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Preface: Evolution of the early solar system: Presolar cosmochemical fingerprints and the formation of watery rocky planets

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Recent developments in cosmochemistry of high-precision and high spatial resolution isotope analyses, and of high-performance computing techniques, have enabled cosmochemists to gain vital insight and information on the pre- and early solar system. This special issue collects cutting edge studies presented in the Theme-1 "Cosmochemistry" of the 24th annual V. M. Goldschmidt conference held in Sacramento, CA, USA. The scope of this issue spans from the nucleosynthesis of the elements and stellar and galactic chemical evolution (Floss and Haenecour, 2016; Qin and Carlson, 2016) to the lively debate related to the delivery and evolution of water on terrestrial planets in our solar system (Genda, 2016; Kurokawa *et al*., 2016).

Floss and Haenecour (2016) review mineralogical and cosmochemical studies of presolar silicates since their initial discovery in 2003 as the last major type of presolar grains. Presolar grains are interstellar condensed matter that formed in the outflow of evolved stars and in the ejecta of stellar explosions. Presolar silicates are of special interest because they are more abundant and more diverse in mineralogy and elemental composition than most other phases in the presolar grain inventory, providing important information about stellar environments. This paper also reviews how the recent advancements in micro-analytical techniques, including secondary ion mass spectrometry (SIMS), Auger spectroscopy, and transmission electron microscopy (TEM), have contributed to the study of presolar silicates.

Along with the micro-analytical studies of presolar grains, stellar nucleosynthesis has also been intensively investigated based on high-precision bulk isotope analyses of primitive meteorites and their components, such as calcium-aluminum-rich inclusions (CAIs). Qin and Carlson (2016) comprehensively review studies of mass independent isotopic anomalies of heavy elements (Ca, Ti, Cr, Ni, Sr, Zr, Mo, Ru, Ba, Sm, Nd, Hf, W, and Os) that have provided new constraints on the sources, distribution, and dynamical nebular processes of nucleosynthetic products in the early solar system.

The existence of persistent surface/subsurface water is closely linked to the climate, near-surface environments, and habitability of life on terrestrial planets and possibly icy moons. Genda (2016) tackles a challenge to the long-standing issue of the origin of Earth's ocean water. He synthesizes astronomical, cosmochemical and high-pressure experimental studies to answer key questions about the delivery, distribution, and inventory of water on Earth.

Earth is not the only rocky body in our solar system that contains evidence of significant water. Fluvial landforms on Mars suggest that it was once warm enough to maintain persistent liquid water on its surface. The transition to the present cold and dry Mars is closely linked to the history of surface water, yet the evolution of surficial water is poorly constrained. Kurokawa *et al*. (2016) describe the evolution of hydrogen isotope compositions (D/H) and volumes of Martian water reservoirs based on a new multi-water-reservoir model. The model suggests the possibility that subsurface water-ice exists, and that it exceeds the observable present surface water inventory on Mars.

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REFERENCES

Floss, C. and Haenecour, P. (2016) Presolar silicate grains: Abundances, isotopic and elemental compositions, and the effects of secondary processing. *Geochem. J*. **50**, this issue, 3–25.

Genda, H. (2016) Origin of Earth's oceans: An assessment of the total amount, history and supply of water. *Geochem. J*. **50**, this issue, 27–42.

Kurokawa, H., Usui, T. and Sato, M. (2016) Interactive evolution of multiple water-ice reservoirs on Mars: Insights from hydrogen isotope compositions. *Geochem. J*. **50**, this issue, 67–79.

Qin, L. and Carlson, R. W. (2016) Nucleosynthetic isotope anomalies and their cosmochemical significance. *Geochem. J*. **50**, this issue, 43–65.