
Preface

“Going up to the space, reaching the interior Earth, entering into the sea” are three magnificent feats of human beings to challenge the natural world to expand living space. For thousands of years, human beings have achieved great success in going up to space and entering into the sea, while still struggling hard with the exploration of the interior Earth. Scientific drilling is a great project with epoch-making significance in contemporary Earth Science research. Through the direct observation of the lithosphere by scientific drilling, the material composition and structure of the continental crust can be explained, results of geophysical telemetry of the deep Earth can be rectified, the deep Earth fluids system and geothermal structure can be studied, the distribution and incubation conditions of subsurface microbes can be explored, and then the development of deep Earth geology can be promoted, and all these are helpful to solve a series of fundamental scientific problems, such as global climate change, law of earthquakes and biological origin, etc. In conclusion, scientific drilling, which is of very important significance to solve the problems of resources, disasters, and environment during the development of human society, is also a major scientific project which can bring along the development of relevant engineering technology, and is another magnificent challenge toward the Earth after man’s landing on the moon.

The China Continental Scientific Drilling (CCSD) Project is a major national science project listed in the ninth Five-Year Plan (1996–2000), as well as a project of the International Continental Scientific Drilling Program (ICDP) currently being implemented. The main task of the project is to drill a 5,000-m-deep well for continuous directional cores, rock, and fluid samples, and in situ downhole observation data in Dabie-Sulu ultrahigh-pressure metamorphic belt, a global significant convergent plate boundary, to make comprehensive geophysical surveys, identify the material composition and structure of the continental orogenic belt, and reveal the formation and exhumation mechanism of the ultrahigh-pressure metamorphic belt. The 5,000-m-deep well will be built as a long-term underground observation and experimental base.

With tremendous technical difficulties, it is the first time in our country to construct a 5,000-m-deep well in hard crystalline rocks for full-hole continuous coring, which is one of the most difficult drilling constructions in the world as well. For nearly four years, from the project feasibility study, drilling technical personnel of our country have played their wisdom and creativeness and overcome numerous difficulties during the stages of engineering design, drilling construction, research and application of the key technologies, and solved construction problems until the successful completion of the project. While absorbing the world’s advanced technology on scientific drilling, they successfully created and applied a series of new technologies and equipment, formed the new scientific drilling technology system with Chinese characteristics, which withstood the severe test of hard rocks and complex formations in Sulu ultrahigh-pressure metamorphic belt, completed CCSD-1 Well with high quality and efficiency and at low cost, and made outstanding important engineering achievements. These achievements greatly promoted the progress of scientific drilling technology, as well as exploration drilling for energy and resources. The success of CCSD-1 Well not only showed that deep drilling technology in our country had obtained great progress, but also greatly enhanced China’s international standing in drilling technology.

The implementation of the CCSD Project is the start of the magnificent plan of “reaching the interior earth” in China, with initiative in the history of the Earth Science research in the country. In recent years, the environmental scientific drilling and the Cretaceous scientific drilling have been started in China, and the ultra-deep scientific drilling for oil and gas resources and deep solid mineral resources will be gradually started. A new situation in Earth Science has been formed; marking China’s new step that has made it from a large geoscience country to a powerful geoscience country, which is bound to make impacts on the harmonious development of the society and nature and the modernization of our country.

This book comprehensively describes the drilling technologies of CCSD-1 Well, brings together various data and information accumulated in the process of drilling, and shows the latest technologies and research achievements of scientific drilling in China. The main authors of the book all used to take the major tasks at the construction site as technical backbone, and this book is a summary of their creative thinking in drilling practice, and the crystallization of their wisdom.

Veteran drilling experts threw all their energy into the project. They laid a very strong technical foundation for the start of the project. The project gathered a large number of outstanding middle-aged and young technical experts; some of them have extensive management experience; some have solid theoretical foundation and research experiences of many years, being creative and good at solving the new problems arisen during the construction; some have worked throughout the year at drill sites for technical services and production supervision and been adept in solving complex problems happened at the drill sites; and some just graduated from schools, being quick thinking and enthusiastic, with new professional knowledge, especially modern data processing technology, and brought fresh air to the drill site.

In order to enable the project to come up to international professional standards, the majority of the construction staff received training from the International Continental Scientific Drilling Program (ICDP). It is their hard work that offered the book with a wealth of original materials.

It has to be particularly noted that Liu Guangzhi, an academician of the Chinese Academy of Engineering, has led and organized the continental scientific drilling in China for decades. He first introduced the recent progress in this field and advocated the implementation of China’s Continental Scientific Drilling Project; organized the planning of scientific drilling program and the discussions of technical program in the country, compiled a Series of Exploration of the Deep Continental Crust (eight volumes), cultivated a great number of middle-aged and young scientific and technological personnel engaged in scientific drilling, and therefore laid a solid technical foundation for the success of CCSD-1 Well.

Dedicated help and support to CCSD-1 Well project were given from the Institute of Exploration Techniques of CAGS, Beijing Institute of Exploration Engineering, the Institute of Exploration Technology of CAGS, China University of Geosciences (Wuhan), China University of Geosciences (Beijing), Construction Engineering College of Jilin University, Chengdu University of Technology, Zhongyuan Petroleum Exploration Bureau of Sinopec Group, Shengli Petroleum Administration Bureau of Sinopec Group, Dezhou Oil Drilling Institute of the Academy of Oil Exploration and Development, and Drilling Research Institute of CNPC and China University of Petroleum (Beijing). The Department of Land and Resources of Jiangsu Province and Geology and Mineral Exploration Bureau of Jiangsu Province Lianyungang City, Donghai County, and other circles paid great attention to the project. The authors would like to express their heartfelt thanks to the Drilling Engineering Advisory Committee and the experts from all fields, for their suggestions and great efforts to the drilling engineering. The members of the Drilling Engineering Advisory Committee are as follows:

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The China Continental Scientific Drilling Project

CCSD-1 Well Drilling Engineering and Construction

Wang, D.; Zhang, W.; Zhang, X.; Zhao, G.; Zuo, R.; Ni, J.;

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