Some Salient Results (MCC / MSM)

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VEDAS, Feb 28, 2017
1) Status & Planned Objectives
2) Objectives met with
3) Highlights
4) Future plans
Launched - 5 Nov 2013
MOI - 24 Sept 2014
Ideal for comprehensive geological interpretation (Varying Scales)
PLANNED OBJECTIVES –

1. To map various morphological features on Mars with varying resolution and scales using the unique elliptical orbit.

2. To observe dynamic events like dust storms, dust devils, clouds etc.

3. To attempt opportunistic imaging of natural satellites of Mars and other celestial bodies, if any.

4. To provide context information for other science payloads.

5. To map the geological setting around sites of Methane emission source.

6. To map Martian polar ice caps and its seasonal variations.
MCC coverage 24-09-2014 to 27-02-2017

Number of images having spatial resolution
i) up to 20 m: 6
ii) 20 to 50 m: 84
iii) 50-100m: 30
iv) 100-200: 95
v) >200m: 501

Total number of data sets: 716

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Last date of acquisition: 03-01-2017
Full Disc: Unique

Marci, MRO (NASA)

Click to Play

Visual Monitoring Camera, VMC (ESA)

MCC

Uniform Radiometry

Good Geometric Control
Martian Surface Studies

- Morphological
- Structural
- Polar Ice
- Change detection studies
- Surface Age Determination

Martian Atmosphere

- Dust Storms / Dust Devils - Monitoring
- AOD
- Clouds
Strike-Slip fault

Offset ridge

Fault

Offset ridge

0.8 km
Formation of new Impact crater or exposure of buried crater: Amazonis Planitia, Mars

MOC Data (1997)

MCC Data (2014)

Viking Data (1976)
Fine Dust Mantling

Gale

Lasswitz Crater
139m Spatial resolution
Altitude 2664 km
Start Time 2015-02-25, 10:00:02.795

- **Length of streaks:** 8km to 45 km
- **Area of bright region in southeast side of Kinkora crater (yellow)** could be new deposits of sand or dust is 2095 sq. km. (MCC), 1710 sq. km. (MOC)
- **Total number of streaks in the present study regions:** 68
- **New streaks found in MCC:** 2 (they also have been seen in MGS-MOC)

231 m Spatial resolution
MGS-MOC Mosaic (1996)

230 m Spatial resolution
Viking Mosaic (1975 to 1980)
Study area - Terra Cimmeria,

Results: The estimated age is 3.82, 3.92 Ga (Noachian unit) which matches with published maps (Middle Noachian highland)

✓ (Noachian epoch 4.5 billion years ago to 3.5 billion years)

```ALL THE ADEQUATE NO. OF CRATERS HAVE BEEN PICKED UP BY MCC REQUIRED FOR AGE-DETERMINATION OF SURFACE```

(Arya et al 2012, Current Science)
MCC mosaic of the Martian North Polar Region,

1. Layered deposits and permanent ice (ld-pi)
2. Smooth plains (sp1)
3. Rippled plains (rp)
4. Etch-pitted plains (epp)
5. A light deposit that thinly mantles the underlying cratered plains (sp2)
6. Mottled cratered plains (mcp). Two lesser units shown are
7. Craters (c)
8. Volcanic deposits (vd).
Comparison of MCC and MOC image of the same season (near Summer Solstice)

Mars Color Camera (onboard Mars Orbiter Mission) image mosaic from 24-26 Dec 2015
Area=792375 km² (upto 8 degrees from north pole)

10 to 12 days before 3 Jan 2016 (summer solstice).

Mars Orbiter Camera (onboard Mars Global Surveyor) image taken on 5 Dec 2000,
Area=862625 km² (upto 8 degrees from north pole )

11 days before 16 Dec 2000 (summer solstice).

The 1 pixel per degree binned global MSM SWIR (1.65μm) apparent albedo map over MOLA map.

Five months of MSM radiance data for reference channel are converted to the top of atmosphere reflectance normalised to sun-sensor viewing geometry and incoming solar flux.
The 1 pixel per degree binned global short wave infrared (SWIR) 1.6 µm albedo map. The bright regions (SWIR albedo greater than 0.4) are localized in Northern hemisphere with the highest albedo found over the Tharsis region. The low SWIR albedo regions (less than 0.2) are mainly localized in Syrtis Major and Southern highlands, although low SWIR albedo regions such as Acidalia are also identified in the Northern hemisphere.
The height of the cloud is estimated using shadow method and is found to be 38 kms, which qualifies it to be CO$_2$ ice cloud.
MCC Unusual Mars Limb View

- **Mars disc**
  - 2 Dec 2014
  - High Altitude Layer (~250 Km From Mars Surface)

- **Mars disc**
  - 13 Dec 2014
  - High Altitude Layer (~200 Km From Mars Surface)

- **Mars disc**
  - 21 Nov 2014
  - High Altitude Plume (~100 Km From Mars Surface)
Atmospheric Optical Depth (AOD) estimation

AOD using Stereo method

Exponential fit:
AOD = 1.17 \times \exp(-0.07\times Z)

Scaled height of optical depth (H):
H = (1/0.07) = 14.28 \text{ km}

Estimation of dust variability and scale height of atmospheric optical depth (AOD) in the Valles Marineris on Mars by Indian Mars Orbiter Mission (MOM) data, Icarus, 265, 84–94
3. To attempt opportunistic imaging of natural satellites of Mars and other celestial bodies, if any.

COMET C/2013A1 SIDING SPRING  OBSERVED BY MCC ON 19TH OCT, 2014

Brightened Coma of the comet  
(partial view)
Second frame (490 ms)
Time of Acq: 18:08:47

The pre-encounter estimates for the size and magnitude of coma of the Comet are commensurate with the post-encounter results derived from MCC images.

Post-Encounter
- FOV
- Size 18-20k kms  

Post-Encounter MCC = -4.3

The variation in the count is observed from E to F (i.e. from dark space to brighter observations).

- The variation is then plotted in the XY co-ordinate system to observe the trend of the count values along with the distance.
- Average count of the three bands is used for trend average estimation.
- The trend shows a positive slope i.e. as the distance increases from a point from the centre we see that the count value also decreases.

Predicted Magnitude of the comet = -5.4
Magnitude of the stars within the MCC FOV = 4.14 to 2.17
4. To provide context information for other science payloads.
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ACHIEVED (Y/N) | REASON / COMMENTS
--- | ---
Y | Change detection, Age-determination, Fault Slip Estimation
Y | Cloud Type, AOD estimation, Change Detection
Y | Deimos Far-side, Siding Spring
Y | MSM / TIS
N | Methane detection awaited
Y | Polar Ice Caps not imaged so far
Highlights

- Most of the planned objectives of MCC have been met so far.
- Established the far-side view of Deimos, which is a rarity among contemporary orbiters.
- Single-shot, illuminated full disc view of Mars captured, which is not possible from contemporary satellites.
- Atmospheric optical depth estimation using multi-view angle of MCC images has been demonstrated.
- 1st Martian Albedo map using 1.6 µm (MSM).
Publications:


Thank You .......

MOM : Made in India