Agate Inclusions Rebuttal of Dr. Jenz Goetze, Agates III, 1/3

Here is my rebuttal to the inclusion list of Dr. Jenz Goetze, page 67, Agates III. I will cover only those minerals I disagree form common inclusions in the agates:

1. Galena. Never. Now, perhaps someone can use transmission electron microscopy (TEM) to find a nano particle of galena, but no means do we ever see agate in the following systems:
    a. Agate is not formed in acid systems.
    b. Agate is not formed in sulfide systems.
    c. Agate is not found in lead sulfide (galena) ore deposits.
    d. Sulfides are less than 3% composition of agates, occurring in minute to microscopic amounts only. That is, there is no 50 lb chunk of galena with 50 lbs of agate on it that will ever be found.
2. Rutile. Never. There is a 2kbar pressure and 575 C limit to inclusions in agates. High temperature-pressure minerals are found in quartz, not agate. Agate is not quartz. Think of quartz as another inclusion in agate like all the rest. This means rutile is out of bounds. Its kin ilmenite on a microscopic level is found in agates because it forms over a broad range of conditions including conditions that are in bounds.
3. Celestite. Many sulfates are found in agates. This is because carbonate and acid systems kills the acid, buffers it to alkaline conditions, and makes sulfate. It also precipitates silica. Unfortunately, due to the wrong geochemical behavior, celestite is found in geodes with other minerals but not agate.
4. Serpentine, talc, prehnite, datolite, epidote, apophyllite. Never. These are high temperature-pressure metamorphic minerals and as such are out of bounds. They are found with quartz, not agate. Agate is not a variety of quartz hauling in all of the inclusions and chemistry of quartz. These metamorphic minerals are found in the source rocks reworked in tectonic and volcanic systems where agate later can form, but they are not part of the same geochemical world and do not interact. It is the constant din of calling agate a quartz variety the produces this serious error in critical thinking. It can be shown as this:
    a. The San Andreas Fault is full of schists with quartz, eclogites, and other metamorphic rocks in California. They have zero agate.
    b. The San Gabriel Mtns. of California have 500 miles of granite and pegmatite. This has zero agate.
    c. Shales, mudstones, slates are all made mostly of quartz, are metamorphic.
    d. Jaspers can have actinolite and epidote likely from alteration after formation.
5. Asphalt, bitumen. Exceptionally rare. It takes a change of conditions from acid to alkaline to find silica with bitumen. It also takes volcanic eruptions through sedimentary rocks. The listing here that this is common is misleading. For example, we do not hunt coal, tar sands, or peat deposits for agates as there is none there.
6. Copper. As malachite and chrysocolla, these do occur in gem silica at some mine sites in Arizona. The occurrence is uneven. It appears chrysocolla is considerably more common than malachite. Now, if you are looking for a botryoidal, banded malachite/chrysocolla agate, you can forget it. They are going to be as colorants only.
7. Rhodochrosite. There is some evidence that it is geochemically possible to have rhodochrosite with silica, but as it forms closer to acid systems, this would be exceptionally rare and there are no rhodochrosite banded agates.
8. Fluorite. No fluorite and no halides are found in the agates. It is becoming well understood over time that so-called fluorite cubes in agates are all the cubic silica mineral melanophlogite.
9. Analcime and natrolite. These are the two zeolites that appear to form exclusively in hypersaline systems. Careful review shows no evidence of any actual specimens found in an agate so far. Their sodium content puts them out of bounds. The same is probably true of mesolite.
10. The only zeolites in close association with agates the author has found so far are: clinoptilolite/heulandite, stilbite, erionite, mordenite, and ferrierite. The only specimen with a zeolite crust around an agate has ferrierite. Clinoptilolite is found with breach/implosion structures. Generally, zeolites consume all the silica, preventing agates from forming, so only the highest silica content zeolites are found around agates.

Agate Inclusions Rebuttal of Dr. Jenz Goetze, Agates III, 2/3

These list errors are due to the lack of study to constrain the inclusion geochemistry of the agates, jaspers, and opals. This list shows the lack of understanding that agates form only in alkaline, reducing conditions. The list of clays and zeolites lacks the understanding that they are involved in geochemical reactions that release silica and make agate, so they are active genesis players, not passive co-depositional minerals. The list also fails to explain or show that the halide group representing hypersaline conditions is totally incompatible with agate genesis. So, to recap, some differences between agate and quartz are:

1. Quartz is hypersaline (salt) tolerant. Agate is not. Saline systems forms chert, not agate.
2. Quartz is found in sulfide systems. Agate is not.
3. Quartz is found in metamorphic systems. Agate is not.
4. Quartz is found in granitic systems. Agate is not.
5. Quartz is found in oxidizing systems. Agate is not.
6. Quartz is found in deep crustal rocks. Agate is not, it is limited to the upper 750 m of the crust.

Those that want to say agate is a variety of quartz based on this list of differences, promote non-scientifically based generalities.

Furthermore, the lack of geochemical study of agates leads to the following omissions:

1. Calcite is key to precipitating agate.
2. Sulfate (anhydrite) can also precipitate agate.
3. Zeolite reactions, especially in tuffs release silica, making agate and jasper.
4. Clay reactions release silica, making agate and jasper.
5. Calcium, Iron and manganese are catalysts for agate precipitation. This means that calcite, calcium zeolites, and calcium bearing clays are all catalysts of silica precipitation.

So we see that many of the so-called inclusions are active actors in silica systems, and not passive co-habitants at all. It is this lack of understanding that the author considers the major, historical problem of classical European literature on agate genesis.

Agate Inclusions Rebuttal of Dr. Jenz Goetze, Agates III, 3/3

Dr. Jenz Goetz, Agates III, page 67. Agate inclusion minerals.

Mineral group	*Minerals*
Elements :	Cu, Pb, graphite
Sulfides:	pyrite**
	marcasite, sphalerite, chalkopyrite, galenite
Oxides/Hydroxides:	hematite**, goethite**
	todorocite, ramsdellite, birnessite, pyrolusite, rancieite, hollandite, cryptomelane/psilomelane*
	cuprite, rutile
Carbonates:	calcite**, dolomite**, siderite**
	aragonite, rhodochrosite, strontianite, magnesite, malachite
Sulfates:	baryte**
	celestite, anhydrite, gypsum
Phosphates:	apatite (var. dahlite), monazite
Halides:	fluorite*
Silicates:	clay minerals (montmorillonite**, beidellite, nontronite, kaolinite*, illite*)
	zeolites (heulandite/clinoptilolite**, harmotome**, chabasite**, mordenite, analcime, natrolite, scolezite, mesolite, thomsonite, laumontite, stilbite, brewsterite, philipsite), glauconite - seladonit series, chlorite (delessite), serpentine, talc
	prehnite, datolithe, epidote, apophyllite, chrysocolla
Organic:	asphalt, bitumen

without signature: only in agates of basic volcanics - * only in agates of acidic volcanics - ** in agates of both acidic and basic volcanics