RESEARCH ARTICLE OPEN ACCESS

New Results in the Cold Earth Degassing Researches, Their Ecological Aspects

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ABSTRACT
A review of new data in the field of fundamental and applied research of the cold Earth, degassing obtained by the authors in recent years in the Baikal region, interpreted within the fluid dynamic concept is proposed.
Morphostructuralpeculiarities, the lithocomplexes formation main traits ofMesozoic-Cenozoic intracontinental type mud volcanism in the first time allocatedmajor South-Siberian region and mineral associations characterizing the different stages of mud volcanic activity are revealed. Three fluid-dynamic regimes in the formation of the mud volcanic structuresaredefined, which differ with dominant genetic mechanisms of mineral formation: root (patchy) fluid-generation structures,fluid-rock substrate transit channels,hydrothermstransit channels.
Theconstruction peculiarities, the mineral composition, the bioinert travertine and stromatolite-like fine- and mini-structures genesis in Baikal rift zone depressions are specified. The columnar type of pyramidal and cone-like morphostructures are allocated, forming in upland-hill landscape setting and dome-like one, proper to the mud volcanic crater lakes are allocated.
The plasmoidphenomenon form (phenomenon) of the cold Earth degassingexistence has beenproved. Various factors, plasma generation conditions in the lithosphere and atmosphere were evaluated.The morphostructural classification of registered plasmoids is created and peculiarities of their internal construction are revealed. Three levels of plasma generation (its predominant mechanisms) are identified: lower one, endogenous-lithospheric (deformational or mechanoelectric); upper one, exogenous-lithospheric (gases oxidation, sulfates cavitation, dehydration and crystallization); atmospheric one (phase transitions “water-vapor”, “ice-water”).
Keywords: cold degassing, degassing tubes, plasmoid structures, mud volcanoes, natural environment, climate changes.

I. INTRODUCTION

In recent decades, we can see the great progress in the doctrine of the Earth degassing cold (non-magmatic) branch. The most relevantof its problems were considered from the standpoint of fluid dynamics and plume concept [1-7]. Due to the wide use of thecurrent geological, geophysical, petrological, geochemical and other research methods complex, the data on deep drilling, first of all oil and gas sedimentary basins, knowledge of structures, manifestation forms of cold degassing was expanded [8-18]. At the same time, a number of fundamental nature areas, which are very important for the ecology, forecasting and prospecting of ore mineral deposits, has not been reflected in the fluid dynamic concept of the cold Earth degassing doctrine due to insufficient study of some phenomena and processes.

In proposed article, the authors give an overview of the results in the field of fundament and applied research of the cold Earth degassing,obtained by them in recent years and interpreted within the fluid dynamic concept.

Their gist is illustrated on the example of the Baikal region and is as follows:
-vast South-Siberian area of intracontinental mud volcanism has been allocated [19];
– land dome and columnar bio-inert structures are revealed, other morphological types of the mud volcanism manifestations [20];
- plasmoid phenomenon of the cold Earth degassing existence proofs are obtained [21].

A separate article section is dedicatedto thediscussion of ecological problems which are considered based on the conceptual model of the cold Earth degassing ecological-geological system proposed by the authors.

II.SOUTH SIBERIAN REGION OF MUD VOLCANISM

The main lithocomplexesformation traitsfor the first time allocated major South-Siberian region of Mesozoic-Cenozoic mud volcanism inland type (Fig. 1) are specified.

The vast majority of mud-volcanic depressions are shallow (less than 2 km), mud volcanoes channels penetrate deep into the Precambrian basement. The depth of their foci is evaluated as 3.5-15 km. The mud volcanic eruptions products are, mainly represented by lithocomplexes of psammite-gravelite-conglomerative dimensionality with an abundance of griffon sands. Rounded and oval-like arrays of griffon sands up to 200 m high, with an area of up to 400 km² and more occupy 70-75% of the Tunka, Barguzin, Chara depressions [14, 22]. They also make small cones and ridge-shaped uplifts.

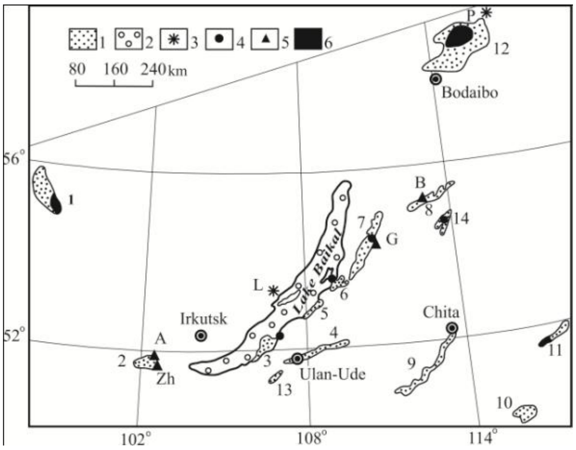

Fig. 1. Mud volcanism manifestations scheme in the South of East Siberia (South Siberian mud-volcanic region)

1 –Cenozoic and Mesozoic age rift depressions with the mud volcanic complexes (1 – Presayan deflection depressions 2 – Tunka, 3 – Ust-Selenga, 4 – Uda, 5 – Kotokel, 6 - Ust – Barguzin, 7 – Barguzin, 8 – Baunt, 9 – Chita-Ingoda, 10 – Torey, 11 – Undino-Dainsk, 12 – Bodaibo, 13 – Gusinoozersk, 14 – Aunik); 2 - Baikal depression with underwater mud volcanoes, thermal sources, gas hydrates, gas and oil occurrences; 3 – craters of the gas explosive origin (L – Left Sarma, P – Patom); 4 – bioinert travertine and stromatolite like structure of the mud microvolcanism; 5 –mud volcanic deposits of thermal springs studied by the authers (a – Arshan, B – Baunt, G - Garga, Zh – Zhemchug); 6 – ore mineralization distribution area of mud volcanic origin in the depressions (Bodaibo and Undino-Dainsk – gold, Presayan deflection – manganese)

A remarkable trait of the South Siberian mudvolcanic region is a wide manifestation in the late Cenozoic processes of mud volcanism in the zones of discontinuous tectonic disturbances among the ancient crystal complexes. Herewith the gas volcanic crater morphostructures, similar to astroblemes (Fig. 2) appear.

There are widespread current manifestations of the mud micro volcanism. They characterize not only calm periods between earthquakes in the seismically active Baikal rift zone, but also are discovered in areas with weak seismic activity (Uda and Chita-Ingoda depressions, Khamar-Daban ridge). They are presented by bio-inert structures and manifested on the ice of Lake Baikal (Fig. 3). They are also characterized by very small cylindrical (Fig. 4) and crater forms.

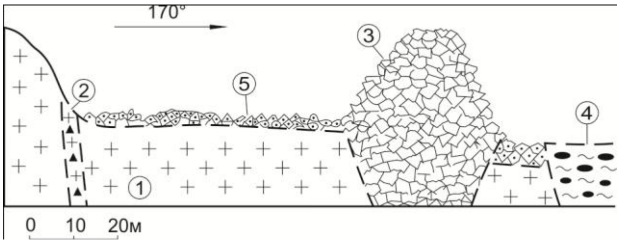

Fig. 2. Left Sarma gas volcano (astroblem-like structure).Sketch part of the structure (see location in figure 1). 1). Vertical scale: 1 cm to 2 m.
1 - medium- and coarse-grained granites; 2 - brecciated granites; 3 – the Central hillock (mouth), composed by metadiabases angular blocks; 4 – sandy-gruss Caldera deposits of the mud volcano; 5 - eluvial–deluvial granites fragments.

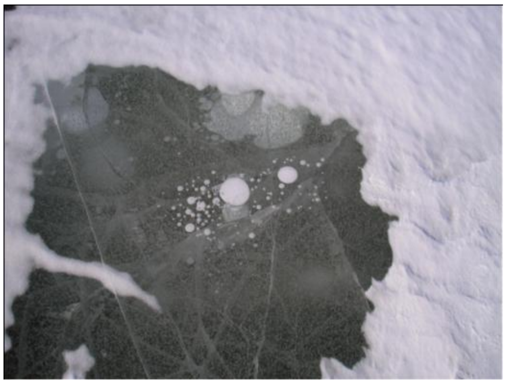

Fig. 3. Gas bubbles preserved in Lake Baikal ice, fixing griffons of underwater gas volcano.

Fig. 4. The outputs of the gas jets on the surface (near Irkutsk) in the form of holes.

The obtained data are consistent with the basic clauses of the mud volcanismfluidodynamicmodel [2]:
- mud volcanoes, oil and gas fields, abnormally high stratum pressures (AHSP) have a common nature and the similar occurrence mechanism;
- mud volcanoes, as well as hydrocarbon deposits of the AHSP zone, are formed as a result of self-oscillating processes in crustal waveguides [1], located at depths of 10-15 km.

The fluid dynamics determines not only the morphological features of the South Siberian region mud volcanoes, but the minerals species composition being a part of their lithocomplexesassociations (table 1). There are three fluiddynamic regimes in the mud volcanic structures formation, which differ by dominant genetic mechanisms of mineral formation: root (patchy) structures of fluid generation, fluidrock substrate transit channels, hydrothermstransit channels.

Table 1.Lithocomplexes mineral associations of the Cenozoic and Mesozoic mud volcanoes formation different phases in the East Siberia south

Stages	Genetic groups of mineral associations	Specified minerals
Gas-explosive	Xenogenic (minerals of mud-volcanic depressions crystalline basement	Olivine, rhombic and monoclinic pyroxenes, zircon, sphene, garnet of pyrope-almandine series, plagioclases, quartz, tourmaline, amphiboles, serpentine, foxit, chrome spinel, ilmenite, magnetite
	Fluido-pyrometamorphic and pyrogenic fusion	Native Au, Pb, Fe, Cu, Si, graphite, alloys of Fe-Mn-Cr-Ni, Ni-Cu, moissanite, cogenite, armalcolite, chrome spinel, spinel, chromomagnetite, ilmenite, maghemite, hematite, rutile, iozit, massicot, galenite, kyanite, sillimanite, stavrolit, andalusite, chloritoid, mullite, melilite, mayenite, garnet, tourmaline, epidote, plagioclase, diopside, hornblende, zircon, topaz, corundum, lime, cristobalite, opal-like quartz
	Fumarole, vapor-gas	Gypsum, anhydrite, aragonite, ammonia, chlorides of Na and Ca, bischofite, lavrencite, brimstone, rutile, hematite, black carbon, opal, chalcedony, analcime
Gas-Water-lithoclastic	Hydrothermal-sedimentary-clastogenic	Native Fe, Au, Ag, Pb, intermetallics Cu-Zn, goethite, hydrogoethite, psilomelane, Ni-cuprite, mangano-ilmenite, hematite, pyrite, marcasite, galenite, cinnabar, plagioclase, quartz, opal, chalcedony, chlorite, hydromicas, illite, smectite, kaolinite, bemit, calcite, siderite, dolomite, ankerite, cerussite, smithsonite, apatite, water phosphateLas, barite, anglesite, Fe sulfate, jarosite, gypsum
Gas-water	Hydrothermal-sedimentary-chemogenic with microorganisms participation	Native Pb, Ni, Zn, Cu, Au, Ag, electrum, intermetallics Cr-Fe, Ni-Cu, Fe-La-Ce-Si, Ce-La-Nd-Pr, cogenite, magnetite, hematite, maghemite, powellite, scheelite, pyrite, sphalerite, vitreous silver, cinnabar, metacinnabar, montroydite, massicot, uraninite, altait, quartz, opal, zeolites, chlorite, smectite, hydromica, calcite, aragonite, dolomite, lantanite, Kutinite, thermonatrite, sylvite, halite, carnallite, bismoclite, glauberite, barite, gypsum, thenardite, jarosite, shayrerite, phosphosiderite, lenarkite, apatite, goseixit, fluorite

2.1. Fluiddynamic regime of the root structures

It is proper to origin centers of mud volcanoes with deformational (mechanochemical) minerals formation mechanism. Basically,these structures minerals association includes the part of the xenogenic group appeared duringdynamometamorphismofultrabasite-basite complexes rocks. It is represented by hydrous silicates (amphibole, serpentine, foxit), that compose the granular aggregates, and anhydrous silicates (garnet, plagioclase, quartz), forming porphyroblasts in cataclasite-milonit matrix.

2.2. Fluid dynamic regime of fluid–rocksubstrate transit channels

It characterizes the processes of fluid-rock mass replacement from destruction zones and fluid generation through the mud volcanoes subvertical and inclined channels (vents) of most often tubular, cylindrical, fractured forms. The fluid dynamic regime here is – pulse-discontinuous. The active eruptions periods arereplacedwithattenuation passive phases and termination of mudvolcanic eruptions. Accordingly, such parameters of the fluiddynamic system as pressure, temperature, solutions pH and fluid components quantitative datavary over a wide range. The consequence of the quickly changing thermodynamic and physical-chemical setting of the fluid system functioning is the minerals large group formation of the gas-explosive and gas-water-lithoclastic stages(table 1), which combines, on the one hand, mineral species,proper to typical magmatic and contact – metamorphic rocks, and on the other hand – to lowtemperature hydrothermalsedimentary, hypergenous one.

2.3. Fluid dynamic regime of hydrotherms transit channels

It characterizes the water-drainage system of mudvolcanic structures. Its water component is represented, mainly by thermal waters containing thin mineral and rock particles, hydrocarbons admixture in small quantities. Its composition fluctuations, physicchemical and thermodynamic parameters are caused by heterogeneity (boiling) of ascending hydrothermal solutions, their dilution with surface and atmospheric waters [11], bacterial communities functioning. These factors determine the species composition specifics of resulting minerals. In the mud volcanoes hydrothermstransit channels the leading role belongs to chemogenic and biogenic mechanisms of the mineral genesis.

The main factor in the fluids generation, initiating mud volcanism in the East Siberia south, is dynamometamorphic one, i.e.,mechanochemical mechanism, causing anhydrous alumosilicates hydration from Precambrian rocks of magmatic and metamorphic strata. Tribochemical dehydration reactions, generating mud volcanoes fluid systems play a major role in the subsequent transformations of early dynamometamorphits in the destruction,zones and are the result of shiftingeotectogenesis, covering the Paleozoic-Mesozoic sedimentary strata, laid on the Precambrian crystalline basement. In the latter case, the mud volcanoes roots may not reach the occurrencedepths of Precambrian strata.

From published data itis known that young mud volcanoes on the Earth are formed in subductional geodynamic setting [23]. Their space location is controlled by collision zones (conflict) of continental margins and island volcanic arcs. Herewith, the main formation mechanism of mudvolcanic fluid systems is considered to be the dehydration reaction of the subduction zones accretion wedge. Then mud volcanism geodynamic conditions in the South-Siberian region is determined by the plume tectonics, [7] which is manifested in the Earth crust in the form of interrelated rift genic and the charriage - thrust structures development. Accordingly, the fluid system that creating mud volcanoes on this territory has another origin.

III. BIO-INERT TRAVERTINE AND STROMATOLITE-LIKE STRUCTURES OF THE MUD MICROVOLCANISMIN THE BAIKAL RIFT ZONE DEPRESSIONS

The construction, mineral composition, genesis peculiarities, of discovered by the authors bio-inert domes and columnar fine - and mini-structures in the Baikal rift zone depressions (Bagdarino, Barguzin, Baunt, Tunka, Ust-Selenga)are studied. It is defined, that they were formed with active participation of bacterial communities in places of gas-water fluids currentdischarge of mud microvolcanoes. These structures sequence and growth mechanisms are considered. For this type structures formation, the main role belongs to the currentfluidodynamic processes of plume nature.

3.1. The dome-like structures

Such structures sizes are in diameter 1-2 m, height 20-30 cm, rarely more. Their formation and composition peculiarities are studied on the example of a dome-likeconstruction located in a shallow water half-swampy lake (70x40 m) of Bauntdepression that appeared in the mud volcano Caldera. In the lake, thethree layeredcyanobacterial mats are widespread providing the domes growth. From their bottom-up section looks like: purple (0.2-0.5 cm), green (0.5 cm), buffy (0.5-0.7 cm) layers.

The first two stages of dome-like structures growth (Fig. 5 A, B) form layered bacterial-mineral domes, similar in structure, composition and genesis to currentstromatolites (mineralized “littlevolcanoes”) Uzon Caldera on the Kamchatka Peninsula [24].

At the final stage, bacterial-mineral domed constructions are built over by soil-plant "hats", thereby transforming themselves into soil-plant knolls (Fig. 5 C), the formation of which is provided by the active work of the soil microorganisms community that “ took up the baton” of structuring from the earlier cyanobacterial mats.

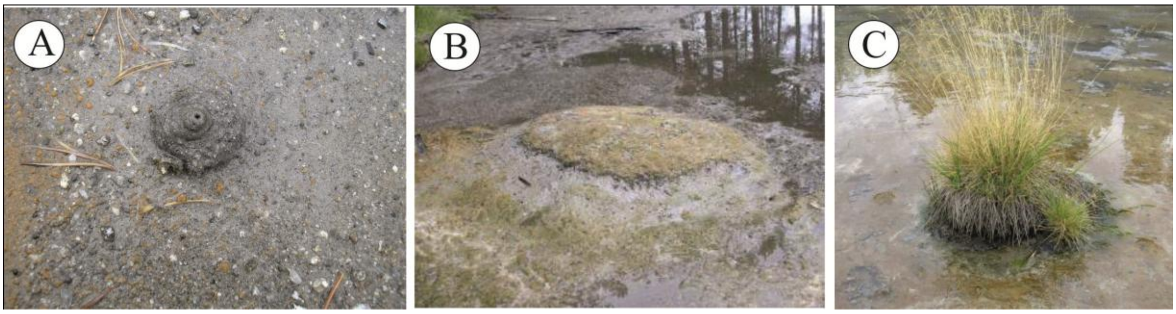

Fig. 5. Successive formation stages of the dome morphostructuresBaunt depression as example. Stages: A – the formation of griffon dome-like mud volcanic construction from fluid-clastogenicpelite- psammite material in shallow water reservoirs. Its covering is of black silt rich with microorganisms; B - pelite-psammite griffon structure transformation in the dome-like one (growth in breadth and up) as a result of cyanobacterial mat active formation, intensive formation of bacterial organomineral aggregates in structure over the water part in terms of griffon water pouring out attenuation, griffon channel occlusion; – the transformation of the dome-like structure in the normal swampy soil-plant hummock, associated with the soil microorganisms functioning; C – domelike structure transformation in normal marsh soil plant hummock, associated with soil microorganisms functioning.

3.2. Columnar structures

In upland-knoll landscape setting a kind of *pyramidal and conical morphostructures columnar type is being formed,* particularly widespread on the surface of the griffon sands arrays in the Barguzin and Bagdarino depressions, where accreted with each other they form small fields.

A columnar structure was studied in the area of developed valley gold placer along the AunikRiver. Here, within the segment of 200x50 m, sporadically, in the areas having size from 1x0.5 to 5x5 m, accumulations of newly formed sand-clay soil cone-like individuals grown on crushed and crushed-stone-gravel substrate are observed. Their height reaches 3-6 cm in horizontal sections (middle part) 1-3 cm. They are partially covered with a sulfate-carbonate composition crust. In the sand-clay material composition of columnar formations the fragments up to 3-4 mm in size of dark green coloring thin bacterial mats are identified. Rosette-and fan-shaped aggregates of gypsum penetrate to the upper soil -plant layer, topping the columnar individuals cut. At the same time, pseudomorphic moss replacement with a mineral aggregate is observed. Psammito-pelitic deposits minerals, composing columnar structures, are presented by feldspar, quartz, zircon, tourmaline, sericite, biotite, chlorite, vermiculite, actinolite, siderite, calcite, ilmenite, rutile, magnetite.

For revealing genetic peculiarities of the considered structures type formation there were used the study results of the bacterial organic mineral aggregates and mineralized biofilms composition (table 2.). Their analysis and geological data have permitted to make the following conclusions.

Columnar structures occur in exit points of a gas-water-lithoclastic pulp small amount from vents of current mud micro volcanoes on the earth surface, characterizing the fluid-dynamic regime different stages manifestation periods of their functioning. Using distinctive lithocomplexes mineralogical features of mud volcanic origin [19], in the minerals set listed in the table 2, the associations genetic groups, proper to the early gas-explosive (fluid-pyrometamorphic and fumarole groups – columns 3, 4 of table 2) and later gas-water-mud and water (gas-hydrothermal injectable and hydrothermal groups – columns1,2 of table 2) stages of mud volcanoes activity are identified.

Table 2. The mineral composition of bacterial organomineral aggregates from columnar structures in the Aunik river valley of Bagdarino depression

1	2	3	4
Pyrite Magnetite, hematite, goethite, hydrocassiterite, diaspore Calcite, aragonite, pistomesite, sideroplasite, mezizite The K-feldspar, albite, quartz, chlorite, chloritoide, muscovite, kaolinite Apatite, fluorapatite, xenotime Gypsum, anhydrite, barite	Sphalerite Halite, sylvite, lawrencite, hydrophillite, chlormagnesium, molisite Goethite Calcite, siderite, dolomite, magnesite, witherite, calicinite, indigirite, nahcolite Albite, anortite, K-feldspar, barium K-feldspar, sphene, tremolite, quartz, muscovite, kaolinite, pyrophyllite, makatite, norbergite, ferripyrophillite, paragonite Apatite, chlor-apatite, strengite, babiera Anhydrite, gypsum, barite, szomolnokite, melanterite, jarosite, keseric, mirabilite, thenardier, leonhardite, mercallite, alunite	Fe, Au, Cu-Zn, Al, Pb Anorthite, oligoclase, disten, wollastonite, olivine, enstatite, ferrosilite, garnet of almandine-pyrope series, cordierite	Fe, Al, Si, carbides (Fe-Si-Ti), hamrabaevite, cogenite, moissanite Rutile, ilmenite, arizonite, magnetite, magnesioferrite, hematite, ionite, spinel, gerzinite chromite, tugarinovitebeidellite, corundum, lime, periclase anortite, andesine, barium K-feldspar, quartz, ferrosilite, rhodonite, pyrope, tremolite

Note**.** 1 - biogenic macro-and microminerals, appeared with the microorganisms active participation ;
2 – the same – regulatory nanominerals of bacterial films, calculated by the stoichiometric ratios of mineral forming chemical elements; 3 – microminerals, appeared with the active participation of mud-volcanic fluids gas components; 4-the same regulatory nanominerals. The minerals list partially includes xenogenicsphene, feldspar, quartz, chlorite, tremolite, magnetite, ilmenite, muscovite.

Differences in morphology, size, material composition of combining them litho- and mineral complexes are mainly determined by the fluid dynamic characteristics of the mud micro volcanism manifestations and correlated with them the development extent of bacterial communities, first of all, cyanobacterial one.

Bioinertmorphostructures, quickly becoming covered with soil-plant formations, i.e., finally transforming in phytogenic hummocks, bond griffon sands arrays. Thus, they inhibit the Eolian dispersion of sand material, the dunes formation and movement, i.e. desertification processes in the Transbaikalia region.

IV. PLASMOID PHENOMENON OF THE COLD EARTH DEGASSING

V. I. Vernadsky defines the cold Earth degassing as “gas breathing of the planet". Thus he emphasizes its main feature-the pulsating (wave) nature of the fluid dynamic processes manifestation. The plasma matter state is considered as one of the fluidodynamic systems supposed attributes that form the autowave Earth energy structure [13].

The authors carried out researches on identification, typification, genesis of natural plasmoid formations in the near the Earth troposphere over current gas-emitting structures of the Baikal rift zone (Fig. 6).

In addition to visual registration (V-plasmoids), more than 1,500 photographs were obtained on a digital camera, recording an invisible to eyes group of F-plasmoids at all observation points.

V-plasmoids are rare. At the test ground MedvedchikovKlyuch , such their forms were observed: 1) toroidal with an outer diameter of the ring 6-7 m; 2) conical; 3) spherical in diameter up to 1-1,5 m; 4) triangular; 5) a columnar-shaped with a diameter of 30 m. For spheroid V-plasmoids larger and slow-moving (10-15 m/s) in different trajectories their “start” points from the surface, presented by current gas-emitting mud volcanic structures, could to be caught, and then investigated, (small salsas of 0.2-0.3 m height, the funnels 1,0-2,5x0,8-1,7 m in the griffon sands array).

The **F-plasmoids** space-genetic relation with local gas-emitting structures is identified too. They were discovered at the mentioned test ground, as well as over the gas griffons with firing gases. Cooling vapor columns over the gassing griffons of Goryachinsk and Gusikhathermal waters resources photography showed the timing to them of various shapes, construction plasmoid formations while the latter absence out of their boundaries.The entire set of Fplasmoidsregistered in Baikal regions aregrouped, in form and construction, into several types and subtypes (table 3). Cellular morphological structures [17], as well as formed by gravitational-capillary waves on the water surface causedby electric fields [4]. Disorderedplasmoidsof the torch and the vortex (Fig. 7) types are similar to polar lights, to some varieties of plasma-dust structures obtained in experiments [25]. Quasi-crystal polyhedral plasmoidsof simple forms have similarities with experimentally revealed two-dimensional and three-dimensional ordered structures of heterogeneouslow-temperature plasma solid macro particles [26]. The structures allocated in the subtype of irregular of the cloud-like and torch types are comparable with structures such as hydrodynamic “quasi-crystals”

polygons (a type of quasi-crystal combined and complex forms) are very similar (Fig. 8) tomorphotypes of experimentally obtained cold plasma clots [27]. Quasi spheroid plasmoids (Fig. 11), except wave-shape subtype, are characterized by serrated (like “massage ball”) crystal surfaces of the outer shells. They correspond to the neutral plasma morphostructural model obtained with laser cooling (”freezing plasma") [28]. The plasmoids, very unusual complex in the form, arecharacterized by the presence of hollow processes - "proboscis".

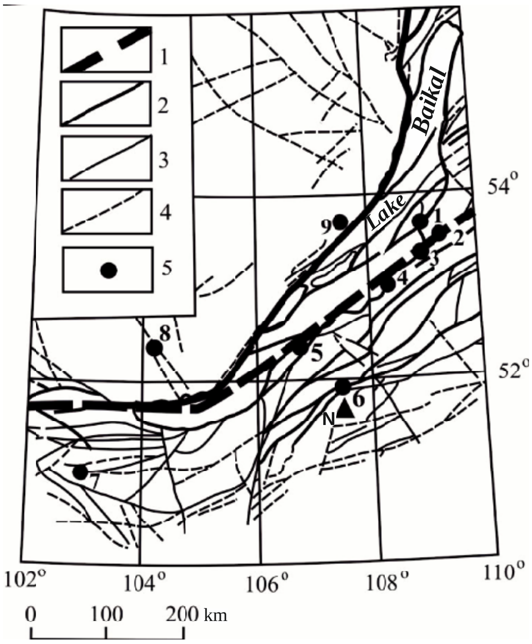

Fig. 6. Observation points of plasmoid structures on the active faults map of Baikal rift system [29]

1 – axis zones of current lithosphere destruction; 2 – faults with magnetic index of seismic activity (MISA)≥12 (very active); 3 – faults with MISA 10-11 (active); 4 – faults with MISA 8-9 (weakly active); 5 – plasmoids observation points (1 – Kuliny swamps, 2 – Gusikha source 3 – Ust-Barguzin, 4 – Goryachinsk source 5 – Proval Bay, 6 – test ground MedvedchikovKlyuch, 7 - Khamar – Daban), 8 – Irkutsk, 9 – Zama; N –geophysical monitoring station in village Nadeino.

Table 3. Characteristics of F-plasmoidsmorphostructural types.

Types	Subtypes (the established sizes regarding to the landscape elements)
The cloud - like	Cellular(10x50 m, 100x200 m)
	Non-ordered(1.0x2.5 m, 3.0x10 m, 70x100 m, 100x150 m)
The torch	Cellular(0.7x1.5 m, 3.0x5.0 m, 5.0x10 m)
	Non-ordered(0.5x40 m, 1.5x5.0 m 15x60 m)
Thevortex	(1.0x2.0 m, 1.5x3.5 m, 150x500 m)
Quasi-crystal, of simple shapes	Polyhedral (up to 30 m, predominant 0.2-5 m)
	Polyhedrally striped (up to 2.0 m)
Quasi-crystal, of combined and complex shapes	Comet-like(0.2x0.6 m, 0.15x0.7 m, 0.5-0.9x0.5-1.3 m, 0.2-0.3x1.5-2.0 m)
	Irregular polygons (0.2x0.3 m, 0.4x1.0 m, more often up to 1.0 m)
Quasi-spheroidal	Uniformly coloured
	Zonal-spotted-coloured (0.1-2.5 m)
	Wave-shaped (1.5-5.0 m)
Complex, of curvilinear shapes	(3x5 cm, 5x10 cm, 0.3x1.0 m, 0.4x0.6 m, 0.9x2.0 m, 1.5x6.0 m)
Biomorphicpseudomorphs	Glowing leaves, tree branches and insects (mosquitoes, butterflies)

The daily dynamics of F-plasmoids number variations is characterized by a quasi-periodic trend (Fig. 9). It is coherent with quasi-periodic changes in the real-time fault activity of the Baikal rift system, seismic events short-period energy fluctuations in the individual tectonic disturbances [29].

A significant part of atmospheric plasmoid structures is formed by fractal self-organization of electrically charged polyhedral clusters of the "hidden" water phase (quatarons), as shown in the ball lightning model [30]. Quatarons, forming close to quasi-spherical and quasi-crystal morphotypes and structures are similar to Coulomb and plasma crystals [26]. The characteristic plasmoids serrated structure is dueto loose particles packing on the quatarons surface.

Fig. 7.A vortex-type plasmoid at the MedvedchikovKlyuch test ground.

Fig. 8. Comet-like plasmoids. Detail – elongated smooth 6-gon with the "tail". The contour of the polygon is highlighted by a strip of violet and yellow colorings. In the head of the plasmoid– green plasmoid. MedvedchikovKlyuch test ground.

Studied F-plasmoids are the multicomponent structures (complex plasma, according to [25]). They consist of gas (in varying degrees ionized), charged dust mineral and organic particles, hydrosols and aerosols – products of the "cold" Earth degassing Quantitative relations between them can be very different. This is indicated by the variety of their structures and colors.

The authors believe that the main plasma-generating self-oscillating processes in the Earth crust are deformational one (mechanoelectric), probably, with themantle gas fluids participation, and gas-water-mud-volcanic one (electrochemical effects, electrization). Thestructuring of emerging plasma-dispersed substance begins in the lithosphere, and ends in the troposphere.

Cold degassing forms 3 levels of plasma generation with different plasma substance formation and structuring mechanisms: lower endogenous-lithospheric one (deformational or mechanoelectric); upper exogenous-lithospheric one(gases oxidation, sulfates cavitation, dehydration and crystallization); atmospheric one(phase transitions "water–vapor", "ice–water").

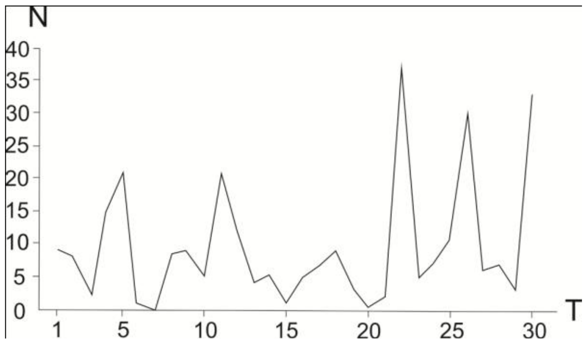

Fig. 9. Daily (T) dynamics of plasmoids number changes (N). The test ground MedvedchikovKlyuch, November 2010

V. ECOLOGICAL PROBLEMS OF THE COLD EARTH DEGASSING

Natural phenomena and processes included in the concept of the cold Earth degassing combines a number of peculiarities that allow them to be considered within the scope of a multi-component ecological and geological system specific model (according to [31]):

– manifestationsshort duration and impulsiveness (periodicity, more exactly,quasi-periodicity);

– preliminary local functioning character of the model main structural element – degassing tubes (gas, gas-water-lithoclastic mud volcanoes, decompacting zones, the tectonic and seismotectonic disturbances, water resources, hydrocarbon deposits), with very large dimensions (diameter) in plane (from the first centimeters to the giant sizes of the Earth poles) and in depth (from tens of cm to the level of upper mantle and lower);

–degassing tubes timing not only to seismically active oceanic and continental rift zones with strong earthquakes, but also to areas with trigger seismicity [32], characterized by weak earthquakes and short-term activation of neotectonic faults individual segments. These areas, where earthquakes with magnitude> 3 occur rarely, are usually proper to the platform territories [33];

–mostly latent, rarely directly observable processes and morphological structures of the degassing tubes active work. For this reason, the mud micro-volcanismoccurrence extent on the continents and in the Global Ocean is not always objectively evaluated.

Researches do not pay yet due attention to the degassing tubes impact to the environments. Sometimes this leadsecologists to makewrong conclusions. For example, it concerns the pollution causes of lakes Baikal and Kotokel, which are the part of the South Siberian mud volcanism region. Below, on the examples of this area, we will show the impact of intracontinental mud volcanism on the environment and its negative ecological impact on humans and other representatives of the living world:

Lakes periodic drying and filling, their chemical composition change.

During the period of 212 years (1772-1969) the largest lakes of the Ttansbaikalia territory Zun-Torey and Barun-Torey (water mirror area of 850 km²) completely dried out 7 times [34]. The chemical composition varied from fresh to bitter salty or alkaline soda water. These processes occurred independently on the climate and were determined by the underwater sources functioning regime.

Unstable and often extreme parameters different combination of mud-volcanic origin water reservoirsfluidodynamic regime specifymicroorganisms functional groups, genera and species variety and proportions.

Twelve allocated areas of space isolated bacterial communities are adapted to different fluid dynamic environment of ecological-geological system by aligning their parameters with the microorganismsnumber and qualitative composition [35].

Geological data clearly indicatemud volcanoes to play a major role in the deserts formation

Mud volcanoes of gas-water-litoclastic type [19], hydro-volcanoes [9] sporadically throw out onto the earth surface large masses of griffonaleurite-sand material (Fig. 10) which is then subjected to Eolian transfer and wide area distribution.

Mud volcanoes active phases cause gas poisoning of people, animals and birds.

A number of such cases have been registered: the mass death of fish in the Torey lakes, in the lake Kotokel, in the mouth of the river Barguzin, which flows into Baikal (2004-2009). Two people died after eating dead Kotokel fish;death (more than 140 individuals) of the Baikal seal in the summer of 2017; poisoning of children on February 21, 2006 at Zarechny village school No. 8 of the Ulan-Ude, followed by fainting, headaches. All symptoms testified the mud-volcanic gases effect on children.

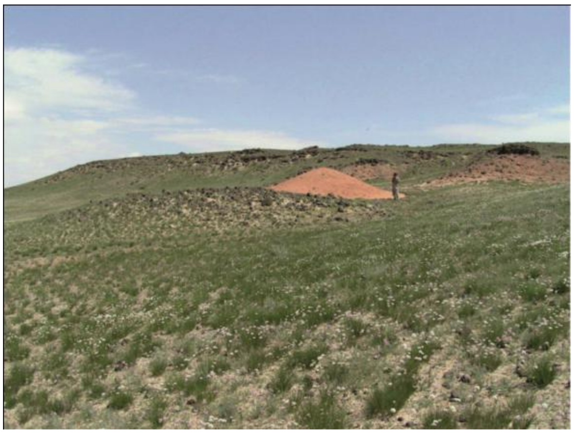

Fig. 10. Sandy hill ("volcanic breccia") that appeared above the mud volcano griffon. Mongolia. Photo by S. V. Rasskazov. Natural model of early (pre-Aeolian) stage deserts formation.

Gas volcanism, characterized by the release of high concentratedmethane and other combustible gases, is often the cause of fires, harming very much the environment.
Most often, fires sources are observed in forests and peatlands of Buryatia, sometimes near (Cheryomushki) and even inside (Bichura) populated points. Around the city of Gusinoozersk the coal combustion in the developed deposits underground mines is being observed.

Separate mud volcanoes together with water take up oil, polluting water reservoirs (lakes Baikal, Baunt, etc.), as well as coastal beaches (summer 2017, Ust-Barguzin).
Even the waters of some ground thermal mineral springs of the Baikal rift zone (Arshan, Garga, Goryachinsk) contain small amounts of liquid oil, and the oil bitumen inclusions are being found in the deposits formed by them.

5.1. The cold Earth degassing – the most important factor of regional and local climate and a natural environment changes

The cold Earth degassing is considered by many researchers to be as one of main reasons for the global climate, natural environment changes and associated hazards. There is a hypothesis that due to cold degassing at least 95% of deep origin natural gases (CO, CO_2, CH_4, etc.) enter the planet atmosphere and the GlobalOcean. [36] Global warming and global cooling, respectively, are associated with deep degassing increase or decrease. However, the concept of global changes in climate and the environment is not consistent with geological functioning, spatial distribution of the cold Earth degassing structures. The nature of the degassing tubes spatial placement, their small size up to several tens of km contradicts "Globality".Except two degassing tubes of giant sizes at the Earth poles, discovered from space, which theoretically, incase of their strong activation, can cause global climate and environmental changes, followed withharmful for all living disasters.Often formed areas of spatially contiguous degassing tubes (for example, mud-volcanic areas, regions, zones) are unlikely to be rightfully attributed to global, i.e. planetary structures. The areasimpacton the climate and the environment has a regional nature. On large territories, they create mosaic-contrast (differentiated) pattern of climatic (meteorological) changes, with alternation of sporadically occurred anomalous areas or zones not exposed to degassing tubes impact. For this reason, it is very difficult, if not impossible, to calculate the global numerical values of climate variability. Their averages for the global level do not provide essentially an understanding of the real events taking place on the planet. For example, from the average temperature growth rate evaluation [37] on Earth for the period of 1950-2010, it follows that its annual growth was 0.01°C. Thus, it can be concluded that in 60 years of "global warming" the average temperature of the earthsurface has increased by 0.66°C. However, this figure canhardly be considered as an indicator of global environmental threats.

Another thing, the discovering of several regional water temperature anomalies ("spots") in the Atlantic and Pacific oceans [38].The largest area of them is 2000x2000 km. Herewith, the plus temperatures rise for 1 - 4˚C is marked. Observed in the North Pacific ocean, the constant change in time of the temperature cold (negative) and warm (positive) phases and relative short duration (several months) of the anomalous "spots existence" – i.e., these phenomena cyclical nature, clearly indicates their spatial and genetic relation with the regional structures of the cold Earth degassing.

Cold degassing is the formation reason of the regionally isolated ozone "holes" groups [5]. In Russia and on adjacent territories, V. L. Syvorotkin hasallocated 5 regional groups (centers) of ozone negative anomalies [18]. The largest ozone anomaly with the center over Baikal was registered in February 1995.

Linear cloud anomalies (LCA) occur periodically over the activated discontinuous disturbances of the Earth lithosphere, clearly distinguishable in space photos [39]. Their dimensions reach 700x500 km.The LCA existence time in the atmosphere ranges from several ten minutes to several hours and is determined by pulse variations of geophysical fields (seismicity, electromagnetic radiation), mud volcanoes aerosols emissions [40].

5.2. Different forms ecological consequences of the cold Earth degassing local manifestations

5.2.1. Continental ecological-geological system of cold degassing

Table 4 shows the characteristics of environmental disasters, threats and hazards arising from degassing tubes. Below we will demonstrate some episodes of different phenomena, the forms and types of cold degassing damaging impact on the continents ecosystems.

Based on the informationanalysis, published in the media, it is possible to identify the following facts groups,indicating the negative environmental role of various types plasmoidstructures: 1) deaths of people, domestic and wild animals, other representatives of the terrestrial and aquatic fauna; 2) health deterioration and people disappearance; 3) shutdown and ignition of electric networks, appliances, electronic devices and other mechanisms; 4) the death of the aircraft.

The most harmful to all living things on Earth is the explosive gas volcanism. Herewith, explosions can be different in power and destructive force, and generate local earthquakes. They pose a particular threat to nuclear power plants (NPPs), radioactive waste and ammunition depots, and ground-based missile systems.

For example: in 1999, a series of gas explosions occurred near the Kursk nuclear power plant (Russia) with crater (funnel-shaped) structures formation [41]. The explosions were successivelyapproaching to a nuclear power plant. The last funnel with a diameter of 40 m and 8 m deepwas only 20 km away.

Gas volcanism, not accompanied by explosions, is mainly dangerous by two environmental troubles: people, animals, birds and water fauna poisoning, the fires emergence.

Fast, almost instantaneous landscape-geomorphological earth surface violations ,which produce gas-water-lithoklastic mud volcanoes, like positive (hills, hillocks) and negative (dips, depressions, funnels, wells) relief morphostructures , are able to cause great damage to the population and the environment. They pose a threat to nuclear

Table 4. Ecological consequences of intracontinental mud volcanism and the Earth bowels neotectonicactivation

Phenomena, types and forms of cold degassing	The impact on the biota habitat threats and dangers to life
Plasmoid formations in the atmosphere	Damage to health, disappearance and people death, animals. Radio communications interference, electrical appliances and equipment operation
Explosive gas volcanism	Local earthquakes. Fires. Death of people, animals and birds. Damage to the economic infrastructure. Threat to nuclear power plants and radioactive waste repositories
Gas volcanism without explosions	Poisoning, death of people, animals and birds. Fires. Damage to the equipment during well drilling
Gas-water-lithoclastic mud volcanism on land	Local areas water-swamping and crater lakes formation, depressions, sinkholes, funnels, hummocky and hilly topography. Desertification. Changes in the level and chemical composition of underground waters, pollution. People death in large pits and funnels. Initiation of life-threatening landslides, mountain glaciers descending. Communications damage (roads, pipelines, transmission supports, etc.). Beaches pollution with the natural oil. Threat to nuclear power plants and radioactive waste repositories
Mud volcanism in water basins	Fluctuations in underground hydrosphere level, chemical composition and waters pollution degree, including drinking one. People, fish, crustaceans, seals and other fauna death. Periodic lakes drying and filling,their water level fluctuations. Local tsunami formation

powerplants and radioactive waste repositories. The catastrophic accident reason at unit 4 of the Chernobyl nuclear power plant in 1986 was probably a sudden activity start of the mud-volcanic structure under it, timed to the tectonic fault in the crystalline basement.

A huge failure in May 2017 opened the concrete vault in one of the nuclear waste repository underground tunnels in Hanford (Washington State). Fortunately, the downfall occurred over a tunnel section, where there were boxcars with waste equipment, slightly contaminated with radiation, rather than tanks with liquid radioactive waste.

Underwater mud volcanism in the intracontinental waters, the manifestations of which are very diverse (from gas and oil emissions to the outpouring of thermal mineral waters) is also an environmental hazard.

5.2.2. Oceanic ecological-geological system of cold degassing

In the Global oceans and seas, catastrophic events are no less if not more spread than on continents. Some researchers, including the authors of the article, as well as the mass media associate a significant part of them with various manifestations of the cold Earth degassing. Here are a few episodes that led to the people death. Unusual plasmoid structures – “the Quakers”, emitting a strange low frequency audio signals (“bloop”), similar to the frogs croaking, sometimes pursue nuclear submarines in the Atlantic ocean, Norwegian, Caribbean, Barents seas. Apparently, the death root cause of several submarines belonging to the USSR and the USA, are the mentioned “Quakers”

According to the latest data, hundreds of thousands gas craters (“pockmarks”), gas torches and mud volcanoes have been allocated at the bottom of many shallow water areas in the World ocean [12, 42]. This number of cold degassing structures in the oceans and seas creates, on the one hand, a favorable habitat for certain biocenoses and, on the other hand, threats to human life and many marine fauna species.

VI. CONCLUSIONS

The submitted new data allowed to formulate the scientific concept of "the cold Earth degassing ecological and geological system". All the main Earth shells enter it: lithosphere, hydrosphere and atmosphere. The processes originality and various forms of cold degassing manifestation, its distinctive features are considered. Prospects and possibilities of these data application in fundamental and applied science and especially in the field of ecology are shown. At the same time, beyond the proposed concept, there are many important problems that need to be solved in the future by coordinated efforts of various profiles scientists and specialists:

- the gas volcanism temperature duality. On the one hand, there is a thermal effect on the environment, and on the other hand, degassing tubes work on the principle of a refrigerator with the ice and snow formation. The study of this phenomenon can help to solve the problems of the glaciation origin at the Earth poles, glaciation covering and permafrost in Eurasia, on other continents
- the effect of degassing plasmoid form on terrestrial and atmospheric biota, on any organic substance;
- the role of cold degassing processes in the dinosaurs extinction, migration and resettlement of the ancient man;
- the effect of degassing on the level and chemism changes in hydrosphere underground water reservoirs.

The cold degassing is proper not only to the Earth. There are its signs on Jupiter, Saturn, moon and even comets. They need scientific analysis. Researches in this direction are very relevant in the light of space exploration solution.

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Tatarinov A.V "New Results in the Cold Earth Degassing Researches,Their Ecological Aspects "International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.5, 2018, pp. 58-70