100% natural 100% synthetic

Bernardo Cesare

Petrography – the study of rocks – requires a good hammer and a good microscope, possibly equipped with a good camera. I have taken photomicrographs for almost 20 years, mainly for researching rocks and minerals (e.g., Cesare, 2008), and the tiny bubbles that they contain (“fluid inclusions”, e.g., Cesare *et al.*, 2007). But along with this scientific side, essentially in black and white, I’ve also approached photomicrography as a form of “artistic” (the word may be overstated) expression. With the use of a microscope, rocks reveal an unthinkable variety of landscapes, colours and shapes. This is due to the power of polarized light, enabling “interference colours” to be exposed.

Rock fragments aren’t the only exciting subject for polarized-light photomicroscopy: since the first shots during preparation of my Master thesis, I have also experimented with synthetic materials such as plastic and pieces of nylon. The results are fascinating.

This article is intended as a gallery of the beauty of rocks (100% natural) and plastic material (100% synthetic) when looked at using a microscope. Images were taken with either a film or a digital camera mounted on a transmitted-light polarizing microscope. Preferred interference colours were created by use of the red tint plate and by rotating the polarizers, without manipulation after shooting.

Rocks

In order to become transparent, minerals need to be thin. After slicing down to 30 microns (!) - the conventional thickness for petrographic research - a “thin section” of rock is carefully glued between glass holder and cover, and is ready for inspection.

The images shown here come from the three main rock types – magmatic, sedimentary, and metamorphic – occurring on the Earth’s surface, and were taken for aesthetic purpose. Even if they do not have a specific scientific value, they can nonetheless tell us a small geological story.

Plastic

Normally this non-crystalline material is isotropic, i.e. plain black when viewed between crossed polarizers. But when it is deformed, either during industrial processes such as molding or simply by tearing and breaking apart, it acquires directional structure and exhibits unpredictable colours between crossed polarizers, often arranged in beautiful fringes. Viewers appreciate the aesthetic power of nylon as much as, sometimes more than, that of natural rocks.

The 100% synthetic gallery mainly features torn and folded fragments of shopping bags; in this case the type of nylon, its thickness and the way it was deformed make it more or less photogenic. Unlike for rocks, these photos don’t tell any particular story: just relax and take a look.

Acknowledgements

The ideas of "MicROCKScopica" started long ago, inspired by Luca Zaggia. Over the years my photomicrographic skill has greatly benefitted from the advice of Claudio Brogiato, Raffaele Poli and Stefano Castelli. Several people, quoted in the captions, have been so kind to send me pieces of their rocks for my photos. Thanks to them all.

References

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Cesare B., Gomez-Pugnaire M.T., Sanchez-Navas A. & Grobety B. (2002) Andalusite - sillimanite replacement (Mazarrón - SE Spain): microstructural and TEM study. American Mineralogist, 87. 433-444.

Cesare B., Maineri C., Baron Toaldo A., Pedron D. and Acosta Vigil A. (2007) Immiscibility between carbonic fluids and granitic melts during crustal anatexis: a fluid and melt inclusion study in the enclaves of the Neogene Volcanic Province of SE Spain. Chemical Geology, 237, 433-449.

Dimensions indicated in the figure captions refer to the approximate long side field view.

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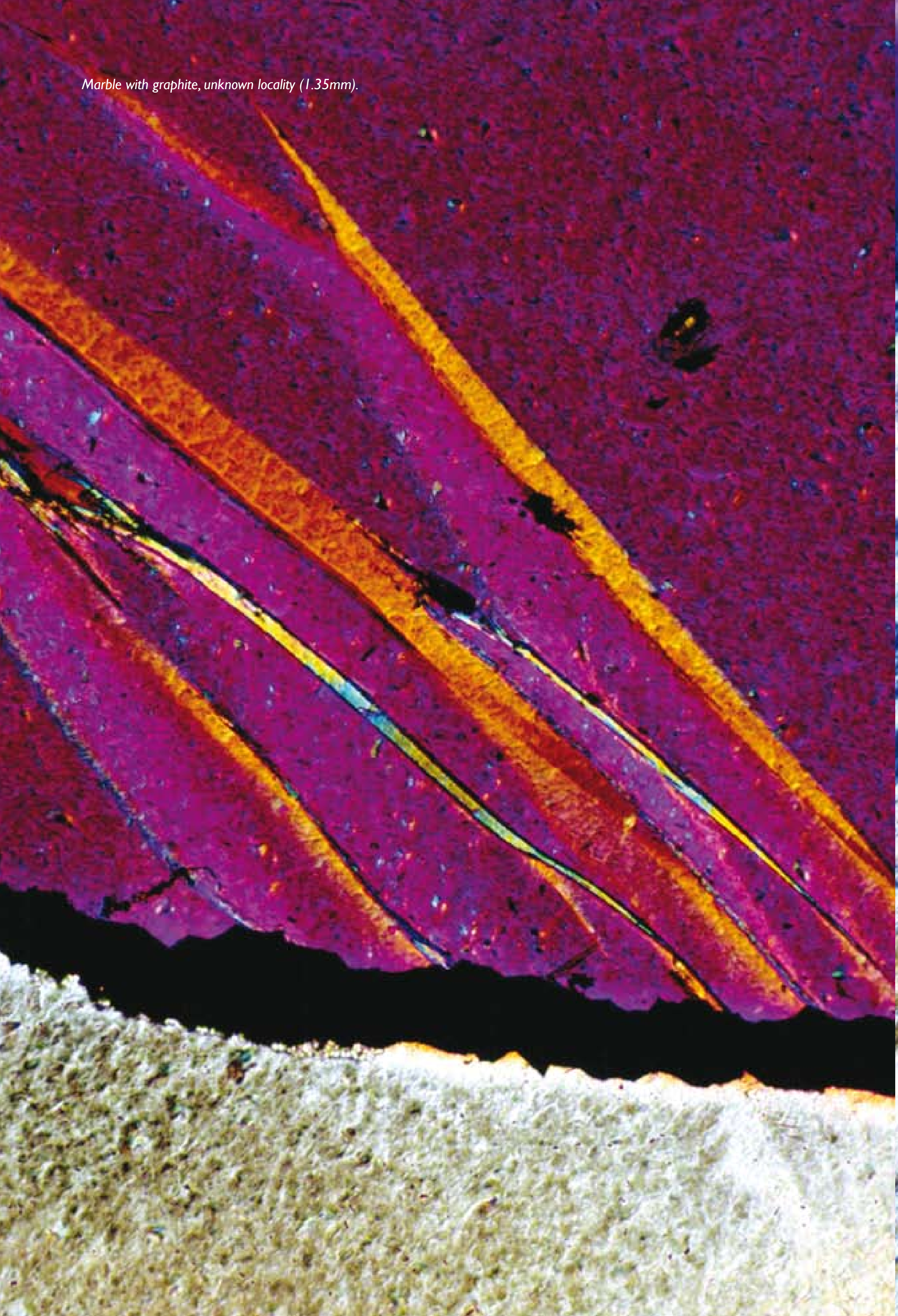
Bernardo Cesare, a new member of the RMS, is associate Professor of Petrology and Petrography. His scientific interests include metamorphism and melting of rocks, the origin of granitic magmas, petrologic mineralogy, the study of fluid inclusions and the geology of Alps. In his publications (see www.dmp.unipd.it/bernardo/papers.html) he extensively uses photomicrographs and macrophotographs, along with SEM and TEM, to describe the subjects of study and their morphological features. He is deeply involved in the training of early-stage researchers, and coordinates the Marie Curie "European Intensive Seminars of Petrology" (www.eurispet.eu).

Bernardo is also an amateur photographer with artistic intent. His rock photomicrographs have been displayed in galleries, at mineralogical and scientific exhibits and in Natural Sciences Museums in Italy, France and Germany, as well as published in geological journals and photographic and popular magazines. He won the MicroGeo2008 photo contest of the Russian Mineralogical Society.



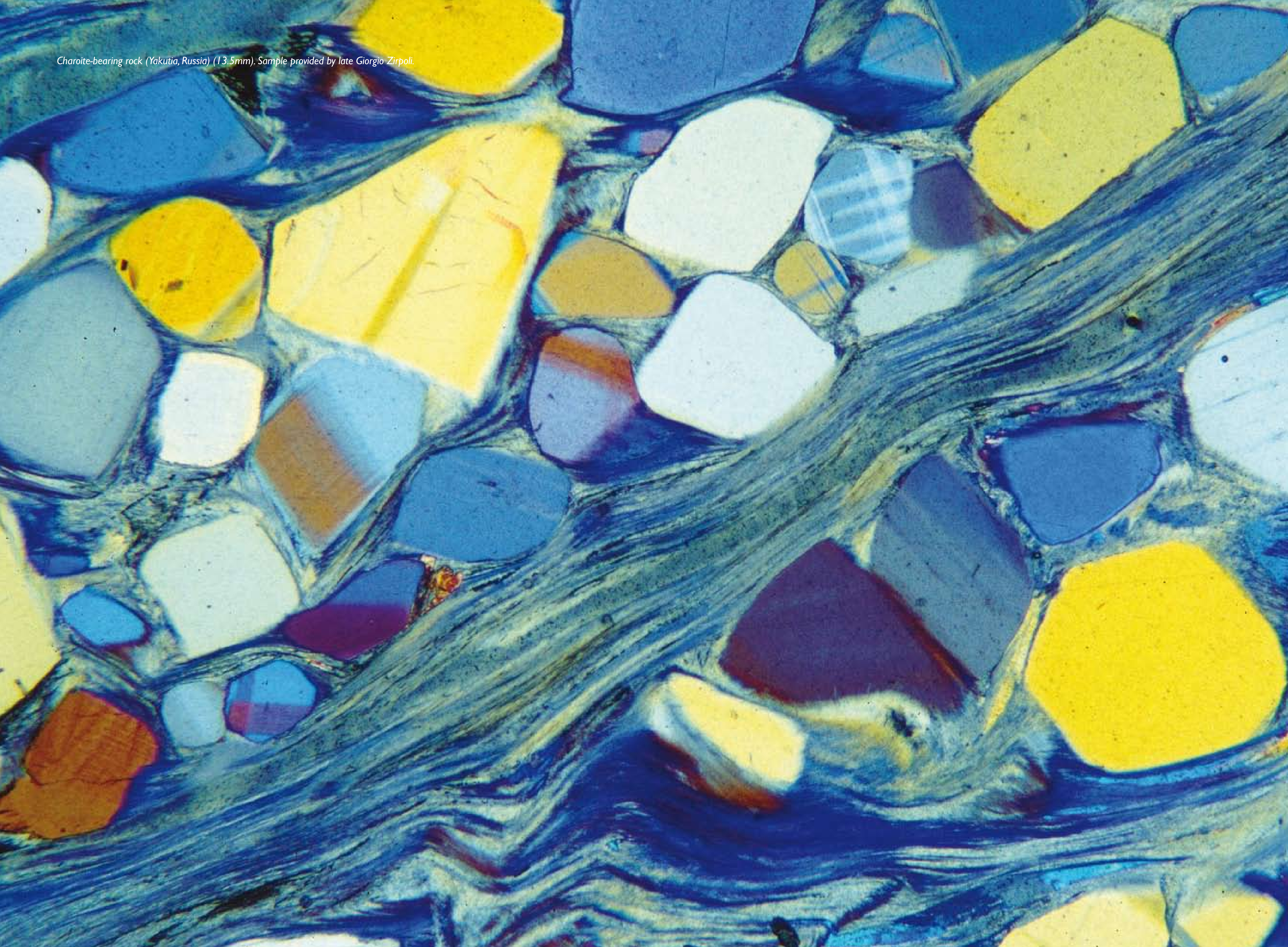
Marble with graphite, unknown locality (1.35mm).

Fragment of plastic bag (5.5mm).

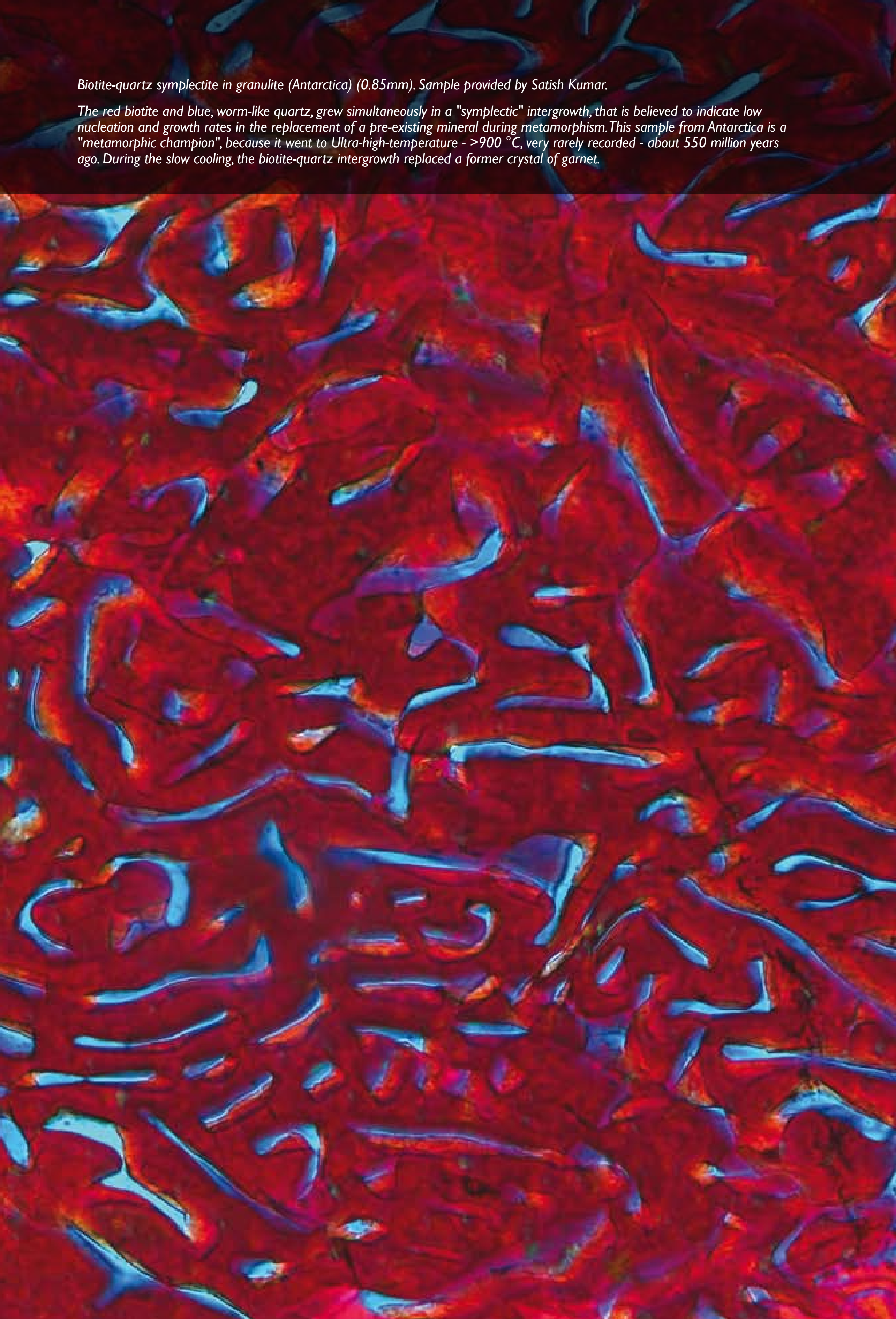
Nummulitic limestone (Vicenza, Italy) (3.4mm).

These flying-saucer-looking objects are fossil skeletons of Nummulites, unicellular organisms living in shallow and warm marine habitats during the Tertiary period, after the disappearance of dinosaurs. After their death, these variously and elegantly crafted, disk-shaped shells accumulated on the sea floor, forming thick piles of sediments, subsequently lithified into limestones. In northeastern Italy, nummulite-bearing limestones were intensely quarried as ornamental stones since Roman times and used in villas, palaces and for statues by artists such as Palladio and Sansovino.

Fragment of plastic bag (5.5mm).



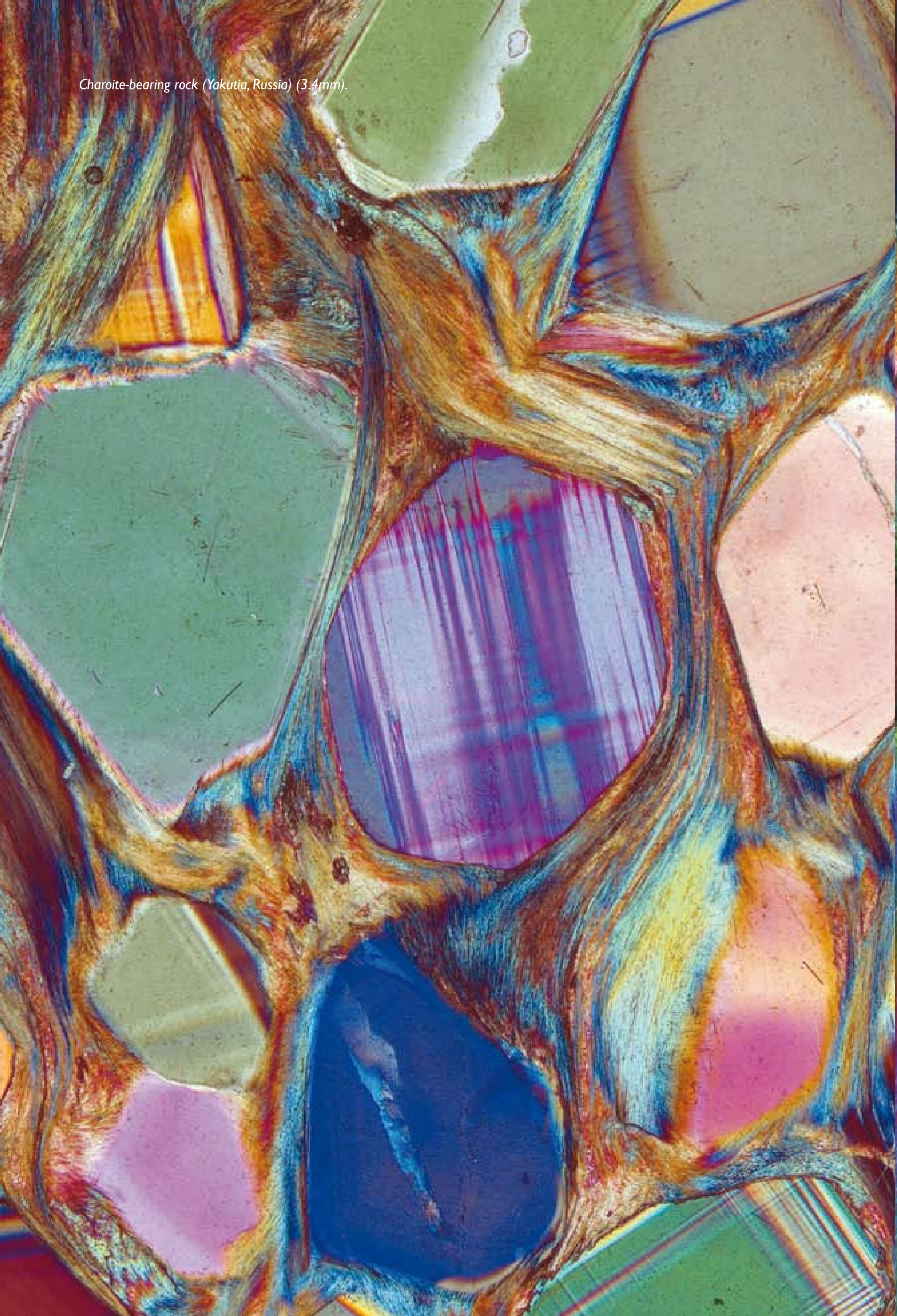
Charoite-bearing rock (Yakutia, Russia) (13.5mm). Sample provided by late Giorgio Zirpoli.

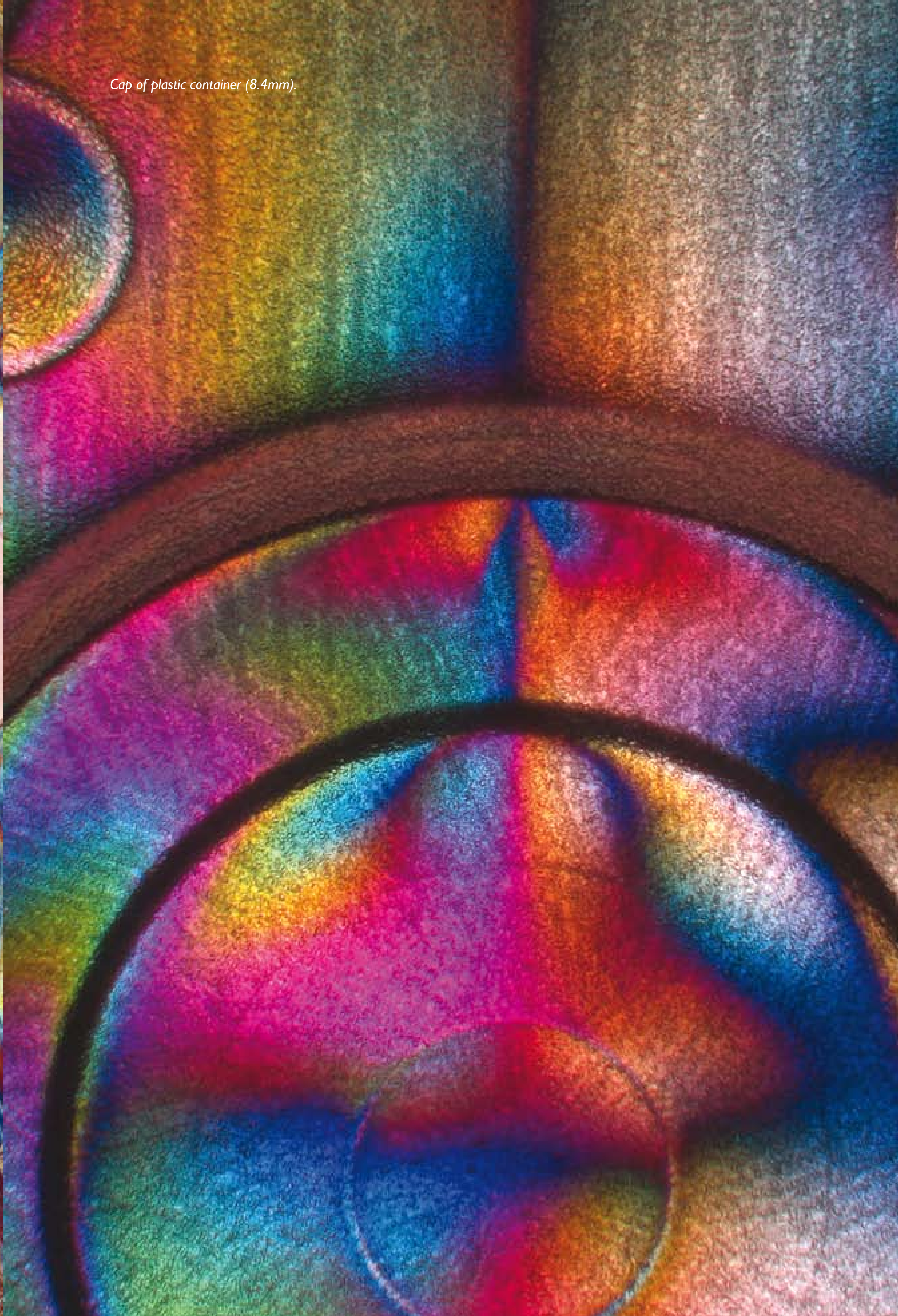


Biotite-quartz symplectite in granulite (Antarctica) (0.85mm). Sample provided by Satish Kumar.

The red biotite and blue, worm-like quartz, grew simultaneously in a "symplectic" intergrowth, that is believed to indicate low nucleation and growth rates in the replacement of a pre-existing mineral during metamorphism. This sample from Antarctica is a "metamorphic champion", because it went to Ultra-high-temperature - >900 °C, very rarely recorded - about 550 million years ago. During the slow cooling, the biotite-quartz intergrowth replaced a former crystal of garnet.

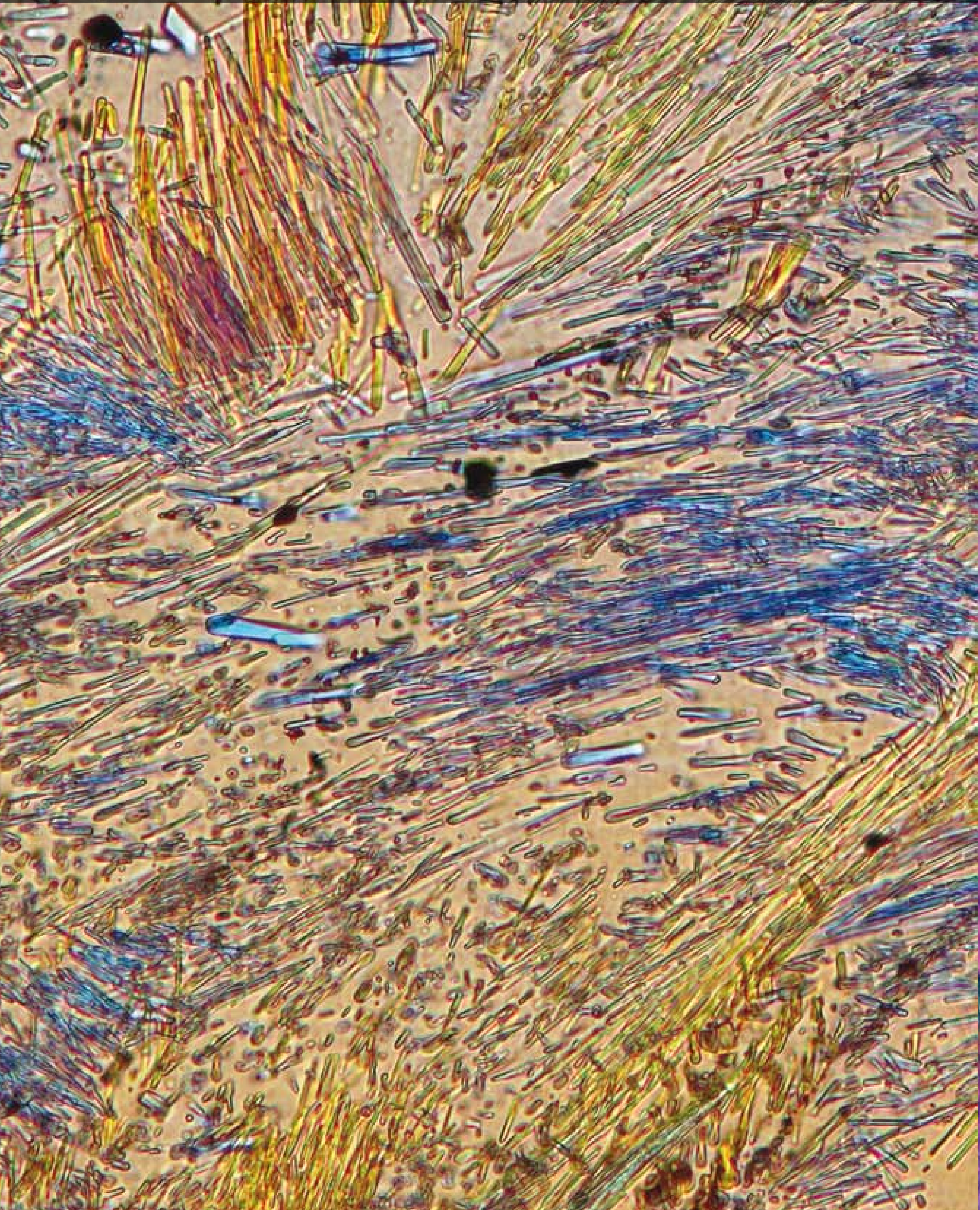
Fragment of plastic bag (1.3mm).


Charoite-bearing rock (Yakutia, Russia) (3.4mm).

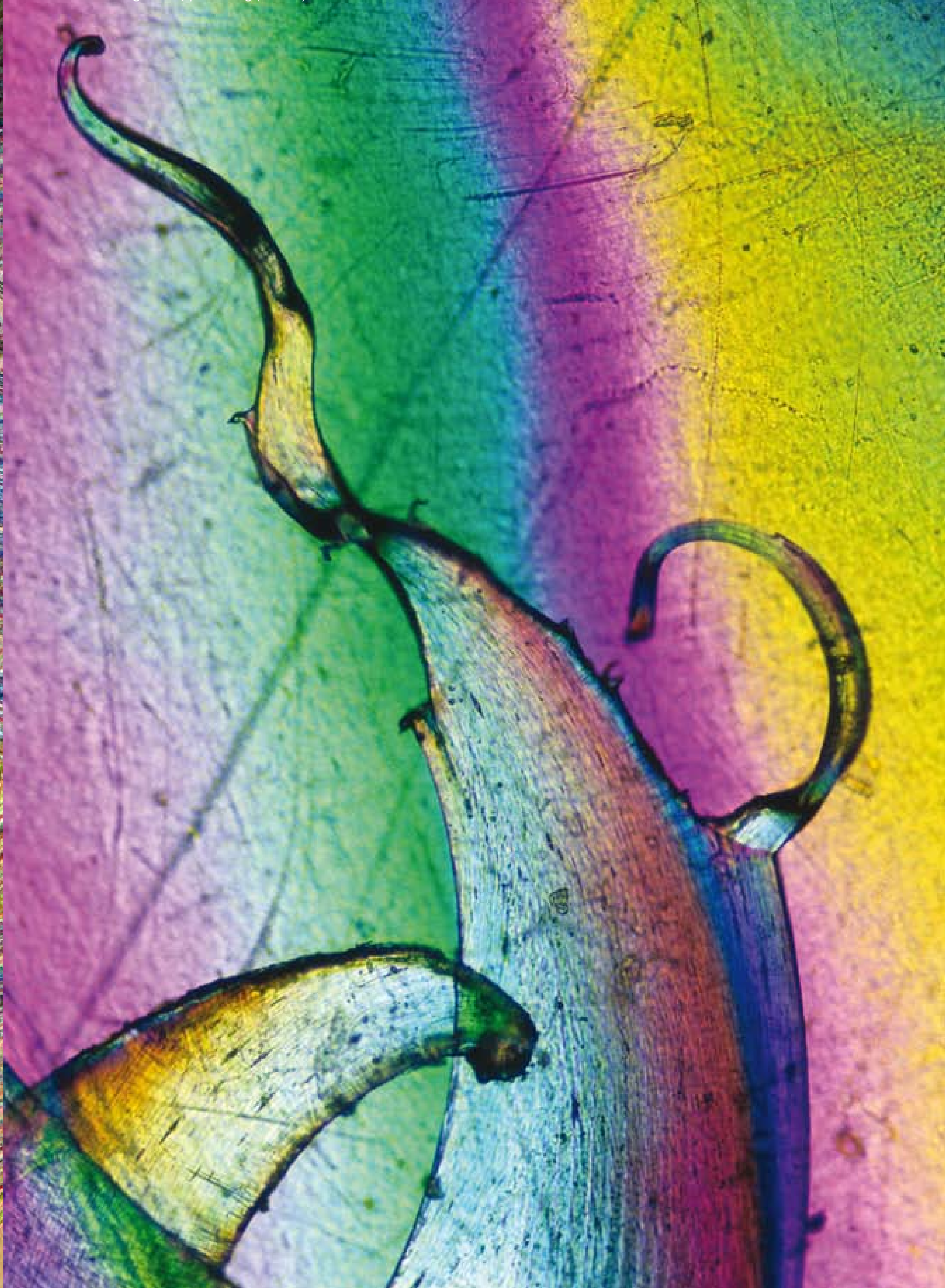

Cap of plastic container (8.4mm).

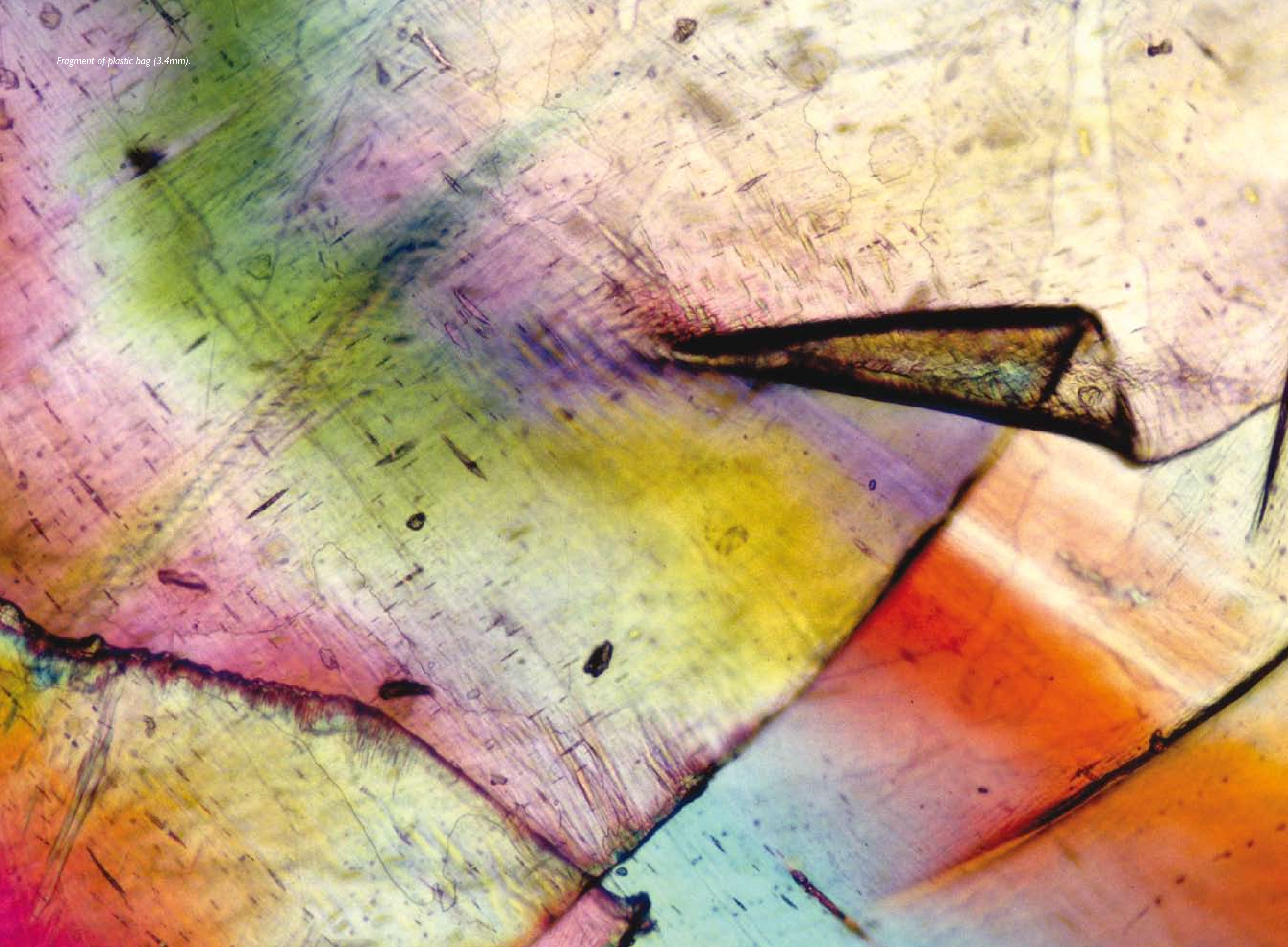
Sillimanite needles in cordierite (El Hoyazo, Spain) (0.85mm).

This image may recall paintings by Van Gogh or, more simply, a shoal of sardines swirling in the ocean. Actually it shows one large crystal of cordierite – the yellow background - with many needle-like inclusions of sillimanite, one of my favourite minerals (Cesare et al., 2002). This rock comes from a small volcano in Andalusia (Spain) and formed at a temperature greater than 800°C some 20 km within the crust. The different orientation (crenulation) of sillimanite tells us of an event of strong rock deformation, possibly the smashing of Africa into Europe at Gibraltar.



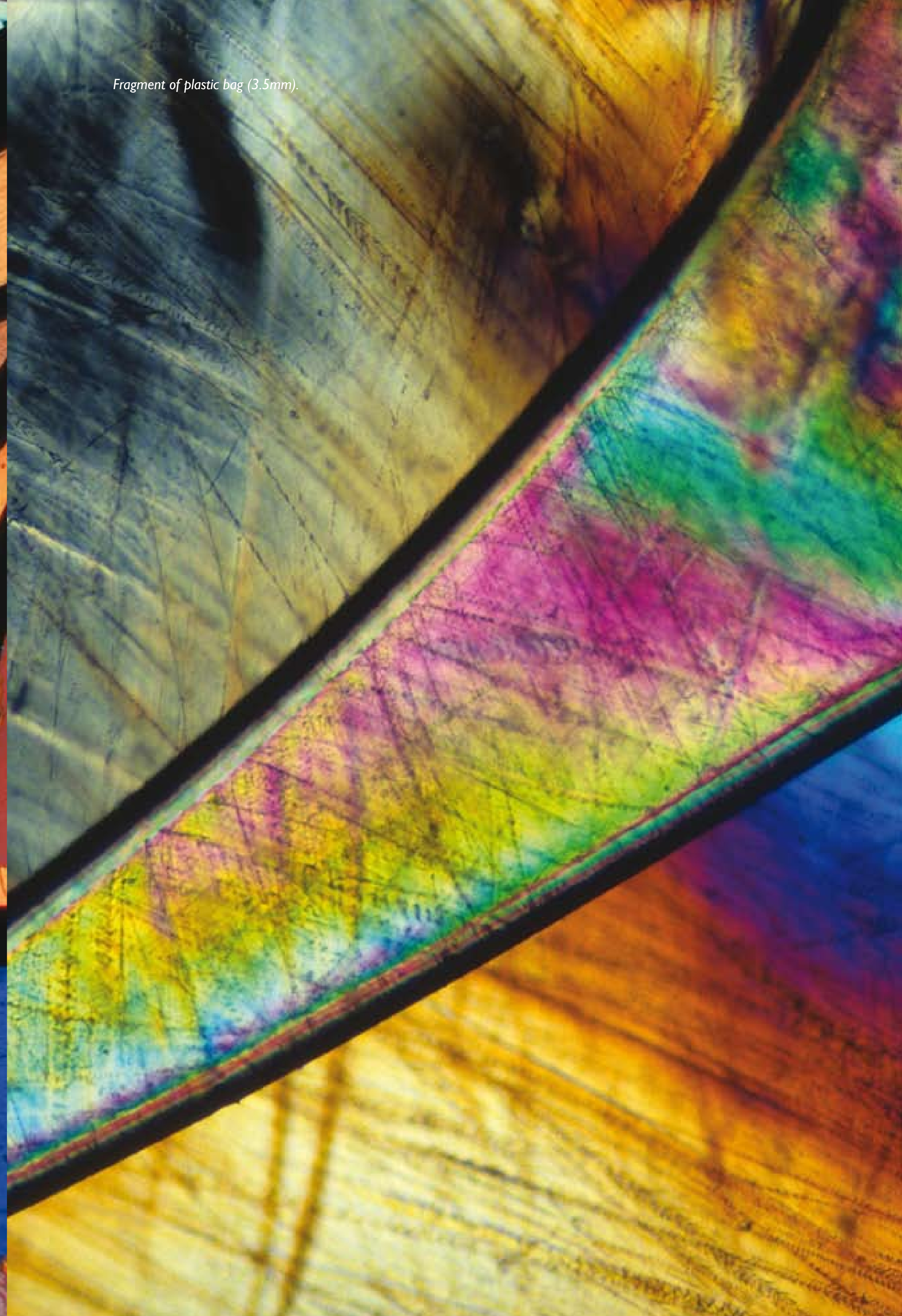
Fragment of plastic bag (3.5mm).





Fragment of plastic bag (3.4mm).

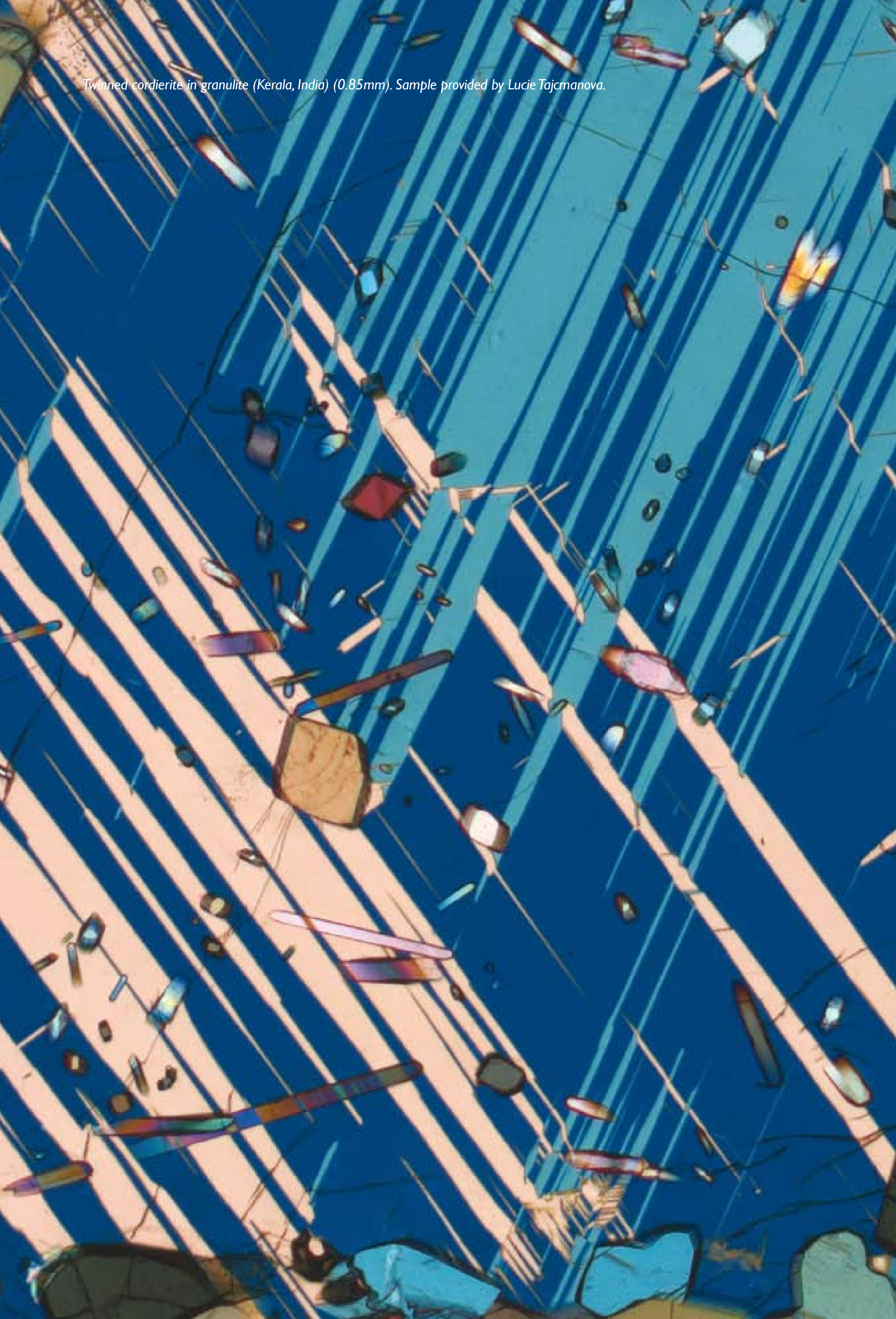
Graphite in leucosome (Kerala, India) (3.4mm). Sample provided by Satish Kumar.



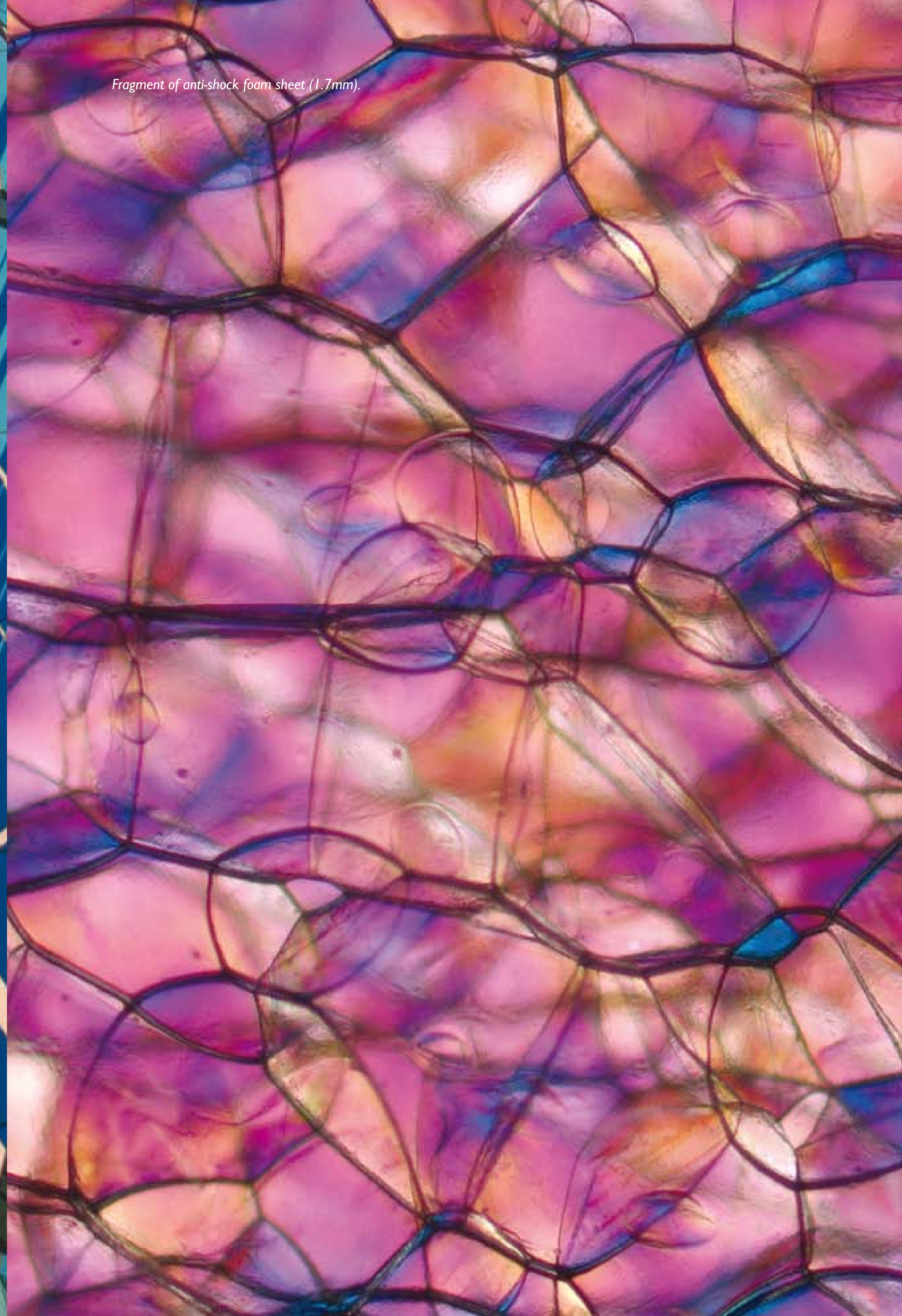
Fragment of plastic bag (3.5mm).

Micas in metapelite (Eastern Alps, Italy) (1.7mm).

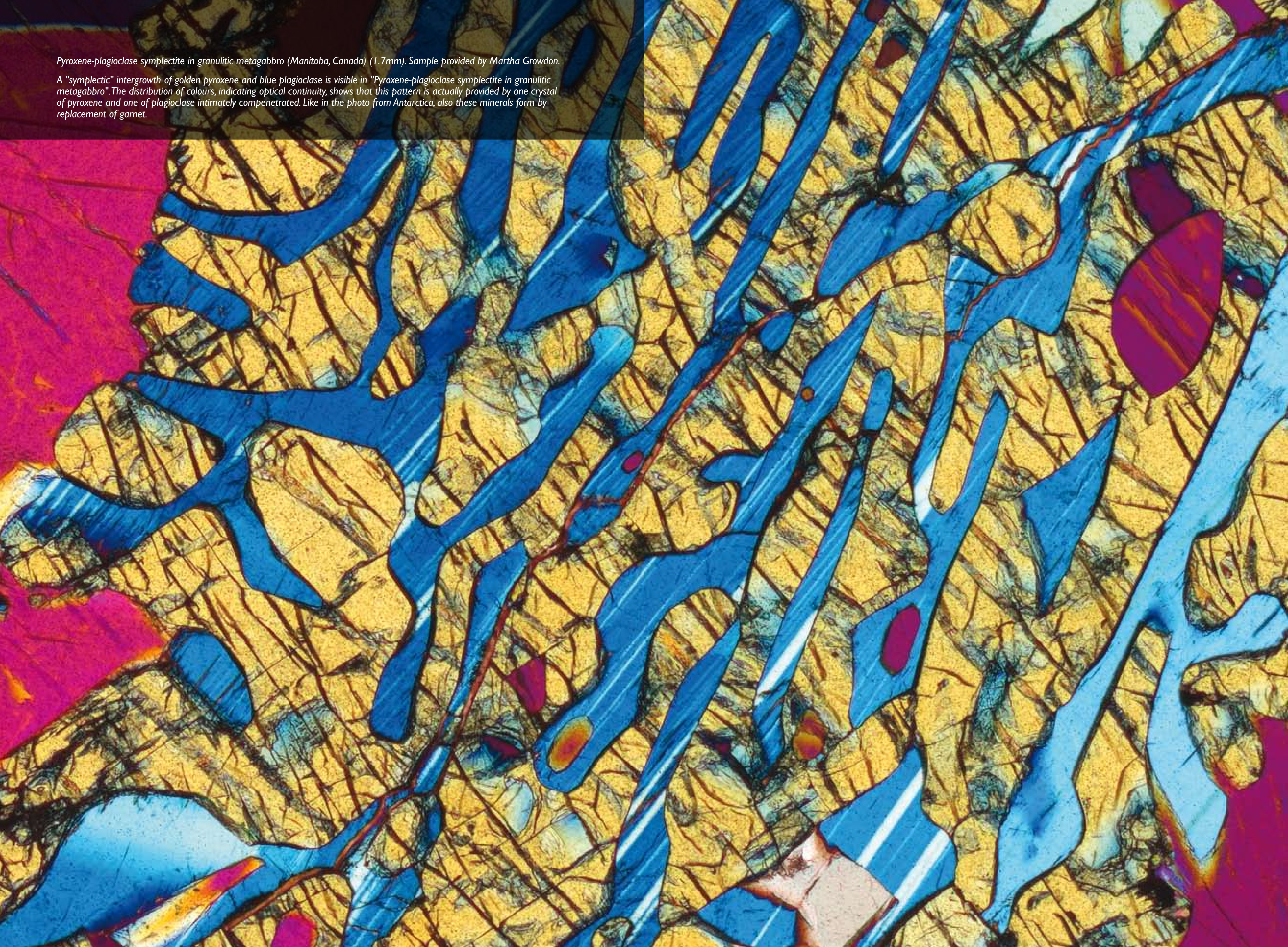
Fragment of plastic bag (1.7mm).



Twinned cordierite in granulite (Kerala, India) (0.85mm). Sample provided by Lucie Tajcmanova.

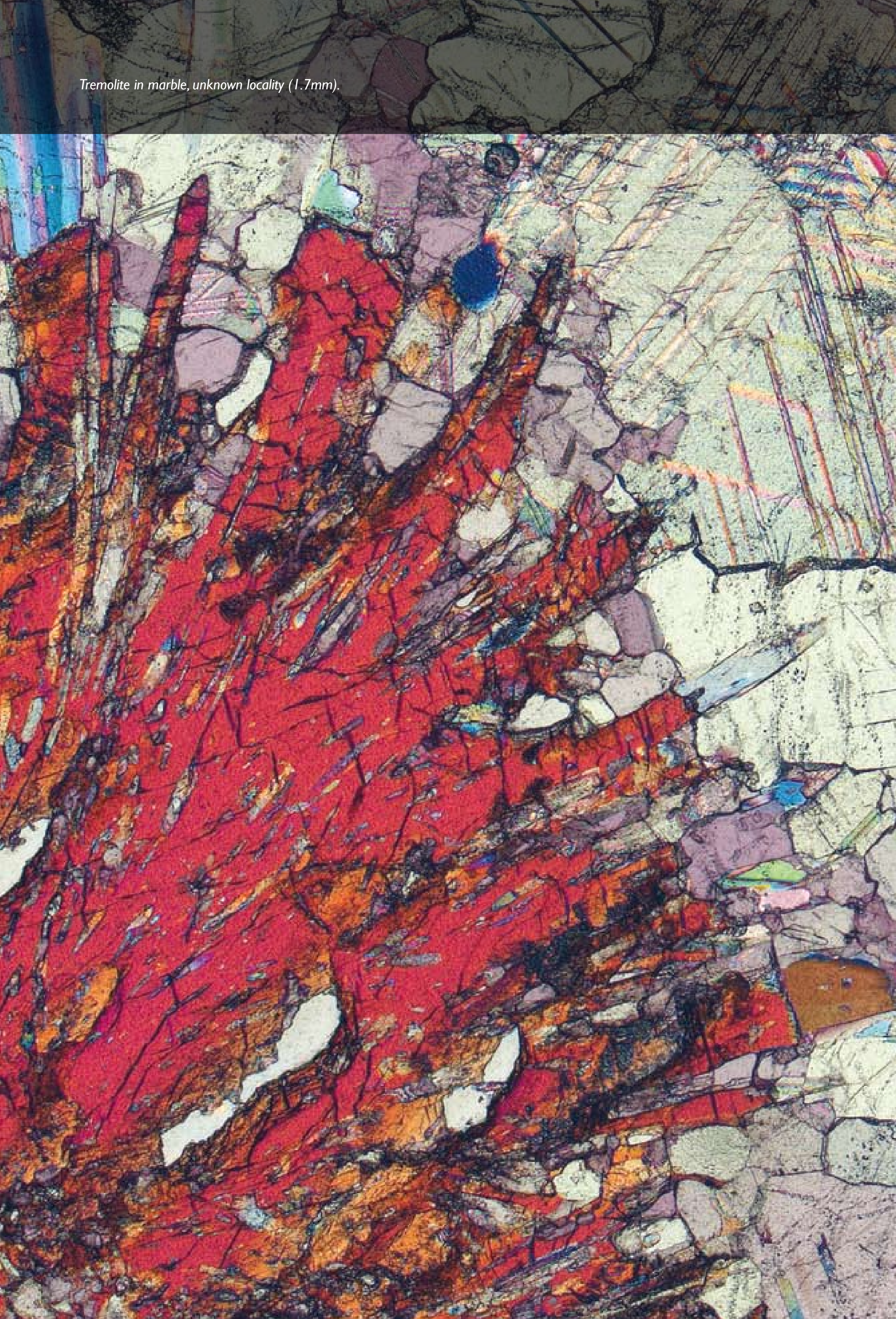


Fragment of anti-shock foam sheet (1.7mm).



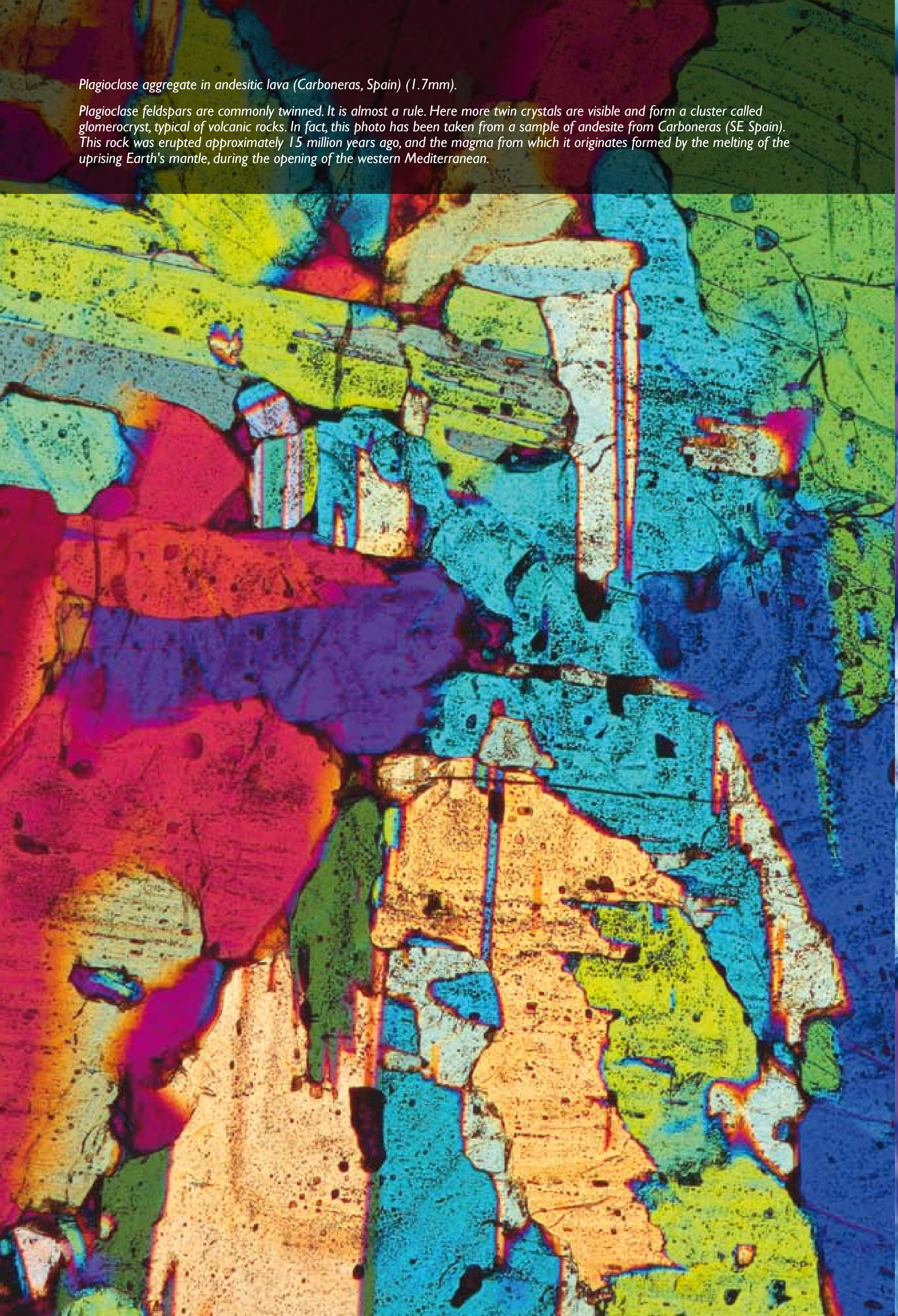
Pyroxene-plagioclase symplectite in granulitic metagabbro (Manitoba, Canada) (1.7mm). Sample provided by Martha Growdon.

A "symplectic" intergrowth of golden pyroxene and blue plagioclase is visible in "Pyroxene-plagioclase symplectite in granulitic metagabbro". The distribution of colours, indicating optical continuity, shows that this pattern is actually provided by one crystal of pyroxene and one of plagioclase intimately compenetrated. Like in the photo from Antarctica, also these minerals form by replacement of garnet.



Tremolite in marble, unknown locality (1.7mm).

Fragment of plastic bag (3.5mm).



Plagioclase aggregate in andesitic lava (Carboneras, Spain) (1.7mm).

Plagioclase feldspars are commonly twinned. It is almost a rule. Here more twin crystals are visible and form a cluster called glomerocryst, typical of volcanic rocks. In fact, this photo has been taken from a sample of andesite from Carboneras (SE Spain). This rock was erupted approximately 15 million years ago, and the magma from which it originates formed by the melting of the uprising Earth's mantle, during the opening of the western Mediterranean.

Fragment of plastic bag (3.5mm).

Fragment of plastic bag (6.5mm).