Pakistan Journal of Hydrocarbon Research
Vol.3, No.2(July 1991), P.43-46, 2 Figs.

Exploration for Subtle Traps in Pakistan

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ABSTRACT

Pakistan is facing acute energy crisis. The rise in the price of oil is adversely affecting the country's economy. Therefore, exploration of high risk subtle oil pools is now essential under the circumstances to supplement production from conventional traps. Enough data for the exploration of unconventional or subtle traps is available for the sedimentary basins of Pakistan which need proper interpretation by geologists. This data has been used for the search of areas of possible unconventional petroleum deposits in Pakistan in this paper.

An example of possible subtle accumulation of oil is cited from the mega-synclinal depressions of Punjab and Sindh. The study indicates that oil accumulation in big pools is possible on the platform side of the Punjab-Sindh monocline in the form of a belt composed upwards of light oil, heavy oil and bitumen. A method to explore such accumulation of oil has been indicated in the paper emphasizing on their exploration alongwith the search for conventional pools.

INTRODUCTION

The present energy crisis in Pakistan has been further aggravated by the unstable situation in the Middle East. The price of oil is also unstable and on the whole continues to show an upward trend in Pakistan. It is not only immediately affecting the overall development of the country but in consequence raising the prices of items of daily needs of common man.

It is, therefore, imperative for Pakistan that a planned acceleration should be made in exploration in which un-conventional pools should also be included. In this paper, the exploration for subtle traps or un-conventional pools in Pakistan has been discussed by providing an example for the same.

DATA AVAILABLE FOR EXPLORATION

As a result of wide spread geological studies during the last thirty years or so many factors of local as well as of regional interest have been brought out. Till to-day many petroleum structures have been mapped by geophysical and geological methods in various sedimentary basins of Pakistan. Also a number of exploratory wells have been drilled in these basins, which provide a wealth of information on petroleum geology. Almost all these wells have, however, been drilled simply on the basis of prospect generation by the ordinary and routine exploration technique of mapping a structural closure by the seismic and the geological surveys and then to drill the same if it has suitable stratigraphical environment.

Recently some good work on petroleum geology of Pakistan has been done by the Hydrocarbon Development Institute of Pakistan (HDIP) and Oil and Gas Development Corporation (OGDC). The HDIP has published a few maps which are of basic use including the one showing petroleum zones of Pakistan (Figure 1).

The data collected, interpreted and the studies made and published by various departments in the country are liberally being used in oil exploration in Pakistan by the foreign as well as the Pakistani oil companies. The author also has made use of this data for the review he is making at present of the petroleum potential of those areas which have some chances of un-conventional or subtle accumulations of oil and gas (Sokolov and Shah, 1966; Shah, 1972; Kingston et al, 1983; Kingston and Dishroon, 1983; North, 1984; Raza et al, 1989; and Hiller and Ahmed, 1990). For this purpose concepts are being developed to design methods to explore these possible un-conventional accumulations.

AN EXAMPLE OF POSSIBLE SUBTLE ACCUMULATION IN PAKISTAN

On the examination of the oil zones map (Figure 1), the eastern flank of the Punjab-Sindh mega-synclinal depression seems to be one of the receivers of oil generated in this depression. The geological reasons for the same are straight forward and given in the following paragraphs.

The oil which has been generated from the source rocks mainly of Cretaceous age in the depressions of Sulaiman and Kirthar regions (features A and B, Figure 1) partially migrated up towards the west and accumulated mainly in the traps met in pre-Eocene reservoirs on the way along the eastern side of the Sulaiman and Kirthar fold belt. In the same way a part of the oil has migrated up to the east on the monocline or the platform side of the depression. Because of the tectonic setting of this side, structures

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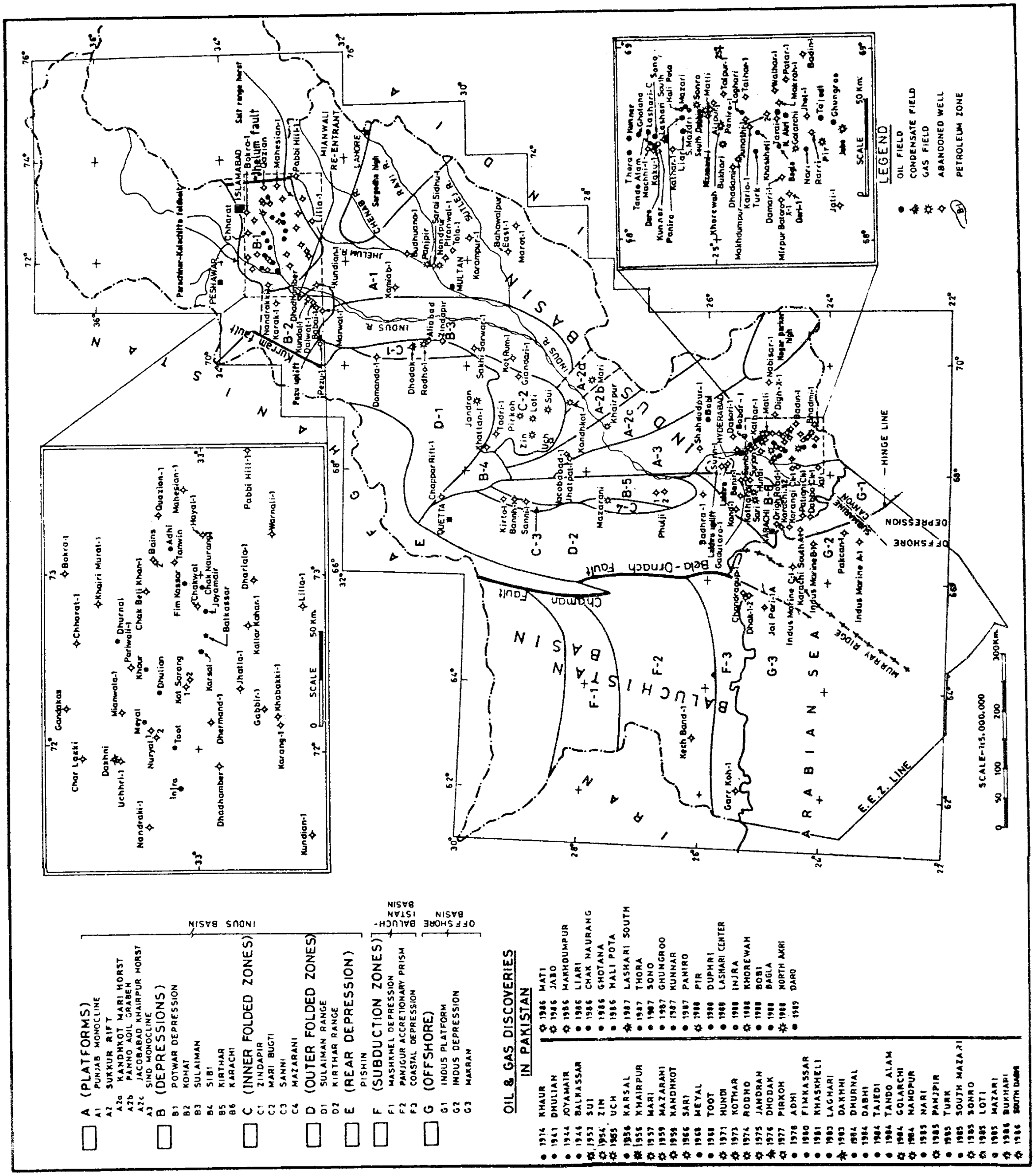

Figure 1— Petroleum zones of Pakistan (after Raza et al, 1989).

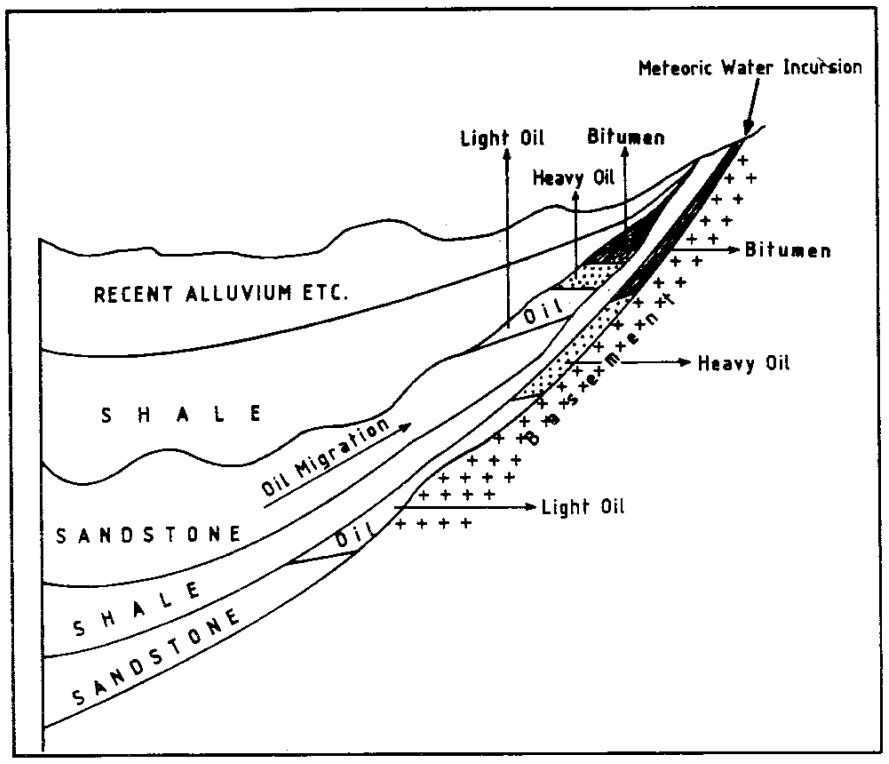

Figure 2— A diagramatic cross-section of typical monoclinal situation for accumulation of bitumen, heavy oil and light oil on the platform side of the basin.

similar to Sulaiman-Kirthar fold zones have not formed here. The migrating oil, if it at all accumulated, would be in the traps other than the orogenic ones. In many parts of the world long belts of bitumen and heavy oil are formed in this way on the platform side of the basin along the monoclines.

The regional hydrodynamic situation of the middle and the lower Indus basins suggests that the oil on the whole is hydrodynamically displaced or pushed from the hydraulically higher region of the west to east. This possibility is also indicated by Hiller and Ahmed (1990). It is in addition to the oil originally migrated to east from the megatrough. It is contemplated that in this way huge amount of oil has migrated east across the Punjab and the Sindh monoclines. The present structural configuration of the basement high and the overlying sediments in the region of Punjab and Sindh monoclines suggests a possibility that a part of the high might have come in the upper region under the influence of fresh water from the Indian shield in the east (Figure 2). The influx of the meteoric water might have as usual degraded the oil to form a belt of tar and bitumen, which might be flanking the monocline and may now be covered by thick deposits of U.Tertiary and Quarternary sediments. Evidence of tar has occasionally been reported from the marginal area of the sediments over the Indian Shield. The bitumen thus formed often serve also as a lateral seal for the pool (Figure 2).

Generally down the tar belts of the monoclinal slopes occur pools of progressively light oil. This is a subtle possibility but is well within the geological framework of oil occurrence on such monoclines.

METHOD OF EXPLORATION OF THE POOLS

An examination of the petroleum prospect of the monoclinal areas should be made first with the help of the existing geophysical and geological data and also by the study of wells which have already been drilled on the Punjab and Sindh monoclines. It will also assess what further work is needed to evaluate satisfactorily the areas of possible pools. Subsequently the suitable seismic and geological methods may be designed to locate the possible traps on the monocline. These traps may partially be closed by elements other than the structure. The updip seal in most of the cases is provided by the bitumen layer. For this purpose those wells which are on the higher part of the monocline should be examined for the occurrence of bitumen in the various reservoirs. This evaluation can easily be done with the help of the well logs and available rock cuttings and cores.

Similarly there is also a possibility of subtle traps in other oil zones in Pakistan. The exploration depending on geological environments of such traps is of higher risk as it is based on concepts rather than the closure which can be brought out by the routine structural mapping. However, the regional factors studied suggest that there is every likelihood of finding big pools of oil under such a subtle situation in the sedimentary basins of Pakistan.

RECOMMENDATIONS

It is the proper time that serious efforts should be made along with the exploration of structural traps for the search of subtle traps in the country. The exploration of such traps generally needs enough local as well as regional data to be properly interpreted to conceive the various types of controls on accumulation of oil in the region.

It is to be emphasized that the factors which control the hydrocarbons accumulation in the Middle and the Lower Indus basins seem to be such that majority of the subtle traps in the Mesozoic or older formations may yield mainly oil or oil with gas.

It is, therefore, recommended that the exploration, as suggested, be made sooner. It should, however, be done as much as possible side by side of the exploration for conventional oil and gas pools by picking up a compromised drilling location for various situations to test

them by one hole. This is being mentioned for the sake of balance of the cost between the conventional and un-conventional exploration to fit the same in the exploration budget.

REFERENCES

Hiller, K., and R. Ahmed, 1990, Oil resource potential of Eocene limestones in Sulaiman Depression: Pakistan Journal of Hydrocarbon Research, Islamabad, v.2, no.1, p.17-28.

Kingston, D.R., C.P. Dishroon, and P.A. Williams, 1983, Global basin classification system: AAPG Bulletin, v.67, p.2175-2193.

----------, 1983, Hydrocarbon plays and global basin classification system: AAPG Bulletin, v.67, p. 2194-2198.

North, F.A., 1984, Unconventional petroleum and natural gas deposits: Petroleum Geology, Allen and Unwin, London, p.94-112.

Raza, H.A., R. Ahmed, S. Alam, and S.M. Ali, 1989, Petroleum zone of Pakistan: Pakistan Journal of Hydrocarbon Research, Islamabad, v.1, no.2, p.1-19.

Shah, S.H.A., 1972, Geological Structure-As a guide in search for groundwater in higher region of Balochistan: Geonews, G.S.P., v.II, no.2, p.21-22.

Sokolov, B.A., and S.H.A. Shah, 1966, Major tectonic features of Pakistan part I, western Province, Science and Industry, PCSIR, Karachi, v.4, no.3, p.175-199.