BHANDARKHAL PAVILION BASE

Report of the Institute of Conservation (IoC), University of Applied Arts Vienna

Fig. 1: Overview of pavilion facing the tank, 2014

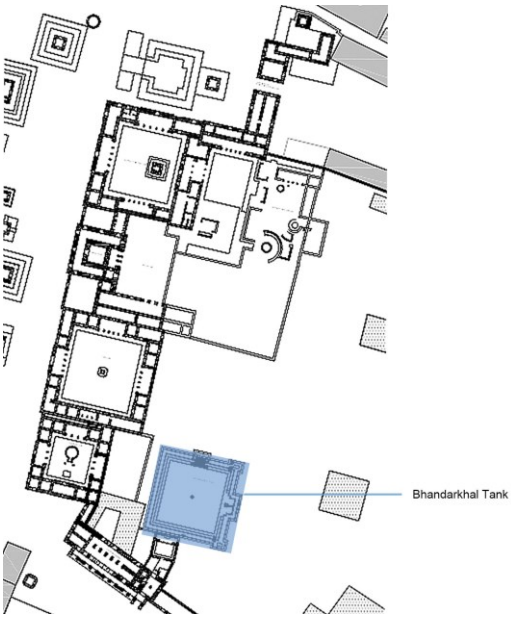

Fig. 2: Location within the Palace Complex

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Data Sheet

Description

The Bhandarkhal Tank is the focal element of the palace garden and measures about 16 by 16 metres. Dating back to 1647 (Malla era), the water basin is part of Patan's historic water infrastructure and was once the main water supply of the adjacent Royal Palace.
The pavilion is situated at the centre of the north tank wall and consists of a stone base and the wooden pavilion. The base is comprised of small blocks made of a fine-grained sandstone with intricate carvings depicting deities and mythical sceneries. The wooden structure was lost sometime during the second half of the 19th- and the first half of the 20th century. During that time the stone structure was without proper protection against rain. In the 1950s, a concrete balustrade was put on top of the stone base and concrete stairs were added on the occasion of the enthronement of King Mahendra. Both were removed later by the Kathmandu Valley Preservation Trust (KVPT). Prior to the conservation, the structure was threatened by collapse and leaning towards the water tank because of its foundation sinking. Furthermore, an overly dense joint mortar and acrylic-based surface coating were applied during former restorations, which both had a negative impact on the water balance of the stone. The blocks showed high salt contamination and microbiological colonization.
The conservation of the stone base was the first project of the Institute of Conservation in Patan, carried out in close collaboration with the KVPT and Nepali craftsmen. The wooden pavilion on top was reconstructed in 2010-2011 by local carpenters. Historic views of the tank provided a sufficient basis for this.

Names	-	
Dated	1647 (according to Sanday 1646)	
Measurements (H x W x D)	Pavilion stone platform:	2.2 x 2.74 x 1.96 m
	Wall thickness:	0.25-0.30 m
Materials/Technology	Base:	Stone, iron
	Seating of wooden pavilion:	Timber, bricks
Interventions (IoC)	Survey	2010
	Mapping	2010
	Sampling	2010
	Analyses	2010
	Conservation	2010-2011
	Maintenance	2011-2014
	Evaluation	2024
Team (IoC)	Gabriela Krist, Manfred Trummer, Marija Milchin, Lisa Gräber, Martina Haselberger, Katharina Fuchs	
Academic Research (IoC)	Pre-Thesis by Susanne Leiner	2011

Survey: Materials and Technology

- Base built of several individual stone blocks
- Two different stones used: sandstone [1] and calcitic schist [2]
- Processing marks on stone blocks: bolster with 5 cm width, carving chisel with a few mm until 1.5 cm width
- Originally not pointed with mineral mortar, fixing with copal resin
- Capping of walls of the pavilion base (seating) made out of a calcitic schist frame, stone blocks still show slots for the original wooden pavilion

Fig. 3: Detail of processing with bolster

Fig. 4: Detail of fine processing with chisel

Fig. 5: Figuratively carved stone block

Fig. 6: Ornamentally carved stone blocks

Fig. 7: Detail of copal glue used for fixing stone pieces (joints)

Previous (Conservation) Interventions

Unkown	Copal/Colophonium (?) for gluing former fractures
Unkown	Completions made of mortar with high cement content and/or pure cement (probably around the late 1950s)
1934-1955	Reconstruction and stabilising work
1956/58	Concrete balustrade was put on top of the stone base and concrete stairs were added (according to the inscription found at the bricks within the ceiling construction)
1987	Repair work in course of the SAARC meetings in Kathmandu
Early 1990s	“Cleaning campaign” and application of synthetic coating (based on acrylics and/or silan/siloxane) done by Italian conservators (oral information from the KVPT)
2005	Pointing of damaged joints with Portland cement (done by the Nepalese Department of Archaeology)
2006/07	Survey and conservation plan by Alessandra Fonzo
2010	Removal of the 1956 introduced balustrade by the KVPT

Fig. 8: Former concrete balustrade 1956-2010

Fig. 9: Detail of former iron clamps

Fig. 10: Former seating, loose bricks / wooden beams

Fig. 11: Mud on top of seating, calcitic schist capping/frame

Survey: Condition and Causes of Decay (2010)

- Problems concerning the seating, especially the wooden beams in combination with bricks alternated with mud (high water retention capacity)
- Missing wooden pavilion accelerates (rain-)water ingress into the stone pavilion base from the top
- Portland cement mortar in joints and applied as a thin layer on surfaces acted as a water vapour barrier
- Surface coating acts as water barrier and turns surface hydrophobic
- Salinization of some stone blocks (nitrate, sulphate)
- Heavily weathered surfaces of some blocks (salts and too dense joint mortar)
- Biological colonization on and underneath (1-2 mm) the stone surface
- Losses and missing parts in exposed areas (corners, details of figures, etc.) and on edges
- Fractures, broken edges, and parts

Fig. 12: Detail of extremely weathered carved stone and cement joint (upper part)

Fig. 13: Detail of surface coating

Fig. 14: Detail of thin cement coating on the surface

Fig. 15: Hydrophobic stone surface due to coating

Conservation (IoC)

2010

- Dismantling of the structure including a detailed plan of every stone block
- Removing of demolishing waste (mud, brick parts, etc.)
- Introducing a foundation made of bricks set in mortar/sand (done by KVPT)
- Introducing a pond liner as horizontal isolation (done by KVPT)
- Mechanical reduction of surface coating with brushes/scalpel and acetone
- Cleaning with water and brushes
- Desalination bath (stone blocks J2, J3, K3, L2 and F1 according to the mapping of Leiner 2010)
- Exchange of highly salt damaged stones – new stone blocks were made by craftsmen of KVPT
- Biocide treatment (quaternary-ammonia-salts 2% in water), repeated 2-3 times
- Reassembling of the dismantled parts and introduction of a ring of inox clamps to form a ring bracing (earthquake resilience) – completed by craftsmen of KVPT
- Repointing of joints by craftsmen of KVPT

Conservation Materials* and Recipes used:
- QUATS (quaternary-ammonia-salts 2% in water)
- Acetone
- Inox clamps

* Product / technical data sheets can be found in the supplement [A]

2011

- Removing of damaged and unsatisfactory joint mortar until a depth of 3-4 cm
- Mechanical removal of mortar remnants on stone surface with glass fibre pencil and scalpel
- Biocide treatment (quaternary-ammonia-salts 2% in water), repeated 2-3 times
- Repointing of joints with joint mortar; locally available green pigment was added to adjust the colour (pigment was tempered in water and alcohol; fluid colour was added to slaked lime before mixing it with the brick dust); scratching-off the joints on surface level of the stone
- Introducing calcitic schist/marble stairwways on each side and a calcitic schist/marble seating for the wooden pavilion (done by KVPT)
- Reconstruction of the wooden pavilion (done by KVPT)
- Introducing six stone slides at the balcony to elevate the balustrade approx. 2 cm (together with the craftsmen of KVPT)
- Introducing inox needles and clamps to fix the cornice stone blocks at the balcony balustrade

Conservation Materials* and Recipes used:
- QUATS (quaternary-ammonia-salts 2% in water)
- Inox needles and clamps

Joint mortar: 1 vol. part lime : 3 vol. parts brick dust
- Slaked lime (local)
- Brick dust 0-3 mm, finer parts with 0-1 mm and coarser ones with 0-3 mm grain size distribution (local)
- Pigment “Iron-oxide pigment – green” (local)

* Product / technical data sheets can be found in the supplement [A]

2014

- Partial retouching of stones next to the joints with silicate paint and ochre pigments

Conservation Materials* and Recipes used:

Silicate paint mixed with Triokat Color and water (1:1)
- Silicate paint Adler Silikatfarbe GKW
- Adler Triokat Color W 10
- Clayé Feinste Künstler Pigmente: Terre Naturali

* Product / technical data sheets can be found in the supplement [A]

Fig. 16: Desalination within water bath with rainwater

Fig. 17: Removing former (cement) mortar

Fig. 18: Inox clamps

Fig. 19: Pointing joints

Fig. 20: Mortar filling

Fig. 21: Reducing mortar residues

Before and after Conservation

Fig. 22: North side of Pavilion Base before conservation, 2010 (© KVPT)

Fig. 23: North side of Pavilion Base after conservation, 2014

Fig. 24: South side of Pavilion Base before conservation, 2010 (© KVPT)

Fig. 25: South side of Pavilion Base after conservation, 2014

List of Publications / Reports (IoC)

Leiner, Susanne. 2010. „Der Pavillon am Bhandarkhal-Tank. Palastkomplex Patan, Nepal." Unpublished Pre-Thesis, University of Applied Arts Vienna.

Milchin, Marija, Krist, Gabriela, and Lisa Gräber. 2013. "Conservation Case Studies from the Patan Royal Palace, Nepal. An International and Interdisciplinary Story." In *Interdisciplinarita v péči o kulturní dědictví. Sborník z conference,* edited by Petra Hečková, Petr Horák and Luboš Machačko, 113-131. Pardubice: Univerzity Pardubice.

Fuchs, Katharina. 2014. "The Royal Palace in Patan, Nepal. Evaluation of the Conservation Treatments and Recommendation for a Maintenance Program." Unpublished Diploma-Thesis, University of Applied Arts Vienna.

Supplements

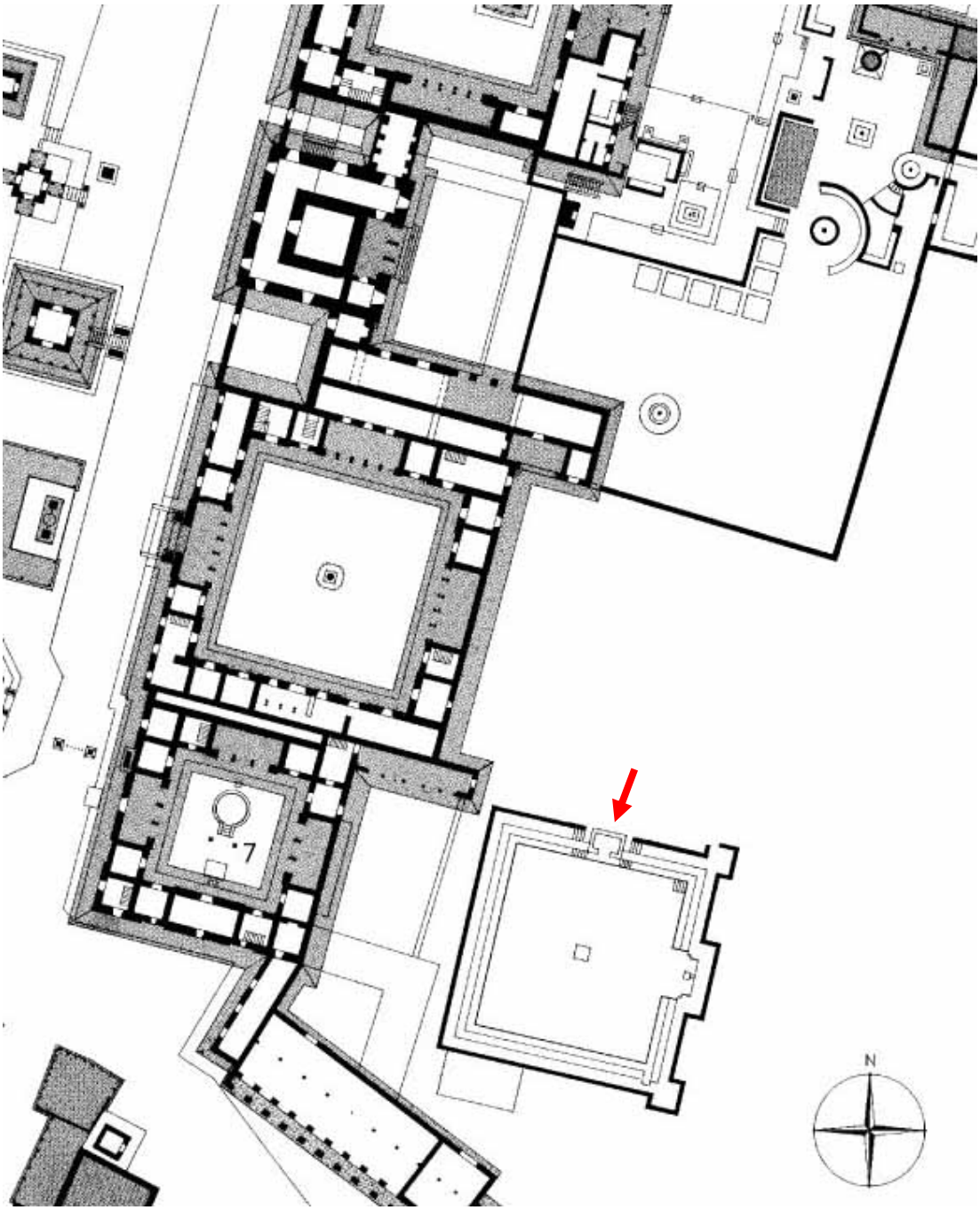
[A] List of all product / technical data sheets

[1] Detailed material characterisation - sandstone

[2] Detailed material characterisation - calcitic schist

Photo Credits

GENERAL INFORMATION		
Monument Bhandarkhal Tank Pavilion Base	**Orientation** North side of Bhandarkhal Tank	**Size (H x L x W)** 220 x 274 x 196 cm
Date of Production 1674 (?)	**Location** Royal Palace Gardens	
Date of the last Treatment Conservation 2014: see short report	**Institutions of the last Treatment** IoC	



Condition Assessment		
Date of Evaluation May 2024	**Evaluation done by** Martina Haselberger Fabian Sever Sarah Moyschewitz	
Recent Damages:		
☐ Stability Problems ☒Not detected	☐ Major ☐ Medium ☐ Minor	
Comment:		
☐ Broken / - into several Pieces ☒Not detected	☐ Many ☐ Some ☐ Few	
Comment:		
☒ Lose / Missing Parts ☐Not detected	☐ Many ☐ Some ☒ Few	Surface erosion of already weathered surface Mostly east and southside (Fig. 1, 2)
Comment:		
☒ Joints ☐Not detected	☒ Open ☒ Cracked	☐ Many ☐ Some ☒ Few ☐ Many ☐ Some ☒ Few At the edges to the stone (Fig. 3, 4)
Comment:		
☒ Scaling, Sanding or Powdering ☐Not detected	☐ Major ☐ Medium ☒ Minor	Minimal scaling is present at areas with remnants of surface coating (Fig. 5).

		Mostly on the south side and upper part of relief stones at heads height)	
Comment:			
☒ Biological Colonization ☐Not detected	☒ Microbiological Growth	☐ Major	
		☒Medium	Mostly on the balustrade and the stairs at the east and west side (Fig. 6)
		☐ Minor x	
	☒ Mosses	☐ Major	
		☒Medium	On the balustrade (Fig. 7)
		☐ Minor	
	☒ Higher Plants	☐ Major	
		☐Medium	
		☒ Minor	
Comment:			
☒ Mechanical Damage ☐Not detected	☒ Abrasion	☐ Major	
		☐Medium	
		☒ Minor	Mostly on the west side, minor mechanical damage from harsh cleaning
	☐ Other	☐ Major	
		☐Medium	
		☐ Minor	
Comment:			
☒ Salt Deterioration ☐Not detected	☒ Efflorescence	☐ Major	
		☐Medium	
		☒ Minor	Some joints and some stone blocks at ground level on the east- and west side show minor salt deterioration; also inside on the floor stones and up until ground level height (Fig. 6, 7).
	☒ Subflorescense	☐ Major	

		☐Medium	
		☒ Minor	Some joints on the east side show minor subflorescence.
Comment:			
☒ Soiling ☐Not detected	☐ Heavy		
	☐ Medium		
	☒ Light	Light soiling on areas not protected by the pavilion roof; blackening on the south side, from the balcony floor up to 30 cm.	
Comment:			
☐ Other	Comment:		

Evaluation of the Condition

☒ good (no need for treatment)

☐ satisfactory (some minor treatments necessary)

☐ unsatisfactory (major conservation measures necessary)

Conclusion

The joint mortar is in good condition with some cracks along the edges of the joints. Silicate paint retouching of the joints is powdering off in most areas (Fig. 8, 9).

Cracks in the middle and left side of the arch on the south side may be from settlement of the structure.

The general surface condition is good, no recent loss was obvious.

Inox pins and clamps at the balustrade are in good condition, although the mortar on top has mostly chipped off (Fig. 10, 11).

PHOTO DOCUMENTATION

Condition at Evaluation Date

Fig. 1: Surface loss, erosion.

Fig. 2: Surface loss, erosion.

Fig. 3: Joints cracked along the edged to the stone.

Fig. 4: Joints cracked along the edged to the stone.

Fig. 5: Scaling on stone surface.

Fig. 6: Salt efflorescence on the inside of the pavilion base.

Fig. 7: Salt efflorescence causing material loss.

Fig. 8: Powdering of joint retouching.

Fig, 9: Powdering of joint retouching revealing pinkish joint mortar.

Fig. 10: Inox pins at the balustrade with chipped off mortar.

Fig. 11: Inox pin.

[A] Product Data Sheets – Links[1] to Suppliers/Manufacturers

AEROSIL® 200
https://products.evonik.com/assets/or/ld/AEROSIL_200_TDS_DE_DE_TDS_PV_52043839_de_DE_WORLD.pdf

Aviva Silikat Grundierung
https://www.adler-lacke.com/Canto/tmb/aviva-silikat-grundierung_tmb_4079_de.pdfA
Alkylbenzyldimethylammonium chloride
https://www.sigmaaldrich.com/AT/en/sds/mm/8.14858?userType=anonymous

Klucel™ EF
https://www.kremer-pigmente.com/elements/resources/products/files/63701-63713.pdf

Aviva Tirokat-Color, Adler
https://www.adler-lacke.com/Canto/tmb/aviva-tirokat-color_tmb_4087_de.pdf

Mixtion Le Franc, Kremer
https://shop.kremerpigments.com/elements/resources/products/files/98000e.pdf

Waxes, Deffner und Johann
https://deffner-johann.de/media/datasheets/4186000/EN/Zusatzinformation_Wachse_DE_DJ.PDF

Injection mortar HFX
https://productdata.hilti.com/APQ_HC_RAW/ASSET_DOC_7567931.pdf

Kölner Classic Ölmixtion 3h; 12h; 24h
https://www.kolner-vergolderprodukte.de/produkte/koelner-oelmixtion/

KSE 500 E
https://media.remmers.com/celum/export/documents/Remmers_0715_KSE-500-E-_Technisches-Merkblatt_de_DE_26355.pdf

Lascaux 498 20 X acrylic adhesive
https://deffner-johann.de/media/datasheets/2051100/DE/2051100_Technisches%20Datenblatt_Lascaux%20Acrylkleber%20498%2020%20X_DE_DJ.pdf

Marble dust
https://www.kremer-pigmente.com/elements/resources/products/files/58500-58580_59001-59690.pdf

Natural hydraulic lime
https://www.preservationworks.us/wp-content/uploads/2019/10/NHL-Datasheet-Lafarge-23.5.pdf

Plextol B-500 (acrylic dispersion)
https://deffner-johann.de/media/datasheets/2556500/DE/2556500_Technical%20Data%20Sheet_Acrylic%20Dispersion%20B%20500_EN_DJ.pdf

Primal® SF 016
https://deffner-johann.de/media/datasheets/2543001/DE/2543001_Technical_Data_Sheet_Primal_SF_016_DJ_EN.pdf

AKEPOX® 2010
https://data.akemi.de/fileadmin/user_upload/products/productdocuments/TMB/Akepox_2010_TMB_D.pdf

[1] All links were last accessed on 13 May 2025.

EPO-TEK® 301-1
https://www.epotek.com/docs/en/Datasheet/301-1.pdf

Titebond Wood Glue
http://sds.franklini.com/msds/1411.042k0nmo0020.pdf

Paraloid™ B-72, Kremer
https://www.kremer-pigmente.com/elements/resources/products/files/67400-67409.pdf

Keim Granital®
https://www.keim.com/documents/de-AT/723/TM_Granital_DE-AT.pdf

[1]“Sandstone”	
Visual characteristics	- Fine and homogenous grain structure - Whitish to ochre colour
Samples taken (sample names and origin)	- **KAT2**, (Leiner 2010) Bhandarkhal Tank Pavilion Base (Fig. 3, 4) - **KRP Original** (Fuchs 2013), Stone Gate, Patan Darbar Square (Fig. 5–9) Cross and thin sections of the samples were prepared and examined with light microscopy and SEM. **Sources**: Leiner, Susanne. 2010. “Der Pavillon am Bhandarkhal-Tank. Palastkomplex Patan, Nepal.” Pre-thesis, University of Applied Arts Vienna. Fuchs, Katharina. 2013. “Bitumen Coating on Stone, a Nepalese Problem? The Conservation of Two Stone Relief Gates at the Nasal Chowk, Patan Royal Palace.” Pre-thesis, University of Applied Arts Vienna.
Petrographic/geological characterization	- quartz sandstone ("arkose" sandstone) - rich in feldspar - silica grains angular, interlocked and covered by layers of iron oxides/hydroxides and clay - clayey binder (contains mostly sheet silicates) - different amounts of iron-compounds with sheet structure - fine grained with average grain size of 50 µm, coarse grain fraction with 250 µm
Physical properties	- varying porosity but in general highly porous, 20–25% porosity (Leiner 2010, S. 62), intergranular porosity - capillary active - varying colours and weathering behaviour due to different clay and iron content - homogenous structure with some bedding - relatively soft
Use at Patan Darbar Square	Scientifically confirmed: - Stone Gates - Bhandarkhal Tank By visual inspection only: - Harishankara temple base - Vishveshvara temple base and elephants - Krishna Mandir - Tusha Hiti - Mul Chowk Lions
Origin of material	- unknown

Fig. 1: Visual inspection of the sandstone from Bhandarkhal Tank Pavilion Base, © IoC 2010.

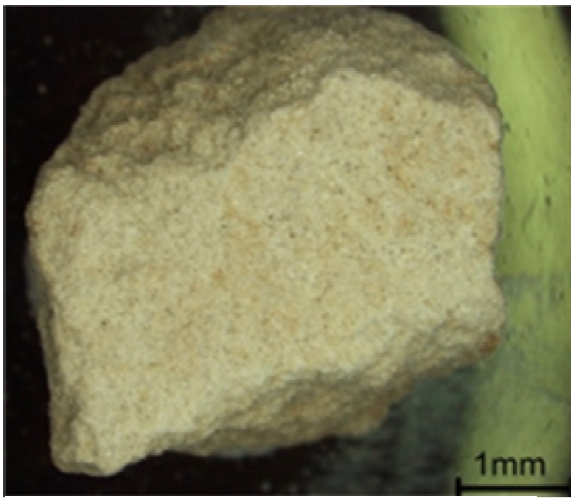


Fig. 2: Visual inspection of the sandstone from Bhandarkhal Tank Pavilion Base, © IoC 2010.

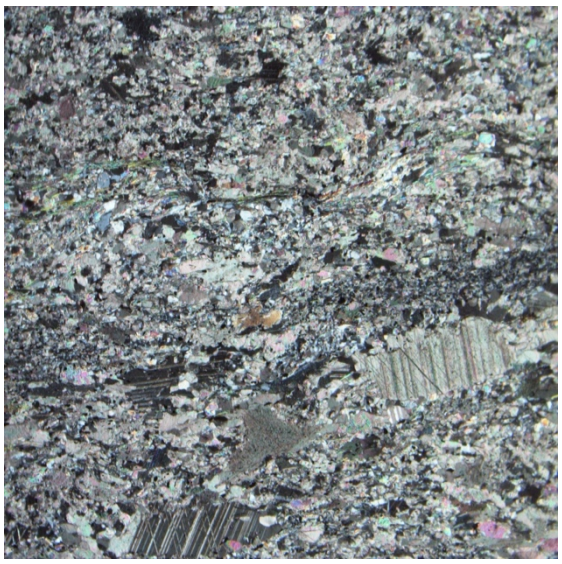


Fig. 3: Sample KAT2, thin section, optical microscopy, polarized light, x24.

Fig. 4: Sample KAT2, thin section, optical microscopy, transmitted light, x24.

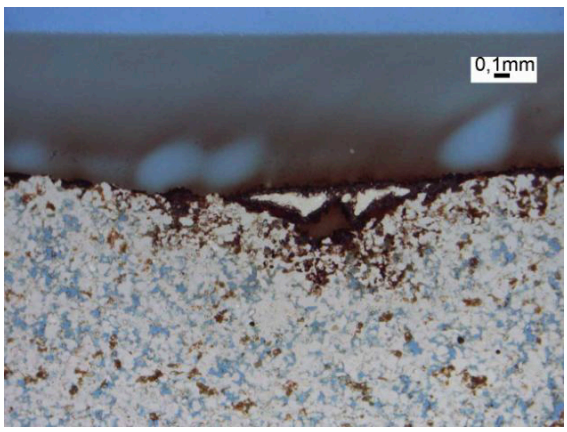


Fig. 5: Sample KRP Original, polished thin section, stereo microscope (Nikon SMZ 1500), reflected light, polarized light. The sample shows stone with bitumen coating.

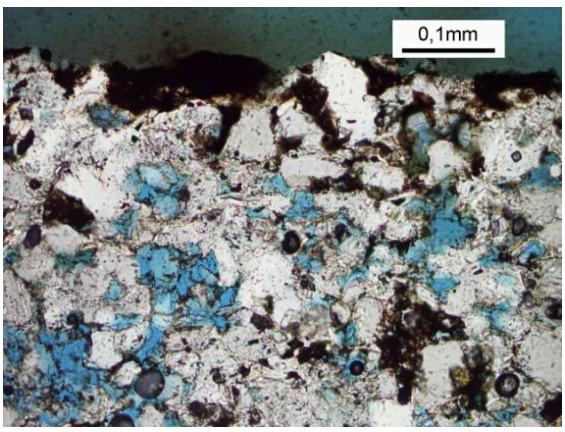


Fig. 6: Sample KRP Original, polished thin section, stereo microscope (Nikon SMZ 1500), reflected light, polarized light. The sample shows stone with bitumen coating.

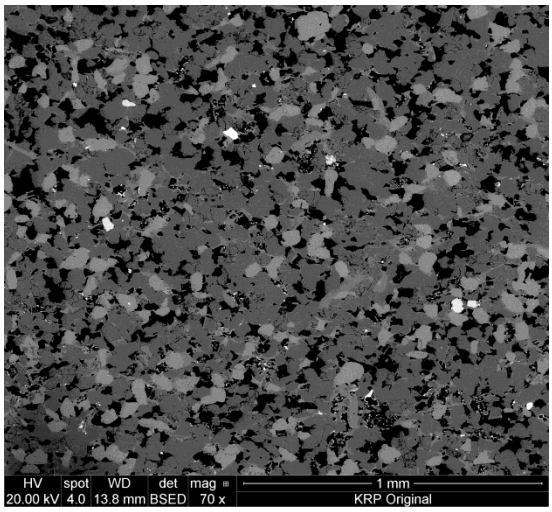


Fig. 7: Sample KRP Original, SEM; description: black = pores, dark grey = quartz, light grey = feldspar, white spots= Fe-(hydr)oxides.

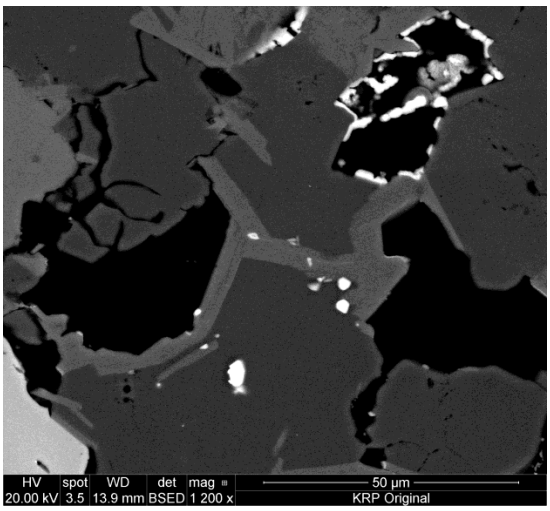


Fig. 8: Sample KRP Original, SEM; description: black = pores, dark grey = quartz, light grey = feldspar, white spots= Fe-(hydr)oxides.

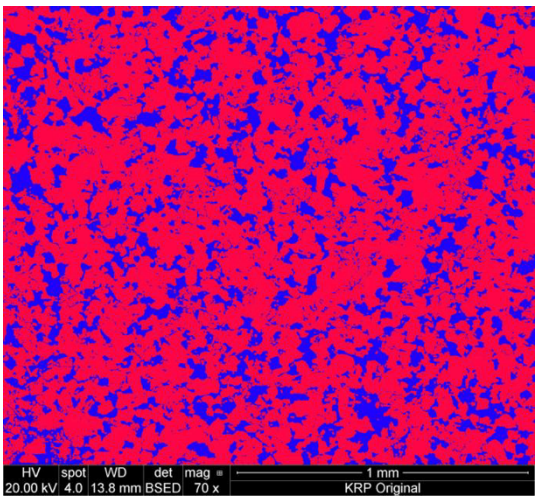


Fig. 9: Sample KRP Original, SEM photo of thin section in false colours (red = grains, blue = pores).

[2]“Calcitic schist”

Description of visual characteristics	- light grey to almost black colour - occasional white inclusions with reddish center - characteristic schist surface with homogeneous foliation and inclusions
Samples taken (sample name and origin)	- **KAT1** (Leiner 2010), Bhandarkhal Tank Pavilion Base (upper covering) (Fig. 3, 4) - **P06, P07** (Kaipf 2017), Yoganarendra Pillar (Fig. 5–16) - **NEP_ST_1** (Haselberger/Fuchs 2023), loose material around Royal Garden workshop (Fig. 17–22) Cross and thin sections of the samples were prepared and examined with light microscopy and SEM. **Sources**: Leiner, Susanne. 2010. “Der Pavillon am Bhandarkhal-Tank. Palastkomplex Patan, Nepal.” Pre-thesis, University of Applied Arts Vienna. Kaipf, Luis. 2017. “The Pillar of Yoganarendra Malla. Condition Survey, Conservation Treatment and Re-erection.” Pre-thesis, University of Applied Arts Vienna. Johannes Weber, Katharina Fuchs, Martina Haselberger. 2023. Scientific investigation of the stone sample NEP_ST_1 from Patan Royal Garden Workshop. Unpublished report, Institute of Conservation, University of Applied Arts Vienna.
Petrographic/geological characterization	- weakly metamorphic schist, predominantly calcareous - high concentration of silicates arranged in foliations, surrounded by a very fine-grained siliceous marble - homogenous matrix and slight banding - average grain size of major calcite crystals between 0.03–0.05 mm; 0.05–0.25mm for silicate crystals - minor components of Phlogopite mica (grain size 0.1–0.2mm) - grain borders linear or curved - analyzed sample displays shear zone of ore minerals or graphite
Pyhsical properties	- relatively dense and heavy material - almost no water absorption
Damage patterns	- (hair) cracks and loss of material due to mechanical stress – probably stone intrinsic due to metamorphosis - almost no water related damage
	Scientifically confirmed: - Pillar Yoganarendra Malla - Bhandarkhal Tank Pavilion Base (upper covering)

Use at Patan Darbar Square:	By visual inspection only: - Lion Pillar - Garuda Pillar - Harishankara Temple Base (cornerstones with lion protomes, inner threshold) - Kings Throne - Stone Gates (inner profile) - Tusha Hiti - Visveshvara Temple Base (cornerstones with lion protomes, inner threshold)
Probable origin of material:	- Probably mined in the Kathmandu Valley – the alluvium filled Kathmandu Valley is bordered by a sequence of unmetamorphosed to slightly metamorphosed sedimentary rock in the east, south and west - Most probably from the southern part of the Kathmandu Valley, according to the geological map (Himalayan Maphouse [Ed.] Comprehensive Geological Map, GL701), possibly associated with the Chandragiri Formation. - According to the map, the stone from the Chandragiri Formation is defined as following: *"light fine grained crystalline limestones partly siliceaus thick to massively bedded white quartzites in upper parts. Wavy limestones contain late ordovician schinoderms."*

Fig. 1: Upper stone covering of Bhandarkhal Tank Pavilion Base, © IoC, 2010.

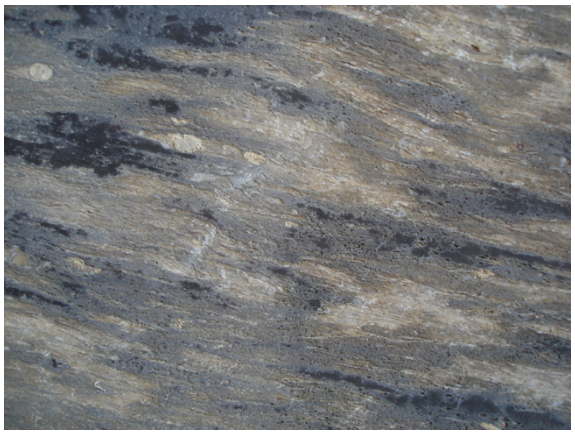


Fig. 2: Visual inspection of stone from Yoganarendra Malla Pillar, © IoC, Kaipf, 2017.

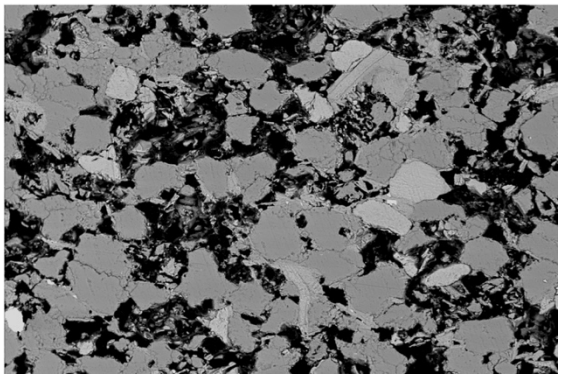


Fig. 3: Sample KAT1BS1, thin Section, SEM BSE.

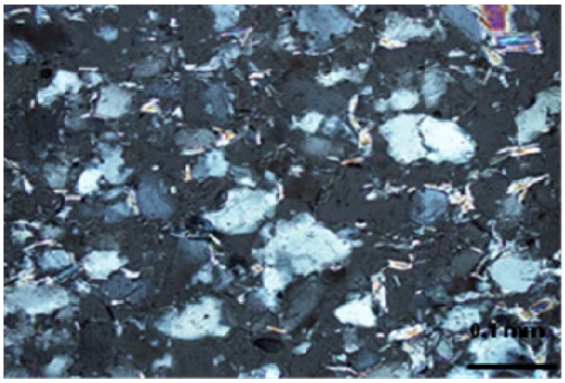


Fig. 4: Sample KAT1, thin section, optical microscopy, x200.

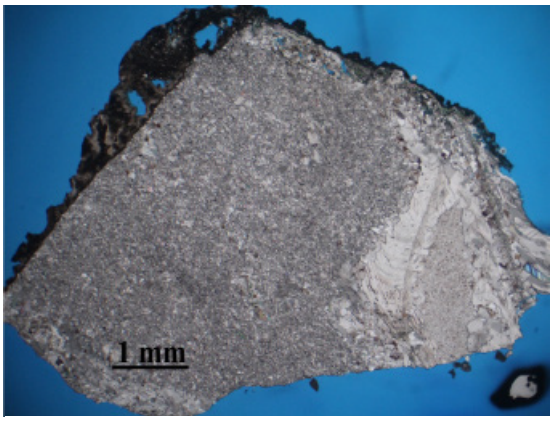


Fig. 5: Sample P06, thin section, optical microscopy, x24.

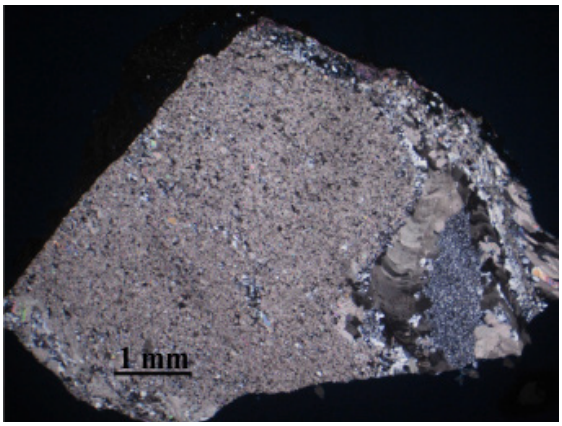


Fig. 6: Sample P06, thin section, optical microscopy, x24.

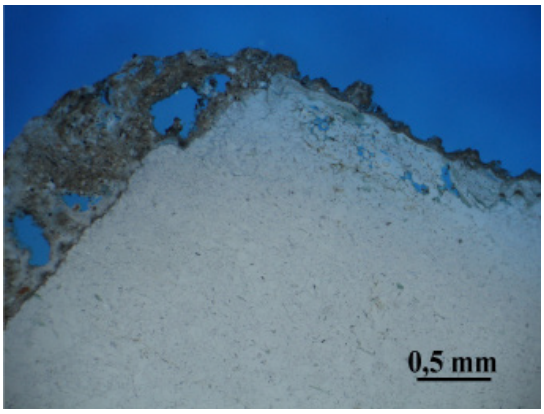


Fig. 7: Sample P06, thin section, optical microscopy, x48.

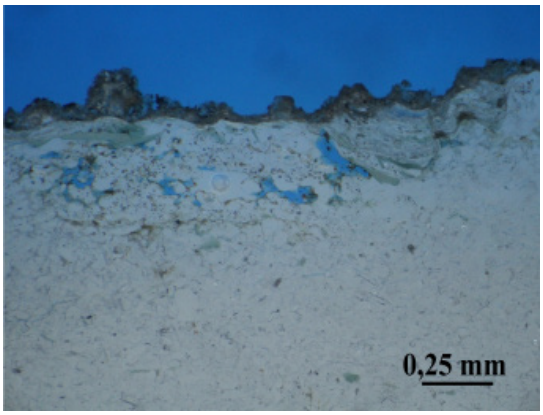


Fig. 8: Sample P06, thin section, optical microscopy, x48.

Fig. 9: Sample P07 taken in 2016, Lotus ring, Pillar of Yoganarendra Malla, Kaipf 2017.

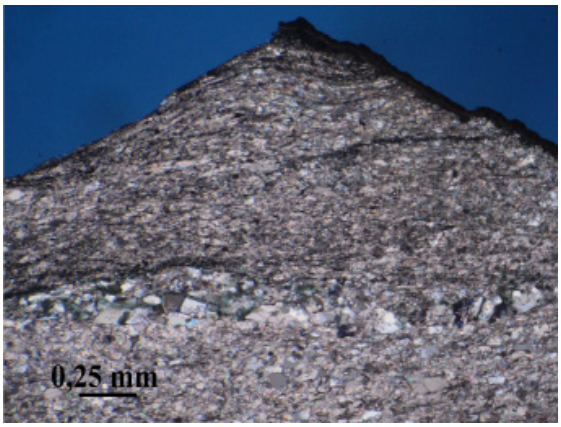


Fig. 10: Sample P07, thin section, x72. Fabric with relatively homogenous matrix and slightly developed banding.

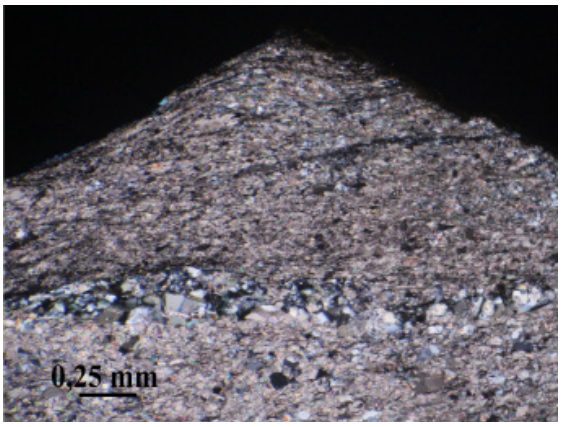


Fig. 11: Sample P07, thin section, x72.

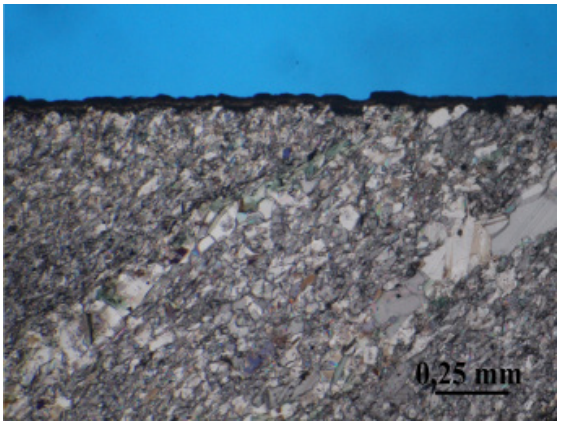


Fig. 12: Sample P07, thin section, x90.

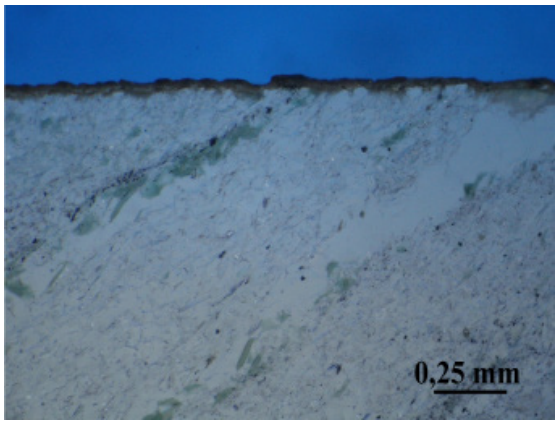


Fig. 13: Sample P07. thin section, x90.

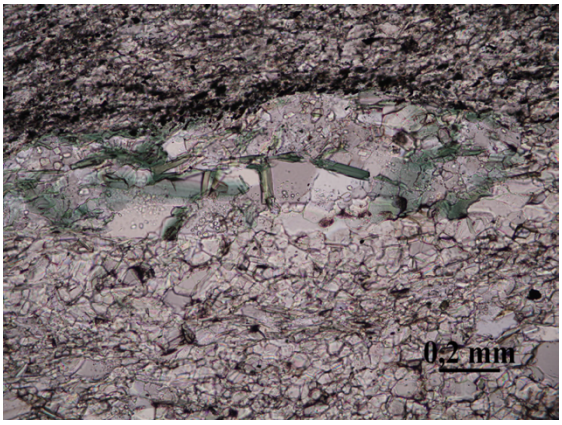


Fig. 14: Sample P07, thin section, x100; Phlogopite.

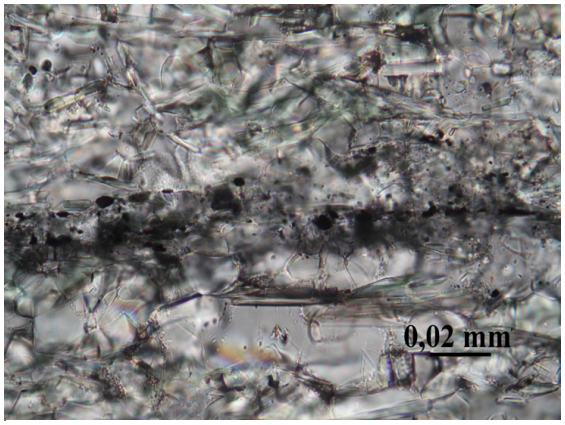


Fig. 15: Sample P07, thin section, x1000; Shear zone.

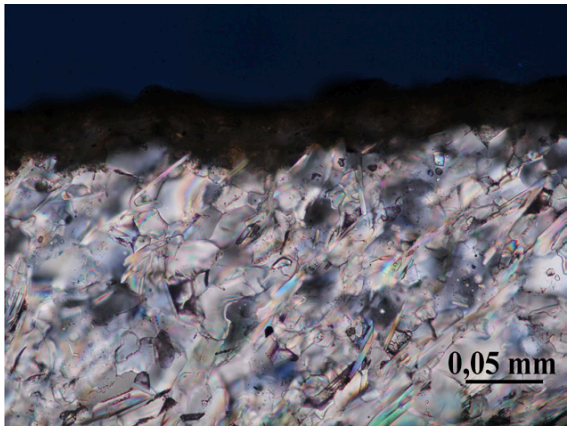


Fig. 16: Sample P07, thin section, x500. Equigranular grain aggregate with mainly polygonal grain forms.

Fig. 17: Sample NEP_ST_1.

Fig. 18: Sample NEP_ST_1.

Fig. 19: Sample NEP_ST_1, Nikon SMZ 500, transmitted light, crossed polarizers. Overview of the rock matrix with coarser and finer layers.

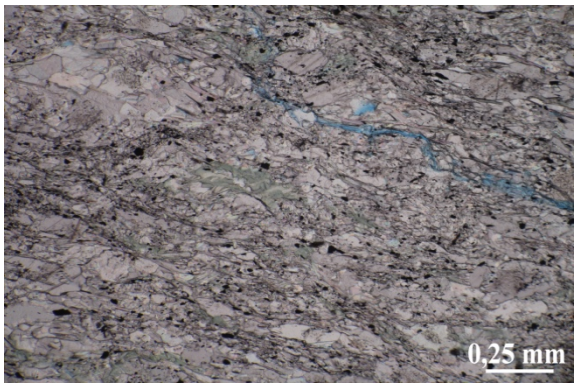


Fig. 20: Sample NEP_ST_1, Nikon SMZ 500, transmitted light, parallel polarizers. Detailed view of the matrix.

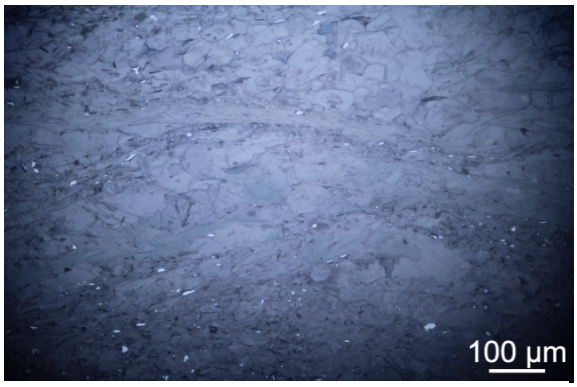


Fig. 21: Sample NEP_ST_1, Olympus BX40, incident light, bright field. Overview of mica inclusions (whitish spots).

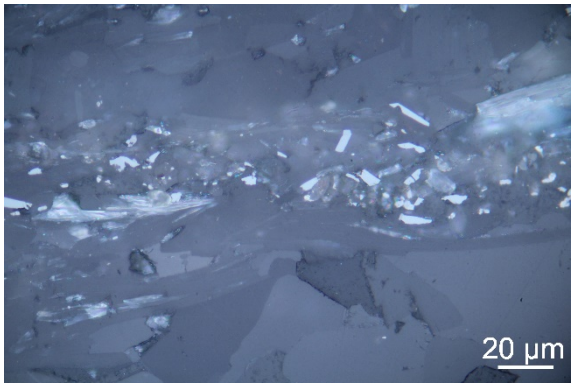


Fig. 22: Sample NEP_ST_1, Olympus BX40, incident light, bright field. Detail of a fine layer with mica flakes.