

We first present a compilation of chemical structures of biochemical compounds that are involved in metabolism of (poly)extremophiles. Our focus is on the molecules which are involved in the energy harvesting and transport. Next, we look for the chemical features that make such compounds uniquely suitable for their functions. We then consider such chemical features as potentially universal for a putative (poly)extremophile life on Mars. We explore the idea if these universal chemical features are “chosen” via chemical evolution, as is the case in which nature “chose” phosphate in our genetic system. Both actual compounds and the proposed universal compounds could be used as biomarkers for life on Mars. Finally, we present a compilation of Infrared (IR) frequencies of both actual and proposed universal compounds that could be useful in their identification by the IR, both as the *in situ* measurements on Mars or on the samples returned from Mars. The IR spectroscopic technique would supplement the Raman spectroscopy. The latter often suffers from complications due to the background interference, while the former does not.