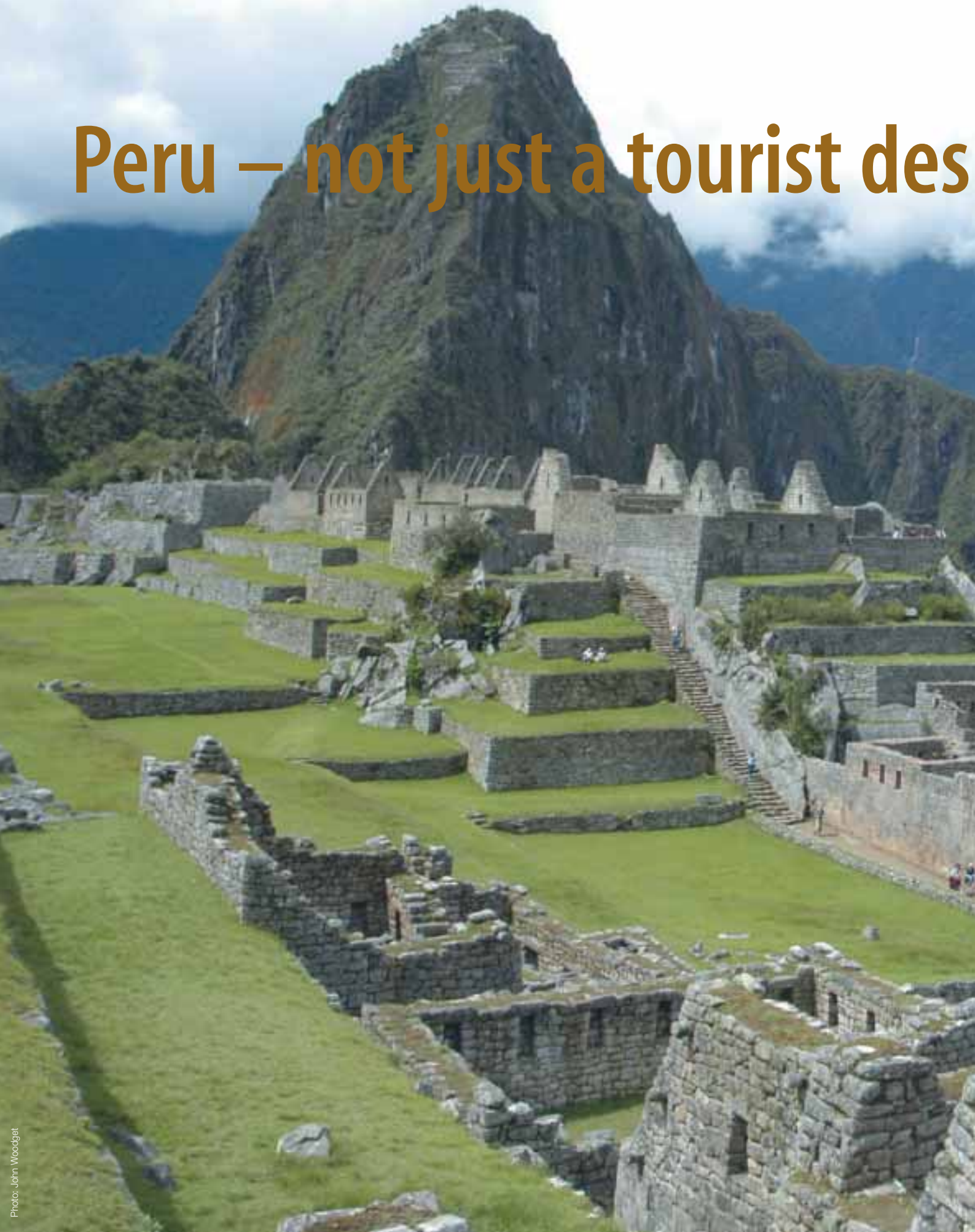
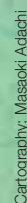


# Peru – not just a tourist des





# destination



Exploration and production in Peru are concentrated in four widely separated basins: The interior Marañon Basin in the northeast (900 MMbo produced to date), the largely offshore Talara Basin west of the Andes (1,400 MMbo produced), the Ucayali Basin east of the Andes (800 MMbo and 12.5 Tcfg proven reserves), and the newly emerging gas province of the Madre de Dios Basin (2.5 Tcfg probable reserves), also east of the Andes. All basins in Peru are considered to contain the main elements for a petroleum system and many frontier areas remain undrilled, so considerable potential remains in both the explored and unexplored basins.

Machu Picchu, often referred to as the lost city of the Incas, attracts historians and tourists alike. An astounding archaeological stone citadel, it stands 2,400 metres above sea level and is believed to be more than 600 years old. Many visitors choose to hike the Inca Trail, ancient Inca pathways leading to Machu Picchu, along which some of Peru's most dazzling scenery can be experienced. Note the location of Machu Picchu due south of two hydrocarbon bearing basins and within crystalline rocks (see map above).

**After many years of civil unrest and terrorist activity Peru has now experienced relative economic and political stability for more than 15 years. A well-established hydrocarbon industry offering attractive terms has helped rebuild this beautiful country. However, faced with rising internal energy consumption, the country is trying to attract foreign companies to undertake exploration in new, possibly high-risk areas like the remote Madre de Dios Basin. Can Peru ever become self-sufficient in hydrocarbons again?**

*Jane Whaley*

**H**ydrocarbons were known to exist in Peru for many centuries; indeed, it is thought that the conquistador Pizarro caulked his ships with tar from seepages when he arrived in 1521.

Oil exploration began in the middle of the 19th century and the Zorritos Field, found in 1861 in north-west Peru, was the first discovery in South America. This was followed shortly afterwards by the finding of the first giant oilfield in the world (i.e. more than 500 million barrels in reserves), the La Brea-Parinas Field, discovered in the same area in 1869 in the Talara Basin. This field is still producing, having produced over a billion barrels of oil.

Oil was first exported in 1905, making Peru the first hydrocarbon exporter in South America. With such an impressive and innovative start, Peru could fairly have been expected to be in the forefront of exploration throughout the 20th century. It

was, however, rapidly overtaken in importance by other South American countries such as Brazil and Venezuela, and for many years has been considered an 'also-ran' in the hydrocarbon industry. Is this purely the result of unfavourable geology, or have other factors been to blame? And, more importantly, can there an optimistic outlook for the future of the hydrocarbon industry in Peru?

## Complex petroleum geology

Structural geology in Peru is dominated by the evolution of the Andes, as the east moving oceanic Nasca plate is subducted by the westward movement of the crustal South American plate. The main sedimentary basins are therefore found in the fore-arc coastal region and in the sub-Andean Foreland area.

The first discoveries were made in north-west Peru, where the Proto-Amazon delta flowed westwards into the Pacific, before the Andean uplift in the late Tertiary. This

## Machu Picchu

Almost everyone feels they must visit Machu Picchu at some time in their lives. Occupying a outstanding position overlooking the dramatic gorge of the Urubamba river, and protected by the impressive dome of Huayna Picchu, the Incan city is surrounded on all sides by magnificent ridges and snow capped peaks.

The overgrown site was found almost by accident in 1911 by American archaeologist, Hiram Bingham. Little is known about the city, which had possibly been abandoned before the Spanish arrived. It was obviously a very important royal or religious ceremonial town, boasting many large temples and palaces with the highest quality stonework and ornamentation.

This spectacular city is built on intrusive igneous rocks, mostly grey and white granites and batholithic granodiorite of Permo-Triassic or late Hercynian age. Quaternary and Recent glacial and erosional processes have broken much of the surface granite into major blocks, many of which are incorporated into the fabric of the city. All the buildings are made from this granite and the quarry which provided much of the stone lies within the city limits.

Rockslides have occurred in the past and the huge number of visitors to Machu Picchu each year, coupled with high rainfall and steep slopes, make the site very vulnerable. The Incas themselves stabilised the land with terraces and containment walls, but they had not anticipated that 500,000 people would visit their city annually. While measures have been introduced to control the numbers walking the Inca Trail, the majority of tourists travel to Machu Picchu by train, and the huge financial benefit to the whole country from these visitors makes any decision to limit numbers a difficult one. Let us hope that Incan engineering will allow visitors to enjoy the unique ambience of their fabulous city for many years to come.



Photo: John Woodget

A growing population and rapidly increasing demand for energy means that Peru is now a net importer of oil.





Photo: John Woodget

The Ordovician San Jose Formation and the granite of the Machu Picchu Massif overlook a high flat plateau of Tertiary rocks.

area produced the majority of Peru's hydrocarbons for many years, but has now been overtaken by the vast Marañon Basin in the sub-Andean Foreland belt in the Amazon jungle in the north-east of the country, which now accounts for about 65% of total production.

Oil was discovered in the remote sub-Andean Ucayali Basin in 1931 and it remains one of the most prospective areas in Peru, with a large number of seismically identified undrilled prospects. It has multiple, mature source rocks, with large quantities of oil migrating through the system. Interest in this late Tertiary basin was enhanced by the discovery of the non-associated gas fields which make up the Camisea Project. Success in the Ucayali Basin sparked further exploration in the even more isolated Madre de Dios Basin, which is productive in Bolivia from a world class Devonian source rock. Promising indications were reported from the few wells which have been drilled, culminating in the 1999 discovery of the undeveloped Candamo Field.

There are a number of smaller, underexplored but possibly prospective Andean basins, mostly east of the Andes. Basin modelling will be key in these areas, allowing better understanding of their complex tectonic history, as well as elucidating hydrocarbon migration and hydrodynamics.

### Roller-coaster economy

In the early 20th century the economy of Peru was strong, with a major export boom

involving sugar, cotton, copper and oil. A strong ruling elite of local landowners and merchants held power, together with international companies, and there was little investment by the state. This situation came to an abrupt halt with the Great Depression in 1929, and the government then tried to intervene with economic measures such as price controls and import duties. Widespread poverty and general unrest led to military intervention, the introduction of measures to encourage exports and the development of a new elite. This roller-coaster cycle of political instability, state intervention and civil unrest continued through most of the 20th century and while the hydrocarbon industry had some successes, it meant that there was little enthusiasm for the country from the international oil community.

For many years exploration remained confined to the north-west coastal region, as the region east of the Andes was considered by most companies to be too inaccessible to be economically prospective. With the discovery of the Corrientes Field in the Marañon Basin in the 1970s, however, there was a rush to the Amazon tributary areas, and wildcats were drilled in new, even more isolated eastern areas such as the Madre de Dios Basin, east of Machu Picchu.

Exploration slowed in the 80s, despite the 1984 Shell discovery of the giant Camisea gas fields. It took years to develop this complex, partly because the domestic market for gas was undeveloped at the time, but also due to political volatility and fierce opposition to Amazon rainforest development. Peru's state of political

## Tourism in Peru

Peru could be regarded as one of the most perfect travel destinations in the world. A beautiful coastline, tropical jungle, the breathtaking Andes and some of the earth's most important historical sites make Peru a truly 'something for everyone' travel destination.

Firmly established on the radar of the trend-setting young backpacker and a very popular trekking destination, Peru is fast becoming one of the highlights of South American travel. It has remained a safe place to visit since Alberto Fujimori was elected president in 1990 and tourism has responded accordingly. Between 1996 and 2000, Peru saw a 29% annual growth of tourist arrivals, with the total number of visitors in 2000 exceeding 1 million for the first time. This number is expected to dramatically increase over the next few years.

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Other visitors to Peru come to be baffled by the mysterious Nasca lines, a collection of giant geoglyphs and lines depicting animals and birds that were etched into the desert rock in about 600 A.D. They are almost half a kilometre in length and are virtually unrecognisable unless viewed from the air.

In addition to the historical and natural sites of Nasca and Machu Picchu, Peru has abundant attractions for the foreign traveller. Lima is a modern metropolis with art galleries, museums, theatres, superb shopping and a glittering nightlife and those looking for a more traditional holiday can visit the stunning northern beaches for some sun, sea and sand.

Many believe that Peru will be a leader in the trend for eco-tourism, with an emphasis on the importance of being a responsible traveller, encouraging the old mantra, 'take only photographs, leave only footprints'. Whatever the tourist trend happens to be, Peru is such a beautiful and awe-inspiring country that there will always be visitors.



Photo: John Woodgate

The jungle covered granite massif rises into the clouds from the deeply incised Urubamba River, seen here from Machu Picchu.

turmoil and instability during these years slowed oil exploration and exploitation considerably.

After many years inactivity and decline the Peruvian oil industry entered a new phase in the 1990s when stability returned. In 1993 the government introduced new fiscal terms, privatised all state-owned upstream assets and created Perúpetro to promote private investment. Progress was still slow, so in 2003 the Peruvian government established a new royalties scheme with tax-exempt exports to encourage foreign investment. In addition the Peruvian government offers generous free access to data (see [www.perugasoilexplor.com](http://www.perugasoilexplor.com)).

## Looking to the future

These initiatives appear to have been successful in renewing interest in the industry, with a number of new entrants signing exploration and production contracts and an encouraging number of new discoveries throughout the country. It led to further exploration in the Amazon region and earlier this year two blocks were awarded in the Marañon Basin. Other license contract awards are pending in the country and there was a major new discovery, Buena Vista, in Block 39 in the Marañon Basin in June this year.

As exploration pushed into the Amazon jungle, environmental problems and issues involving the indigenous people became major concerns. The Madre de Dios Basin, for example, is considered to contain some of the most pristine rainforest remaining in the world, with many unique species and a

subtly balanced ecosystem. The Peruvian Government has attempted to address these issues, providing services to advise oil companies on environmental concerns. Environmental issues inflate exploration economics and are of great significance when development projects are under consideration.

There has also been an upsurge of interest in the coastal area in the north-west. In addition to the existing producing fields in the Talara and Tumbes-Progreso Basins, there are plans by BPZ to develop the offshore Corvina gas field, discovered in 1982, along with commercialising other shut-in gas discoveries in the area.

The coastal basins south of Talara have had limited success until recently, but in June this year Peru announced the first oil discovery in the Sechura Basin, after 100 years of exploration history. It is the most southerly discovery offshore Peru, and has encouraged further exploration in the southern basins, including the Salaverry Basin, south of Sechura, and the Pisco Basin, south of Lima. These offshore basins are thought to have sedimentary sequences up to 4,000m thick and prospective structures have been identified on seismic, although it is possible that extensive local volcanism may have made potential source rocks overmature.

## The outlook for gas

Political stability has also seen the long overdue development of the Camisea project, which took 20 years to come to fruition, but finally resulted in the construction

of natural gas and NGL pipelines to Lima and a fractionation plant on the coast. Production started in August 2004, although current gas production is below the maximum capacity due to lack of demand and inadequate export facilities. About 350 MMcfg/d is reinjected because there is no commercial market for it at present.

The initiation of these pipelines should be a key factor in opening up the country east of the Andes and in commercialising gas. Peru is thought to have one of the largest total gas reserves in South America, but before the construction of the Camisea pipelines most gas finds were automatically considered non-commercial, due to the cost of developing infrastructure and the lack of a home market. This situation is changing, as domestic consumption of gas is rising rapidly and the Peruvian government has encouraged investment in gas-fired power plants and the construction of an LNG terminal.

## An attractive proposition?

Peru has a long history of the exploitation of hydrocarbons and could be considered to be a mature oil country, past its peak. However, the discoveries made to date have been achieved with a relatively small exploratory effort, especially considering the complexity of the geology.

Proven remaining reserves of oil are 353 million barrels and gas reserves are 16Tcf. Oil production in Peru peaked at about 200,000 bopd in the early 1980s, and by 2004 had dropped to 94,120 bopd. However, with the Camisea project now online, the 2005 production rate is 112,000 bopd.

Peru is unlikely to ever be a low risk proposition, so the government needs to continue encouraging enough companies to participate in the sector to maintain and accelerate this reversal of the longstanding production decline curve. With a stable political and economic environment, together with favourable terms and the development of an infrastructure system for hydrocarbon distribution, refining and export, Peru can now be thought of as a far more attractive proposition. With its long history of hydrocarbon exploration and exploitation, could Peru finally be on course to realise its potential?

### Acknowledgements

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