

## STUDY ON THE IMPORTANCE OF NATURAL RESOURCES AT INTERNATIONAL AND NATIONAL LEVEL

**Lecturer PhD. Marian SOCOLIUC**

*Stefan cel Mare University of Suceava, 720229, Romania  
marians@seap.usv.ro*

**Student Gabriela-Paraschiva SAVU**

*Stefan cel Mare University of Suceava, 720229, Romania  
gabriela\_savu10@yahoo.com*

### Abstract

*This paper studies the importance of natural resources in economic survival and development. The global population is always growing, which shows that society becomes even more dependent on natural resources. The purpose of this article is to analyze the situation of oil and gas producing countries as well as their reserves at international and national level. Another purpose of the article is to explore the key fields of exploration by choosing an appropriate resource assessment. The abundance of natural resources promotes economic growth, but dependence on them impedes economic activity. The daily fame of black gold leaves its mark on our lives, due to its use in every aspect of life.*

**Key words:** *black gold; development; fossil energy; fuels; natural resources.*

**JEL Classification:** *M40.*

### I. INTRODUCTION

Natural resources are and will remain an up-to-date topic, because it is the most important source of energy and raw materials that we can not lack, using them unconditionally. Moreover, the "battle" for these non-renewable resources is currently at the level of our country but also internationally and will continue, for decades to come.

The energy of oil has arrived at a peak. Its excess leads to the increase of risks, because the combustion of fuels generates greenhouse gases, which has affected the planet's climate eventually. This danger, still unresolved, masks another one that is more direct and perhaps faster. Once consumed in our cars, the energy dissipates and disintegrates irretrievably in the form of heat. In this way, our limited reserves of fossil energy are consumed with greed and ever increasing.

The natural resources reflect all the mineral and mineral deposits, the cultivable regions, the waters and forests that a certain country has.

Exploration and evaluation of mineral resources „means the search for minerals, including minerals, oil, natural gas and similar non-regenerative resources after which the entity has obtained legal exploration rights in a particular area, as well as determining the technical feasibility and commercial viability of the extraction mineral resources” (Radu, 2014: 84; Cosmulese & Zlati, 2019).

### II. THE SITUATION OF NATURAL RESOURCES INTERNATIONALLY, USA AND SAUDI ARABIA

At international level, the impact of the exploitation of natural resources is a very strong one. The problem of natural resources seems to be global due to the unequal distribution records of these resources, and the competition is getting stronger for the raw materials and the deficient ones.

Oil reserves are unevenly distributed in deposits worldwide, and the European Union is not significantly carrying these resources (only 4.4% of world production is found in the North Sea area, this area being depleted). The cost of a barrel extraction of crude oil in Europe is \$ 7-11, compared to \$ 1-3 in the Middle East area.

The natural gas reserves of the European Union represent only „2% of the worldwide volume, which at the current rate of extraction ensures domestic production for up to 20 years” (Iliş & Gâf-Deac, 2014: 7).

According to the statistics, the ranking of the largest oil producers but also of natural gas was outlined. Due to the increase of oil and natural gas production the classification is structured as follows (see Table 1):

**Table 1. Ranking of oil and natural gas producing countries at present**

No.	Region	Oil production Barrels / day	Region	Gas production m3 / year (billion)
1.	USA	12.000.000	USA	611.0
2.	Russia	11.800.000	Russia	588.9
3.	Saudi Arabia (OPEC)	11.113.710	Canada	159.8
4.	Iraq (OPEC)	4.451.516	Iran	138.5
5.	Iran (OPEC)	3.990.956	Qatar	116.7
6.	China	3.980.650	Norway	106.4
7.	Canada	3.662.694	China	96.8
8.	United Arab Emirates (OPEC)	3.106.077	Saudi Arabia	83.9
9.	Kuwait (OPEC)	2.923.825	Indonesia	82.0
10.	Brazil	2.515.459	Algeria	80.4
11.	Venezuela (OPEC)	2.276.967	Netherlands	70.5
12.	Mexico	2.186.877	Malaysia	66.5
13.	Nigeria	1.999.885	Egypt	61.3
14.	Angola	1.769.615	Uzbekistan	59.1
15.	Norway	1.647.975	UK	57.1

Source: Authors' own processing

*United States* - a leader in the ranking of oil and natural gas producing countries and a very important competitor on the international market. In 2018, oil production increased tremendously, thus exceeding the results achieved by Saudi Arabia and Russia, later ranking as the largest oil producer in the world. The „epicenter of the boom is Texas itself. "More than a quarter of the largest 100 oil reserves in the United States are in Texas, mostly in the Permian Basin of western Texas and in the south-central part of the state" (Awad, 2019).

USA also holds the leading position in natural gas production, followed by Russia with fairly close quantities in the oil industry as well as in the gas sector. The other regions are trying to score significant productions by slightly devastating those in the lead.

According to statistics, the countries that have the most oil and natural gas reserves in the world are structured as follows (see Table 2):

**Table 2. Ranking of the countries with the largest reserves of oil and natural gas**

No.	Region	Oil reserves (barrels)/ billions	Percentage of total	Region	Natural gas reserves/ billions	Percentage of total
1.	Saudi Arabia	264.600	19%	Russia	47.570	25,02%
2.	Canada	175.200	12,58%	Iran	29.600	15,57%
3.	Irak	143.500	12%	Qatar	25.470	13,39%
4.	Iran	137.600	9,88%	Turkmenistan	7.500	3,95%
5.	Kuweit	104.000	7,47%	Saudi Arabia	7.460	3,92%
6.	United Arab Emirates	97.800	7,02%	USA	6.930	6,93%
7.	Venezuela	97.770	7,02%	United Arab Emirates	6.700	6,07%
8.	Russia	74.200	5,33%	Nigeria	5.250	2,76%
9.	Libya	47.000	3,38%	Japan	5.100	2,72%
10.	Nigeria	37.500	2,69%	Venezuela	4.980	2,68%
11.	Kazakhstan	30.000	2,15%	Algeria	4.500	2,37%

12.	Qatar	25.410	1,82%			
13.	China	20.350	1,46%			
14.	USA	19.120	1,37%			
15.	Angola	13.500	0,97%			

Source: Authors' own processing

*Saudi Arabia* - also known as the Kingdom of Saudi Arabia has 19% of the world's oil reserves and ranks as the largest oil exporter. Its oil and gas sector accounts for about 50% of gross domestic product and about 70% of export revenues. „Saudi Arabia's oil reserve is estimated at 315 billion barrels for the upcoming period, and the natural gas reserve is estimated at 47 billion cubic meters” (Badawi, 2018). Saudi Arabia's „production supports the theory of compromise, as it adapts its production strategy to an optimal level of production, in order to meet general policy objectives, such as preserving oil exports and its market share, on the global oil market” (Dagoumas, Perifanis & Polemis, 2018: 273).

In the context of natural gas reserves, „Russia holds the largest reserves with 25.02% of the global total. Most of these reserves are located in Siberia, in three gas fields such as: Yamburg, Urengoy and Medvezhye, representing approximately 45% of Russia's total gas reserves. Significant reserves are also located in northern Russia” (Căpîlnean, 2012).

### III. NATIONAL SITUATION OF THE NATURAL RESOURCES IN THE BLACK SEA BASIN

The axis that favors Romania's territory from an energy point of view is the one of the Black Sea.

The Black Sea is a unique marine environment, representing the largest terrestrial basin in the world. „Its low salinity and the presence of the cold intermediate layer form its circulation properties” (Shapiro, 2019: 303).

It is said that the Black Sea witnessed the external growth of interest and involvement. On the one hand, this could be explained by the „geostrategic importance of the Black Sea as a crossroad of important roads for oil, gas, transport and trade routes, which transformed the region into a key area making it appear and compete between Great powers: Russia, the US and the EU” (Vladova & Knieling, 2014: 45).

The Western Black Sea is considered to be more prone to gas, while the East is dominated by oil. In Romania, marine drilling began in the mid-1970s and since then approximately 100 exploration wells have been drilled. The drilling activity in „Bulgaria began in the mid-1980s and 30 exploration wells were drilled. At the beginning of the 1990s, the Romanian and Bulgarian waters of the Black Sea registered an increasing interest from the international oil companies with the drilling operations carried out further from the coast in deeper waters” (Piccoli, 2017).

The reduction of the old oil fields has made the operators look for new opportunities in previously unexplored areas. „The challenges of these new frontiers and the high cost of drilling rigs usually result in very expensive wells” (Rocha, Arduino & Pereira, 2011).

Recent findings have highlighted the presence of at least two active and efficient oil systems, which cover much of the Black Sea Basin” (Tari & Simmons, 2018: 1).

Through the offshore sector, part of the global production of crude oil and natural gas is registering significant increases according to the production of these resources. „In order to drill to the greatest depths, investments need to be increased to allow technological processes to act” (Stephen, 2015).

The effect of successfully expanding upstream offshore projects would spread to the related sectors (eg, transportation, distribution of natural gas) but also to other industries (for example, petrochemical, chemical and natural gas production), where possible investments of almost 9 billion USD due to the surplus of gas and the economic competitiveness thus created. These investments would lead to the establishment and maintenance of approx. 42,000 jobs by 2040, with an estimated cumulative impact of \$ 18.3 billion on revenue to the state budget, as well as a cumulative surplus of nearly \$ 99 billion in national production of goods and services between 2020 and 2040.

The various activities in the Black Sea have a series of characteristic risks as follows (see Table 3):

**Table 3. Specific risks of some operations in the Black Sea**

No.	Operations performed in the Black Sea
1.	The Black Sea has a difficult topography of the marine relief, significantly complicating the construction of the pipes;
2.	The deep waters of the Black Sea have a high corrosivity, which requires special and expensive technologies;
3.	Certain reserves of the continental shelf are mainly natural gases that have a lower commercial value than oil, although they require investments in exploration, development and production of the same size;

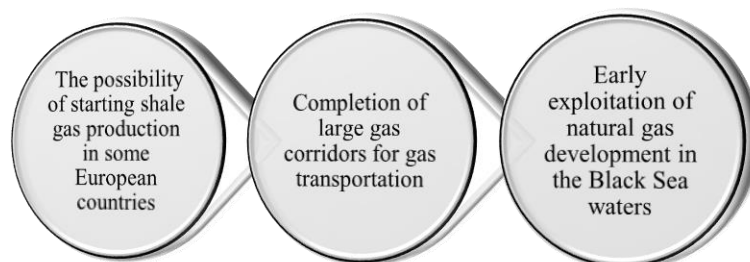
No.	Operations performed in the Black Sea
4.	Lack of natural gas transport infrastructure;
5.	Reduced availability of support services for offshore activities;
6.	Difficult access through the Bosphorus, resulting in high mobilization costs;
7.	Increased geopolitical risk in the region;
8.	The decrease in the oil price affects the calculation of the commercial viability of offshore deposits, despite the decision of the Black Sea operators not to diminish the exploration budgets.

Source: Authors' own processing after: [www2.deloitte.com](http://www2.deloitte.com)F and Deloitte, 2018

From a qualitative point of view, „the natural gas in Romania is comparable, the best exploited in the world, it is very pure, with a high methane content, small quantities of inert gas, all these qualities causing an advantageous use not only for the production of energy., but also for heat treatments, fertilizers, plastics, pharmaceuticals, etc” (Neagu, Bulearcă & Sima, 2015: 288).

Due to its geographical position in the vicinity of large reserves of natural gas and proven oil, the Black Sea region has a triple geostrategic and geo-economic dimension, as a direct source of energy, a major transport corridor for Eurasian energy resources for EU consumers, the emerging area. of the Caspian Sea - Black Sea - Mediterranean Sea and a major factor of energy security for the EU and Romania.

The year 2020 is expected to be a common deadline for achieving several strategic objectives, (see Figure 1):



**Figure 1 - Strategic objectives for 2020**

Source: Author's own work after: Papatulica, 2015: 470

In the view of the orientation of some gas structures from the north and the central area of the Transylvanian Depression, it is permissible to easily identify real constitutive geological models that support the exploration activity. The eastern part of the basin houses gas structures that, besides methane, also contain other gases: CO<sub>2</sub>, N<sub>2</sub>, He.

When the CO<sub>2</sub> concentration exceeds 50-55%, the gas is considered to be non-combustible. „In this basin of Transylvania more than 100 gas structures (the sequence of the post-salifer sedimentary) were detected and the activity of exploring the three blocks (RG01 - North Transylvania, RG02 - South Transylvania and RG03 - South Transylvania) continued with development and exploitation of commercial natural gas fields” (Horhe, 2014).

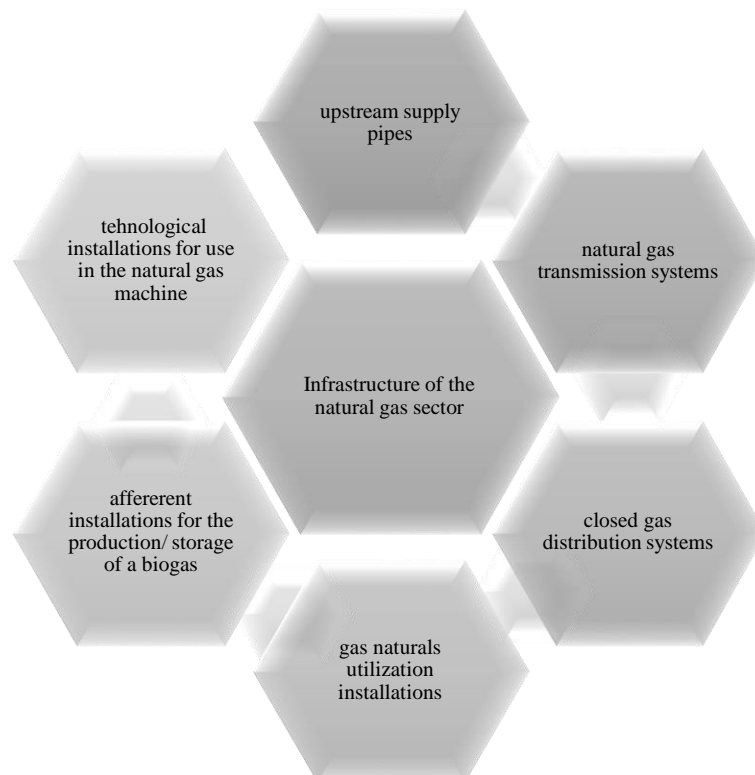
The gas in the Transylvanian basin is largely "microbial", but it also shows indications of a minor thermogenic component that is probably linked to a deep oil system. For the main hydrocarbon areas in Romania, the molecular and isotopic compositions of the gas and the fluxes of methane, ethane and propane in the atmosphere were reported. „The modeling formats of the generation of thermogenic gases and the maturity suggest that most of the Romanian gases come from the mature kerogen type II and III” (Baciu, Ionescu & Etiope, 2018: 130). For high-intensity gas cases, the gas has the same hydrocarbon molecular composition as the

reservoir, while in the weaker areas and in some areas where there are mud volcanoes the gas is modified by molecular fractionation (a loss of C2 and C3).

Romania as a member of the European Union favored the path of liberalization of the natural gas market and of the interconnection of SNT with the transport structures of the neighboring states. „National and international investments in the research and progress of new deposits have strengthened the availability, over a longer period, of natural gas in the Romanian economy” (Iuga & Dudău, 2018: 7).

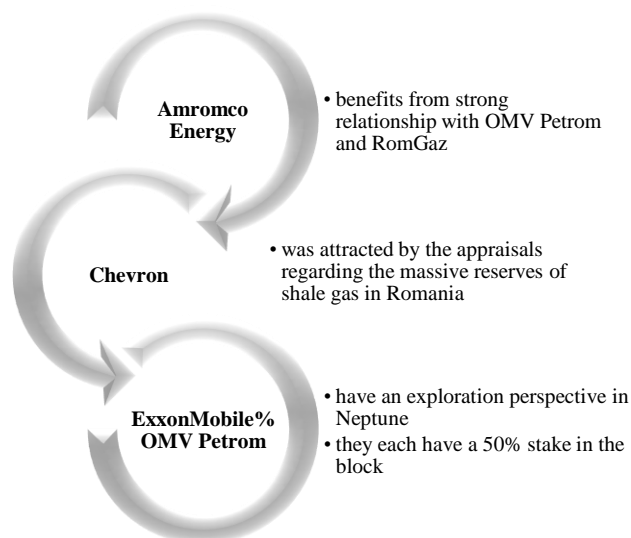
Natural gas is extracted from the basement in a gaseous state as opposed to oil, which can be transported in a liquid state, with a rather high speed and relatively cheap globally. It requires an infrastructure (which is expensive and stable) for pipeline transport or the compression or liquefaction of the extracted gas (with significant energy consumption, with the related infrastructure but with greater adaptability).

The systems that constitute the infrastructure of the natural gas sector can be grouped as follows (see Figure 2):



**Figure 2 - Infrastructure of the natural gas sector**  
Source: Author's own work after: Câmpean, 2011

Romania is committed to liberalizing the energy sector and privatizing the energy sector. To this end, „the country has been privatized by Petrom, which is mainly concerned with information from Austria OMV. There are several international oil products for the upkeep operation in the upstream sector and the positive deployment schedule” (Popescu & Anghelache, 2013). In this sector, Romania has managed to attract the following oil producers and to look in the US (see Figure 3):



**Figure 3 - US oil and gas producers, attracted by Romania**

Source: Authors' own processing

The role of liquid fuels and their contribution to air „pollution and gas emissions have been recognized in EU legislation, which provides for a minimum quality of reduction requirements and objectives for a range of different oil and biological fuels” (Havezov, 2015: 7).

In addition, ports, oil terminals, immediate surroundings and straits are at risk from maritime accidents involving oil-bearing vessels. „In the Gulf of Sevastopol, a major port for the Black Sea navy, oil concentrations were measured more than 100 times higher than the background level” (Stoica, 2017).

The worst form of pollution is the one of the „chemical compounds polluting the soil and degrading its quality. Unlike water and air where the pollutants have the possibility to disperse and dilute easily, in the soil it accumulates very easily” (Laura & Carmen, 2015).

Rapid economic development has led to an increase in serious pollution problems due to the increasing use of oil and its products, which makes controlling oil pollution an urgent task (Cosmulese, 2019). „Studies have shown that in oil-contaminated soils, large quantities of nematodes that feed on bacteria are present; their function is still unclear” (Jihai, Chen & Huang, 2019: 430).

#### IV. CONCLUSIONS

In this paper we have highlighted both the wealth of our country which is at a very high level and the outside areas with a high potential. The exploitation of resources in the Black Sea area is part of an international trend characterized by the development of the share of oil and natural gas from deep deposits in the total production of hydrocarbons, in order to satisfy the growing global demand.

Deepwater hydrocarbon production has expanded in recent years and has been fueled by rising demand, high oil prices, declining production from conventional fields and technological advances.

The evolution of the oil and gas industry is a historical opportunity for Romania, and can contribute to the benefits of energy, economic and social security.

We believe that the implementation of a fair and stable regulatory framework, intelligent and competitive, that will allow the development and production to be carried out, as well as a realistic and comprehensive assessment of the risks faced by the oil projects (which ultimately determines the investment decisions) is a necessity in our country.

In our opinion, the specialized human resources needed to define an optimal oil framework influence the development of companies.

#### V. REFERENCES

1. Awad, B. (2019). *Texas, State Profile and Energy Estimates*. Retrieved October 28, 2018 from: <https://www.eia.gov/state/analysis.php?sid=TX>.

2. Baciu, C., Ionescu, A., Etiope, G. (2018). *Hydrocarbon seeps in Romania: Gas origin and release to the atmosphere*. Published in the Marine and Petroleum Geology, 89 (1), 130-143 Retrieved March 15, 2019 from: <https://www.sciencedirect.com/science/article/abs/pii/S0264817217302222>.
3. Badawi, R.. (2018). *Saudi Arabia Petroleum & Mineral Resources*. Published in the Nova Stars Information Services, Special Communication Systems, Retrieved November 03, 2018 from: <http://www.the-saudi.net/saudi-arabia/oil.htm>.
4. Căpîlnean, S. (2012). *Resursele naturale ca si instrument al Geostrategiei, Cazul Rusiei si al gazului natural*. Bucharest, Romania
5. Câmpean, M. (2011). *Organizația țărilor exportatoare de petrol*, (thesis of doctorate), Babes University - Bolyai, Cluj, Retrieved March 15, 2018 from: [https://doctorat.ubbcluj.ro/sustinerea\\_publica/rezumat/2011/relatii-internationale/Campean\\_Marius\\_RO.pdf](https://doctorat.ubbcluj.ro/sustinerea_publica/rezumat/2011/relatii-internationale/Campean_Marius_RO.pdf).
6. Cosmulese, C. G., Zlati, M.L. (2019), Considerații privind sustenabilitatea și dezvoltarea sustenabilă, International Scientific Student Conference „Prospects Of Accounting Development: The Young Researcher’s View”, 15 March, Chisinau, III Edition.
7. Cosmulese, C.G. (2019). Reflections on Sustainable Development and Durability of Resources, European Journal of Accounting, Finance & Business 9(19).
8. Dagoumas, A., Perifanis, T., Polemis, M. (2018). *An econometric analysis of the Saudi Arabia's crude oil strategy*. Published in the Resources Policy, 59, 265-273, Retrieved November 03, 2018 from: <https://www.sciencedirect.com/science/article/abs/pii/S0301420718302526#!>.
9. Deloitte. (2018). *Contribuția proiectelor de explorare și producție a hidrocarburilor din Marea Neagră la dezvoltarea economiei românești*. Bucharest, Retrieved January 05, 2019 from: [https://www2.deloitte.com/content/dam/Deloitte/ro/Documents/20180424\\_ImpRepRBSTA\\_RO.PDF](https://www2.deloitte.com/content/dam/Deloitte/ro/Documents/20180424_ImpRepRBSTA_RO.PDF).
10. Havezov, K. (2015). *EU fuel quality monitoring*. Published in the European Environment Agency.
11. Horhe, G. (2014). *Geologia Bazinului Transilvania*. Project Paralaxa, Retrieved February 18, 2019 from: <https://www.scribd.com/document/160328892/Geologia-Bazinului-Transilvania-Complet>.
12. Iliăș, N., Gâf-Deac, I. (2014). *Viziuni internaționale și abordarea utilizării resurselor naturale în condiții de suficiență în România*. Sibiu, 7, Retrieved December 10, 2018 from: [https://www.researchgate.net/publication/318725057\\_Viziuni\\_internationale\\_si\\_abordarea\\_utilizarii\\_resurselor\\_naturale\\_in\\_conditii\\_de\\_suficienta\\_in\\_Romania](https://www.researchgate.net/publication/318725057_Viziuni_internationale_si_abordarea_utilizarii_resurselor_naturale_in_conditii_de_suficienta_in_Romania) International\_visions\_on\_the\_use\_of\_natural\_resources\_in\_terms\_of\_sufficiency\_in\_Romania?fbclid=IwAR3gSzPpg7i\_SGNucJrFPInf5O-mmhMI9oYK68VGmhmOQHMRBCNirL9LiE.
13. Iuga, V., Dudău, R. (2018). *Perspectivile gazelor naturale în România și modalități de valorificare superioară a acestora*. Retrieved March 15, 2019 from: <https://www.petroleumclub.ro/downloads/links/Perspective.pdf?>
14. Jihai, Z., Chen, D., Huang, R. (2019). *Effects of bacterial-feeding nematodes on soil microbial activity and the microbial community in oil-contaminated soil*. Published in the Journal of Environmental Management, (234), 424-430, Retrieved April 20, 2019 from: <https://www.sciencedirect.com/science/article/pii/S0301479719300210>.
15. Laura, D., Carmen, P. (2015). *Poluarea cu petrol, bioremedierea și microorganismele implicate în acest proces*. Cluj-Napoca, Retrieved April 06, 2019 from: [http://sppt.ro/wp-content/uploads/2015/03/Rev-PP-nr-83-84\\_4.pdf](http://sppt.ro/wp-content/uploads/2015/03/Rev-PP-nr-83-84_4.pdf).
16. Neagu, C., Bulearcă, M., Sima, C. (2015). *A SWOT analysis of Romanian Extractive Industry and Re-Industrialization Requirements of This Industry*. Published in the Procedia Economics and Finance, 22, 287-295, Retrieved January 05, 2019 from: <https://reader.elsevier.com/reader/sd/pii/S2212567115002889?token=D072E4C44F1BE818E99B1DA0DDA3D46B20311E80831E800FC9692CB641FA8E00211BEC303AD1D40BAE0629E278292153>.
17. Papatulica, M. (2015). *Black Sea Area at the Crossroad of the Biggest Global Energy Players' Interests. The Impact on Romania*. Published in the Procedia Economics and Finance, 22, 470-478, Retrieved February 18, 2019 from: <https://www.sciencedirect.com/science/article/pii/S2212567115002403>.
18. Piccoli, A. (2017). *E%P activity in the Romanian and Bulgarian waters of the Black Sea: Where do we go from here?* Published in the Journal of Energy & Natural Resources Law, Retrieved December 06, 2018 from: <https://ihsmarket.com/research-analysis/ep-activity-in-the-romanian-and-bulgarian-waters-of-the-black-sea-where-do-we-go-from-here.html>.
19. Popescu, G., Anghelache, A. (2013). *Romania's Oil and Gas Market Overview*. Bucharest, Retrieved April 06, 2019 from: [http://files.export.gov/x\\_8022846.pdf](http://files.export.gov/x_8022846.pdf).
20. Radu, B. (2014). *Dependența de resurse naturale- un avantaj sau o povară pentru economia unei țări?* Published in the Transilvanian Journal of Administrative Sciences, 2 (35), 84-97, Retrieved March 12, 2019 from: [https://www.academia.edu/16271120/Dependen%C8%9Ba\\_de\\_resurse\\_naturale\\_un\\_avantaj\\_sau\\_o\\_povara%C4%83\\_pentru\\_economia\\_unei\\_%C8%9B%C4%83ri](https://www.academia.edu/16271120/Dependen%C8%9Ba_de_resurse_naturale_un_avantaj_sau_o_povara%C4%83_pentru_economia_unei_%C8%9B%C4%83ri).
21. Retrieved November 03, 2018 from: [https://www.academia.edu/3201496/Gazul\\_rusesc\\_unealta\\_a\\_Geostrategiei](https://www.academia.edu/3201496/Gazul_rusesc_unealta_a_Geostrategiei).
22. Rocha, L., A., Arduino, E., G., Pereira, M.B. (2011). *Overcoming Black Sea Ultra Deepwater Drilling Challenges*. Published in the Offshore Technology Conference, Retrieved December 06, 2018 from: <https://www.onepetro.org/conference-paper/OTC-21676-MS>.
23. Shapiro, G., I. (2019). *Black Sea Circulation*. Published in the Encyclopedia of Ocean Sciences (Third Edition), 3, 303-317, Retrieved November 15, 2018 from: <https://www.sciencedirect.com/science/article/pii/B9780124095489116033>.
24. Stephan, B. (2015). *Elementele unui regim fiscal optim al sectorului offshore din România*. Published in the Energy Policy Group (EPG), Bucharest, Retrieved December 06, 2018 from: [http://www.ropeca.ro/lib/foto/1436339778EPG\\_Policy-Brief\\_Regimul-fiscal-petrolier-offshore\\_RO.pdf](http://www.ropeca.ro/lib/foto/1436339778EPG_Policy-Brief_Regimul-fiscal-petrolier-offshore_RO.pdf).
25. Stoica, A. (2017). *BSOG to start offshore gas production in 2019*. Published in the Petroleum Industry Review, Retrieved April 06, 2019 from: <http://www.petroleumreview.ro/ro/revista/2017/martie/88-march-2017/1282-bsog-to-start-offshore-gas-production-in-2019>.
26. Tari, G., Simmons, M. (2018). *History of deepwater exploration in the Black Sea and an overview of deepwater petroleum play types*. Published in the Geological Society, London, Special Publications, 464, 439-475, Retrieved December 06, 2018 from: <https://sp.lyellcollection.org/content/464/1/439>.
27. Vladova, G., Knieling, J. (2014). *Potential and challenges for the Black Sea regional cooperation*. Published in the Eastern Journal of European Studies, 5, 39-66, Retrieved November 15, 2018 from: [http://ejes.uaic.ro/articles/EJES2014\\_0501\\_VLA.pdf](http://ejes.uaic.ro/articles/EJES2014_0501_VLA.pdf).