

Title: Planetary geological mapping and tectonic analysis of Mercury

Tutor: Prof. Luigi Ferranti

Co-tutor: Dr Valentina Galluzzi

Research program

Planet Mercury is a geological end-member of our Solar System. Its surface maintains the traces of processes happened more than 4 Ga, although there is also some evidence of recent geological activity. Mercury is characterized by unfragmented stagnant-lid tectonics, where thousands of thrust faults are scattered on the surface in response to the planet's global contraction. Nevertheless, many of these faults are organized into fault systems. It has been observed that these fault systems are correlated to the presence of large crustal regions of different composition that cause lateral crustal discontinuities. This tectonic asset could represent a possible scenario for stagnant-lid tectonics prior to lithospheric fragmentation.

The National Aeronautics and Space Administration (NASA) MErcury Surface, Space Environment, GEochemistry, and Ranging (MESSENGER) mission orbited the planet between 2011 and 2015 providing global coverage of Mercury's surface with monochromatic and false-color images at an average resolution of 200 m/pixel up to 8 m/pixel. MESSENGER data can be openly downloaded from the Planetary Data System (PDS) and used for geospatial analysis and photointerpretation. The joint European Space Agency (ESA) and Japanese eXploration Agency (JAXA) BepiColombo mission is currently on a seven-years journey to the innermost planet and will start orbiting Mercury in December 2025. An intense geological mapping activity, based on MESSENGER data, has begun in order to lay the basis for the future observational strategies of the Spectrometer and Imagers for Mpo Bepicolombo-Integrated Observatory System (SIMBIO-SYS) instrument on-board BepiColombo. The geological mapping of Mercury has started as a cooperation between INAF-IAPS and DiSTAR as a quadrangle-based series, and is today enlarged to a collaborative effort among several international institutes. The completion of a quadrangle map leads to the scientific analysis of the mapped geological units, whereas the regional-scale structural analysis leads to uncovering Mercury's tectonic asset.

Proposal for a PhD position

The Department of Earth, Environmental, and Resources Sciences at the University of Naples Federico II invites applications for one PhD position in Earth Sciences. The potential PhD research project will be carried out in collaboration with the National Institute Astrophysics, Institute for Space Astrophysics and Planetology (INAF-IAPS) in Rome, where the PhD candidate will carry part of the research activities.

This PhD project involves the use of camera data from the NASA MESSENGER mission, their processing and photointerpretation, to compile a 1:3M geological map of one of the quadrangles of Mercury and conduct a structural analysis of the faults present in the area. This project is part of the preparatory activities of the BepiColombo mission and of the SIMBIO-SYS instrument, in particular with regard to the understanding of the tectonic evolution of the planet and the identification of targets to propose for future high-resolution observations.

The candidate expenses for the activities related to the PhD project will be covered by IAPS funds allocated through the ASI-INAF cooperative agreement for the BepiColombo mission. The

candidate is expected to have solid background in structural geology/tectonics and a general knowledge of geographic information system software (GIS). Knowledge of programming techniques useful for the processing of space data is desirable but not necessary.