



Mars Express science highlights and future plans

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After 16 years in orbit Mars Express remains one of ESA's most scientifically productive Solar System missions which publication record now approaches 1300 papers. Characterization of the geological processes on a local-to-regional scale by HRSC, OMEGA and partner experiments on NASA spacecraft has allowed constraining land-forming processes in space and time. Recent studies suggest geological evidence of a planet-wide groundwater system on Mars and surface clay formation during short-term warmer and wetter conditions on a largely cold ancient Mars. HRSC team released the Digital Elevation Model (DEM) of the MC-11 quadrangle and the Southern polar cap at 50 m/px resolution. Mars Express provided essential contribution to the selection of the Mars-2020 landing sites and supporting characterization of potential landing sites for Chinese Tianwen-1 mission.

One-and-one-half decade of monitoring of atmospheric parameters such as temperature, dust loading, water vapor and ozone abundance, water ice and CO₂ clouds distribution, collected by SPICAM, PFS, OMEGA, HRSC and VMC together with subsequent modeling have provided key contributions to our understanding of the Martian climate. In 2019 PFS confirmed observations of a methane abundance "spike" in the Gale crater observed in situ by the Curiosity Rover. Recent similar quasi-simultaneous observations were in disagreement, thus indicating that the methane "enigma" continues. This poses a significant challenge to both observers and modelers. The radio-science experiment MaRS revealed fine structure of the boundary layer which depth varies from 2 km in topographic lows to ~10 km over highlands.

Observations of the ion escape during a complete solar cycle revealed that ion escape can be responsible for removal of about 10 mbar of the atmosphere over Mars' history. This implies existence of other, more effective, escape channels. The structure of the ionosphere derived from MARSIS and MaRS sounding was found to be significantly affected by the solar activity, dust loading in the lower atmosphere, and crustal magnetic field. The observations suggest that the sunlit ionosphere over the regions with strong crustal fields is denser and extends to higher altitudes as compared to the regions with no crustal anomalies. Ionospheric models aim at creating user-friendly data base of plasma parameters that would be of great service to the planetary community. Focused exploration of the Martian moons continues.

The mission is notionally extended till the end of 2022. A science case for the mission extension till the end of 2025 has been submitted. The talk will give the Mars Express status, review the recent science highlights, and outline future plans including synergistic science with TGO.

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