Trichites: Filamentous Inclusions in Obsidian from the Glass Buttes, Oregon, USA

by Ulf Thewalt and Gerda Dörfner (Gerstetten, Germany)

Translated into English by Johann Zenz using the DeepL translation software.

Obsidian is solidified glass. What is a note about obsidian doing on www.agates.click ? There are three reasons: (1) Both obsidian and agate contain a high proportion of SiO_2. (2) Under sufficient magnification, both reveal fascinating patterns. (3) Both contain inclusions about whose origin little is known so far. This note deals with such inclusions in obsidian.

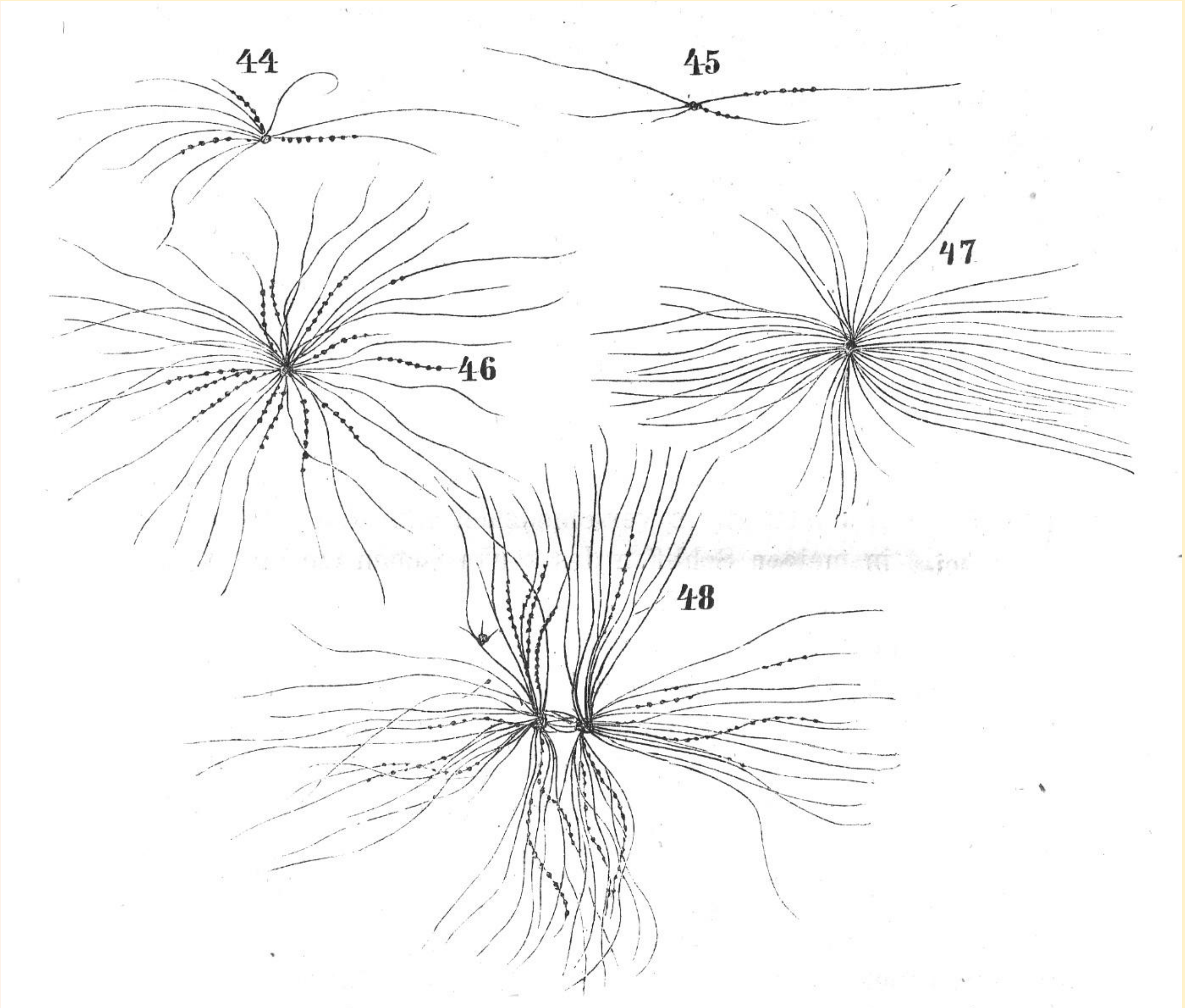

Fig. 1: Aggregates, each consisting of several trichites. Original illustration from KENNGOTT's (1864) paper on Caucasian obsidian. ZIRKEL (1873, p. 354) writes: *"... shapes appear that bear some resemblance to a many-legged spider."* Perhaps these thread-like aggregates should still be referred to today as spider trichites (or trichite spiders).

Fig. 2: In the background, the Glass Buttes (max. 1,946 m above sea level); in the foreground, a small, nearly dried-up rainwater collection basin. The ground, or rather what lies beneath the surface: largely obsidian, as far as the eye can see.

All photos in this article were taken by the authors. The objects shown are part of the authors' collection.

Well-known for a long time

Such filamentous structures were first carefully described and illustrated by the mineralogists KENNGOTT (1869) and ZIRKEL (1873). The obsidian examined at that time came from Mount Ararat (Armenia). In addition to individual filaments, clusters of many filaments were noted (Fig. 1). The term “trichite” was proposed for the filaments (trichite = hair, Greek). In the period between the publication of these reports and the present, simple trichites and aggregates of trichites have also been observed in obsidian from other localities and occasionally illustrated, for example by ROSS (1962). It has been reported on multiple occasions that the black filaments and the attached black crystals consist of magnetite. However, there are still no well-founded theories regarding the origin of these bizarre structures (HEIDE & HEIDE 2011). We became aware of them by chance when, during a visit to an obsidian deposit, we examined some nearly transparent obsidian fragments more closely under a magnifying glass.

A popular source

The prospecting area we visited, with the promising name Glass Buttes, is located in the heart of Oregon, along Highway 20, about 50 miles west of the small town of Burns. It covers several square kilometers and is officially designated for prospecting. Up to 25 pounds of collected material per person per day is permitted (according to the Bureau of Land Management). And there are no fees. Below, we present and discuss photos of a few finds. The main finding of our observations is that thread-like iron oxide inclusions in obsidian—at least in obsidian from Glass Buttes—are not the exception, but rather a common occurrence. A note on the macro photos: Some are of thin obsidian fragments (with an almost colorless, transparent-appearing glassy matrix) and some of compact (opaque-appearing) polished sections of hand pieces. In each case, several individual images were stacked using the Helicon Focus program (Helicon Soft, 61062 Kharkiv, Ukraine).

Fig. 3: In addition to completely black obsidian, other types of obsidian are also found. Of these, the type with dark red to orange areas, as in the piece shown here, is of particular interest. Even when viewed with the naked eye, its color pattern reveals that the formerly viscous glass mass was violently churned up within a confined space (on a scale of millimeters to centimeters). The variant in which the red areas show an approximately parallel orientation of their fibrous-looking components is referred to as mahogany obsidian. Width 6 cm.

Fig. 4: The dynamics of obsidian formation are also documented on this specimen. We will return to the curved, thin black spatial patterns later on. Such patterns in Glass Buttes obsidian can certainly captivate agate experts as well: A macro photograph of a Glass Buttes obsidian, similar to the one shown here, is the front cover of a book on agates (ARNOTH, 1986).

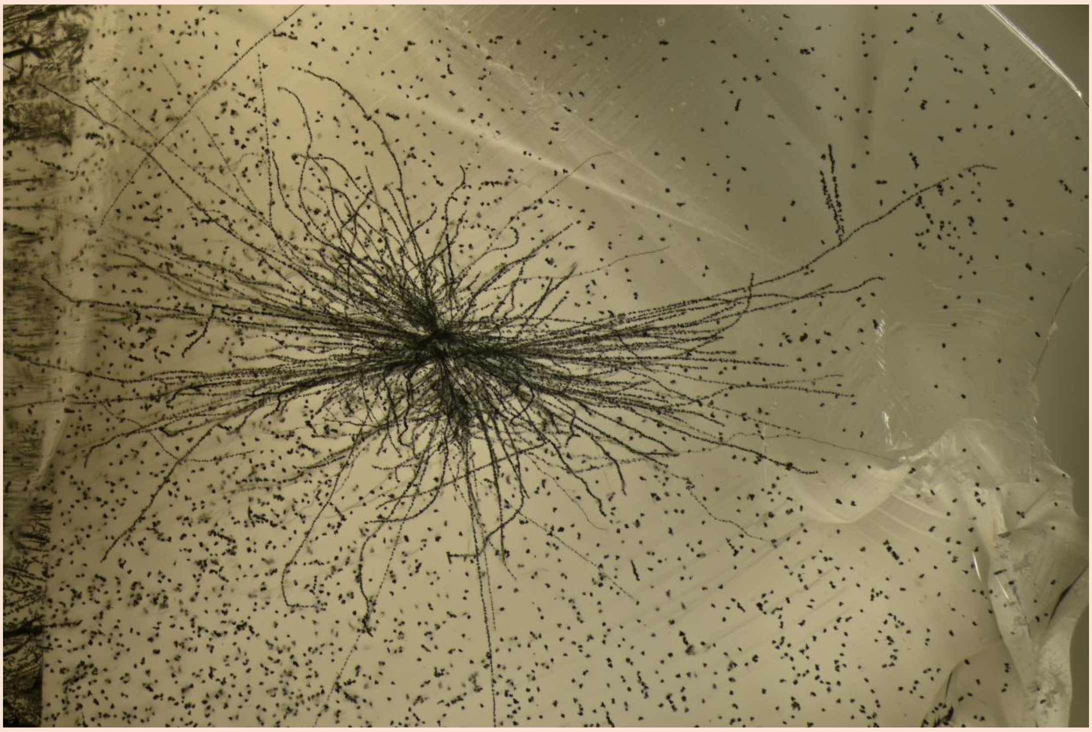

Fig. 5: Obsidian fragment with delicate spider trichite. The surrounding glass is almost colorless and transparent. The black grains are ubiquitous magnetite crystals that are more or less corroded. Image width 3.6 mm.

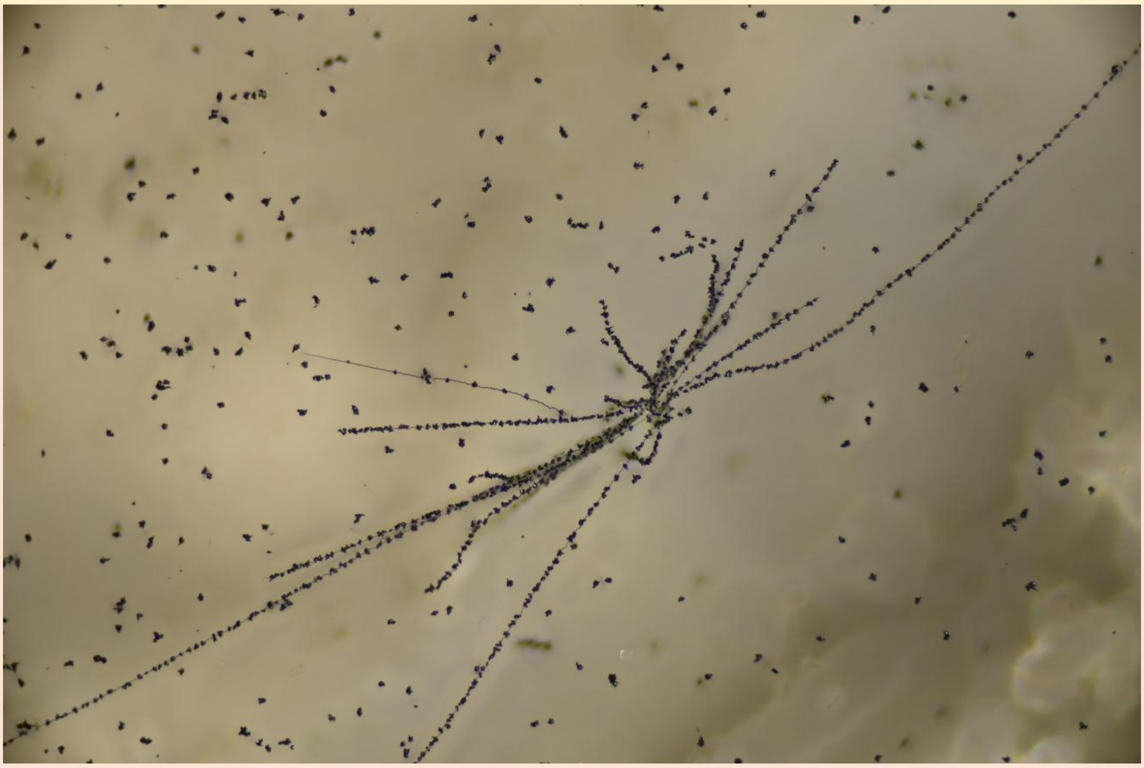

Fig. 6: Spider trichite with only a few filaments and equidistantly grown magnetite crystals. Image width 1.7 mm.

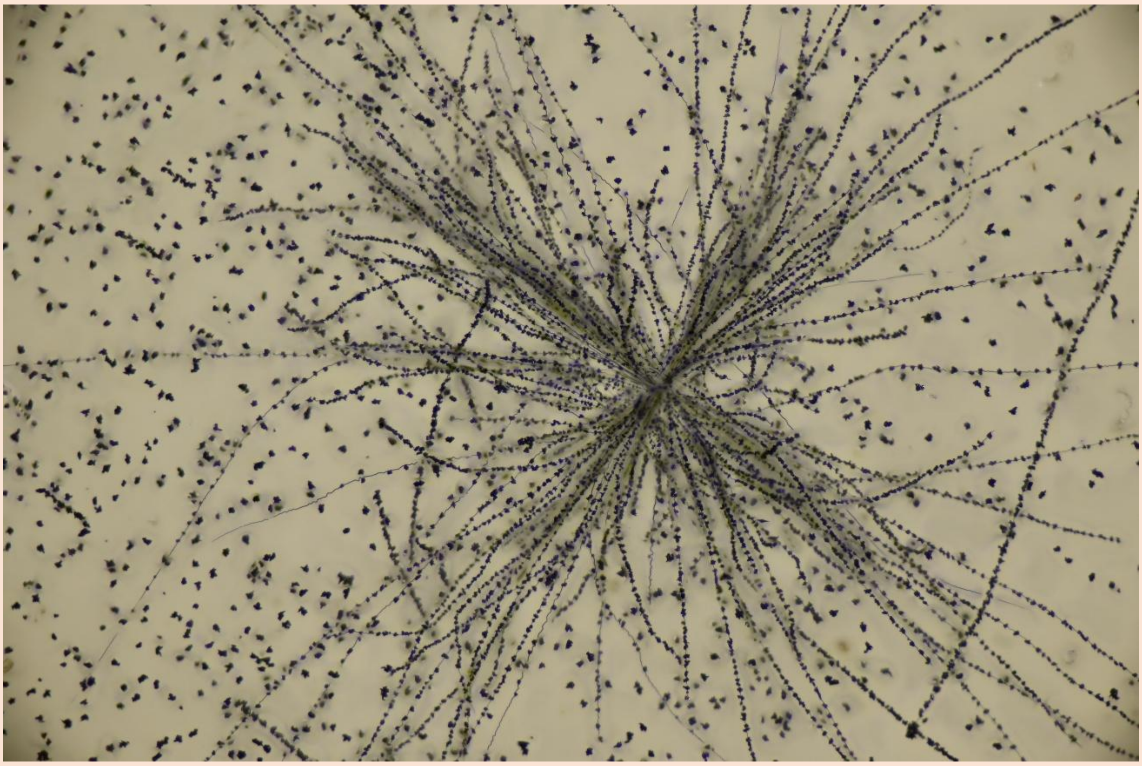

Fig. 7: In this spider trichite within an obsidian splinter, it is striking that the filaments are bundled together. Perhaps this bundling has something to do with the cubic symmetry of a "seed crystal." As hypothesized by KENNGOTT (1864). Image width 1.8 mm.

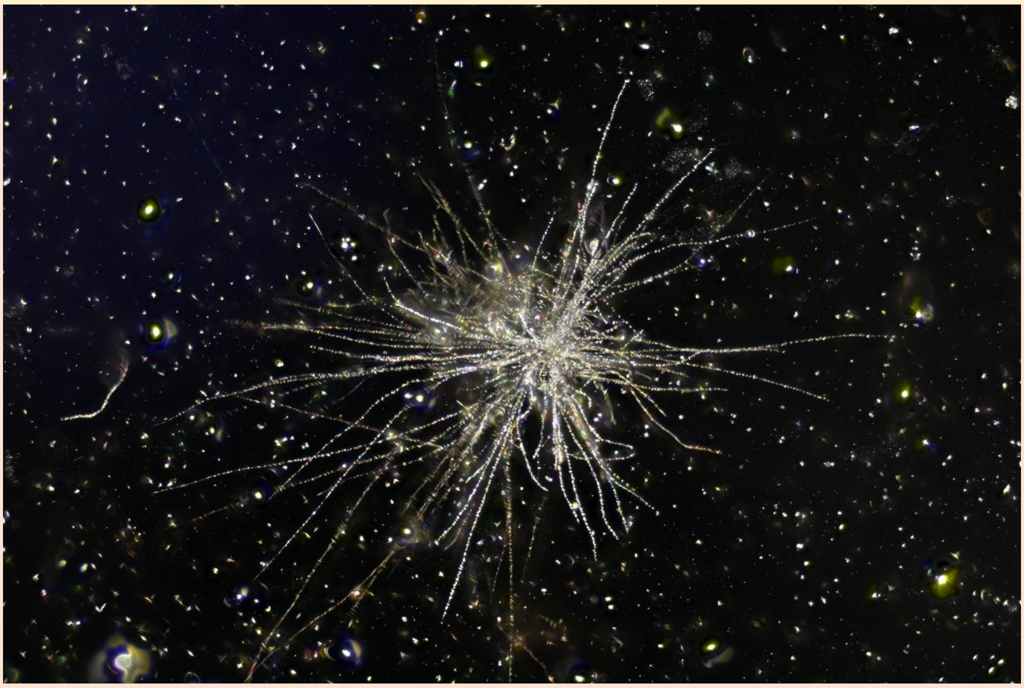

Fig. 8: While the preceding trichite photos were taken of thin fragments in transmitted light, this image was captured using reflected light on a relatively thick rock fragment with a point-source light. The magnetite particles and filaments scatter/reflect the light and therefore appear bright against a dark background. Image width 3.6 mm.

Fig. 9: The central region of a spider trichite under high magnification. The filaments are noticeably curved in places. Their diameter is (nearly constant) 0.001 mm. No (flat) crystal faces are visible on the corroded magnetite crystals that have grown on the filaments. The corrosion must have occurred while the glass was still liquid. Image width 0.45 mm. There is no sign of a (possible) seed crystal.

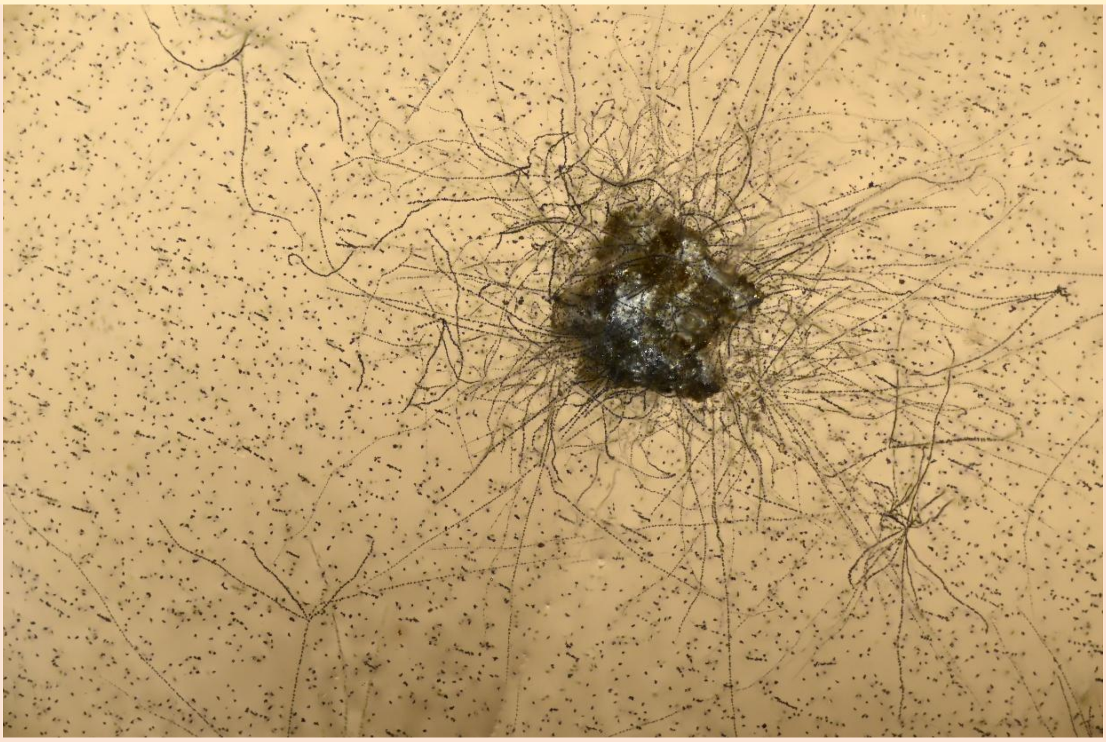

Fig. 10: A spider trichite-like structure: The individual filaments originate from a relatively large (unidentified) mineral grain. Filaments from neighboring spider trichites and many individual magnetite crystals also populate the obsidian splinter. Image width 3.6 mm.

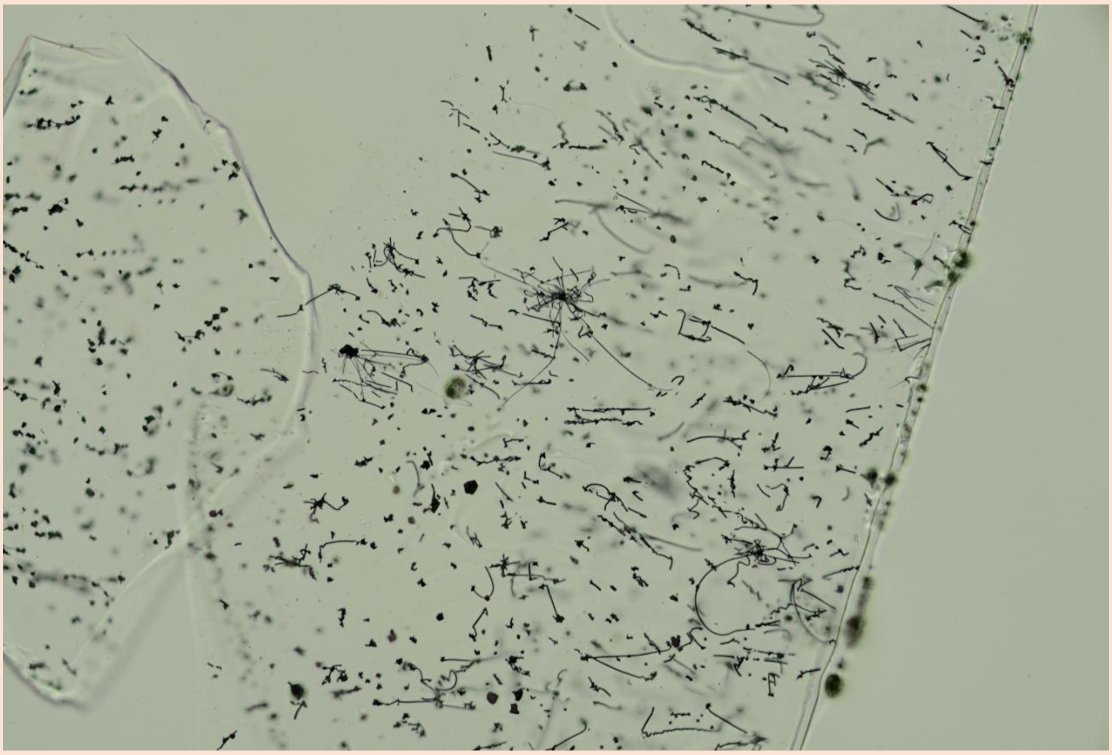

Fig. 11: Two thin obsidian splinters with filament fragments and remnants of spider trichites. Unlike the previous trichites, the filaments in the fragment on the right are not decorated with magnetite crystals. Image width 3.6 mm.

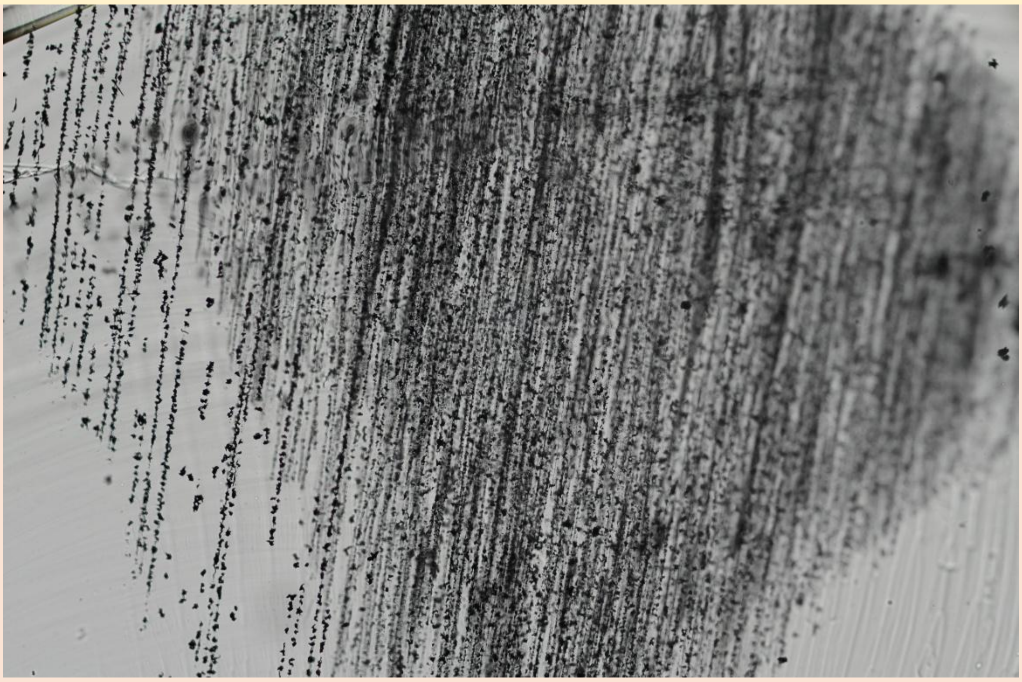

Fig. 12: This pattern is frequently encountered: magnetite fibers oriented exactly parallel to one another with long filaments. As with the spider trichites, the individual filaments are studded with corroded magnetite crystals in a string-of-pearls pattern. Image width 1.1 mm.

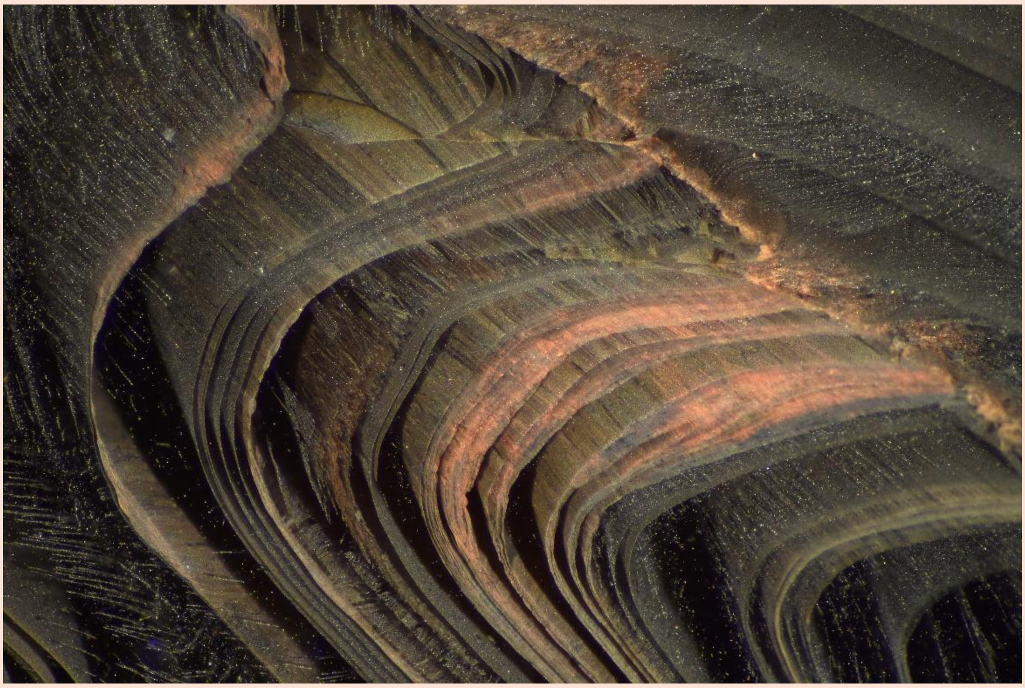

Fig. 13: Layers of parallel magnetite filaments. This pattern is commonly found in variegated (red/black) obsidian, such as that shown in Figs. 3 and 4. However, the magnetite grains may also be evenly distributed within the layers without any discernible filament pattern. Under specific additional conditions regarding grain size and the refractive index of the surrounding glass matrix, corresponding obsidian specimens from the Glass Buttes exhibit a wonderful play of colors (for details, see MA et al. 2007). Such pieces of "fire obsidian" are sought after and expensive. Image width 5.2 mm.

Fig. 14: Thin bands of parallel magnetite filaments, resembling fluttering flags, are embedded here in nearly clear glass. Image width 4.9 mm.

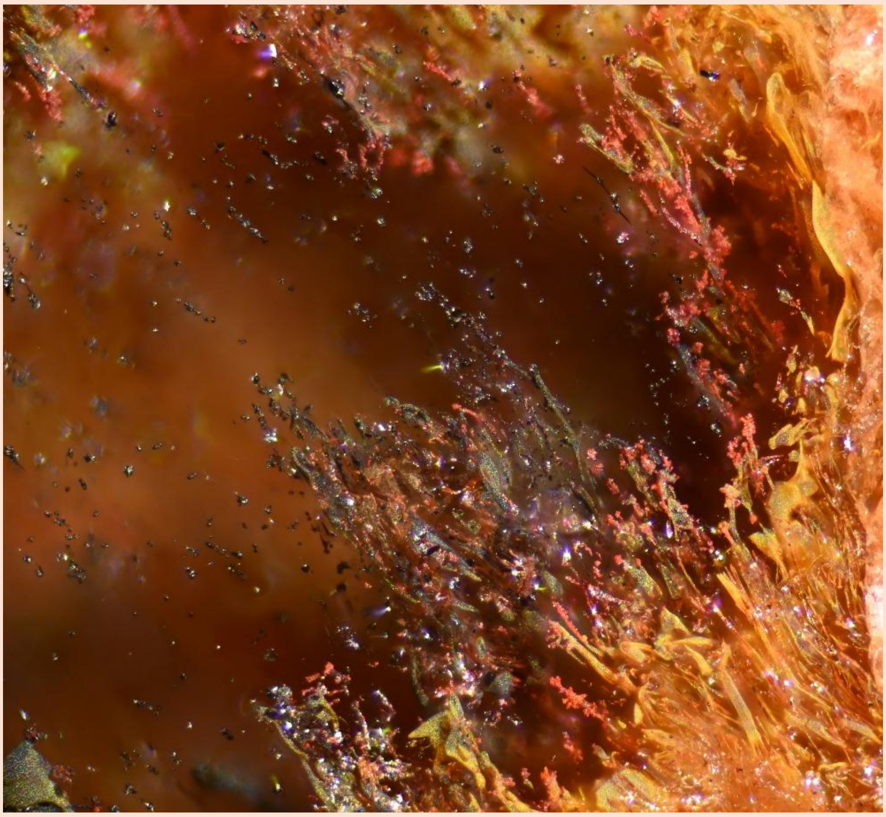

Fig. 15: Areas where red and black obsidian regions border each other, as seen here, are particularly interesting with regard to trichites. There, one finds illustrative material regarding the chemistry of iron. The colors red, brown, and orange correspond to iron(III) oxide compounds; the color black corresponds to the oxide that contains both Fe(II) and Fe(III): magnetite. Image width 1.8 mm.

Fig. 16: Here, the individual filaments are arranged only approximately parallel to one another. Based on their color, the red filaments are composed of hematite, the common iron(III) oxide. Image width: 3.5 mm.

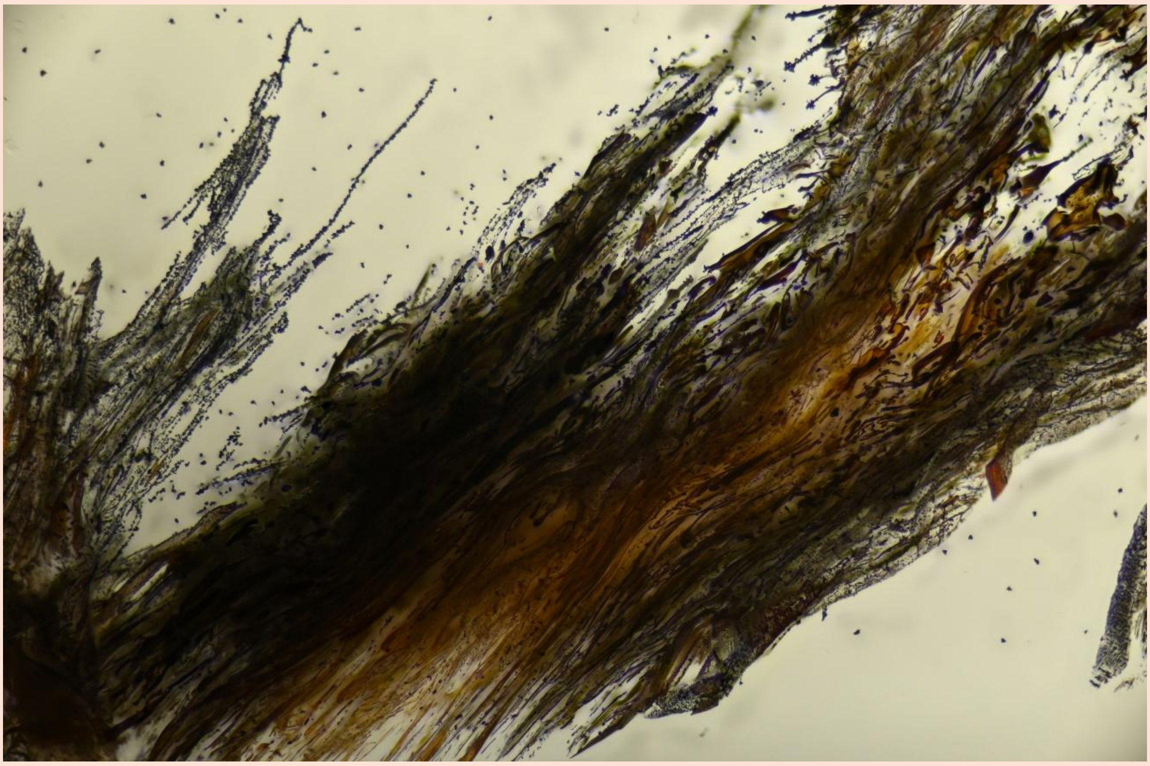

Fig. 17: Filament formations in the transition zone from reddish-orange iron compounds to magnetite. In this example, the filaments are (only) approximately parallel. Image width 1.8 mm.

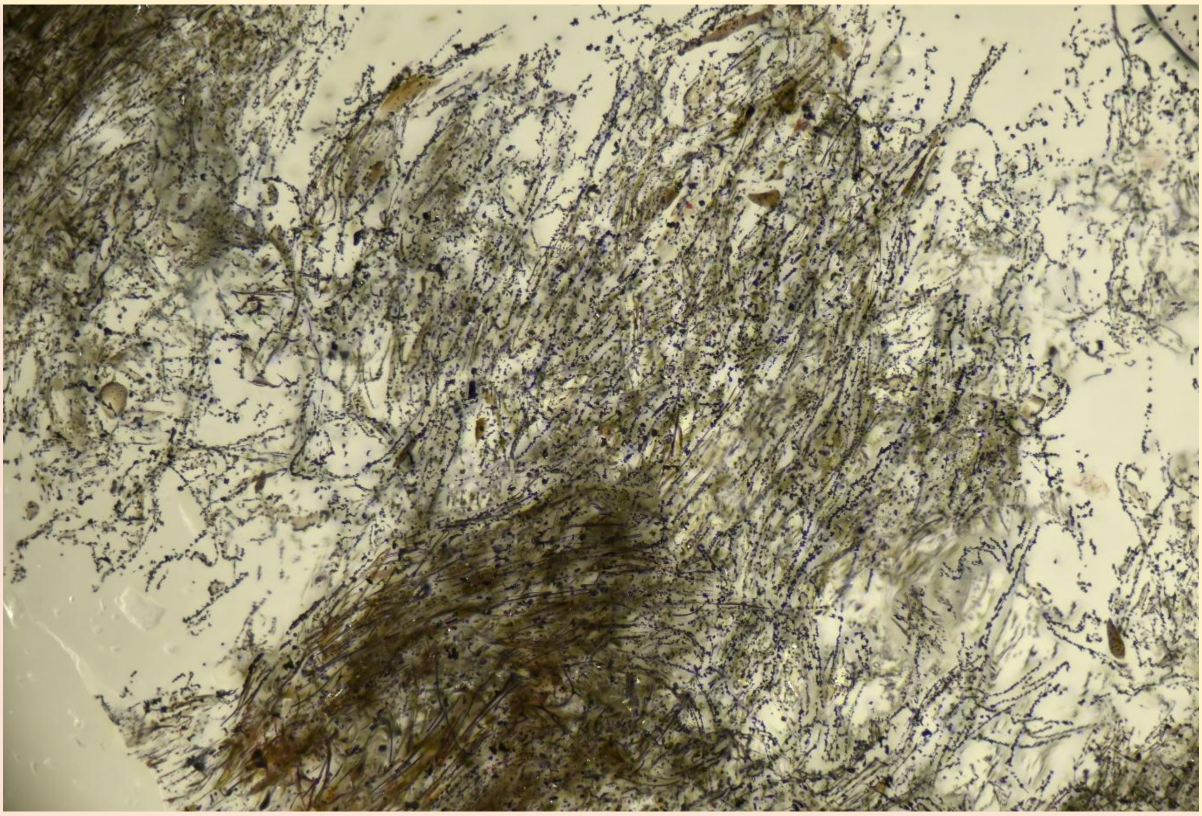

Fig. 18: This obsidian fragment contains an accumulation of long, non-parallel trichites. Such patterns can be found in the wafer-thin layers/bands of some black obsidians. Image width 1.8 mm.

Conclusions

It is difficult to find satisfactory explanations for the majority of the observations described. Somehow, “things don’t work that way in obsidian” as they do in other systems. The realization that obsidian represents an unexpectedly complex system is increasingly emerging from studies employing sophisticated modern physical methods. These studies show that tiny crystals (“nanocrystallites”) of iron minerals play an important role (KENNEDY et al. 2022) and, in particular, their magnetic properties (MAMELI et al. 2016).

Finally, it is worth mentioning the very recent finding that obsidian forms when the molten rock cools slowly (LLEVELLIN et al. 2026), contrary to the frequently repeated claim that rapid cooling is essential.

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