IN-SITU EXPLORATION OF RECENT AND LIQUID WATER RESOURCES ON MARS BY INVESTIGATING YOUNGEST GULLY-FEATURES – A SCIENTIFIC AND ENGINEERING APPROACH. M. Voelker[1], [1]Institute of Geographical Sciences, Freie Universität Berlin, Berlin, Germany (martin.voelker@fu-berlin.de).

Introduction: The following abstract refers to Challenge Area 1 – Interrogating the shallow subsurface of Mars, both from orbit and from surface.

For many years planetary research focused on finding evidence for past water activities on Mars. Thus, most of the martian landers and rovers were constructed to look for evidences of past water activities on the planet. After proving this theory by the Mars Exploration Rovers in 2004 [1], the next objective should be the discovery of recent (liquid) water sources on Mars. As a primary target for recent water activities there are many so-called gullies distributed over the planet. The following abstract will summarize and assess the possibilities of a mission to martian gullies.

Objectives: The main objective is the examination of recent water resources (e.g., for future manned missions). It can be divided into two further classes: primary and advanced objectives.

Primary objectives. Were gullies formed by liquids anyway? Which processes had shaped these forms? Are there saline components? Are there biosignatures? If there is water, could it be a considerable source for possible manned missions?

Advanced objectives. Are the microclimatic conditions suitable for providing liquid water temporally? How are the geomorphological and geological conditions?

Distribution and morphology of gully-systems: On Mars recently active gully-systems occur especially around 30° – 42° latitude on both hemispheres [2]. Elevation ranges from approximately -5,000 to +3,000 meters with respect to the martian datum, with focus on areas between -500 to +2,000 meters [2]. Generally, gullies are separated into three parts; the upper erosional area is called alcove and the depositional area is represented by a fan structure. Both are connected by narrow channels. They occur on slopes of around 20° to 35° (Fig.1). When the gully-system has developed there are distinctive values of inclination between the three separate units (alcove, channel, fan). Digital elevation models have shown values of ~30° - 35° for alcoves, ~26° for channels and ~15° for the alluvial fans (Fig. 2). Most of the gully-systems are orientated polewards, except a portion between ~40° to ~55° latitude on both hemispheres (Fig. 1).

Technologies: Since most of these gully-systems are located at higher latitudes facing the poles the use of solar panels for robotic missions will not be reasonable. Therefore, battery-driven rovers should be considered. For lowering costs it is possible to send little rovers to Mars. Their main task will be the detection of recent water activities (e.g., by observations and spectrometric or drilling analyses). Thus, these rovers will not need full instrumental equipment. Minimum instrumental requirements would comprise a camera system, a Mini-TES [3] and further meteorological sensors for investigating microclimatic conditions. As there is a certain risk for choosing a gully containing several obstacles which cannot be recognized by remote sensing data (e.g., misinterpreted datasets or too steep slopes), it is necessary to develop small low-cost rovers. For increasing probability of success more than one rover should be sent to Mars.

High inclination values of gully locations require driving technologies for sending a rover on slopes up to 35° [2]. As there are some uncertainties in determining surface roughness local slopes exceeding 35° could exist. Both MER were able to climb slopes to almost 30° [4]. So there are already running gears for climbing less steep slopes along the alluvial fans and channels of gully-systems. This maximum value could be possibly increased by adding more rough wheels (e.g., deeper rills or higher spikes).

Most of the gully-systems are located within craters of few tens of kilometers in diameter more precise landing systems are necessary. With a landing ellipse of 10 x 12.5 kilometers the MSL landing system has already an accurate precision, sufficient enough to target such craters [6].

Landing Sites: According to the distribution of gully-systems landing sites could only be located around 30° to 42° N and S and between -5,000 and +3,000 meters. But recent landing technologies require heights of 0 to -1,300 meter below the martian datum at maximum [5, 6]. By this constraints most of the discovered gully-systems will be excluded [2]. Generic landing sites could be Dao Vallis east of Hellas Planitia or Newton Crater in Terra Sirenum [2, 7].

Conclusions: The discovery of recent water sources is essential for future manned missions to Mars. Furthermore, those missions are conducive for understanding the current Late Amazonian martian hydrosphere. If the existence of active gullies should be proved, this will be the most important progress in examining possible extraterrestrial ecological niches.

Certainly, recent available rover technologies are not able to fulfill such a mission's challenge. Thus, it is necessary to evolve new small landing spaceship devices.

Main objective of this mission is to look for the answer whether there is liquid water in Mars' youngest history at all. If one of these rovers could prove this assumption a further rover with a greater payload of scientific instruments can be sent to this landing site.

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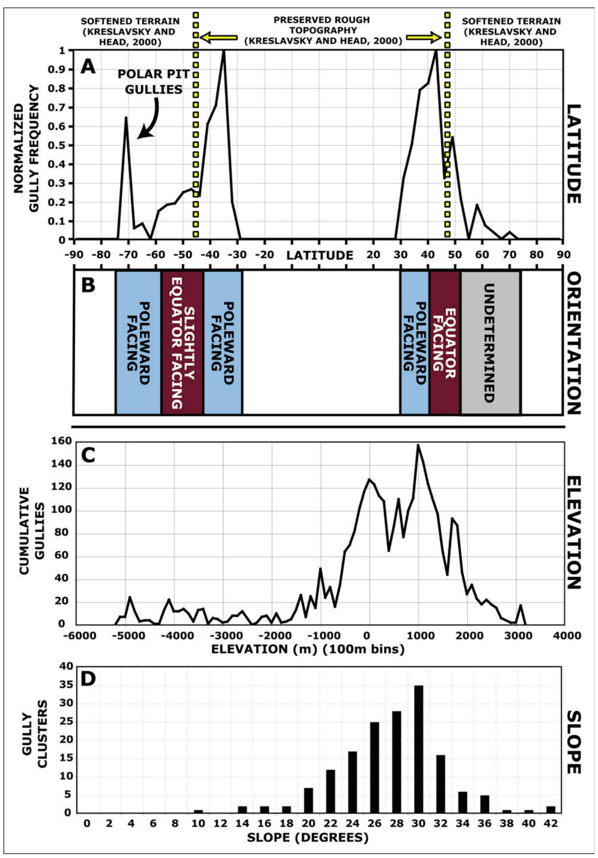

Fig. 1: Graphical table of distribution, orientation, elevation and inclination of gully-containing slopes (abstracted from [2]).

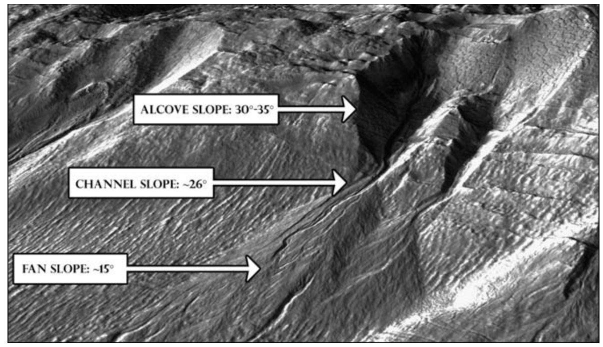

Fig. 2: Perspective view of various inclination values on gully slopes (abstracted from [2]).