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SUPPLEMENTARY ONLINE MATERIAL FOR

Ontogenetic stages of ceratopsian dinosaur *Psittacosaurus* in bone histology

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Published in *Acta Palaeontologica Polonica* 2019 64 (2): 323-334.
https://doi.org/10.4202/app.00559.2018

Supplementary Online Material

Figure S1 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing "longitudinal" vascular canals, using regular transmitted light.

Figure S2 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using elliptically polarized light

Figure S3 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using crossed plane-polarized light.

Figure S4 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using regular transmitted light.

Figure S5 Lamellar bone around the vascular canals in the hatchling stage of *Psittacosaurus lujiatunensis.*

Figure S6 Lamellar bone around the LAGs in the juvenile stage of *Psittacosaurus lujiatunensis.*

Table S1 Number of vascular canals in inner and outer cortex in hatchling stage of *Psittacosaurus lujiatunensis*.

Table S2 Measurements of diameter of the vascular canals in hatchling stage of *Psittacosaurus lujiatunensis.*

Table S3 Measurements of diameter of the vascular canals in juvenile stage of *Psittacosaurus lujiatunensis.*

Table S4 Measurements of diameter of the vascular canals in subadult stage of *Psittacosaurus lujiatunensis.*

Table S5 Measurements of diameter of the vascular canals in adult stage of *Psittacosaurus lujiatunensis.*

Table S6 Comparisons of the number of vascular canals in inner and outer cortex in juvenile stage of *Psittacosaurus lujiatunensis.*

Table S7 Comparisons of the number of vascular canals in the outermost cortex of the tibia in each ontogenetic stage of *Psittacosaurus lujiatunensis*.

Supplementary Online Material

Figure S1 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing "longitudinal" vascular canals, using regular transmitted light.

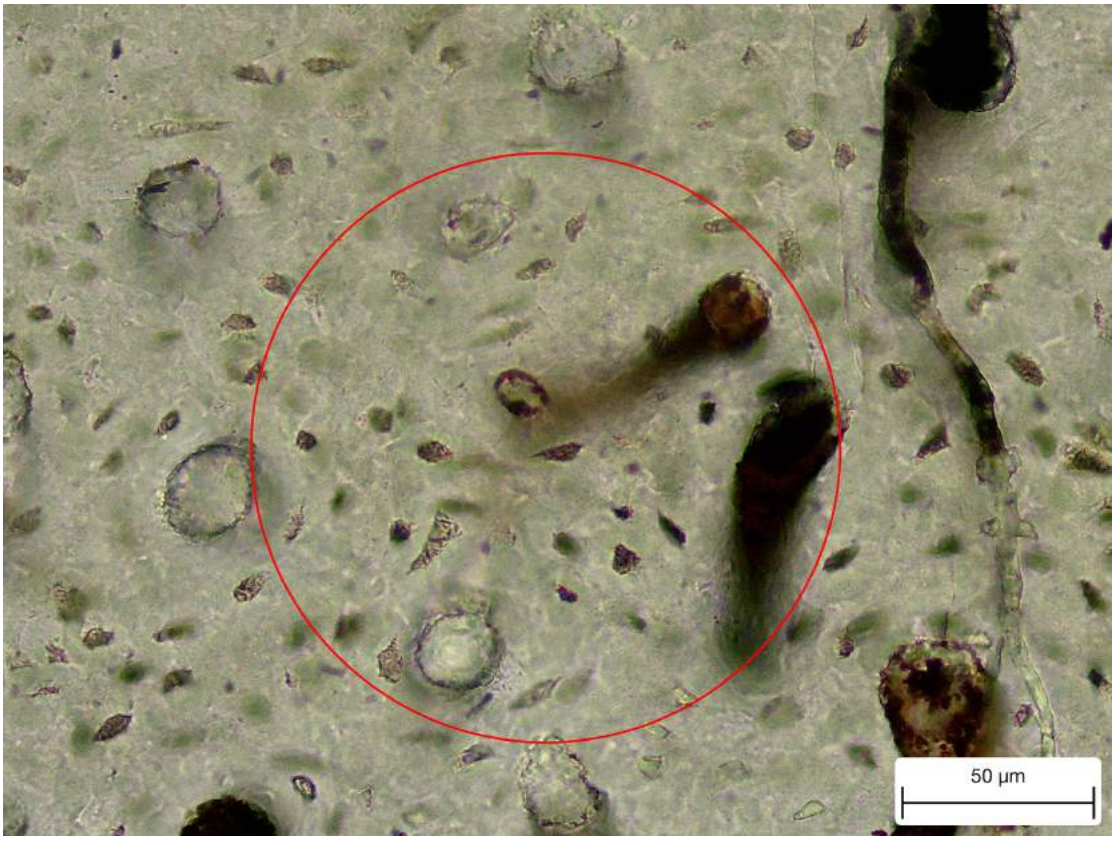


Figure S2 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using elliptically polarized light

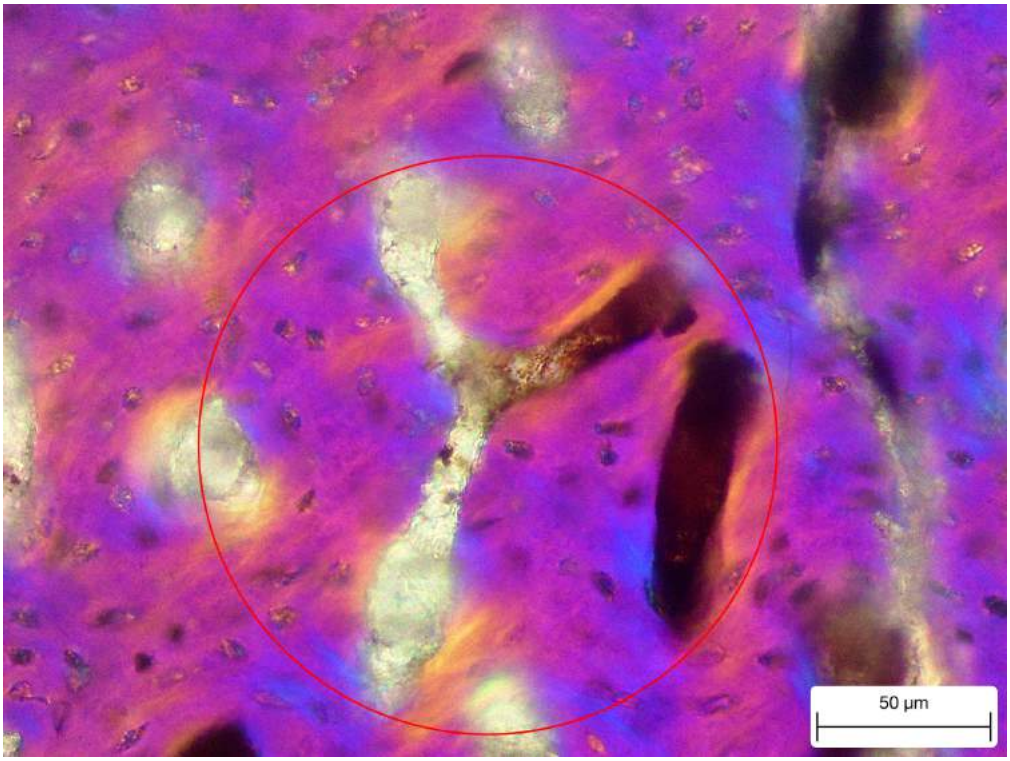


Figure S3 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using crossed plane-polarized light.

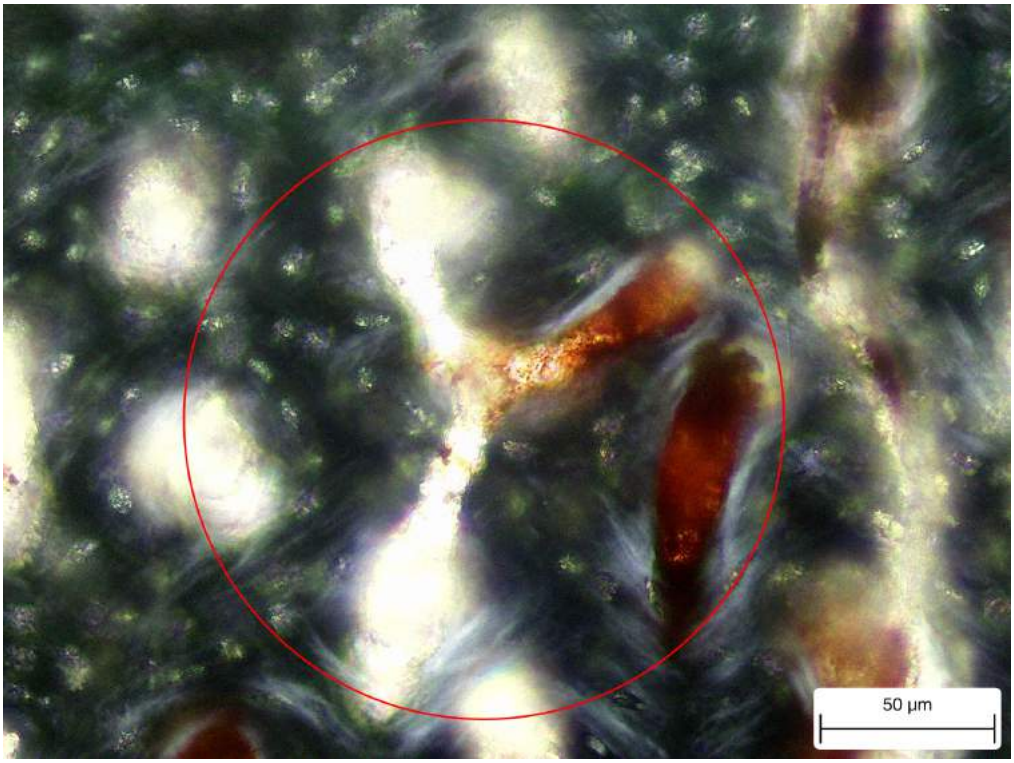


Figure S4 Bone microstructure in hatchling *Psittacosaurus lujiatunensis* (IVPP V16902.1, tibia) showing reticular vascular canals, using regular transmitted light.

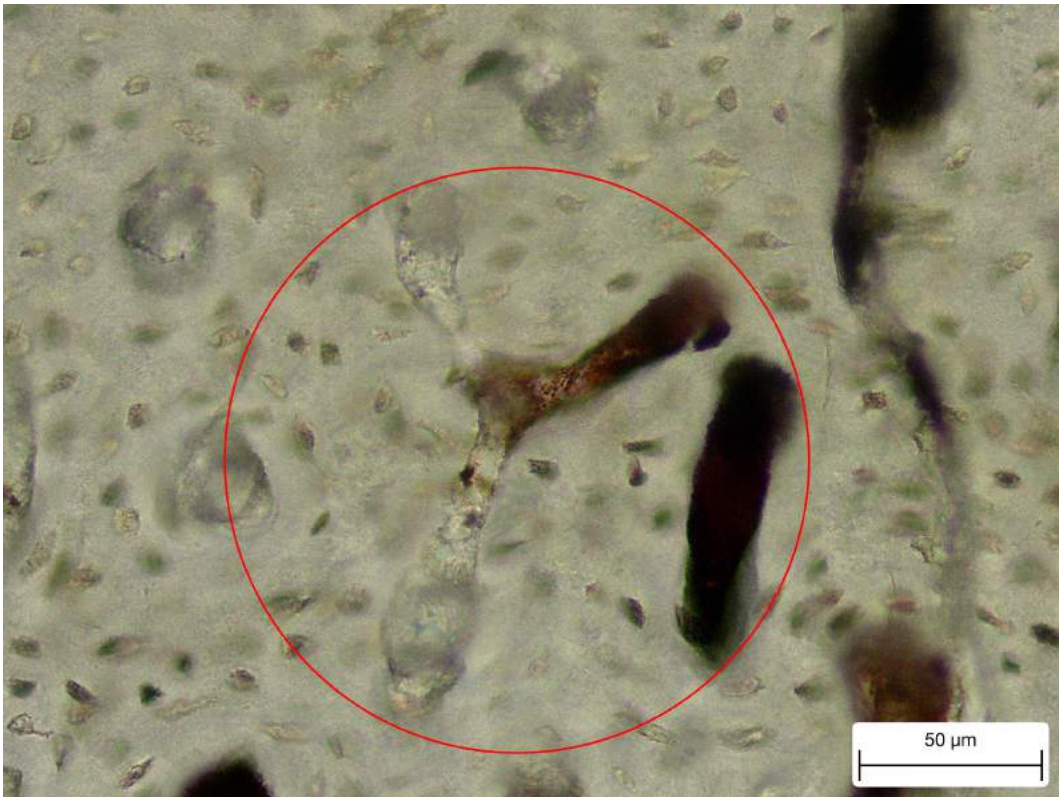


Figure S5 Lamellar bone around the vascular canals in the hatchling stage of *Psittacosaurus lujiatunensis.*

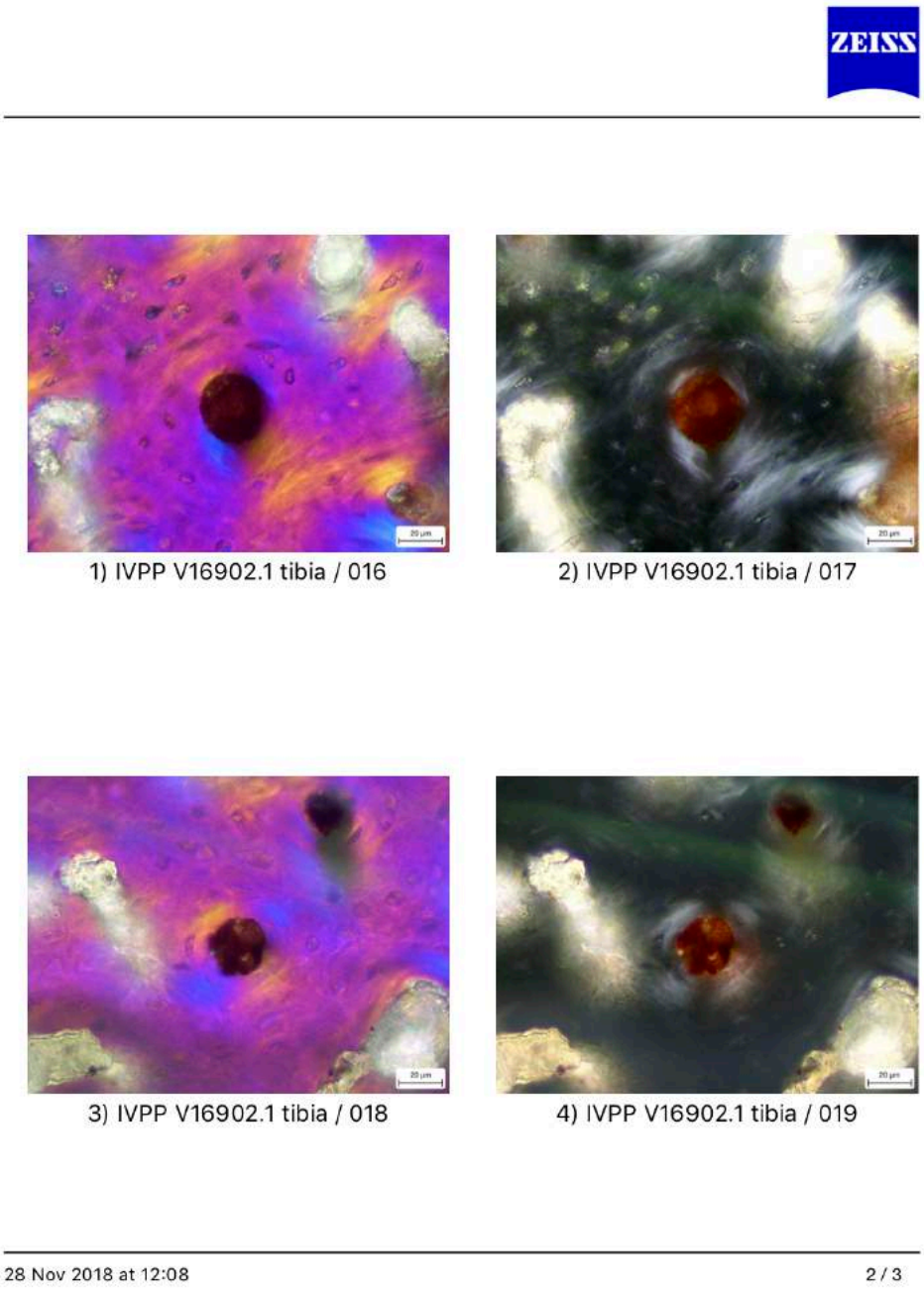
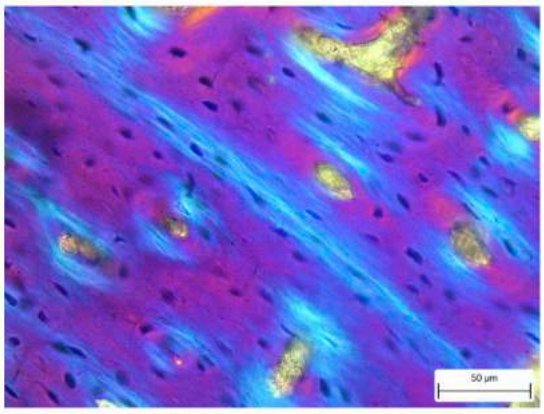
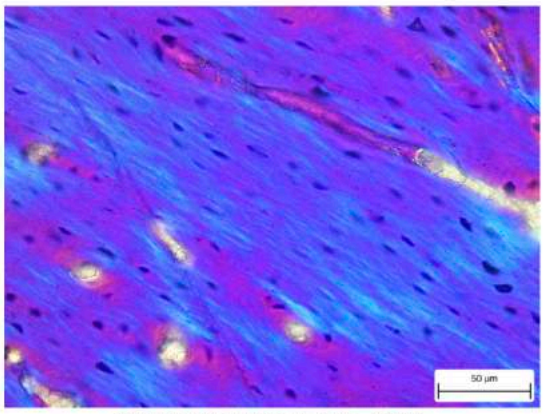


Figure S6 Lamellar bone around the LAGs in the juvenile stage of *Psittacosaurus lujiatunensis.*

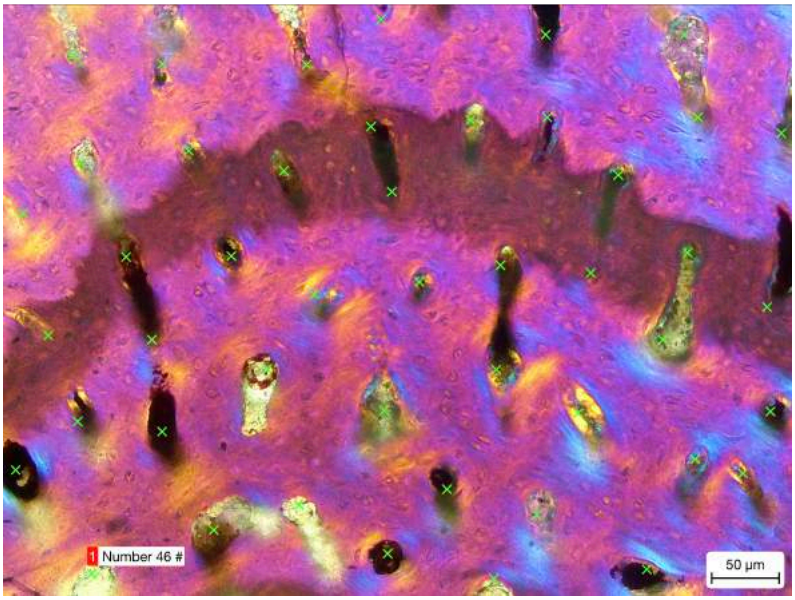


1) IVPP V14341.5 tibia / 005

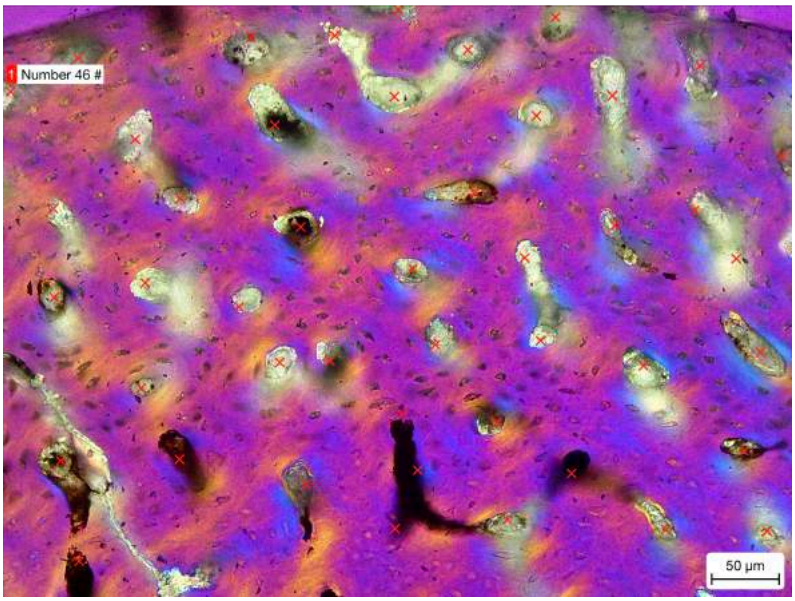


2) IVPP V14341.5 tibia / 004

Table S1 Number of vascular canals in inner and outer cortex in hatchling stage of *Psittacosaurus lujiatunensis*.



1) IVPP V16902.1 tibia / inner cortex

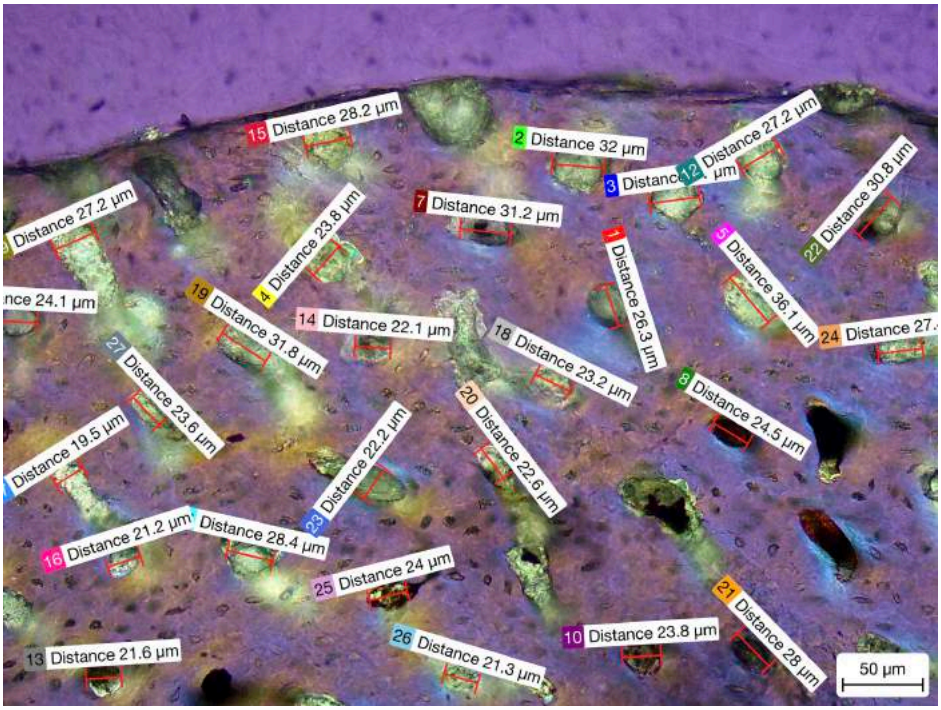


2) IVPP V16902.1 tibia / outer cortex

Measurements

Specimen Number	Location	Number of vascular canals	**Density**
IVPP V16902.1	Inner cortex	46	188 per mm^2
IVPP V16902.1	Outer cortex	46	188 per mm^2

Table S2 Measurements of diameter of the vascular canals in hatchling stage of *Psittacosaurus lujiatunensis.*



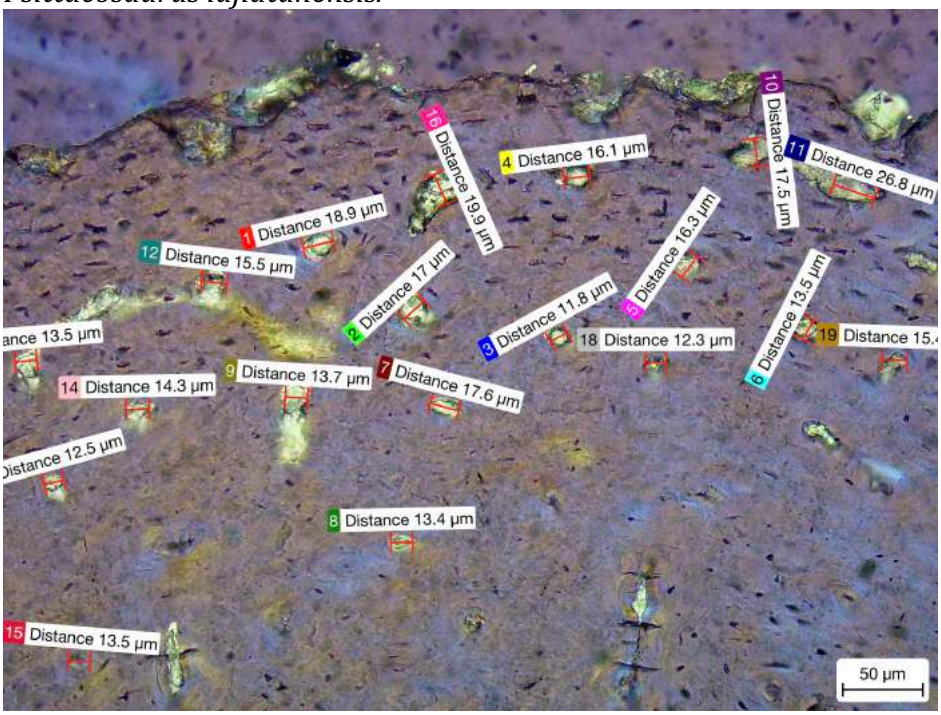
IVPP V16902.1 left tibia

Measurements

ID *	Tool	Feature	Unit	Value
1-N-1	Distance	Distance	µm	26.3
1-N-2	Distance	Distance	µm	32
1-N-3	Distance	Distance	µm	31
1-N-4	Distance	Distance	µm	30.5
1-N-5	Distance	Distance	µm	36.1
1-N-6	Distance	Distance	µm	28.4
1-N-7	Distance	Distance	µm	31.2
1-N-8	Distance	Distance	µm	24.5
1-N-9	Distance	Distance	µm	27.2
1-N-10	Distance	Distance	µm	23.8
1-N-11	Distance	Distance	µm	24.1
1-N-12	Distance	Distance	µm	32.7
1-N-13	Distance	Distance	µm	21.6
1-N-14	Distance	Distance	µm	22.1

Minimum layer thickness: 21.6
Maximum layer thickness: 36.1
Average layer thickness: 28
Layer thickness standard deviation: 4.4

Table S3 Measurements of diameter of the vascular canals in juvenile stage of *Psittacosaurus lujiatunensis.*



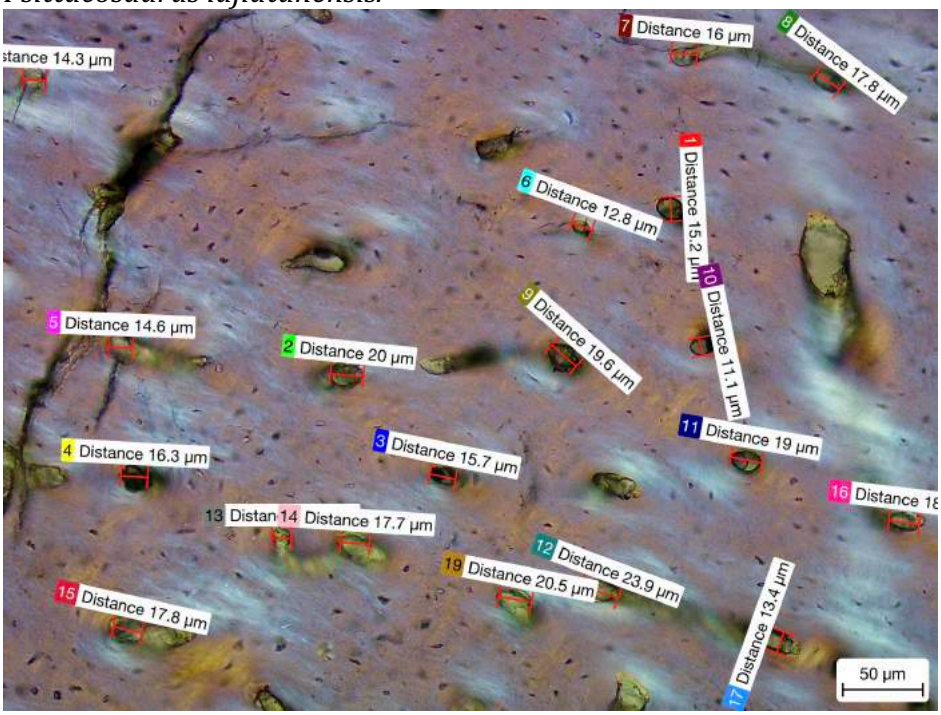
IVPP V14341.2 right tibia

Measurements

ID *	Tool	Feature	Unit	Value
1-N-1	Distance	Distance	µm	18.9
1-N-2	Distance	Distance	µm	17
1-N-3	Distance	Distance	µm	11.8
1-N-4	Distance	Distance	µm	16.1
1-N-5	Distance	Distance	µm	16.3
1-N-6	Distance	Distance	µm	13.5
1-N-7	Distance	Distance	µm	17.6
1-N-8	Distance	Distance	µm	13.4
1-N-9	Distance	Distance	µm	13.7
1-N-10	Distance	Distance	µm	17.5
1-N-11	Distance	Distance	µm	26.8
1-N-12	Distance	Distance	µm	15.5
1-N-13	Distance	Distance	µm	12.5
1-N-14	Distance	Distance	µm	14.3
1-N-15	Distance	Distance	µm	13.5
1-N-16	Distance	Distance	µm	19.9
1-N-17	Distance	Distance	µm	13.5
1-N-18	Distance	Distance	µm	12.3
1-N-19	Distance	Distance	µm	15.4

Minimum layer thickness: 11.8
Maximum layer thickness: 26.8
Average layer thickness: 15.8
Layer thickness standard deviation: 3.5

Table S4 Measurements of diameter of the vascular canals in subadult stage of *Psittacosaurus lujiatunensis.*



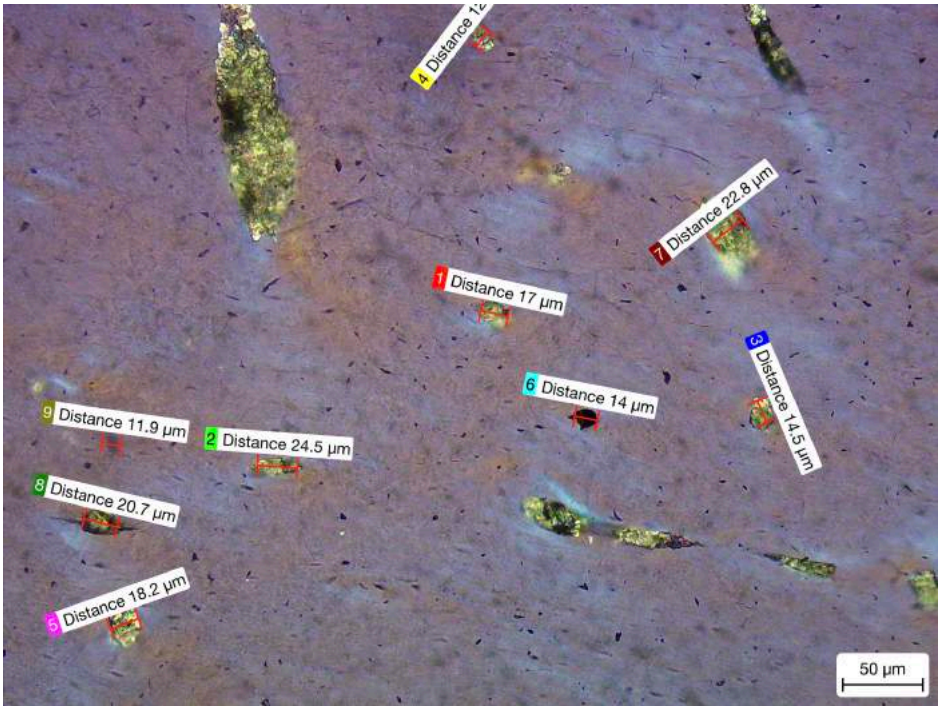
IVPP V18344 left tibia

Measurements

ID *	Tool	Feature	Unit	Value
1-N-1	Distance	Distance	µm	15.2
1-N-2	Distance	Distance	µm	20
1-N-3	Distance	Distance	µm	15.7
1-N-4	Distance	Distance	µm	16.3
1-N-5	Distance	Distance	µm	14.6
1-N-6	Distance	Distance	µm	12.8
1-N-7	Distance	Distance	µm	16
1-N-8	Distance	Distance	µm	17.8
1-N-9	Distance	Distance	µm	19.6
1-N-10	Distance	Distance	µm	11.1
1-N-11	Distance	Distance	µm	19
1-N-12	Distance	Distance	µm	23.9
1-N-13	Distance	Distance	µm	11.8
1-N-14	Distance	Distance	µm	17.7
1-N-15	Distance	Distance	µm	17.8
1-N-16	Distance	Distance	µm	18.6
1-N-17	Distance	Distance	µm	13.4
1-N-18	Distance	Distance	µm	14.3
1-N-19	Distance	Distance	µm	20.5

Minimum layer thickness: 11.1
Maximum layer thickness: 23.9
Average layer thickness: 16.6
Layer thickness standard deviation: 3.3

Table S5 Measurements of diameter of the vascular canals in adult stage of *Psittacosaurus lujiatunensis.*



IVPP V16902.1 left tibia

Measurements

ID *	Tool	Feature	Unit	Value
1-N-1	Distance	Distance	µm	26.3
1-N-2	Distance	Distance	µm	32
1-N-3	Distance	Distance	µm	31
1-N-4	Distance	Distance	µm	23.8
1-N-5	Distance	Distance	µm	36.1
1-N-6	Distance	Distance	µm	28.4
1-N-7	Distance	Distance	µm	31.2
1-N-8	Distance	Distance	µm	24.5
1-N-9	Distance	Distance	µm	27.2
1-N-10	Distance	Distance	µm	23.8
1-N-11	Distance	Distance	µm	24.1
1-N-12	Distance	Distance	µm	27.2
1-N-13	Distance	Distance	µm	21.6
1-N-14	Distance	Distance	µm	22.1
1-N-15	Distance	Distance	µm	28.2
1-N-16	Distance	Distance	µm	21.2
1-N-17	Distance	Distance	µm	19.5
1-N-18	Distance	Distance	µm	23.2
1-N-19	Distance	Distance	µm	31.8
1-N-20	Distance	Distance	µm	22.6
1-N-21	Distance	Distance	µm	28
1-N-22	Distance	Distance	µm	30.8

1-N-23	Distance	Distance	μm	22.2
1-N-24	Distance	Distance	μm	27.4
1-N-25	Distance	Distance	μm	24
1-N-26	Distance	Distance	μm	21.3
1-N-27	Distance	Distance	μm	23.6

Minimum layer thickness: 19.5
Maximum layer thickness: 36.1
Average layer thickness: 26
Layer thickness standard deviation: 4.2

Table S6 Comparisons of the number of vascular canals in inner and outer cortex in juvenile stage of *Psittacosaurus lujiatunensis.*

Element	Number of vascular canals		Density of vascular canals (per mm^2)	
	Inner cortex	Outer cortex	Inner cortex	Outer cortex
Humerus	47	44	193	180
Ulna	46	36	189	148
Radius	44	31	180	127
Femur	44	33	180	135
Tibia	57	40	234	164
Fibula	57	46	234	189

All the images are taken by the integrated camera in the Zeiss Primotech at a magnification of 20x. The numbers of vascular canals are calculated by the tools in the software of the Zeiss Labscope.

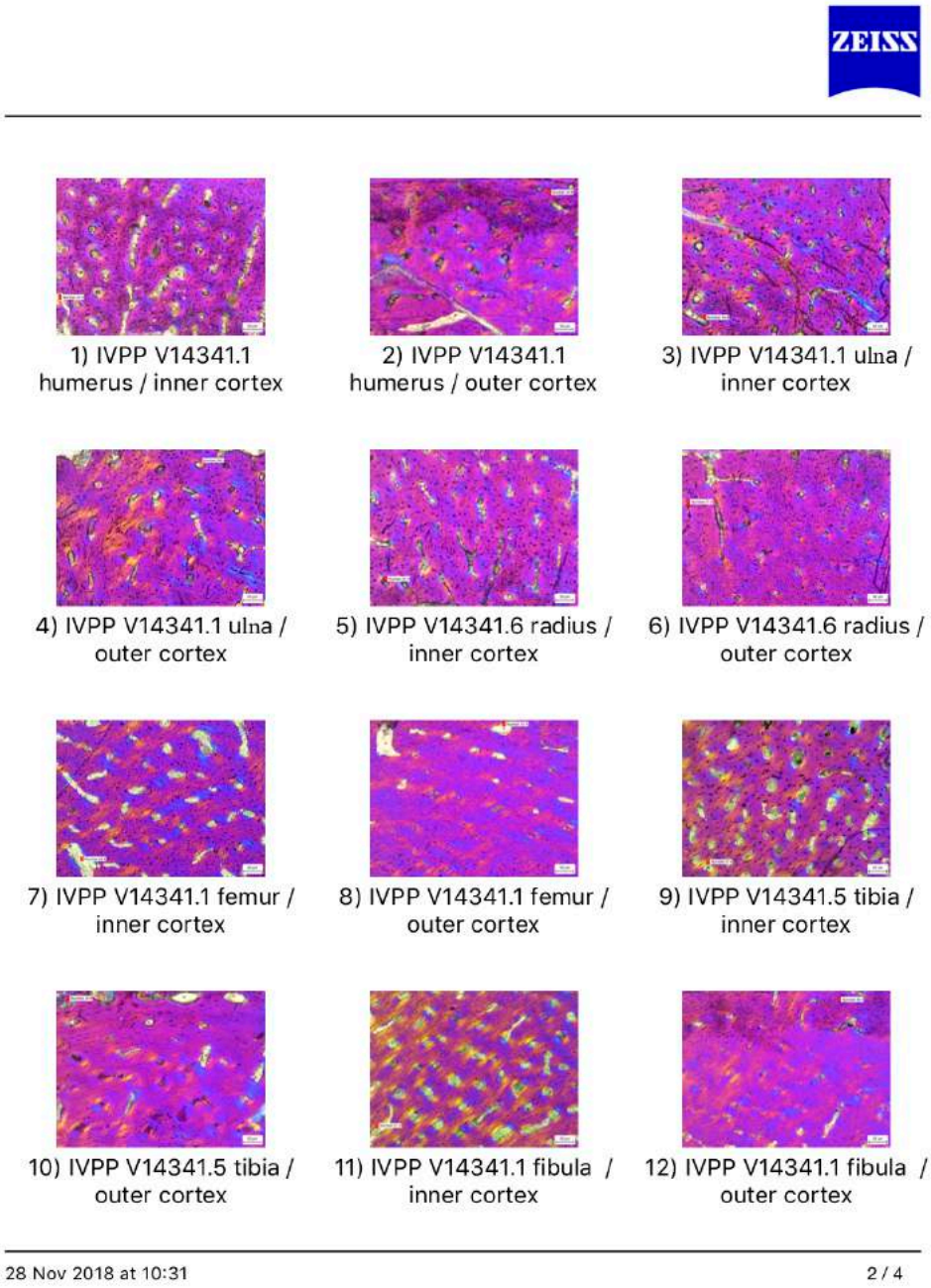
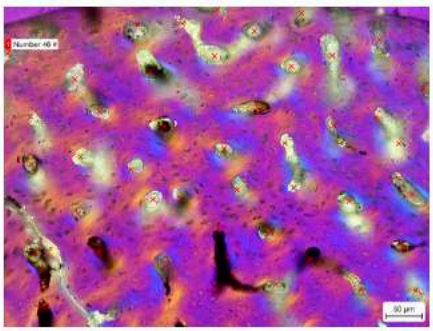


Table S7 Comparisons of the number of vascular canals in the outermost cortex of the tibia in each ontogenetic stage of *Psittacosaurus lujiatunensis*.

Specimen number	Ontogenetic stage	Number of vascular canals	Density of vascular canals (per mm^2)
IVPP V16902.1	Hatchling	46	189
IVPP V14341.5	Juvenile	40	164
IVPP V18344	Subadult	31	127
IVPP V12617	Adult	12	49

All the images are taken by the integrated camera in Zeiss Primotech at a magnification 20x. The numbers of vascular canals are calculated by the tools in the software of the Zeiss Labscope.



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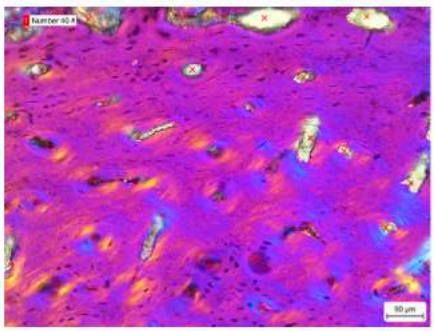
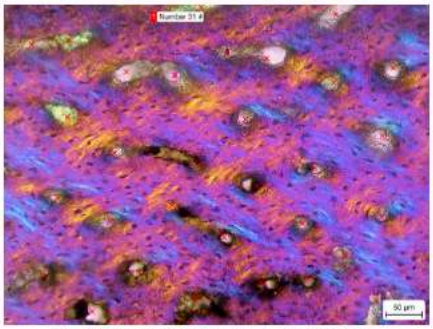
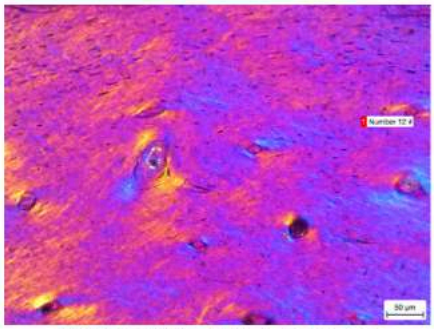


2) IVPP V14341.5 tibia / 003-02



3) IVPP V18344 tibia / 002-02



4) IVPP V12617 tibia / 001-02