MORPHOMETRY OF ARSIA MONS BY MARS ORBITER MISSION-MARS COLOR CAMERA (MOM-MCC) DATA. N. Jain, R. Singh, P. Kaur P. Chauhan and A. S. Kiran Kumar, Space Applications Centre (ISRO), Ahmedabad, Gujarat, India (nirmala@sac.isro.gov.in/ Fax: +91-07926915823).

Introduction: Mars Orbiter Mission (MOM) is the first Indian inter planetary mission to Mars carrying five different payloads. One of the sensors is Mars Color Camera (MCC). MCC was developed and build by Space Applications Centre, ISRO. It is operating in the visible range (0.4-0.7) of EM spectrum and taking images of Mars in varying resolution ranging from 100m to 3Km. MCC has done medium resolution imaging of Arsia Mons on the surface of Mars. here we present the results on morphometric analysis of this data.

Morphometry of volcano is an important parameter in order to understand the volcanism of any planetary body. In the present study the morphometric properties of Arsia Mons are estimated to developing an understanding its formation. Earlier studies have derived elevation and slope of Martian volcanoes using Mars Global Surveyor (MGS)-Mars Observer Laser Altimeter (MOLA), Viking stereogrammetric or photoclinometric methods and Earth-based radar [1], [2] and [3]. Previous studies have also estimated the altitude, flank slopes, relief and volume of different volcanoes of Mars [4], and [5]. This work describes morphometrical study of Arsia Mons using Mars Color Camera (MCC). Height, slope of mons, caldera width and caldera depth of Arsia Mons have been calculates (table1) from MCC data. This study is important in order to learn processes of formation of extraterrestrial volcanoes through remote sensing data.

Study area: The Arsia Mons is the southernmost volcano of the Tharsis region. Of the three aligned Tharsis Montes (Arsia, Pavonis and Ascraeus), Arsia Mons has the second largest summit altitude, 17 km [6]. Its summit is characterized by a large caldera (110 km in diameter) bounded by concentric normal faults [6]. The geologic history of Arsia Mons shows to have had major events for example large number of eruption of lava, the formation of the aprons on flanks of volcano, filling of the caldera and deposition of volcanic material on the caldera floor.

Datasets and methodology: MOM-MCC data has been used along with MOLA topography to construct 3D images of the Artia Mons (fig.1) in order to determine height, topographic profiles, flank slope, caldera depth and caldera width. MCC data sets have been geo-corrected using Mars Orbiter Laser Altimeter (MOLA)-DEM. Topographic variations along the profiles (Fig. 2a b and c) across the dome were studied. It provides information about variation of topography versus distance at the Arsia Mons. A slope map (Fig. 3) shows slope variations over the Arsia mons. It was calculated from MCC-DEM.

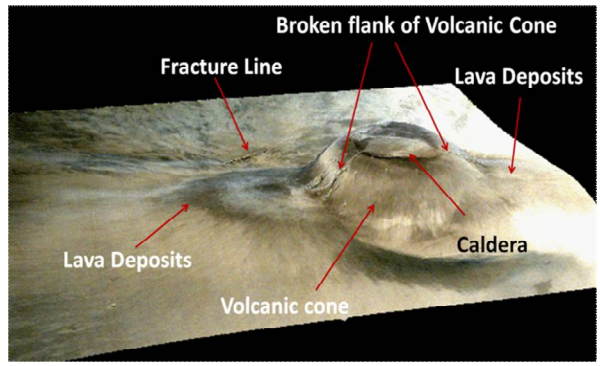

Figure 1: 3-D view of MOM-MCC shows different geomorphological units. Digital Elevation Model (DEM) with exaggeration factor, 15x.

Results: The diameter of caldera is observed between -121.3^0 to-119.2^0 latitude. The caldera floor is almost 1.16 km below the rim (Fig. 2c), from the surrounding rim of caldera. On the southern and northern flank of the Arsia Mons, collapsed terrain lead to formation of aprons with slopes of around 2º are clearly visible in the MCC image. They are about 11 km thick above from the surrounding area. Both are covered by lava and ash deposits.

The fractured zone through which lava flows vented out are also visible and marked in the image (fig. 1). MCC image draped over DEM shows several terraces and concentric rim fractures are visible on the caldera rim formed due to subsidence of the summit (fig. 1). These morphological features were earlier described using MOLA profiles which revealed presence of several scraps formed by block faulting involving downward translation and inward rotation toward the caldera floor. Arsia Mons summit has undergone several deformations by subsidence and inward tilting and faulting due to subsidence of the caldera interior due to change in magma reservoir input output volume. The profiles (Fig. 2a, b and c) across the Arsia Mons were studied, so that it provides information about variation of topography versus distance. Average flank slopes are in the range of 0^0 to 5^0 consistent with shield volcanism. The very low slopes of Arsia Mons are also consistent with pyroclastic volcanism.

Hight of volcano suggest the long-term eruption rates required to build this volcano.

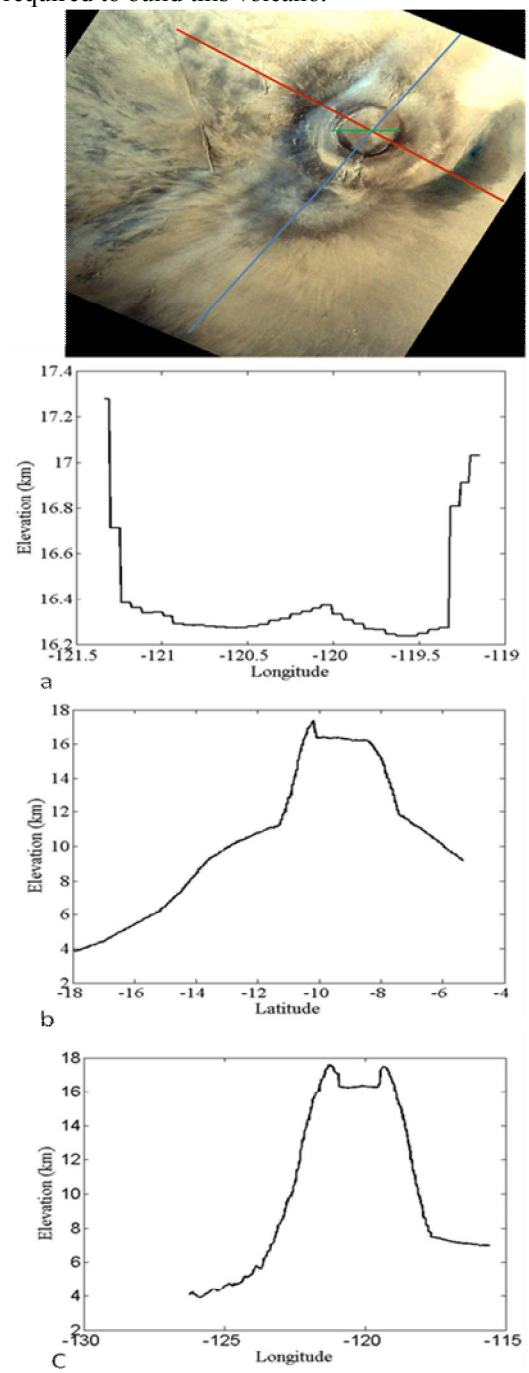

Figure 2: Location of Arsia Mons on MOM-MCC data. Green, blue and red lines are profiles taken for the study of topography of Arsia Mons, a), b) and c) are location map of topographic profiles (green, blue and red) superimposed over the Arsia Mons.

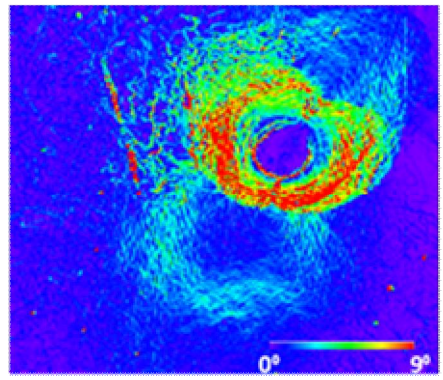

Figure 3: Slope map of the Arsia Mons using MCC DEM.

Table 1: Morphometric featurs of Arsia Mons

Parameters	Arsia Mons
Height (km)	13.45 (from basal portion of debris flow)
Slope (^{0})	0^0 to 5^0
No. of Caldera	1
Caldera Width (^{0})	-121.3 to -119.2
Caldera depth (km)	~1.16 (with respect to the rim)

Conclusions: We tried to estimate morphometric parameters such as height, topographic profiles, flank slope, caldera depth and caldera width of Arsia Mons through Mars Color Camera (MCC). We also indentified deposition of volcanic debris on both northern and southern broken flanks of Mons. This debris could have been formed due to continuous eruption of lava flows or by deposition of ash. Region of Arsia Mons is very important in order to understand the martian volcanism. Further studies will focus on estimation of volume od debris flows deposited near the flanks of the Arsia Mons in order to undertstand the style of volcanic eruption at Arsia Mons through use of MCC data sets.

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References: [1] Wu S. S. C. et al. (1984) Nature, 309, 432–435. [2] Robinson M. S. et al. (1993) Icarus, 104, 301– 323. [3] Malin M. C. et al. (1977) Geol. Soc. Am. Bull., 88, 908–919. [4] Head J. W. et al. (1998) LPSC, XXIX, 1322.