BOOK REVIEW

A review with comments on *Genetic Mechanisms and Occurrence of Immature Hydrocarbons*

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(**Wang Tieguan *et al.*, Petroleum Industry Press, Chinese edition, 1995, pp. 1—239, ¥25; English edition, 1997 (in press)**)

SINCE commercial immature condensate and crude oil were found from the Beaufort-Mackenzie Basin, Canada and from the Shengli Oilfield, China in the early 1980s (Snowdon, 1980; Snowdon & Powell, 1982; Shi Jiyang *et al.*, 1982), petroleum geologists have attached importance to the genetic study of immature crude oil in order to search for new hydrocarbon resources. The book, *Genetic Mechanism and Occurrence of Immature Hydrocarbons* by Chinese scientists Prof. Wang Tieguan (T.-G. Wang) *et al.*, should be the first monograph on immature crude oil study although some papers concerning the discovery and generation of immature hydrocarbons have been published in succession in the world. This book is really an informative and applicable work important to the genetic research and exploration of immature hydrocarbons.

The book contains 12 chapters. Besides an introduction to the occurrence and distribution of immature crude oils in China and in the world in Chapter 1 and an overview of geological and geochemical regularities of immature hydrocarbon generation in Chapter 8, the authors use a space of five chapters from Chapter 2 to Chapter 6 specially to discuss immature source rocks, including maceral and organic composition investigations, qualitative evaluation and dividing criteria of evolution phases based on organic petrological and geochemical methodologies as well as source rock compaction and hydrocarbon expulsion and migration and so on. Taking some Chinese sedimentary basins or sags as cases, Chapters 9—12 expound five types of genetic mechanisms of immature hydrocarbons derived from suberinite, resinite, bacteria-reworked terrestrial organic matter, biolipids and early degraded sulfur-rich macromolecules. In addition, Chapter 7 is specially used to illustrate physical and chemical characteristics, distinguishable markers and genetic classification of immature oils and gases. Thus it can be seen that the emphases of this book are laid upon organic petrological and geochemical characteristics of immature source rocks as well as genetic

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other hand, the epigenetic features were formed as the result of remobilization or reworking of the preexisting stratiform ores by epigenetic hydrothermal solutions of meteoric origin during the late Mesozoic to Cenozoic. The authors think that the idea about the deposit origin of micro-disseminated gold deposits in southwestern Guizhou may open a new thinking for the study of the Paleozoic to Mesozoic sediment-hosted stratabound gold deposits in southern China.

References

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mechanisms of five kinds of source materials. All these are important issues for source rock evaluation and immature oil distribution in genetic theory study and explorational practice of immature hydrocarbons. Therefore, the book has very strong applicability.

The book was written on the basis of both the results of National Scientific and Technical Key Project and the projects supported by the National Natural Science Foundation of China, which were achieved by the authors during the "Eighth-Five-Year Plan" (1991—1995). Almost all the geochemical and petrological data on Chinese immature oils and source rocks are the novel information obtained from the analyses and detection in the authors' own laboratory. The samples analyzed by authors were collected from 9 sedimentary sags (i.e. Banqiao and Beitang Sags in Huanghua Depression; Dezhou and Shenxian Sags in Linqing Depression; Jihu, Hongze and Huai'an Sags in Subei Basin; Qianjiang Sag in Jianghan Basin and Xihu Sag in East China Sea Basin) and 5 middle-small basins (e.g. Turpan Basin in Xinjiang, East Jiuquan Basin in Gansu, Baise Basin in Guangxi, Huangxian Basin in Shandong and Jinggu Basin in Yunnan). Totally 563 source rock and 33 crude oil samples from 102 exploratory wells and related sections were collected, 24 items of analytical techniques of organic geochemistry, organic petrology and isotopic geochemistry adopted and 4 187 analytical data achieved. Therefore, the book provides the novel and abundant information and data on the major Chinese immature hydrocarbons and their source rocks for readers, which would be of significant and applicable value, especially for the research on geochemical characteristics and genetic mechanism of Chinese immature hydrocarbons as well as for directing immature hydrocarbon exploration.

Based on the analysis and investigation of various source rocks (e.g. mudstones and coal) of freshwater swamp and limnic facies, fresh-, brackish- and saline-water lake facies and hypersaline lake facies, by means of the study of maceral and biomarker assemblage features and genetic correlation between maceral/bitumen and hydrocarbons for representative source rocks in several typical basins, an important content in this book would be the demonstration of five mechanisms of early hydrocarbon generation from different source materials, i.e. suberinite, resinite, bacteria-reworked terrestrial organic matter, algal and higher plant biolipids as well as sulfur-rich macromolecules (such as non-hydrocarbons, asphaltenes and type Ⅱ-S kerogens). In addition to respective case analysis of rocks and oils sampled from relevant basin (or basins) for each source material, these genetic mechanisms have revealed the multiplicity of source material for immature hydrocarbon generation processes, which implies that the immature hydrocarbon generation would not be limited to only one model or one kind of source material, and multiple model and source material types may be involved. In nature, crude oil and natural gas generation should be closely related to either the original composition of organic matter itself, or the function of various geological agents, and be studied from macroscopic observation of geological phenomena to microscopic analysis of macerals and molecular compounds. It is the five genetic mechanisms established in the book that furnish readers with a paragon of research in this field and inspire people greatly.

One reason why five genetic mechanisms of immature hydrocarbons can be established and their source materials can be determined in the book would be the investigation of various sedimentary rocks conducted by the authors, from which a variety of typical source rocks respectively with a certain predominant source material for hydrocarbon generation have been discovered and studied. Another reason is related to a combining application of organic petrological and organic geochemical techniques, which has been introduced in detail by the authors. As for the application of organic petrological method in the book, for instance, features of maceral fluorescence spectra have been commonly adopted to characterize the hydrocarbon generation processes and divide evolutional phase of maceral besides a general observation of optical and shape characteristics. As far as organic geochemistry is concerned, biomarker assemblage characteristics of total hydrocarbon fractions are also used to show the source input feature of immature source rocks, which would have made gratifying progress in the methodology of biomarker parameter application to describing source input from qualitative to quantitative stages, in addition to the application of individual biomarker to characterizing source material and recognizing bacterial reworking on organic matter during hydrocarbon generation. Undoubtedly, all these methods would be worthy to be used by scientific and exploration researchers for reference in theoretical and methodological studies of oil and gas generation.

Moreover, based on the literatural investigation and their own research result, the authors have also introduced occurrence and distribution of immature oil resources both in China and in the world as well as

their geological and geochemical regularities. These are valuable for reference especially in the research and exploration of Chinese immature hydrocarbons.

The publication of this book has made an encouraging step for the theoretical study of immature crude oil generation. The genetic mechanisms of five kinds of immature oils proposed by the authors are principally established on the basis of biomarker assemblage and source input percentage in source rock as well as relationship between burial depth and hydrocarbon transformation ratio. However, owing to the fact that the source input of organic components with lower chemical activation energy has multiplicity and complexity, both the determination of organic composition in macerals, and the reaction mechanism and hydrocarbon generation process of lipids and sulfur-bearing macromolecules are still in need of further substantiation and perfection. As for the application of biomarker assemblage to distinguishing source inputs, how to select better representative markers also remains to be further studied. In addition, the book expounds, after all, mainly immature source rocks and their relationship with immature crude oils, there is less relation with immature gas. In brief, the publication of the book opens up a research field for petroleum geology and organic geochemistry and makes contribution to theoretic research of immature crude oil generation, and its deficiency offers thinking and chance for our further study.

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