FOSSIL IDENTIFICATION AT MARS ANALOGUE DRILLS – EVALUATION OF ELIGIBILITY CRITERIA. B.Polonkai[1] (H 1117, Budapest, Pázmány Péter sétány 1/C, Hungary.) A. Kereszturi [2]MTA CSFK (H 9400 Sopron, Csatkai u. 6-8, Hungary.) (E-mail: polonkaib@caesar.elte.hu)

Introduction: There are two resons for fossil hunting on Mars are life might emerge there, and the we could improve our knowledge on to separate very old abiogen and biogen features as Mars any sedimentary features is expected to be preserved better than on Earth. Opposite to Earth because of weak weathering and lack of global plate recycling, very old sediments (>3.5 Ga) are well preserved. Our knowledge and experience in the identification of oldest fossils on Mars could improve much with analyzing the oldest rocks on the Earth. The aim of this work is to establish some framework for the approach, how certain fossils on the Earth could be used to better understand the expectations for morphological fossil identification on Mars.

Methods: During the work we used optical microscopy, morphometry and samples from Hungary [1,2]. Most of these biological investigations were carried out during the PHD study of the first author at the ELTE university. Here astrobiology relevant aspects are indicated with specific emphasis on the ExoMars rover (EXM) analyzing capability of the drilled material [3,4]. Although the activity of the crushing station might destroy several type of possible fossils, as primitive organisms are expected to leave behind small scale features, there are some possiblites for successful observations. In this work we outline some theoretical background for such approach.

Results: Searching for possible fossils on Mars, the criteria system applied in such work should be modified to better fit to the expected Martian conditions. In Table 1. several of such parameters can be read, and it also shows that substantial improvement is still necessary to estimate what kind of differences are expected comparing fossile identification on Earth and Mars.

Analyzing specific examples, several such features can be seen in the insets of Figure 1. Using Earth based knowledge, a potential classivfication of mm-micrometer scale fissiles can be read in the Table 2. focusing on the spatial scale that might be used by ExoMars rover's instruments. The main facilities for such activity are CLUPI and MicrOmega detectors. Details of the indicated image insets are: a) Zeolites on basalt, b) Chalcedony and zeolite in andesite, c) Possible Hungarian outcrop contains goethit (Buda Hills, Hungary), d) Twisted threads of goethite (Breiðdalur, Iceland, [5]), e) BIF, red: FeOH minerals, grey: quartz and silicates (Encyclopedia of Science), f) Macrobiological generated trace fossil in Lapis Limestone (Pécs, Hungary), g) Stromatolite [6], h) Stromatolite at Polgárdi Limestone Formation (Polgárdi, Hungary), i) Calcareous algae containing thin section (Dinnyés Dolomite Fm, Gárdony, Hungary), j) Microfossil containing rock (Mályinka Limestone Fm, Berenás, Hungary), k) Green algae containig rock (Büdaörs Dolomite Fm, Nagykovácsi, Hungary), l) Green algae containig rock (Büdaörs Dolomite Fm, Nagykovácsi, Hungary), m) Gipsum-anhydrite rock from (Perkupa Evaporite Fm, Perkupa, Hungary), n) Microbiofilm of carbonaceous matter in transmitted light [7], o) Cryptobioitc crust (Kitty's Gap Chert Fm, Pilbara, Australia, Adventure-Buddies Blog), p) hypolit colonization of qartz pavement (Tibetan Plateau, [8])

Table 1. Criteria for retention and analysis of fossils

Factor	Features on Earth	Features on Mars
locali-zation	general geological mapping methods	similar to Earth, by spacecrafts and surface missions
strati-graphical correlation	regional geological settings (stratigraphy)	difficult for Martian meteorites, estimated for Mars surface
geological dating	geochronology	mainly from stratigraphy and craterin ages
syngenetic with host rock	difficulty: after sedimentation it can be redeposited or / and permeated by fluids	weakly modified after sediment formation, expect surface oxidation and irradiation
metamor-phic grade	The higher the metamorphic grade, the more the fine structure overwritten	expected to be low because the lack of global plate tectonism
show features of biological origin	preserved cell structure, trace fossil (element association in the strata by life activities), fenestral pores, organic material	if conditions at the possible origin of life on Mars were similar to Earth, similar expactations are for microfossile structures (no better approach)
compari-son to current micro-organism	biological origin element differentiation in the sediments can be examined	invers comparison: to compare abiogen and biogen origin especially for minerals in Martian simulation chambers

Mars relevant expectations: Based on the listed potential analogue sites (Table 2., fourth column) Hungarian locations could also improve the fossile identification methods, and at least provide background information on various abiogen features and possible pseudo-fossils in the analyzed spatial scale.

References: [1] Polonkai B. et al. (2015) *Hantkeniana* 10, 135–142. [2] Polonkai B. et al. (2015) *A Magyar Földtani és Geofizikai Intézet évi jelentése a 2015. évről*. MFGI, in prep. [3] Westall F et al. (2015) *Astrobiology* 15:998-1029. [4] Foucher et al. (2014) *EPSC*, 2014-472-1. [5] Hoffman F. (2000) *PSS* 48:1077–1086. [6] New York St. Dep. of Environmental Conversation. [7] Westall F. et al. (2010) *PSSe* (2010) 59:1093–1106. [8] Fiona K. Y. Wong et al. *Microb Ecol* (2010) 60:730–739.

Table 2. Main fossile types as examples (1,2,3 columns), identification method (4. col.), EXM relevant possibilities (5. col.)

Fossil "type"	size range	Earth example occurrence	Earth example in Hungary	method of identification	identification possibilities for ExoMars rover
SFF	1-3 µm-mm	Kozakov (CZE), Germany, Iceland, Fundy-bay (CND)	calcedons in volcanic rocks (Gyöngyössolymos, Erdőbénye), zeolite, quartz in neogéne volcanites, goethit (Buda Hills)	optical micriscopy	possibly observable by MicrOmega above 50-100 µm diameter
Trace fossils: BIF, stromatolite	stromatolite mm-cm	SW Australia, N-Shark Bay (recent), Bahama-islands.	Polgárdi Limestone Formation, Villány Formation, (Villány Templom Hill)	optical macroscopic obs. (morphology)	in ideal case MaMISS could identify by scanning method, but this has not been tested.
	BIF cm	Brazil, Australia, USA	-	morpology, isotopic	
micro-fossiles	mm-cm	Isua, Greenland, Pilbara (AUS)	calcareous algae: Dinnyés Fm, phylloid algae: Mályinka Fm, green algae: Nagyvisnyó Fm, *Diplopora*: Budaörs Fm, diatomite: Szurdokpüspöki Fm, alginite: Pula Fm.	in situ, optical microscopy	CLUPI could have been able to observe, but it would be quite difficult to identify in the fine comes out of the drilled hole
halophils	mm	Bad Ischl (AUT), Chott el Jerid (TUN)	evaporitic formations (Perkupa Fm., Tabajd Fm.)	optical, SEM, EDS, X-ray	
microbiofilm	µm	Pilbara, Australia	unknown	SEM, EDS	
cryptobiotic crust	µm-mm	Pilbara (AUS) 2,5 Ga, Devon-isl. recent	Szabadbattyán (cianobacteria)	optical microscopy	by MicrOmega above 50-100 µm diameter if larger than a kb. 50-100 µm
hypolithic colonies	mm-cm	Atacama desert (CHI) recent	possible in Pleistocene rocks	optical microscopy SEM, EDS	

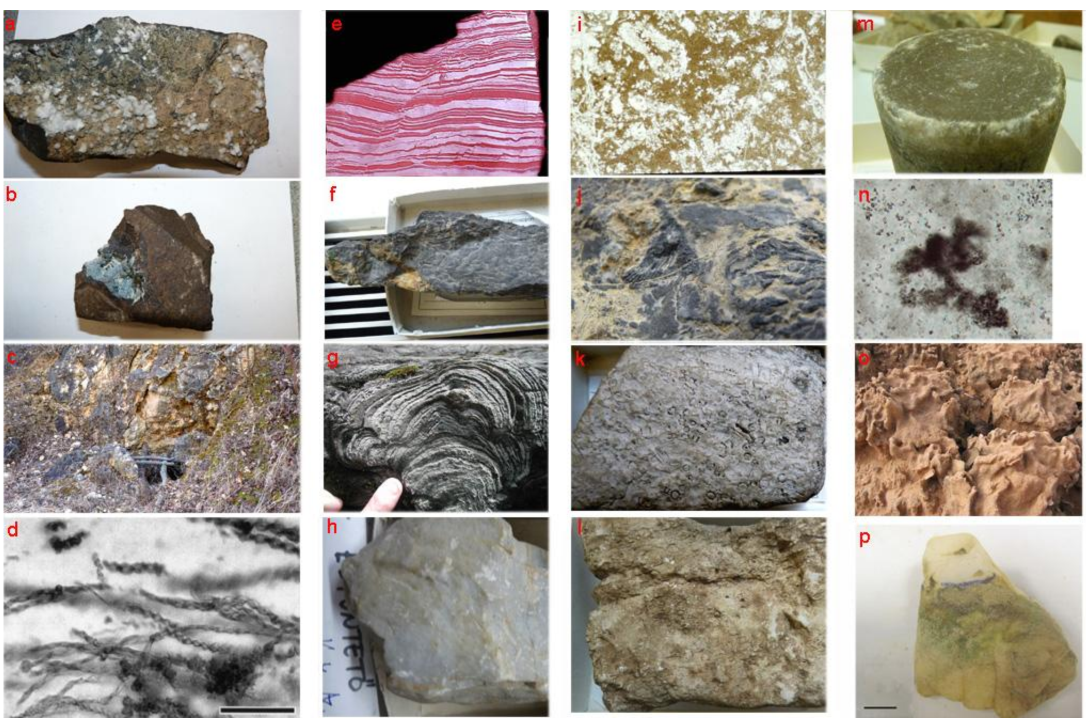

Figure 1. Images of various fossils (see the text for details)

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