The Controlling Factors of Fractured Limestone Reservoir-Forming of Upper Cretaceous in North Kairouan Region, Pelagian Basin, North Africa*

Yilin Deng[1] and Chunlin Yang[2]

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[1]PetroChina, Lanzhou, China (dengyl@petrochina.com.cn)
[2]China National Oil and Gas Exploration and Development Corporation, Beijing, China

Abstract

The Pelagian Basin in North Africa is one of the important oil and gas basins. So far, forty exploration wells have been drilled among the twenty structures in the North Kairouan (NK) Region. There are signs of oil and gas in most exploration wells, but commercial reservoirs are discovered only in one structure, which demonstrates that the hydrocarbon forming conditions of the reservoir in this region are complicated. Based on the seismic, drilling, analytic and testing data, the comprehensive analysis of the hydrocarbon forming conditions of the Upper Cretaceous fractured limestone reservoir reveals the following points: 1) the formation of the oil and gas reservoirs in this region is mainly controlled by oil resource conditions, the strike and abundance of fractures and faults, as well as the distribution of effective transport layers and thick cap rock; 2) the structural areas developed northwest faults and fractures, composite passage system; and 3) the thick cap rock is a favorable area of hydrocarbon migration and accumulation.

Introduction

The Pelagian Basin in North Africa is one of the important oil and gas basins. The North Kairouan region is located in the western Pelagian basin (Figure 1). Large-scale oil and gas exploration in the North Kairouan region was conducted since the 1980s. Drilling at the initial stage of oil and gas exploration was centered on structural traps. In contrast, the research on the reservoir-forming conditions was far from enough, and the achievements of this exploration are limited. Based on the seismic, drilling, analytic and

testing data, the comprehensive analysis of the forming conditions of the Upper Cretaceous fractured limestone reservoir reveals the following points: the formation of the oil and gas reservoir in this region is mainly controlled by oil resource conditions (Figure 2), the strike and abundance of the fracture, as well as the distribution of effective transport layer and thick cap rock; the structural areas near oil resources, and the structural areas of northwest faults, fracture development, composite passage system and thick cap rock are favorable areas of hydrocarbon migration and accumulation.

Discussion

Such viewpoints are based on the following factors. The main structures in the study area cannot generate hydrocarbons because they are located above the hydrocarbon-generation threshold, so no oil and gas can accumulate in the trap unless the hydrocarbon migrates from the oil generation center to the upper part of the structure (Figure 3). In addition, the conditions of long distance transportation of hydrocarbon are not available. Therefore, it is easier to capture hydrocarbon in the structures, which are near the oil resources than those which are far from the oil resources. Affected by the Northern Atlas fold belts, the study area was affected by northwest-directed compressional stress since late Cretaceous.

The faults and fractures are closed, which is unfavorable for the hydrocarbon migration and accumulation. However, the faults and fractures are unsealed, which is beneficial for the lateral and vertical migration of the hydrocarbon and for the improvement of the limestone reservoir property. The movement of salt in the late Palaeocene partially eroded mudstone of the Haria Formation, which is the regional covering strata (Figure 4), resulting in the maldistribution and the change of the thickness of the cap rock in the region (Figure 5). This can greatly influence the height of the hydrocarbon column in the reservoir, which can be sealed. The hydrocarbon column of reservoir with thick cap rock is high, while that with thin cap rock is low.

Conclusion

Based on this research, we concluded that the complex anticline belt in the central NK and the nosing belt in the eastern NK are two favorable areas of oil and gas accumulation, which provides guidelines for the exploration of carbonate reservoirs in this region.

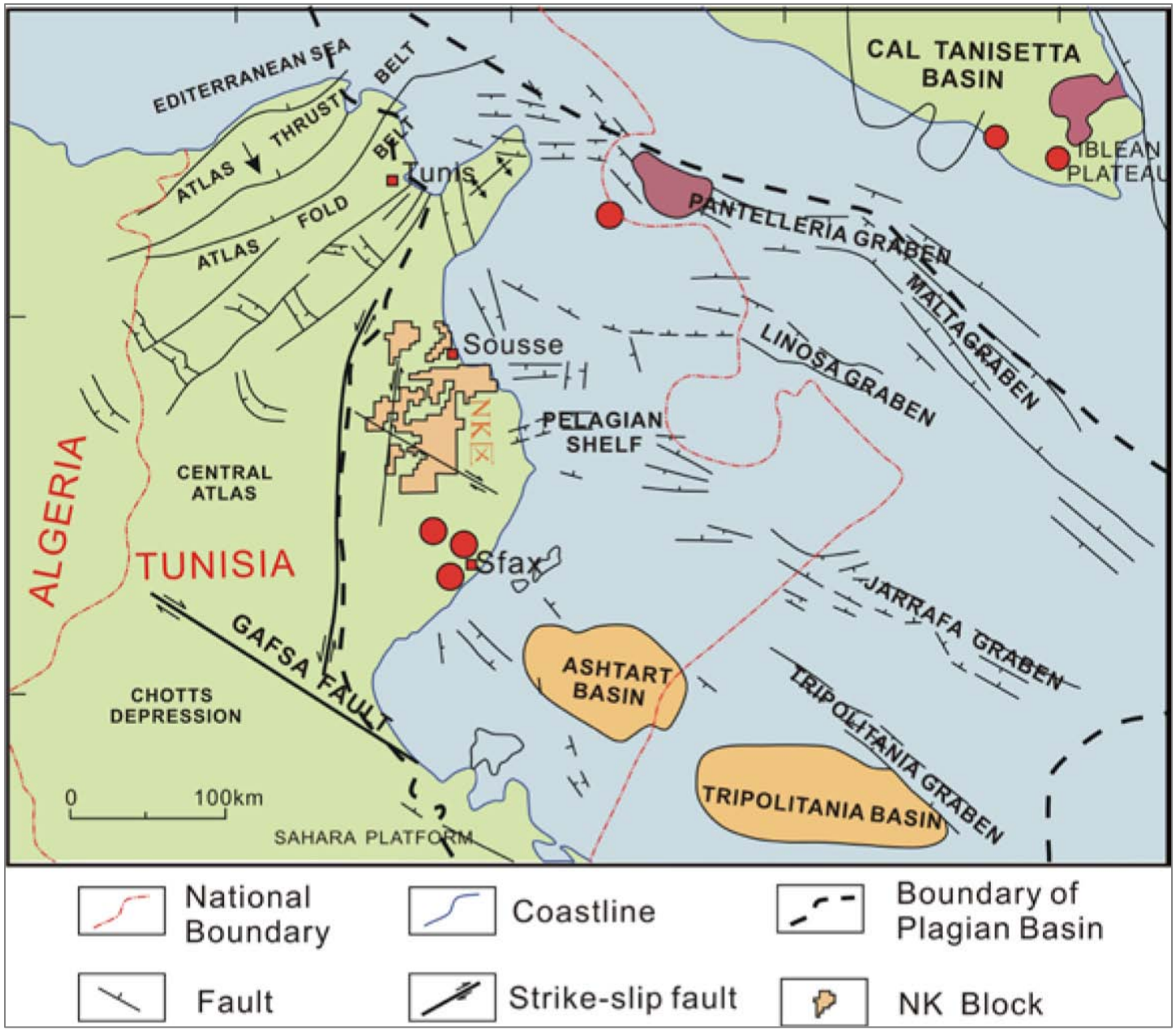

Figure 1. The structural location of NK.

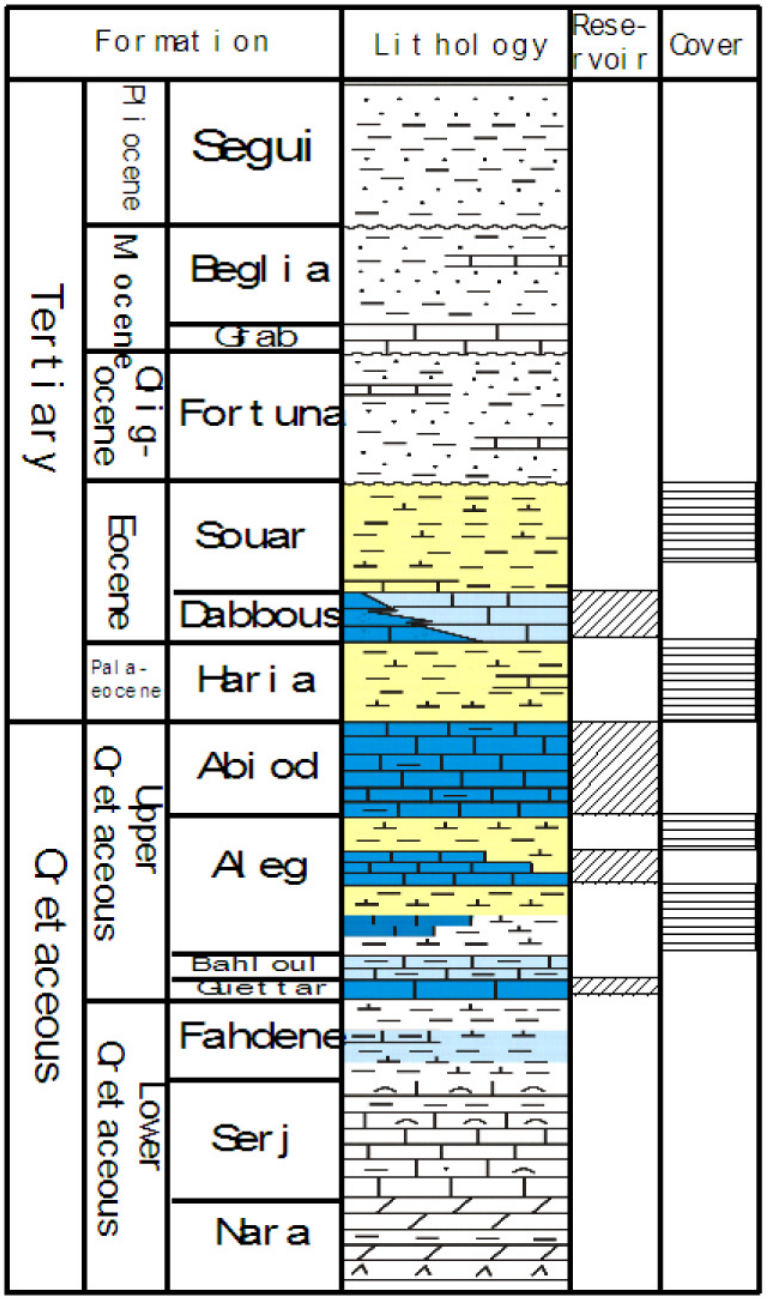

Figure 2. The stratigraphic column of Pelagian Basin.

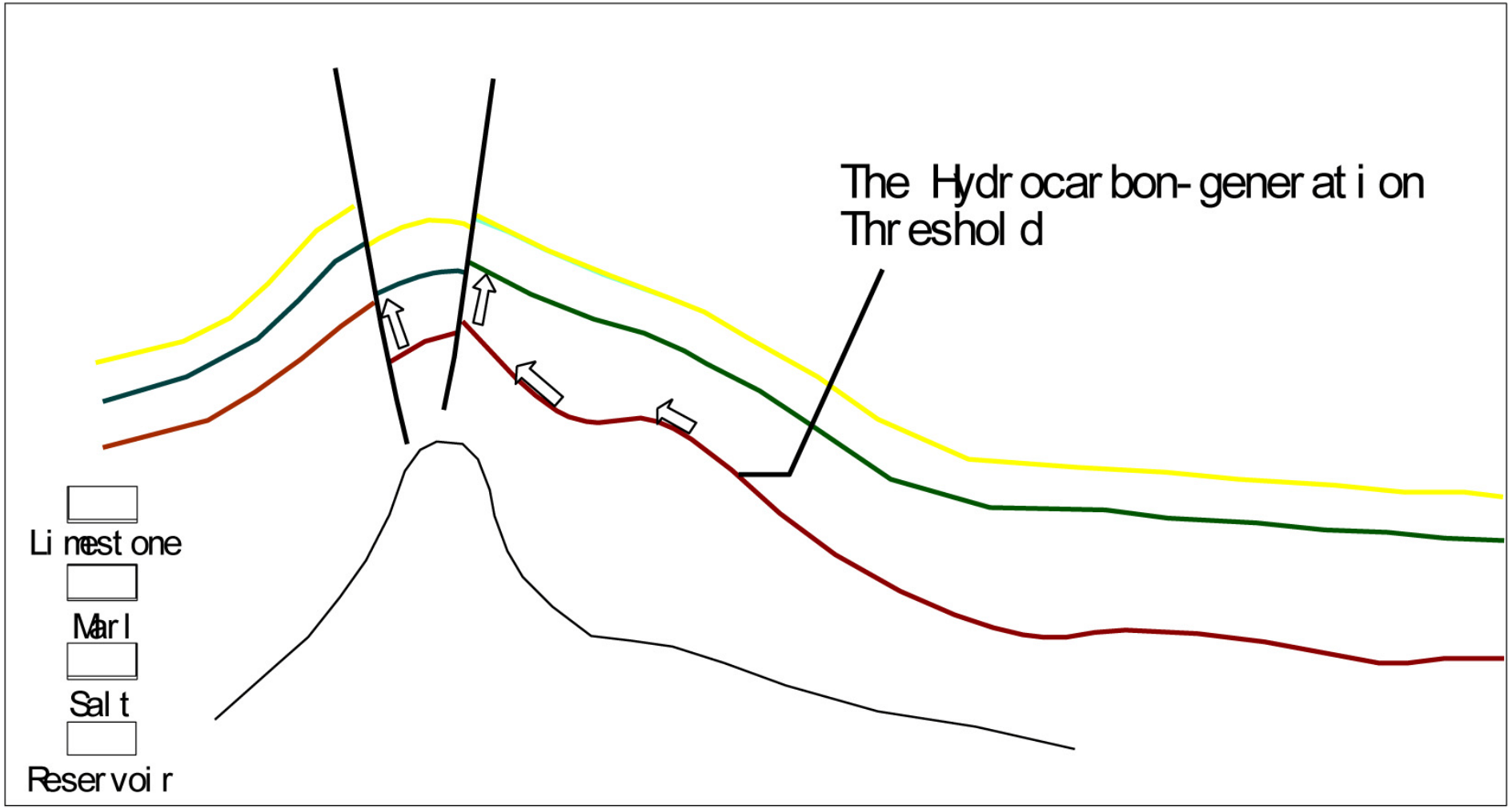

Figure 3. The relation hydrocarbon migration and accumulation of NK Region, Pelagian Basin.

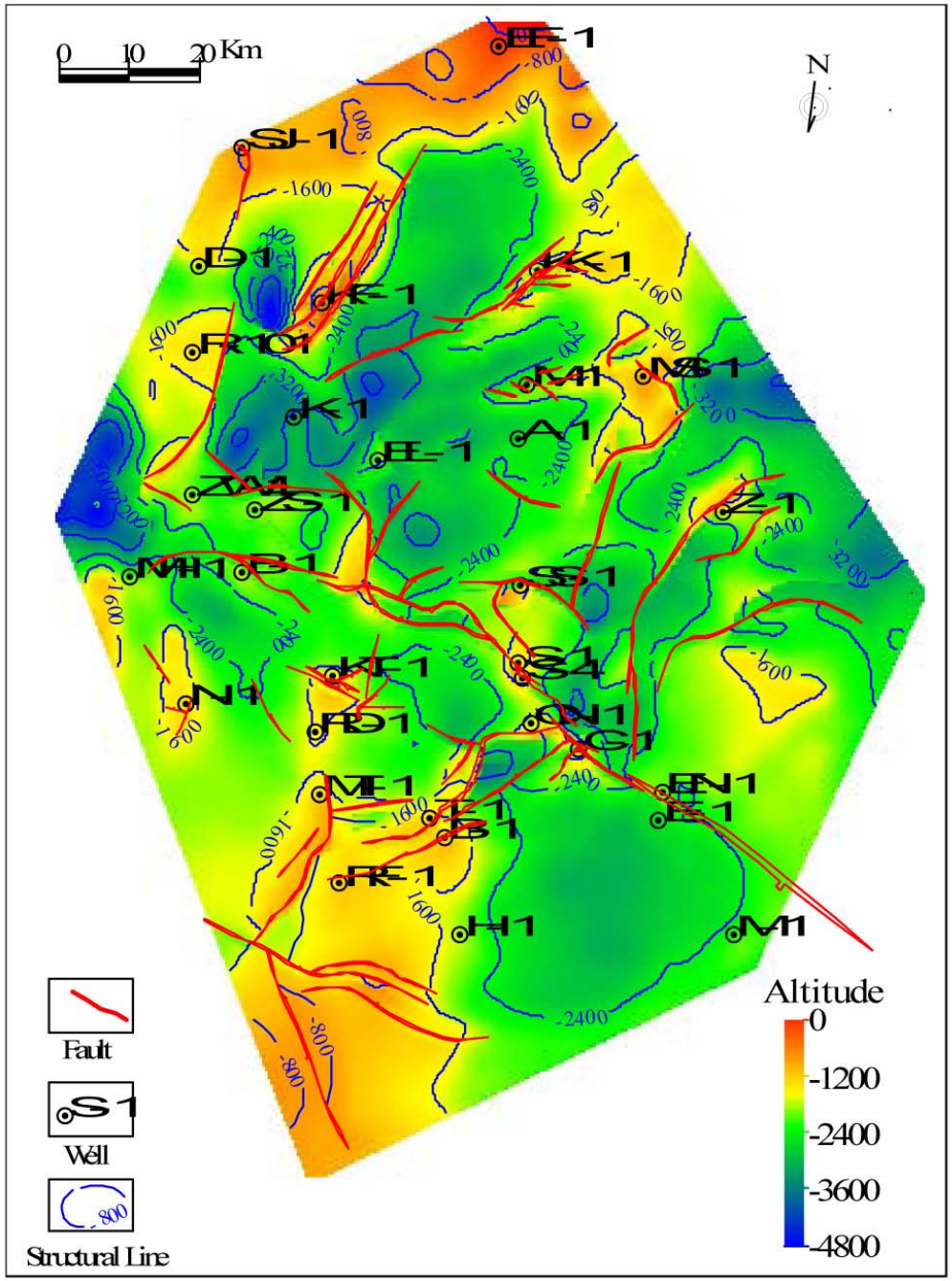

Figure 4. Sketch Structural Map of the Top of Cretaceous in NK Region, Pelagian Basin.

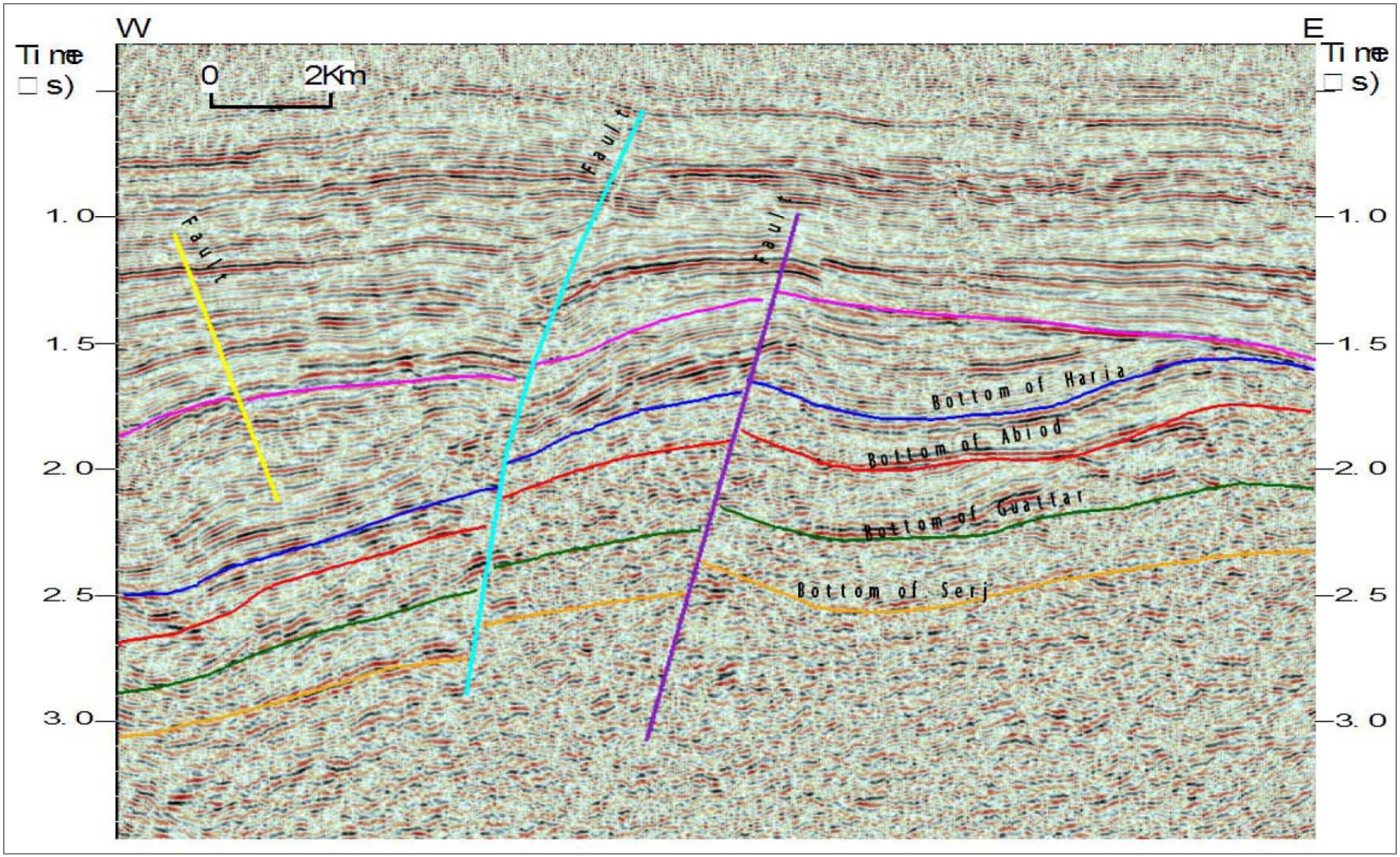

Figure 5. Seismic Section of the Southern NK Region, Pelagian Basin.