MARS EXPRESS PLANETARY GEOSCIENCE INFORMATION SYSTEM (MEGIS) PROJECT. G.G. Ori[1], E. Flamini[2], A.P. Rossi[1], S. Di Lorenzo[1], L.V. Lorenzoni[2],L. Marinangeli[1], A. Di Iorio[1], [1]International Research School of Planetary Sciences, Universita' D'Annunzio,Viale Pindaro 42, 65127 Pescara (email: ggori@irsps.unich.it), [2]Agenzia Spaziale Italiana, Viale di Villa Grazioli, 23 00198 Roma (email: enrico.flamini@asi.it)

Introduction: The Mars Express Geosciences Information System (MEGIS) is a pilot project to develop a planetary geoscience data archive for Mars in the framework of the Mars Express mission. A demonstrative Planetary Geosciences Information System for Mars has been built up at IRSPS using available Mars data from Viking, Mars Global Surveyor and Mars Odyssey missions under an Italian Space Agency (ASI) grant. The project also focuses on the development of a European network of geo-scientific institutions to provide geological mapping of the Martian data. Geological mapping is one of the most important outcomes of planetary missions. Europe has to develop the proper skills in order to provide the data analysis of the planetary missions that are in preparation.

The MEGIS project leader (G. G. Ori) is Co-I of the HRSC and MARSIS and IDS for the geological analysis of Mars Express. This favorable situation has allowed MEGIS to be directly involved in the data analysis and mission operations. Leila V. Lorenzoni has been the ASI contract Project manager.

Scientific Objectives: The interpretation of planetary geo-scientific data is nowadays based on the combination and fusion of several data sets and their integration in a single set of data (Fig. 1).

The aim of MEGIS is to build a planetary GIS system integrating data from Mars missions, in particular Mars Express, that probably is the first in Europe. The project needs major scientific effort in the analysis of Martian data and the use of both commercial and specially developed software tools.

The construction of these computing tools cannot be detached from the geo-scientific analysis of the data, not only to validate them, but even to provide a scientific background for the definition of the tools. For this reason is of paramount importance the analysis of the former data and investigations of Earth analogues with respect to the geological features of Mars. The last aspect is important because this kind of analysis allow us to envisage which kind of content the future data (with higher resolution and more stereo and color capabilities) will have when displaying subtle geological features.

As minor objective of the present project there is the implementation of a scientific database using standard Relational Data Base Management System (RDBMS) and Web-GIS interface, able to store raw data as well as intermediate and final results of the scientific data processing chains foreseen by the project. This objective will be continued by means of the systematic implementation of existing standards or the definition of new ones for those instruments that need specific data formats.

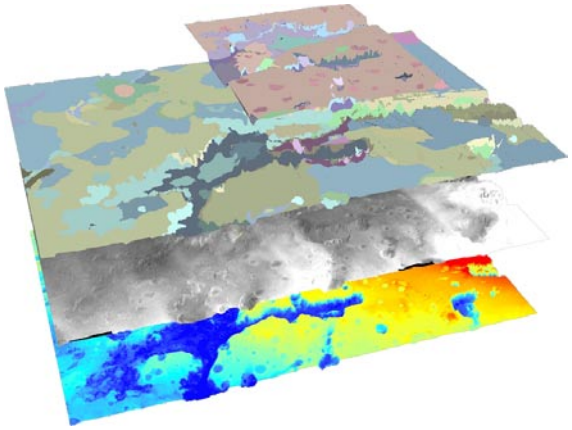

Figure 1: Example of different raster and vector datasets (Gangis Chasma area) draped on MOLA DTM. From bottom to top: MOLA color-coded topography, MOC WA mosaic, Mars 1:15.000.000 Geological Map [1] geological map by G. Komatsu [2].

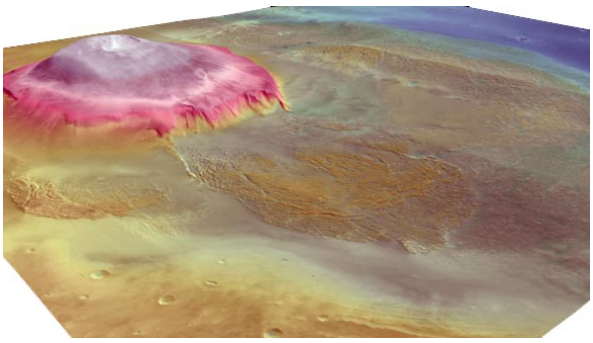

Figure 2: Perspective view of Mons Olympus volcano and aureole. Data fusion derived from MGS MOC Wide Angle images mosaic and MOLA-derived color coding, draped on MOLA gridded topography

MEGIS Geographical Information System (GIS) Archive description: The pilot project has been developed along three major lines: (i) creation of global and local databases for the data analysis and testing, (ii) implementation of procedures leading to

the creation of scientific products, (iii) preparation of the procedures and operations for the Mars Express activities and data analysis. These activities allowed the team to define some of the procedure needed to process the data set in GIS-compatible format and to define the procedures to create data and analysis products. Moreover, to develop MEGIS it has been necessary to establish enough knowledge of the MARSIS data with the production of simulations and enhancing the interpretation capabilities.The initial phase of the project has been addressed to build up the Reference Geographic Information System of the planet Mars, including most of the data acquired already from previous NASA missions even if in some cases it has been necessary to review and reprocess these data. MEGIS archive is based on ARCINFO software and presently consists of: both global datasets and local ones. Global raster datasets include: MOLA topography (and derived data sets, such as slope), Viking MDIM2 mosaics, MOC WA mosaics. For selected areas MOC NA and THEMIS images have been included.

Local datasets are covering several test areas, which are currently being mapped, e.g. Aram Chaos [3], Holden Crater [4], Gangis Chasma [2]. Extensive collection, processing and integration of available datasets have been performed on these areas.

The concept and tools developed for the geoscientific data fusion can be used for the merging of other planetary data sets concerning other scientific aspects such as the atmosphere composition or metereology.

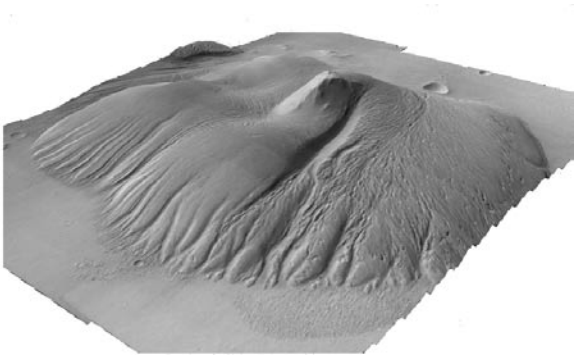

Figure 3: Nicholson crater bulge: mosaic of Themis VIS images draped on MOLA topography.

3-D Visualization of Mars data: Besides geological maps of the Martian surface, the sets of data may be used to develop the 3-D reconstruction of the Mars surface Digital Elevation Models and surface topography (using the images produced by the HRSC complemented by MOLA data) will be integrated by mineralogical and geological maps produced by OMEGA data processing chain, surface temperature maps and subsurface geological layers up to 5 Km below ground will be produced by MARSIS data pipelines. The integration of all these different layers for a selected zone will constitute a unique interdisciplinary data warehouse system for planetary research and will foster scientific data mining and data knowledge discovery.

Figure 4: Themis IR frame in 3-D perspective: plateau-chasma transition (Gangis).

Future Development: Future goals will be the setting up of specific data processing chains or pipelines, one for each instrument, to produce specific and validated maps or layers to be included in a global Planetary Geosciences Information System (PGIS) also referred as Geosciences data warehouse. Then, the PGIS will be implemented on the Web to permit the scientific community an easy access to the validated Mars Express data and perform their research tasks.

This part is currently going to be extended in a wider framework with a direct involvement of the ASI Science Data Centre.

In this scenario the MEGIS project, as it is now, has completed its task and from a pilot project is evolving in a permanent project that foreseen the capability to include the Martian data acquired also by future missions, like the data that the Italian Sharad radar on Board of *Mars Reconnaissance Orbiter* Mission will provide, and as next step to include data from other planetary missions.

References: [1] Scott D. H. and Tanaka K. L. (1986) *USGS Misc. Inv. Series*, Map I-1802-A, [2] Komatsu G. et al., (2004) *LPS*, *XXXV*, submitted [3] Ori G. G. et al., (2004) *LPS*, *XXXV*, submitted [4] Pondrelli M. et al., (2004) *LPS*, *XXXV*, submitted