Controls in sedimentary facies and related carbonate factories

of volcanic islands, seamounts and shallow water platforms around the Azores **(M150 – BIODIAZ)**

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Research questions

- Do the sediments reflect the different evolutionary stages of oceanic islands from a volcanically active island to a completely submerged seamount?

Background: Due to their bioclastic composition (molluscs, echinoderms, foraminifers, bryozoans, tube worms), it is expected that carbonate production by benthic ecosystems starts when small island shelves with an even topography have been developed, and is fully established when reaching a seamount stage. This would imply a shift in sediment source from terrestrial to marine, i.e. from volcanoclastic towards biogenic sediments.

- Is the biogenic sedimentation controlled by/ restricted to benthic habitats and their respective communities?

Background: Based on data from POS466 MAPS cruise it is expected, that epibenthic communities are most frequent in shallow waters characterized by a rocky sea floor. The biosedimentary systems may be classified as BryoMol-types showing a variety of habitats controlled by ecosystem engineering species, i.e. bryozoan thickets and oysters. Under more open oceanic conditions around the submerged banks (Princess Alice and Formigas) the pelagic production (pteropods, planktonic foraminifers) should become a more significant sediment source.

- What impact do landslides, storms and mass flows have on the sedimentation and benthic communities? Do the communities differ after recovery from those of undisturbed areas?

Background: The islands of the Azores are essentially drowned by a combination of marine erosion, flank collapses and subsidence. These processes are the foremost agent in the decay of volcanic islands. Flores Island represents a stage of an island where important processes like flank collapses contribute for the erosion and ultimately the life span of an island.

Methods

- Three **volcanic islands** of different ages and tectonic settings (Flores, Terceira, St. Maria), one **seamount** (Princess Alice Bank), one **shallow water platform** (Formigas)
- Shore-normal transects **from 50m to 300m** water depth
- 53 stations, up to 4 replicates per station
- **45 sediment samples** analysed
- grain size distribution, **component analysis** (~400 particles each grain size fraction, **20 variables**, see Sarnthein 1971), carbonate content
- **statistcal analysis** (nMDS, cluster, facies)

Fig. 2: (left) Sample #T8-243Ter (51m water depth) Volcano-clastic gravel with only 5.8% of biogenic particles (benthic gastopods, tube worms and *Miniacina miniacea*).
(right) Sample #T8-266Ter (305m water depth) Bioclastic sand mainly composed of bryozoans, benthic foraminifers and pelagic pteropods and globigerinids.

Study area

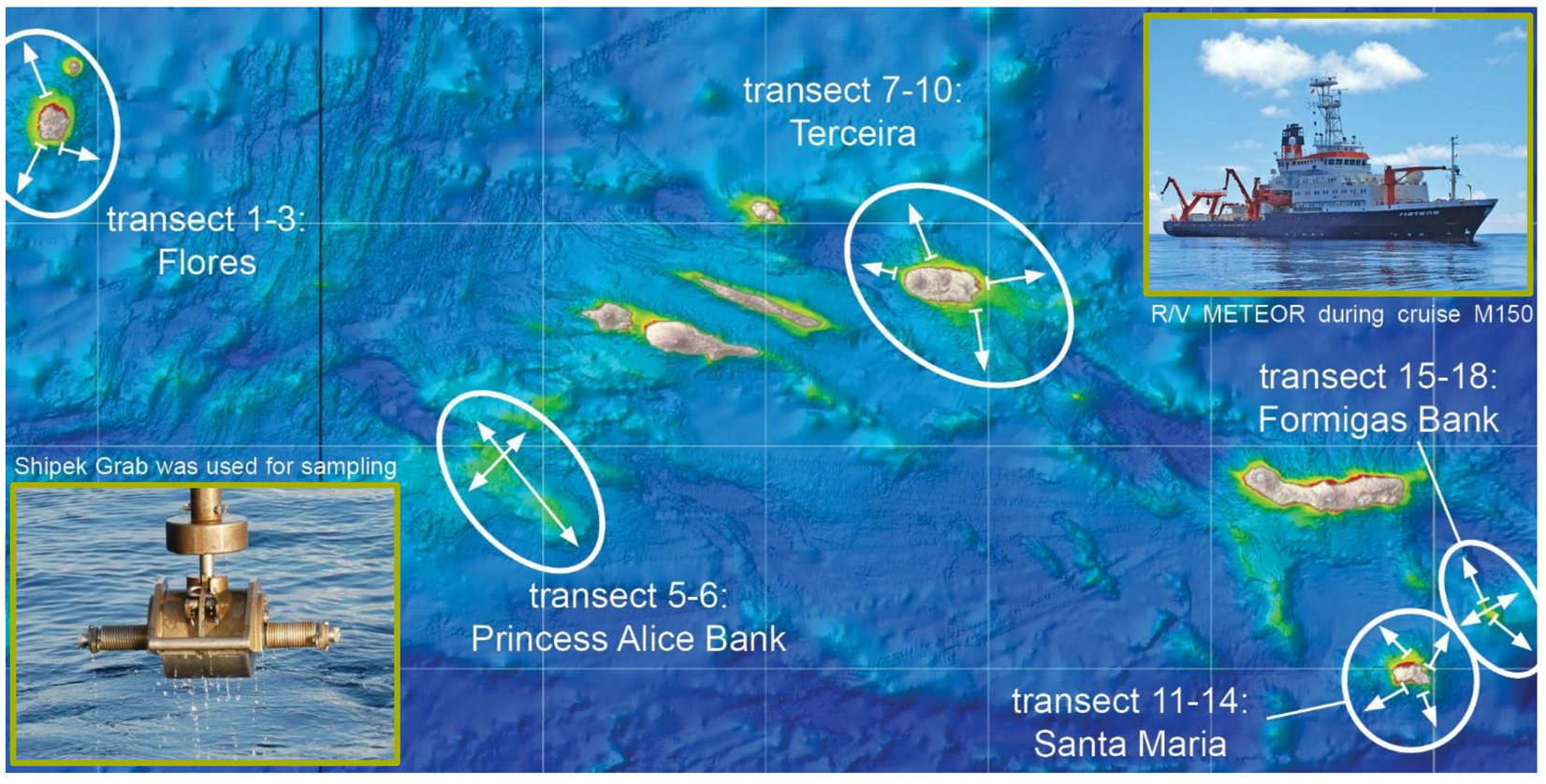

Fig. 1: Sampling transects reflecting different structural settings (i.e., volcanic islands, seamounts, shallow water platform, abyssal plain) and hydrodynamic exposures.

Results

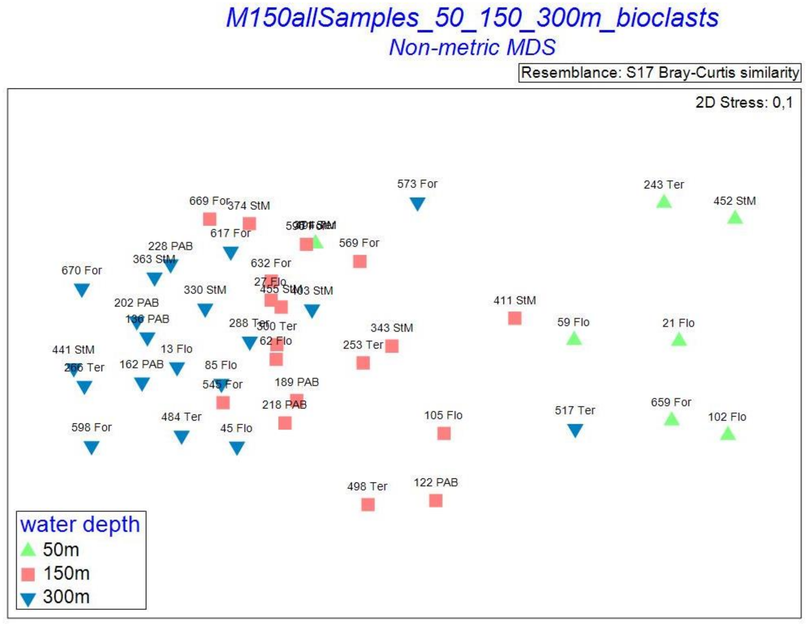

Fig. 3: nMDS-plot of component analysis data (45 samples, 20 variables) of the bioclastic components showing a clear water-depth depended grouping of samples.

50m stations

- Well sorted medium sands to fine gravel, $CaCO_3$ 6-100% (mean 58%), rocky hardground
- Main biogenics: tube worms, benthic gastropods, *Miniacina miniacea*, and bivalves

150m stations

- Medium to well sorted medium sands to fine gravel, $CaCO_3$ 21-100% (mean 79%)
- Main biogenics: bryozoans, pteropods, *Miniacina miniacea*, bivalve, and tube worms

300m stations

- Well to bimodal sorted fine to coarse sands, $CaCO_3$ 56-100% (mean 88%)
- Main biogenics: bryozoans, pteropods, *Miniacina miniacea*, other benthic and pelagic foraminifers

Conclusions

- Biogenic sediment composition show a strong correlation to water depth and related habitats
- Input of volcanoclastic terrigenous material decrease with distance from the islands shore
- Shallow water (50m) carbonate production is controlled by the availability of rocky habitats
- Pelagic biogenic signal increases with distance from shore and increasing water depth
- Bryozoans are the most important carbonate producers, followed by tube worms, foraminifers and pteropods
- Sediment composition is also controlled by the structural settings. Younger islands have a higher input of terrigenous input due to steeper relief (with flank collapses, etc.).
- The relictic sediment material of PAB at all 150m stations is interpreted to be formed at lower sea levels during last glacial stages
- The Formigas represents a non-tropical (warm-temperate) carbonate platform with $CaCO_3$ values of 98-100% in all water depth

Acknowledgements
We gratefully thank Capt. Detlef Korte, the ship's crew and our scientic colleagues for the successful cruise. This work was supported by the DFG under MerMet 17-11.

Reference Sarnthein M, (1971): Oberflächensedimente im Persischen Golf und Golf von Oman. II Quantitative Komponentenanalyse der Grobfraktion, „Meteor"-Forschungsergebnisse 1971, C, 5: 1–113