WIDESPREAD EXPLOSIVE VOLCANISM IN NOCTIS FOSSAE ON MARS. B. Pieterek[1], M. Laban[2], J. Ciążela[2], A. Muszyński[1]; [1] Institute of Geology, Adam Mickiewicz University, ul. Bogumila Krygowskiego 12, 61-680 Poznań, Poland, barpie@amu.edu.pl [2] Institute of Geological Sciences, Polish Academy of Sciences, Research Centre in Wrocław, Podwale 75, 50-449 Wrocław, Poland, j.ciazela@twarda.pan.pl.

Introduction: The surface of Mars has been broadly reshaped by volcanic processes that most likely occurred throughout the entire history of the planet. The range of observed volcanic landforms shows that effusive eruptions prevail over the explosive type. Only a few explosive volcano fields [1,2] have been detected so far, although theoretical considerations [3] suggest that basaltic explosive volcanism should be more common on Mars. Even though major differences between terrestrial and Martian scoria cones have been identified [3,4], there is still a need for searching new explosive volcanic fields on Mars to extend the current state of knowledge. On Mars, scoria cones reveal differences in morphological characteristics compared to their terrestrial counterparts. Due to the reduced gravity and lower atmospheric pressure, the martian cones are significantly wider and lower in height with gentler slopes [4]. The formation of explosive-origin volcanic cones is most likely generated by the expansion of dissolved gases in magma or by an interaction of magma with volatiles in country rocks (for example subsurface ice) [1]. Such an eruptive style might result in the migration of postmagmatic fluids and/or activation of hydrothermal circulation by subsurface magma-water interaction [5].

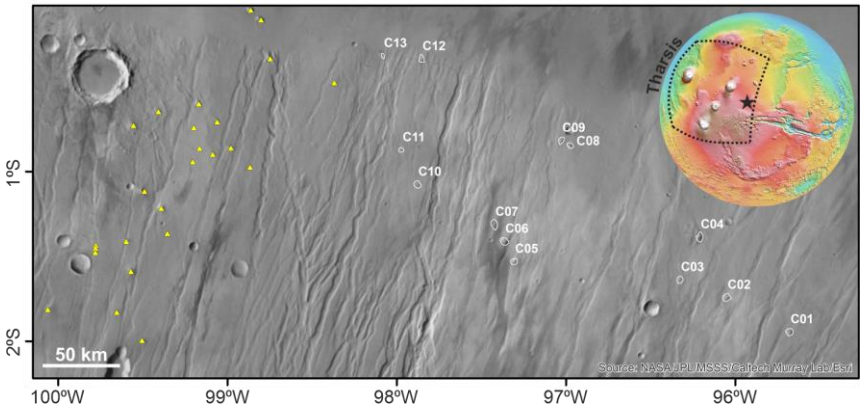

Figure 1: Location of the investigated cone-like structures (C01-C13) to the east of the Noctis Fossae volcanic field (yellow triangles; CTX global mosaic). The marker on the insert shows the location of the study area in relation to the Tharsis volcanic province in the west.

To reduce the time of mapping martian landforms such as scoria cones, Pieterek et al. (this issue) have developed an automated algorithm for searching and identifying pitted cones including explosive-origin volcanic cones on Mars. Using this automated algorithm, we found previously undescribed cone-like structures located to the east (~200 km) of the Noctis Fossae volcanic field [2] (Fig. 1). The new volcanic field, which we describe for the first time here, may provide more insights into the regional magmatic system of Noctis Fossae and its potential relationship with the Tharsis-magmatic system further west (inset in Fig. 1).

Methods: To map and describe the cone-like structures, we used the ArcMap software on a set of images from 1) the Mars Orbiter Laser Altimeter (MOLA) of the *Mars Global Surveyor* (MGS) and the High- Resolution Stereo Camera (HRSC) of the *Mars Express* (MEX) (spatial resolution of ~200 m/pixel), 2) the Context Camera (CTX) of the *Mars Reconnaissance Orbiter* (MRO) (6 m/pixel), and 3) the High Resolution Imaging Experiment (HiRISE) of MRO (~50 cm/ pix-

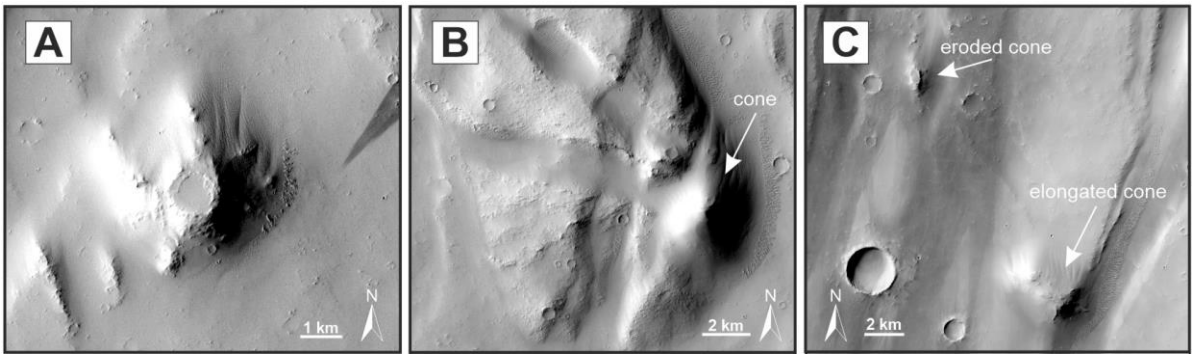

Figure 2: Examples of cone-like structures identified in the studied area. The CTX images of the cones that show conical shapes **(A&B)** with well-developed summit crater (C01) and summit peak (C03), respectively. **(C)** Two adjacent C06 and C07 cones are characterized by different states of preservation. The C07 cone is interpreted as a highly eroded relict of the subsurface dike.

el). To provide initial morphological characteristics of these features, we used the methodology provided by Grosse et al. [6], often applied for the martian volcanic cones [2,4,7]. The initial topographic information is derived from version 2 of a blend of a Digital Elevation Model (DEM) data derived from the MOLA and HRSC images.

Results: The newly mapped cones are spread over an area of 175 x 50 km (the total area including Noctis Fossae volcanic field is 260 x 120 km; Fig. 1). Eight cones are isolated (e.g., C01-C04, C10-13), whereas five occurs in small clusters (C08-09 and C05-07; Fig. 2). Their shapes are mostly conical but may be elongated. The cones are almost pristine to highly eroded (e.g., possible dike relicts; Fig. 2). Cone basal diameters (W_{CO}) vary between 1.7–3.7 km, with a mean value of 2.4 km (based on the 13 cones; Fig.2). In some cases, these structures are characterized by circular summit craters (C01-02), sometimes more elongated (C05) which have diameters (W_{CR}) between 0.2–0.8 km (0.5 km on average). Others show a central peak at the summit (C03, C08-09). The cone heights (from the basement to the summit) range between 50–470 m, with an average of 160 m. In addition, we have calculated the W_{CR}/W_{CO} and H/W_{CR} ratios that show values between 0.08–0.23 (average of 0.18) and 0.19-0.43 (average of 0.35), respectively.

Discussion: The cones resemble scoria cones from other volcanic fields in Ulysses Colles [7], Hydraotes Colles [4], Coprates Chasma [5], and adjacent Noctis Fossae [2] (Fig. 3). Based on the tectono-structural map provided by Pieterek et al. [2], we found that the newly described cones are emplaced along the same direction (NNW-SSE) as scoria cones from Noctis Fossae volcanic field (N015W). For example, the cones C05–C11 from this study followed the same direction as cones N01–N04 from the Noctis Fossae volcanic field [2] (Fig. 4). Based on the structural interpretation, it appears that newly described cones are further manifestation of the subsurface dikes that sourced the Noctis Fossae volcanic field (Fig. 4). We suppose that the newly described cones represent the same volcanic origin related to Tharsis Montes. However, to reconstruct the entire magmatic system of Noctis Fossae more detailed studies will be needed.

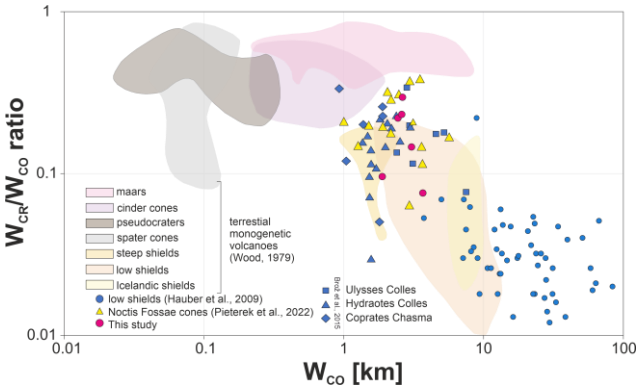

Figure 3: W_{CO} vs. W_{CR}/W_{CO} ratio of the studied cones compared to explosive and effusive volcanoes in Tharsis [8] and Earth. W_{CO} – cone basal diameter; W_{CR} – summit crater diameter.

Conclusions: Our initial results of cone-like structures in Noctis Fossae suggest the occurrence of volcanic-origin scoria cones which may be genetically related to the adjacent volcanic field described by Pieterek et al. [2]. This observation indicates the widespread character of the explosive volcanism between Tharsis Montes and Valles Marineris. This area might represent the most extensive explosive volcanic field on Mars.

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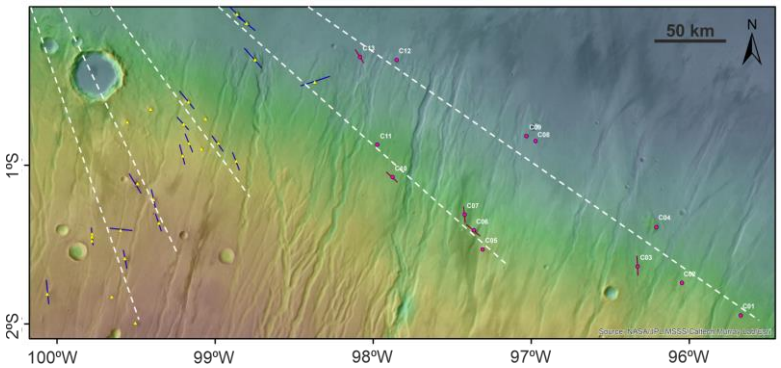

Figure 4: The tectono-structural map of the Noctis Fossae region with the cones and summit alignments identified by Pieterek et al. [2] (yellow triangles and blue lines, respectively) and in this study (red circles and lines). The spatial arrangement of the cones together with their summit alignments within the entire Noctis Fossae region indicate potential orientations of the possible feeding dikes (white dashed lines) in the NNW-SSE- trending directions interpreted as radial dikes from one of the Tharsis Montes volcanoes as suggested by Pieterek et al. [2]. The basemap is a combination of HRSC MOLA DEM v2 (transparency of 60%) and CTX global mosaic.

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