doi:10.1017/S143192762100814X
Microsc. Microanal. 27 (Suppl 1), 2021

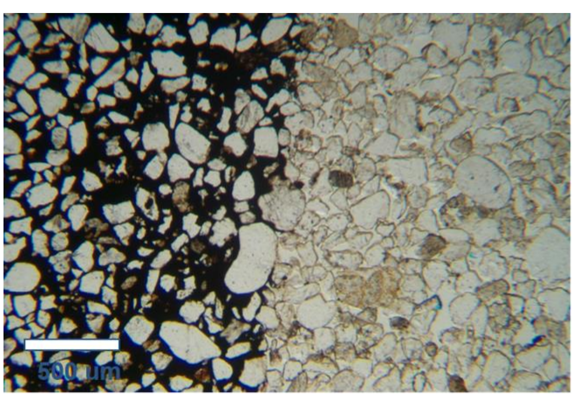
Blueberries on Earth and Mars: Correlations between Concretions in Navajo Sandstone and Tyerra Merdiani on Mars

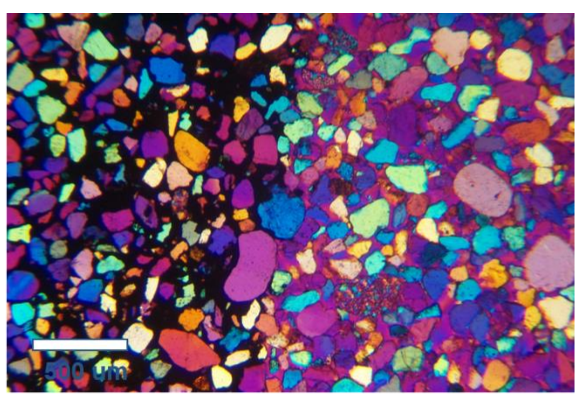
Andrew Havics[1], William Mahaney[2] and Dennis Netoff[3]

[1]pH2, LLC, Avon, Indiana, United States, [2]York U., Toronto, Ontario, Canada, [3]Sam Houston State University, Huntsville, Texas, United States

Concretionary Fe-Mn-rich nodular authigenic constituents of Jurassic Navajo sandstone (moki marbles) bear a certain relationship to similar concretionary forms ("blueberries") observed on Mars. Their origin on Earth is considered to invoke variable redox conditions with underground fluids penetrating porous quartz-rich sandstone leading to precipitation of hematite and goethite-rich material from solution, generally forming about a central nucleus of fine particles of quartz and orthoclase, recently verified by XRD and SEM-EDS analyses. At the outer rim/inner nucleus boundary, bulbous lobes of fine-grained quartz often invade and fracture the outer rim armored matrix. The bulbous forms are interpreted to result from fluid expulsion from the inner concretionary mass, a response to pressure changes accompanying overburden loading. Moki marbles, harder than enclosing rock, often weather out of *in situ* sandstone outcrops and lie about on surfaces exposed to the subaerial atmosphere, developing a varnish-like crust. The marbles appear morphologically similar to "blueberries" identified on the martian surface in Terra Meridiani through the MER-1 Opportunity rover. On Earth, redox fluids responsible for the genesis of marbles may have emanated from deep in the crust (often influenced by magmatic processes). These fluids, cooling to ambient temperatures, may have played a role in the genesis of the cemented outer rim of the concretions. The low frequency of fungi filaments in the marbles, contrasts with a high occurrence in Fe-encrusted sands of the Navajo formation, indicating that microbial content is of secondary importance in marble genesis relative to the fluctuating influx of ambient groundwater [2]. Nevertheless, the presence of filaments in terrestrial concretions hints at the possibility of discovering fossil/extant life on Mars, and thus should be considered as prime targets for future reconnaissance missions to Mars.

The cross sections were analyzed by Polarized Light Microscopy (PLM) as shown in Figures 1&2. The grains were revealed to be more than just quartz, with some microcline for instance. Also noted was grain boundary migration of a fractal nature in some of the quartz grains, revealing a previous history for those grains. The cross sections were analyzed by SEM-EDS with selected elemental mapping. There was a distinctive band correlating with the iron concentration in the matrix of the brown concretions. The blue concretion did not reveal any significant iron, but rather weak counts of aluminum and chlorine; perhaps the origin of the blue color.





https://doi.org/10.1017/S143192762100814X Published online by Cambridge University Press

Figure 1. Brown concretion thin section by Polarized Light Microscopy (PLM). Lt: Crossed Polarized Light (XPL), Rt: XPL with a first order Red plate.

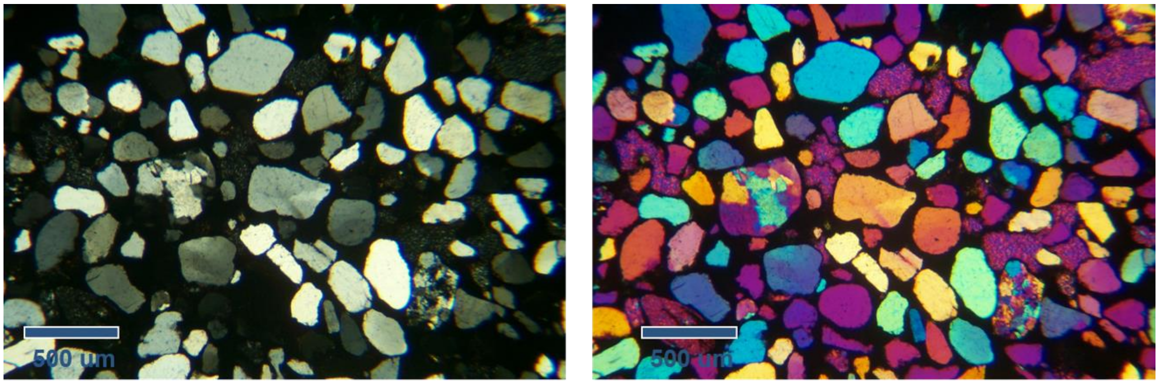


Figure 2. Blue concretion thin section by Polarized Light Microscopy (PLM). Lt: Crossed Polarized Light (XPL), Rt: XPL with a first order Red plate.

References

1. Catling, David C.: On Earth, as it is on Mars, *Nature* 429:707-708, 2004.
2. Mahaney, W. C., Milner, M. W., Netoff, D. I., Malloch, D., Dohm, J. M., Baker, V. R., ...& Komatsu, G.: Ancient wet aeolian environments on Earth: clues to presence of fossil/live microorganisms on Mars. *Icarus 171*(1):39-53, 2004

https://doi.org/10.1017/S143192762100814X Published online by Cambridge University Press