What are menilite nodules of Morocco and Spain made of?

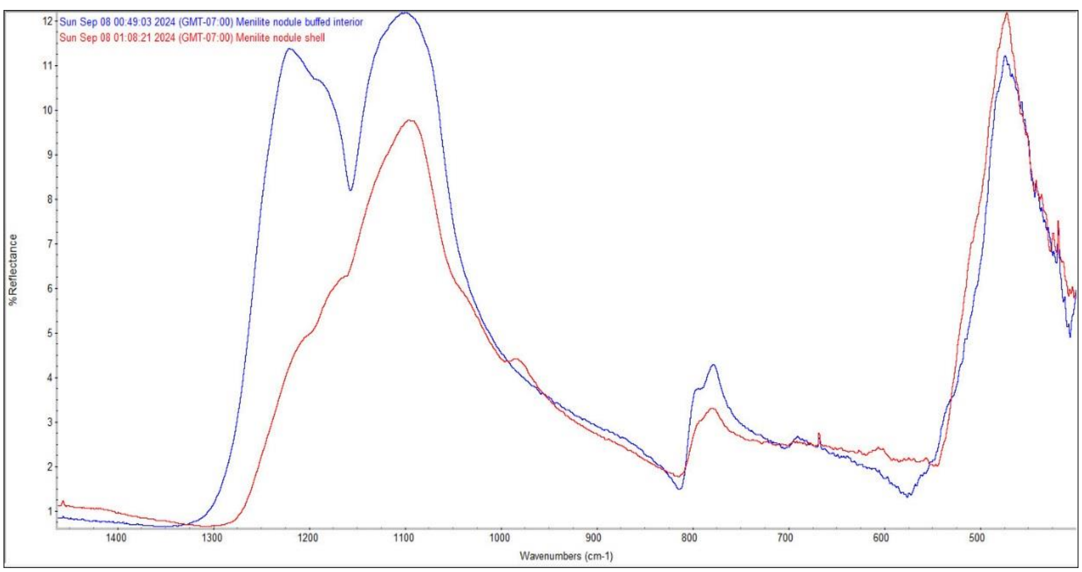
Donald Kasper, 9-9-2024, updated 9-22-2024

According to mindat.org, the menilite nodules of Spain and Morocco are opal-A. Mindat calls them "Opaline concretions found in marls, gypsums and shales. Sometimes considered a variety of opal but probably impure and really just young Flint nodules which haven't recrystallized to quartz yet; thus, really a rock rather than a mineral."

The sites matter, and the author's samples appear to hail from Morocco, as a paper by Pimentel, etal.[1] indicates Spanish melanites are comprised of opal-A, opal-CT, dolomite, and quartz.

Armed with infrared spectroscopy and 8 Moroccan samples, these nodules are zoned with a core and shell, so two were ground down to expose the interior to scan.

Infrared spectroscopy shows that the shells are opal-beta-cristobalite and quartz and carbonate. There is not enough carbonate to show the bands well enough to identify the carbonate type. The cores are fine quartz, trace alpha-moganite, and trace opal-beta-cristobalite. Fine quartz would be equivalent to a jasper or chert, identified as certain quartz bands are suppressed then disappear in infrared with finer grained quartz specimens. The entire specimen has a lot of water seen in infrared. The outer shells are probably the initial nodule formation that alters over time to fine quartz. These are not opal nodules. They are flints other than the presence of clay in the shells, likely palygorskite, that would make them difficult to chip into arrowheads and cutting tools.



Menilite shell (blue) v interior (red). 605 cm-1 pk is beta-cristobalite. Alpha cristobalite is at 621 cm-1. 1159 cm-1 trough is quartz. 1198 cm-1 trough or ledge is cristobalite. Lack of a quartz 535 cm-1 peak occurs with fine quartz. 550 cm-1 offset rise is moganite. 950 cm-1 pk is likely palygorskite, and indicated by its water bands (not shown).

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[1] Carlos Pimentel, Carlos Gutiérrez-Ariza, Antonio G. Checa, C. Ignacio Sainz-Díaz & Julyan H. E. Cartwright, **Mineralogical description and hypothesis on the formation of menilites from Galera, Granada (Spain)** (2024) Physics and Chemistry of Minerals, Vol 57, Article no. 7.

Then, sometime later, the author was able to buy a specimen from Agramon, Spain for purchase. Let us look at a typical description:

“Menilite Opal from Spain in matrix

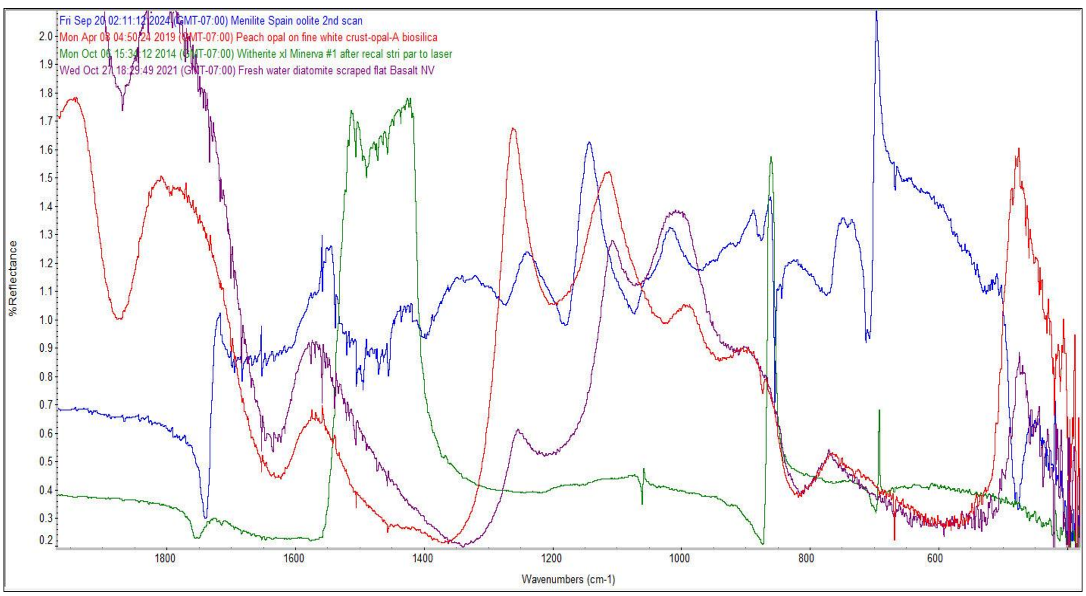
Reference PUMI2435-2

This is a very strange and rather rare mineral: the Ménilite Opal. Initially discovered and named in Ménilmontant, Paris. Discovered as nodules in shale, Menilite Formation? in 1795. But this group comes from southern Spain: Agramon, near Murcia.

Spanish "menilitas" are found in a field of diatomaceous earth (fossils of marine microorganisms with "glass" skeleton - silica-). The nodules are made of massive opal sometimes light to light-grey caramel, with abundant diatomaceous inclusions (themselves composed of opal), with a chalky white surface of powdery opal, so three "varieties" of opal in a single nodule. The interiors are hard and compact and take a good varnish, and are sometimes used for opaque lapidary work.”

From: objetdecuriosite.com.

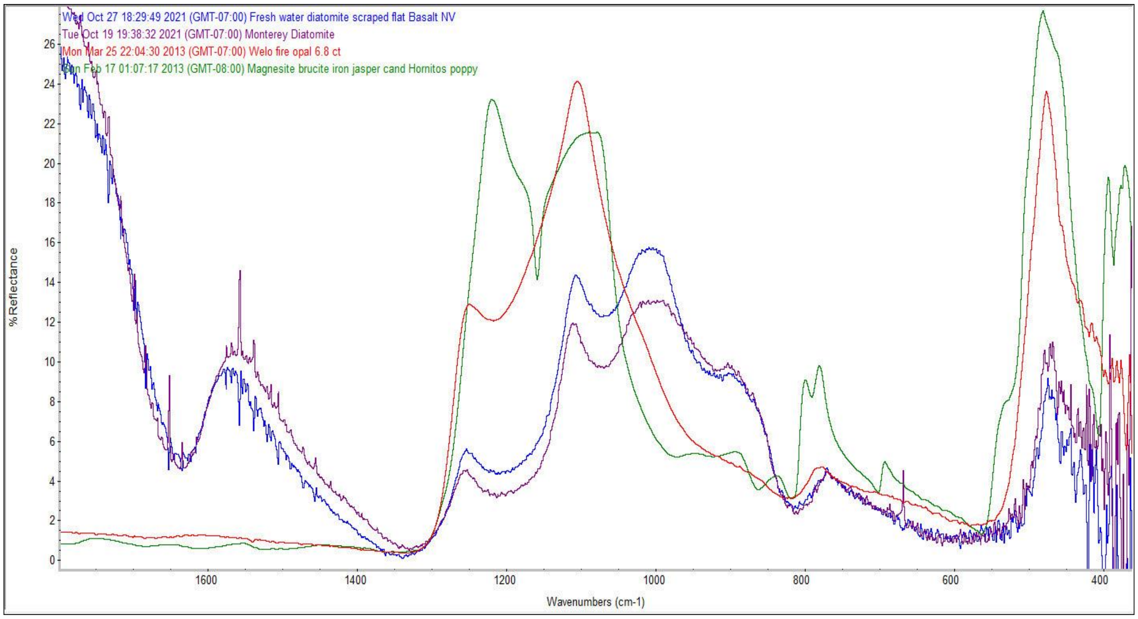
Ah, let us scan an orb and the matrix in infrared. And what kind of opal do we get? We get a mix of biosilica, witherite ($BaCO_3$), and water spectra in near infrared (not shown) show carbonate bands and celadonite clay. The celadonite would be linked to volcanic ash, which provides the silica to cause diatom blooms in the ocean. Without it, the diatoms cannot form as the ocean has little free silica.



Agramon, Spain spherulite (blue), two U.S. biosilica specimen locales (violet and red), and witherite (green). The spherulites and matrix are a combination of witherite and biosilica (diatomaceous earth).

Opal-A versus Biosilica

Too many scientists and too many online sites indiscriminately confuse opal-A and biosilica as the same thing. Here are some spectra for comparison using famous Welo, Australia opal-A fire opal and biosilica diatomites from famous California and Nevada locales. The biosilica contains opal-A probably from alteration weathering but anyone thinking the two groups of spectra are the same is just being ignorant and lazy. In fact, different genera of diatoms and radiolarians probably have different biosilica spectra. Yes, biosilica is a thing, it is a mineral with its own IR spectrum.



Basalt, NV diatomite mine (blue), Monterey, CA diatomite (violet), Welo, Australia fire opal, an opal-A (red), and Hornitos, CA poppy jasper, a radiolarian chert (green). The poppy jasper is mostly quartz with biosilica radiolarians that is different that the diatom biosilica. The 1255 cm-1 peaks of the biosilica are opal-A, but have two additional peaks no opal-A site the author has studied over 10 years IR work contains. Infrared is not unreliable and the peaks wander around, it is reporting different mineral structures and compositions. Why do so many geologists make this clear mistake? They use X-Ray spectroscopy which has serious problems identifying opals, glasses, and some silica minerals that don't have enough crystal structure on the right scale to trigger X-rays to respond properly, so it sees noise. In fact, opal-A means opal amorphous to X-rays, meaning it does not produce a clear signal response. However, as we can see, opal-A is not amorphous to infrared light. Low signal output for rough specimen surfaces in the 400 cm-1 region is noise. 1600 cm-1 fine noise is incomplete cancellation of background atmospheric water vapor.

Conclusions: Don't forget, biosilica is NOT opal-A. It is entirely possible that biosilica can weather, dissolve, precipitate as opal-A, so the two can also be mixed. Its peaks are very different and different diatoms may be producing slightly different biosilica spectra as well since the formation is enzymatically controlled by the diatom species. No opal-A has a triplet in the 1200-1000 cm-1 region, for example. The Spanish nodules may have formed due to presence of barite. The Spanish menilites are marine and the Moroccan ones are more likely volcanic.