MARIVEL: Modern **A**dvances in high-**R**esolution **I**maging of **V**olcanic **E**ruptive **L**andforms- unrevealing concealed Martian volcanic evolution by studying terrestrial analogues

Planetary sciences are currently one of the most developing branches of industry and science which meet humanity's aspirations to explore Space. Just after the Moon, Mars is one of the most trailblazing research fields, as it constitutes a critical step forward in planetary exploration. Nevertheless, a detailed Martian evolution is fundamentally unknown and this carries with it significant consequences for human exploration plans and missions, for example in terms of the development of in-situ resource utilization and mitigation of the hazardous. Although it is widely accepted that Mars's evolution has been mainly controlled by magmatism expressed on the surface by volcanic centers, the ongoing acquisitions of datasets provide great advances in Martian surface visualization increasing our capability of investigating volcanic landforms that have been previously overlooked. For decades the narrative around Martian volcanism has focused on a global reduction in explosive volcanism paired with a simultaneous increase in the contribution of effusive eruptions. However, the most recent high-resolution data challenges this inference. Therefore, the overreaching goal of the MARIVEL project is to significantly advance the current understanding of how volcanism has developed on Mars, by providing a missing characterization and identification of small-scale volcanic landforms within the youngest volcanic provinces. Martian observations will be supplemented by investigations of their terrestrial analogues to provide more in-depth insight. Such knowledge is currently lacking due to the relatively short time span of Martian research, and the limited geographical scope of modern high-resolution observation efforts, supplemented by previously not produced topographical models. To solve this problem, combining standard planetary research approaches by applying the high-resolution topographical data with modern multiproxy analysis of terrestrial volcanic landforms has to be utilized to look for parallels in the geological archives such as the volcanic products and their preserved morphological characteristics.

MARIVEL utilizes three interconnected work packages (WPs) that are independent but complementary to each other and will serve the critical knowledge needs and research objectives. During the first phase of the project, research focusing on Martian volcanism (WP1) will deliver the previously unknown characterization of volcanic landforms and hence allow us to interpret the volcanic evolution during Amazonian. This will be achieved by high-resolution volcanological mapping based on images and paired digital elevation models, surface model age determinations by crater counting method, as well as spectral analysis of volcanic products. The Martian observations will be supplemented by WP2 which focuses on systematic characterization of the terrestrial volcanic systems, in particular small-scale landforms both in the vent-proximal and distant environments applying UAV-based photogrammetry coupled with volcanological mapping and sampling. Comprehensive terrestrial laboratory studies on the physical properties of volcanic products will permit the conduct of a first robust assessment of Martian volcanic deposits by applying the transfer of knowledge through modelling into Martian environments. Collectively, the work in WP1 & 2 will allow to present the systematic and integrated portrait of Amazonian-aged Martian volcanism, especially focusing on the small-scale landforms across Mars whose investigation may breakthrough our understanding of the most recent magmatic processes. This will be achieved by the reconstruction of eruptive sequences and processes involved in the volcanic activity that will allow for generating critical data for the trans-planetary comparison and implications of components in WP3. Therefore, the trans-planetary approach implemented in MARIVEL comprises both traditional and cutting-edge methods, combining standard planetary research approaches with modern multiproxy analysis of terrestrial volcanic landforms.

Recent developments in both planetary (ongoing acquisitions of image datasets) and terrestrial (approachable UAV usage in mapping) imaging have significantly advanced the accuracy and potential of volcanological records. Taking advantage of these advances, MARIVEL will, bring together these approaches in comprehensive research, and will be directly informative for future directions in the development of volcanism-concentrated research on Mars. Furthermore, by utilizing the trans-planetary approach, MARIVEL will deliver highly relevant knowledge to both the Martian- and terrestrial-based scientific communities and build a bridge between these disciplines. Therefore, the results will be highly interesting for an international audience and can be published in high-impact journals.