A NEW EXPLORATION METHOD FOR BURIED-HILL OIL FIELDS, THE LIAOHE DEPRESSION, CHINA

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ABSTRACT

New advances have been achieved in recent years in exploration for basement-rock buried-hill oil and gas fields of early Tertiary age in the faulted Liaohe Depression. A number of highly productive buried-hill oil fields have been discovered in the Shuguang, Qijia, Dujiatai, and Dongshengpu areas, with a daily oil production from each well in the range of 100 to 1,503 tons. Basement-rock fault-block structures and erosion-produced weathered-rock buried-hill reservoirs have formed many high-yield oil fields in Archean granite, Middle and Upper Proterozoic dolomite and quartzite, and Mesozoic volcanic rocks. The oil accumulations in dolomite occurs in miarolitic cavities and in fractures, but, most importantly, in quartzite and granite fractures. Lower Tertiary strata serve as the main source beds and cap rocks for buried-hill reservoirs. The major oil discoveries will be characterized by the new proposition that oil generated from younger petroleum source rocks may migrate into older reservoir rocks. There will be vast oil-bearing prospects for the buried-hill type structure.

INTRODUCTION

The faulted Liaohe Depression is located at the northeast corner of the Bohai Bay Basin, covering an area of 12,400 km². During Mesozoic and Cenozoic time, a continental-rift-faulted depression formed at the location of the ancient Sino-Korea peneplain. From Upper Jurassic to lower Tertiary time, the Pacific Plate thrust under the Eurasian Plate and resulted in faulting and subsiding of this area along the great Tancheng-Lugiang fault belt of East China. Basement rocks were uplifted and depressed along this fault, and several well-developed branch faults and many volcanic eruptions occurred along the fault zone. Under the control of these branches of the great fault, the major faulted depression was separated into three smaller depressions, the western, eastern, and Damintun (Figure 1). In these depressions, Mesozoic and Cenozoic strata were deposited to a thickness of as much as 8,000 m. The geothermal gradient is high, averaging about 4°C per 100 m. During Mesozoic and Cenozoic time, conditions for oil generation and accumulation were good. The Liaohe Depression is a structurally complex and organically rich area for oil and gas. There are multi-oil bearing strata, multi-types of traps, and multi-types of reservoirs throughout the depression.

In the Liaohe Depression, the main petroleum objective was the lower Tertiary stratigraphic sequence during the primary stages of exploration and development. The exploration of pre-Tertiary basement-rock buried-hill traps expanded as exploration progressed below the lower Tertiary stratigraphic oil and gas fields. As early as 1972, the Xinglongtai buried-hill reservoir was discovered and flowed commercial oil and gas from basalt at the base of the Tertiary sequence, and from weathered granite of Archean age below the Tertiary. These oil wells commonly produced 30 to 100 tons of oil and 100,000 m³ of gas per day. However, at that time, because of the limitation of seismic and drilling technology, we could not explore for basement-rock buried hill oil fields as thoroughly as we can today. Later, with the advanced computerized seismic and drilling technology being used, exploration flourished again. More and more productive oil fields were discovered. In 1979, the Shuguang buried-hill oil field was discovered. A daily output of 609 tons was obtained from the