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Evidence of life on Mars?

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Joseph, in his article "life on Mars (Joseph, 2014) suggests possible forms of life on the soil of Mars, such as algae, fungi and lichens, mainly based by NASA's Curiosity rover color shots. He then asks the question: "If its not biological, what is it? However, Joseph's hypothesis is supported by a simple comparison of some images, without an overall assessment of the conditions that may support this idea. Answers can only be provided by a thorough study of the many images taken by the rovers in different sites and at different scales. Joseph's biological interpretations, undoubtedly impressive, is in line with the results obtained in the past by other researchers (Levin and Straat, 1978; Strickland, 1981, 1986). Also, the outcomes of our studies, essentially based on the Microscopic Imagery (MI) shot by the Spirit and Opportunity NASA rovers confirm the presence of peculiar structures, made by a variety of microspherule settings that we supposed of microbial nature and similar to those of terrestrial stromatolites (Fig. 1; Rizzo and Cantasano, 2009, 2011).

In particular, looking at the pictures reported on the article, we could consider the following:

As depicted in Figures 1-3 (Joseph 2014), the occurrence of moisture on Martian soil is well known and could also reach a large amount. Soil composition is made by a fine detrital fraction, including clay dust, ice and salts (mainly sulphates), as well peroxides. This particular composition alone, depending on the local amount of moisture, can explain the different consistence observed at various sites: sometimes hardened into crusts, sometimes plastic and strongly adhesive. It should be noted that in some amplified MI images was noted the occurrence of structured/transparent films, resembling biogenic matter, as EPS and/or collagen, that may also be the main source of adhesiveness (Fig. 2; see also Figure 7 in Rizzo and Cantasano, 2009).

As illustrated by the pictures in Figures 4-8 (Joseph 2014), there is an evident whitish encrusting increase over time. Is it an increase or a cleaning of a putative desert crust? As regard our studies, we lack of data in order to support dimensional or tonality variation of encrusting bodies. We have only to observe that, in fact, "recent" and "on surface" whitish crusts occur, besides the well-known "desert varnish" (Di Gregorio, 1997; Di Gregorio, 2010), as well exist "external growing bodies" and "internal growing bodies". Some examples of these textures are shown on Figure 3 (examples of internal growing are also shown on Figure 8, in Rizzo and Cantasano, 2011 and in Figure 2a in Rizzo and Cantasano, 2009). Really, the typical dark shiny patina observed on terrestrial desert rocks could also be seen on Mars but these forms could be the result of geochemical weathering processes, involving the transportation or the deposition of Manganese iron oxide on Martian ground.

As shown in Figures 9-21 (Joseph, 2014), these spherules have dimensions of some millimeters, probably of various composition and origin, including the well-known "blueberries". In the article, many parallels to lichen and fungi are made and, also, the occurrence of thin filaments, supporting blueberries, is taken into account to refer fungi. Further, Opportunity shots, at sols 3247-3250, confirm structural and morphological parallels to terrestrial "moqui", whose microbial activity seems to be proved (Aubrey et al., 2006; Loope et al., 2010, 2011). These parallels regard their concentric and polispherules structure, as well their composition. Our microstructural studies are perfectly in line with this biological interpretation and show that blueberries are polispherule arrays, set in concentric sheets or spatial/polispherules bodies (see Figures 6 and 7 in Rizzo and Cantasano, 2011), also observed in cyanobacterial communities. However, color and roughness (and composition too?) somewhere seem to be different (Fig. 3). Really, terrestrial fungi are quite different in composition while filaments, bearing blueberries, could be explained differently, due to differential erosion or to growing processes at the end of microspherule filaments. At the same time, visual parallels with lichens could be done (Fig. 4) but their effectiveness is to be demonstrated.

Joseph's (2014) article presents new and old assumptions about unresolved issues. Does exist life on Mars? Based the data presented by Joseph, and on our data (see Figures 1-3_, it is evident that life thrived on Mars and probably still exists not only as microbial form, but also in a more developed stage (as are lichen and so on).

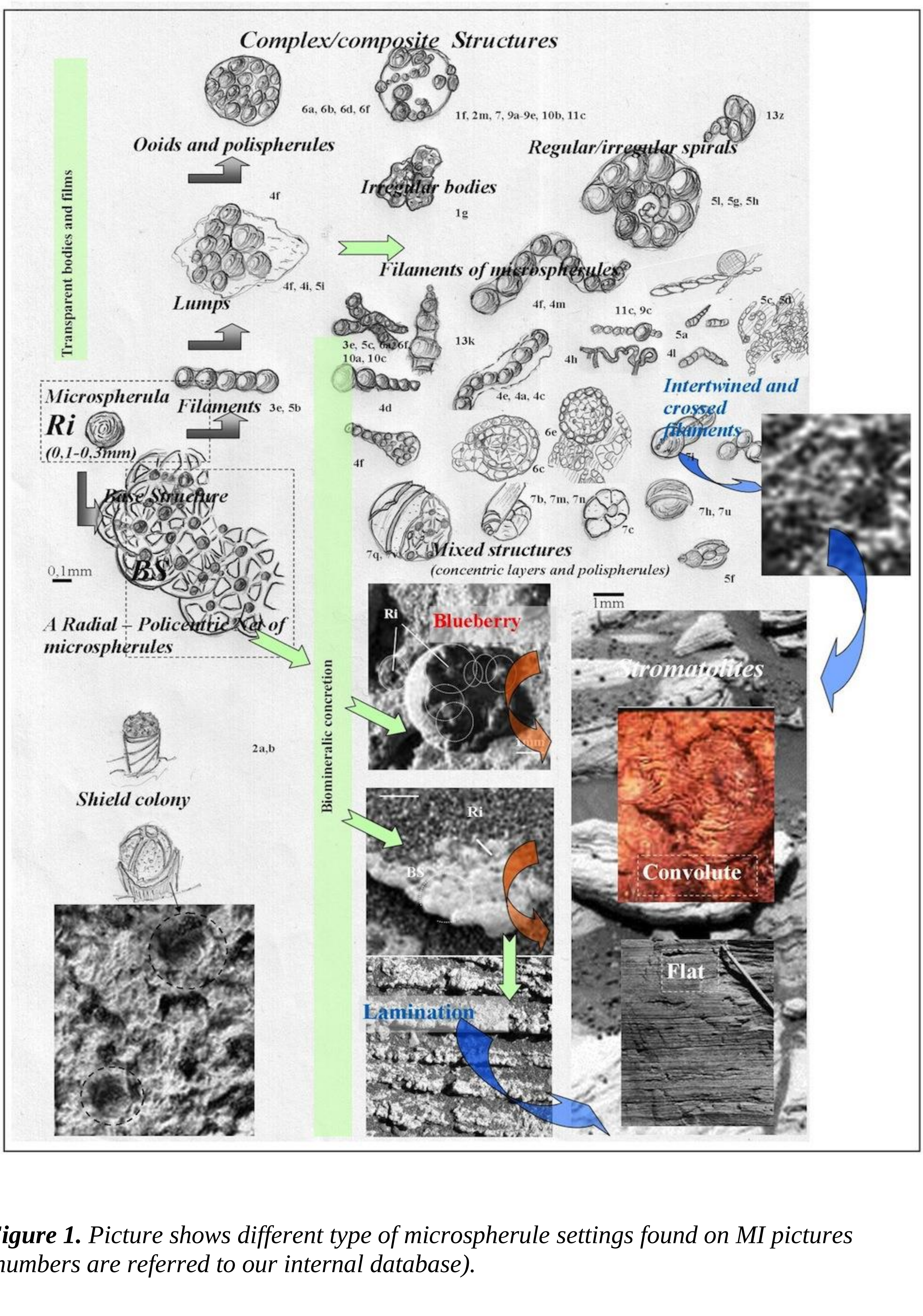

Figure 1. *Picture shows different type of microspherule settings found on MI pictures (numbers are referred to our internal database).*

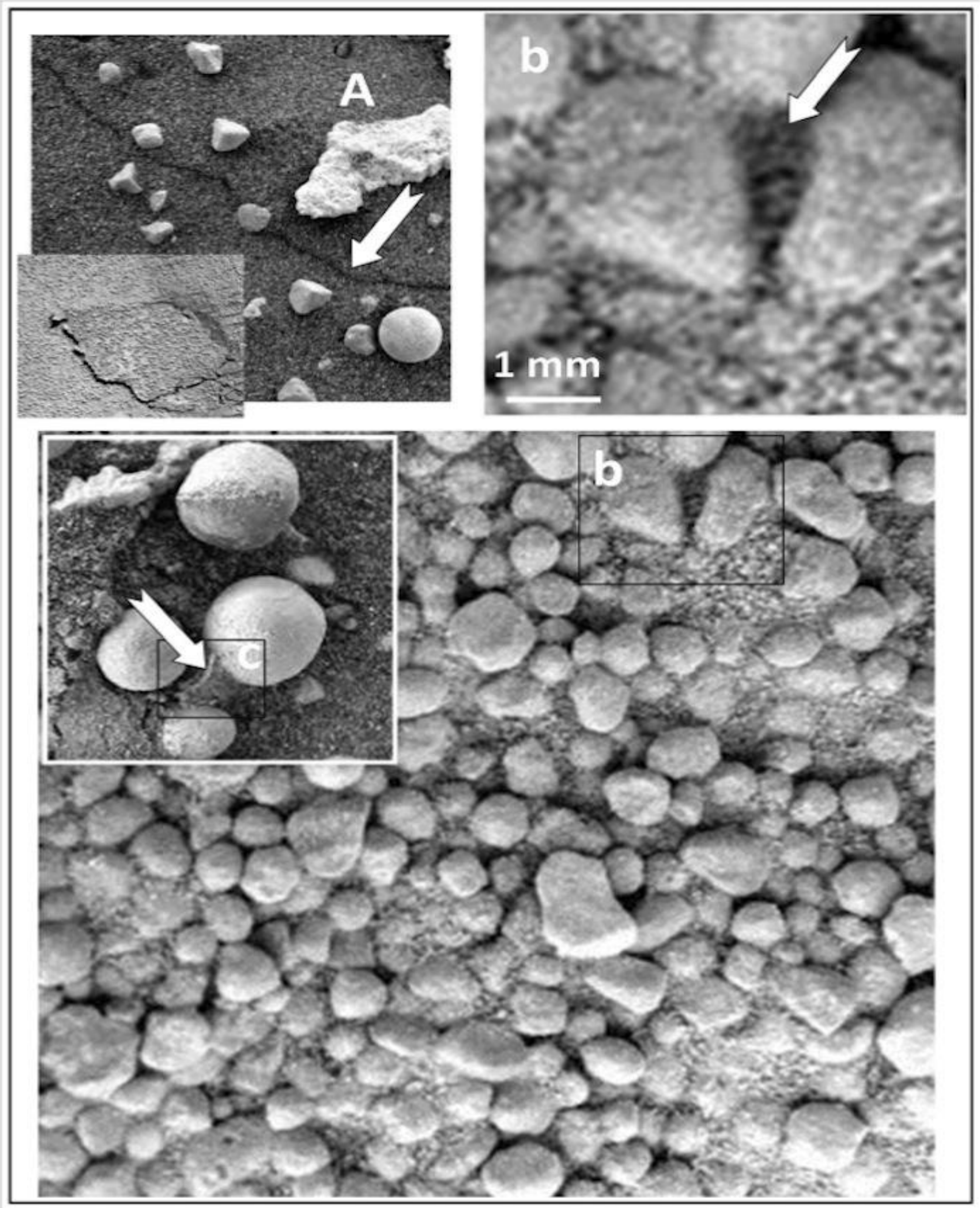

Figure 2. *Occurrence of transparent/structured film on Mars soil. Left on the top: image A shows soil plasticity (overthrust at low angle is marked by arrow) or hard consistence (crust) on soil surface thin layer. Occurrence of film contained microspherules is shown in the big picture and inside the enlarged frames b and c (arrows). Film is highlighted by reflection and his structure is shown on frame b (nearest and above the vacuum).*

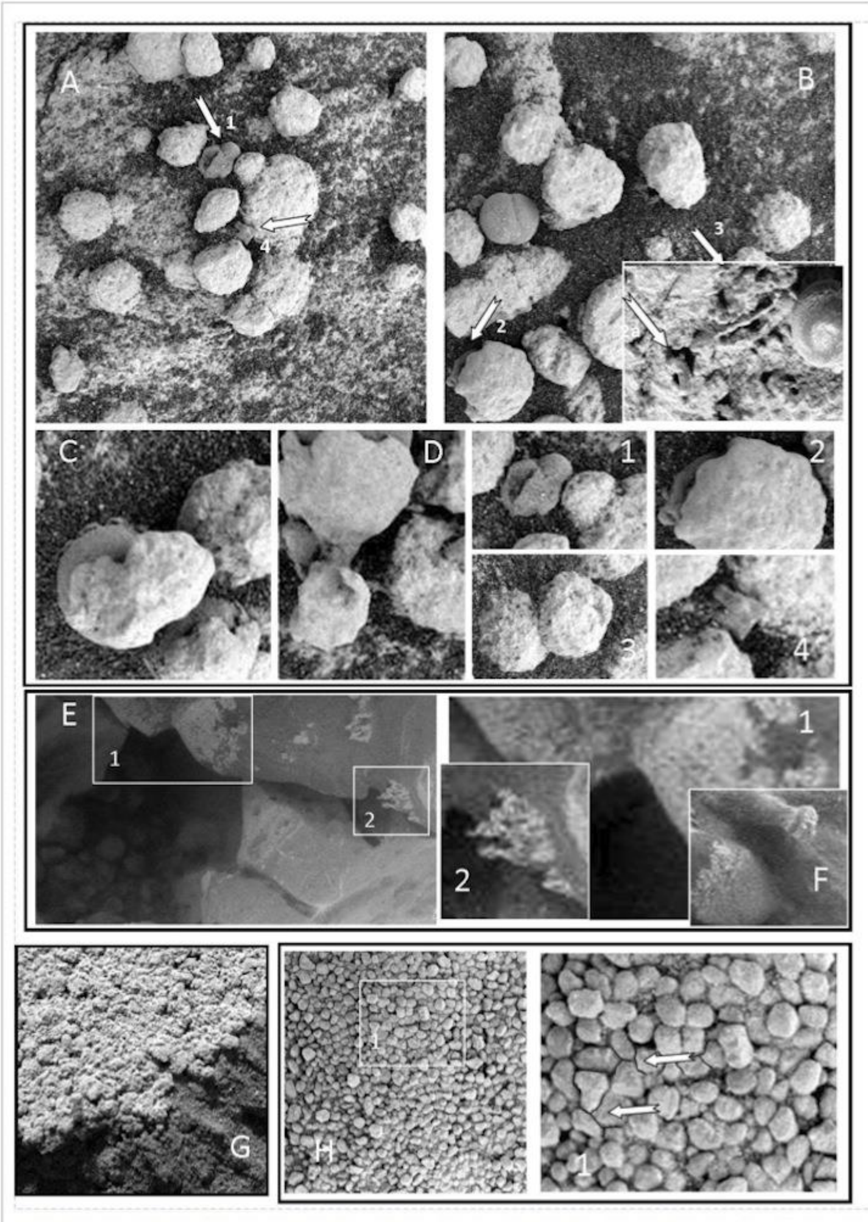

Figure 3. *Examples of "on surface" recent growing (biological or biologically induced?). Pictures A and B (at Opportunity sol 194-199) show whitish concretion (arrow) and recent encrusting. On particular 1: an opening body (it is not a fracture!); on particular 3: a structure overlapping; on particulars 2 and 4: strange, recent bodies (from the near thermal shield impact?). As regard particular 2, on note (on the frame over) a similar body (fossil? Arrow indicate the peculiar collar) found no far (on sol 28). On note, on pictures B, C and D differences, on gray tonality and surface roughness, between blueberries and their enveloping whitish bodies, somewhere growing as spot on black sand. Picture E (on sol 2858) shows whitish crust around a cavity; its microstructure pattern is shown inside particular 1; similar crust/encrusting were found on sol 3502 (picture F). Picture G and H show interdigitated (arrows) structures (on G, resembling pebbles), probably post-genetic and recent, due to salt concretion (biologically induced?).*

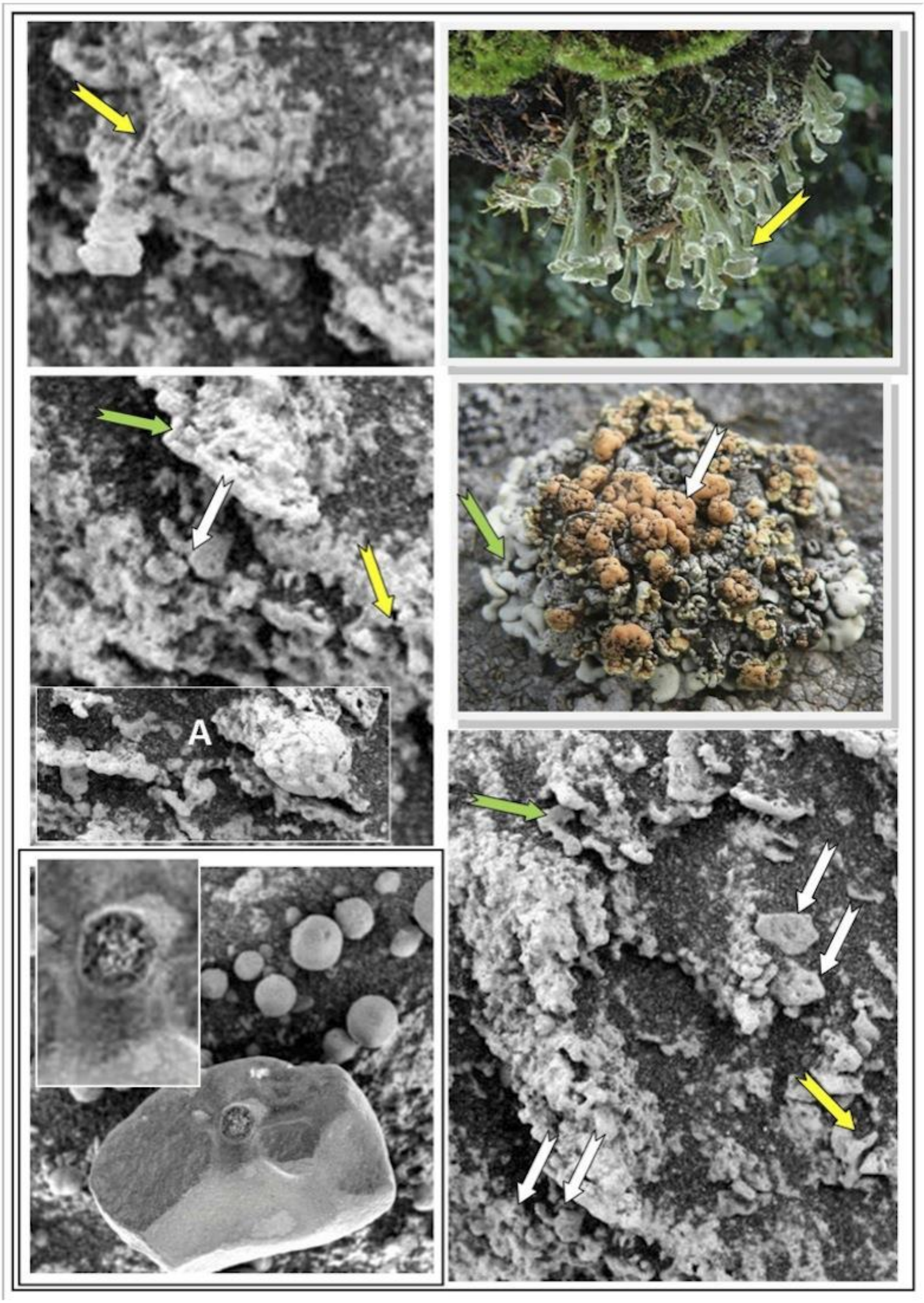

Figure 4. *Pictures and arrows show visual parallels between lichens and outcroppings on Mars (Opportunity, sol 282); on frame A: a spherule covered by a filamentous body. Below on the left: a possible fossil alga on Mars.*

Conclusions

In conclusion all data, as presented by Joseph (2014), our selves and others, are converging on supporting the hypothesis of life on Mars.

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