Save Australia's Great Barrier Reef from hunger

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Abstract

Reefs of all eras in the development of the Earth represent the base of mineral resources for all of Mankind. The Great Barrier Reef of Australia, according to the observations of scientists, is at the stage of extinction due to the fact that reef builders and their biota experience mineral and oxygen starvation due to the lack of iron, manganese, aluminum and other elements that has arisen in recent years. It is proposed in natural conditions to immediately conduct experiments on the development of an optimal diet for reef builders of the Great Barrier. Simultaneously with the experiments, it is necessary to organize feeding of the reefs in the areas of their discoloration with iron-manganese wastes, including the Australian bauxite mines.

Keywords: Australia, Great Barrier Reef, coral death, stromatolites, dust storm, iron, bauxite, experiment, Riphean reefs.

On 6 July 2009 in London at the Royal Society Chair at Caraton House Terrace, renowned naturalist David Attenborough introduced former Australian Marine Research Institute Chief Scientist John Veron, who reported on the extinction of Australia's Great Barrier Reef.

John Veron has analyzed past reef extinctions and has collected much evidence of the effects of sea level change, heatstroke, starfish destruction of reefs, and anthropogenic impacts on nutrient content. All of this has exacerbated his long-standing concerns about the health of the Great Barrier and other reefs in the world.

The Verona study found that during weather cycles associated with El Niño (El Niño - Warm Ocean Current), surface waters in the Great Barrier Reef Lagoon, already heated to unusually high values by warming caused by greenhouse gases, fueled by a mass of warm ocean waters from the western Pacific Ocean, splashing onto the delicate living corals of the reef. For corals, exposure to temperatures two to three degrees above their maximum (31° C for the Great Barrier Reef species), combined with increased levels of solar radiation, is lethal.

Heat is not the only problem faced by corals, however. Other destructive mechanisms of interaction cannot be stopped. According to Verona, reefs are natural archives containing evidence of environmental change millions of years ago. These archives tell us that four out of five previous massive destruction of coral reefs on our planet have been linked to the carbon cycle. They were caused by changes in ocean chemistry due to the absorption of two major greenhouse gases, carbon dioxide and methane, during the acidification of ocean water.

Phytoplankton - the food of tiny crustaceans, a key element in the food chain in southern ocean waters - will also be affected by acidification. And who knows what kind of chain of environmental consequences can come.

There is no more heartfelt spectacle than the final moment of Verona's performance in July 2009 in a quiet audience. Throwing away his notes, he apologizes for such a depressing speech. He encourages listeners to reflect on what they have just heard: "Use your influence. For the future of the planet, help make this story public. This is not fiction - this is reality." So ended the description of the meeting David Attenborough.

Imbued with the appeal of D. Verona, being thousands of kilometers from still living reefs, having fossil reefs with a billion-year history under our feet, we conducted this study. Let's see what is happening in another living reef oasis 22500 thousand km from the Great Barrier Reef in the west Atlantic in the Bahamas using the example of stromatolites. Stromatolites are reef thin-layered pillars or mounds of various shapes, consisting of calcium carbonate and sandy-argillaceous material (fig. 1).

Figure 1 – Modern stromatolites (Australia)

Stromatolite is formed as a result of the vital activity of a community of bacteria called cyanobacterial mat (cyanobacteria are also called blue-green algae). Mats exist in many parts of the world, but in modern times, true stromatolites exist only in Shark Bay on the west coast of Australia and on the Atlantic coast of the Bahamas. Stromatolites reliably appear in the geological record in the oldest sedimentary formations of Warrawuna (Western Australia) with an age of 3.5 billion years - this is the oldest known form of life. The greatest flowering of cyanobacteria fell on the Proterozoic eon.

Paleontologists from the United States, Australia and the United Kingdom have shown that the stramatolite structures of the Strelley Pool Formation in western Australia are biological in nature. Until now, the origin of these stromatolites, formed about 3.45 billion years ago, in the early Archean, has been in doubt. Now a team of researchers led by Abigail Allwood has managed to find traces of the bacteria that formed these deposits.

Paleontologists from the Allwood group published the first results of their research back in 2006. Now an article by scientists dedicated to their discovery has appeared in the publication "Proceedings of the National Academy of Sciences" (PNAS).

Stromatolites inhabited salt and fresh waters. In the Proterozoic, huge reefs with a thickness of hundreds of meters consisted of stromatolites. Individual deep-sea stromatolites reached a height of 75 m. Proterozoic stromatolites reached a high level of complexity: forms with all kinds of branching columns, peaks, various layering and microstructure, etc. appeared. Modern stromatolites formed by bacterial mats are much simpler.

Bahamas stromatolite bacterial mats are the subject of study by UM Rosenstiel Lewis G. Weeks School under the supervision of Professor Peter Swart. The professor and his colleagues drew attention to the fact that cyanobacteria contain a lot of iron, sources of which are not found in the vicinity of the Bahamas and the adjacent land.

Researchers at the University of Miami (UM) Rosenstil School of Marine and Atmospheric Science have shown that iron-rich sugar dust provides the nutrients specialized bacteria need to build the carbonate backbone of the Bahamas chain.

Professor Peter Swart and colleagues at UM Rosenstiel Lewis G. Weeks analyzed the concentrations of two trace elements characteristic of atmospheric dust - iron and manganese - in 270 seabed samples collected along the Grand Bahamas Bank over a three-year period. Scientists have found that the highest concentrations of these micronutrients are found west of the island of Andros, an area that has the highest concentration of proteins made by photosynthetic cyanobacteria. The study's lead author, Peter Swart, noted that "Cyanobacteria consume 10 times more iron than other photosynthesizers because they fix atmospheric nitrogen. This process assimilates carbon dioxide and precipitates calcium carbonate. Traces of atmospheric nitrogen by its isotopes are visible in precipitation."

Swart's team suggests that high concentrations of iron-rich dust brought by storms across the Atlantic from the Sahara are responsible for the existence of the Great Bahama Bank, which has been formed over the past 100 million years by precipitation of calcium carbonate. The dust particles, blown into the waters of the Bahamas and directly onto the islands, provide the nutrients needed for cyanobacterial blooms, which in turn produce carbonate proteins in the surrounding waters.

Persistent winds from Africa's 3.5 million square miles of Sahara desert lift the mineral-rich sand into the atmosphere, where it travels 5,000 miles towards the United States and the Caribbean.

Thus, we can state that the indispensable nutrient medium of the Bahamian stromatolite reefs is iron and manganese, brought by dust storms from the Sahara in Africa.

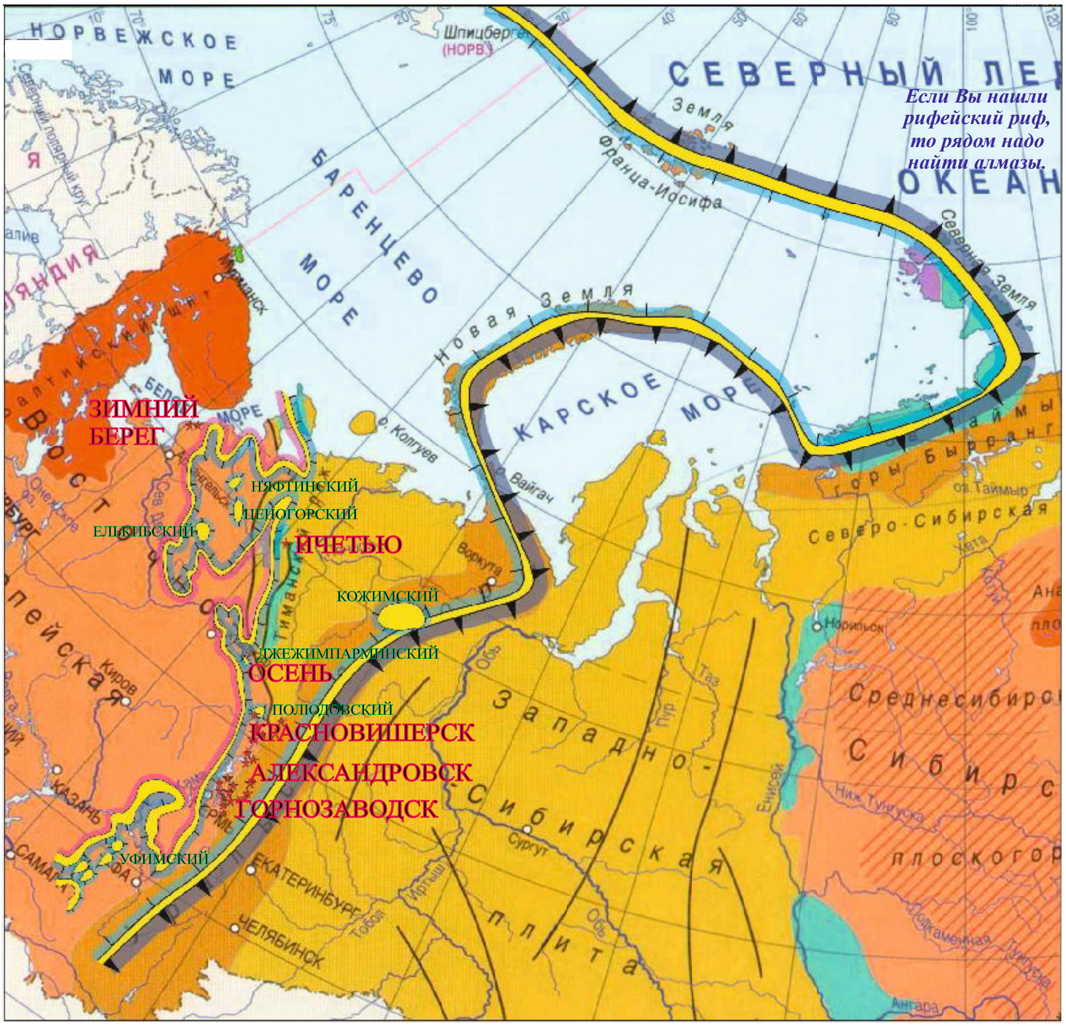
Stromatolites are one of the main reef builders of the Riphean Volga-Timan (fig. 2, 3) and the East European barrier reefs of the East European platform, available for comfortable study in the outcrops and quarries of the Chinya-Voryk village in the Komi Republic of Russia. [2, 3, 5, 6,7].

Figure 2 – Riphean reef builders (stromatolites) in the Chinya-Voryk quarry (Middle Timan) (photo by Bogdanov B.P., 2015)

The ancient reef-bearing complex is the Riphean one, the reefs of which are established in outcrops and wells of Timan, Vychegodskiy trough, Perm Prikamye, eastern slope of the Tatar arch, Bashkirian anticlinorium, Subpolar Urals, Pai-Khoi [2, 3, 5, 6, 7]. We have established the barrier nature of two cycles of reefs stretching from the Kanin stone through the Tsilmensky stone, Chetlasky stone, Vymskaya ridge, Ochparma, Nivshera, Keltmensky shaft, Perm Prikamye, Tatar arch. It was proposed to call this reef the Volga-Timan reef (Bogdanov et al, 2000) (fig. 3, 4, 5) At different distances from the deep-water slope of the barriers in the depression zone on horsts and other uplifts, the Vymsky, Dzhezhim-Parminsky, Polyudovsky, Karatau single reefs were formed. The height of the reefs when combined is 2000 m or more. It was established from a set of data that the Volga-Timan barrier reef arose on the northeastern slopes of the Russian plate, which were fractured flexures with zones of deep faults saturated with intrusions and mineralized fluids.

The reef sections of the Bashkir anticlinorium, the Kazhim uplift of the Subpolar Urals, Pai-Khoi, Spitsbergen are called by us the East European barrier reef that arose in the Middle Riphean on the slope of the paleocontinent of the same name, the Riphean-Paleozoic slope of which passes through Novaya Zemlyuyatiya, the modern Taimyr Lands, Franz Josef Lands, Spitsbergen (fig. 3). The reef also formed over two cycles separated by a hiatus.

Within the Middle and South Timan, a large bauxite-bearing province has been established, which includes two stratigraphic levels: Devonian (Middle Riphean) and Carboniferous (fig. 7) [1,8]. Devonian bauxites on reef carbonates of the Riphean were discovered in the Middle Timan in 1970. They belong to two groups of deposits: Vorykvinskaya and Zaostrovskaya.



Волго-Тиманский барьерный риф (значки направлены в глубоководную зону)

ОСЕНЬ Месторождения или проявления алмазов

ПОЛЮДОВСКИЙ Одиночный риф и его название

Восточно-Европейский барьерный риф (значки направлены в сторону глубоководной зоны шельфа и континентального склона)

Figure 3 – Riphean reefs of the East European platform on a fragment of a tectonic map

There are 4 known deposits in the Vorykva group: Vezhayu-Vorykvinskoye, Verkhne-Shchugorskoye, Vostochnoye and Svetlinskoye. The Zaostrovskaya group includes 2 deposits: Zaostrovskoe and Volodinskoe. All these deposits are products of laterite weathering of Late Proterozoic carbonate-terrigenous rocks and are represented by both sedimentary and redeposited bauxites.

The bauxites of the Chetlassky Kamen are more diverse in composition and type of section (composition of the substrate rocks). All known deposits here are confined to the zone composed of rocks of the Bystrinskaya series, forming a reef formation with a full complex of typical facies: pre-reef, reef, and back-reef.

The upper part of the bauxite-bearing layers of reef deposits has a red-crimson color due to the content of iron and manganese. Along the entire length of the Volga-Timan barrier reef, in the single reefs of Dzhezhim Parma, Polyudova Kamen, Karatau, the rocks have a red-crimson coloration (fig. 4). In the zone of the East European barrier reef in the Bashkir anticlinorium, the reef rocks of the Satka and Bakal formations are red-brown-brown in color.

Figure 4 –Bauxites of the Chetlasky Stone deposits of the Middle Timan

On the East European Platform, the zones of development of reefs (carbonate structures) of the Riphean often coincide with the zones of development of different types of reefs of the Upper Devonian, Carboniferous - Lower Permian, sometimes building on each other, although between the epochs of their life there are about 1 billion years.

Carboniferous bauxites are developed mainly in South Timan, where two groups of deposits have been identified. These deposits are confined to the weathering crust of carbonates of the Frasnian stage, enclosing various types of reefs of the Domanik-Upper Frans.

Thus, on the example of Riphean, Upper Devonian reefs, reefs of other stratigraphic levels, we see that their obligatory components are iron and manganese.

Dust storms rage over Australia every year, bringing iron from Australia itself, from India and Africa. And dust always settled on the mainland and the water area, framed by reefs from north to east for 2500 km. And suddenly, on the northern coast of Australia, the reefs began to discolor. And it can be assumed that the reef builders began to lack iron, manganese, and other elements in their food - the reefs began to starve.

And this is quite likely if you pay attention to the following changes on Earth. Scientists are alarmed: the northern latitudes are heaving. In the Arctic, where bare land stood quite recently, dense vegetation has appeared. Northern latitudes are covered with tall bushes, low, creeping vegetation, in turn, moves to more northern latitudes. The authors of the article observed this personally on the example of the Bolshezemelskaya tundra in the Komi Republic and the Nenets Autonomous Okrug north of latitude 67°, where river floodplains were rapidly overgrown with bushes.

In the taiga and tundra, the area of vegetation cover has increased by more than 40% over the past 30 years. It should be noted that the growth of vegetation is also observed in the western part of Australia, in the African Sahel, in the arid regions of India.

The rapid greening of the Earth in the last 30-40 years means that the surface from which iron and manganese particles rise up during dust storms has decreased, which is also noted for Western Australia. From recent news, directly related to dust storms, it must be said about the catastrophic fires in Australia in 2019-20, which covered most of its eastern coast, facing the Great Barrier Reef, which turned the surface into a desert. In Russia there is a saying – "there would be no happiness, but misfortune helped" ... It can be understood as follows - dust storms can again arise over the scorched earth of Australia, which will bring iron and manganese to the Reef.

British scientists have carefully studied the waters of the world's oceans and found that the pH level continues to rise rapidly. In the near future, this could lead to tragic consequences for coral reefs and its other inhabitants. The work was published in the American edition of Earth and Planetary Science Letters. The study focuses on the history of ocean acidity - in particular, over the past 22 million years. Experts believe that within 80 years the pH level will exceed 7.8. And this will be a record since the Miocene era, dating back 14 million years.

The acidity level of ocean waters is increasing due to the high content of carbon dioxide in the atmosphere, which dissolves and breaks down into weak carbonic acid. In 2017, scientists recorded a record for the concentration of CO_2 - over the past 150 years, the level of the substance has increased by 43%. Environmentalists predict its further increase. According to their calculations, the level of carbon dioxide will increase 2.5 times.

Following D. Veron, ecologists note that changes in the level of acidity in the ocean cause significant harm to corals. Oxidation has a depressing effect on the formation and regeneration of coral skeletons, which are composed of carbonate. This leads to massive death of corals. By 2100, the Great Barrier Reef may become lifeless. And today, 1500 species of fish and 400 species of coral are found here.

It is believed that the inhabitants of the ocean adapt to changes in the chemical composition of the water in the ocean, but whether this will actually happen and how quickly is unknown. Israeli scientists, for example, note that creatures that inhabit the ocean and build their skeleton from calcium carbonate (corals, some types of plankton) are already replacing part of this element with strontium and other substances.

While trying to find information on the chemical composition of reefs in the literature, we came across the website of the RED SEA company on the Internet, which specializes in growing corals in aquariums and notes: modern laboratory analysis of the Red Sea water showed the presence of 57 individual chemical elements and, although water parameters are affected most of them, some are more important in maintaining overall chemical stability. These elements form the basis for the reef environment and include three main elements: calcium, magnesium and bicarbonate. These 3 basic elements significantly affect the chemical characteristics of water (pH stability, alkalinity, ionic strength of seawater) and many of the biological processes that take place in corals (skeleton formation, ion exchange, photosynthesis).

Using the example of the deposits of the Vorykvinskaya and Zaostrovskaya bauxite groups of the Chetlassky Kamen above, we showed which elements of the periodic table they contain: iron, manganese, niobite, tantalum, thallium, scandium, vanadium, rare earths. And it is quite obvious to assume that these elements, together with aluminum, were extracted from seawater by reef builders, which means the entire reef biota together with polyps, algae, fish, crustaceans, etc.

First of all, using the example of the reefs of the Bahamas, it seems to us that the reefs of the Great Barrier Reef are simply starving, deprived of iron, manganese and other elements from the reduced dust storms. And it is very simple to fight such hunger, realizing that without reefs, humanity itself will starve tomorrow - it is necessary to feed the reefs with elements from the dumps of deposits of bauxite, iron, manganese.

There is an example of the development by reef builders of the SS Uondala passenger ship that sank in 1911 at a depth of 30 m, the hull and fragments of which were overgrown with soft corals, which attracted thousands of species of fish and marine life. Moreover, the authors of this episode from the life of corals believe that the reason for the fouling of the body with corals is its morphological expression on the seabed. It seems to us that this is not the main factor in the settlement of reef builders, since the depth of 20-30 m is not the most favorite place for corals to live - they love the zone of action of surf waves, and the main thing is that the hull of the ship is all of the iron so necessary for reef builders.

Of course, one should think that initially the reefs of all epochs in the history of the Earth were inhabited in the zones of tectonic faults. This was the case in the Middle Riphean, when the Volga-Timan barrier reef began to grow on the eastern slope of the Russian plate from Kanin Nos to the eastern slope of the Tatar arch and on separate horst-like blocks such as Tsilmensky and Chetlasky Stones, Vymskaya ridge, Ochparma, Dzhezhimparma, Permsky, Krasnokamsky, Karatau (fig. 3). The East European barrier reef began to grow on the oceanic slope of the East European paleocontinent, stretching from the Bashkir anticlinorium through the North, Subpolar, Polar Urals, Paykhoi, Novaya Zemlya, Taimyr, Severnaya Zemlya, Franz Josef Land to Spitsbergen. The elements of the periodic table and minerals, necessary for reef builders, entered the overlapping reefs along the faults. This process continued until the end of the collisions between the East European continent and the Siberian oceanic plate (up to the Early Permian in the Ural zone).

It became apparent that the Great Barrier Reef of Australia is experiencing mineral and oxygen starvation. Possible causes of mineral ("iron-manganese") starvation are discussed above, and oxygen starvation is provoked by an increase in the temperature of seawater due to global warming.

From literary sources, films and videos, Universities in Australia have great laboratories and specialists to study the seas and their inhabitants, and they can conduct long-term experiments on feeding reef builders to find out their rational menu.

On the example of the oceans of the Soviet Union D.V. Naumova, M.V. Propp, S.N. Rybakov [4], it is known that after death for various reasons, the reef biota of Oceania can recover in 7 years. And one can think that under laboratory conditions with artificial feeding, the recovery process of sick, including discolored, reef-builders will occur faster. Naturally, experiments should be carried out on the marine reef plantations of the Barrier Reef.

The required elemental-mineral diet of reef builders can be established by determining such a composition of healthy varieties. Without fail, the diet should contain waste from bauxite mines in Australia, which the continent has been rich in for a long time (fig. 5).

Figure 5 –Bauxite Mine of Australia

It will not be difficult for the human community to "feed" Australia's 2500-kilometer Barrier Reef for the duration of its subsequent existence, since it is located in ideal conditions for life.

The authors of this article for 40 years have been "land" researchers of the billion-year history of the life of reefs, sometimes touching on their modern life [Bogdanov B.P., American Scientific Journal № (18)/2018], and are aware of their greatest role in the creation of mineral resource base, beauty for the rest of mankind. And we must heal our smaller brothers, because we are thinking people.

Conclusions:

1. Explorers of the World Ocean are concerned about the state of Australia's Great Barrier Reef, the colonies of which are rapidly discoloring and dying off. There are dramatic predictions by scientists who fear the death of a 2,500-kilometer oasis of life of thousands of species by 2050.
2. Based on the example of modern studies of the stromatolite reefs of the Bahamas, carried out by American scientists, the most important role in the nutrition of iron and manganese stromatolites, which give rocks red hues, the main source of which are dust storms from the African Sahara, is shown.
3. On the East European Platform, stromatolites are the main reef builders of the Volga-Timan and East European Riphean barrier reefs, which are often red-fulvous-brown in color due to the presence of iron, manganese, bauxites, other elements and minerals.
4. The accumulation of iron, manganese, aluminum and other elements is a regularity in the life of reefs at all epochs of the Earth's development. Dust storms are typical for Australia, but with the dramatic greening of the continent in the last 30 years, the transport and deposition of these elements has decreased, which has led to an ordinary "starvation" of the reefs.
5. Therefore, it is necessary to immediately begin experiments on the introduction of iron, manganese from bauxite waste in the experimental areas of the Great Barrier Reef. In case of positive results, a reasonable person will have to take custody of the reef for a long time of mutual existence.

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