## A review of:

### Mineralogy and Geochemistry of Agates from Paleoproterozoic Volcanic Rocks of the Karelian Craton, Southeast Fennoscandia (Russia)

**By: Evgeniya N. Svetova and Sergei A. Svetov. (2020) Minerals, MDPI.com, Vol. 10. No. 1106 20 Pgs.**

**MDPI.com is a pay-for-publish predator journal, although in all fairness, all publishing is vanity press work.**

**Review by: Donald Kasper, 11/21/2022**

Overview: Agates formed here are in pillow (subsea) lavas, in the cores of, and between pillows. This would be like the mining of jaspers cores in pillow lavas for Oregon Bruneau jasper. The metamorphic alteration with sea water salt alters calcium feldspars to sodium feldspars with chlorite, epidote, and quartz. No waterline agates were found, so the agates formed subcritical (<374C).

Donald Kasper

Items as encountered are:

1. Abstract. First paper I have seen recognizing foreign mineralization in agates. They use XRD and plasma spectrometry were used, but no Raman or Infrared study.
2. Abstract. They state agates form in hydrothermal systems, about 190 million years after the volcanism at a locale ended, but then there were sill intrusions.
3. Pg 5 shows agates between lava pillows. To the authors this proves latent hydrothermal action, but don't consider exsolution of silica from the pillows at the time of emplacement.
4. Pg 8 claims prehnite in agate. The Figure 2i image looks like prehnite and mosaic quartz crystals (a hash of quartz crystals). This is possible, as it is also inferred from a Lake Superior pillow lava study as well (they were not studying agates, just regional geology).
5. Pg 9 Figure 4 claims the green in the agate shell is chlorite. Invariably, this is incorrect and would be celadonite. Photo b are not pseudostalactites, they are quartz stalactites. Photo g does not prove carbon inclusions because they are dark. The more common case is iron oxides. Photo c orb matrix labelled as pycrobasalt is probably radiolarian fossils. The English language literature has no pycrobasalt. This might be a derivative of picrobasalt, really meaning amygdaloidal basalt. Photo f is a implosion breach that dumped calcite. This would indicate brecciation infiltrated calcite, not the quartz. The quartz was an alteration byproduct of the silicate mineralization.
6. Pg 9 that the dark coloration, also called smoky, is carbon is somewhat true. It is not carbon per se, but humic acid staining over time. This is also common in Lake Superior ophiolite agates maybe due to marine biological influence, maybe northern latitude forest location of these sites.
7. Pg 10 Figure 5 statement of epidote in banding planes is speculative, but the author has seen this in candidate specimens very rarely as well.
8. Pg 12. So, they bashed samples into powders and only found quartz, not moganite or opal, etc. and conclude they altered because the rocks are old. How about the quartz overwhelms the spectrum and Raman and infrared spectroscopy on whole specimen inclusions should have been done instead. The declaration the specimens have no moganite using XRD is more likely a limitation of XRD, not the absence of moganite.
9. Pg 13. The rhombohedral crystals would be the calcite that formed first, before silica deposition, or rather, the morphology of calcite formed because of the presence of quartz, a situation proposed by others in the literature going back 100 years. The calcite being black or brown does not make it siderite; it makes it humic acid stained calcite as the typical case.
10. Pg 13. Iron oxides trapped in banding planes is found in sites like South Dakota TeePee Canyon and Kentucky agates, probably from organic decay by iron reducing bacteria and entrapped organics.

11. Pg 14 Figure 8. Labelling inclusions in thin sections as chlorite is a guess from backscatter imaging, not a method of spectroscopy studying composition. This is not remotely as accurate as a method of spectroscopy. Although the authors are ambiguous using a lot of general matrix mineral XRD study, basic agate study, and then roaming over to thin section study without being clear this is what they did. Chlorite itself is a slang term as there are two key minerals in the chlorite group unnamed in this paper—clinochlore and chamosite.
12. Page 15. Banded epidote and quartz are not agate, it is banded epidote. There are over 60 banded minerals.
13. Page 17. It is often ignored that standard mean ocean water has no standard as the original batch of equatorial water ran out a decade ago, so oxygen-18 study for some idea of temperature of formation is much less reliable than gets projected in these papers. It depends highly on the kind of water that circulated through the rocks, rocks in the ground and under the sea for 2 billion years.

**Conclusion:**

The locality is agates formed as quartz byproducts of calcium feldspar alteration to sodium feldspar (saussuritization metamorphism) with prehnite and chlorite, and then quartz as a reaction byproduct that formed agate. Late stage hydrothermal action took place clearly occurred leaving its classical marker of calcite hash in veinlets and the cores of agates, particularly at the flow base. Weathering would produce calcite at the flow top. The authors understood part of the agate story but not the complete story. The green shell in agate amygdules is invariably celadonite. The author has found just one site in Scotland with a chlorite shell agate. That is it for 10 years of agate study in infrared.

Any geochemical reaction with quartz as a byproduct will produce opal, quartz, or agate, depending on conditions.

These are 2 billion year old agates with agate banding so the model view that agates convert to granular quartz over time we can declare disproven.