GEOLOGICAL MAPPING AND CHRONOLOGICAL BASED CRATER COUNTING ANALYSIS (CSFD) OF MARS. Fares M. Howari*[1], Manish Sharma[1], Yousef Nazzal[1], Fatima AlAydaroos[2], and Cijo M Xavier[1], [1]College of Natural and Health Sciences, Zayed University, P.O. Box 144534, Abu Dhabi, UAE (*Fares.howari@zu.ac.ae),[2] UAE Space Agency, P.O. Box 7133, Abu Dhabi, UAE.

Introduction: Although only half the size of the Earth, Mars has a remarkably rich and complex preserved geological record. The knowledge on Martian Geology has enormously increased in last 40 years. Several missions orbiting or roving Mars revolutionized our understanding of its evolution and geological features, in several ways like Earth, but extremely different in many respects.

The study area (Latitude 0°N-45°N, Longitude 60°E-120°E) lies near to the landing site of Viking 2 and MSL (Mars Science Laboratory), having a total area of 9,080,730 square kilometers (5642505 square Miles) is shown in Fig.1. The Viking 2 mission was part of the American Viking program to Mars and consisted of an orbiter and a lander, which landed in Utopia Planitia [1]. whereas, Mars Science Laboratory (MSL) was a robotic space probe mission to mars launched by NASA on November 26, 2011, with objectives of investigating Mars habitability of past and present environments within Gale crater, studying its climate and geology, and collecting data for a human mission to Mars [2].

The geologic map of Mars, which records the distribution of geologic units and landforms on the planet's surface through time, is based on unprecedented variety, quality, and quantity of remotely sensed data. These data have provided morphologic, topographic, spectral, thermophysical, radar sounding, and other observations for integration, analysis, and interpretation in support of geologic mapping. The geology map of study area is composed of Ahi (Amazonian and Hesperian impact unit), AHv (Amazonian and Hesperian volcanic unit), Av (Amazonian volcanic unit), HNt (Hesperian and Noachian transition unit), eAb (Early Amazonian basin unit), eHt (Early Hesperian transition unit), eHv (Early Hesperian volcanic unit), eNh (Early Noachian highland unit),IHI (Late Hesperian lowland unit), IHt (Late Hesperian transition unit), INh (Late Noachian highland unit), mAI (Middle Amazonian lowland unit), MNh (Middle Noachian highland unit) and mNhm (Middle Noachian highland massif unit) and 10 major geological structures obtained from USGS as can be seen in figure 2.

The establishment of time scales for planetary bodies is based upon geological mapping as defined by surface properties and delineated by geologic contacts and the superposition of individual units following basic stratigraphic principles [3]. There are two methods of obtaining absolute ages of rock surface units of planetary bodies, One method links radiogenic isotope age [4] and another method, rates for formation of impact craters [5,6]. Crater based age determination of surface features for any kind of planetary body is essential for understanding the categorization of geological events in the past [7]. The chronological based crater counting is a well-established technique for determining relative and absolute model ages of planetary surfaces of Mars, Moon, Mercury [8,9].

Relative ages can be derived by measuring the size-frequency distribution of impact craters that have accumulated in a planet's history through time which means that densely cratered surfaces are older than less-densely cratered surface units. Thus, a geologic unit records the age as expressed by the number of impact craters formed during meteoritic bombardment and the time a unit was exposed to the projectile impact flux [10,11].

Results and Discussion: Study area has been classified in three units i.e. Amazonian, Hesperian and Noachian unit according to the geological map obtained from USGS. Crater density map of study area having crater size >1.5 km is shown in Figure 3. Figure 4 (a) showing the Hartmann and Neukum (2001) defined model while (b), (c) and (d) showing the age ~3.10 Ga, 3.65Ga and 3.78Ga by crater counting method for Amazonian, Hesperian and Noachian Unit respectively. Table 1 showing the comparison of the study area units derived ages with the Hartmann and Neukum (2001) Model ages, which stating that Amazonian and Hesperian unit are derived from their Early period while Noachian is derived from late Noachian period.

S. No	Geological Units	Craters Counted	Derived Unit Ages (Ga)	Hartmann and Neukum (2001) Model age (Ga)
1	Amazonian	2681	~3.10	< 3.37
2	Hesperian	13647	3.65	3.37 – 3.71
3	Noachian	3295	3.78	>3.71

Table 1: Comparison of the study area units ages with the Hartmann and Neukum (2001) Model ages.

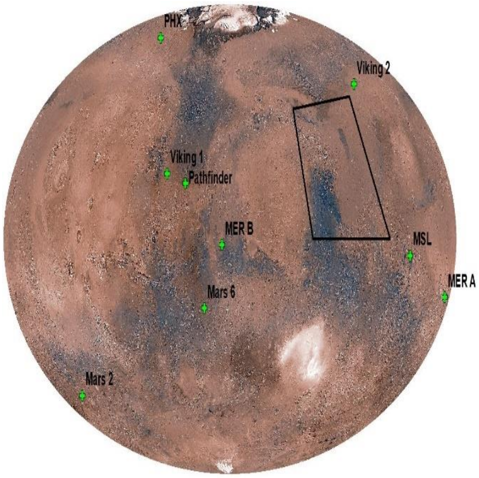

Figure 1- Study area marked in black polygon near Viking 2 and MSL Landing sites.

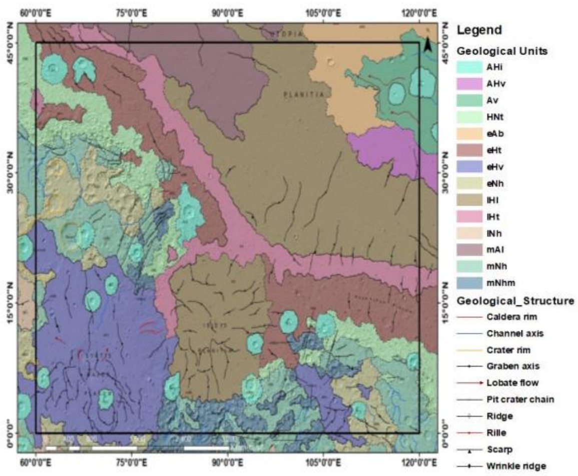

Figure 2-Distribution of major geological units and structures in the study area.

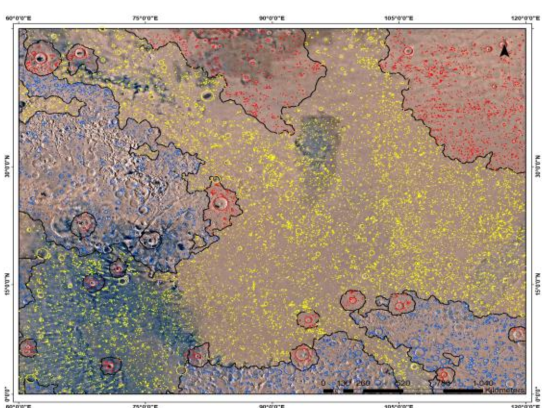

Figure 3-Crater density map (>1.5 Km) of study area shwoing Amazonian, Hesperian and Noachian units as Red, Yellow and Blue color craters respectively.

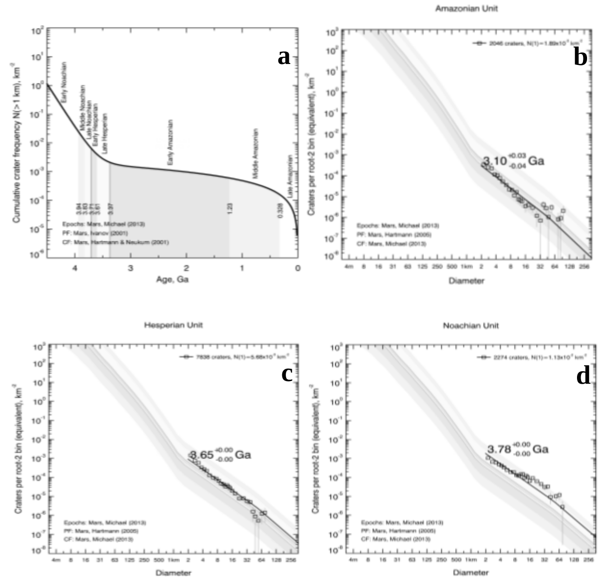

Figure 4-(a) Hartmann and Neukum (2001) defined model, (b), (c), (d) showing age by crater counting method of Amazonian, Hesperian and Noachian Unit respectively.

Acknowledgments: The author would like to extend our thanks and appreciation to UAE Space Agency for funding this research Z01-2016-001.

References: [1] Moore H. J. et al. (1977) JGR, 82. [2] Vasavada A. R. et al. (2014) JGR Planets, 119, 1134-1161. [3] Steno, N. (1669) Ex typographia sub signo stellae, Florence 76.[4] Hartmann, W.K. and Neukum, G. (2001), Space science Reviews 96,165. [5] Hartmann et al. (1981) BVTP, 1049-1128. [6] Schmidt, R.M. and Housen, K.R. (1987), IJIE 5, 543. [7] Arya. et.al. (2012), *Current Science*, vol 120, pg.no.5. [8] Hiesinger. et.al. (2000) *J.Geophys. Res.* 105 (E12), 29239–29275. [9] Hiesin-ger. et.al. (2012) *J. Geophys. Res*. 117. [10] Baldwin, R.B. (1964), Astro-nomical Journal 69,377. [11] Neukum, G. et al. (1975), Moon 12,201.