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Thermal Field in the Sedimentary Complex of the Eastern Black Sea Region and Gas Hydrates Content in the Guria Deflection

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ABSTRACT

The geological and geophysical conditions of gas hydrates formation in the Guria Trough in the Black Sea and results of studying of heat flow distribution and calculations of temperatures in the sedimentary complex of the Eastern Black Sea region are given in this work. The results are presented in the form of maps of heat flow and deep temperatures. The results of studies of gas hydrates conducted in cooperation with German scientists from the University of Bremen during the sea cruises. It is shown, that in the case of Guria Trough intensive gassing (Batumi seep) observed is associated with the content of gas hydrates in marine sediments in the region.

Key words: thermal field, sedimentary complex, Black Sea region, gas hydrates content

The Black Sea region is a small part of important and huge European-Asia Minor oil-gas bearing province. It contains the coastal shelf, eastern, northeastern and southeastern part of the Black Sea. There are certain oil and gaseous reservoirs in this area, mainly along the eastern Black Sea shelf and Guria Deflection (Guria Trough).

The zone of oil-gas formation of Guria deflection (on land) belongs to the west part of Guria sector of Ajara-Trialeti folded system. Sea prolongation of Guria foothill deflection spatially is stretched on the prolongation of the middle of rivers Supsa-Kintrishi to the south-west into Paleogene series, in the zones of shelf and the continental slope. On the whole, sea part of Guria deflection is situated in the extreme south of Georgian sector of the Black Sea.

On the basis of complex geological-geophysical, geomorphological and cosmic data, it is established that tectonic faults (observed on land) extend in the zones of shelf and the continental slope; this is well reflected in thickness distribution of separate geocomplexes of sedimentary cover and formation of wide net of submerged canyons.

These weakened zones participate with various intensity in lithogenetic processes of eastern Black Sea depression, which is well expressed in peculiarities of separate facies and sediment accumulation velocity, spatial distribution of diapirism, mud volcanism and intensive gas streaming areas at the sea ground. Sea prolongation of such weakened zones is deep faults of Supsa, Natanebi, Kobuleti, Chorokhi. Existence of these fluid-conductive mobile faults conditioned the formation of diapiric structures in Oligocene-Miocene sediments of Guria deflection. At modern stage of geological development (land-the Black Sea) weakened zones are within sedimentary cover, as well as foundation; they are characterized by high values of thermal

indices. Ajara-Trialeti zone and Guria foothill deflection are characterized by anomalously high heat flows (70-80-mvt/m^2) and anomalously high depth temperatures, which reach up to 150-200 ^{0}C on the base of sedimentary cover.

In the article work results of studying of distribution of a heat flows and calculations of temperatures in a sedimentary complex of east part of the Black Sea water area are given.

The map of heat flows distribution (fig. 1) is made on the basis of the experimental data and also on the basis of the calculated values of flows.

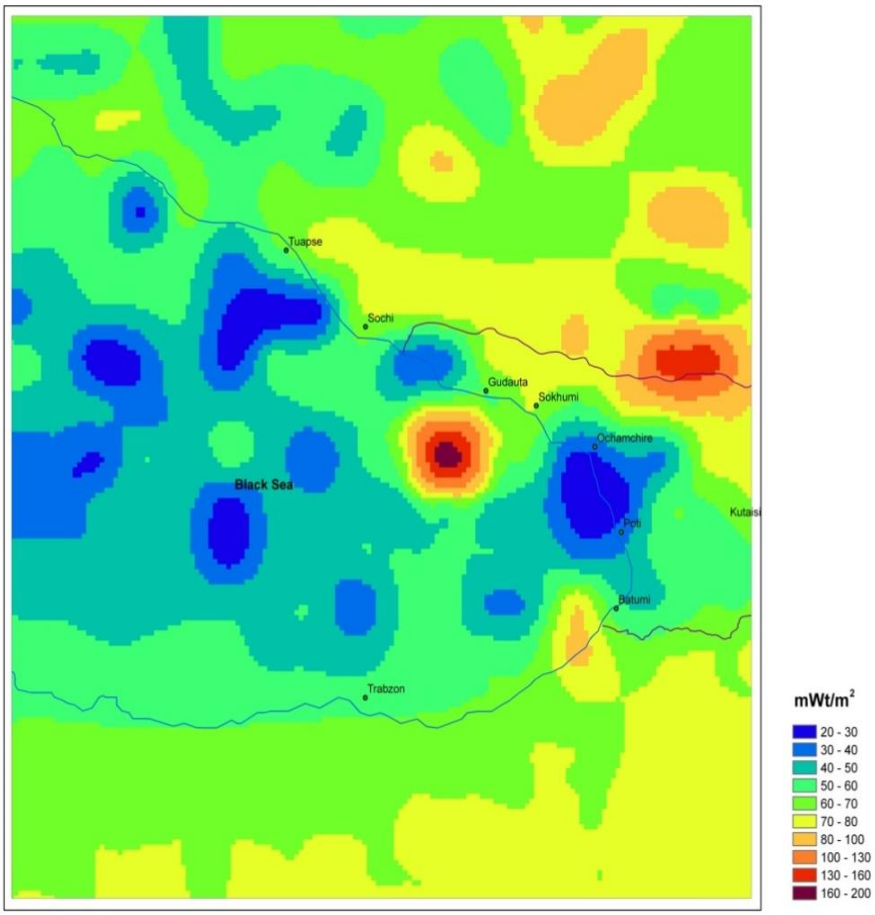

Fig.1. The map of distribution of a heat flow

Calculation of deep temperatures for Black Sea water area has been spent earlier only for points with available experimental data of flows. In the given work calculation of temperatures in a sedimentary complex of investigated region has been spent with use of the experimental and calculated values of heat flows – in points where there were no experimental data about flows its calculated values were used. Temperatures in a sedimentary complex have been received by the solving of the stationary equation of heat conductivity, and the received results are given in m of temperatures distribution on the bottom border of a sedimentary complex (fig.2).

High values of tectonically weakened zones and heat flows and temperatures, as well as intensive submersions, especially in subsequent period of Eocene, condition the formation of elision fluidodynamical system of eastern Black Sea depression and Guria deflection as well. Biochemical, lithogenetic and depth genesis hydrocarbon fluids participate at certain stages of lithogenesis.

Powerful oil-gas manifestations in land of Guria deflection are connected with Middle Eocene, Middle Miocene, Sarmatian (Supsa) and Meotian (Shromisubani) collectors.

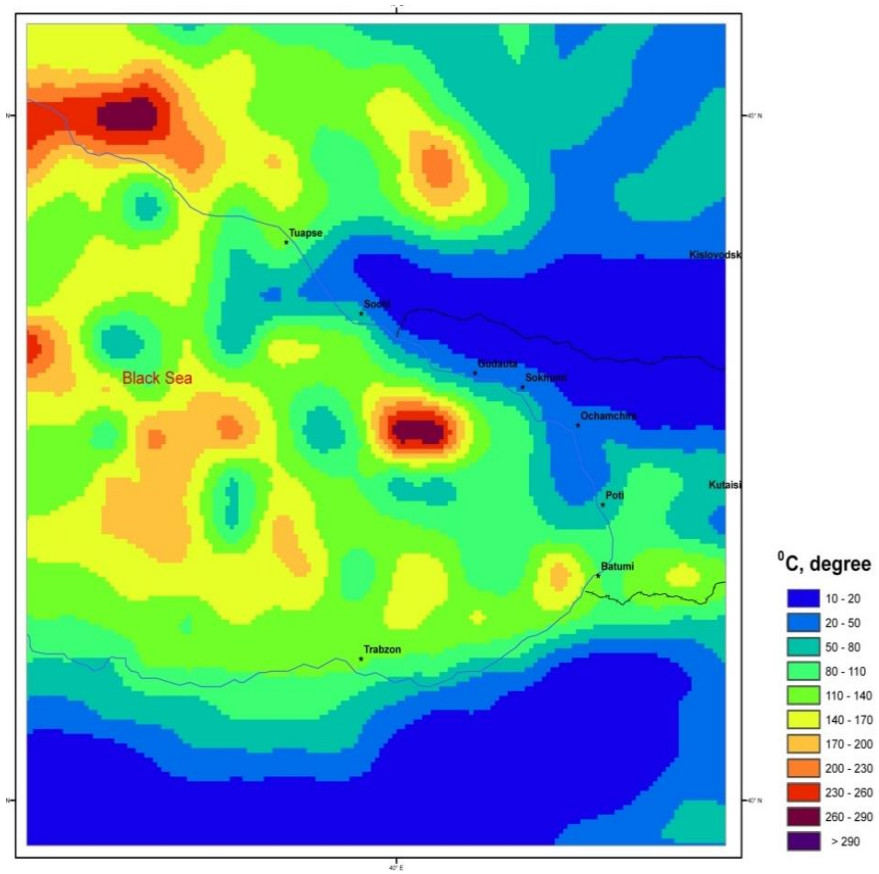

Fig. 2. The map of distribution of temperatures on the bottom border of a sedimentary complex

Hydrocarbon (oil, gas) resources can be revealed in anticlinal and diapiric structures of Cretaceous-Miocene geocomplexes. Deposits of biochemical gas can be revealed in geocomplexes of Mio-Pliocene-Quaternary, in the zone of deltaic sediments of paleorivers, in the form of lithologic-stratigraphic traps.

Highly perspective region of gas-hydrate formation is stretched in the zone of the continental slope, section of rivers Chorokhi-Supsa. Holocene-Quaternary sandy sediments are considered perspective. Gas-hydrate deposits can be revealed below sea ground till 500-800 m depth.

Activity studies of gas hydrates are concentrated in the Black sea for various reasons. It is the largest anoxic basin with much higher methane concentrations than in any other marginal sea. Sediments of 10-19 km thickness reveal a potential reservoir for methane generation and hundreds of methane emission site are known from water column investigations of Russian, Ukraine and German researchers.

In the last decade studies of gas hydrates in the Black Sea were conducted by German scientists from the University of Bremen which was coordinated by prof. Gerhard Bormann during cruises on the boards R/V Poseidon, R/V Meteor and R/V Mary S. Merian. The scientists from Georgia participated in these studies.

Shallow gas hydrates, potentially associated with free gas, are known from sediments in several areas and are of specific interest in the black Sea where a large number of active methane emission sites exist. In the territorial waters of Georgia gas flares, ascending methane gas bubbles recorded by echosounder were discovered at several sites offshore Suchumi and offshore Batumi (Guria deflection).

The area offshore Batumi (Batumi seeps area) was intensively studied by ELAC swath bathymetry, DTS side scan sonar, OFOS video sled and GC gravity corer, where gas bubbles were detected in about 800

m water depth. There in an area of about 1 km^2, occur about 25 gas bubble streams in 10 distinguishable clusters. This is the area in the Black sea with the strongest within the gas hydrate stability zone.

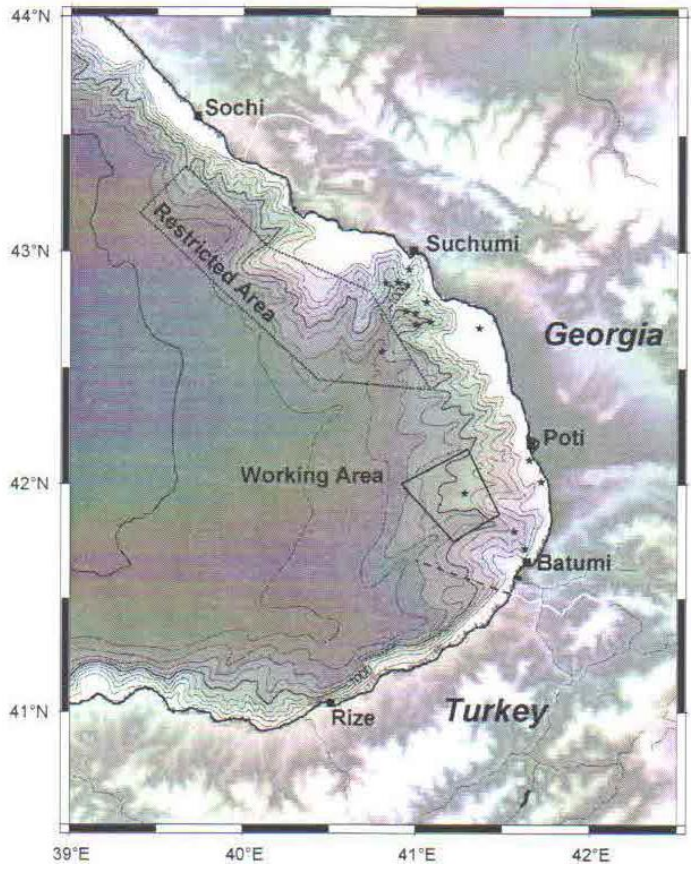

Fig. 3. The working area of Georgia, stars – the location of gas flares

Studies were concentrated on the seafloor observations and sediment sampling on Batumi Seep. It is placed on the ridge between the canyons and on a local high that rises about 10 m at 855 m water depth.

It should be noted that zones of gas emissions in the Guria deflection coincide with zones of high heat flow and high temperatures in the sedimentary complex, received by us.

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სითბური ველი აღმოსავლეთ შავი ზღვის რეგიონის დანალექ საფარში და გაზური ჰიდრატების შემცველობა გურიის როფში

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რეზიუმე

ნაშრომში განხილულია შავი ზღვის შელფზე გურიის როფში გაზური ჰიდრატების წარმოქმნის გეოლოგიურ-გეოფიზიკური წინაპირობები. აგრეთვე მოცემულია აღმოსავლეთ შავი ზღვის რეგიონში სითბური ნაკადის განაწილების სურათი და ამავე რეგიონში სედიმენტური კომპლექსის საგებზე გამოთვლილი ტემპერატურები. ნაკადებისა და ტემპერატურების განაწილება მოცემულია რუკების სახით. სტატიაშიMმოყვანილია ბრემენის უნივერსიტეტის მეცნიერებთან ერთობლივი საზღვაო ექსპედიციების დროს მიღებული გაზური ჰიდრატების კვლევების შედეგები. ნაჩვენებია, რომ გურიის როფში აღინიშნება გაზების ინტენსიური გამოყოფა (ბათუმის გაზგამოყოფა), რომელიც არის დაკავშირებული ზღვის ნალექებში გაზური ჰიდრატების არსებობასთან.

Тепловое поле осадочного комплекса восточной части региона Черного моря и содержание газовых гидратов в Гурийском прогибе

Е.А. Сакварелидзе, Г.А. Кутелия, Л.Е. Глонти

Резюме

В статье рассмотрены геолого-геофизичесеие условия формирования газовых гидратов в Гурийском прогибе на шельфе Черного моря. Предлагается картина распределения теплового потока в восточной части региона Черного моря, а также температуры, расчитанные на основании осадочного комплекса этого региона. Распределения потоков и температур дается в виде карт. В статье приведены результаты исследований газовых гидратов, полученные во время морских экспедиций, проведенных совместно с исследователями из Бременского университета. Показано, что в Гурийском прогибе имеет место интенсивное выделение газов (Батумское газовыделение), связанное с существованием в морских осадках газовых гидратов.