L. Geographical Distribution of Methane Hydrates and International Geopolitics of Energy: Resources in the Eastern Mediterranean

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Abstract: Methane Hydrates are a new energy resource in the global energy market which has received extreme attention from a technological and geopolitical point of view. The reserve estimates exceed by far the overall estimates of all the other conventional energy reserves. With the existing technological know-how the exploitation of methane hydrates is expected to dominate the international energy market within the next 10-15 years. Methane hydrates have been mapped within the Hellenic Submarine Space and especially in the region of Kastellorizo, with whatever consequences it may have of geo-strategic nature for the political decisions of Greece and its relations with the neighboring countries and the delimitation of its EEZ.

I. Introduction

Methane Hydrates (permafrost and marine) have received extreme attention from a technological and geopolitical point of view, on a global scale, because of the identification of vast volumes of methane within these natural deposits that constitutes an important part of the global balance of methane deposits and in the future a probable endless resource of natural gas.

According to the chronological records of scientific publications regarding methane hydrates, few scientists knew or had begun to study methane hydrates until the 80's. Methane hydrates are not stable in sea-level conditions, a fact that forced scientists and engineers to research for innovative technologies for the recovery, sample preservation and measurement of methane hydrates properties in in-situ conditions. Most of their initial questions have risen as a fundamental solution for a problem concerning the preservation of oil and natural gas pipeline flow, because methane hydrates were blocking the flow. During the mid-90s it became obvious that methane hydrates are nature's most significant mechanism for the storage of organic carbon. This remark gave rise to independent research projects conducted mostly by American and Russian scientists with the aid from the discoveries from the Deep Sea Drilling Program (DSDP) and the Ocean Drilling Program (ODP).

Until 2007, the most conservative estimates of carbon stored in methane hydrate deposits were about 2,500 Gigatons. More optimistic studies estimate that the carbon deposits exceed 1,000 Gigatons. This figure is perhaps higher, by a factor 2, than all other fossil fuel resources on a global scale (coal, oil, natural gas, tar).

Because of their dense structure methane hydrates produce 10-15% more energy compared to conventional lignite and coal for the same level of CO2 emissions in the atmosphere. From this point of view, methane hydrates will not provide a solution for the CO2 emissions which is a known greenhouse gas, but will certainly mitigate the problem, to the same degree as natural gas. It is important to understand that methane hydrates is a natural resource that has the same environmental impact as natural gas.

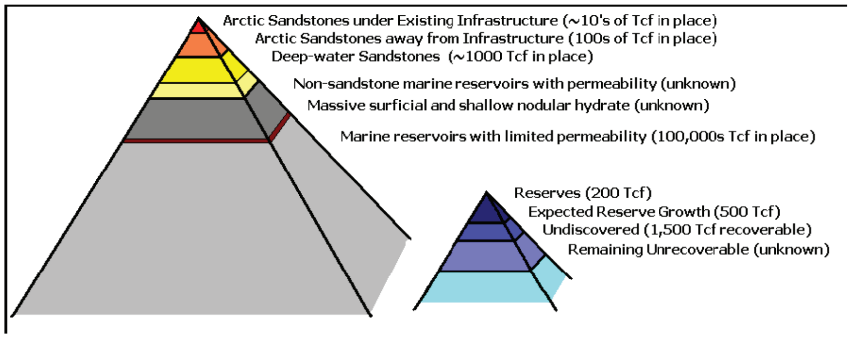

Fig. 1: Estimation of global gas hydrates reserves (Source: USGS)

On an international level, Japan is pioneering efforts aiming at the exploitation of marine methane hydrates deposits for the decade 2010-2020, mostly in the region of the Nankai trench southwest of Kyushu Island.1

Canada is also the leader of an international research consortium, with strong German and Japanese contribution that is active in the field of methane hydrates production testing in the permafrost bounds of the McKenzie Delta in the Arctic region.2 In the USA, the Department of Energy has already funded large scale, long-term activities for basic knowledge research in the Gulf of Mexico aiming to the full understanding of the formation and the quality of methane hydrates as an exploitable natural resource. Other national actors have also created international consortia, e.g. China (with the participation of Canada, US and Germany), S. Korea (with the participation of Canada and the USA) and India (with the participation of Canada and the US). Their aggressive activity translates into financing of more than several hundred million Euros. The exploitation of methane hydrates on a global scale is estimated to begin in 10-15 years.

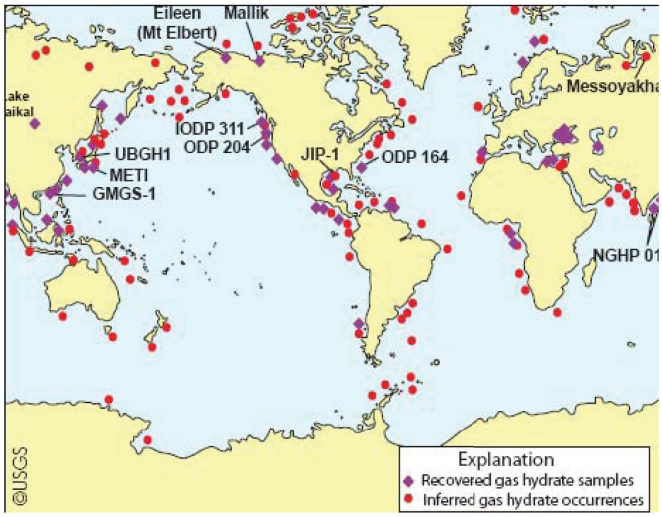

Fig. 2: Global distribution of proven and possibly recoverable gas hydrates (Source: USGS)

1. Ryo Matsumoto, Hitoshi Tomaru Hailong Lu, «Detection and Evaluation of Gas Hydrates in the Eastern Nankai Trough by Geochemical and Geophysical Methods», *Resource Geology* 54 (2004), 53-67.
2. Geological Survey of Canada; *Bulletin* 585, August 2005.

II. The political determination of the USA regarding Methane Hydrate Research

In 2000, the US Government was convinced about the importance of methane hydrates as a future energy resource giving a new R&D boost. With the beginning of the new millennium, hydrate research funding was implemented through the Methane Hydrate Research and Development Act. The legal instruments of US Energy Policy are described in general in the following text, taken from the US Congress:[3]

i. In order to promote energy independence and meet the increasing demand for energy, the United States will require a much diversified portfolio of substantially increased quantity of electricity, natural gas and transportation fuels.

ii. According to the report submitted to Congress by the National Re-search Council (NRC) entitled "Charting the Future of Methane Hydrate Research in the United States" the total United States resources of gas hydrates have been estimated to be on the order of 200.000 trillion cubic feet (TCF).[4]

iii. According to a report by the National Commission on Energy Policy entitled "Ending the Energy Stalemate – A Bipartisan Strategy to meet America's Energy Challenge", the United States may be endowed with over ¼ of the methane hydrate deposits in the world.

iv. According to the Energy Information Administration, a shortfall in natural gas supply from conventional and unconventional sources is expected to occur in or about 2020.

v. The National Academy of Sciences states that methane hydrate may have the potential to alleviate the projected shortfall in natural gas supply.

As can be seen from the above-mentioned extract, the political determination and the relevant financial resources developed a specific dynamic for methane hydrate research. In 2008, the USGS and the Minerals Management Service (MMS) developed new technological tools for the assessment of deposits. Based on new technology, the estimate

3. US Department of Energy: FY 2008, Methane Hydrate Program Report to Congress.

4. Our emphasis. The quantity described is huge, based on existing data and the conventional energy sources of oil and natural gas.

of methane hydrate deposits in the Gulf of Mexico is 21.444 TCF (mean estimate).[5] The USGS also estimates that there are still 85 TCF of methane recoverable hydrates in the Alaska region.[6]

The collaboration of private sector companies (Chevron) and the above-mentioned civil services lead to new discoveries in the Gulf of Mexico. Based on current estimates the new deposits may be the largest methane hydrate re-serves in the world.[7]

III. International collaboration and scientific research

III.1. USA-India

On April 8, 2008, the US signed with India a memorandum of understanding and cooperation for R&D in New Delhi. The scope of this agreement is the understanding of the geological structure, distribution and production of methane hydrates as well as production testing procedures. India will benefit from the US know-how and the US will expand their database of new deposits. Both countries have begun their common efforts in 2010.

III.2 US-S. Korea

On April 18, 2008, the General Secretary of Energy, Mr. Samuel Bodman and the Korean Minister of Economic Affairs Lee-Youn-ho signed a Letter of Intent on the exchange of information regarding the exploration and exploitation of methane hydrates as well as the estimates of these deposits, test production in proposed drilling sites and climate impact of the methane hydrates. South Korea regards methane hydrates as a future energy source that will cover its energy need for 30 years. The US hopes to gain access to new technological tools.

5. http://goo.gl/Qu3kFd.
6. http://goo.gl/sBxlHT.
7. Phaedra Friend, «US Gas Hydrates Find Has Worldwide Implications», June 2009, http://goo.gl/eYoynn.

III.3. US-Japan

In June, 2008 the General Secretary of Energy and the Japanese Minister of Economic Affairs, Trade and Industry Mr. Akira Amari signed a Letter of Intent to collaborate in the field of methane hydrate research. Japan is extremely interested in this new energy resource because of the lack of other conventional energy reserves. This is the reason why Japan has already implemented a successful research project for the exploration of large methane hydrate deposits and successful production tests in the Canadian Arctic. Collaboration with Japan focuses on the acceleration of commercial exploitation based on the already existing scientific results.

China followed the steps of other developed countries, initializing research projects regarding methane hydrates. As of September 2009, China announced the discovery of deposits in the permafrost region of Qinghai-Tibet plateau. This deposit is as important as the oil deposit in Daqing that was discovered 50 years ago.[8]

The EU has already developed research projects regarding the mapping of possible methane hydrates locations. Until now, methane hydrates have been found in the Norwegian Sea, the Barents Sea and in the Eastern Mediterranean. Vast reserves have been found in the Black Sea. However, European countries have not so far developed individual projects aiming at the exploitation of this natural resource.

IV. Methane Hydrates in the Eastern Mediterranean

The Eastern Mediterranean is in a stage of geodynamic evolution due to the interactions between tectonic plates within its geographical boundaries. The Arabic and African plates are moving northwards, colliding with the Aegean-Anatolian plate moving in a SW direction. In this main convergence geological setting (extending from the southwest Peloponnese to Southern Turkey) the main morphological formation is the Mediterranean Ridge. It is a large arc-shaped wedge formation, with a length of 1500 km and a width of 200-250 km.[9]

8. Comment in: http://chinatibet.people.com.cn/6773590.html.

9. See also: Leité and J. Mascle, «Geological structures on the South Cretan con-

As in other cases of active continental margins, a large number of mud volcanoes are observed. Their distribution, morphology, acoustic backscatter intensity and subsurface sediment properties in the Mediterranean Ridge have been analyzed and reported in numerous publications since 1981. These are the only known sedimentary structures associated with methane hydrates in the Eastern Mediterranean. The main question is the correlation of the flow mechanism of methane hydrates through mud volcanic formations and cold seeps. Until today, methane hydrate sites have been found south of Crete and in the Kastellorizo region.[10]

However, the intensity observed in the geodynamics of the Eastern Mediterranean, is not the only factor influenced by the methane hydrates reserves and of other conventional power sources that can be directly exploited. It is also the geopolitical redistribution of power that must be taken into consideration.[11] The existence of reserves in the area of Kastellorizo is another reason meriting bold political decisions and political determination, so as to delineate Greece's Exclusive Economic Zone.[12]

Neglect, on the part of Athens, of this issue will cost dearly as far as matters of sovereignty are concerned, as it will reverse Greece's rights deriving in terms of its EEZ in the region and, therefore, also in borderline sea contact between Greece and Egypt. Lacking the EEZ, this contact will be substituted by Turkey, which has unilaterally drawn its baselines, already, albeit ambiguously, as far as legality is concerned.

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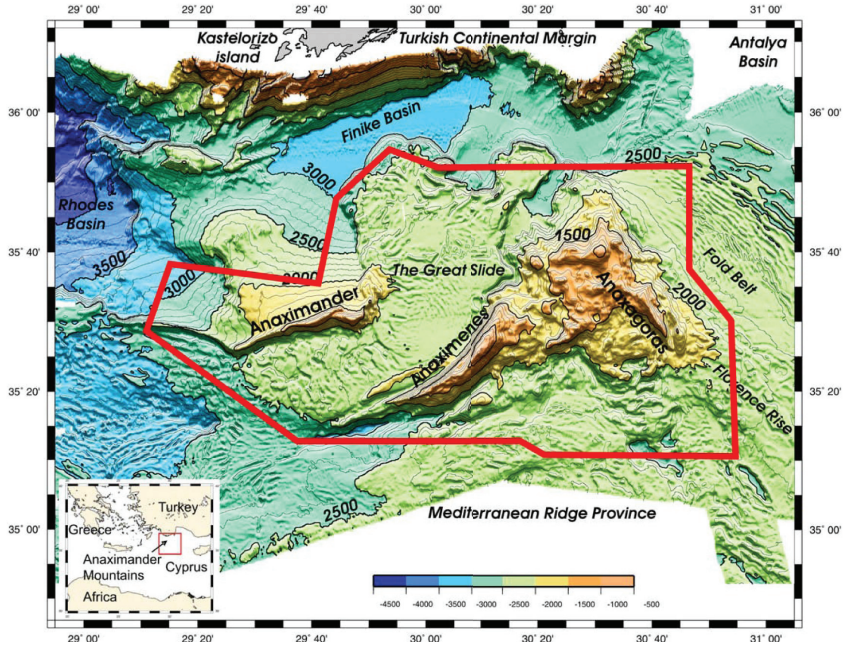
tinental margin and Hellenic Trench (Eastern Mediterranean)», *Mar. Geol.* 49 (1982), 199-223.

10. V. Lykousis, S. Alexandri, J. Woodside, G. de Lange, A. Dählmann, C. Perissoratis, K. Heeschen, Chr. Ioakim, D. Sakellariou, P. Nomikou, G. Rousakis, D. Casas, D. Ballas, G. Ercilla, «Mud volcanoes and gas hydrates in the Anaximander Mountains (Eastern Mediterranean Sea)», *Marine and Petroleum Geology*. 26:6 (2009), 854-872.
11. See also: I. Th. Mazis & G. A. Sgouros, «Geopolitics of Energy in the Kastellorizo-Cyprus-Middle East Complex», *Regional Science Inquiry, The Journal of the Hellenic Association of Regional Scientists* II:2 (12/2010).
12. It is reminded that Greece and Turkey are both signatories to the Protocol of Bern (1976), which has not been denounced by Greece, although its validity has been terminated. The authors believe that the resolution of the subject matter is only feasible through the notion of the EEZ, as delineated in Articles 55–75 of the UNCLOS, since the determination of the continental shelf through the physiography of the islands cannot be determined in a manner acceptable also by the Turkish side.



Map 1: Methane hydrates in the REGION South of Kastellorizo
(Source: Lykousis et al, 2009)

Bibliography

Friend, Phaedra, «US Gas Hydrates Find Has Worldwide Implications», June 2009, http://goo.gl/cx7MAb

Geological Survey of Canada, *Bulletin* 585, August 2005

Leité and J. Mascle, «Geological structures on the South Cretan continental margin and Hellenic Trench (Eastern Mediterranean)», *Mar. Geol.* 49 (1982), 199-223

Lykousis, V., S. Alexandri, J. Woodside, G. de Lange, A. Dählmann, C. Perissoratis, K. Heeschen, Chr. Ioakim, D. Sakellariou, P. Nomikou, G. Rousakis, D. Casas, D. Ballas, G. Ercilla, «Mud volcanoes and gas hydrates in the Anaximander Mountains (Eastern Mediterranean Sea)», *Marine and Petroleum Geology* 26:6 (6/2009), 854-872

Mazis, I. Th. & G. A. Sgouros, «Geopolitics of Energy in the Kastellorizo-Cyprus-Middle East Complex», *Regional Science Inquiry, The Journal of the Hellenic Association of Regional Scientists* II: 2 (12/2010)

Matsumoto, Ryo, Hitoshi Tomaru & Hailong Lu, «Detection and Evaluation of Gas Hydrates in the Eastern Nankai Trough by Geochemical and Geophysical Methods», *Resource Geology* 54 (2004), 53-67