***The Journal of Gemmology* Data Depository**

Petrographic investigations to accompany the article:

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The following petrographic investigations of the samples were performed on polished thin sections using a Leica DMRD polarising microscope and with a Bruker Senterra Raman spectrometer. Raman analyses (R) of analysed phases are available from the authors on request (email info@gemexpert.ch). The samples are arranged in alphabetic order, and for each one the gemmological denomination (in bold font) is followed by the petrographic name (where applicable). Photomicrographs of each sample are presented in Figures 1–25 of the data depository photomicrographs file accompanying this article.

1 **Aventurine quartz, green:** Fuchsite quartzite

***Fabric*:** The fine- to medium grained rock is mainly composed of elongate quartz grains, which are aligned in the foliation (see Figure 1 of the data depository photomicrographs file). A tight alignment is also observed for the fuchsite tablets. Late deformation led to wavy extinction of the quartz grains. The grinding of the blocks occurred perpendicular to the metamorphic foliation and consequently perpendicular to the metamorphic pressure direction.

***Main components*:** Elongate *quartz* grains (R) with wavy extinction have sizes of 0.5 to >2 mm and are aligned in the foliation. They display numerous inclusions of fuchsite flakes.

Fuchsite mica (R) appears as pale green tablets with diameters up to 0.6 mm, which are thoroughly aligned in the foliation.

***Accessories*:** *Zircon* forms roundish grains with high relief and diameters up to 0.1 mm.

Rutile is present as small, dark brown grains and as agglomerates of tiny prismatic crystals.

***Modal composition (vol.%)*:**
Quartz: ~93%
Fuchsite: 7%
Accessories: <<1%

2 **Aventurine quartz, orangey red:** Muscovite-bearing mylonitic quartzite

***Fabric*:** The rock has thoroughly aligned, mylonitic structure, which means that it shows a dynamic recrystallization due to strong ductile deformation processes. This deformation led to the formation of larger quartz ribbons being framed by small, newly crystallized quartz grains

(so-called *neoblasts*), which show a tessellated, plaster-like arrangement (see Figure 2 of the data depository photomicrographs file). Subordinately, muscovite tablets appear with a structural adjustment in the foliation. The grinding of the blocks occurred perpendicular to the mylonitic foliation planes.

***Main components*:** *Quartz* mainly forms lenticular to ribbon-shaped crystals with prominent undulatory extinction and a length of up to 2 mm and a length-to-width ratio of about 10:1. These ribbons are framed by dynamically recrystallized quartz neoblasts with diameters of about 0.05 mm. Both quartz types contain numerous tiny fluid inclusions smaller than 3 µm.

***Accessories*:** *Muscovite* (R) appears in some layers of the rock as small aligned tablets with diameters up to 0.4 mm. Muscovite frequently shows a red staining by hematite.

Hematite (R) is mostly associated with muscovite and subordinately forms small solitary, dark red aggregates.

***Modal composition (vol.%)*:**
Quartz: >99%
Accessories: <1%

3 Chalcedony, light grey

***Fabric*:** The sample is monomineralically made up of small, elongates chalcedony crystals, which show an intensely interlocked aggregation and a random orientation (see Figure 3 of the data depository photomicrographs file). Such a fabric is termed *decussate*. Near the rim of the thin section, several small microfractures are observed.

***Main components*:** *Chalcedony* (R) forms elongate crystals with a length of about 0.05 mm and a length-to-width ration of 3:1–7:1. Along healed microfractures are tiny equigranular chalcedony crystals with diameters >30 µm.

***Accessories*:** none

***Modal composition (vol.%)*:**
Chalcedony: 100%

4 Chrysoprase

***Fabric*:** The rock shows a matrix made up of very small, anhedral chalcedony and quartz crystals, which are intermingled with a brownish substance (probably composed of sheet silicates). Within this matrix, larger round quartz aggregates with a radial texture are interspersed. The sample exhibits several microfractures, on which a growth of palisade-shaped fibres of chalcedony occur. In the central part of some of these fractures, a growth of euhedral quartz crystals took place (see Figure 4 of the data depository photomicrographs file). Rock sections with pervasive fracturing show a reddish brown staining of hematite.

Main components: *Chalcedony* (R) forms the major part of the fine-grained rock matrix. The irregular to fibrous crystals have sizes of about 25 µm and show an intensely 'toothed' texture. Conspicuous are lance-shaped chalcedony fibres with a length of about 0.1 mm, which are arranged like palisades on microfractures. Raman investigations of the matrix subordinately indicate spectra of *quartz*. The main amount of quartz, however, forms round aggregates with a radial growth texture and diameters of about 0.1 mm, as well as subhedral and euhedral crystals with a length of more than 0.3 mm on larger fractures.

Aggregates of tiny brownish grains along grain boundaries of quartz and chalcedony are assumed to be sheet silicates, and judging from the colour of the rock probably consists of *chlorite*. Due to their small size, microscopic identification or Raman analysis was not possible.

***Accessories*:** *Hematite* (R) forms small, irregular, dark red and opaque crystals along some larger fractures and furthermore causes red staining in these zones.

***Modal composition (vol.%)*:**
Chalcedony and quartz: ~98%
Sheet silicates: 2%
Accessories: <<1%

5 Dumortierite: Tourmaline-dumortierite quartzite

***Fabric*:** The sample reveals a compositional layering with dumortierite-rich and quartzitic layers. Remarkable is the growth of numerous dumortierite aggregates with variable sizes and tourmaline crystals in the quartzitic layers (see Figure 5 of the data depository photomicrographs file). The rock is cut by many fractures parallel and oblique to the layering, along which blue tourmaline and to a lesser extent of dumortierite occurred.

***Main components*:** *Quartz* (R) forms mm-wide layers consisting of very small anhedral grains with diameters of ~50 µm and interspersed large (up to 1.5 mm) porphyroclasts.

Dumortierite (R) appears as pale blue, weakly pleochroic crystals with intermediate relief and interference colours up to first-order yellow. The short prismatic crystals, which have inclusion-rich core sections, attain a length of about 0.2 mm. Dumortierite rarely forms granoblastic layers and streaks as well as irregularly shaped aggregates with diameters up to 0.5 mm in the quartzitic layers. Furthermore, small anhedral dumortierite grains crystallized in some fractures.

Tourmaline (R) mainly crystallized on fractures as light blue, distinctly pleochroic, prismatic crystals with a birefringence of the second order. While larger tourmaline prisms reach a length of up to 0.3 mm, some layers contain needle-shaped tourmaline crystals <0.05 mm.

***Accessories*:** The most prominent accessories are dark brown, mainly prismatic *rutile* (R) crystals.

Prismatic *zircons* (R) may show zoning features and attain a length of up to 100 µm.

Subordinate small opaque grains were identified by Raman analysis as *hematite* (R).

***Modal composition (vol.%)*:**
Quartz: 60%
Dumortierite: 30%
Tourmaline: 9%
Accessories: 1%

6 Granite: Monzogranite (plagioclase-rich granite)

***Fabric*:** A holocrystalline rock fabric with a random orientation of numerous subhedral plagioclase and K-feldspar crystals is observed. Large anhedral, intragranular quartz grains are present, while biotite is the dominant mafic mineral (see Figure 6 of the data depository photomicrographs file). The rock experienced a weak post-magmatic hydrothermal overprint leading to a faint sericitisation and saussuritisation of the feldspars and to a chloritisation of the biotite.

***Main components*:** *Quartz* (R) forms anhedral grains with numerous microfractures, a weak wavy extinction and diameters of more than 4 mm.

Orthoclase and *microcline* are present as irregular, mostly subhedral tabular crystals, which attain a length of up to 6 mm. They are weakly sericitised, display oscillatory zoning and contain numerous microfractures. Along their grain boundaries with plagioclase, myrmekites (tiny, vermicular intergrowths of quartz and plagioclase) are rarely observed.

Plagioclase appears as elongate, subhedral to euhedral crystals with distinctly variable grain sizes of 0.5–4 mm. They reveal albite and pericline twins and often display an oscillatory zoning with a distinct saussuritization in the core.

Biotite forms strongly pleochroic brown flakes with diameters up to 1 mm. They are often chloritized along their rims and on cleavage planes, which is accompanied by the formation of leucoxene.

***Accessories*:** Small amounts of *white mica* are often associated or intergrown with biotite.

Prismatic euhedral *zircon* crystals reach lengths of up to 0.12 mm and are often enclosed in biotite.

Allanite forms prismatic, brownish red, distinctly pleochroic crystals with a length of up to 0.25 mm, which are often enclosed in plagioclase.

Apatite is present as short prismatic and angular small grains with a length up to 0.18 mm.

Cubiform opaque crystals were identified as *pyrite* (R).

***Secondary minerals*:** *Epidote/clinozoisite*, *sericite*, *chlorite* and *leucoxene* are the products of a post-magmatic hydrothermal overprint.

Modal composition (vol.%):
Quartz: 32%
Plagioclase: 35%
Orthoclase: 25%
Biotite: 7%

Accessories: 1%

7 Green quartz: Fuchsite quartzite

Fabric: The rock largely shows an irregular, granoblastic texture due to mm-sized quartz grains, which include numerous small fuchsite flakes. Besides these inclusions, fuchsite also forms small layers, which in part display an intense microfolding (see Figure 7 of the data depository photomicrographs file). The rock is cut by numerous, quartz-filled microfractures, which are oriented parallel or sub-parallel to the mica layers.

Main components: Granoblastic *quartz* grains with diameters of 1–4 mm dominate this sample. Inclusions in the quartz are clusters of tiny fuchsite flakes and fluid inclusions. However, quartz grains in microfractures are lacking these inclusions.

Fuchsite (R) appears as bright green, weakly pleochroic, scaly crystals with interference colours of the second order. Besides the tiny inclusions in quartz, fuchsite forms layers with thicknesses up to 0.2 mm. Individual fuchsite flakes in these layers exhibit diameters up to 60 µm.

Accessories: Anhedral, angularly shaped, dark red and opaque crystals were identified by Raman analysis as *hematite* (R), which also forms red veils in the sample.

Calcite (R) forms small mineral aggregates in the fuchsite layer.

Baryte (R) is present as small grains with intermediate relief and some opaque inclusions.

Modal composition (vol.%):
Quartz: 95%
Fuchsite: <5%
Accessories: <<1%

8 Heliotrope: Green chalcedony

Fabric: The microscopic view shows a mass of tiny, elongate, often irregularly and radiantly intergrown chalcedony crystals. The thin section shows colourless, faintly greenish and brownish areas with roundish opaque grains being present in the latter (see Figure 8 of the data depository photomicrographs file).

Main components: *Chalcedony* (R) mainly forms elongate single crystals but also sheaf-like and fan-shaped aggregates with diameters up to 0.25 mm. Remarkable are irregular, patchy areas with ball-shaped chalcedony agglomerates showing diameters of 30 µm. Raman spectra of the colourless and the green chalcedony areas were virtually identical.

Accessories: *Hematite* (R) is present as roundish, frayed grains with diameters up to 0.5 mm, which are intergrown with chalcedony. The brown area of the sample contains tiny spear-like hematite crystals and brown hematite stains.

Modal composition (vol.%):
Chalcedony: 98%
Hematite: 2%

9 ***Jadeite*****:** Fluoro-richterite Cr-omphacite jadeitite

Fabric: The rock displays an inhomogeneous texture, which is dominated by mostly prismatic crystals. Tiny crystals of short-prismatic jadeite (pale green in the hand specimen) and long-prismatic Cr-omphacite (dark green in the hand specimen) reveal a distinct foliation and sometimes show microfolding structures (see Figure 9 of the data depository photomicrographs file). Intercalated are several mm- to cm-sized, mostly subhedral crystals of fluoro-richterite (dark brown in the hand specimen).

Main components: *Jadeite* (R) forms colourless, prismatic crystals with intermediate relief and a length of up to 0.5 mm, which are arranged in up to 5 mm wide layers. Conspicuous are their low birefringence and zonal structures in larger crystals.

Cr-omphacite (R) is present as bright green, pleochroic, prismatic crystals with high relief and lengths up to 1 mm. Furthermore, aggregates of distinctly smaller, needle-shaped crystals are present in some areas. Similar to jadeite, the Cr-omphacite usually shows a strong alignment in the foliation. Additionally, it also appears as the filling of larger fractures in fluoro-richterite.

The clinoamphibole *fluoro-richterite* (R) appears as pale brownish, highly fractured, prismatic crystals with a length of up to 1.2 cm. Similar to jadeite, it reveals an intermediate relief and a low birefringence.

Accessories:
Ferro-holmquistite (R) mainly forms small, bluish green edges on the large fluoro-richterite crystals. Subordinately, it appears as small solitary prismatic crystals associated with Cr-omphacite.

Rarely, strongly corroded relics of *pyrite* appear, which are mantled by limonite.

Modal composition (vol.%):
Jadeite: ~40%
Cr-omphacite: 35%
Fluoro-richterite: 25%
Accessories: <1%

10 **Jasper, red:** Andradite- and hematite-bearing quartzite (jasper)

Fabric: An irregularly banded texture consisting of pure quartzitic layers, and pinkish and dark brown quartz-hematite layers is observed (see Figure 10 of the data depository photomicrographs file). This fabric is probably due to different phases of hydrothermal activity. Conspicuously, the quartzitic layers are cutting through the other layers and therefore can be regarded as the last hydrothermal mineralization.

Main components: *Quartz* forms roundish, subordinately elongate anhedral crystals with variable grain sizes of 0.01–0.25 mm. The largest grains show a wavy extinction and are found in the quartzitic layers while the smallest grains occur in the hematite-rich sections.

Accessories: *Hematite* (R) appears as red to dark brownish red agglomerates of tiny anhedral crystals. It is always acutely intergrown with quartz and andradite.

Andradite (R) is mainly found in hematite-rich layers and subordinately in the hematite-poorer sections while it is absent from the quartzitic layers. Due to its numerous inclusions of hematite and quartz, it can only be recognized in reflected light. It forms racked, fringed crystals with intermediate reflection and lengths up to 75 µm.

Goethite (R) is rarely associated with hematite, forming small needles.

Magnetite (R) appears as irregularly shaped opaque crystals with diameters of less than 40 µm.

Modal composition (vol.%):
Quartz: 99%
Accessories: 1%

11 Lapis lazuli: Phlogopite-diopside-lazurite schist

Fabric: The sample shows indistinct banding with lazurite- and diopside-phlogopite-rich layers. Especially the diopside-phlogopite-rich bands reveal an alignment of the minerals in an S1 foliation, which is parallel to the compositional banding. Lazurite-rich layers lack any foliation and rarely contain mm-sized porphyroblastic diopside grains (see Figure 11 of the data depository photomicrographs file).

Main components: *Lazurite* (R) appears as intensely bright blue, anhedral, isotropic grains with low relief and sizes up to 0.6 mm. Remarkable are irregular, greyish blue stripes in these grains, which display the same Raman spectra as the bright blue areas.

Diopside (R) is present as short prismatic and granoblastic, pale brown crystals with high relief and distinctly variable grain size. In diopside-phlogopite-rich layers, diopside prisms have a length of about 0.15 mm while large, porphyroclastic grains with diameters up to 1 mm appear in lazurite-rich bands.

Phlogopite (R) forms colourless tablets with an intermediate relief, a distinct cleavage, interference colours of the second order and diameters up to 0.18 mm. Most phlogopite crystals are aligned in the S1 foliation although some tablets grew obliquely to the foliation.

Accessories: *Calcite* (R) forms granoblastic crystals with diameters up to 0.25 and is easily recognizable by its high birefringence.

Opaques are present as anhedral grains in some layers of the section. Raman analyses classify them as *pyrite* (R).

Modal composition (vol.%):
Lazurite: 42%

Diopside: 35%
Phlogopite: 20%
Accessories: 3%

12 Magnesite: Quartz-magnesite marble

Fabric: The sample is mainly composed of a dense mass of tiny magnesite crystals, which reveal a random orientation (white areas in the hand specimen). This mass is cut by numerous, up to mm-wide veins (grey stripes in the hand specimen), in which a growth of larger magnesite granoblasts with subordinate euhedral quartz crystals occurred (see Figure 12 of the data depository photomicrographs file).

Main components: *Magnesite* (R) forms a mass of tiny anhedral colourless crystals with diameters of about 10 µm. Furthermore, granoblastic and elongate magnesite crystals with lengths up to 3 mm are found as fracture fillings. Larger magnesite grains in fractures contain numerous two-phase aqueous fluid inclusions.

Quartz (R) appears as euhedral and subhedral prismatic crystals with lengths up to 0.5 mm. Quartz crystals include numerous tiny magnesite grains, which are arranged parallel to the crystal planes.

Accessories: *Montmorillonite* (R) is found in microfractures forming small, colourless tablets with low relief and interference colours of the second order.

Rutile (R) appears as dark brown tiny crystals within microfractures and in the dense mass of magnesite.

Modal composition (vol.%):
Magnesite: ~96%
Quartz: 4%
Accessories: <<1%

13 Malachite

Fabric: The sample almost monomineralically consists of malachite and shows alternating dark green and bright green layers (see Figure 13 of the data depository photomicrographs file). The colour of these layers mainly results from micrometre-sized opaque and fluid inclusions in the malachite crystals. The sample blocks were oriented perpendicular to the layering. Another orientation was not used for this investigation but further studies may include such samples.

Main components:
Malachite (R) forms bright green, often fibrous crystals with a length up to 1 mm. The orientation of the crystals perpendicular to the layering points to their growth on steadily opening fractures. The malachite crystals contain tiny opaque and fluid inclusions.

Accessories:

Elongate opaque inclusions in malachite have a length of >3 µm and could not be identified by Raman analysis.

Modal composition (vol.%):
Malachite: >>99%
Accessories: <<1%

14 Nephrite: Uvarovite- and magnesiochromite-bearing actinolitite

Fabric: The rock consists of intensely intergrown, fibrous, mainly short-prismatic clinoamphibole crystals with a random orientation. Some microfractures are recognizable in which a growth of somewhat larger clinoamphibole prisms occurred (see Figure 14 of the data depository photomicrographs file).

Main components: *Clinoamphibole* (R) forms faintly green, strongly toothed prismatic crystals with lengths of 50 µm to more than 400 µm. Raman spectroscopy could not unambiguously identify the clinoamphibole, pointing to actinolite or tremolite. Judging from the dark green colour of the sample, the amphibole should be actinolite. Around the interspersed opaque magnesiochromite crystals, a seam of very small, pale green clinoamphibole crystals is observed. Their green colour probably results from elevated Cr contents.

Accessories: Small, angular, mostly opaque grains with strongly corroded rims were identified by Raman analysis as *magnesiochromite* (R).

Around the magnesiochromite grains were tiny mineral aggregates made up of greenish, highly refractive crystals, which were revealed as *uvarovite* (R) by Raman analysis. These areas also tend to contain brown stains of *limonite*.

Modal composition (vol.%):
Clinoamphibole: 99%
Accessories: 1%

15 Obsidian, 'mahogany'

Fabric: The rock is hyaline and shows a marked flow structure with streakily interwoven, colourless and pale brown glass layers (see Figure 15 of the data depository photomicrographs file). Conspicuous are numerous tiny columnar hematite crystals showing an alignment parallel to this flow structure.

Main components: Volcanic *glass* (R) is present as colourless and brown varieties in mm- to cm-wide streaks, which are irregularly interwoven. The brown glass probably originated from a more mafic, and the colourless type from a more felsic, magmatic melt that solidified during flow processes. Raman spectra of both glass types did not show any significant differences.

Accessories: *Sanidine* (R) forms aligned, lath-shaped crystals with lengths up to 0.15 mm. They often reveal Carlsbad twins and contain small inclusions of glass.

Biotite (R) is present as a few reddish brown, pleochroic tablets with diameters up to 0.1 mm, which also show an alignment in the flow structure.

Hematite (R), the most prominent accessory mineral, mainly occurs as numerous tiny, dark red stripes with lengths of about 15 µm and occasionally forms larger angular, opaque grains and dendritic opaque accumulates.

A single roundish grain of *zircon* (R) with a diameter of 0.1 mm is present in the thin section.

Modal composition (vol.%):
Volcanic glass: 98%
Accessories: 2%

16 'Opal', pink or 'Andes': Quartz- and opal-bearing chalcedony palygorskitite

Fabric: The central portion of the thin section, which consists of palygorskite enclosed in chalcedony, is mantled by a mass of small, hastate crystals of chalcedony and some anhedral quartz grains. At the interface between the central palygorskite and the outer chalcedony section, small seams of clearer opal formed (see Figure 16 of the data depository photomicrographs file).

Main components: The clay mineral *palygorskite* (R) is present as pale brown, irregularly fibrous to tufted crystal aggregates with low relief and an interference colours up to first-order yellow. Individual crystals may reach a length of 0.3 mm and are completely included in chalcedony.

Chalcedony (R) appears as hastate and stalky crystals in the outer portion of the thin section and shows concentric, banded growth around the palygorskite core of the sample. In some cases, sheaf-like growth textures are observed. The largest chalcedony crystals have a length of up to 0.5 mm. In the central portion of the sample, very fine-grained chalcedony surrounds the palygorskite crystals.

Accessories: Within the chalcedony bands, granular anhedral *quartz* (R) grains with diameters of ~0.1 mm show a mosaic intergrowth.

Opal (R) forms light brown, irregularly curled seams intergrown with chalcedony close to the inner palygorskite zone.

Small anhedral grains with high to very high relief were identified by Raman analysis as *epidote* (R) and *titanite* (R).

Modal composition (vol.%):
Palygorskite: 83%
Chalcedony: 15%
Accessories: 2%

17 Quartz, smoky

Fabric: The sample consists of a single crystal of smoky quartz, which is cut slightly obliquely to the optic axis. Under the microscope, a faint wavy extinction is observed. The sample contains isolated, two-phase fluid inclusions pointing to an aqueous fluid phase with low salinity. Rare mineral inclusions consist of thin rutile needles and grains (see Figure 17 of the data depository photomicrographs file).

Main components: The sample almost monomineralically consists of *quartz*.

Accessories: Sporadically, thin golden yellow needles and roundish grains of *rutile* appear.

Modal composition (vol.%):
Quartz: ~100%
Rutile: >0.1 %

18 Quartz, rose

Fabric: Similar to the previous sample, this specimen is a single-crystal rose quartz cut obliquely to its optic axis. The mineral shows a weak wavy extinction and contains numerous parallel to subparallel microfractures, which are often filled with a brownish substance (see Figure 18 of the data depository photomicrographs file). Perpendicular and inclined to these microfractures, healed fissures containing secondary, two-phase fluid inclusions (<5–30 µm wide) with a fluid and a gas bubble (and no saline daughter minerals) testify to a low-salinity aqueous fluid phase.

Main components: The sample monomineralically consists of *quartz*.

Accessories: The brownish material filling the microfractures could not be identified microscopically or by Raman analysis. It is assumed to be *limonite* or *hematite*.

Modal composition (vol.%):
Quartz: ~100%

19 Rhodochrosite: Rhodochrositite

Fabric: The almost-monomineralic sample shows a medium- to coarse-grained, subhedral texture made up of large, mostly rhombohedral rhodochrosite crystals with a random orientation. Only in a few locations, smaller rhombohedral carbonate crystals are embedded in an aggregated mass of tiny anhedral carbonate grains with larger interspersed opaque minerals (see Figure 19 of the data depository photomicrographs file).

Main components: *Rhodochrosite* (R) forms colourless to slightly pinkish, subhedral and rarely euhedral, strongly fractured rhombohedral crystals up to 6 mm long. Along internal fractures parallel to the crystal faces, a large amount of aggregated fluid inclusions with sizes of >2–10 µm trace the zonal growth of the crystals. Such zonation patterns are also observed with the

smaller carbonate crystals while the tiny anhedral carbonate grains lack any fluid inclusions. According to Raman analyses, the large, small and aggregated carbonate crystals are without exception rhodochrosite.

Accessories: Numerous opaque, mostly angular and cube-shaped crystals, which are interspersed in the dense matrix of small aggregated rhodochrosite grains are *pyrite* (R).

Along its rim, pyrite is rarely intergrown with a dark brown mineral identified as *sphalerite* (R) by Raman analysis.

Modal composition (vol.%):
Rhodochrosite: >99%
Accessories: <1%

20 Rhodonite: Spessartine rhodonitite

Fabric: The sample exhibits an inhomogeneous fabric with a large variation in grain size and a random orientation of the minerals. Rhodonite appears in some areas as large granoblasts and in others as short prismatic crystals of intermediate size and locally as small anhedral grains. Spessartine often forms irregular and strongly cracked porphyroblasts, which are enriched in some areas (see Figure 20 of the data depository photomicrographs file). Accessory carbonate and quartz mainly occur along grain boundaries. The rock is cut by numerous microfractures, which are filled with an opaque phase.

Main components: *Rhodonite* (R) forms pale pinkish, weakly pleochroic crystals with high relief and low birefringence of the first order. Rhodonite granoblasts have grain sizes of 0.5–2 mm while the subhedral prismatic crystals are about 0.5 mm long and the small xenoblasts have diameters >0.15 mm. Remarkable are the marked cleavage of the crystals and the lamellar twinning of the granoblasts.

Spessartine (R) is present as colourless, irregular porphyroblasts with high relief and numerous tiny fluid inclusions, which create a spotted appearance. Spessartine also has numerous rhodonite inclusions and is often fragmented together with rhodonite crystals in fractures.

Accessories: *Quartz* (R) locally forms small anhedral crystals along the grain boundaries of rhodonite.

Carbonate appears as irregular layers and aggregates of small grains along grain boundaries and in microfractures. According to Raman analyses it was identified as *rhodochrosite* (R).

Opaque layers and grains filling the larger microfractures show a strongly variable reflexion pointing to a complex intergrowth of different phases. The main constituent of this material, however, was classified as *vernadite*, $(Mn,Fe,Ca,Na)(O,OH)_2 \bullet nH_2O$, by Raman analysis.

Modal composition (vol.%):
Rhodonite: 80%

Spessartine: 16%
Accessories: 4%

21 Sannan-Skarn: Calcite-aegirine-winchite skarn

Fabric: Sannan-Skarn, a complex metamorphic rock from Pakistan (Hänni *et al.* 2016), shows an inhomogeneous, strongly deformed texture due to numerous shear bands and brittle fractures. The rock is dominated by a fine-grained matrix made up of elongate winchite crystals and aggregates of aegirine prisms and is cut by shear bands and two generations of microfractures. Larger winchite crystals and small amounts of aegirine formed in mm-wide fractures of the first generation. The distinctly smaller fractures of the second generation, which are filled with calcite, cut the larger fractures of the first generation. Shear bands stained with limonite strike through the fractures of the first generation but are cut by the fractures of the second generation (see Figure 21 of the data depository photomicrographs file). Deformation processes on these shear bands led to a significant grain size reduction of the aegirine and winchite crystals.

Main components:
Winchite (R) forms pale yellow, prismatic crystals with intermediate relief and variable lengths of <0.3–3 mm. Due to the intensive deformation processes in this rock, winchite often reveals distinct fracturing. Larger winchite crystals may include agglomerations of tiny aegirine prisms.

Aegirine (R) is found as agglomerates of small, anhedral grains as well as euhedral prims with high relief and distinct pleochroism from dark green to yellowish green. The size of the aegirine crystals rarely exceeds 0.25 mm.

Calcite (R) appears exclusively in fractures of the second generation as granoblastic crystals with numerous microcracks and diameters up to 1 mm.

Accessories:
Fractures of the second generation locally contain irregular opaque crystals, which were identified as *magnetite* (R) by Raman analysis. These grains are often coated by *limonite*, the latter also staining the shear bands.

Modal composition (vol.%):
Winchite: 70%
Aegirine: 21%
Calcite: 3%
Accessories: 1%

22 Sodalite: Carbonate-paragonite-natrolite sodalitite

Fabric: The sample shows an isotropic mass of sodalite, which is cut by numerous vein-like microfractures with random orientations (see Figure 22 of the data depository photomicrographs file). In the veins, a growth of natrolite, paragonite and carbonate took place.

Main components:

Sodalite (R) forms a strongly fractured, greyish blue, isotropic mass with low relief. Individual crystals are not recognizable. Besides inclusions of carbonate, paragonite and alumohydrocalcite, sodalite shows numerous tiny fluid inclusions.

The zeolite mineral *natrolite* (R) is present as colourless crystals with low relief and grey interference colours of the first order. Natrolite exclusively grew in microfractures as prismatic crystals with lengths of about 0.15 mm. Quite often, the crystals form fan-shaped, chubby aggregates.

Paragonite (R) appears as colourless, euhedral tablets with diameter up to 0.3 mm. Besides individual crystals included in sodalite, paragonite aggregates and intergrowths with natrolite are found in larger microfractures.

Carbonate is found as agglomerates of tiny anhedral grains (<20 µm) and also forms larger crystals intergrown with natrolite and sodalite. Raman spectroscopy identified the tiny grains as *ankerite* (R) whereas the larger crystals were without exception *calcite* (R).

Accessories: Mineral aggregates shaped like balls of wool were recognized by Raman spectroscopy as *alumohydrocalcite*, also termed *khakassite* (R), $CaAl_2(CO_3)_2(OH)_4 \bullet 3H_2O$. The weakly brownish aggregates attain diameters up to 0.2 mm and are easily recognizable by their interference colours of the fourth order.

Granular and cubiform opaque crystals showing a high reflectivity and yellow colour in reflected light are *pyrite* (R).

Minor amounts of *limonite* appear as a decomposition product of pyrite.

Subordinately, small brown crystals of *titanite* (R) are included in calcite.

Modal composition (vol.%):
Sodalite: 73%
Natrolite: 20%
Paragonite: 3%
Carbonate: 3%
Accessories: 1%

23 Sugilite: Aegirine-phlogopite-pectolite-quartz sugilitite

Fabric: The rock displays a very fine-grained matrix consisting of intensely intergrown sugilite and quartz crystals without any preferred mineral orientation. Interspersed in the matrix are irregularly distributed agglomerates of pectolite, phlogopite and aegirine (see Figure 23 of the data depository photomicrographs file). These minerals are also present in numerous fractures cutting through the rock.

Main components: *Sugilite* (R) forms weakly red, short prismatic crystals with intermediate relief and interference colours of the first order. These crystals are tightly intergrown with quartz and reach lengths of 0.03–0.1 mm.

Quartz (R) forms as anhedral, often rounded grains with diameters of about 0.1 mm, which are intensely intergrown with sugilite. Subordinately, lenticular, monomineralic accumulations of somewhat larger quartz grains appear.

Pectolite (R) appears as prismatic, colourless crystals with intermediate relief and interference colours of the second order. The crystals attain lengths up to 0.25 mm, and not only form accumulations with phlogopite in the microfractures but also rarely occur in the sugilite-quartz matrix.

Phlogopite (R) forms colourless tablets with sizes similar to pectolite and is intergrown with the latter in mm-wide mineral accumulates.

Aegirine (R) is present as reddish brown, highly refractive accumulations of tiny crystals and subordinately as anhedral grains in fractures and around lenticular quartz accumulations. The grain sizes rarely exceed 30 µm.

Accessories: Irregular, anhedral opaque grains were identified by Raman spectroscopy as *hematite* (R), which also forms a reddish stain in microfractures.

Modal composition (vol.%):
Sugilite: ~40%
Quartz: 35%
Pectolite: 15%
Phlogopite: 7%
Aegirine: 3%
Accessories: <<1%

24 Tiger's-eye: Goethite-bearing quartzite

Fabric: The microscopic view shows a bimineralic rock, which consists of thin quartz fibres co-laterally intergrown with stems of goethite (see Figure 24 of the data depository photomicrographs file). Such a texture usually evolves by simultaneous growth of minerals in opening fractures. The sample blocks were ground perpendicular to the long axes of the goethite stems and the quartz fibres.

Main components: *Quartz* (R) forms long fibres that measure up to 10 × 0.3 mm (average 5 × 0.15 mm). The fibres have a distinct wavy extinction and display a long-wave bending. In places, elongate fluid inclusions are recognizable in the fibres.

Accessories:
Goethite (R) occurs as pale red to reddish brown needles and stripes with a width of about 30 µm and distinctly variable length. Like the quartz fibres, they show wavy extinction.
Hematite (R) rarely occurs as opaque, angular grains with diameters up to 25 µm.

Modal composition (vol.%):
Quartz: >99%
Accessories: <1%

25 Verdite: Diaspore-corundum-margarite-fuchsite schist

Fabric: An irregularly folded structure is made up of predominant fuchsite- and corundum-rich green layers alternating with brownish margarite-rich layers in the mm-range (see Figure 25 of the data depository photomicrographs file). A distinct alignment of the mica flakes in the foliation is particularly visible in the fuchsite-rich layers, which also contain streaky agglomerates of tiny rutile crystals. The rock reveals numerous mineralized microfractures oriented perpendicular and oblique to the foliation. A retrograde overprint led to the formation of diaspore at the expense of corundum and to accumulations of vermiculite.

Main components: *Fuchsite* (R) forms pale green, pleochroic tablets with diameters of 10–30 µm and mainly occurs in association with corundum in the green layers. In the brownish, margarite-rich layers, only small fuchsite crystals occur in minor amounts.

Margarite (R) is found in the brownish layers as small tablets (<10 µm). Larger margarite crystals with diameters up to 70 µm grew in microfractures.

Corundum (R) mostly appears as the variety ruby showing distinctly pink colours, while violet to pale blue sapphire is subordinate. Corundum crystals often reveal rounded shapes with diameters up to 1 mm and are distinctly corroded at their rims.

Diaspore (R) grew at the expense of the corundum crystals and forms irregular, blurred rims around them. Diaspore crystals have a high relief and appear as aggregates consisting of small, mostly stalky crystals with lengths of >20 µm.

Accessories: *Rutile* (R) forms elongate aggregates of anhedral small crystals in the green fuchsite-rich layers and rarely appears opaque. Larger, dark brown rutile prisms are rare.

Vermiculite (R) occurs in small lenses as accumulations of colourless tablets with diameters of >50 µm.

Modal composition (vol.%; average values, strongly varying contents from layer to layer):
Fuchsite: 65%
Margarite: 24%
Corundum & diaspore: 10%
Accessories: 1%