



Preliminary biological characterization of the Saldanha hydrothermal field at the Mid-Atlantic Ridge (36°34'N, 32°26'W, 2200 m)

Manuel BISCOITO¹, Armando J. ALMEIDA² and Michel SEGONZAC³

(¹) *Estação de Biologia Marinha do Funchal - IMAR, Cais do Carvão, 9000-107 Funchal, Madeira, Portugal.*

Fax: +351-291766339, E-mail: manuel.biscoito@cm-funchal.pt

(²) *Universidade de Lisboa, Faculdade de Ciências, DBA, Laboratório Marítimo da Guia - IMAR, Estrada do Guincho, 2750-642 Cascais, Portugal.*

(³) *Département Etude des Ecosystèmes Profonds (DEEP), Ifremer, Centre de Brest, BP 70, 29280 Plouzané Cedex, France*

Abstract: A preliminary description of the biology of the Saldanha hydrothermal field in the Mid-Atlantic Ridge (36°34'N, 32°26'W, 2200 m) is given, based on direct observation, video images and samples. Venting occurs mainly in a diffuse way through sediment, but hydrothermal fluid discharges are visible through centimeter-long orifices, scattered on the sediment, over an area of approximately 400 m², at depths between 2,200 and 2,220 metres. Emitted fluids are transparent, with a temperature of 7-9°C. An almost complete absence of macro- and megafauna around the venting orifices was found. The only vent invertebrate identified was the gastropod *Phymorhynchus* sp., with only two juvenile specimens caught. A careful examination of the images taken at these orifices showed bacteria-like filaments undulating with fluid discharge. At the level of the benthic bathyal megafauna the dominant species seemed to be the sponge *Cinachyra* sp. (Demospongiae, Spirophorida, Tetillidae). At least 4 species of fish are new records from the area.

Keywords: Hydrothermal vents • Mid-Atlantic Ridge • Fauna assemblage • Gastropoda • Bathyal megafauna • Sponge • Fish • *Acanthonus* • *Antimora* • New records

Introduction

Up to the present, eight hydrothermal vent fields supporting typical vent fauna or having signs of it have been discovered in the Mid-Atlantic Ridge (MAR), north of the equator (Fig. 1). Their depths vary from 700 m at Lost City to 3050 m at Logatchev. All but Lost City show the presence of living hydrothermal vent fauna characterized

by the presence of alvinocaridid shrimps and/or mytilid bivalves of the genus *Bathymodiolus* (Van Dover, 1995; Gebruk et al., 1997; Tunnicliffe et al., 1998). At Lost City, subfossil shells and shell fragments of *Bathymodiolus azoricus* Cosel & Comtet, 1998 as well as empty shells of other vent obligate mollusks have been found, proving at least the recent presence of “classical” hydrothermal macrofaunal communities (Gebruk et al., 2002; Sagalevich

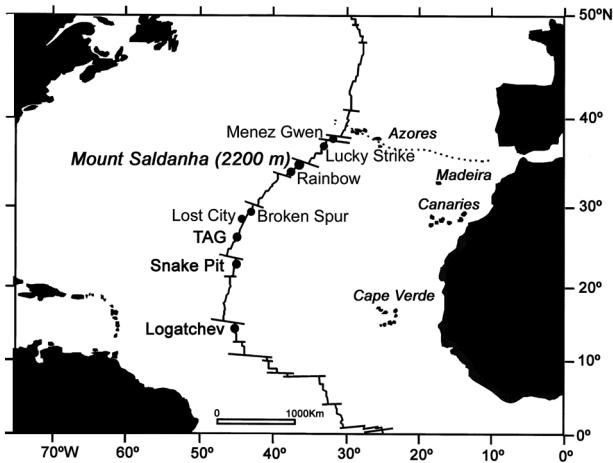


Figure 1. Location of Mount Saldanha vent field and other vent fauna-bearing fields at Mid-Atlantic Ridge, north of Equator.

Figure 1. Localisation de la zone hydrothermale du Mont Saldanha et d'autres zones hydrothermales abritant de la faune sur la ride médio-atlantique, au nord de l'équateur.

Table 1. List of invertebrates observed/collected at the Saldanha Seamount vent field.

Tableau 1. Liste des invertébrés observés/récoltés sur le site hydrothermal du Mont Saldanha.

Class	Order	Family	Species
Demospongiae	Spirophorida	Tetillidae	<i>Cinachyra</i> sp.
	Haplosclerida	Chalinidae	<i>Gellius</i> sp.
	Poecilosclerida	Raspailiidae	<i>Lithoplocamia spinispiculum</i> (Carter, 1876)
	Tetractinellida	Geodiidae	<i>Geodia</i> sp. <i>Geodia barretti</i> Bowerbank, 1858 gen. sp.
Hexactinellida			<i>Anthomastus</i> sp.
Anthozoa	Alcyonacea	Alcyoniidae	<i>Iridogorgia</i> sp.
	Gorgonacea	Chrysogorgiidae	<i>Umbellula</i> sp. gen. sp.
	Pennatulacea	Umbellulidae	<i>Stichopathes</i> sp.
	Ceriantharia	Antipathidae	<i>Phymorhynchus</i> sp. gen. sp.
Gastropoda	Caenogastropoda	Conidae	<i>Cirroteuthis</i> sp. <i>Grimpoteuthis</i> sp. gen. sp.
Aplacophora			<i>Colossendeis</i> sp.
Cephalopoda	Octopoda	Cirroteuthidae	<i>Nematocarcinus</i> sp. gen. sp.
		Magnapinnidae	gen. sp.
Pycnogonida	Pantopoda	Colossendeidae	<i>Nematocarcinus</i> sp. gen. sp.
Malacostraca	Decapoda	Nematocarcinidae	gen. sp.
Amphipoda			gen. sp.
Cumacea			gen. sp.
Isopoda			gen. sp.
Tanaidacea			gen. sp.
Crinoidea			
Comatulida	Bourgueticrinida	Hyocrinidae	<i>Anacalypsicrinus cf. nefertitii</i> (A.-M. Clark, 1973) gen. sp.
	Asteroidea		
Ophiuroidea	Phanerozonia	Goniasteridae	<i>Pseudarchaster gracilis</i> (Sladen, 1889) gen. sp.
	Forcipulata	Brisingidae	
Echinoidea	Ophiurida	Ophiacanthidae	<i>Ophiacantha crassidens</i> Verrill, 1885
		Ophiopidae	<i>Ophiocentrotus</i> Pattern, Tyler & Gage, 1982
Holothuroidea	Diadematoidea	Echinothuridae	<i>Araeosoma</i> sp.
	Elasipodida	Elpidiidae	<i>Peniagone</i> sp.
		Psychropotidae	<i>Benthodytes</i> sp. <i>Psychropotes longicauda</i> Théel, 1882
Ascideacea	Enterogona	Holozoidae	<i>Polydistoma azorensis</i> Monniot, 2003
		Didemnidae	<i>Leptoclinides faeroensis</i> Bjerkan, 1905

et al., 2005).

Geologically, Rainbow (36°N, ~ 2300 m), Lost City (30°N, 700-800 m) and Logatchev (14°45'N, 2900-3050 m) vent fields at MAR are hosted on peridotite and gabbroic material, a characteristic also shared by the Saldanha vent field (Barriga et al., 1998; Kelley et al., 2001).

The Saldanha hydrothermal field, discovered in 1998 during the SALDANHA Cruise (Barriga et al., 1998) is located on the Mid-Atlantic Ridge, south of the Azores (36°34'N, 32°26'W, 2200-2220 m), between Pico and Oceanographer fracture zones (Fig. 1). It is on top of a serpentinized massif (Mount Saldanha), at a non-transform offset (NTO5). Venting occurs mainly in a diffuse way through sediment, but hydrothermal fluid discharges are visible through centimeter-wide orifices, scattered on the sediment (Fig. 2A), over an area of approximately 400 m² (Dias & Barriga, 2006). Fluids are transparent, with a temperature of 7-9°C and surrounding seawater temperature is in the range of 2°C (Barriga et al., 2003).

Material and methods

Information on the macro- and megafauna present on Saldanha hydrothermal field was mainly gathered by direct observation and video images taken during the SALDANHA (1998) and SEAHMA (2002) cruises, with the deep submersible *Nautilie* and ROV *Victor 6000* (Ifremer, France) respectively. A few invertebrates were also collected by these engines on three dives, as well as some fish sampling was done using bottom long-lines during VENTACO-3 cruise (2002). Most of the specimens collected are deposited in the collections of the Museu Municipal do Funchal (História Natural) (MMF) and the Laboratory EEP-Centob, Ifremer.

Results

The Saldanha hydrothermal field is characterized by the absence of vent obligate macro- and megafauna. A careful examination of the images taken at the venting orifices showed bacteria-like filaments undulating in the fluid discharge. However, neither shrimps nor mussels, vent organisms found in the nearby Rainbow vent field (Desbruyères et al., 2001) were seen in this hydrothermal field. So far the only invertebrate which is also present in other vent fields, was the gastropod *Phymorhynchus* sp., with only two juvenile specimens caught.

The existing benthic bathyal megafauna was dominated by the sponge *Cinachyra* sp. (Demospongiae, Spirophorida, Tetillidae) (Fig. 2B, C). These bristly surfaced globular sponges were distributed in patches on the sedimentary plateau, forming sometimes dense aggre-

gations (Fig. 2A). There was no relation between sponge aggregation and the presence of venting orifices. Over the sedimentary plateau, other benthic fauna was distributed very scarcely, in most cases only solitary organisms were observed, such as holothuroids. A list of the invertebrates observed or collected on site is presented in Table 1.

Benthopelagic megafauna recorded from the area include cirroteuthid and magnapinnid cephalopods (Tab. 1, Fig. 2I-L), the latter having only been observed from submersibles and ROVs at three locations in the Atlantic Ocean (off west Africa, off Brazil and in the Gulf of Mexico), two locations in the Indian Ocean and one location in the central Pacific Ocean, and their systematic position still remaining unclear (Vecchione et al., 2001).

A total of 13 fish families have been identified from the vent field and its immediate surroundings (Table 2, Fig. 3A-M). Among the species observed or collected, four deserve particular attention: *Synaphobranchus* sp., *Narctes* sp., *Antimora rostrata* Günther, 1878 and *Acanthonus armatus* Günther, 1878, as they are new records from the area.

The rocky surfaces surrounding the Mount Saldanha plateau were colonized by the usual bathyal invertebrates: hexactinellid sponges, hydrozoans, anthozoans, crustaceans and tunicates, such as the recently described *Polydistoma azorensis* (Monniot, 2003).

Discussion and conclusion

The most striking biological feature of the Saldanha vent field is the absence of typical vent species found in the other hydrothermal fields at MAR. A straight-forward explanation for this fact could not be found. Similar geological settings are found at Rainbow (only 25 nautical miles away from Saldanha and at the same depth) Lost City and Logatchev fields (Kelley et al., 2001). However, Rainbow and Logatchev have a profusion of vent obligate fauna (Gebruk et al., 2000; Desbruyères et al., 2001). Also, the diffuse character of the rare and weak fluid outlets found at Mount Saldanha cannot explain this faunal absence, since at Logatchev a similar situation occurs (Anya's Garden) and a population of vesicomid clams are found there (Gebruk et al., 2000). As proved by recent discoveries, "classical" hydrothermal macrofaunal communities existed in the Lost City area recently (Sagalevich et al., 2005), but no traces of it could have been found on the two occasions Mount Saldanha was visited.

Mount Saldanha is a serpentinized massif surmounted by a thin basaltic layer covered by pelagic sediments. These sediment layers are perforated by rare transparent relatively cool fluid outlets, at ground level and without visible mineral deposits. Very few fluid samples have been obtained up to the present, but these fluids may be mainly



Figure 2. A. Détail d'un venting orifice. B. Champ d'éponges *Cinachyra* sp. C. *Cinachyra* sp. D. Eponge Hexactinellida. E. Alcyonacea *Anthomastus* sp. F. Pennatulacea *Umbellula* sp. G. Gorgonacea *Iridogorgia* sp. H. Ceriantharia. I. Cephalopod cirroteuthid *Grimptoteuthis* sp.1. J. *Cirroteuthis* sp. K. *Grimptoteuthis* sp. 2. L. Cephalopod Magnapinnidae. M. Pycnogonid *Colossendeis* sp. N. Stalked crinoid *Anacalypsicrinus* cf. *nefertiti*. O. Comatulid crinoid. P. Echinoid *Araeosoma* sp. Q. Holothurian *Peniagone* sp. R. Holothurian *Psychropotes longicauda*. S. Holothurian *Benthodytes* sp. T. Colonial tunicate *Polydistoma azorensis*.

Figure 2. A. Détail d'une source hydrothermale. B. Champ d'éponges *Cinachyra* sp. C. *Cinachyra* sp. D. Eponge Hexactinellida. E. Alcyonacea *Anthomastus* sp. F. Pennatulacea *Umbellula* sp. G. Gorgonacea *Iridogorgia* sp. H. Ceriantharia. I. Céphalopode cirroteuthidé *Grimptoteuthis* sp.1. J. *Cirroteuthis* sp. K. *Grimptoteuthis* sp. 2. L. Céphalopode Magnapinnidae. M. Pycnogonide *Colossendeis* sp. N. Crinoïde pédonculé *Anacalypsicrinus* cf. *nefertiti*. O. Crinoïde comatulidé. P. Echinoïde *Araeosoma* sp. Q. Holothurie *Peniagone* sp. R. Holothurie *Psychropotes longicauda*. S. Holothurie *Benthodytes* sp. T. Tunicier colonial *Polydistoma azorensis*.



Figure 3. Fishes observed at Mount Saldanha. **A.** *Etmopterus princeps*. **B.** *Hydrolagus affinis*. **C.** *Halosaurus macrochir*. **D.** *Polyacanthonotus rissoanus*. **E.** *Ilyophis* sp. **F.** *Bathyterois phenax*. **G.** *Bathyterois grillator*. **H.** *Bathysaurus ferox*. **I.** *Coryphaenoides rudis*. **J.** *Antimora rostrata*. **K.** *Acanthonus armatus*. **L.** *Spectrunculus grandis*. **M.** *Cataetys* sp.

Figure 3. Poissons observés au Mont Saldanha. **A.** *Etmopterus princeps*. **B.** *Hydrolagus affinis*. **C.** *Halosaurus macrochir*. **D.** *Polyacanthonotus rissoanus*. **E.** *Ilyophis* sp. **F.** *Bathyterois phenax*. **G.** *Bathyterois grillator*. **H.** *Bathysaurus ferox*. **I.** *Coryphaenoides rudis*. **J.** *Antimora rostrata*. **K.** *Acanthonus armatus*. **L.** *Spectrunculus grandis*. **M.** *Cataetys* sp.

Table 2. List of fishes observed/collected at the Saldanha Seamount vent field.**Tableau 2.** Liste des poissons observés/récoltés sur le site hydrothermal du Mont Saldanha.

Order	Family	Species
Squaliformes	Somniosidae	<i>Centroscymnus coelolepis</i> Bocage & Capello, 1864
	Etmopteridae	<i>Etmopterus princeps</i> Collett, 1904
Chimaeriformes	Chimaeridae	<i>Hydrolagus pallidus</i> Hardy & Stehmann, 1990
		<i>Hydrolagus affinis</i> (Capello, 1868)
Notacanthiformes	Halosauridae	<i>Halosaurusopsis macrochir</i> (Günther, 1878)
	Notacanthidae	<i>Polyacanthonotus rissoanus</i> (Filippi & Vérany, 1859)
Anguilliformes	Synphobranchidae	<i>Ilyophys</i> sp.
		<i>Synphobranchus</i> sp.
Osmeriformes	Alepocephalidae	<i>Narcetes</i> sp.
Aulopiformes	Ipnopidae	<i>Bathypterois phenax</i> Parr, 1928
		<i>Bathypterois grillator</i> (Goode & Bean, 1886)
Gadiformes	Synodontidae	<i>Bathysaurus ferox</i> Günther, 1878
	Macrouridae	<i>Caelorhynchus labiatus</i> (Koehler, 1896)
		<i>Coryphaenoides rudis</i> Günther, 1878
		<i>Antimora rostrata</i> Günther, 1878
Ophidiiformes	Moridae	<i>Acanthonus armatus</i> Günther, 1878
	Ophidiidae	<i>Spectrunculus grandis</i> (Günther, 1877)
		Bythitidae

sea water, with low concentration of methane (Charlou et al., 1996). Due to the lack of data on the chemistry composition of the fluids and the small number of faunal samples obtained, no more can be said about the absence of vent fauna, without entering the field of speculation.

Amongst the bathyal invertebrates collected, most of them are taxonomically difficult, therefore their identification at species level is currently under way by several specialists and the results of these studies will be published in the years to come.

Of the fishes collected at Mount Saldanha, two species observed are new records from the Azores. *Antimora rostrata* Günther, 1878, although having a worldwide distribution, except the North Pacific north of 10°N (Cohen et al., 1990) is for the first time recorded from the Mid-Atlantic Ridge off the Azores. *Acanthonus armatus* Günther, 1878 also being cosmopolitan below tropical and subtropical areas of all oceans (Nielsen et al., 1999) is also recorded for the first time from the Azores area.

Two other species are most certainly new records for the area of Azores too, *Synphobranchus* sp. and *Narcetes* sp. They are currently being studied and will be treated elsewhere.

The Saldanha vent field biota deserves a further study, with particular emphasis on the micro- and meiofauna which may reveal a more intimate relation with the hydrothermal activity occurring there.

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