MARS ANCIENT HISTORY; A REAPPRAISAL. J.-P. Bibring[1], J. Carter[1], F. Forget[2], B. Gondet[1], Y. Langevin[1], S. Murchie[3], F. Poulet[1],and M. Vincendon[1], [1]Institut d'Astrophysique Spatiale (IAS), CNRS/Université Paris Sud, Orsay, France, [2]IPSL/LMD, Université Paris 6, Paris, France, [3]JHU/APL, Laurel, MD, USA.

Introduction: Over the past decade, remote and in situ observations, together with modeling and simulations, have provided a dramatically modified understanding of Mars evolution. Following the seminal "mineralogical history" of Mars [1] suggesting in particular an early era of potential habitable conditions, subsequent in depth studies have matured the view of Mars' History and provided evidence for the diverse processes and environments that occured. Here, we shall focus on the most ancient era (the first billion years), discussing both key recent discoveries, and some of the still unresolved questions related to surface features that are not well accounted for. Emphasis is on paradigms changes, specifically with regards to the potential for early habitability of Mars.

Data sets: A major driver of this reappraisal is the coupling between compositional (spectroscopic primarily) and contextual (imaging) data, the former providing evidence for the processes that took place, and the later providing their chronology. The primary remote data of relevance for this study are the VIS/NIR hyperspectral images acquired by OMEGA/Mars Express and CRISM/MRO, coupled to the HRSC/Mars Express and HiRISE/MRO images. Additional support for the geologic interpretation is provided by the CTX/MRO images, MOLA data and MAG/ER remnant magnetic maps (the latter acquired by MGS). On the global scale of these characterizations, the MERs and MSL provide critical ground truths with unprecedented accuracy. Most results of relevance are described in companion papers (e.g. [2] to [5]).

Pre-accretion and early accretion history: The early migration of Jupiter and Saturn ([6]) has severely modeled the solar cavity in which the inner planets have accreted, in particular as for their mass and content in volatile (including water) species. The further dynamical and collisional evolution, up to giant impacts, has paved the way for distinct planetary pathways, and in particular for their specific water and tectonic histories. They have initiated the diverged evolution of Earth and Mars. A brief description will be proposed, and the few observational witnesses indicated.

Ancient aqueous alteration: The variety of aqueously altered minerals, beyond early recognition of Mg/Fe phyllosilicates and sulfates [7,8,9], has increased very significantly, through improvements in data coverage, spatial resolution and data reduction ([2] to [5]). These discoveries have been complemented by: 1. their being integrated in a geomorphological context; 2. experimental and model simulations of mineral formation process; 3. assessment of quantitative mineral abundances; and 4. ground truths from the operating rovers. As a major outcome, mineralogical diversity can be translated in an evolutionary pathway, reflecting the evolution of Mars' environmental conditions. Its major features will be presented, with major questions still unresolved exhibited, in particular with respect to the later onset of aqueous activity.

Mars during the LHB: The Late Heavy Bombardment (LHB), which has started ~ 4 billion years ago (~ the age of the major Mars basins), has severely affected the surfaces of terrestrial planetary bodies, and erased most of the preceding geologic record. At Mars, deposits formed by pre-LHB processes seem to have been preserved in a few locations; how could they be protected? A simulation of the atmospheric circulation in pre-LHB Mars conditions ([10]), for which the topography was dominated by the large dichotomy, will be presented: water condensation in specific locations, along its surrounding walls, might have built thick layers of ice, protecting the underlying mineralogical strata from the massive LHB gardening, and inducing a variety of surface effects. These protected areas constitute unique sites, possibly in the entire solar system, to have preserved witness of conditions that prevailed during the first hundreds of million years after the planets accreted, when Mars might have harbored habitable conditions.

Post-LHB evolution: Magmatic activity connected to the slow radioactive heating of the mantle has resulted in major surface effects, which can be monitored through the composition of the minerals, both igneous and altered, processed at that time. Magmatic outflows have been observed (Martian mare formation), as well as features related to the raise of the geothermal front coupled to volcanic activity.

References: [1] Bibring J.-P. et al., *Science* 312, 400-404, 2006. [2] F. Poulet et al., *this conference*. [3] J. Carter et al., *this conference*. [4] A. Ody et al., *this conference*. [5] J. Flahaut et et al., *this conference*. [6] K. J. Walsh et al., *Nature* 475, p. 206-209, 2011. [7] J.-P. Bibring et al., *Science* 307, 1575-1581, 2005. [8] F. P. Poulet, et al., *Nature* 438, 623-628, 2005. [9] A. Gendrin et al., *Science* 307, 1587-1591, 2005.[10] J.-P. Bibring and F. Forget, *45th LPSC*, 2014 .