

## New conventional oil and gas discoveries

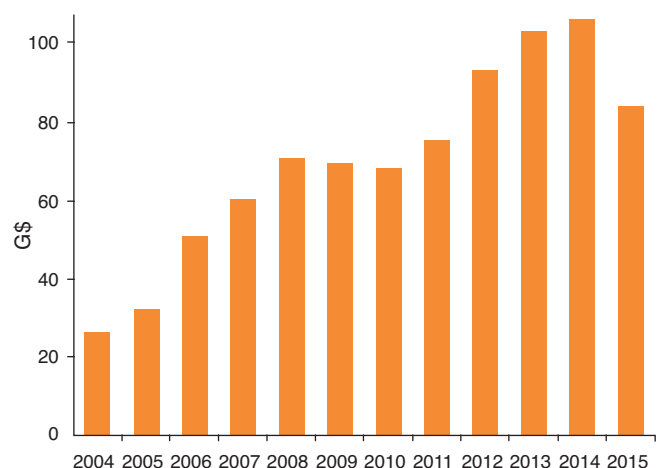
Following a decline in 2014, spending on exploration is expected to drop by more than 20% in 2015, a clear shift from the consistently upward trend observed for over ten years, with the exception of a slight dip in 2009 and 2010. On the other hand, there is no expectation that the downward trend in volumes discovered will reverse itself, having fallen every year for the past five years despite a sharp rise in exploration budgets between 2010 and 2014. Notwithstanding, this overall decline in exploration performance worldwide has been accompanied by some spectacular successes, such as the two massive Pobeda discoveries in the Kara Sea in 2014, and the 2015 Zohr discovery in Egyptian offshore waters.

This note mainly concerns discoveries made using conventional exploration methods. Except for certain notable discoveries, source-rock hydrocarbons and tight formations, which are behind the strong growth of production in the United States, are not covered here. Discoveries made in these fields are not usually announced by the companies, except on initial exploration in a new province. Once the formation is in operation, the reserves are constantly reassessed and increase with each new well, but this does not constitute a discovery in the strict sense of the term.

### Modest rise in spending on exploration in 2014, sharp decline expected in 2015

Spending on exploration and assessment rose by approximately 3% in 2014 and are expected to fall by more than 20% this year, a clear break from the solid upward trend observed since 2010 (Fig. 1a). Between 2010 and 2013, investment in exploration and assessment rose by over 50% while, on the contrary, volumes discovered each year declined by a comparable amount (-56% in 2013 compared with 2010).

Fig. 1a – Trends in spending on exploration

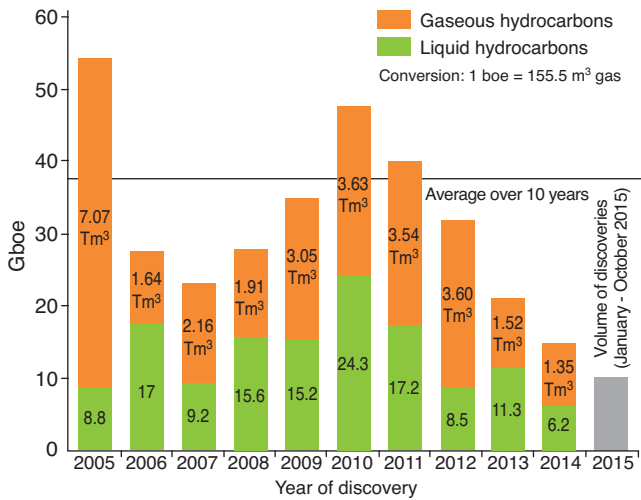


Source: IFPEN

This downward trend in volumes discovered since 2010 can be explained by the lack of new discoveries on the scale of those in South Iolotan in Turkmenistan (2005), the Brazilian pre-salt layer (from 2006) or the Rovuma basin in Mozambique and Tanzania (from 2010). The initial estimates for 2014 are close to 15 billion barrels of oil

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Fig. 1b – Estimated discoveries between 2004 and 2014



Source: IFPEN according to Wood Mackenzie

equivalent (Gboe), down by nearly 30% compared with the previous year (Fig. 1b). These are only preliminary estimates, which will most likely be revised upward in the coming months. When compared to estimates made one year ago for 2013, the decline is no more than 12%. Exploration activities have been weak in 2015, as it was in 2014 in the Brazilian pre-salt layer and in Mozambique (no exploration wells in 2015), where the most prolific basins in recent years are located. In both cases, operators are focused on assessing and developing previous discoveries. In East Africa, exploration activities have shifted to Tanzania, where average volume per discovery is below that of neighboring Mozambique.

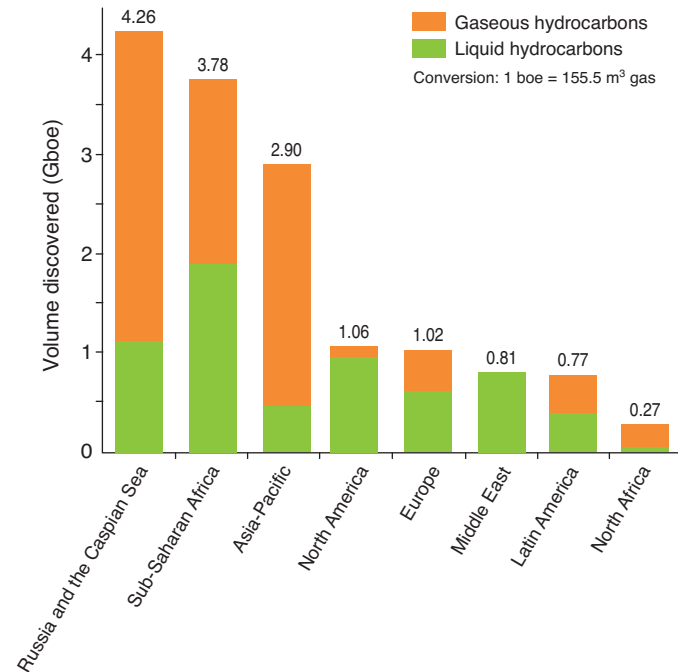
### Review of the main discoveries of 2014

Approximately 15Gboe was discovered in 2014 (Fig.3 and Tab. 1), a figure two times lower than the average of the previous ten years, and the worst performance for conventional exploration since 1995 (Fig. 2). Sub-Saharan Africa, which was the most prolific region in 2012 and 2013, was ranked second behind the Russia-Caspian Sea region, which represented 30% of volumes discovered in 2014 thanks to the massive Pobeda discovery in the Kara Sea. This discovery contains nearly all of the volume discovered in this region, and alone represents over one-quarter of the volume discovered in 2014.

Sub-Saharan Africa remains prolific, however, with five of the ten largest discoveries for the year despite discovered volumes 40% lower than in 2013. East Africa has declined compared with previous years, with a little less than 1,000 Mboe discovered in Tanzania, Mozambique and

Kenya. In West Africa, 700 Mb of oil were discovered in the Bové basin of Senegal and Mauritania, signaling the opening of a new oil-producing province. The Kwanza basin in Angola affirmed its oil-producing potential with nearly 600 Mboe discovered (mainly condensates). Two-thirds of this volume was contained within the Orca discovery, the year's 4th largest. Significant volume was also found off the Congolese coast with the Minsala Marine discovery (the year's 5th largest), along with the smaller Lidongo Marine discovery, while in the Ivory Coast, the Saphir discovery was the first made within the San Pedro basin.

Fig. 2 – Volumes discovered by geographic region in 2014

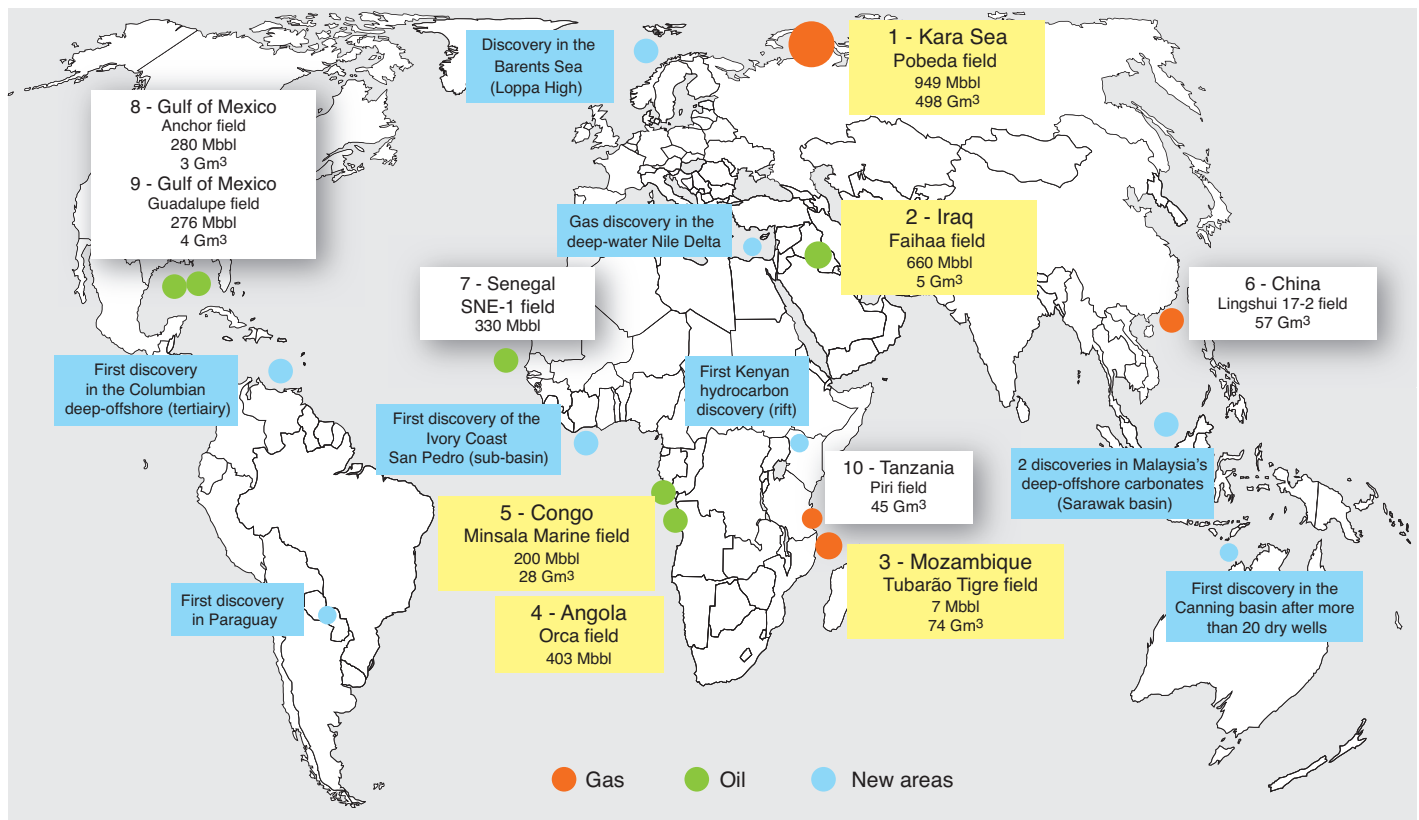


Source: IFPEN according to Wood Mackenzie

The Asia-Pacific region posted performance similar to the previous year. With approximately 2,900 Mboe discovered — 20% of the worldwide total — the region ranks 3rd in terms of volume discovered in 2014. Malaysia has 38% of the region's discoveries by volume, with more than 20 successes (including four discoveries in excess of 100 Mboe), uncovering slightly over 1 Gboe in new resources. China reported 15 discoveries totaling nearly 700 Mboe, including the Qiongdongnan discovery, the 6th largest of the year in size (57 Gm³ of gas, i.e. 340 Mboe). Australia stood out with a number of significant discoveries (21 announcements listed), generally modest in size (averaging 20 Mboe), except for the Lasseter discovery, the world's 11th largest in 2014 (280 Mboe). Lastly, Indonesia reported a significant discovery (Merakes: 220 Mboe).

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Fig. 3 – The ten main discoveries of 2014 and new frontier basins



Source: Wood Mackenzie

Table 1  
The ten main discoveries of 2014

	Country	Basins	Field	Oil/condensats (Mbbl)	Gas (Gm³)	Total (Mboe)
1	Russia	Kara Sea	Pobeda	949	498	3,937
2	Iraq	Widyan	Faihaa	660	5	692
3	Mozambique	Rovuma	Tubarão Tigre	7	74	451
4	Angola	Kwanza	Orca	403	0	403
5	Congo	Bas Congo	Minsala Marine	200	28	370
6	China	Qiongdongnan	Lingshui 17-2	0	57	340
7	Senegal	Bové	SNE	330	0	330
8	United States	Gulf of Mexico	Anchor	280	3	299
9	United States	Gulf of Mexico	Guadalupe	276	4	299
10	Tanzania	Coastal basin	Piri	0	45	272

Source: Wood Mackenzie

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In the Middle East, Kuwait Energy made the year's largest discovery with the Faihaa-1 well in Iraq. In the United States, two discoveries made by Chevron in the Gulf of Mexico ranked among the year's ten largest. The Orca gas discovery in Columbia (42 Gm<sup>3</sup>, i.e. approximately 250 Mboe) was the largest in Latin America during 2014. It was also the 1st discovery made in Columbia's deep-offshore waters which could herald future success for exploration in the Caribbean Sea. Other significant discoveries should be noted, including the Alta discovery in the Norwegian Barents Sea, estimated by Lundin to contain between 125 and 400 Mboe with assessment through additional bore-holes, and the Notus discovery in the Nile Delta which, with approximately 240 Mboe in gas and condensates, was North Africa's largest discovery in 2014 (Fig. 4).

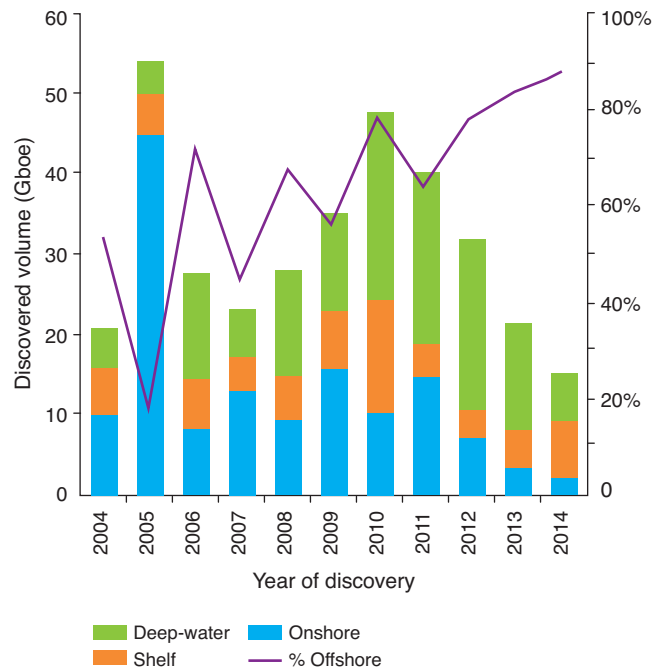
Offshore discoveries, at all depths, represented 88% of discoveries during 2014, continuing an upward trend over the past several years.

### Main trends in 2015

As of December 14, 2015, we have identified 133 announced discoveries in 43 countries, down by more than 30% compared with the previous year. Estimated discovered volume declined in by the same amount (though these figures are likely to change). This reflects declining exploration budgets as well as a downward trend in volumes discovered per dollar spent, which has been observed since 2010. North Africa led the pack in terms of discovered volume thanks to the massive Zohr discovery in Egypt. Sub-Saharan Africa ranked 2nd, with large discoveries mainly in Mauritania, as well as in Tanzania and the Congo.

The most successful exploration in 2015, both in term of discovered volume and its regional impact, was undoubtedly ENI's discovery of the Zohr field. With estimates of gas in situ of 850 Gm<sup>3</sup> (5,100 Mboe), it is the largest discovery to date in the Mediterranean. Following discoveries by BP — Salamat (45 Gm<sup>3</sup>) in 2012 and Atoll (40 Gm<sup>3</sup>) in 2015 — and by BG Group — Notus (40 Gm<sup>3</sup>) in 2014 — Zohr caps off a series of recent successes in offshore Egyptian waters. This discovery could be a game-changer in the Mediterranean by making Egypt gas-independent, and even allowing to resume its position as a net exporter. Existing infrastructure and the presence of a growing Egyptian market makes it possible to quickly develop the deposit, which is expected to start production in 2018. The development of Zohr could also slow down other discoveries in the Levant basin, particularly Leviathan in Israel and Aphrodite in Cyprus. In addition to other

Fig. 4 – Change in type of discovery since 2004



Source: IFPEN according to Wood Mackenzie

regional issues, ENI may need to make trade-offs between the Zohr development its other massive discoveries in Mozambique.

In sub-Saharan Africa, Kosmos made two important gas discoveries in Mauritania's ultra-deep offshore waters: Tortue (estimated between 140 and 340 Gm<sup>3</sup>) which could extend to neighboring Senegal and Marsouin (at least 140 Gm<sup>3</sup>). However, these discoveries will be difficult to develop due to a lack of infrastructure and the absence of a sufficient domestic market. In Congo-Brazzaville, ENI achieved a string of successes in the Marine 12 block. After the oil discoveries at Nene Marine (700 Mboe in place) in 2013, and at Minsala Marine last year (1,000 Mboe in place), the Nkala Marine well led to the discovery in November 2015 of between 250 and 350 Mboe of condensate gas, the 7th largest discovery of the year. Exploration in other sub-Saharan African countries led to somewhat disappointing results, with the exception of the Mdalasini-1 gas discovery in Tanzania (between 28 and 50 Gm<sup>3</sup> of gas), the only offshore discovery in East Africa during 2015. These poor results are directly linked to declining exploration in the Rovuma basin and the coastal basin of Mozambique and Tanzania, with only two wells (one for assessment) drilled in Tanzania, and none in Mozambique. Between 2012 and 2014, between 11 and 15 exploration wells were drilled each year in these two basins (Tab. 2).

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Table 2  
The ten main discoveries of 2015

	Country	Basins	Fields	Types	Volume (Mboe)
1	Egypt	Levant	Zohr-1	Gas	5,100
2	Mauritania	Senegal-Mauritania	Tortue-1	Gas	852-2,040
3	Mauritania	Senegal-Mauritania	Marsouin-1	Gas	850+
4	China	Ordos	Changqing	Shale oil	730
5	United States	Gulf of Mexico	Sicity	Oil and gas	300-400
6	Congo	Congo basin	Nkala Marine	Gas and condensates	250-350
7	Tanzania	Coastal basin	Mdaldasini-1	Gas	170-306
8	Guyana	Guyana	Liza-1	Oil	250
9	Egypt	Nile Delta	Atoll-1	Gas	230
10	Romania	Black sea	Lira-1	Gas	180

Source: Wood Mackenzie

Other noteworthy facts:

- the Asia-Oceania region led the way in number of discoveries, with 46 recorded successes. Most of these discoveries were small, but China stood out with CNPC's discovery of a significant deposit of tight oil, with more than 700 Mboe contained in the Ordos basin of Shaanxi province. This discovery was the 4th largest in 2015. The Australian company Santos discovered 15 Gm<sup>3</sup> of gas in Malaysia. In Australia, 23 discovery announcements were listed, including a significant discovery announced by Chevron in the Carnarvon basin;
- in the United States, Chevron announced a significant discovery in the Sicity prospect in deep-offshore waters of the Gulf of Mexico. This deposit, which could contain between 300 and 400 Mboe, will be costly to develop given its great depth (2,000 meters of water and total depth of 9,000 meters) and its distance from existing infrastructure, the closest of which is located 100 km away. In the same area, Shell confirmed the potential of the Kaikias field, which exceeds 100 Mboe. Permex announced four discoveries in Mexico totaling 350 Mboe;
- in Latin America, ExxonMobil announced the discovery of 250 Mb of oil in Guyana (the year's 8th largest discovery), Ecopetrol revealed 180 Mboe in Columbian offshore waters and in Bolivia, the national company YFPF made its first oil discovery in 23 years;
- Lukoil's discovery in Romania (30 Gm<sup>3</sup> of gas) confirms the potential of deep offshore waters in the Black Sea, following the Domino discovery (85 Gm<sup>3</sup>) by ExxonMobil in 2012. Three exploration wells were drilled in the area, of which two resulted in a discovery. According to the consultant Wood Mackenzie, volumes already discovered could allow Romania to double its gas production and become a gas exporter after 2020. Also in Europe, 19 discoveries were listed in Norway with total volume exceeding 200 Mboe. More than one-half of this volume (approximately 140 Mboe) come from three discoveries in the Aasta field, allowing it to increase its reserves by one-third;
- in the Middle East, with two exploration wells, the US company Genie Energy may have identified a 350 meter thick layer containing oil. The area may hold several billion barrels of oil, but it is still too soon to have a reliable estimate of volume, whose commercial possibilities have not yet been proven.

### Conclusion

The 2010-2014 period was characterized by a steady rise in spending on exploration, accompanied by an equivalent decline in discovered volumes. This has led to an explosive increase in cost per discovered boe, which has increased threefold over this period. These trends are clearly unsustainable. Throughout 2015, exploration has naturally been impacted by the sudden collapse of

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Fig. 5 – Number of discoveries announced in 2015 (as of 14 December) by country



Source: IFPEN

oil prices, but streamlining was inevitable in the face of declining performance during the preceding years (Fig. 5). Operators are focusing greater attention on the assessment and development of previously-identified pools. The decline in exploration of the most prolific basins has logically resulted in fewer new discoveries in terms of number and volume. Exploration also tended to focus on areas close to existing infrastructure, which allowed faster development of discovered volumes, but where the likelihood of a major discovery is lower. Despite results that have declined worldwide when compared with 2014, 2015 nevertheless had a number of

notable successes, the first of which was the Zohr gas discovery in Egyptian offshore waters, which offers the key advantage of rapid monetization due to the proximity of existing infrastructure and rapidly growing local demand.

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