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On the Geology of the Cenozoic Geosyncline in Middle and Northern Taiwan (China) and Its Petroleum Potentialities*

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ABSTRACT

This elaboration deals with the basement, the sequence of strata and the development of the Cenozoic geosyncline in northern and middle Taiwan, the tectonical structure in respect to its chronology and the structural features and the relationship between Taiwan and the Riukiu Island Arc.

The basemement of the Cenozoic geosyncline of Taiwan is formed by the pre-Tertiary Chinese mass. Its Pacific contours are generally indicated by the north-south stretched island of Taiwan and the Riukiu Island Arc, with its shape convex towards the Pacific, which joins Taiwan almost perpendicularly in its northern half.

The basement, is composed of incomplete or thin Mesozoic and is folded by possibly young Kimmeridgean and later by slight Laramic movements. As for the movement, the basement condition can not yet be designated fully stabilized, in comparison to the inner cratonic regions of the Chinese mainland.

The Cenozoic geosyncline prevailingly trends north-south. It is split into an western and an eastern trough by a geanticline, conjecturally existing since the beginning of the Tertiary, having its nucleus in the Paleozoic-Mesozoic complex of the Central Mountain Range. Merely the western trough is the subject of this investigation. Paleogene strata are the most ancient deposits in the geosyncline. They consist of transgressing Eocene and incomplete Oligocene. Their thickness might amount to several thousand meters. Basic to intermediate magmatic rocks introduce the initial magmatic phase in the geosyncline. This magmatic activity extended interruptedly till the upper Miocene. A hiatus in the upper Oligocene might be correlated with relatively faint (apparently Savic) movements.

The Miocene is subdivided into three sedimentary cycles. The lower Miocene comprises the most ancient sedimentary cycle. It is merely indistinctly developed. Orthoquartzites, graywackes and shales of a littoral facies gradually change upward into orthoquartzites with coal seams of a paralic facies and shales with graywackes of a highly marin facies. Approximately 1200 m of sediments have been deposited at the western shelf and at least 2500 m in the inner basin. The sequence of the Iower Miocene as well as the middle and upper Miocene changes to marine in the central part of the basin toward south.

The middle Miocene forms the middle sedimentary cycle with coal-bearing paralic sediments above which alternating graywacke-shale sequences and purely marine shales follow.

The thicknesses fluctuate between 600 m and roughly 2000 m. The trough area is subdivided at its western rim by three shelf or swell units, respectively, and three partial basins, thereby forming transversal elements striking east-west. These are designated from north to south as follows: Kuanyin Shelf, Hsinchu Basin, Miaoli Swell, Taichung Basin, Peikang Shelf and South Taiwan Basin.

The upper sedimentary cycle of the Miocene in the upper Miocene is only complete with the inclusion of the Chinshui Shale of the lowermost Pliocene. It contains orthoquartzites with coal seams of a paralic facies, which grade upwards through alternating sequences of deep and shallow water deposits to marine shales. The thicknesses fluctuate from 800 m to more than 2400 m. The transversal subdivision of the trough in swell and basin units is more apparent due to stronger thickness fluctuations.

In the upper Pliocene and Quaternary with an estimated maximum total thickness of 6000m, the sediments reflect the initiation, progress, climax and fading of the orogenesis. Pleistocene conglomerates lie locally on top of thick Pliocene graywackes, shales and gravels. They initiate the climax of the folding phase. A synorogenic plutonism is unknown. Subrecent volcanic lavas of an dacitic to andesitic composition are conjecturally representing the subsequent volcanism.

The tectonics are essentially determined by the Pleistocene folding. After a gradually increasing unrest of the basin floor in the strata of the lower Pliocene the movements are intensified in the early middle Pleistocene—after deposition of the cited Pleistocene conglomerates —to the orogenesis. Subsequently, the deformations gradually fade but even recent dislocations are possibly still coherent therewith.

The orogenic forces were particularly exerted against the northwest temporarily with a more northern, temporarily with a more western component. The structural features are *alpinotype* from the inner part of the trough almost up to the shelf margin of the Chinese craton in west. The shelf sediments are not deformed. Gradual decrease of folding in greater depth infers the phenomenon of gravitational sliding combined with decollement from the basement. The vertical throw at regional thrusts is frequently reaching 3 km. Diagonal fractures are caused by a younger stress phase. Respective east blocks in some locations were shifted northward for several kilometers at strike-slip faults.

The occurance of west-east trending transversal elements in the Miocene of the north-south stretched geosyncline of Taiwan could be conceived as the effect of subsiding and uplift movements at the margin of the Chinese craton. Preference is given to the interpretation that the epeirogenic relations reflect the interference of the dominating north-south directrix of Taiwan and the subordinated east-west directrix of the Riukiu Island Arc.

The petroleum potentialities are evaluated on the basis of the development of the geosyncline. The partly metamorphic and indurated Mesozoic basement is beyond any petroleum interest. The Oligocene which prevailingly consists of thick shale sequences is to be judged to have been a source rock for the Miocene petroleum deposits. In the lower, middle and upper Miocene sedimentary cycles, petroleum has been generated with certainty but it is strongly controled by the facies. In each cycle the coalification of the interbedded plant debris could have provided natural gas. The most favorable source rock sequences have been found to be spread in the area of the northernmost partial basin and its adjacent depositional slopes. The strata sequences on the shelf regions may have been too porous for the entrapment of deposits.

The first migration of petroleum will have taken place from the northernmost partial basin toward the Kuanyin Shelf and the Miaoli Swell. Shelf- and swellward the petroleum will possibly have moved from the other basins also, if some had been generated there.

At all probability the petroleum will lie as secondary deposits in the present anticlines. In the exploration preference is given first to structures within the regional swell area including its sedimentary slopes and second to the lower shelf zones. Anticlines in basin areas which imply local synchronous highs and pre-existing swells signify good prospects also.