PILLAR OF YOGANARENDRA MALLA

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

Fig. 1: Overview of the Pillar of Yoganarendra, 2017

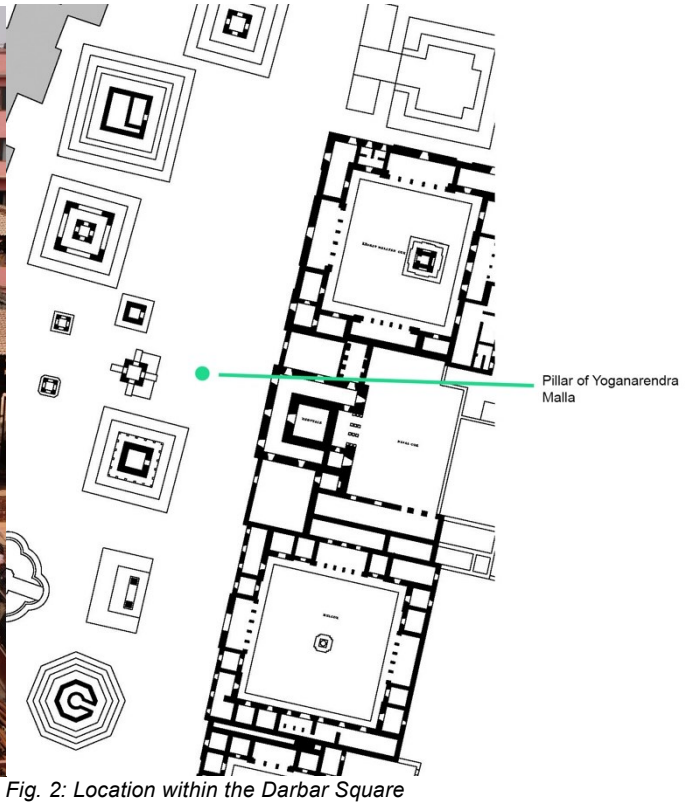

Fig. 2: Location within the Darbar Square

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Data Sheet

Description

The Pillar of Yoganarendra Malla is a landmark of the city of Patan, prominently positioned at Darbar Square opposite of the Royal Palace. Erected by King Yoganarendra around 1700, it consists of a multi-piece, eight metres high pillar, made of a locally available metamorphic calcitic schist. The fire-gilded metal sculpture on top depicts the king himself in devotional attitude consorted by his two wives and sheltered by a divine serpent (naga); a bird is sitting on the naga's head. The king is sitting on a lotus, holding his hands in front of his chest in praying posture, wearing elegant clothes and a hat on his head, two swords in his belt and a shield next to him.
After having survived the earthquake in 1934, the prominent monument collapsed in the course of the earthquake 2015. Only the lowest portion of the shaft remained standing. The stone parts above fell down and were only slightly damaged, whereby cracks and fissures within the stone matrix as well as small losses are visible. The metal sculpture suffered from severe deformation. In 2016, the stone pillar could be conserved and re-erected. In spring 2017, conservation work on the metal sculptures, which started in 2016, could be concluded and the ensemble re-installed on top of the pillar.

Names	Yoganarendra Stambha, Yoganarendra Pillar	
Dated	Around 1700	
Measurements (H x W x D)	Total Height	H = c. 8.2 m
	Max. diameter	Ø = 1.27 m
	Height of pillar without plinth and sculpture: 7.23 m	
	Height until lotus ring without plinth and gilded metal elements 4,86 m Stone pillar: 486 x 30 x 34 cm Stone plinth (altogether four stone blocks): 10 x 105 x 105 cm	
Materials/Technology	Calcitic schist, gilded copper, iron	
Interventions (IoC)	Survey	2015-2016
	Mapping	2016-2017
	Sampling	2016
	Analyses	2016-2017
	Conservation	2016-2017
	Maintenance	-
Team (IoC)	Gabriela Krist, Marija Milchin, Johannes Falkeis, Kathrin Schmidt, Martina Haselberger	
Academic Research (IoC)	Pre-Thesis by Luis Kaipf	2017

Survey: Materials and Technology

- Monument comprises six parts: foundation; four stone elements, connected with different types of stone dowels; fire gilded copper sculptures
- Foundation: depth of 150 cm, more than eight brick layers piled up with mortar, in addition two stone belts keep the pillar shaft in the ground in position, each stone belt is made of six stone blocks, partly spolia (dimensions of the stone blocks are c. 12 x 114 x 30 cm (H x W x D)), upper belt is loosely attached to the pillar in contrast to the one below, which is fixed in the brick layers

Stone pillar:

- Calcitic schist [2], processed with hammer and chisel
- Pillar itself is divided in four constructive parts (square shaft, octagonal shaft, cylinder and lotus shaped bowl)
    1. Square shaft: area measuring 66 x 63 cm, height of 472 cm, at the top stone dowel in cylindrical form (Ø 20 cm, H = 11 cm)
    2. Octagonal shaft: area measuring max. 65 x 68.5 cm, height of 128 cm, square ornamented base (protruding sculpted wave frieze) transforms into octagonal and further into cylindrical shape, at the bottom negative mould for stone dowel of square shaft, at the top cylindrical part / dowel (Ø 63.5 cm, H = 3,5 cm)
    3. Cylinder: max. diameter of 100 cm and height of 63 cm, round area changing to a wider circular pedal strip with 18 spheres lined together (Ø 18 cm), at the bottom negative mould (Ø 39 cm, H = 10 cm), at the top negative mould for probable loose cylindrical stone dowel which was lost after the earthquake in 2015 (Ø 22 cm H = 9.5 cm)
    4. Lotus shaped bowl: max. diameter of 127 cm and height of 60 cm, three upturned lotus petal, bowl inside hollow for weight reduction, at the bottom negative mould for the probable loose stone dowel (Ø 20 cm, H = 3.8 cm)
- Original method of construction most probably a simple plug-in system, whereby upper three stone parts are placed above each other kept in place by small stone dowels (dowels were largely lost after earthquake 2015)
- Two iron belts were superimposed between the two shaft elements and between the octagonal shaft and cylinder (probably later addition)
- Colophony was used as gluing media or for fixing the joints

Metal sculptures:

- Seven main parts: king, two wives, big naga, small naga with five heads, small ornate frame and the base lotus; each part again consists of multiple elements
- King is made of eight components and smaller accessories (belt, shield, swords, etc.)
- Both wives are made of four components and additional jewellery applications;
- Big and small naga consist each of three components, whereas the big one has a bird on its head
- Small ornate frame consists of fourteen components
- Lotus consists of approximately eight components
- Main parts of the sculptures, frame and lotus made of hammered, chased and fire gilded copper sheet; smaller parts, as hands, feet, ears, and jewellery applications (flowers and necklaces) are casted, fire-gilded brass
- Individual metal components are held together with plugging system with split pins and rivets
- Sculptures were fixed on the pillar with a complex iron rod plugging system

Fig. 3: Processing marks, 2016

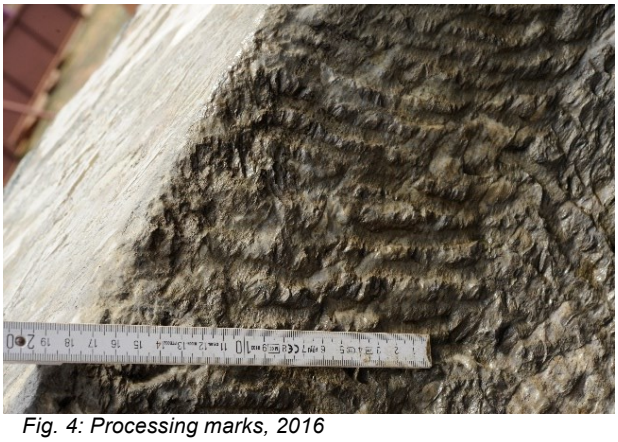


Fig. 4: Processing marks, 2016

Fig. 5: Remnants of colophony, 2016

Fig. 6: Overview of foundation, 2016

Fig. 7: Detail of foundation with pillar, 2016

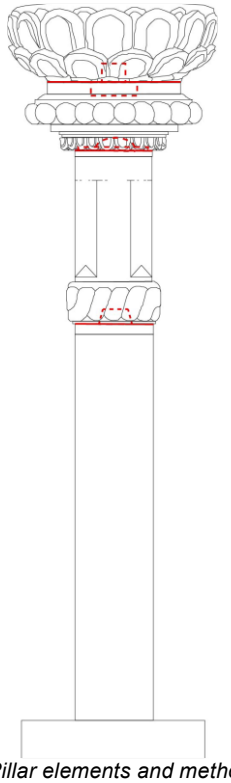


Fig. 8: Pillar elements and method of construction (dowels and joints in red)


Fig. 9: Spolia in foundation, 2016


Fig. 10: Two fixed split pins, 2016

Previous Interventions

-

Survey: Condition and Causes of Decay (2015-2016)

Stone pillar:

- Collapse during the earthquake in 2015, only the square shaft remained standing
- Cracks until a depth of 13 cm (due to ultrasonic pulse velocity measurements)
- Missing parts – only a small edge of the second element was smashed through the impact of collapsing;
- Soiling (pigeon droppings, dust and other deposits such as greasy layer, wax remnants)

Metal sculptures:

- Heavy deformations on all metal elements due to falling of the pillar during the earthquake 2015;
- Assembly connections partly loose or lost
- Voids and cracks due to falling during the earthquake
- Iron rods of the substructure connecting the sculpture with the stone pillar are highly corroded and deformed due to the earthquake
- Missing of original supporting construction
- Soiling (thick layers of dirt, dust and deposits)
- Partial corrosion
- Large areas without original fire-gilding (weathered) but only soiled copper

Fig. 11: Partly collapsed stone pillar, 2016

Fig. 12: Visible Crack, 2016

Fig. 13: Graffiti, 2016

Fig. 14: Collapsed upper elements of pillar, 2016

Fig. 15: Broken part (cylinder) due to collapse, 2016

Fig. 16: April 2015 (© Suresh Man Lakhe)

17: Deformed sculpture of the king, 2016

Fig. 18: Cracks, 2016

Fig. 19: Big crack, 2016

Fig. 20: Deformed naga and soiled surface, 2016

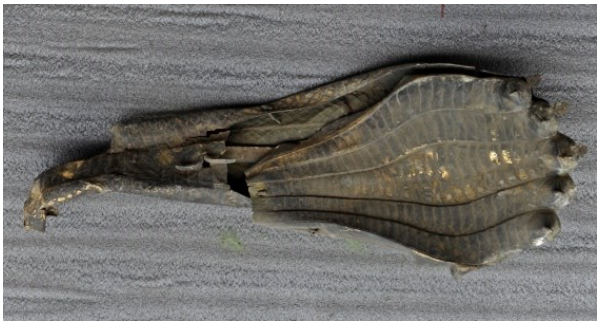


Fig. 21: Deformed nagas and soiled surface, 2016

Fig. 22: Deformed back of the queen's head, 2016

Fig. 23: Torn rivet and soiled surface, 2016

Fig. 24: Deformed elements of ornate frame, 2016

Conservation (IoC)

2016

Stone:
- Closing of cracks (pre-cleaning with scalpel and brushes in combination with water) with epoxy resin (EPO-TEK) injections by using syringes, repeated several times
- Pinning of two deeper cracks with four carbon fibre rods (diameter 10 mm, length 500 mm) fixed with injection mortar based on polymethyl methacrylate and three different methacrylates (Hilti injection hybrid mortar HFX)
- Broken off edge of the pillar shaft was replaced by stone indent glued with epoxy resin
- Cleaning with water and surfactant (dish detergent)
- Mechanical removing of sticky soiling with scalpel
- Removing of remnants of wax and oily residues of worshipping with white spirit
- Removing of graffiti with acetone poultices
- Mechanical reduction of crusts by hammer chisel and rasps
- Reassembling by using a crane (and a temporary introduced hanging system at the lotus bowl), in addition following measures were done to strengthen the structure while avoiding to make it too rigid and stiff:
    - ○ two new stones dowels (shape of flat hemisphere and cylindrical) made out of calcitic schist were introduced to replace the lost ones
    - ○ four stainless steel reinforcements (three connecting the two pillar shaft pieces, one connecting upper shaft, cylinder and lotus shaped bowl) were introduced and fixed on one side only with epoxy resin (Akepox) respectively to avoid stiff connections
    - ○ lead sheets were inserted between the pillar elements to allow large contact area (without mortar or glue; not possible between second and third stone element)
    - ○ dashes of hybrid mortar were inserted between the pillar elements
- Existing iron belts were reformed and shortened

Conservation Materials* and Recipes used:
- Epoxy resin EPO-Tek® 301-1
- Epoxy resin Akepox® 2010
- Hilti® injection hybrid mortar HFX
- Acetone
- White spirit
- stainless steel rods
- lead sheets

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

2017

Fire-gilded sculptures:
- Complete dismantling and removal of old substructure (together with the local copper smith and the KVPT)
- Dry cleaning with brushes
- Wet cleaning with surfactant (dish detergent), subsequent cleaning with water and drying
- Cleaning with citric acid (1:10) diluted in water, metal elements put in bath or citric acid applied with poultices (exposure time between 4-10 minutes), subsequent cleaning with water and immediate drying with cotton cloths
- Rectification of deformed parts by the local coppersmiths in order to regain the original shapes and to make the parts fit together again; rectification preferably by using rubber or skin hammers, some parts had to be reshaped by using heat (naga, torso of the king) and some larger parts (arms of king) had to be cut to make internal space accessible for rectification, cut pieces were weld afterwards

- Closing of cracks and holes by using pigmented epoxy resin (Akepox) mixed with a filler (Aerosil);
- Re-gilding of visible welding seams and surfaces where fire gilding was worn off or lost in the process of reshaping and rectifying with gold leaves (Dukaten Doppelgold), pre-cleaning with acetone where regilding was necessary, applying gold leaves with an adhesive based on linseed oil (Mixtion)
- Partial reduction of regilding with acetone
- Application of a protective layer over regilded areas with acrylic resin (Paraloid B 72, 20% in acetone) coloured with umber pigments
- Introducing a new substructure (done by the craftsmen of the KVPT) for applying the lotus ornate frame
- Re-assembling the sculpture: new copper sheets were mounted underneath the lotus ornate frame, a new circular copper sheet was placed on top of the substructure acting as base plate for the sculpture, majority of the supporting structural elements of the sculpture could be preserved and was reused after being painted with red lead, single parts of the substructure and sculpture where fixed by either wedging with wood or with hooks, or screws (gilded)
- Re-assembled sculpture was lifted on the pillar using a crane
- Final retouching on site

Conservation Materials* and Recipes used:
- Epoxy resin Akepox® 2010
- Aerosil
- Mixtion LeFranc 3h
- Dukaten Doppelgold
- Acrylic resin Paraloid B 72, 20% in acetone
- Umber pigments

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

Fig. 25: Cleaning the stone elements with water, 2016

Fig. 26: Re-forming the iron belts, 2016

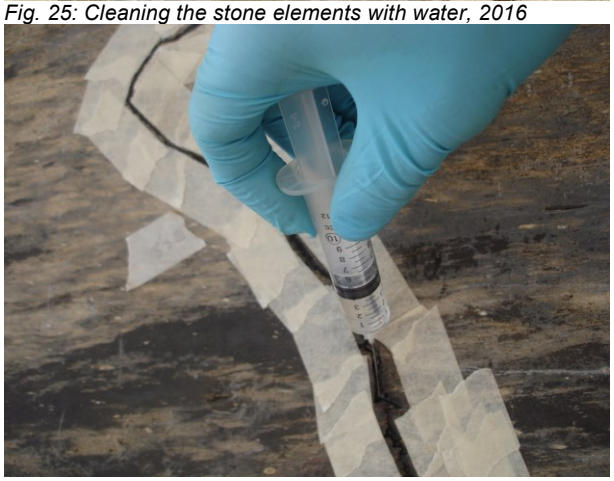


Fig. 27: Injection of epoxy resin in cracks, 2016

Fig. 28: Preparing the new stone dowels, 2016

Fig. 29: Drilling the holes for introducing carbon fibre pins, 2016

Fig. 30: Lead sheets and stainless steel pins, 2016

Fig. 31: Newly made stone dowel in the shape of a flat hemisphere, 2016
Fig. 32: Newly made stone dowel in cylindrical shape, 2016
Fig. 33: Stone indent to replace the damaged edge on the top of the pillar, 2016

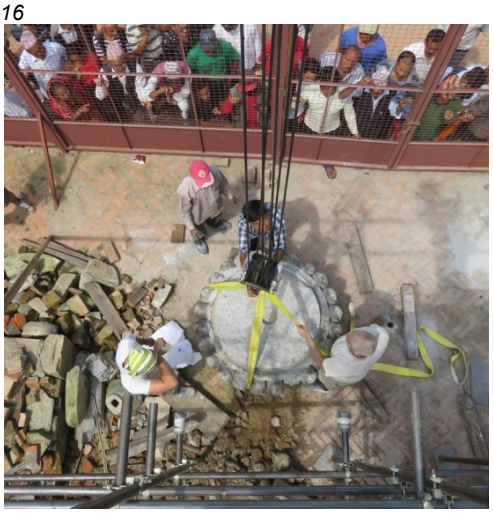


Fig. 34, Fig. 35, Fig. 36: Re-erection, lifting of single parts with crane, 2016

Fig. 37: Lead sheets and stainless steel pin, 2016

Fig. 38: Temporary hanging system at the lotus bowl, 2016

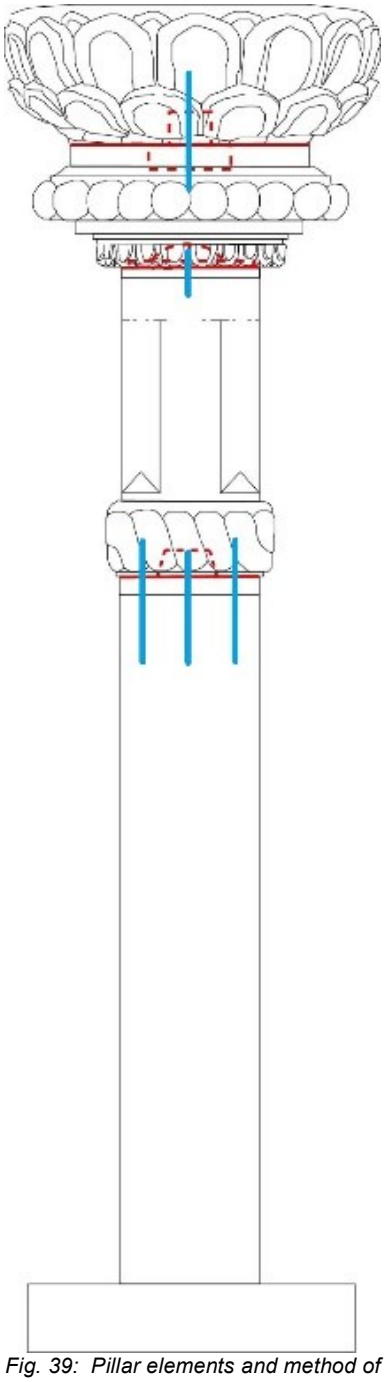


Fig. 39: Pillar elements and method of construction (dowels and joints in red)

Fig. 40: Rectification by hammering, 2017

Fig. 41: Reshaping with heat, 2017

Fig. 42: Deformed ornate frame, new substructure, 2017

Fig. 43: Mounting lotus on substructure, 2017

Fig. 44: Cleaning with citric acid dissolved in water, 2016

Fig. 45: Re-gilding on worn off gilded surfaces, 2016

Fig. 46: Closing cracks with epoxy resin, 2017

Fig. 47: Retouching of newly gilded parts, 2017

Before and after Conservation

Fig. 48: Before Conservation, 2016

Fig. 49: After conservation, 2017

Fig. 50: King before conservation, 2016

Fig. 51: After conservation and re-erecting, 2017

List of Publications / Reports (IoC)

Haselberger, Martina, Ranjitkar, Rohit, and Gabriela Krist. 2021. “Post-Earthquake Recovery and Conservation-Restoration in Patan, Nepal.” In *Analysis of Case Studies in Recovery and Reconstruction, Case Studies*, Vol. 2, edited by ICCROM and ICOMOS, 6-37. Rome: ICCROM and ICOMOS.

Haselberger, Martina, and Gabriela Krist. 2020. “Tracking Trends: A Study of Post-Earthquake Approaches to Conservation in Patan, Nepal.” *Studies in Conservation* 65/Issue sup1: Special issue: IIC 2020 Edinburgh Congress preprints. https://doi.org/10.1080/00393630.2020.1758872.

Kaipf, Luis. 2017. “The Pillar of Yoganarendra Malla. Condition Survey, Conservation Treatment and Re-erection.” Unpublished Pre-Thesis, University of Applied Arts Vienna.

Krist, Gabriela, Milchin, Marija and Martina Haselberger. 2016. “The Durbar Square and the Royal Palace of Patan, Nepal – Stone Conservation before and after the Great Earthquake of April 2015.” *In Science and Art: A Future for Stone: Proceedings of the 13th International Congress on the Deterioration and Conservation of Stone*, Volume II, edited by John Hughes and Torsten Howind, 1171-1180. Paisley: University of the West of Scotland.

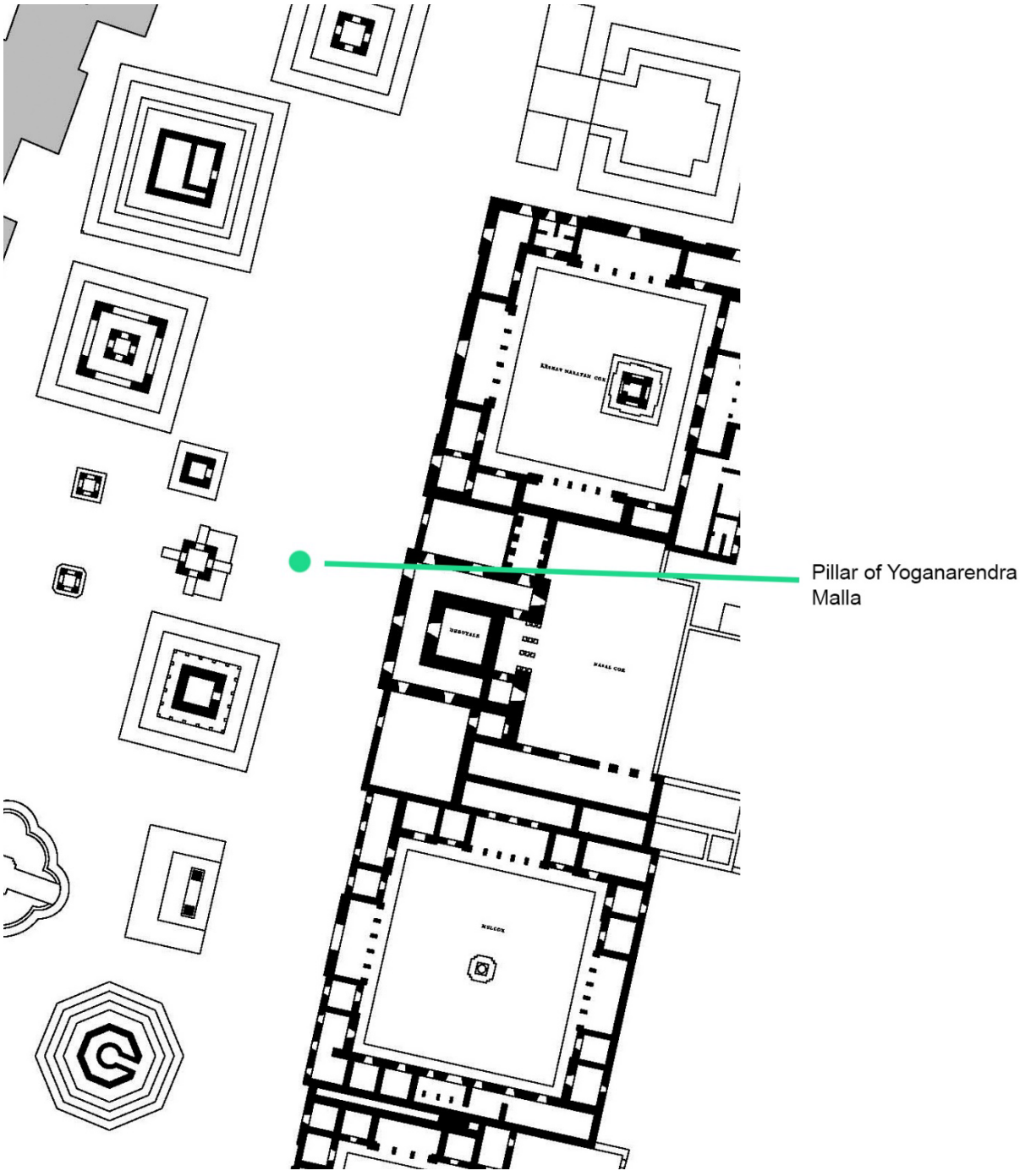
Supplements

[A] List of all product / technical data sheets

[2] Detailed material characterisation - calcitic schist

Photo Credits

GENERAL INFORMATION		
Monument Yoganarendra Malla Pillar	**Orientation** -	**Size (H x L x W)** 8,2 m (height)
Date of Production Ca. 1700	**Location** Darbar Square	
Date of the last Treatment Conservation 2016-2017	**Institutions of the last Treatment** IoC	



Condition Assessment		
Date of Evaluation May 2024	**Evaluation done by** Martina Haselberger Sarah Moyschewitz	
Recent Damages:		
☐ Stability Problems ☒Not detected	☐ Major ☐ Medium ☐ Minor	
Comment:		
☒ Broken / - into several Pieces ☐Not detected	☐ Many ☐ Some ☐ Few	
Comment:		
☒ Loose / Missing Parts ☐Not detected	☐ Many ☐ Some ☒ Few	One of the lotus-rim elements is broken off (west side) (Fig. 1). Half of one lotus element is missing (south-west side).
Comment:		
☐ Joints ☒Not detected	☐ Open ☐ Cracked	□ Many □ Some □ Few □ Many □ Some □ Few
Comment:		
☒ Scaling, Sanding or Powdering ☐Not detected	☐ Major ☐ Medium ☒ Minor	Scaling at pillar shaft was found under the square metal rim (Fig. 2).
Comment:		

		-
☐ Biological Colonization ☒Not detected	☐ Microbiological Growth	□ Major □ Medium □ Minor
	☐ Mosses	□ Major □ Medium □ Minor
	☐ Higher Plants	□ Major □ Medium □ Minor
Comment:		
☐ Mechanical Damage ☒Not detected (See: Loose/ missing parts)	☐ Abrasion	□ Major □ Medium □ Minor
	☐ Other	□ Major □ Medium □ Minor
Comment:		
☐ Salt Deterioration ☒Not detected	☐ Efflorescence	□ Major □ Medium □ Minor
	☐ Subflorescense	□ Major □ Medium □ Minor
Comment:		
☒ Soiling ☐Not detected	☐ Heavy	
	☐ Medium	
	☒ Light	Typical human induced soiling in the lower area of the pillar (Fig. 3).
Comment:		
☒ Other	Comment:	

	Rust stains from metal rim on lowest pillar shaft.

Evaluation of the Condition

☒ good (no need for treatment)

☐ satisfactory (some minor treatments necessary)

☐ unsatisfactory (major conservation measures necessary)

Conclusion

In general, the object is in good condition; the upper parts show dark crusts, with partial flaking of the crust, exposing the stone underneath. Loss of one and a half lotus rim element (recent?). Cracks seem unchanged since last treatment (Fig. 4, 5, 6), iron rim heavily rusted, causing rust stains on the stone.

PHOTO DOCUMENTATION

Condition at Evaluation Date

Fig. 1: Broken off lotus rim element.

Fig. 2: Scaling of the schist stone under the square iron rim.

Fig. 3: Darkened area at the base of the pillar shaft.

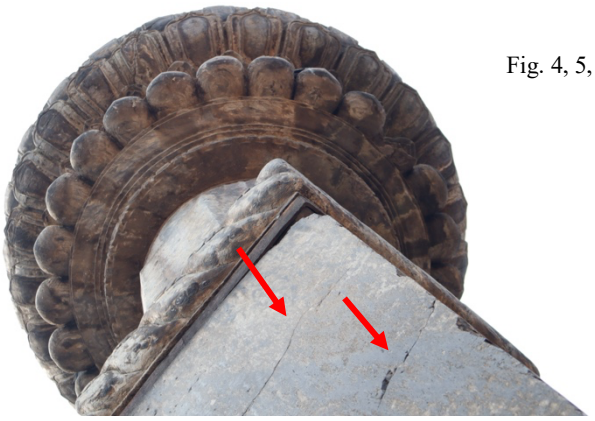
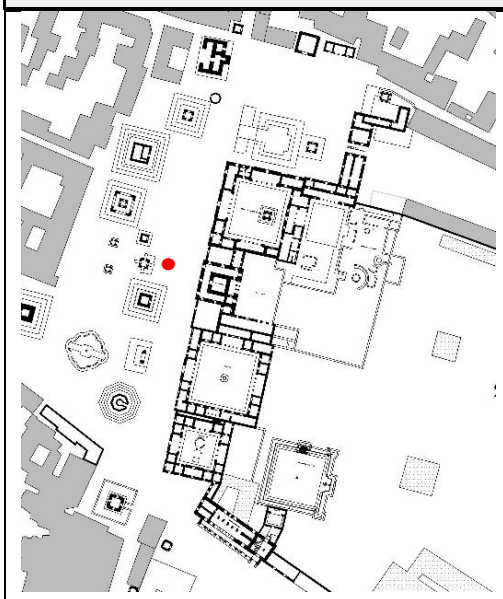
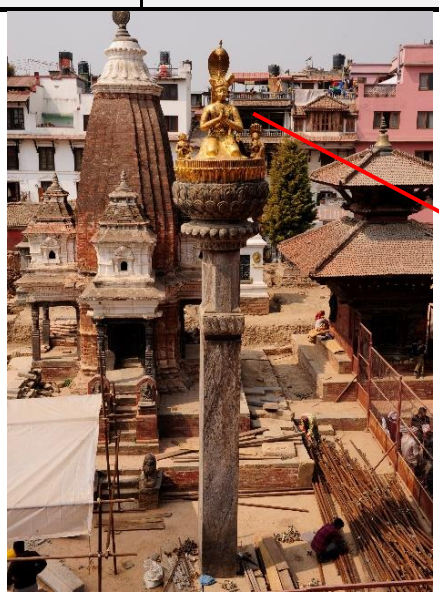
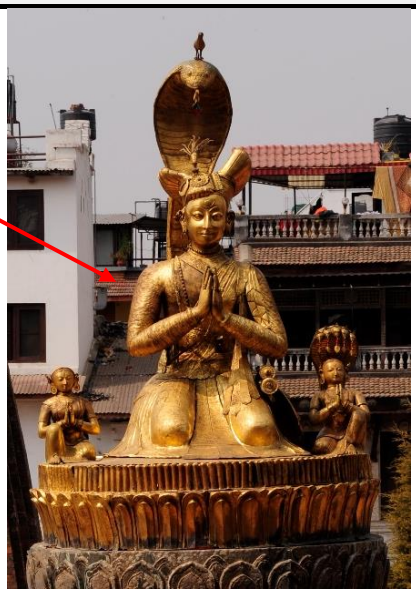


Fig. 4, 5, 6: Cracks in the shaft.

GENERAL INFORMATION		
Object / Monument Yoganaredra sculpture	**Orientation** Top of Yoganarendra Malla Pillar / facing Degutaleju Temple	**Size (H x L x W)** -
Date of Production Around 1700	**Location** Patan Durbar Square	
Material and Technology - Copper repoussé, fire-gilded (main parts of the sculpture, frame and lotus) - Casted brass, fire-gilded (smaller parts as hands, feet, ears, and jewellery applications) - Internal wrought iron substructure		
Date of the last Treatment Conservation 2017: see short report	**Institutions of the last Treatment** IoC	







EVALUATION	
Date of Evaluation May 2024	**Evaluation done by** Meral Hietz, Katharina Mendl
All descriptions from king's perspective	
Recent Damages:	
☐ Stability Problems	☐ Major ☐ Medium ☐ Minor
Comment:	

☐ Broken / - into several Pieces	☐ Many ☐ Some ☐ Few	
Comment:		
☐ Lose / Missing Parts	☐ Many ☐ Some ☐ Few	
Comment:		
☒ Cracks / Holes	☒ Many ☐ Some ☐ Few	- Cracks and holes on bottom of lotus base (copper plate inserted on backside) - Large crack and a hole on left knee of Newari wife (sitting on king's left side)
Comment:		
☒ Deformation / Dents	☐ Major ☐ Medium ☒ Minor	- 2 dents on the rod-shaped ornament above lotus line on the base - Left upper earring of the king - Lower part of right upper earring of Newari wife
Comment:		
☒ Abrasion / Worn out Gilding	☐ Major ☒ Medium ☐ Minor	- Bottom of lotus base - Hat, chest, partial areas on the backside of the body, left upper arm and shoulder, centre part of the garment at the bottom, jewellery, hilt of the swords, swords, rivets of the shield, feathers on the left arm of the king - Head, bird and back of king's naga - Body of Newari wife - Head and back of Newari wife's naga - Body of the second wife (sitting on king's right side), especially on back side
Comment:		
☒ Corrosion	☐ Major ☐ Medium ☒ Minor	- General darkening of areas with thin gold layer - Minor green corrosion on the big feather and king's left shoulder - Front side of head and chest (probably green dots at closer inspection) of king's naga
Comment:		

☒ Soiling	☒ Dust	☐ Heavy ☒ Medium ☐ Light	- Matt appearance of the whole surface due to dust layers
	☒ Dirt	☐ Heavy ☒ Medium ☐ Light	- Bird droppings on king's naga (mostly on the head) - Bird droppings (mostly on the head, face and chest) of Newari wife - Bird droppings (mostly on the head) of second wife
	☐ Blood	☐ Heavy ☐ Medium ☐ Light	
Comment:			

Evaluation of the Condition

☐ good

☒ satisfactory

☐ unsatisfactory

Conclusion

In general, the condition of the sculpture was judged as satisfactory. Due to inaccessibility, details of conservation work could only be assessed using binoculars. The technical interventions on the objects (e.g. repair of deformations, welding), carried out mainly by local craftsmen, have proved to be stable to date. Unfortunately, due to the lack of direct access, it has not been possible to assess the adhesive securing (e.g. closing cracks) with epoxy resin.

The surface treatments have also proven to be stable over time. In principle, the overall appearance of the sculpture blends in well with the surroundings of Darbar Square. However, the object appears blotchy today, as the areas with (retouched) gold leaf and the worn areas of the original fire gilding show different degrees of ageing (areas of the oil gilding are much lighter in colour).

The sculpture also has a matt appearance due to the dust deposits. Deposits (soiling and especially bird droppings) can be found on the surface and are a major cause of corrosive reactions. In this respect, maintenance is the key to the long-term preservation of the sculpture. Regular cleaning and removal of bird droppings must be considered by the local community as the most important factor in long-term conservation. Where citric acid is used to chemically reduce corrosion, it is essential that the surface is thoroughly rinsed after cleaning, as acidic residues accelerate corrosive reactions.

PHOTO DOCUMENTATION

Fig. 1: Yoganarendra sculpture after conservation, 2017

Fig. 2: Yoganarendra sculpture in May 2024

Fig. 2: Yoganarendra sculpture after conservation, 2017

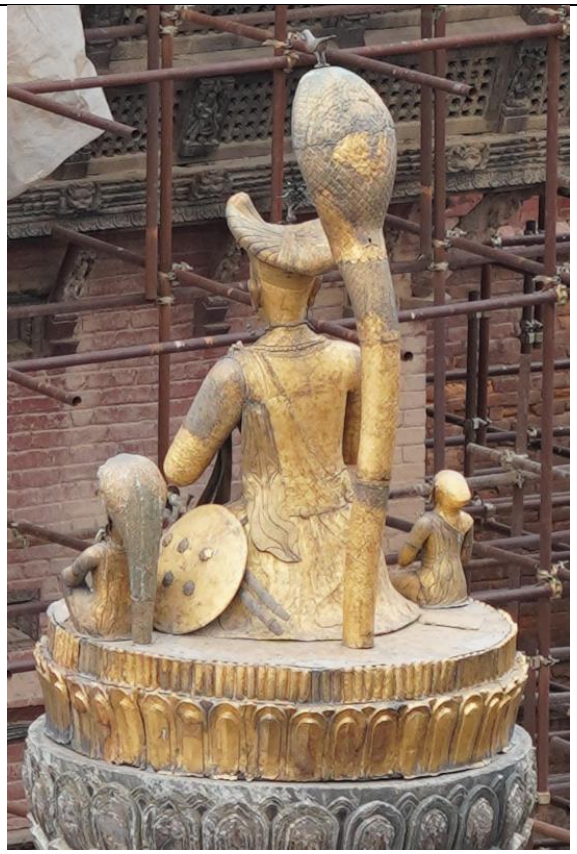


Fig. 4: Yoganarendra sculpture in May 2024

Fig. 5: Yoganarendra sculpture in May 2024

Fig. 6: Yoganarendra sculpture in May 2024

[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

[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.

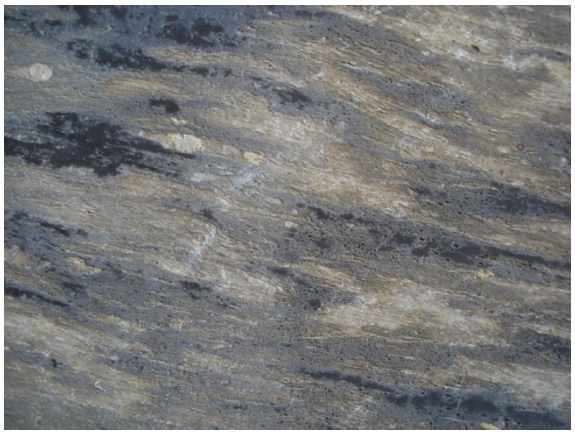


Fig. 2: Visual inspection of stone from Yoganarendra Malla Pillar, © IoC, Kaipf, 2017.

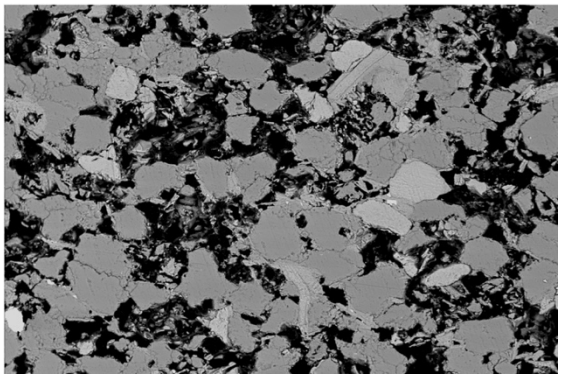


Fig. 3: Sample KAT1BS1, thin Section, SEM BSE.

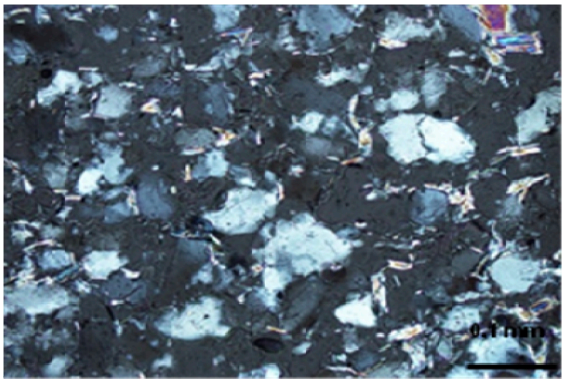


Fig. 4: Sample KAT1, thin section, optical microscopy, x200.

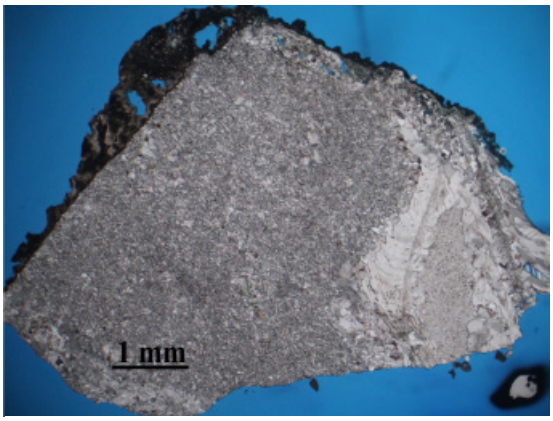


Fig. 5: Sample P06, thin section, optical microscopy, x24.

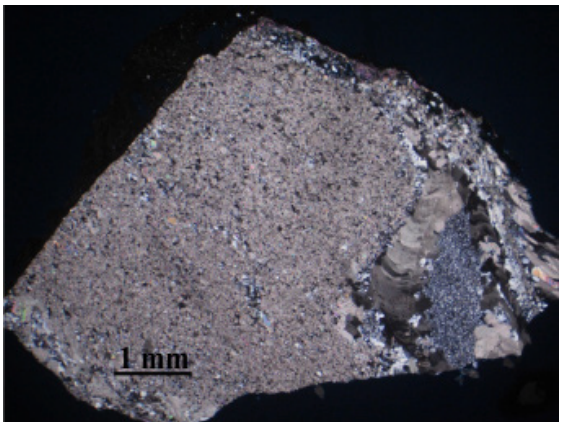


Fig. 6: Sample P06, thin section, optical microscopy, x24.

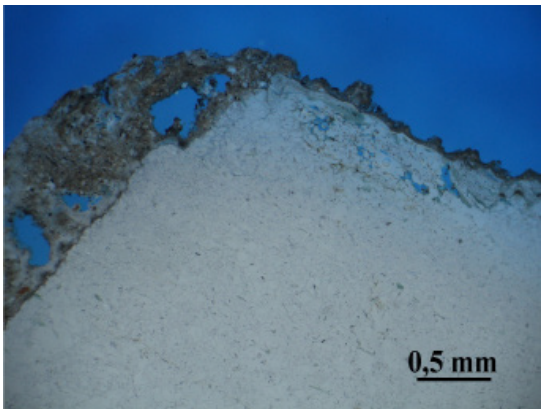


Fig. 7: Sample P06, thin section, optical microscopy, x48.

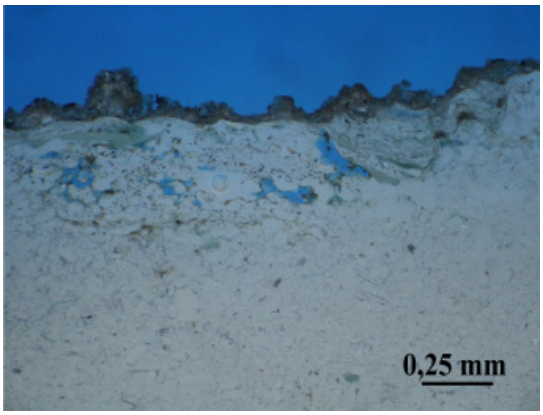


Fig. 8: Sample P06, thin section, optical microscopy, x48.

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

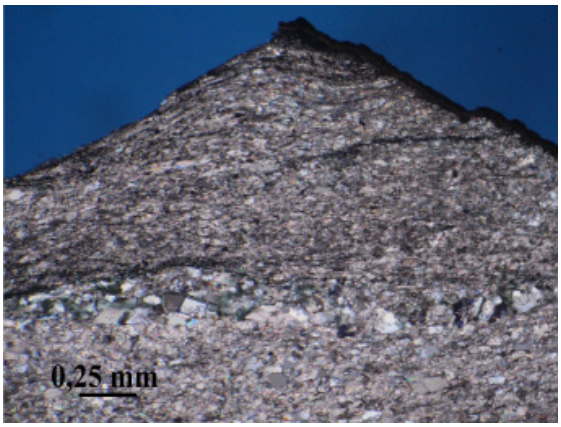


Fig. 10: Sample P07, thin section, x72. Fabric with relatively homogenous matrix and slightly developed banding.

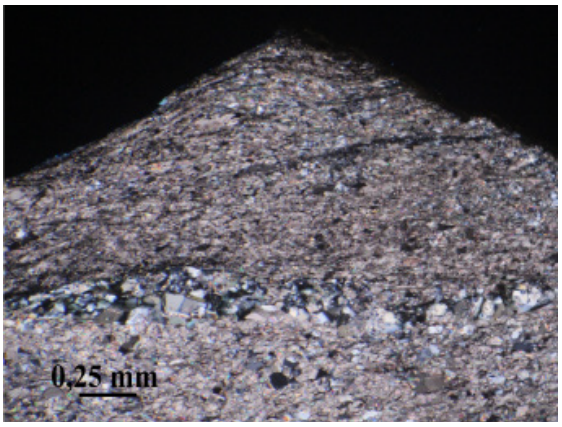


Fig. 11: Sample P07, thin section, x72.

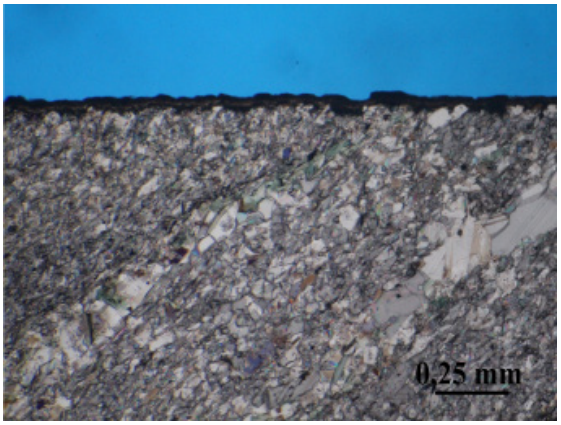


Fig. 12: Sample P07, thin section, x90.

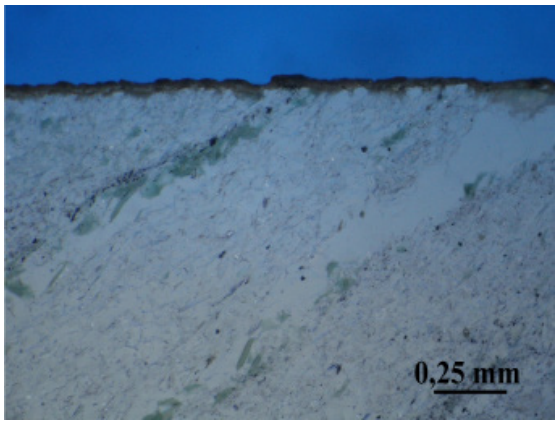


Fig. 13: Sample P07. thin section, x90.

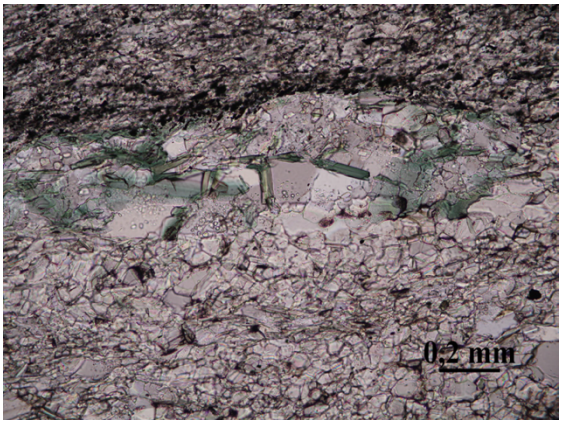


Fig. 14: Sample P07, thin section, x100; Phlogopite.

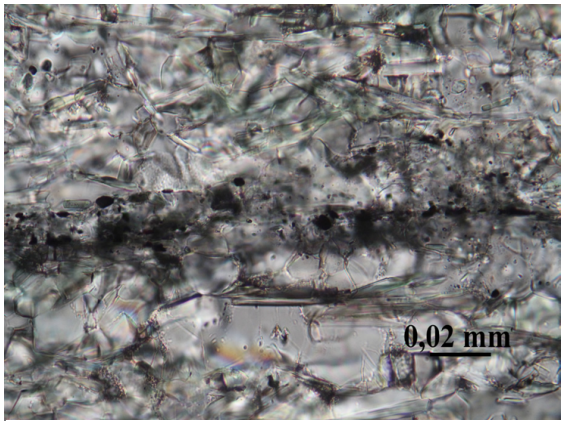


Fig. 15: Sample P07, thin section, x1000; Shear zone.

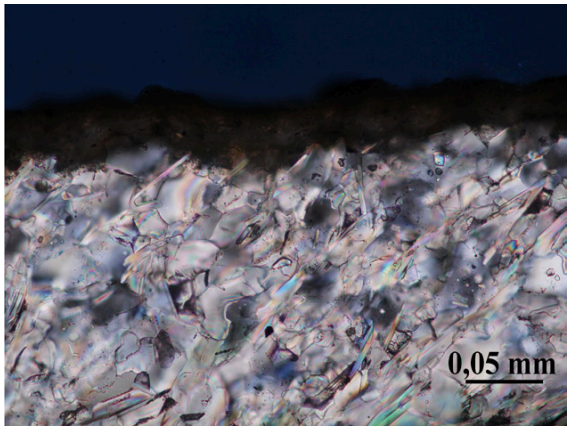


Fig. 16: Sample P07, thin section, x500. Equigranular grain aggregate with mainly polygonal grain forms.

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.

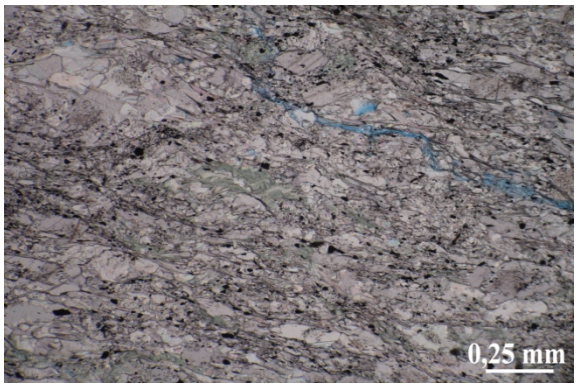


Fig. 20: Sample NEP_ST_1, Nikon SMZ 500, transmitted light, parallel polarizers. Detailed view of the matrix.

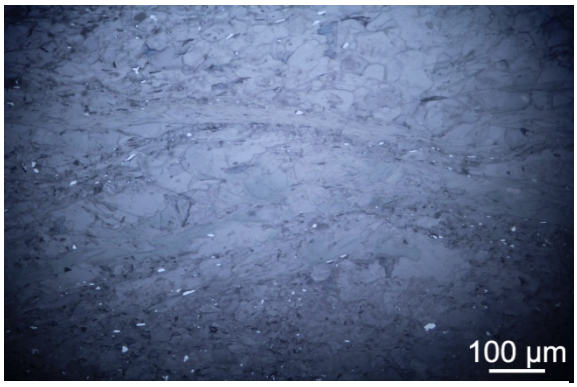


Fig. 21: Sample NEP_ST_1, Olympus BX40, incident light, bright field. Overview of mica inclusions (whitish spots).

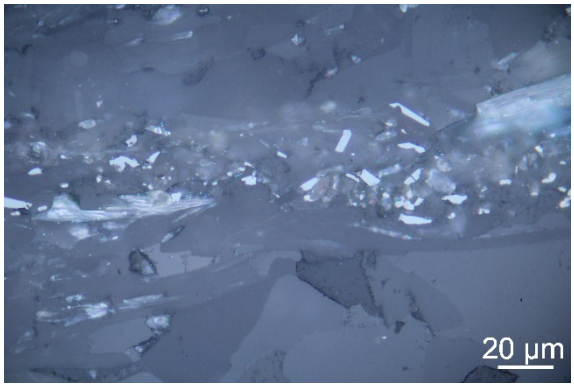


Fig. 22: Sample NEP_ST_1, Olympus BX40, incident light, bright field. Detail of a fine layer with mica flakes.