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NOTED ON THE OIL PROSPECTS OF PORTUGESE TIMOR

by

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INTRODUCTION.

The island of Timor has attracted the attention of geologists for more than one hundred years. The first geological investigations were carried out on behalf of the Government of the Netherlands East Indies as early as 1829. The western part of the island was visited by several geological expeditions and the rich Permian and Triassic faunas were described by Wanner and others in their standard work "Palaeontology of Timor".

Although the earlier investigations had for their main objective the collecting of fossil material, the intricate tectonics of the island were also realized. Competent geologists such as G. Molengraaff, J. Wanner and F. Weber arrived indepently at the conclusion that the tectonics of western Timor were of the alpine type with thrust sheets (nappes) resting on an intensely folded autochthonous substratum. The isolated limestone masses (fatu = batu in Malay = rock, rocky mountain) were recognized as erosional remnants (klippen) of a previously continuous overthrust sheet. The facies of the Permian and Triassic was compared with the Tertiary Flysch facies of the Alps.

In the eastern, Portuguese part of the island the same type of facies and tectonics was first described by Hirschi in 1907. Later geological investigations have confirmed Hirschi's ideas.

The geological data as supplied by the Allied Mining Corporation's report (1937) on the natural resources of Portuguese Timor, are too inadequate as to allow a proper evaluation of the oil potentiality of this part of the island. Therefore the "Report on the Geology of Eastern Portuguese Timor" by E. E. Escher, written on behalf of the Royal Dutch Shell Group was also consulted. The stratigraphic names used in these notes are adopted from Escher's report.

It is evident that this latest geological investigation was rather a reconnaissance than a thorough and systematic survey. Nevertheless it still is the most detailed description of the geology of Portuguese Timor. The conclusions arrived at by this geologist, i.e. that the tectonic complications were such that further geological work was not warranted, have to be taken with a grain of salt. Other far reaching developments within the sphere of interest of a world-wide organisation such as the Royal Dutch Shell, might have carried greater weight in the decision to abandon Timor than the actual geological conditions.

STRATIGRAPHY.

Two stratigraphic units which are also tectonic units can be distinguished, i.e. the overthrust Fatu Complex and the autochthonous series. Only the latter is of

interest, in relation to oil geology.

The Fatu Complex.

It consists of crystalline schists, basic to intermediate igneous rocks, red crinoidal limestones of Permian age and various other limestones ranging in age from Triassic to Eocene. The Miocene (Tertiary "e") is present in a limestone-, marl-, sandstone facies.

The autochthonous Series.

The oldest formations exposed are the Cribas (Permian) and Mota Bui (Triassic) Series.

The Cribas Series.

This series was found in two areas only, i.e. in the Cribas area, where a normal section is exposed and in the Tutala area at the eastern end of the island. In the type locality the series, as far as it is exposed, begins with a quartzitic non-fossiliferous sandstone, followed by a shale sequence with intercalated limestones which contain a typical Permian ammonite fauna. Towards the top the pelecypod Pterinea only occurs. The contact with the overlying Triassic Mota Bui Series is transitional. The thickness of the Cribas Series from the basal sandstone to the highest Pterinea-bearing limestone is given as approximately 1,000 meters (3,281 feet).

The Mota Bui Series.

The Triassic Mota Bui Series together with the Permian Cribas Series form a typical comprehensive series deposited in a geosynclinal area, where subsidence has more or less kept pace with deposition. Its facies was compared by all geologists who have studied it to the Tertiary Flysch of the alpine orogene. Shales and marls are the predominating rocks. They were found to be bituminous in places. Interbedded with the shales and marls are radiolarian limestones, fossiliferous, sandy limestones, sandstones with fontainbleau structure, claystones and some conglomerates composed mainly of debris or radiolarian limestone and sandstone of the Mota Bui Series. A Triassic age is proved by the pelecypods Habia, Daonella and Monotis and other less abundant ammonites and brachiopods. In the Pualaca area the Jurassic ammonite Perisphinctes was also found in the Mota Bui Series. This proves that the same type of sedimentation was still prevailing in Jurassic time.

Structural complications apparently prevented the establishing of a proper stratigraphic sequence and consequently the thickness of the Mota Bui Series is only estimated as being of the order of 1,000 to 2,000 meters (3,281 to 6,562 feet). All major oil- and gas seepages occur in this Series.

The Bibiliu Series.

The Bibiliu Series of Upper Cretaceous and Eoeene age overlies the Bota Bui Series unconformably. It consists mainly of clay, marl, chert and sandstone. In the lower part clay and marl predominate, but limestone chert and foraminiferal sandstone are also present. Bituminous shales are reported from this lower part of the series. The upper part consists mainly of clays and sandstones. The clays are often developed as block-clays, i.e. they contain embedded in a clay metrix pebbles and angular boulders of Permian, Cretaceous and Eocene Limestone. The similarity of the facies of these tectonic erratics (exotic blocks) with that of rocks of the Fatu Complex suggests that the early stages of the overthrust movement date back to early Tertiary time.

The Viqueque Series.

The Pliocene Viqueque series rests with a marked unconformity on the Upper Cretaceous-Eocene Bibiliu Series. It has been less severely folded than the older series. A lower division composed of clays, block-clays and sandstones and an upper division of marl and sandstone can be distinguished.

The block-clays contain mainly boulders and fragments of rocks of the Mota Bui and Bibliu Series, but Permian limestone and igneous rocks derived from the overthrust Fatu Complex are also present.

The abundant foraminifera in the lower as well as in the upper division indicate a Pliocene age.

Summarizing the stratigraphic record of the eastern half of the island of Timor we can say that marine sedimentation in an area of subsidence began in Permian time and continued uninterruptedly through Triassic into Jurassic time. Radiolarian cherts and limestones together with great thickness of marls, clays and shales indicate bathyal conditions. More neritic phases and regressive movements of the sea, however, are indicated by the repeated occurrence of coral limestones and sandstones. After a period of emergence in Upper Jurassic and Lower Cretaceous time a new cycle of subsidence followed in Upper Cretaceous and Eocene time.

This was followed by a second phase of emregence in Middle Tertiary time and a third cycle of subsidence and deposition during the Pliocene.

These pulsating movements are typical for a geosynclinal area ane are especially strong in the eastern sector of the Indonesian geosyncline of which Timor forms a part. The geosynclinal sedimentation moreover was accompanied by crustal movements resulting in the formation of overthrust sheets (nappes) in several phases, the oldest of which appears to have taken place in early Tertiary time. In their earliest stages already, the overthrust sheets were subjected to erosion and the debris were deposited in the contemporaneous sediments (ddest block-clays of the Bibiliu Series). This adds to the complexity of the depositional record, which is closely interrelated with the tectonic history of the area.

Seen from this angle it is evident that an evaluation of the oil prospects of the island of Timor has to face stratigraphic and tectonic problems which are absent in adjacent oil provinces and can only be compared with those of the sub-Carpathian zone of Roumania and Moldavia.

STRUCTURE.

The fact that the Fatu Complex is an overthrust mass and is resting on an autochthonous series is proved by the superposition of metamorphic and igneous rocks and limestones of Permian to Eocene age, on younger sediments. Zones of tectonic breccias at the base of the overthrust masses were found in many places. The thrust plane in undulating and slopes regionally towards the south coast. In some areas, however, the thrust mass in intensely folded into the substratum.

In the central part of the island the Fatu Complex is still preserved as a continuous mass, but to the south it is more or less dissected by erosion and only isolated erosional remnants indicated its former extent. These "fatu" or "klippen" give the Timorese landscape its typical appearance.

The autochthonous series is extremely heavily folded and faulted, partly because of the overriding thrust mass, but also because of its low degree of competency. The result is an intricate pattern of intensely folded blocks, with abrupt changes of dip and strike. In the area investigated only one rather normal anticline was found. It is the Cribas anticline, closed in the uppermost Permian Cribas formation. Other normal folds were observed to occur in the Pliocene Viqueque Formation. But Escher quite rightly assumes that the gentle folding would be confined to the Pliocene Viqueque Series whereas the underlying Mota Bui-Bibiliu Series would be as strongly folded as elsewhere in the area. But Escher quite rightly assumes that the gentle folding would be confined to the Pliocene Viqueque Series whereas the underlying Mota Bui-Bibiliu Series would be as strongly folded as elsewhere in the area.

OIL INDICATIONS.

The numerous indications for oil are confined to two areas in the southern part of the island and within the stratigraphic column to the Mota Bui Series.

The oil seepage of Pualaca is the most important of them. The oil is seeping out of alluvial gravels, but its derivation from the Mota Bui Series which crops out in the vicinity, cannot be doubted. Four shallow pits (26 to 65 feet deep) were dug by the Japanese during the last war and are at present in exploitation by the local Government. It is said that approximately 6,600 imp. gallosn are produced annually.

Three very active seepages of wet gas are reported to occur to the west of the Pualaca oil seepage.

They are situated near the erosional edge of a sheet of crystalline rocks of the Fatu Complex.

To the south-east of the locality of Viqueque and close to the coast the mud volcano of Bibiluto is situated. It consists of a flat cone with a central mud pool wherefrom gas bubbles occasionally escape. An extinct cone to the south-east of the active one indicates a slight shifting of the center of eruption possibly along a fault line. A faint oil smell was noticed. We do not consider mud volcanoes as a positive sign for oil. The salt water rather indicates marginal conditions and the emanating gas might be the last vestige of formerly existing oil accumulations. Moreover in Netherlands Timor and in the adjacent island of Roti as well as on the north coast of British Bornea mud volcanoes do occur which are in no relation to oil deposits.

Another group of oil seepages is centred around the locality Aliambata near the south coast of the eastern part of the island. One pit yields about one gallon of oil per day. There are also numerous scattered oil and gas seppages as well as oil impregnations in this south-eastern area. With one exception all indications occur in the Mota Bui Series which, in some places, also contains bituminous shales.

It is evident that several pelitic members of the Triassic-Jurassic Mota Bui Series have the properties of a source formation and that several of its sandstone members have acted as reservoir rocks.

OIL PROSPECTS AND SUGGESTIONS FOR AN EXPLORATION CAMPAIGN.

1. The Permian Cribas and the Triassic-Jurassic Mota Bui Series have an aggregate thickness of 6,500 to 9,800 feet. They were deposited in an area of subsidence and are developed in a facies which generally is considered as favourable for the forming of oil.

2. Bituminous shales in various horizons of the Mota Bui Series indicate that favourable conditions for the forming of bituminous substances have, at least temporarily, existed.

3. Active oil and gas seepages occur within the Mota Bui Series. They are sufficient to prove that oil and gas accumulations were formed in porous rocks of this series.

4. The strong tectonic movements, resulting in a most complicated structure of the whole sedimentary sequence, might be a detrimental factor to the forming of pools of large size. Accumulations presumably are of the tectonic type and can be expected to occur in suitable places along faults and thrusts. Therefore production might be erratic and confined to many small areas.

5. The surface mapping done so far is inadequate for

the selection of an area which could be subjected to exploratory drilling, excepting the Cribas anticline closed in the upper Cribas Series of Permian age. However, oil indications are lacking in the Permian and therefore such a well might be a failure.

6. Prior to an exploratory drilling campaign the whole area between the central watershed and the south coast should be systematically mapped.

7. If necessary several seismic sections should be shot across the southern coastal plane.

8. In view of the favourable facies of the Mota Bui Series the numerous oil and gas indications and notwithstanding the complicated structure, Portuguese Timor is to be considered a potential oil-producing area. The establishing of commercial production, however, would be difficult task and could only be accomplished through systematic geological mapping and an active drilling campaign. The costs of such a venture would undoubtedly be high.