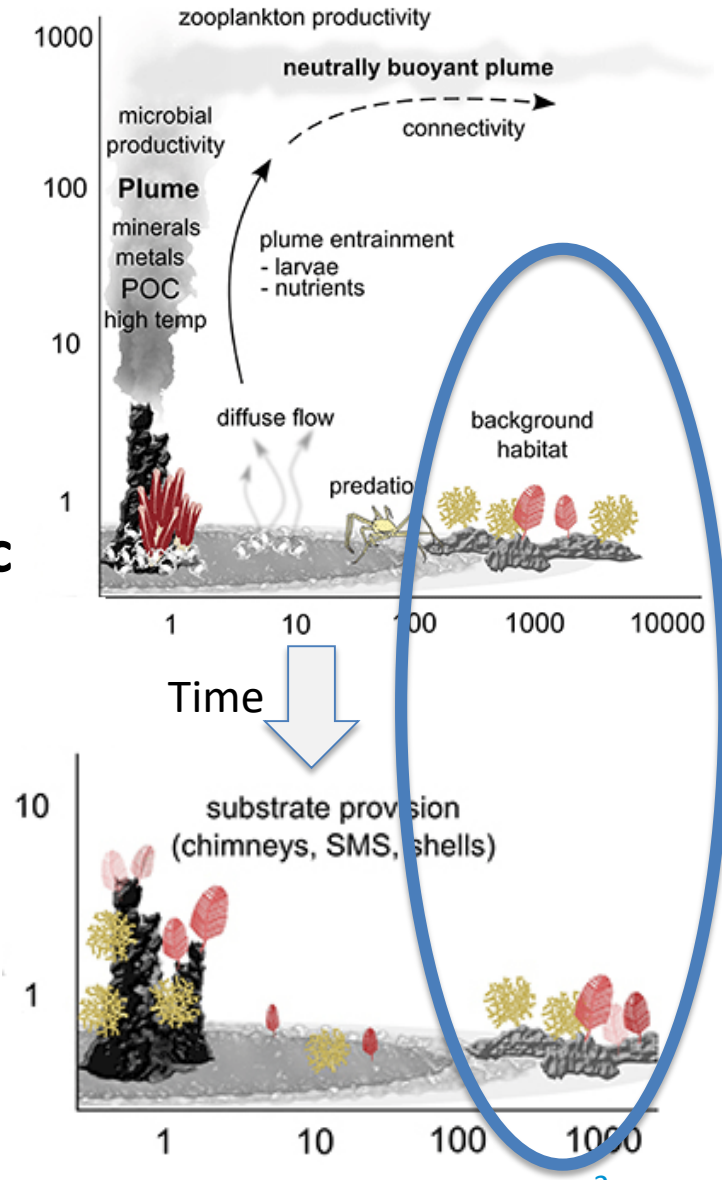
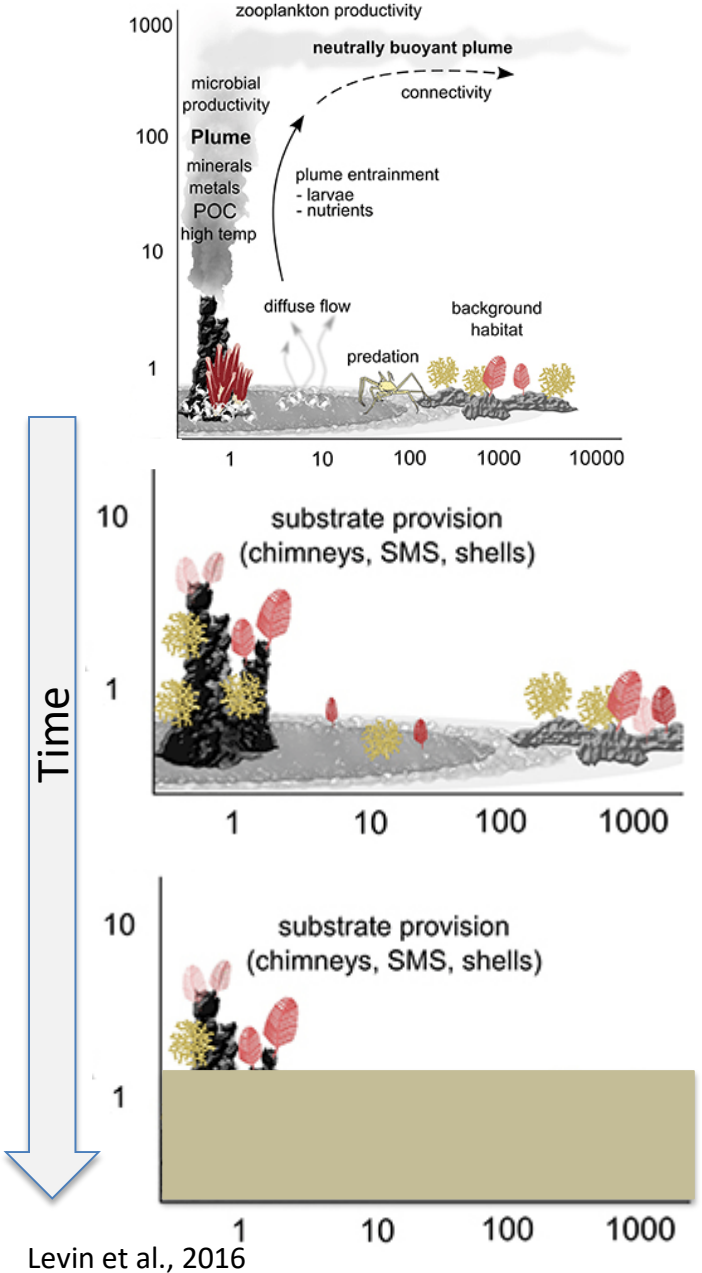
The non-vent benthic fauna of the Mid-Atlantic Ridge

1. **Why should we care about non-vent fauna?**
2. **What do we know about the non-vent fauna of the MAR?**
3. **Is there a non-vent MAR endemic fauna?**
4. **What drives the structure and composition of benthic communities along the MAR?**
5. **Are there non-vent Vulnerable Marine Ecosystems on the MAR?**



Levin et al., 2016

Why should we care about non-vent fauna?



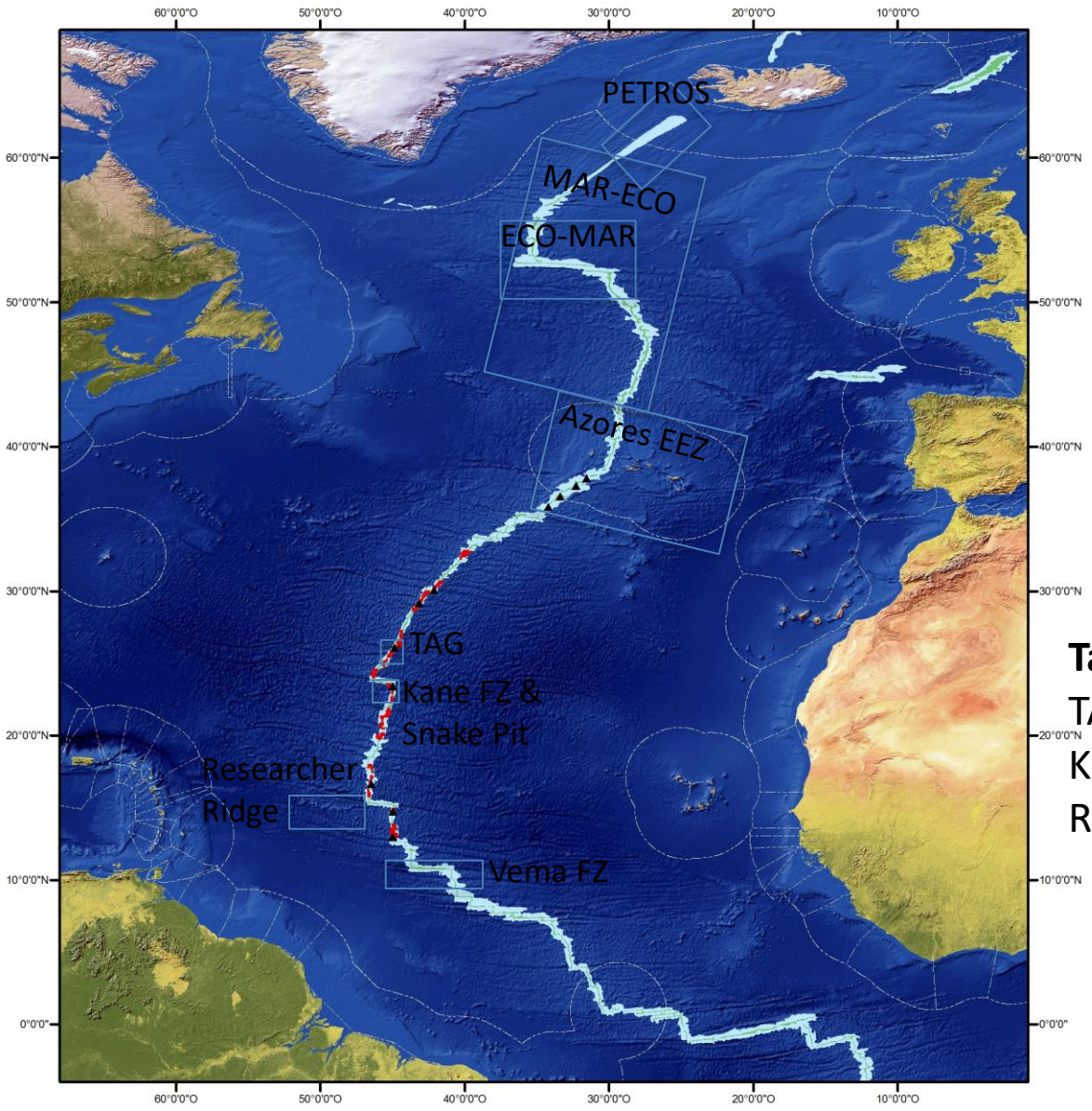
Levin et al., 2016

The particle plumes may impact the non-vent fauna at the periphery of mined sites

The non-vent fauna may provide source populations for the recolonization of mined sites

The sediment fauna will be impacted by removing the sedimentary pile

What do we know about the non-vent fauna of the MAR?



PETROS – Reykjanes Ridge
Copley et al., 1996

Mar-Eco
Bergstad & Godø, 2002

ECO-MAR
Priede et al., 2013

Azores EEZ
Braga-Henriques et al. 2013

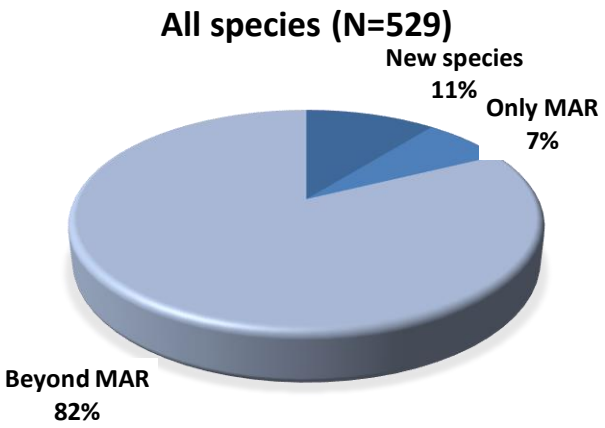
Taxonomic papers
TAG, Snake Pit
Kane & Vema Fracture Zones
Researcher Ridge

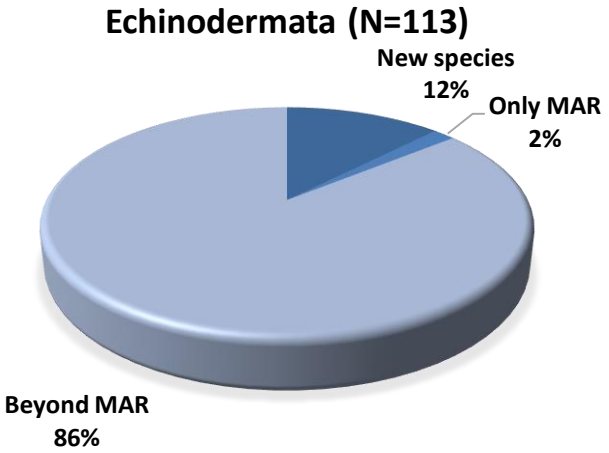
Harris, P.T., Macmillan-Lawler, M., Rupp, J., Baker, E.K., 2014. Geomorphology of the oceans. Marine Geology 352, 4-24, https://doi.org/10.1016/j.margeo.2014.01.011.
Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at http://www.marineregions.org/. https://doi.org/10.14284/386

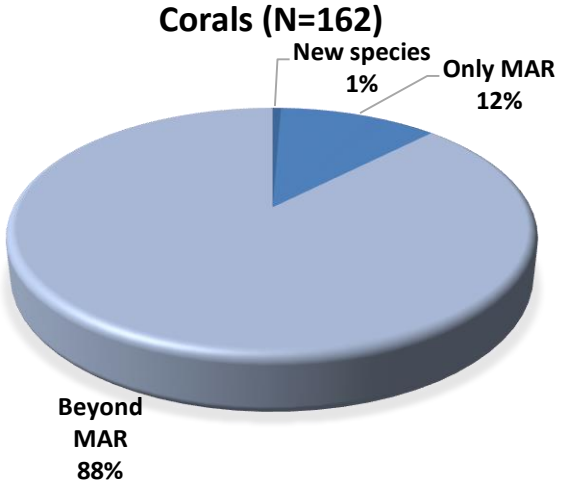
Is there a non-vent MAR endemic fauna?

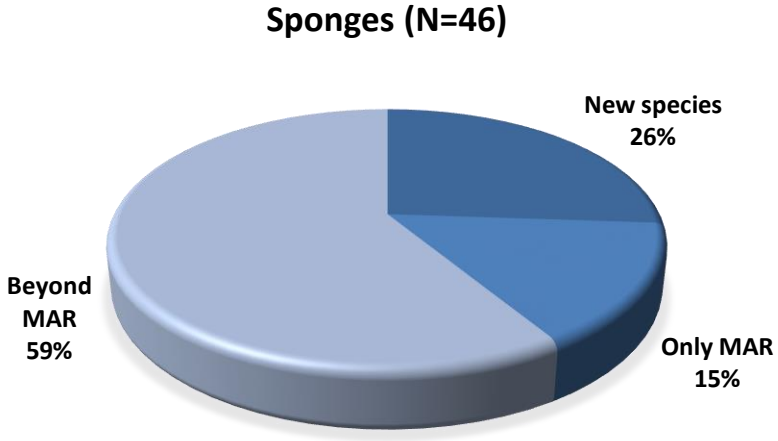
Source	Taxonomic group	Total species	New species	Only MAR	Beyond MAR	Location
Horton et al. 2013	Amphipoda (scavenging)	28	15		13	ECOMAR
Kongsrud et al. 2013	Polychaeta	22	1		21	ECOMAR
Rogacheva et al. 2013, Gebruk 2008	Holoturoidea	42	8	1	33	ECOMAR
Dilman 2008, Dilman 2013	Asteroidea	42	3		39	MAR-ECO
Tabachnick 2008, Tabachnick 2013, Tabachnick & Menshenina 2013	Hexactinellida	24	10	2	12	MAR-ECO
Cárdenas et al. 2015	Desmosponges	22	2	5	15	ECOMAR
Molodtsova et al. 2008	Actiniaria	8		2	6	MAR-ECO
Molodtsova et al. 2008, Braga-Henriques et al. 2013	Scleratiniaria	60		3	57	MAR-ECO & Azores EEZ
Molodtsova et al. 2008, Braga-Henriques et al. 2013, Molodtsova 2017	Antipatharia	20	1	3	16	MAR-ECO & Azores EEZ & Russian claim
Molodtsova et al. 2008, Braga-Henriques et al. 2013	Alcyonacea	82		13	69	MAR-ECO & Azores EEZ
Molodtsova et al. 2008	Pennatulacea	8			8	MAR-ECO
Cardoso et al. 2014	Shrimps	83		2	81	MAR-ECO
Martynov & Litvinova 2008	Ophiuroidea	29	3	1	25	MAR-ECO
Meland & Aas 2013	Gnathophausia		1		4	ECOMAR
Priede et al. 2012	Enteropneusta	3	3			ECOMAR
Braga-Henriques et al. 2013	Stylasteridae	9		4	5	[illegible]
Young 1998	Cirripeds	9			9	Kane FZ, Snake Pit, Lucky Strike
Larsen et al. 2006	Tanaidacea	11	6		5	Lucky Strike
Calder & Vervoort 1998	Hydroids	19	2	1	16	SW Azores (HV), Reseracher ridge, Vema FZ
Mapstone et al. 2016	Rhodaliids	2	2		0	TAG and Snake Pit - far field
Corbari & Sorbe 2018	Amphipoda	1	1		0	TAG - non vent
Hestetun et al. 2013	Sponges - Cladorhizidae	5	2		3	Kane FZ and 15°N

Is there a non-vent MAR endemic fauna?









≈ 15% of the non-vent fauna is endemic to the Mid-Atlantic Ridge

What drives the structure and composition of benthic communities along the MAR?

Species distribution and community composition shift at 60°N and 1000 m depth

=> Water mass structure: warmer Subpolar Mode Water (SPMW) and cooler Upper North Atlantic Deep Water (UNADW)

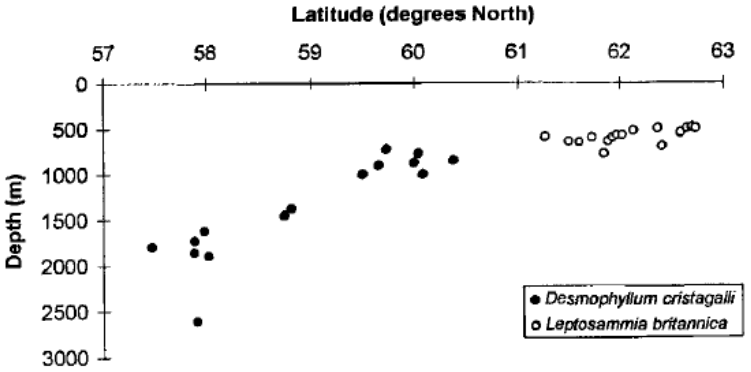


Figure 2

Spatial distribution of common solitary scleractinian species among CD80 samples.

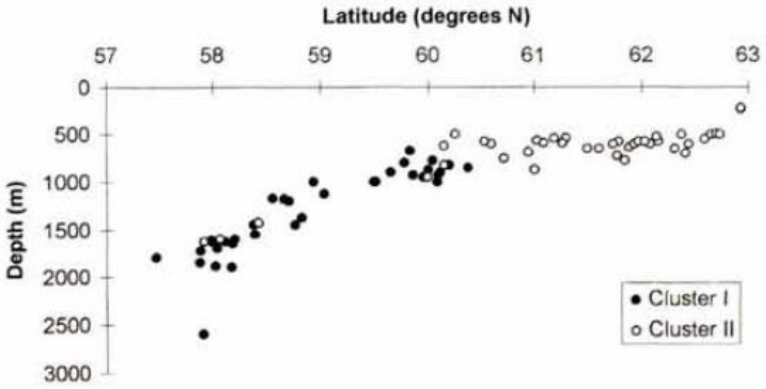


Figure 7

Spatial distribution of CD80 stations belonging to the two main clusters recognised by multivariate analysis.

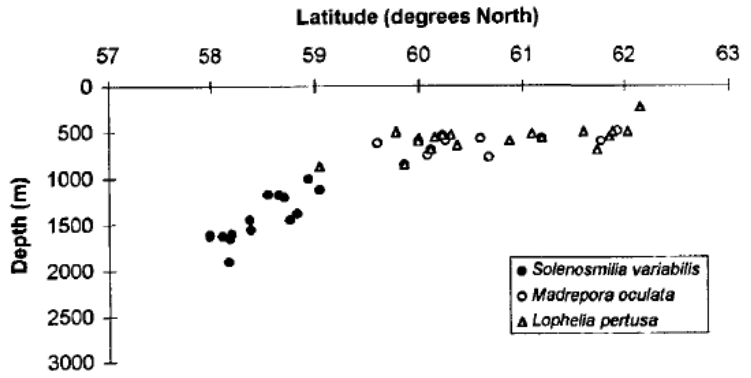
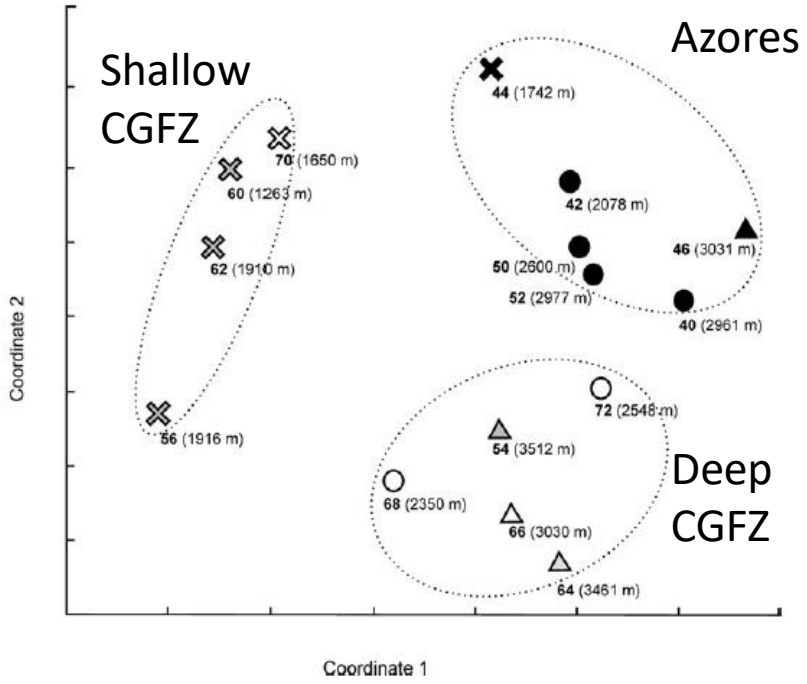


Figure 3

Spatial distribution of colonial scleractinian species among CD80 samples.

Copley, J.T.P. et al. 1996. Megafauna from sublittoral to abyssal depths along the Mid-Atlantic Ridge south of Iceland. Oceanologica Acta 19 (5), 549-559

What drives the structure and composition of benthic communities along the MAR?

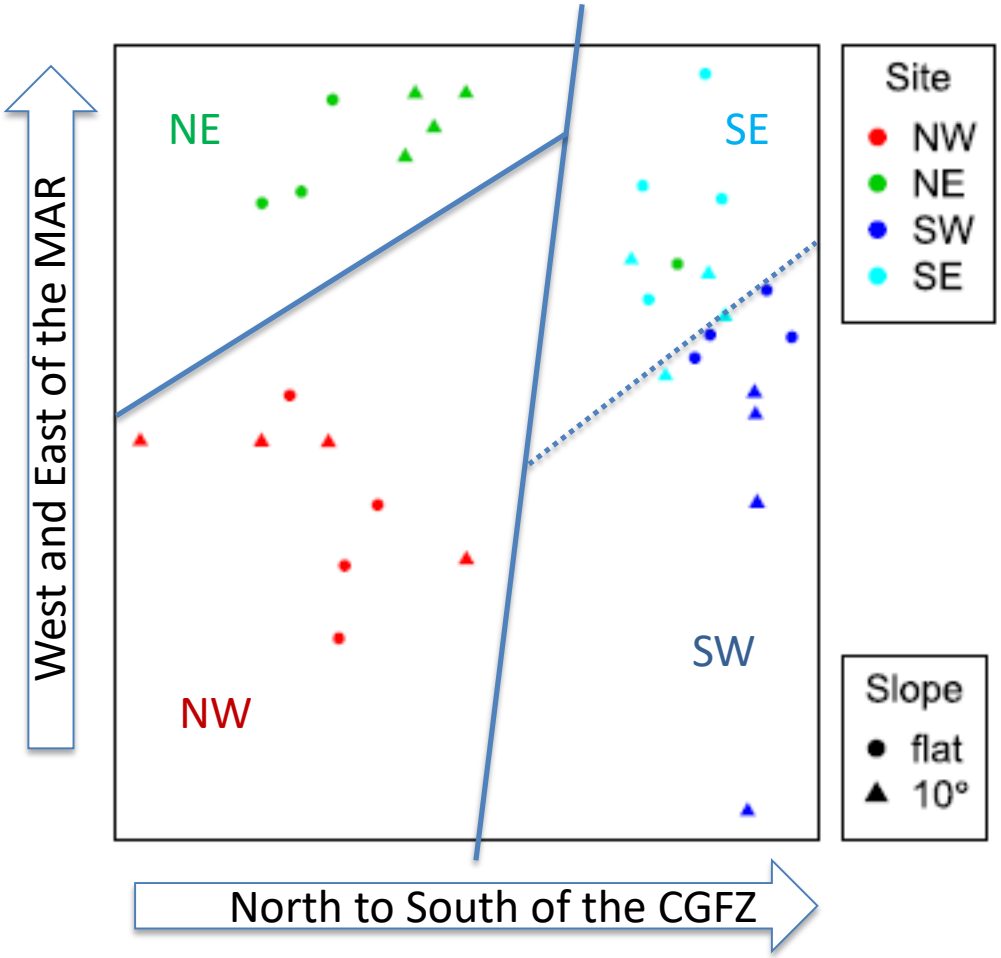


Turnover in benthic bathyal fauna between the Charlie-Gibbs Fracture Zone and the Azores, which could be related to the presence of the Sub-Polar Front and its **influence on surface productivity.**

Changes in bathyal fauna across the ridge showed that the fauna had some differences east and west from the ridge, indicating that **the ridge may structure local faunas in the east–west direction.**

Gebruk et al., 2010. Bathyal benthic fauna of the Mid-Atlantic Ridge between the Azores and the Reykjanes Ridge. Journal of the Marine Biological Association of the UK 90 (01), 1-14.

What drives the structure and composition of benthic communities along the MAR?

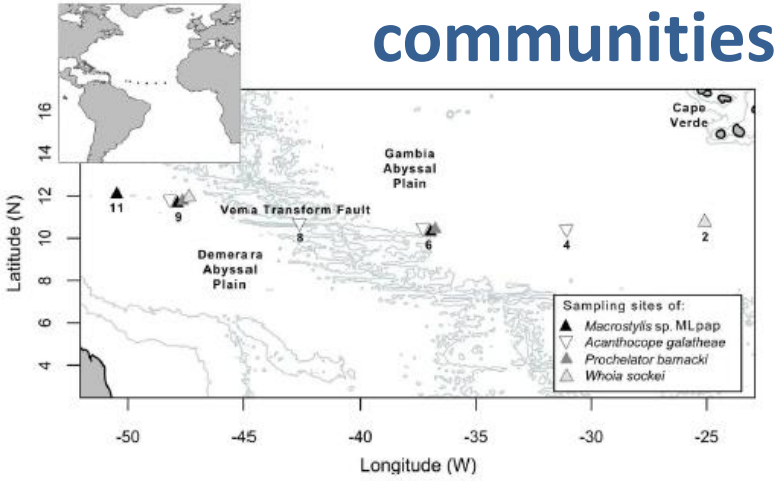


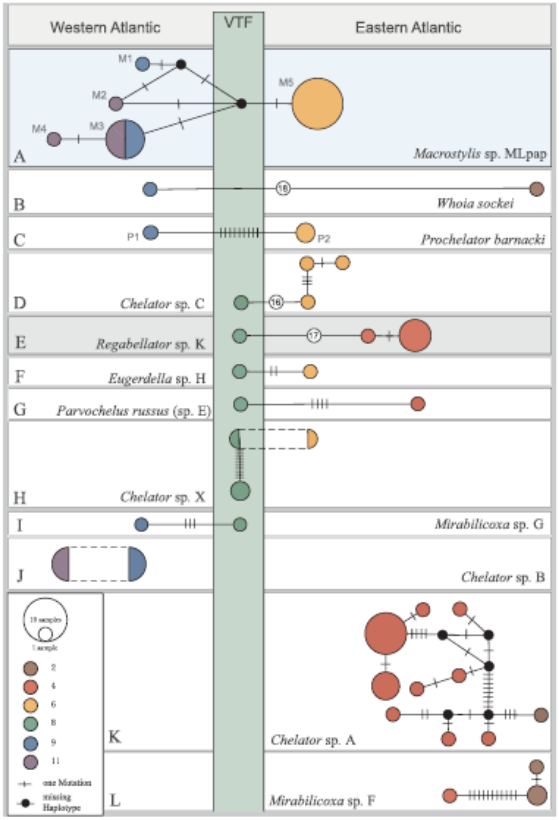
The community composition of the megafauna differs North and South of the CGFZ.

North of the CGFZ, the community composition of the megafauna differs East and West of the MAR.

Alt et al., 2019. Bathyal benthic megafauna from the Mid-Atlantic Ridge in the region of the Charlie-Gibbs fracture zone based on remotely operated vehicle observations. Deep Sea Research Part I: Oceanographic Research Papers 145, 1-12, https://doi.org/10.1016/j.dsr.2018.12.006.

What drives the structure and composition of benthic communities along the MAR?



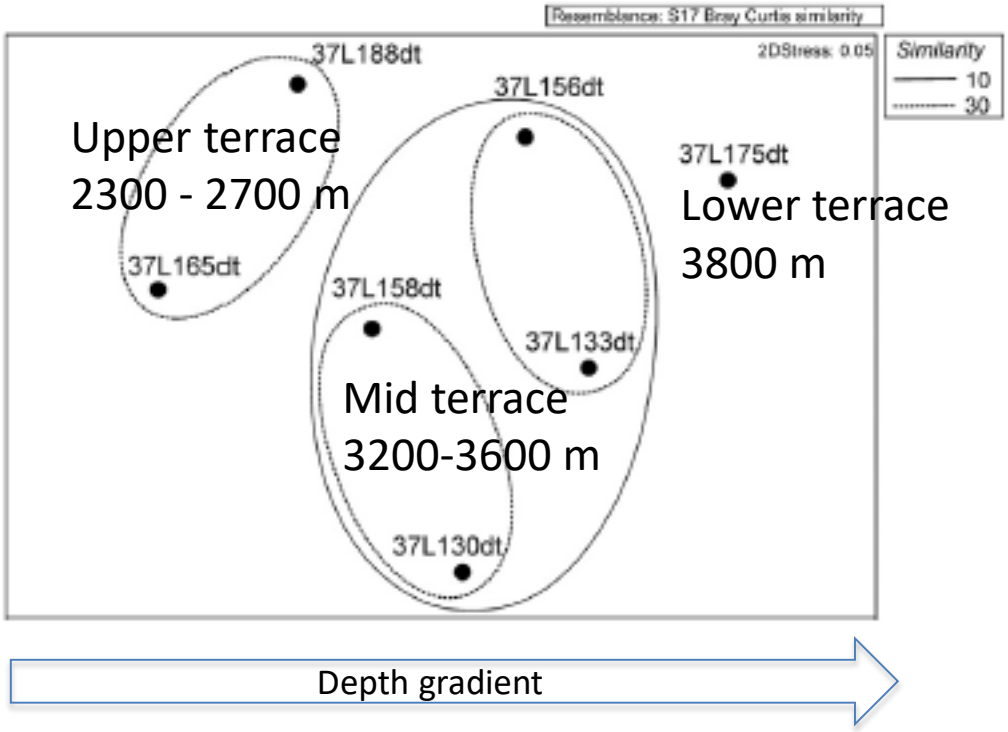


The MAR seems to be a dispersal barrier for the non-swimming Macrostylidae as well as weakly-swimming Desmosomatidae and Nannoniscidae.

But persistent gene flow across the MAR for the swimming Munnopsidae.

Bober et al. 2018. Does the Mid-Atlantic Ridge affect the distribution of abyssal benthic crustaceans across the Atlantic Ocean? Deep Sea Research Part II: Topical Studies in Oceanography 148, 91-104.

What drives the structure and composition of benthic communities along the MAR?



Community composition of the soft sediment benthic fauna varies with depth

Molodtsova et al., 2017. First data on benthic and fish communities from the Mid-Atlantic Ridge, 16°40'– 17°14'N. Deep Sea Research Part II: Topical Studies in Oceanography 137, 69-77, https://doi.org/10.1016/j.dsr2.2016.10.006.

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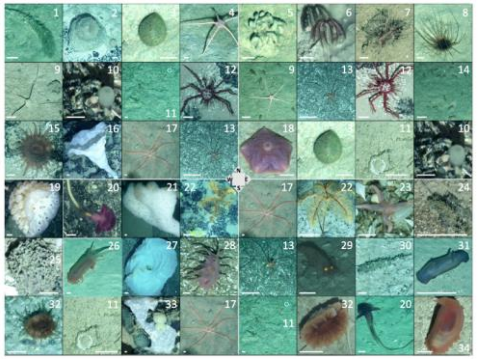


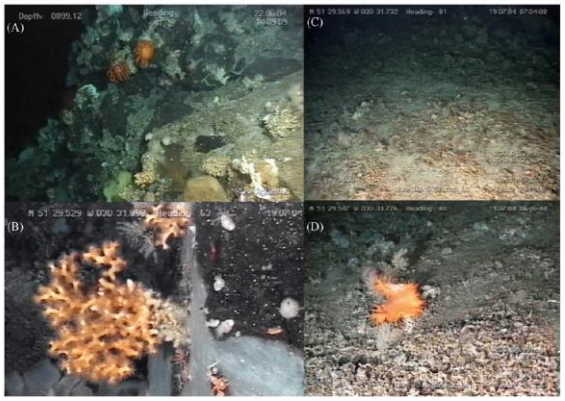
Alt et al., 2019

Bell et al., 2016: Fine-scale habitat structure at steep slopes of the MAR was highly variable, ranging from sediment-covered slopes to sheer rock cliffs.

Morris et al., 2012: Coral densities and species numbers were higher on hard rock substratum than on sediment only substratum, with a further increase on sloped rock substratum, which probably reflects increased current flow and hence food supply on inclined surfaces.

Alt et al., 2019: Local habitat complexity was increased by the pteropod thanatocoenoses and biotic structures, such as xenophyophores and sponges.

The seafloor on the MAR is complex, with variations in topography, substratum and biogenic structures, which enhance species turnover at local scale



Mortensen et al., 2008

Are there non-vent Vulnerable Marine Ecosystems on the MAR?

i. **Uniqueness or rarity** – an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems.

ii. **Functional significance of the habitat** – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages or of rare, threatened or endangered marine species.

iii. **Fragility** – an ecosystem that is highly susceptible to degradation by anthropogenic activities.

iv. Life-history traits of component species that make **recovery difficult**.

v. **Structural complexity** – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features.

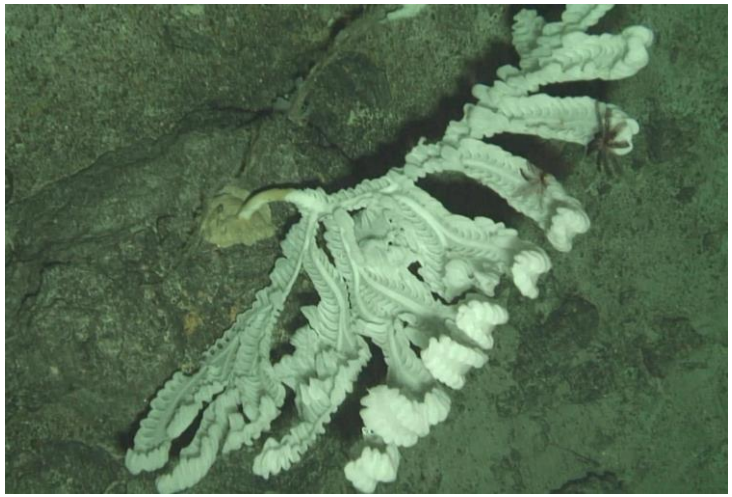
Are there non-vent Vulnerable Marine Ecosystems on the MAR?

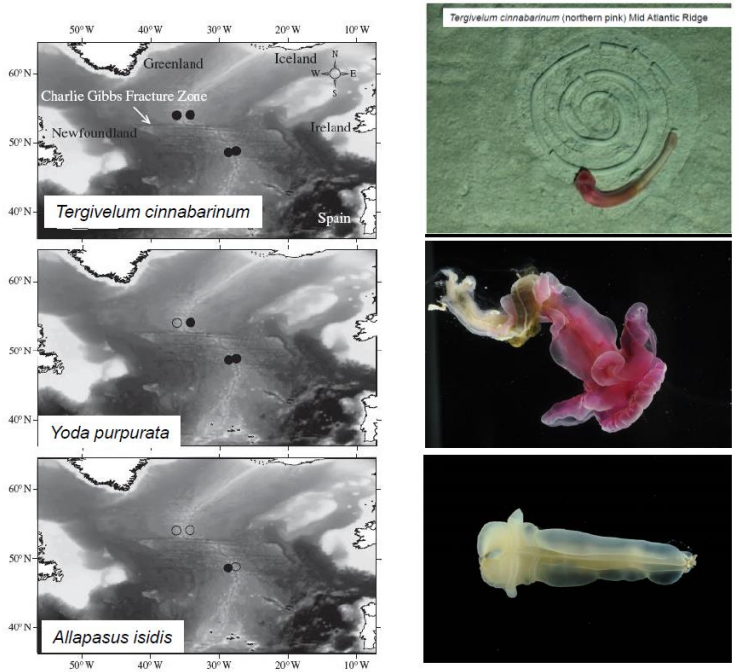
The VME indicator taxa: Sponges and corals

- Important component of the hard-substrate fauna on the Mid-Atlantic Ridge
- Play an important role in benthic coupling-pelagic coupling
- Habitat-forming organisms enhancing biodiversity
- May play a crucial role as a refuge, feeding ground and nursery for fish and invertebrates
- Extremely long-lived

Mortensen et al. 2008: The number of megafaunal taxa was 1.6 times higher in areas where corals were present compared to areas without corals.

Are there non-vent Vulnerable Marine Ecosystems on the MAR? – The unknows





Discovery of a sponge garden on the flank of a MAR seamount at 1700 m depth near Snake Pit vent field.

236 records of sponges were spotted along the 4800m of a dive track, including gardens of a coral-like creature, tentatively identified as a sponge.

Enteropneusts of the MAR (Priede et al.,2012) :

- Extremely fragile, easily destroyed and rare
- *Yoda purpurata* and *Allapasus isidis* are only known from the Northern Mid-Atlantic Ridge
- Areas of the sediment surface with extensive enteropneust feeding trails could constitute a VME

Conclusions

- About **15% of the non-vent fauna may be endemic** to the MAR
- **Large-scale species turnover** according to latitude, longitude and depth
- The drivers could be water masses, food availability, barriers to dispersal
- **Small-scale species turnover** due to topography, substratum and biogenic structures
- Aggregations of sponges and corals on hard substrates, enteropneusts on soft substrates are potential VMEs on the MAR
- The non-vent fauna of the MAR has been vastly undersampled, discoveries of new VMEs are likely

Thank you for your attention