Extraterrestrial life may be relatively common but oh so difficult to detect!

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With so many missions to search for extraterrestrial life in progress or planned and two superb in situ missions on Mars (Mars Science laboratory and Mars 2020) it is timely to consider what we are looking for. Justifiably, we base our search on what we know of life on Earth, particularly life in the kinds of extreme environments that may have existed or may still exist on other planets or moons. But life on Earth today has evolved far from the earliest forms of life that existed on Earth or on any other Solar System body. The oldest, preserved traces of life on Earth record already relatively evolved life forms, like anoxygenic phototrophic microbes. They preferentially inhabited sediment surfaces in shallow water environments. At the same time, other, more primitive types of microorganisms preferred the relative shelter of porous volcanic sediments or chemically precipitated gels. These microbes obtained their energy from inorganic substrates, such as mineral surfaces (chemolithotrophs) or by oxidising the organic matter (e.g. the remains of dead chemolithotrophs). These were the chemoorganotorphs. The lithotrophs are interesting because they were everywhere. However, their means of obtaining energy is not very efficient, therefore they grow slowly, are small, and do not produce a lot of biomass. Their physical and organochemical expression is “discrete” and “diffuse”. Organotrophs create more biomass but are generally concentrated around hydrothermal activity. Chemotroph-like microbes are likely to be the most common type of life form in the Universe but they are difficult to detect and to identify. Could microbes similar to phototrophs have evolved on Mars, where shallow water sediments with access to sunlight abounded? This is what Mars 2020 is looking for but was Jezero Crater habitable long enough to have been colonised by life and for that life to have evolved photosynthesis?