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SUMMARY OF MULTISCALE OBSERVATIONS OF MARTIAN CARBONATES: IMPLICATIONS FOR PLANETARY SYSTEM SCIENCE

Abstract

As an important terrestrial object in the solar system, the formation and evolution of Mars has always been the focus of our attention. Martian carbonate plays an incomparable important role as an important mineral to interpret the "atmosphere-rock-water" interaction process on Mars and to indicate the evolution of Martian climate and environment. The rise of Earth System Science is an important embodiment of systems thinking in Earth Science research, but unfortunately, the current planetary science returns a small sample size, which is not conducive to the comprehensive understanding of extraterrestrial objects. Considering the increasing number of extraterrestrial samples and scientific data obtained by planetary exploration missions, it is urgent to extend the research paradigm of Earth system science to other planets. In this paper, we synthesize orbital spectral data (CRISM, OMEGA), lander/rover data, meteorite research and analogy experiment simulation data to reveal the distribution of Martian carbonates from the perspective of planetary system science, and evaluate the current model of the formation mechanism of Martian carbonates from different dimensions. In this paper, we focus on the three dimensions of the spatiotemporal heterogeneity of Martian carbonate distribution (global-scale orbiter data-regional-scale lander data)-micro-scale meteorite research)) and the evaluation criteria of each Martian carbonate formation mechanism model, and thus propose the five core concepts of planetary system science: systems thinking, interdisciplinary integration, comparative planetology, and multi-scale research in time and space. In addition, the Martian carbonate synthesis study identified six main scientific methods for planetary system science: observation and exploration, laboratory simulation, numerical simulation and modeling, comparative analysis, data-driven research, and interdisciplinary collaboration. Finally, from the perspective of planetary system science, the formation of carbonates can be used to invert the changes in the surface environment of Mars by establishing the coupling process of atmosphere, hydrosphere and lithosphere, which provides new enlightenment for the study of planetary habitability and the exploration of extraterrestrial life.