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SUPPLEMENTARY ONLINE MATERIAL FOR

**Two new basal coelurosaurian theropod dinosaurs from the Early Cretaceous
Sao Khua Formation of Thailand**

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Supplementary Online Material

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SOM 1. Figures

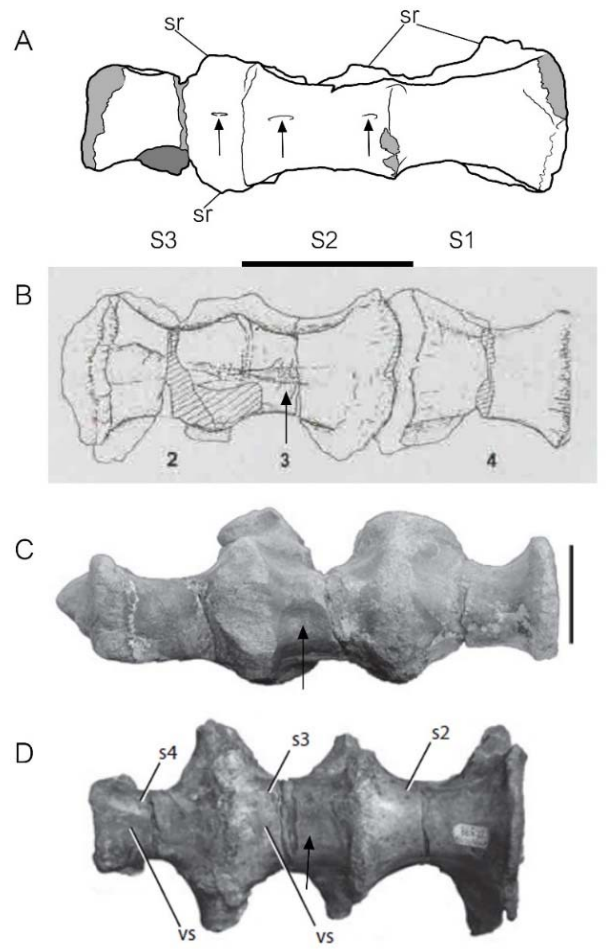
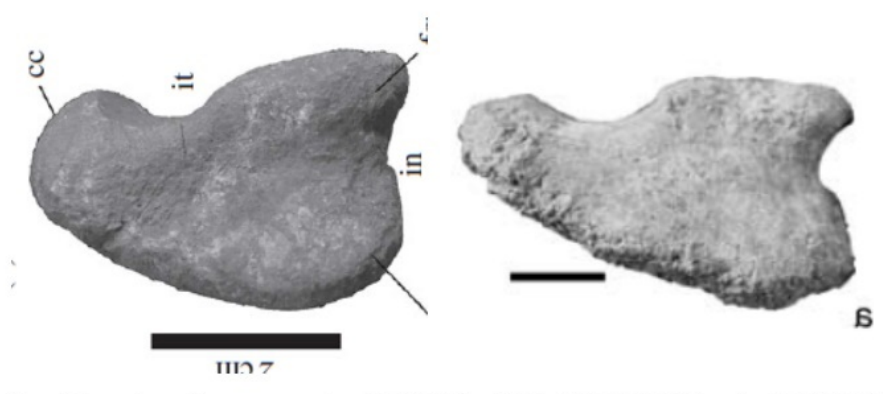


Fig. S1. Sacral vertebrae in ventral view in various theropods showing ventral groove (arrow). A, *Phuwiangvenator yaemniyomi* gen. et sp. nov; B, *Neovenator* (Brusatte et al. 2008); C, *Condorraptor* (Rauhut 2005); D) *Falcarius* (Zanno 2010).



Fig. S2. Right astragalus of *Fukuiraptor* and left astragalus of NMV P150070 in posterior view showing accessory posterolateral ascending process (plap – arrow).

We note that the autapomorphy of *Tachiraptor* “the caudolateral corner of the fibular condyle forms a sharp angle in proximal view and extends slightly more caudally than the medial condyle” in Langer et al. (2014) is also present in a small abelisauroid from Tanzania (MB.R.1751; Rauhut 2005; pers. obs.).



Tachiraptor (Langer et al 2014); MB.R.1751 (Rauhut 2005)
scale bar=20 mm scale bar=10 mm

Fig. S3. Tibiae in proximal view of *Tachiraptor* (left) and MB.R.1751 (right).

SOM 2. Tables

Table 1. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of sacral vertebrae (SM-PW9B-unnumbered) (in mm). * = incomplete

Sacral vertebrae (SM-PW9B-unnumbered) in mm	S1	S2	S3
Centrum length at midheight	89	73	92
Posterior centrum height	54	75	63
Anterior centrum height	67	53	68
Posterior centrum width	54*	64	54*
Centrum central thickness	46*	48*	48*
Neural spine height	?	?	?
Neural spine width maximum	?	?	?
Neural spine apical length	?	?	?
Neural spine basal length	?	?	?
Anterior centrum width	74	55*	69

Table 2. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of manual phalanges (SM-PW9B-3, 4, 5, 8, and 9) (in mm).

	SM-PW9B-3	SM-PW9B-4	SM-PW9B-5
Length	107	50	49
Transverse width (middle)	24	18	12
Prox. height	35	24	19
Prox. width	37	22	17

Table 3. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of manual unguals (SM-PW9B-19, 21, and 23) (in mm). * = incomplete.

	SM-PW9B-19	SM-PW9B-21	SM-PW9B-23
Length	55*	39*	35*
Length at base (prox. height)	41	25	32
Width at middle (prox. width)	19.5	11	12
Proximal height/ width ratio	2.1	2.27	2.67

Table 4. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of right tibia (SM-PW9B-unnumbered) (in mm).

Total length	615
Proximal mediolateral width	58
Proximal craniocaudal width	83
Craniocaudal length of proximal articular end	142
Mediolateral width of proximal articular end	104
Circumference at midshaft	190
Midshaft mediolateral width	60.5
Midshaft craniocaudal width	44.5
Distal mediolateral width	120
Distal craniocaudal width	60
Height of facet for ascending process	89

Table 5. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of left tibia (SM-PW9B-unnumbered) (in mm). * = incomplete.

Total length	?
Proximal mediolateral width	55
Proximal craniocaudal width	84.5
Craniocaudal length of proximal articular end	132*
Mediolateral width of proximal articular end	76*
Circumference at midshaft	?
Midshaft mediolateral width	?
Midshaft craniocaudal width	?
Distal mediolateral width	132
Distal craniocaudal width	68
Height of facet for ascending process	91*

Table 6. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurement of left astragalus (SM-PW9B-18) (in mm) * = incomplete.

Ascending process height	?
Ascending process width at base	59*
Craniocaudal width at mid	53
Mediolateral width	94
Maximum width at medial/ craniocaudal width at medial condyle	66
Cranial height at the middle	32
Total height (ascending process + base)	?
Total breadth (maximum/ mediolaterally)	103

Table 7. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurement of left calcaneum (SM-PW9B-18) (in mm).

Width craniocaudally	66
Width mediolaterally	25
Height	39
Total width of astragalocalcaneum	123.5

Table 8. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurement of right astragalus (SM-PW9A-B17) (in mm).

Ascending process height	?
Ascending process width at base	63.5
Craniocaudal width at mid	49
Mediolateral width	90.5
Maximum width at medial/ craniocaudal width at medial condyle	70.5
Cranial height at the middle	30
Total height (ascending process + base)	?
Total breadth (maximum/ mediolaterally)	103

Table 9. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurement of right calcaneum (SM-PW9A-B17) (in mm).

Width craniocaudally	62
Width mediolaterally	24
Height	45
Total width of astragalocalcaneum	122

Table 10. *Phuwiangvenator yaemniyomi* gen. et sp. nov. measurements of selected pedal unguals (SM-PW9B-10, 22) (in mm).

	SM-PW9B-10	SM-PW9B-22
Length	68	43*
Height at base	26	37
Width at base	21	22

Table 11. *Vayuraptor nongbualamphuensis* gen. et sp. nov. measurements of left tibia (SM-NB A1-2) (in mm).

Total length	515
Proximal mediolateral width	44.5
Proximal craniocaudal width	52
Craniocaudal length of proximal articular end	112
Mediolateral width of proximal articular end	71
Circumference at midshaft	140
Midshaft mediolateral width	48
Midshaft craniocaudal width	37
Distal mediolateral width	90
Distal craniocaudal width	43
Height of facet for ascending process	73

Table 12. *Vayuraptor nongbualamphuensis* gen. et sp. nov. measurements of left Astragalus (SM-NB A1-2) (in mm).

Ascending process height	70
Ascending process width at base	42
Craniocaudal width at mid	38.5
Mediolateral width	62.5
Maximum width at medial/ craniocaudal width at medial condyle	49
Cranial height at the middle	19.5
Total height (ascending process + base):	105
Total breadth (maximum)	70

Table 13. *Vayuraptor nongbualamphuensis* gen. et sp. nov. measurements of left calcaneum (SM-NB A1-2) (in mm)

Width craniocaudally	41.5
Width mediolateraly	18
Height	42
Total width of astragalocalcaneum	82

Table 14. Morphological comparison of sacral vertebrae in various theropods (Y=yes; N=no).

	Proportion	constriction	Pleurocoel	Camerate/ Camellate	ventral view
<i>Phuwiangvenator</i>	Longer than high	N	N		Flat
SMNS 58023	Longer than high	N	Y	Y	Convex
<i>Siamotyrannus</i>		Y	N	N	Convex
<i>Megaraptor</i>			Y	Y	Flat
<i>Aoniraptor</i>		?	Y	Y	Flat
<i>Datanglong</i>		Y	N		Convex
<i>Suchomimus</i>	Longer than high	N			Convex
<i>Spinosaurus</i>		?	?		Convex
<i>Baryonyx</i>		?	?		Flat

Table 15. Morphological comparison of sacral vertebrae in various theropods.

	Centra anteriorposteriorly	Ventral view/ ventral ridge	Ventral in lateral view
<i>Ichthyovenator</i>	possibly long?	?	
<i>Baryonyx</i> holotype	Long	convex/flat, NA?	
<i>Suchomimus</i>	Long	Convex, no ridge?	
<i>Spinosaurus</i>	Long	Convex, no ridge?	
<i>Phuwiangvenator</i>	Long	Flat, no ridge, sulci	Less concave
<i>Aoniraptor</i>	Short	Flat, no ridge?	Less concave
<i>Datanglong</i>	Short	Convex, no ridge	Less concave except the last sacral
<i>Megaraptor</i>	Short	Flat?, no ridge	Less concave
SMNS 58023	Long	Convex, no ridge	
MPMA 08-003-94	Long	Flat	
CPPLIP 1324	Long	Flat	
<i>Neovenator</i>		?Convex, groove	
<i>Falcarius</i>		?flat, groove	
<i>Condorraptor</i>		Flat, groove	

Table 16. Manual ungual I-2, the ratio of proximal height/ width

<i>Torvosaurus</i> (Benson et al. 2010)	1.95
<i>Suchomimus</i> MNBH GAD 500	1.78
<i>Baryonyx</i> cast of BMNH R9951	1.9
<i>Allosaurus</i> UMNH VP5676	1.9
<i>Chilantaisaurus</i> (Benson and Xu 2008)	2.7
<i>Fukuiraptor</i> FPDM-V43-11	2.7
<i>Phuwiangvenator</i> SM-PW9B-19	2.4
<i>Australovenator</i> (Benson et al. 2010)	2.4
<i>Megaraptor</i> (Benson et al. 2010)	2.75

Table 17. Measurement of the tibiae of some megaraptorans and other theropods (in mm) showing tibial height and the length/width at mid-length ratio of the tibia in various theropods. * = incomplete.

Theropod tibia	Length in mm	Length/width ratio
<i>Phuwiangvenator</i> gen. et sp. nov.	615	13.82
<i>Vayuraptor</i> gen. et sp. nov.	515	13.9
<i>Australovenator</i>	569 (left), 564 (right)	12.53
<i>Fukuiraptor</i>	App. 507*	≈14.3-14.5
<i>Murusraptor</i>	690	11.9
<i>Chilantaisaurus</i>	954	
<i>Aerosteon</i> referred material	635	14
<i>Neovenator</i>	680 (left), 685 (right)	
<i>Orkoraptor</i>	700* or 600* (Coria and Currie 2016)	
<i>Qianzhousaurus</i>	760	
<i>Spinosaurus</i> Neotype	668	12.09
<i>Suchomimus</i> MNBH GAD 500 Holotype	960 (pers. obs.); 945 (Serenio et al. 1998)	9.6
<i>Suchomimus</i> MNBH GAD97 'subadult'	760	10.86
<i>Suchomimus</i> MNBH GAD72 'juvenile'	700	11.67
<i>Allosaurus</i>	690	
<i>Sinraptor</i>	769 (left); 776 (right)	

Table 18. Cross-section of tibia at mid-length in various theropods.

Theropod tibia	Shape in cross-section
<i>Vayuraptor</i> gen. et sp. nov.	anteriorly flat (pers. obs.)
<i>Phuwiangvenator</i> gen. et sp. nov.	anteriorly flat (pers. obs.)
Abelisauroid (MCT 1783-R)	oval (Machado et al. 2013)
Abelisaurid (MB.R.3625)	anteriorly convex (pers. obs.)
Abelisaurid (MB.R.3626)	anteriorly convex (pers. obs.)
<i>Majungasaurus</i>	anteriorly flat? (Carrano 2007)
<i>Pycnonemosaurus</i>	subcircular (Delcourt 2017)
<i>Megalosaurus</i>	oval (Benson 2010)
<i>Suchomimus</i> (MNBH GAD 500)	anteriorly convex (pers. obs.)
<i>Spinosaurus</i> (FSAC-KK 11888; cast)	anteriorly flat/ slightly convex (pers. obs.)
Spinosaurine (LPP-VP-42)	anteriorly flat/ slightly convex (pers. obs.)
Sinraptorid (SM10)	Slightly flat (pers. obs.)
<i>Sinraptor dongi</i> (cast of Holotype housed at FPDM)	convex at mid-length and flatten distally (pers. obs.)
<i>Allosaurus</i>	oval/ anteriorly convex (pers. obs.; Bybee et al. 2006)
<i>Neovenator</i>	anteriorly flat, posteriorly convex (Brusatte et al. 2008)
<i>Chilantaisaurus</i>	slightly flat anteriorly proximally (Benson and Xu 2008)
<i>Australovenator</i>	anteriorly flat (White et al. 2013)
<i>Aerosteon</i> (MCNA-PV-3139; cast)	anteriorly flat (pers. obs.)
<i>Orkoraptor</i>	oval cross-section (Novas et al. 2008)
<i>Gualicho</i>	“anterolaterally-posteromedially elongate ellipse in cross section” (Apesteguia et al. 2016)
<i>Alioramus</i>	anteriorly convex (Brusatte et al. 2012)
<i>Teratophoneus</i> (UMNH VP 16690)	anteriorly convex (pers. obs.)
<i>Tyrannosaurus</i>	oval cross-section (Horner and Padian 2004)
<i>Acrocanthosaurus</i>	anteriorly flat (Stovall et al. 1950)
<i>Murusraptor</i>	anteriorly flat (Coria and Currie 2016)

Table 19. Proportion of the ascending process of the astragalus; * = estimated.
asc.proc. = ascending process of the astragalus; ast.body = astragalar body.

Theropod taxa	asc.proc. height/ asc.proc. width	asc.proc. height/ ast.body height	asc.proc. width at base/ ast.body width
<i>Phuwiangvenator</i> gen. et sp. nov.	1.39*	1.73*	65%
<i>Vayuraptor</i> gen. et sp. nov.	1.66	1.7	63%
<i>Fukuiraptor</i>	1.1	1.7	63%*
NMV P150070	1.3	1.43	55%
<i>Australovenator</i>	1	1.4	70%
<i>Aerosteon</i> cast of referred material	1	1.9	83%
<i>Suchomimus</i> MNBH GAD97	0.88	1.3	56%
<i>Suchomimus</i> MNBH GAD98	0.8	1.25	72%
<i>Allosaurus</i> UMNH VP11003	1	1.14	50%
<i>Falcarius</i>	1.1	1.3	66%
<i>Alioramus</i>	1.4	2.5	78%

