Epilogue

The project "**Basic Theory of CBM Geology and Development in China**" is on the way of the development of China's CBM industry. At the beginning of the project, CBM wells drilled were not more than 300, and the annual output of CBM was less than 1×10^8 m^3 in China. Commercial CBM development had not yet begun. After more than five years, CBM wells drilled have reached more than 2000, and the output has increased to 4.5×10^8 m^3 per year, and the production capacity has expanded to 15×10^8 m^3 per year. The development history of Canada's CBM industry shows that the annual production of CBM was 5×10^8 m^3, and the wells drilled were only 700 in 2003; by 2007, the production of CBM increased to 103×10^8 m^3, and the wells drilled increased to more than 16,000. China's CBM industry is at the beginning of rapid development. China's CBM resources have a great potential, and the technically recoverable resources of CBM are up to 13.9×10^{12} m^3. At present, the proven rate of CBM is less than 0.4%. The development of China's CBM industry should start from basic researches on the forming mechanism, distribution law and control factors of CBM, and finally specific technology.

The basic research plays a very positive role in the development of CBM industry. We have achieved four innovations in basic theoretical research—understood CBM genesis, occurrence, accumulation and permeability, systematically established China's CBM geological theory system, enriched and perfected natural gas geological theory, and built the theoretical basis for gas resource evaluation, enrichment prediction and economic development; and five innovations in method and technology—built an experimental platform for basic research of CBM, and developed a series of technologies for CBM recoverable resource prediction, comprehensive geological evaluation, geophysical exploration and production optimization design which have been applied in field. The application of the innovations has achieved good economic and social benefits.

However, there are challenges that restrict the development of CBM in China.

According to the experience of foreign CBM development, CBM blocks with high abundance play important roles in CBM reserves and production increase. The Fruitland CBM enrichment belt in the San Juan Basin, USA is 14 km wide and 64 km long; the abundance of the CBM resources is 1.6×10^8–3.3×10^8 km^2; and the output of a CBM well can reach 2.8×10^4–16.8×10^4 m^3/d, and the annual output accounts for 50% of the total annual output of CBM in the United States. According to the formation and distribution characteristics of CBM in the Qinshui Basin with high degree of CBM exploration and development in China, the CBM geological characteristics and drilling conditions prove that the southern part of the basin is conducive to accumulation of CBM. But researches have not yet targeted the formation, distribution and prediction of CBM enrichment zones with high abundance, and the control factors and enrichment mechanism of high abundance CBM zones are unclear. These restrict the selection and development of the high-abundance CBM enrichment zones with the similar characteristics to the Fruitland CBM enrichment belt.

The geological conditions of CBM in China are very diverse. At present, CBM production mainly depends on vertical wells and pinnate multi-branch horizontal wells; production increase depends on hydraulic fracturing stimulation; both natural and stimulated productions are low and well production is low. The primary cause is that the mechanism, adaptability and control factors of the producing methods are unclear. For example, the structural deformation of the coal seams in China is quite serious, resulting in complex coal structure, more fragile rock mechanical properties, low permeability, greatly varying production performance, and difficult and ineffective fracturing stimulation. Present economic benefits of CBM development are very unsatisfactory. It is necessary to study interwell interference, improve the theory and technology of coal reservoirs, and understand fracturing mechanism, fracture propagation and control factors, reservoir damage, pinnate horizontal wells, etc., and finally propose optimized CBM development plan to increase CBM production.

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In summary, present researches mainly focus on the microscopic mechanism of CBM occurence, the law of CBM accumulation, the forming mechanism of CBM reservoirs and the distribution of CBM resources in large regions and basins, but less on the distribution law, prediction and evaluation of CBM enrichment zones. For production technology, researches have been done only involving numerical simulation to producing CBM while draining water from single wells and horizontal wells, CBM desorption and seepage laws and seepage mechanism, but less on well group and stimulation mechanisms, even little on interwell interference, reservoir damage and protection. It is recommended to consider the following two important points in the future 973 Program: the mechanism and evaluation of abundant CBM enrichment zones; technical approaches to increase CBM production. All these will promote the basic theoretical researches on CBM geology and development, and make greater contributions to the rapid development of China's CBM industry.