Abstract

The Queensland Plateau (QP) is a drowned small continent SE off Australia and is characterized by vast atoll-like reef platforms which have been poorly investigated only. The reefs are located on basement highs and exhibit carbonate deposits of up to 2000 m of thickness. Some of the reef slopes located at the western margin of the QP were investigated during a German expedition in 2009 (http://www.deepdownunder.de) using the ‘Cherokee’-ROV from the MARUM (Bremen) down to ca. 800 m water depth. The expedition’s goals were to investigate the steep slopes of the Osprey Reef and other reefs (Holmes-, Bougainville-, and Shark Reef), big allochthonous blocks (“Cipit Boulder” type - known from Triassic reef slopes of the Dolomites/Italy), microbial cementation processes, and benthic community analyses. Special foci were set on so-called “living fossils” like hexactinellid and listhistid sponges, echinoderms (e.g. stalked crinoids), deep water corals, and brachiopods, with observations on exceptionally deep-migrating (800 m) Nautilus communities. The slopes are characterized by often vertical walls down to 600 m which exhibit grooves where shallow water sediments are channelized during big storms and quakes. The talus deposits consist of carbonate sediments dominated by Halimeda chips, reef debris, and decametre-scale boulders. These boulders show distinctive dark microbial Fe/Mn crusts covering on the protected surfaces from normal sediment flux. Fluffy sediments covering the exposed top surfaces are cemented by microbial activity forming brownish microbialites like those known from deep reef cave environments. The talus blocks are settled by organisms mainly of the so-called “living fossils”. Soft bottoms of the vast plains between the boulders are characterized by an intense bioturbation activity by endo-
epibenthic assemblages (e.g. invertebrates and demersal fish). Geological settings and benthic distribution were analysed by sampling and imaging methods applied to underwater video footage gained by the ROV ‘Cherokee’.

References


Websites

Sedimentology and Geobiology of Deep Carbonate Slopes from the Osprey- and nearby Reefs (Queensland Plateau, NE Australia) – The Search for Mesozoic/Cenozoic Relic Fauna - „Living Fossils“

Joachim Reitner¹, Marta Rodríguez-Martínez², Stephan Erasmi³, Juliane Germer¹, Nadia-Valérie Quéric¹, Gert Wörheide⁴, Carsten Lüter⁵, Ben Thuy¹,

¹Dept Geobiology, Univ. of Göttingen, Germany
²Dept de Estratigrafía Facultad de Geología Universidad Complutense de Madrid, Spain
³Dept Remote Sensing, Univ. Göttingen, Germany
⁴Dept Paleontology & Geobiology, Ludwig-Maximilian Univ. Munich, Germany
⁵Museum of Natural History Leibniz Inst. Evolution- and Biodiversity Research, Berlin, Germany
Deep Down Under Expedition
December 2009

Queensland Plateau
Search for relic fauna
„living fossils“
Basic Geology of the Queensland Plateau

- Oceanic crust
- Townsville trough
- Carbonate platforms
- Reefs
- Thinned continental crust
- Osprey Reef

Davies 2011
Isolated atoll-like reefs, e.g. Osprey Reef

Wellman et al 1997
Slope structure Osprey Reef – West Wall

Entrance-Channel

Dive 7

Dive 9

Dive 10

West Wall

North Horn

DDU 2009 Search for “Living Fossils” 7
Slope structure Osprey Reef
Slide structures

Low stand channels
Entrance channel
Slope structure Osprey Reef
Slide structures

Low stand channels
Entrance channel
Depositional Environments

Osprey Reef West Wall
Deep Soft Bottoms (800-500m)
Calcereous-coccolith ooze

Dive 9 12-15-06, 28-54
Meadows of arborescent large Foraminifera

"Psammatodendron - Pelosina"

Depositional Environments - Organisms

Osprey Reef West Wall

Deep Soft Bottoms (800-500m)

Araeosoma cf. Belli
Irregular echinid

Laethogone sp.
Sea cucumber

Psammatodendron
Actinid soft coral

Chaunax sp.

Dive 7 12-13-02, 11-56
Dive 8 12-14-04 54-10
Dive 7 12-13-01, 09-42
Dive 8 12-14-05, 29-30
Depositional Environments - Organisms
Osprey Reef West Wall
Deep Soft Bottoms (800-500m)

Meadows of arborescent large Foraminifera
„Psammatodendron-Pelosina“
Osprey Reef West Wall
Depositional Environments – Mound Structures 600-500m

Dive 8 12-14-06, 09-02
Osprey Reef West Wall
Mound Structures 600-500m

Ophiactis definita

Dive 7 12-13-00, 55-34

Thin microbialitic crust – Fe-hydroxid + Mg calcite

DDU 2009 Search for „Living Fossils“ 12
Osprey Reef West Wall
Mound Structures 600-500m

Ophiactis definita

Dive 7 12-13-00, 55-34

Thin microbialitic crust – Fe-hydroxid + Mg calcite

Mound Structures 600-500m

Fe-biofilm
Mg-calcite

"Marine Snow"

Galatheid crab (Munida)

Spondylid bivalves

DDU 2009 Search for "Living Fossils" 12
Osprey Reef West Wall
Depositional Environments –
Steep Walls + Mn Hardgrounds 800-400m

Mn+Fe microbial hardground formation
on „Marine Snow“ -sediment protected areas
Osprey Reef West Wall
Steep Walls + Mn Hardgrounds 800-400m
Biodiversity hotspots

Dyscolia johannisdavisi

DDU 2009 Search for "Living Fossils" 14
Osprey Reef West Wall
Mn Hardgrounds 800-400m

Biofilms of Mn+Fe oxidising microbes

Mn-rich EPS
Osprey Reef West Wall
Depositional Environments – Steep Walls 400-50m

Porphyrocrinus cf. verrucosus

Dive 9 12-15-06, 29-26
Osprey Reef West Wall
Steep Walls – tectonic and bedding structures

Dive 7 12-13-02, 08-08
Dive 9 12-15-06, 32-00
20cm

Neptunian-Dyke

Dive 7 12-13-03, 03-26
Dive 9 12-15-06, 33-58
Osprey Reef West Wall

Depositional Environments – Boulder Fields 700-400 m „Cipit“-Boulders

Dive 9 12-15-06, 31-34

Dive 9
Osprey Reef West Wall

Depositional Environments –
Deep Fore Reef channel lag debris 700-400 m
Osprey Reef West Wall

Deep Fore Reef Boulders
„Benthic Islands“ 700-400 m
„Cipit“-Boulders

Psammatodendron Meadows

Dendrophyllia

Dive 7 12-13-04, 23-06

Comatulid crinoids

brisingid sea stars

Novodinia

Tetractinellid demosponge

Lophelia

Meadows

DDU 2009 Search for „Living Fossils“ 20
Dive 5/9 12-11-03, 24-52

Firm microbial mounds “polished” by downward sediment transport

Dive 5 12-11-02, 43-04
Grain flows
Depositional Environments – Steep Walls 300m

Firm microbial mounds „polished“ by downward sediment transport

Dive 5/9  12-11-03, 24-52
Osprey Reef West Wall

Depositional Environments – Steep Walls 250m

Begin of the photic zone
Steep walls with karst fabrics

Cavernous structures – karst?

Dive 9 12-15-06, 36-22

Dive 9 12-15-06, 37-08
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups

Hexactinellid Sponges: Aspidoscopulia ospreya
Hexactinellid Sponges: 
*Psilocalyx wilsoni*

Dive 4 12-10-04, 04-46

Dive 6 12-12-01, 09-36
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups

Lithistid Demosponges: Mesozoic (Cretaceous) relics!

Pleroma cf. aotea
Deep life: “Living Fossils” and environmental key groups

Lithistid Demosponges: Mesozoic (Cretaceous) relics!

*Jereicopsis graphidophora*

Dive 7 12-13-04, 07-42
Osprey Reef

Deep life: “Living Fossils” and environmental key groups

Lithistid Demosponges: Mesozoic (Cretaceous) relics!

Pleroma cf. aotea

Dive 7 12-13-04, 07-42

Jereicopsis graphidophora

Dive 10 12-16-04, 21-02

Scleritoderma camusi

Dive 10 12-16-04, 21-02
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups

Stalked Crinoids – Triassic relatives
Mound surfaces fixed on microbial cements

Porphyrocrinus cf. verrucosus

Dive 9 12-15-06, 29-04

Dive 9 12-15-06, 29-30
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups
Terebratulid Brachiopods

*Dyscolia johannisdavisi*
Young specimens

Dive 4 12-10-02, 52-48
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups
Ahermatype scleractinian corals

Lophelia pertusa

Dive 9 12-15-06, 32-28
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups

Ahermatype scleractinian corals

Desmophyllid coral

Dive 9 12-15-06, 32-28

Dive 10 12-16-04, 21-32

Dive 4 12-10-03, 31-36

carophyllid corals

DDU 2009 Search for „Living Fossils“ 28
Osprey Reef
Deep life: „Living Fossils“ and environmental key groups

Echinothuria – Jurassic remnants of deep water regular Echinids

Poison sac-spines

Phorosoma cf. placenta

Dive 8 12-14-03, 52-58

DDU 2009 Search for „Living Fossils“ 29
Deep life: „Living Fossils“ and environmental key groups
Deep Reef Caves 100-20m

Coralline sponge: Sphinctozoan demosponge
_Vaceletia sp._ – lower Cambrian – archaeocyathid relic!
Osprey Reef
Deep life: “Living Fossils“ and environmental key groups

*Nautilus pomilious* feeding experiment in 800m water depth

Dive 11 12-17-05, 57-36
Conclusions:
Osprey Reef Deep Slope

Sedimentary Facies

Cavernous structures
250-100m

Steep walls, polished
Microbial mounds
350-200m

Steep walls with
Mn/Fe hard grounds
(800) 400-200m

Microbial mounds
600-500m

Boulder Fields
„Cipit“ boulders
700-400m

Soft bottom
800-500m

Key organisms—“living fossils”

Reef caves
Coraline sponges
100-20m

First light-green algae
250m

Terebratulid brachiopods
Mn/Fe hard grounds
400m

Hexactinellid sponges
Mn/Fe hard grounds
600-400m

Stalked crinoids
Microbial mounds
600-500m

Lithistid sponges
Microbial mounds
600-500m

Echinothurid echinids
Soft bottom
800-500m

Dive 9
DDU 2009 Search for „Living Fossils“ 32
Acknowledgement:

Funding:
Deutsche Forschungsgemeinschaft DFG
German Excellence Program – Courant Research Centre Geobiology
University of Göttingen

Technical and Scientific Support:
ROV Cherockee Team (W. Dimmler & N. Nowald) Marum (Bremen, Germany) providing under water photographs

Crew of the RV PMG Pride

Scientific crew of the Deep Down Under Expedition 2009

Geobiology Team University of Göttingen

Queensland Museum

Bathymetric maps:
Dr. Robin Beaman, James Cook University

Further reading: www.deepdownunder.de/