

Primitive Solar Nebula and Origin of Planets

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Edited by

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Preface

Until the middle period of 20th century, the subject on the Origin of the solar system was the matter of conceptual studies and it was rather close to philosophy than it was science. The present studies on the origin of the solar system are, however, entering in the era to pursue the quests for solving problems as fundamental science relating to the origin of our earth and lives on it: The position of the scientific interest of the studies on the origin of the solar system is then almost equivalent to those of the studies on the origin and evolution of universe and the origin of materials.

New developments of the space technology, especially the efforts of NASA and the former USSR space exploration programs have worked as new frontiers for exploration of the solar system. In addition to the explorations of the moon by Apollo missions, the studies on the exploration of the surface of the terrestrial planets, Venus, Mars, and Mercury have provided data for understanding basic processes for the formation of the solar system. The exploration of the solar system was not limited in the range of the terrestrial type planets but the activities have ambitiously been expanded to the giant planets by Pioneer 10- and 11-spacecraft and also historical monuments of the 20th century were established by two Voyager spacecraft that had made their first visit to the giant planets; eventually one of the spacecraft visited Neptune on August 24, 1989 and now leaving the solar system.

The frontier for exploration of the solar system is not necessarily depending on the gigantic space programs but developments of clever computer system provide new technical supports for understanding, by simulations of the processes, the evolution of the primordial solar nebula. Being combined with observational data provided by cometary observations, we can make approach to confirm the real evolution of the solar system by analyzing the behavior of the nebula gas. To understand past processes for the formation of terrestrial planets and also collection of their original materials, *i.e.*, meteorites, are one of the most important keys to resolve

the question of the processes of the formation of the planetesimal as a kind of Rosetta-stone. Accurate measurements of isotopic anomaly in meteorites are also important by providing basic problems for understanding the behavior of the nebula gas in the primordial solar system. Even more ambitious approach has also been planned for the studies on magnetic fields in meteorites for investigation of ancient magnetic fields in the primordial solar system, which are believed to be frozen in the portion of magnetic materials. In this context, important points are in that the analyses of meteorites and the computer simulation studies for the solar system nebula are subjects in realms of fundamental science that belong to the individual insight and skillful technique of scientists who work in science societies which are not necessarily equipped with gigantic space programs.

Being based on these backgrounds of the society for solar system studies, a scientific project "Primitive Solar Nebula and Origin of Planets" have been held from April 1987 to March 1990, as a project supported by the Grant-in-Aid for Scientific Research on Priority Areas of Japanese Ministry of Education, Science, and Culture. The project has been carried out with six research subjects:

- i) Origin and evolution of the primitive solar nebula,
- ii) Origin and evolution of the giant planets,
- iii) Origin and mother bodies of meteorites,
- iv) Origin and structures of the terrestrial planets,
- v) Origin and evolution of the planetary atmosphere,
- vi) Basic studies on the solar system exploration for the quest
of the origin of the solar system.

The present book is direct outcomes of the project; therefore the book contains results obtained by research activities covering the whole range of the studies in the project. The contents mostly consist of the original contribution papers from the member of research projects; there are, however, a few exception such as the review on the giant planetary observations given in Chapter 2. Chapter 6 is mostly depending on the observational results of Halley's comet, that have been provided by Sakigake and Suisei spacecraft missions that had been conducted by ISAS (Institute of Astronautical and Space Science). There are common reasonings for selecting brief review of NASA giant planet explorations and reports of the Halley's comet explorations, in this book, to include the monumental achievements of objects

directly related to the studies on solar system in 20th century. These are tightly linked to the scopes of the research papers resulted by basic studies in our present project. We hope, therefore, that the present book will make continuous contribution for future studies on the origin of the solar system crossing over AD 2000 year as well as to be useful material for the immediate purposes.

The editor thanks for all of the supports to complete the research program and the present book especially; the studies are supported by the Grant-in-Aid for Scientific Research on Priority Areas of Japanese Ministry of Education, Science, and Culture, “Primitive Solar Nebula and Origin of Solar System” and the program for summarizing the studies with publication is also supported by the Grant-in-Aid for Scientific Research on Priority Areas (No. 02299010). Finally, he wishes to acknowledge Prof. K. Nakazawa and Mrs. T. Yuda for their substantial efforts in the preparation of this book.

December 1, 1990

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