A review of:

Occurrence and Distribution of Moganite and Opal-CT in Agates from Paleocene/Eocene Tuffs, El Picado (Cuba)
By: Jens Götze, Klaus Stanek, Gerardo Orozco , Moritz Liesegang, and Tanja Mohr-Westheide. (2021) Minerals, MDPI.com, Vol. 11. No. 531, 13 Pgs.

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Review by: Donald Kasper, 11/20/2022

Overview: Goetze and others studied 3 agates out of a cherty tuff deposit in NE Cuba consisting of tuff, carbonate, and opal-CT with vein and nodular agates. The authors encounter calcite, and moganite in significant concentrations in the agates. This is the first time the author recalls Goetze describing an inclusion in an agate. Another paper for these agates of this locality show homogenation temperatures of 130-145C which is the temperature water in microbubbles convert to steam, indicating the temperature they were entrapped in the rock. That is also a classical temperature of about 150C for burial diagenetic metamorphism.

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Items as encountered are:

1. Pg 5 indicates high moganite content in the agates. This only occurs in shadow agates where beta-moganite is on the banding planes as an opaque inclusion, but their description is unclear what these agates are.
2. Pgs 8-10 try to use cathodoluminescence to identify trace mineralization. This technique has a lot of problems and what its spectra mean is unclear. Saying certain bands mean certain minerals is not established science. It is like saying that using a spectrophotometer and getting the color green proves a mineral has nickel. Yeah, it might, but it might also mean 100 other things. Goetze keeps trying to use this approach to mean something.
3. Pg 5 Figure 5 it is claimed that they can now see moganite in XRD. This is new. Moganite is defined by Raman spectroscopy, and the author can correlate it to infrared spectroscopy. In infrared, the author can identify candidate quartzine, alpha-moganite, beta-moganite, mixed alpha-beta moganite, and one or both mixed with quartzine. There is no study of quartzine in XRD the author is aware of and is probably confused with moganite.
4. Pg 5 and Pg 6 Figure 7 microscope photo proves opal-CT lepispheres to the authors, but in sedimentary-tuff systems with mixed cherty agates, the author finds innumerable spheroids are radiolarians. This is certainly true for Midwestern US cherty agates. The author has reflectance infrared spectroscopy and the ability to study the opals. Is opal-CT found in the agates of the Western US? Exceptionally rarely in structures like celadonite curls, pendant structures, otherwise mainly in opal geodes. Opal-CT is missing in agates as the main rule, and they are totally missing opal-A. Invariably, the opals are found as crusts surrounding vein and nodular agates typically with celadonite and nontronite, which might be the clays they are seeing. The clay mineralization can be exactly defined in infrared but there are a lot of problems using XRD for clays.
5. Pg 7 stating 15% moganite is only seen in the Western US in cherts called “snakeskin agates” by locals, but are pure granular chalcedonies. They are found in erionite-rich tuffs exclusively. The authors here show clinoptilolite in their host rock.
6. Pg 11 asserts opal-CT converts to quartz, but they are studying 55-million-year-old rocks. Apparently, this takes hundreds of millions of years. But, the author has an opal-C geode that in five years changed its infrared

spectrum to start to show opal-CT by dehydration. Opal-CT and quartz transformation idea comes from ocean drill cores and burial metamorphism.

7. Pg 11 cites papers by Moxon that to them proves moganite is unstable over geologic ages and inverts to quartz. Actually, over geologic time, kaolinite infiltrates the agates and they become confused with cherts.
8. Pg 11 X-ray study shows illite-smectite in the host rock but this hides the fact that illite and smectite are slang terms not mineral names and means that the XRD cannot pin down the species of clays.
9. The authors cite a Moxon paper claiming to prove moganite alteration to quartz over huge geologic time scales. Moxon picked up old rocks with less moganite than some young rocks with more moganite and concluded the moganite changes to quartz over time instead of that he just happened to find some rocks with less and some rocks with more moganite having nothing to do with age. Various sites of various ages and moganite doesn't prove a process; a decrease in moganite in one stratum site does. Moxon has not done this. High moganite content is restricted to erionite tuffs, and if you don't find old erionite tuffs, you aren't going to find old moganite. Maybe the issue is what happens to erionite over time. But for agates, the amount of moganite is always small. High moganite content is only found in cherts, called erroneously "snakeskin agates" and geologically called Magadii-type cherts.

Conclusion:

The paper is a marine cherty-agate that may be confusing ooids of radiolarians with opal-CT. The host rock is a calcareous chert. The author finds that it is not that agates form from precursor gels, they form from precursor calcium-silicate-hydroxyl (CSH) gels and are calcsilica rocks as Goetze and coauthors are starting to come to terms with as they bother to study inclusions in the agates for the first time. Their green jasper on page 3 they might infer is nickel talking about previous Cuban nickel mining, but celadonite is a much better place to start, and if their XRD software cannot distinguish celadonite from illite and smectite, they need to try other identification software and scan some reference celadonite to train the program.