

# Protecting the lost city hydrothermal vent system: All is not lost, or is it?

David Edward Johnson\*

Seascope Consultants, Ltd., Jermyn's House, Romsey SO52 0QA, UK

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## ABSTRACT

Lost City is a unique marine hydrothermal vent field in Area Beyond National Jurisdiction on the front line of deep-sea features that policy-makers should seek to protect. The feature, located on the Mid Atlantic Ridge, is part of a priority area for a future International Seabed Authority Regional Environmental Management Plan. It is also recognized by the Convention on Biological Diversity as being within an Ecologically or Biologically Significant Marine Area and has been mooted as a possible World Heritage site. Together these policy strands present a strong rationale for protection but governance and policy uncertainties remain. The paper advocates a proactive and bold interpretation of UNCLOS in favour of strong protection.

## 1. Introduction

“Lost City”, so named with passing reference to the mythical lost city of Atlantis,<sup>1</sup> is a deep-sea ecosystem of carbonate spires located 15 km west of the axis of the Mid-Atlantic Ridge (MAR), south of the Azores. Only discovered in 2000 [1,2], the geochemical and microbiological processes at this section of the MAR are still the subject of ongoing scientific research [3]. Uniquely, at this location, the process of serpentinization (where seawater encounters peridotite rock from the Earth's mantle) generates calcium-rich water that reacts with carbon in seawater to create tall chimney structures. Carbonate chimneys can reach a height of 60 m [4] with intricate and delicate structures (see Fig. 1). At a depth of 700–800 m, this is the world's longest-lived known venting system representing 30,000 years of hydrothermal activity [4], spewing out high temperature (90 °C), metal-poor, alkaline (pH 9–11) fluids containing high concentrations of non-biogenic hydrogen and methane. The four known vents (IMAX, Poseidon, Seeps and Nature)<sup>2</sup> support a low biomass but a high species diversity [5]. They exhibit geological, chemical and biological processes that are intimately linked, and some scientists postulate this to be a contemporary analogue of conditions where life may have originated.<sup>3</sup> This vent system is therefore a remarkable biotope and one of the most important deep-sea scientific sites in the world where any effects of significant disturbance are unknown.

## 2. Policy context

Lost City is in Area Beyond National Jurisdiction (ABNJ). The International Seabed Authority (ISA) is the organization established by the United Nations Convention on the Law of the Sea (UNCLOS), and mandated by the 1994 Agreement relating to the implementation of Part XI of UNCLOS, to manage mining of minerals in ‘the Area’ (the seabed beyond the limits of national jurisdiction). The ISA is charged with taking the measures necessary to ensure effective protection of the marine environment from the harmful effects of exploration/exploitation of mineral resources it authorizes. It must adopt rules that ‘protect and conserve the natural resources of the Area, preventing damage to the flora and fauna of the marine environment’ [12]. In 2009, the United Nations General Assembly (UNGA) Resolution 63/111 emphasized application of the precautionary approach in terms of ‘management of risks to the marine biodiversity of seamounts, cold-water corals, hydrothermal vents and certain other features’. In 2015, UNGA Resolution 70/235 acknowledged the importance of developing and reviewing regional environmental management plans (REMPs). REMPs can establish the goals, rules, and management tools for a specific region where mining could occur. The intention is to inform decision-making to balance resource development and conservation. The REMP should identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystem structures and functions of the mining area. The intention is then that the ISA should provide

\* Seascope Consultants Ltd, Jermyn's House, Jermyn's Lane, Romsey, Hampshire, SO51 0QA, UK.

E-mail address: [david.johnson@seascopeconsultants.co.uk](mailto:david.johnson@seascopeconsultants.co.uk).

<sup>1</sup> Also, Lost City is located on the Atlantis Massif seamount and was discovered during an expedition aboard the RV *Atlantis*.

<sup>2</sup> InterRidge Vents Database (<http://vents-data.imterridge.org/ventfield/lost-city>).

<sup>3</sup> Just how life began from a prebiotic world is contested. Opinion is divided between synthetic chemists who favour a terrestrial argument versus geologists and biologists views favouring the deep-ocean.

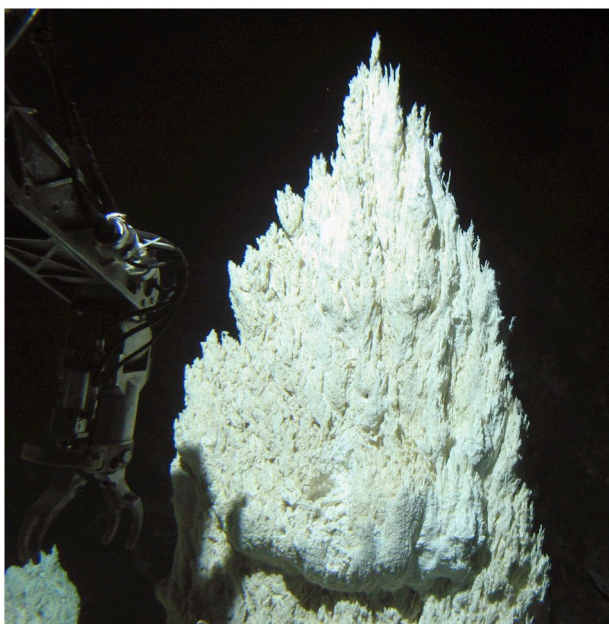


Fig. 1. An underwater spire: the top few feet of an actively venting carbonate chimney at Lost City. Credit: NSF, NOAA, University of Washington. Image courtesy: National Science Foundation].

these areas with an appropriate level of protection. In response, ISA Council noted a preliminary strategy by the ISA Secretary-General for development of REMPs for the Area (ISBA/24/C/3) and agreed the MAR as one of the priority areas for development of a REMP. A workshop, organized in Szczecin Poland in June 2018, considered the design of REMPs for polymetallic sulphides along mid-ocean ridges.

In 2014, a Convention on Biological Diversity (CBD) Regional Workshop for the North-West Atlantic included Lost City as a feature within a Hydrothermal Vent Fields Ecologically or Biologically Significant Marine Area (EBSA) description. This linear EBSA was formally identified and recognized by CBD Conference of the Parties (UNEP/CBD/COP/DEC/XII/22). Lost City ranked highly against five of the seven EBSA criteria (uniqueness or rarity, special importance for life-history stages of species, vulnerability fragility sensitivity or slow recovery, biological diversity and naturalness) that provide the basis of the EBSA process [6]. However, EBSAs only serve as area-based planning tools: they have no management obligation.

Lack of procedures in the World Heritage Convention for sites in ABNJ is considered to be a historical oversight. The 1972 World Heritage Convention placed a primary obligation on the states to propose, assess and inscribe sites in their national waters. However, in 2016 a study for the World Heritage Commission [7] included Lost City on a shortlist of possible sites in ABNJ that could qualify as “Outstanding Universal Value” (OUV<sup>4</sup>). Potential justification of World Heritage Criteria made a case for Criterion VII – superlative natural phenomenon or natural beauty and aesthetic importance; Criterion VIII – major stages in Earth’s history and geological processes; Criterion IX – significant ecological and biological processes in the evolution of ecosystems, communities of plant and animals; and Criterion X – significant biological diversity and threatened species of OUV.

Currently (2018–2020), an Intergovernmental Conference to negotiate an International Legally Binding Instrument under UNCLOS on the conservation and sustainable use of marine biodiversity in ABNJ is being held pursuant to UNGA Resolution 72/249. This Implementing

Agreement, which should not undermine existing legal instruments and frameworks, will determine a regime for an agreed ‘package’<sup>5</sup> of issues. For Lost City, the Access and Benefit Sharing of Marine Genetic Resources associated with novel microbial communities could be very significant. For example, Brazelton et al. [8] recorded biofilms of archaea (Lost City Methanoscarnates) from the oxygen-free interior zones of chimneys and entirely different bacterial assemblage on chimney outer walls. Microbes existing at high temperatures and pressures are known as extremophiles, and can produce novel compounds that have considerable potential for application in the food, pharmaceutical and cosmetics industries [9]. Blasiak et al. [16] identified > 1600 sequences from 91 species associated with deep-sea and hydrothermal vent systems, reflecting commercial interest in organisms from remote ocean areas, as well as a capacity to collect and use the genes of such species. The alkaline environment of Lost City is unique and may support specially adapted extremophile microbes that could offer marine genetic resources not found elsewhere. However, no clear estimate of the economic value of genetic sequence data from genes and enzymes in deep-sea life-forms yet exists.

In 2017 the ISA granted a 15-year exploration contract to the Government of Republic of Poland for an area of the MAR including Lost City. Contractual arrangements with the ISA oblige exploration contractors to undertake environmental baseline surveys and report progress annually and develop monitoring programs. A principal threat to Lost City ecosystem is indirect impact of deep-sea mining from possible plumes and discharges, if exploitation for polymetallic sulphides is sanctioned at adjacent or neighboring locations.

### 3. So is it still possible to protect lost city?

#### 3.1. Yes. The following strands are reasons for optimism

An Atlantic REMP is envisaged in program planning set out by the ISA (ISBA/25/C/13). Any such plan would be the equivalent of the Environmental Management Plan for the Clarion-Clipperton Zone in the northeastern Pacific Ocean, which is considered to be a “proactive spatial management plan that anticipates mining exploitation while at the same time recognizing the designation of Areas of Particular Environmental Interest” [12]. The Atlantic REMP is likely to draw *inter alia* on the results of EU FP7 Project MIDAS<sup>6</sup> and scientific design principles proposed by Dunn et al. [13]. Deep-sea mining contractors are subject to obligations, responsibilities, rules, regulations and procedures. Under Article 145 of UNCLOS, the ISA is required to take necessary measures to ensure effective protection for the marine environment from harmful effects, which may arise from activities in the Area. It is incumbent on both the ISA Council and its Legal and Technical Commission to protect the marine environment taking into account the views of recognized experts in the field. Regulations on prospecting and exploration for polymetallic sulphides were adopted by the ISA in 2010, and form part of the Mining Code regulating all aspects of mining in the Area. Exploitation regulations are currently being finalized.<sup>7</sup>

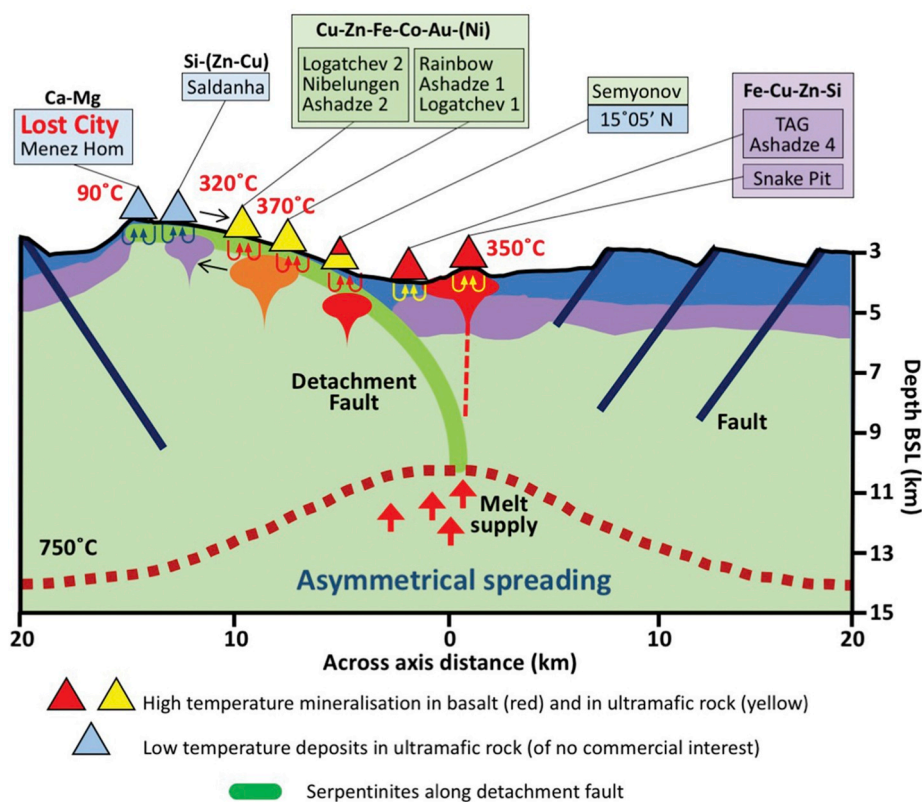
Lost City is an alternative marine ecosystem characterized by extreme conditions, supporting anaerobic thermophile communities, where the impacts of climate change may be least felt [10]. The forthcoming UN Decade of Ocean Science for Sustainable Development (2021–2030) provides an opportunity to better understand key sites such as Lost City. Opportunities could be mobilized to secure more data and/or enhanced potential to find other similar sites for comparison

<sup>5</sup> Agreed in 2011, the package comprises access and benefit sharing of marine genetic resources, environmental impact assessment, area-based management tools including MPAs, and capacity building and technology transfer.

<sup>6</sup> [www.eu-midas.net](http://www.eu-midas.net).

<sup>7</sup> See ISBA/24/LTC/WP.1/Rev.1.

<sup>4</sup> OUV is based on meeting one or more World Heritage criteria; meeting conditions of integrity; and meeting requirements for protection and management.



**Fig. 2.** Schematic model for the location of Lost City and composition of major hydrothermal deposits along the MAR. Vent locations related to detachment faults (heavy green line). Positions of vents are at the scale of their distance from the axis. Adapted from Ref. [14].

purposes. Scientists who discovered the Lost City believe there must be other such sites, they just have not found them yet.<sup>8</sup>

The BBNJ negotiations are charged with designing the most effective international legal regime for the conservation and sustainable use of biodiversity in ABNJ. They demonstrate a 'seriousness of purpose' by the international community in a context of unprecedented commitments to enhance the protection of ocean space. Until any such International Legally Binding Instrument is ratified and adopted, regional solutions may also provide governance frameworks.

### 3.2. However, significant uncertainties demand a precautionary approach

It is far from certain whether sufficient funding will be made available to support the UN Decade of Ocean Science. Its forerunner, the Census of Marine Life, cost in the region of US\$650 m and focused on participating countries' Exclusive Economic Zones.<sup>9</sup> BBNJ is also a long-term process subject to adoption and ratification. To date, negotiators' positions still have significant divergence and, even when any instrument is in place, it is not unusual to spend years interpreting and applying the solutions and compromises conceived in the negotiations.

Whilst the Mining Code and nascent Exploitation Regulations impose a duty on contractors to take necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from their activities in the Area as far as reasonably possible, this evolving regime has yet to be tested. No deep-sea mining has yet taken place<sup>10</sup>. The Polish contract to explore for massive

sulphides will either expire, be renewed or be converted into an exploitation contract for commercial scale mining. Lost City does not have any mineral resources of interest, so it will never be mined. However, adjacent active and inactive vents may be mined (Fig. 2).

The actual impact of particle-laden plumes in the water column generated by mining activities and possible toxic chemicals that might be released is still uncertain [15].

## 4. Conclusion

The take-home message from this case study is that some unique deep-sea locations such as Lost City should be ruled as 'off limits'. Notwithstanding the current legal lacuna for protection of biodiversity beyond national jurisdiction, we should recognize such locations as so important to Common Heritage of Humankind that human exploitation is a non-starter. This demands a bold interpretation of UNCLOS obligations by the ISA and other competent sectoral bodies. Perhaps the most promising catalyst towards achieving appropriate stewardship is through the World Heritage Convention. Evolutionary development of the Convention will likely be informed by a legal report to the World Heritage Commission, expected in 2019 and intended to set out provisions to amend the Operational Guidelines,<sup>11</sup> either through incremental change or through a formal policy change. Such a stance chimes with sentiments expressed by H.E. Peter Thomson, Special Envoy of the UN Secretary-General for the Ocean, who during the Ocean Program of the World Economic Forum in Davos in January 2019, advocated a

<sup>8</sup> The shallow Strytan Hydrothermal Field in Iceland shows some similar characteristics but is not considered comparable [11].

<sup>9</sup> The Census of Marine Life was a 10-year international effort that ended in 2010 involving 2700 scientists from 80 + countries. [www.coml.org/about-census/](http://www.coml.org/about-census/).

<sup>10</sup> In 2017, Japan reported the first successful pilot test, excavating and lifting

(footnote continued)

polymetallic sulphide ore from 1600 m depth near Okinawa Prefecture. [www.meti.go.jp/english/press/2017/0926\\_004.html](http://www.meti.go.jp/english/press/2017/0926_004.html).

<sup>11</sup> The Operational Guidelines provide the basis for the daily implementation of the Convention and are established by the 21 members of the World Heritage Committee [7].

moratorium allowing the UN Decade of Ocean Science for Sustainable Development to take place before disturbing the seabed of the high seas. This might inspire funding to investigate further natural heritage sites in remote locations such as Lost City. Taking a strong unequivocal stance to protect the site could be championed as an expression of Nations' intent to protect biodiversity in all its wondrous forms, no matter where. If such a step cannot overcome systemic inertia and resistance to precaution, what comes around may go around. Atlantis, the fictional island mentioned by Plato, exemplified the destruction of a society corrupted by its material wealth and advanced technology.

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