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Risk assessment

OPPORTUNITIES AND RISKS RELATED TO OFFSHORE ACTIVITIES IN THE WESTERN BLACK SEA

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Abstract. This paper presents an assessment of the offshore activity in the western part of the Black Sea basin considering the environment, security, political and economic factors. The environment was analysed through the perspective of wind, wave and geographical features of the basin based on observed and model data. Then, a short overview of the offshore drilling activities was presented followed by a SWOT analysis. The last section of the proposed work analyses the security and geopolitical climate of the region. For every aspect considered in the present paper, its influence on the offshore activity is also stressed. Finally, the paper also provides some directions to be followed for improving the offshore activity in this particular area.

Keywords: offshore, drilling, oil, gas, risk.

AIMS AND BACKGROUND

The global demand for crude oil in 2017 was increased with 1.3% compared with the previous year while the production growth was only 1%. For natural gas, in 2017, the demand growth was 3.2%, while the production growth was 3.6%, both increasing continuously from 2009 (Refs 1 and 2). Considering these figures and ascending trend it can be readily observed that the world is to find new hydrocarbons deposits. Oil and gas companies are 'combing' the planet to find new reservoirs of hydrocarbons alike onshore and offshore. It is known that the water covers almost three-quarters of the Earth surface thus most unexplored reserves are supposed to be located offshore[3].

The Black Sea has proved to possess significant hydrocarbons reservoirs. From this perspective, all the neighbouring states are working to find the optimum solution to bring these hydrocarbons up to surface and further to convey them to refineries or storing facilities.

On the other hand, the exploitation of oil and gas resources in the western part of the Black Sea basin is neither a simple nor a safe task due to some consid-

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erations linked to the Black Sea environment with storms sweeping the area and anoxic waters beyond 200 m depth. The difficult access into the basin through straits passed by bridges increases the cost of moving drilling assets to and from the Black Sea. Also, as regards the environment, the Black Sea is not topographically enough surveyed. From this perspective, developing a transport infrastructure becomes more difficult and costly.

Apart from the environmental features, the geopolitical context is warming up getting potential investors and titleholders concerned about the opportunity of developing a project in this region. Not the last factor affecting the offshore activity is the legal framework in Romania, which is continuously debated and on change.

On the flip part, Romania has a crucial position in the European gas system and its potential is considered for the future development projects of the European gas transport network Due to its tradition in the oil and gas industry, Romania poses the necessary know-how to exploit, transport and industrialise hydrocarbons resources located offshore.

Along with the offshore sector development, an economic benefit is to register as growing GDP and availability of jobs created directly into the sector or triggered within the whole economy.

Global demand as the trend drives the offshore exploitation of hydrocarbons resources is estimated at a rate of growth with 1.6% per year for natural gas and 0.5% for crude oil up to 2040' (Ref. 4).

The Black Sea in general and Romanian economic exclusive zone is the 'ground' for offshore exploratory activities and extraction of crude oil and natural gas.

The Black Sea consists of an enclosed basin delimited by latitudes 40–46°N and longitudes 27–41°E. With an area of 411 540 km^2 and a volume of 555 000 km^3, Black Sea is the third largest European sea. The mean and maximum depths are 1315 and 2258 m, respectively, while the approximately 3400 km of coastline are shared by Bulgaria and Romania to the west, Georgia, Russia, and Ukraine to the north and east, and Turkey to the south[5].

From a geological point of view, the sea is divided into two sub-basins: eastern and western separated by a central ridge[6]. It is assessed that the western sub-basin is more abundant in natural gas while crude oil is dominant within the eastern one[4].

As an energetic approach, the Black Sea is viewed as the most critical energetic area within the region, a real 'new North Sea'[4,7].

The current work analyses the impact of some environment, technical, security and economic factors on offshore activity within the western part of the Black Sea basin.

Drilling offshore overview. Oil and gas companies drill two types of wells: exploratory with the aim of finding new oil and gas deposits and development to prepare discovered deposits for production.

The jack-up rigs are suitable for waters with depths of 20 to 450 feet and (semi)submersibles, and drillships are used for waters with depths up to 13 000 feet[3,8]. Exploratory drilling well is precluded by seismic surveys to identify oil and gas deposits. Upon survey completion, the exploratory drilling lasts between days and months. The rigs are designed to be efficient for the working process and to provide adequate living conditions, but the primary goal of this installation is to remain steady in sea or ocean waters. Platform rigs are built on fixed platforms and remain in position even after completion of the work due to high removal cost, the only advantage being the possibility of reusing the platform for eventual later work in the same position[8].

Submersible rigs are fitted with a floating system that can be flooded and immersed. Semi-submersible rigs are provided with a light pontoon system which can be partially flooded and submerged. This kind of rig is suitable for anchor mooring or dynamically stabilisation (positioning) and operates in waters with depths up to 6000 feet.

Drillships are large ships able to work in waters with depths of 13 000 feet but are not recommended for turbulent waters. They have the advantage of mobility using onboard propulsion systems. Also, a large storage capacity is available and is dynamically positioned.

The offshore well is drilled similarly with its onshore counterpart with the provision of a system which allows drilling fluids to circulate between the surface and seafloor – the riser. The riser can be slightly bent under sea-induced motion.

Effective cutting of seafloor soil is realised by the drill bit situated at the end of a drill string consisting of a system of pipes and other specific tools connected and having specific functional roles[8].

The sections of string – collars add weight and stability to the drill bit meanwhile drilling fluids acts as lubricants and have the ability to transport the cuttings of drilled material from the seafloor to surface.

Regarding the use of drilling fluids, it is to be observed that some elements composing drilling mud are harmful to the marine environment thus effective measures are to be enforced to prevent drilling fluids from contaminating marine environment[9,10].

The string is hydraulically tensed to prevent rig motion transmission to the bit, and as the string advance to the seafloor, a Blowout preventer (BOP) is fitted to prevent oil or gas eruption even though drilling fluids serve as a first blowout preventer.

The drilling process is carried out in more stages. Firstly, a hole of 18″ diameter is drilled from several hundred to several thousands of feet, the string is removed, and the hole is fitted with a casing array and sealed (cemented). A new section of the hole of 12″ diameter is screwed concluding with an 8″ diameter hole or bottom

hole. After completion of the hole, an expanding device is sent down the hole to seal the whole assembly.

It is necessary to mention some considerations about the cementing job. This process is meant to provide structural support and hydraulically seal the assembly. Inadequate cement selection, temperature, and work discipline result in fluids leaks, the inappropriate structural resistance, and even catastrophic accidents[3].

EXPERIMENTAL

Impact of environmental factors on offshore drilling activities. The environment can pose a significant impact on offshore activities as wind and wave can quickly shut down the activity or produce significant damages to drilling equipment. The bathymetry and composition of the seafloor can increase the costs of exploitation.

Bathymetry. Shallow waters characterise the western part of the Black Sea; the depths reach 100 m at 126 nm Sulina and 75 nm at Tuzla[6]. These values of water depths are facilitating offshore activities as the cost, and the pressure of water column on drilling equipment is reduced.

Being a semi-enclosed sea and communicating with the Mediterranean Sea by Bosporus and Dardanelles straits it is difficult for high structures as a drilling platform to pass under bridges connecting the banks of straits. It is known that bridges connecting Europe with Asia above Bosporus have the height above water of 64 m. The difficulties posed by straits passage lead to the increased cost of bringing the platform into the Black Sea from another area as high components of the platform have to be removed and remounted after getting into the Black Sea.

Wind and wave. Due to its location, the Black Sea climate is influenced by continental air masses, polar air coming from the north and northeast and tropical air masses coming from the southwest (Mediterranean Sea basin area). Short-term climatic patterns within the Black Sea basin are also affected by North Atlantic Oscillation (NAO) and El Niño-Southern Oscillation (ENSO) by reducing the strength of polar masses during winter season[11].

The influence of wind on drilling operations must be considered an influence on all assets implied in drilling and auxiliary fleet and systems serving the rigs. Oil and gas companies have auxiliary fleets consisting of tankers, crew shuttle ships, helicopters, etc.

If a platform usually operates up to wind speed of 50 knots (25.72 m/s) (Ref. 12) for the auxiliary fleet, wind speeds exceeding 13.8 m/s (7 on the Beaufort scale) are considered unsafe for marine navigation, waves with a height exceeding 4 m being generated[13].

Table 1. Values of gust wind speed measured during 01.10.2008–30.09.2018 (Ref. 14)

Station	0–13 (m/s)	14–26 (m/s)	>27 (m/s)
Sulina	92.51	7.46	0.03
Gura Portitei	96.57	3.43	0
Constanta	98.56	1.44	0
Mangalia	98.34	1.66	0

From Table 1, we found out that values observed at Gura Portitei, Constanţa and Mangalia within the period, never exceeded 26 m/s, this is because of high buildings usually obscure meteorological stations.

It is to mention that wind speed values in the open sea are higher than values measured at littoral meteorological stations.

Table 1, referring to values of gust wind speed, was split into 3 categories corresponding with the operational state of drilling assets and auxiliary fleet serving the platforms: 0–13 m/s – both, drilling platforms and auxiliary fleets are operating, 14–26 m/s – only drilling platforms are operating, >27 m/s – neither drilling platforms nor auxiliary fleets are operating.

Actual drilling platforms can operate at a wave height of 9.1 m, and they remain in a safe condition during storms up to 11.9 m.

In Fig. 1 can be observed the array of maximum values of height obtained from an adapted Significant WAve Nearshore model for a time span of 30 years[5,15–19]. It can be noticed that values above the operating conditions cannot be found near Romanian economic exclusive zone thus wave impact can be associated with auxiliary fleet operations that can be shut down by wave height above 4 m.

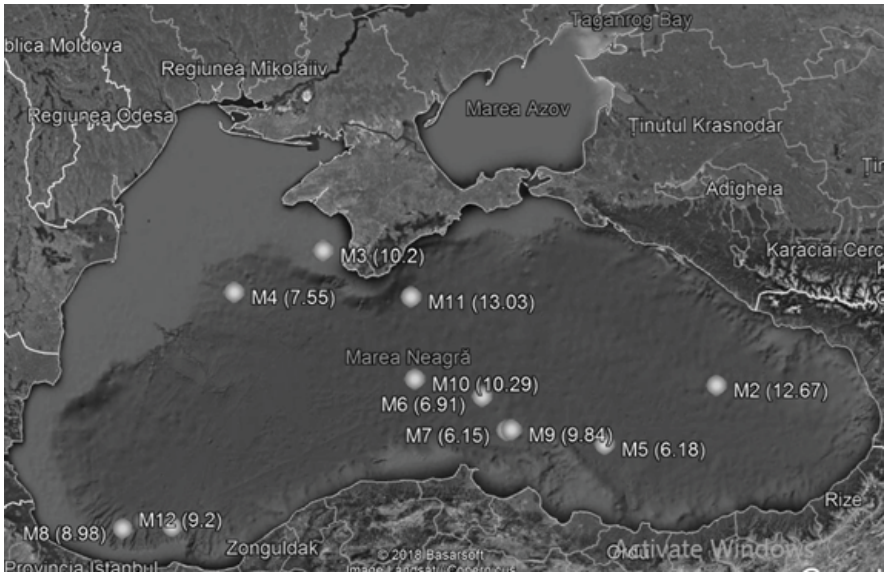

Fig. 1. Maximum values of the significant wave height (m) during 1987–2016 (Ref. 5)

RESULTS AND DISCUSSION

Offshore exploration and recent discoveries. Romania is one of the oldest oil and gas producers in the world. In 1975 the first offshore drilling platform was set up, and offshore oil production started in 1987. From 1987 to 2012 only shallow water extraction was registered while in 2012, within the perimeter DOMINO 1 was discovered the first deepwater gas deposit of 42 to 84 billion m^3.

Romanian offshore exploitable area is approximately 22 000 km^2 in some points deeper than 1000 m. This area is split into perimeters of different sizes most of them being exploited and explored by titleholders[20].

XVIII Istria block holds the oldest discoveries with 185 million barrels of oil and 48 billion m^3 of gas. Within the block Lebada East field started the production in 1987, Lebada West in 1993, Sinoe in 1999, Pescarus in 2003 and Delta in 2009.

XV Midia A block had two essential discoveries, Doina (1995) and Ana (2008), together have an estimated potential of 9.5 billion m^3 of gas and expected exploitation start in 2020. EX-27 Muridava with possible quantities of 4.85 billion m^3 of gas and 11.7 million barrels of oil.

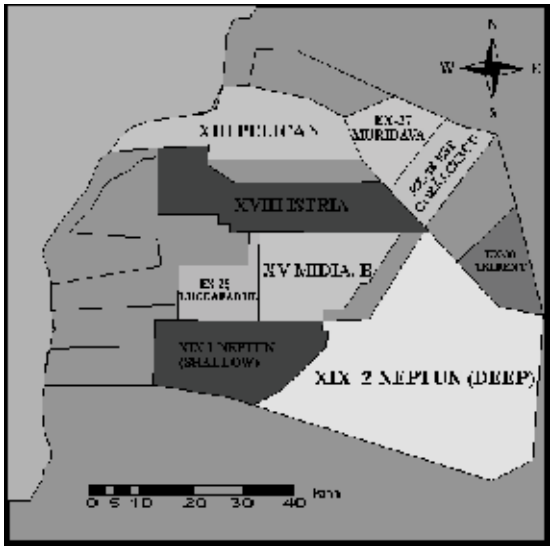

Fig. 2. Black Sea exploration, development and exploitation perimeters[20]

Table 2. Romanian Black Sea blocks and titleholders quota

Block	Titleholder	Quota (%)
XII Pelican	Black Sea Oil & Gas S.R.L.	65
XV Midia, B	Petro Ventures Resources S.R.L.	20
	Gas Plus International B.V.	15
XVIII Istria	OMV Petrom S.A.	100
XIX 1 Neptun (Shallow)		
EX-25 Luceafărul	Petro Ventures Resources S.R.L.	50
	Black Sea Oil & Gas S.R.L.	50
XIX 2 Neptun (Deep)	Exxonmobil Exploration & Production Romania LTD.	50
	OMV Petrom S.A.	50
EX-27 Muridava	S.C. Petromar Resources B.V.	80
	S.C. Petromar Resources S.A.	20
EX-28 Est Cobălcescu	S.C. Petromar Resources B.V.	70
	S.C. Petromar Resources S.A.	30
EX-30 Trident	Lukoil Overseas Atash B.V.	88
	SNGN Romgaz S.A.	12

EX-28 East Cobalcescu, EX-28 East Rapsodia, and XV Midia B blocks until now are not economically feasible for exploitation.

Further discoveries were made in 2012 – XIX 2 Neptun (deep) up to 84 billion m^3 of gas, 2014 – XVIII Istria block potential of 2000 barrels oil equivalent per day and 2015 – EX-30 Trident with 30 billion m^3.

Western Black Sea offshore activity – Strengths, Weaknesses, Opportunities, Threats (*SWOT*) *analysis*

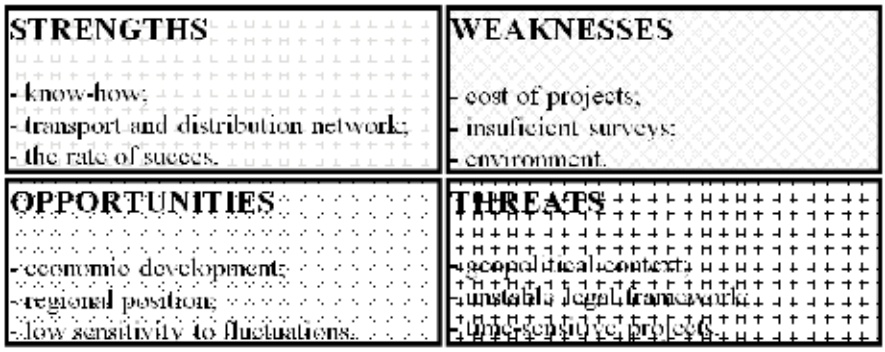

Fig. 3. Offshore activity – SWOT analysis according to the studies performed at the National Institute for Marine Research Grigore Antipa Constanta

STRENGTHS

● *know-how* – due to its early entry in this field, starting with 1857, Romania gain experience and built know-how in this sector, nowadays offshore production represent 8% from domestic production;

● *transport and distribution network* – Romania has an extended over the whole country network of gas transmission, and the offshore component is currently under development, only Black Sea Oil and Gas has a project of building 121 km offshore pipes, currently under public debate regarding environment impact[19,20];

● *the rate of success* – the success rate of Romanian offshore exploratory boreholes was 20–25%. This rate can be judged as low or risky but compared with the 0 rates of success for Turkey or Bulgaria, Romanian offshore potential can be seen as optimistic[4].

WEAKNESSES

● *costs of projects* – the cost for a single exploratory borehole drilled estimated between 150 and 250 million USD, but it is well known British Petroleum Pitanga project which swallows 850 million USD and afterward abandoned;

● *insufficient surveys* – due to insufficient surveys, the topography of the Black Sea bottom is not enough known, this aspect correlated with the instability of seabed can lead to a complicated itinerary of the piping system;

● *environment* – as already presented at environment chapter, storminess potential of the Black Sea is not so high, but storms which can damage the offshore installations are likely to occur. At depths below 200 m, H_2S is present and due to its corrosive effect on pipes and equipment increase the costs of operations[4,5].

OPPORTUNITIES

● *economic development* – it is assessed that every USD spent in offshore projects generate 3 USD in national GDP and every job created and maintained within the offshore area sustain 43 jobs in Romanian economy[20];

● *regional position* – just exploiting the Black Sea confirmed oil and gas resources, the Black Sea basin could become one of the most significant gases producing within the European Union. Besides its actual position within central and eastern European gas transport system, there is a possibility of connection with west European system and Caspian region or Middle East resources;

● *low sensitivity to fluctuations* – generally, an offshore project is characterised by a long period of execution which attenuates short-term fluctuations of oil and gas prices compared with onshore projects.

THREATS

● *geopolitical context* – recent events from Crimea and south-east of Ukraine, tensioned relations NATO – Russia and antagonistic relations between Turkey

and its allies are reflected in a negative geopolitical perception of titleholders or potential investors;

● *unstable legal framework* – well known offshore law is highly debated and amended leading to a climate of instability and unpredictability for potential investors and titleholders.

● *time-sensitive projects* – in offshore projects almost 80% from drilling and completion cost are time sensitive thus oil and gas companies seek methods to shorten the time for delivery to reduce projects costs.

CONCLUSIONS

The Romanian exploitable area has an optimistic rate of success of exploratory drillings comparable with the average of common productive offshore areas. Furthermore, an important issue that has to be taken into consideration in the near future also in the Black Sea basin is the renewable energy extraction in the marine environment. Besides producing energy, such a solution can be considered also for coastal protection.

As a way ahead to improve the offshore activity, it is necessary to provide a stable legal framework and with a fair repartition of benefits between state and investors. Regarding the geopolitical context, a joint effort for neighbour states, EU, NATO, Russia and other states with political and financial influence over the region, is to improve security climate in the Black Sea basin.

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