TITLE
Geological processes in the Martian southern hemisphere: interpretations from recent mission data.

AUTHOR
Graziella Caprarelli, University of Technology, Sydney.

ABSTRACT
Investigation in the geological evolution of early Mars provides insights into the the initial stages of the evolution of the terrestrial planets. On Earth plate tectonics and weathering have essentially erased the most ancient geological structures. In the Martian southern hemisphere the dominant features are the craters produced by large meteoritic impacts. Cratering however did not completely erase early geological structures. Improved resolution orbiter data from recent (1996 – present) NASA and European Space Agency (ESA) missions are unraveling geological features that reveal complex volcano-tectonic histories spanning from Noachian (4.56-3.8 Ga) to Amazonian (< 1 Ga). Combined geomorphological and geophysical evidence from orbiter data has allowed interpretations that, together with numerical modeling, strongly suggest that the geodynamic evolution of early Mars may have been similar to that of Earth, with Mars looking very different from Earth at present largely because of subsequent evolution differences arising from Earth and Mars's different sizes and positions relative to the Sun.

The ESA satellite Mars Express (MEX), which entered Martian orbit in December 2003, has been transmitting telemetry since early January 2004. The High Resolution Stereo Camera (HRSC) on MEX is a linescan device with stereo capability. To date, the HRSC has imaged almost the entire Martian surface at an average resolution of 25 m / pxl for nadir images, while simultaneously registering altimetry data obtained from stereo images. These properties make the HRSC data excellent for the investigation of geological structures, that, thanks to the HRSC orbit large footprint (about 60 km across) can be followed over many kilometers, so that stratigraphic relations and tectonic features can be accurately mapped. The MEX Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) instrument has as its principal aim that of investigating the presence of water and ice in the Martian subsurface. The radar works at 4 frequencies - 1.8, 3, 4 and 5 MHz - at which it images the Martian subsurface to approximately 5 km depth.

Caprarelli and her international collaborators have used data from the HRSC, complemented by NASA Mars Global Surveyor (MGS) and Mars Odyssey (MO) mission data, to conduct a detailed study of sub-equatorial regions (e.g., Caprarelli et al., 2007a-b). The results of the study indicate that some areas are geologically younger than previously thought, and that extensional tectonics and related volcanism occurred where previous studies, based on older datasets, had instead provided compressional tectonics interpretations. Caprarelli and coworkers (Caprarelli et al., in progress), are also using MARSIS data in combination with precision data from NASA MSG and MO missions, to identify subsurface reflectors of geological significance.

The reconstruction of geological processes is one of the most important outcomes of the observation of Mars to date. These and other discoveries are strong motivation for the continuous exploration of Mars.

REFERENCES:
Caprarelli et al. (2007a). Peer reviewed Proceedings 6th Australian Space Science Conference.
Caprarelli et al. (2007b). Icarus 191(2), 524-544.