LONG-DURATION NATURAL STORAGE OF VIABLE ORGANISMS IN GEOLOGICAL MATERIALS AND STRUCTURES AS A MODEL FOR OBLIQUITY OVER-WINTERING ON MARS. P. J. Boston[1], D. E. Northup[2], and M.N. Spilde[3] [1]NASA Astrobiology Institute, NASA Ames Research Center, Moffett Field, CA 94035, penelope.j.boston@nasa.gov, [2]Biology Dept., MSC203-2030,University of New Mexico, Albuquerque, NM 87031 dnorthup@unm.edu, [3]Institute for Meteoritics, MS203-2050, University of New Mexico, .

Introduction: Since the 1960's, reports of viable microorganisms from various rock materials, ice, and crystals are scattered thinly through the literature with claims ranging from a few thousand years to well over two hundred fifty million [cf.1,2,3,4,5,6]. Some of these reports have been controversial and it is admittedly difficult to assure non-contamination while attempting to retrieve live organisms from geological "tombs". However, there is sufficient evidence to believe that there may be many geological settings in which organisms can remain in some form of static state and still be viable over what are commonly known as "geologically significant timescales". The precise duration of such time scales have been the subject of debate and could be a few thousand years, tens of thousands of years, or even millions of years. The eventual determinations of the legitimacy of ancient claims will have profound consequences for life on Earth, a process of organisms surviving their surface extinction only to re-emerge again, a process we have called "geogenetic latency". Further, the Earth cases if they hold up, offer the possibility that indigenous Martian microorganisms could conceivably survive periods of greater climate clemency during the obliquity cycles of that planet that we now know occur and have been roughly estimated as 124kyr in duration and could allow water to flow on the surface [7,8,9]. Such periods of enhanced habitability on Mars could allow a flourishing of a near surface and possibly surface ephemeral biosphere, or even localized relict biosystems for some period of time, then to go into long-duration dormancy once again. How realistic is such a scenario in light of what limited understanding we have of such "Rip Van Winkle" organisms on Earth?

Naica Microorganism Longevity Case: Results of over a decade of work on samples from sulfuric-acid created caverns associated with zinc, lead, and minor copper and silver mining in the mountains of Chihuahua, Mexico, has led us to conclude that we have isolated living organisms from fluid inclusions in gypsum crystals (aka selenite, $CaSO_4$) from proxy depth/age calculations equivalent to times of isolation within the crystal pockets from 1-5 $X10^4$ years. In addition, DNA analysis from materials within some pockets has also been performed. The metabolic state of the organisms at the time of collection was tested in the field and in the lab with live-dead stain (BacLight Viability, Thermo-Fisher), and inoculated into a wide variety of sterile media and buffers on site before transportation back to the laboratory for further work. Obliquity cycles ranging from 100kyrs to possibly longer have been predicted for the Martian case.

Quartz Inclusions Case: Low temperature quartz veins within several different bedrock types from southern New Mexico contain very large fluid inclusions comparable to the Naica crystals. They are on the order of 0.8 to 1.2 Mya and are secondary infillings within the bedrock fractures, deposited by groundwaters We have recently isolated material from from these inclusions and may be seeing growth. Whether the growth is truly not a contaminant but organisms from within the fluid pockets is very difficult to assess and will rely on further genetic analysis should they prove to be truly viable organisms.

Discussion: We are quite confident about the Naica cultures and our interpretations, we are not at all confident about recent work on the much older quartz veins. Instead of clear conclusions, we will present the work to date, but more importantly present the many caveats and difficulties that we experienced during both of these efforts to share with the community that is interested in the notion of geogenetic latency as applied to both Mars and Earth

References:

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