Significant discoveries of the 21st century – presentation abstract

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Below is an abstract from the keynote address Mike Daly, Executive Vice President, Exploration gave at the 30th Anniversary conference of the Petroleum Group of the Geological Society of London in Bath, UK

The turn of the 21st century coincided with a remarkable two years of giant discoveries (Figure 1). In the Caspian Sea Shah Deniz and Kashagan were discovered in 1999 and 2000 respectively. In the same period, giant discoveries were made in the deepwater Gulf of Mexico (Thunderhorse and Atlantis) and Angola (Girassol, Kizomba and Plutonio). The success offshore in the Caspian was a direct result of the demise of the Soviet Union 10 years earlier. The deepwater discoveries resulted from the growing momentum into deepwater exploration and increasingly sophisticated seismic imaging of deepwater systems.

The first decade of the 21st century saw over 300bnboe discovered and sustained industry exploration delivery at around 25bnbboe/pa. Volumes were dominated by the National Oil Companies, in particular Petrobras, Turkmengeologiva and the National Iranian Oil Company who all discovered exceptional fields greater than 5bnboe and cumulative volumes in excess of 20bnboe. During the period the four Supermajors discovered about 10bnboe each with discovery costs ranging from $1.83 to $2.931bbl*.

Nine new plays or provinces were realised in the decade with a strong bias to oil over gas. Of these, all but one was in a deepwater environment. The Brazil Pre-Salt and Angolan Congo Fan dominate in terms of discovered volume. Of the others, the Gulf of Mexico Palaeogene and Ghana Cretaceous emerged as the key new plays for oil and East India's Plio-Pleistocene and Egypt's Nile Delta Oligo-Miocene for gas.

During the decade, BP participated in several of these new provinces and plays with a number of major discoveries. Our underlying exploration philosophy is a deep commitment to geoscience at the regional and prospect scale and access to all available data taken to its technical limit. In particular, three technologies standout as having enabled us to target promising leads early in the competitive game of access and follow through to successful discovery. Case studies from major deepwater discoveries in Egypt and the Gulf of Mexico will be used to demonstrate how the role of fluid flow prediction, an understanding of deep water depositional systems and new seismic imaging and processing techniques have been key to these discoveries.

Large areas of both the Egyptian Nile Delta and the Gulf of Mexico deepwater are overlain by evaporite sections, albeit of very different geometries and composition. In the Gulf of Mexico, large, allocthonous salt bodies hide potential prospects from conventionally acquired 3D seismic. Wide azimuth towed streamer (WATS) seismic acquisition was developed to address this issue and has transformed imaging around and below large salt canopies. This was key to the recognition and discovery of the giant Tiber field in 2009. On a similar theme, multi azimuth (MAZ) seismic enabled the imaging of the complex slope turbidite channel systems below the highly rugose Messinian salt of

the West Nile Delta. This ‘clear sight’ opened the new Oligo- Miocene play through the discovery of the giant Raven field in 2004.

In both areas, the improved seismic image gave great confidence in the sub-salt image of the prospect to be tested. It the case of Tiber, it also ensured a drill location that enabled an inclusion free run through 4000 meters of salt and a clean sub-salt exit.

The seismic quality and regional geological context in both areas led to the recognition of distinctive deepwater depositional systems. Raven is a series of overlapping slope turbidite channels, today laid across a major regional culmination. The reservoir component of these channels, and their lateral sealing properties, became crucial risks to success. In contrast, Tiber is a large basin floor fan complex of overlapping lobes, where reservoir deliverability and structural closure are key. The clear image of a subtle closure under salt and the distinction of a clear submarine fan architecture led to the discovery of this great oil field.

Crucial to success in both the GOM and Egypt has been an improved understanding of hydrocarbon migration. The philosophy of mapping permeability architecture, with a focus on the first carrier bed above a source rock has been key to the relative risking of charge focus in both fields. The bottom up geological understanding resulting from this thinking clearly pointed to Tiber being a location of hydrocarbon focus from the lower Cretaceous sands. The subsequent journey of the molecule is a result of the effective stress of available seals and retention potential of large structures.

As we look forward the directions discussed here will continue to reduce risk in our exploration portfolio and open new possibilities. In particular the sealing mechanism of stratigraphic traps has gained new focus. Equally an understanding of permeability and effective stress will continue to drive our understanding of fluid flow from source rocks to reservoirs. All this is dependant on an ever improving and more sophisticated higher frequency seismic image in the exploration phase.

*WoodMackenzie 2010