

# Discoveries lead to prospecting

*Offshore opportunities abound from Benin to Sierra Leone.*

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When the Kosmos/Tullow/Anadarko group made the **Mahogany** and **Hyedua** discoveries offshore Ghana last summer, the transform margin that stretches from Benin to Sierra Leone became a more prospective region for West African explorers. After appraisal, the discoveries were confirmed as both belonging to the same large Santonian fan, now christened the **Jubilee** field. There are several untested features neighboring the field, which lies in water depths between 3,280 and 6,560 ft (1,000 and 2,000 m). Ghana celebrated its 50th anniversary of independence with the discovery — the largest in offshore Africa for sometime.

**Overview**

Prior to the Jubilee discovery, there had been good evidence of a decent petroleum system along this margin. It started with the **Mamou** Tar Sands in southeast Benin, first reported in 1900, with estimated reserves of up to 3 Bboe. Offshore Benin, there were the **Aje**

(200 million bbl) and **Seme** (80 million bbl) fields, discovered in 1968 and 1975, respectively. Moving westward along the coast, the **Lomé** field (80 million bbl) offshore Togo, discovered in 1980, flowed 432 b/d of 44° API oil. Further west offshore Ghana, similar discoveries were made with the **Saltpond** field (20 million bbl) and the **North** and **South Tano** fields (250 million bbl). West of that, in neighboring Côte d'Ivoire, a further cluster of fields (**Espoir**, **Foxtrot**, **Lion**, **Panthere**, etc.) and discoveries dating back to 1980 confirmed a significant petroleum system that is bringing the Ivorian production close to 100,000 b/d.

The eastern portion of the region is shown in Figure 1. Heading clockwise/northwest along the coast, neither Liberia nor Sierra Leone has seen any exploration drilling for almost 20 years because of long and bloody civil wars. Before the conflicts, nine wells were drilled in shallow water. Seven had shows, and all showed significant reservoir presence; extensive geochemical work indicates that the main prospective zone lies further offshore in water depths between 3,280 and 4,922 ft (1,000 and 1,500 m). Figures 2 and 3 show the offshore blocks of Liberia and Sierra Leone.

**Opportunities**

In Benin, there is a mixture of opportunities from the onshore to ultra-deep water. Undeterred by the disappointing **Sota-1** well in offshore **Block 4**, a geographically diverse contingent of companies has been awarded offshore and onshore blocks.

Farm-in opportunities are available in the two onshore blocks awarded separately to Moncreif (Nigeria) and DGS (Canada), where the targets will most likely be stratigraphic traps up-dip from the Seme and Aje fields. The expected accumulations may not be giants, but the drilling costs will be low. Previous onshore exploration has been limited to a regional gravity survey (1987-88), an aeromagnetic survey (1989), and a seismic survey of 60 miles (100 km, 1991). Additional seismic is required to investigate some of the gravity and magnetic anomalies. There are several open blocks on offer in the ultra-deep water and one farm-in possibility to assist in the seismic commitment in **Block 6** for Crownwell Petroleum (Nigeria).

The narrow offshore of Togo contains two blocks. Oranto has signed up to explore inshore **Block 1**, which covers 579 sq miles (1,500 sq km) out to a water depth of 1,640 ft (500 m) and includes the Lomé-1 discovery well. After

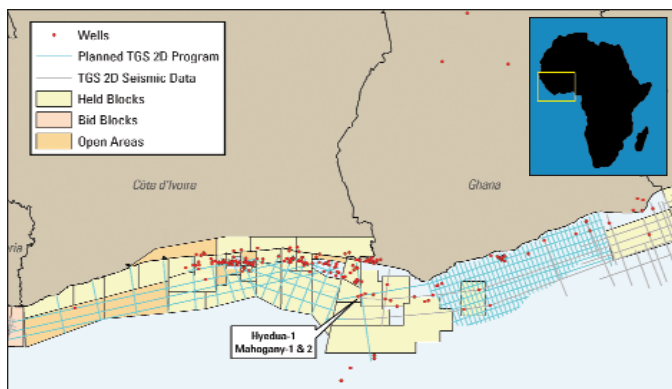


Figure 1. Benin to Côte d'Ivoire. (Images courtesy of TGS)

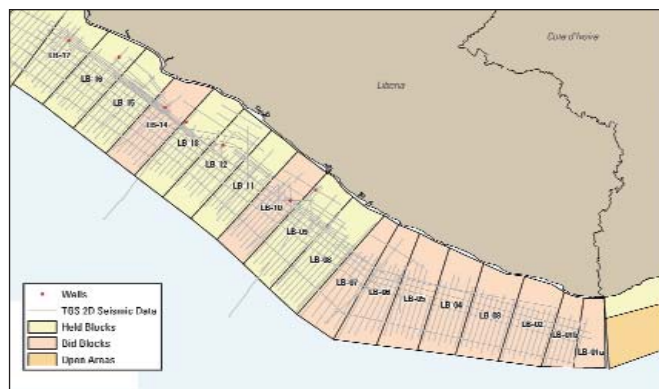


Figure 2. Offshore Liberia.



Figure 3. Offshore Sierra Leone.

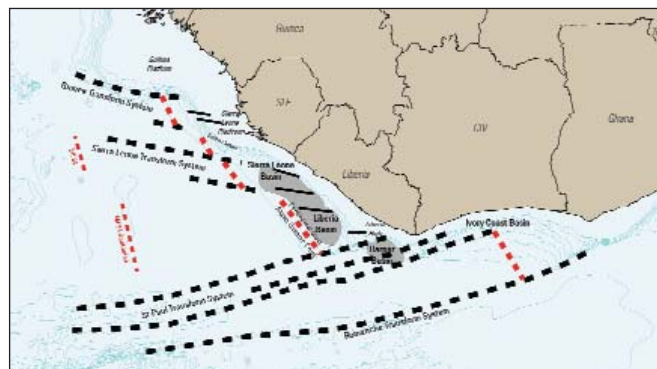


Figure 4. Regional tectonic sketch map. (Rusk and Bennett, 2002)

evaluating the existing data on the block, Oranto will be looking for a partner to help revitalize the Lomé field. **Block 2**, covering 1,815 sq miles (4,700 sq km) in water depths of 1,640 to 11,484 ft (500 to 3,500 m), is being offered by Ministère des Mines, Énergie et de l'Hydraulique.

In Ghana the acreage award process is unclear, and the success of Jubilee has attracted swarms of advisors offering guidance to The Ministry and National Oil Company (GNPC) on how to promote future exploration. Offshore areas could possibly be offered in a license round to be announced later this year, and some of the existing operators could be looking for drilling partners after evaluating recent 3-D seismic surveys. The onshore Voltaian Basin, covering more than 38,600 sq miles (100,000 sq km), has been the subject of an extensive aeromagnetic survey. GNPC officials are reviewing these data with plans for a regional seismic survey to promote exploration there.

Although production in Côte d'Ivoire is well established (~ 90,000 b/d of oil), most of it is on the shelf. The deep water has only seen one well in the western region, which has been an unfortunate disappointment. Lukoil recently farmed in to **CI-205** and **CI-101** and is planning a couple of wells to test the deep water in the east.

Although there have been no permit awards recently, the ultra-deepwater area is being promoted following a

regional 2-D seismic survey there. Farm-in opportunities are abundant, and one attractive candidate is Yams Petroleum, a local company with several offshore blocks, including one on trend with the Jubilee field. Oranto acquired 965 sq miles (2,500 sq km) of 3-D seismic over Blocks **CI-205** and **CI-206** and is looking for a partner to help drill some large features in **CI-206**. Al-Thani may also be looking for a partner in Block **CI-105**.

West of Côte d'Ivoire are the war-torn countries of Liberia and Sierra Leone, where there has been no offshore drilling since the 1980s because of the conflicts. Modern 2-D seismic over the Liberia and Sierra Leone basins is showing several features similar to the Ghanaian discovery, and amplitude vs. offset analyses are providing positive support as well. The main prospective areas off both countries appear to lay between the 3,280 and 6,560 ft (1,000 and 2,000 m) bathymetry markers. There is some seismic evidence in the shallower water of the Palaeozoic section, which has an estimated thickness of up to 9,843 ft (3,000 m) in the Roberts-Bassas Basin onshore Liberia.

Liberia is currently offering nine blocks in the second offshore license round, which closes in July, and there are farm-in opportunities on five of the blocks awarded in the first license round. Oranto (Blocks **11** and **12**), European Hydrocarbons (Blocks **8** and **9**), and Broadway Hydrocarbons (Block

**13**) are all looking for support through the first exploration phase (3-D seismic and one well). The onshore Roberts-Bassas Basin is unlicensed and undrilled, and reports of seepages in this area indicate a possible Palaeozoic system to be investigated.

In Sierra Leone exploration activity is more advanced than in Liberia, with the Repsol/Woodside/Anadarko group (Blocks **SL-6** and **SL-7**) planning to spud a well in the next 12 months. A joint 3-D survey is being acquired over Blocks **SL-5** and **SL-4**, following which operators Oranto and Elixir, respectively, will be looking for investors for the drilling phase. The Jubilee look-alikes seen on 2-D seismic are the main focus for the 3-D. Figure 4 illustrates the tectonic setting for the western portion of the region. There is little reason to believe that the successes in the Romanche-St. Paul compartment cannot be duplicated in other inter-fault zone compartments.

As with most frontier areas, front-end exploration of this region in general has been left to the independents and fledgling companies. The absence of the super-majors in the entire margin from Benin to Sierra Leone and further to Morocco is conspicuous. Only Shell, and only through its takeover of Enterprise, is present in the region. The success of Kosmos, Tullow, et al will undoubtedly bring the risk profile of the region closer to the palate of the super-major. **ENP**