

# **Distinguishing True Biology from Nonbiological Look-Alikes**

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As we are able to sample further back in time and on the surfaces of other planets with remote instrumentation, astrobiologists are confronted with discerning which chemical, physical, or isotopic features are conclusive signals that life once existed. Theory, followed by experimentation, continuing with field testing, and renewed instrument development are all critical aspects for distinguishing early Earth and extraterrestrial life. Carbon was the first stable isotopic tracer of early photosynthetic life, whereas Fe isotope biosignatures were developed within the past 5 years. Can nonbiological processes mimic biological isotopic fractionations? Microstructures in meteorites and ancient rocks could very well be evidence of early life, but geochemical processes can also play cruel tricks and make minerals appear to have been biologically formed. Advances in laser based spectroscopic imaging techniques coupled to isotopic and molecular studies represent our best efforts to challenge the obvious, such that when similar instrumentation is deployed on Mars and Europa, the community will have the analytical and theoretical toolkits to comprehend incoming complex data.