

## Supplementary Tables and Data:

### Supplementary Table 1a

Individual and total La\_REE raw data (in ppm) of the adult/embryonic bone pairs of *Lufengosaurus* (Dawa Locality DW) and *Yimenosaurus* (Yimen Locality YM) with the total La\_REE adult/embryo ratios

DW and YM REE Raw Data (ppm)															
CBA	39.70	68.40	7.17	26.40	5.22	1.03	4.60	0.63	4.13	0.87	2.54	0.40	2.44	0.36	
DW Raw	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Total REE
Adult-50	2,028.91	4,677.43	533.62	4,212.97	3,087.31	360.50	2,649.45	215.62	1,440.99	168.41	427.78	67.14	183.61	22.39	20,076.13
Adult-51	1,098.39	2,799.19	466.05	3,832.31	4,106.91	489.76	3,828.81	372.45	1,900.63	231.27	585.95	35.15	245.69	29.03	20,021.58
adult-NCHU	1,034.25	3,339.75	634.35	4,328.25	1,861.50	439.20	2,128.50	257.93	1,232.25	192.60	414.00	42.52	202.73	25.55	16,133.37
Emb Vert	155.93	461.67	89.26	458.52	80.61	27.52	223.33	46.67	172.22	31.30	68.89	3.47	19.37	2.42	1,841.18
Emb-NCHU	117.75	272.85	50.15	297.00	159.23	44.00	210.30	24.44	102.45	14.52	29.58	2.90	13.63	1.93	1,340.73
												Adult Avg	18,743.69		
YM RAW												Embryo Avg	1,590.95	Adult/Emb Ratio	11.78
CBA	39.70	68.40	7.17	26.40	5.22	1.03	4.60	0.63	4.13	0.87	2.54	0.40	2.44	0.36	
YM Raw	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Total REE
YM Adult-1	1,230.68	4,362.40	645.06	2,835.23	607.00	138.75	685.51	113.88	655.84	131.07	324.69	35.41	146.09	13.33	11,924.91
YM Adult-2	650.53	2,282.73	299.21	1,728.22	727.50	229.41	1,296.77	212.42	1,082.91	188.55	414.56	41.23	184.83	19.98	9,358.81
YM Embryo	217.28	313.61	57.69	242.19	59.91	10.47	63.94	6.11	41.93	5.03	15.42	2.13	12.90	1.68	1050.27
												Adult Avg	10,641.86		
												Emb	1050.27	Adult/Emb Ratio	10.13

Note:

1. Column 1 contains the sample site/number.
2. Concentration in ppm, except the ratio of La\_REE adult/embryo ratio

### Supplementary Table 1b

Adult/Embryo U Ratio

Analysis 1	U avg	Adt/Emb U Ratio	Analysis 2	U avg	AdtEmb U Ratio
Adult	556.80		Adult	2.57	
Embryo	104.78	5.31	Embryo	0.44	5.81

Note:

1. Column 2 and 4, in ppm

Supplementary Table 2

CBS Normalized *Lufengosaurus* (DW) and *Yimenosaurus* (YM) Adult/Embryo La-REE

CBS Normalized DW and YM Adult/Embryo La_REE														
	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
DW_Adult-1B(50)	51.11	68.38	74.42	159.58	591.44	350.00	575.97	342.26	348.91	193.57	168.42	181.46	75.25	62.19
DW_Adult-1B(51)	27.67	40.92	65.00	145.16	786.76	475.49	832.35	591.19	460.20	265.83	230.69	95.00	100.69	80.64
DW_adult-NCHU	26.05	48.83	88.47	163.95	356.61	426.41	462.72	409.40	298.37	221.38	162.99	114.91	83.08	70.98
DW Adult Avg	34.94	52.71	75.97	156.23	578.27	417.30	623.68	447.62	369.16	226.93	187.37	130.46	86.34	71.27
DW_Emb Vert	3.93	6.75	12.45	17.37	15.44	26.72	48.55	74.08	41.70	35.97	27.12	9.38	7.94	6.72
DW_embryo-NCHU	2.97	3.99	6.99	11.25	30.50	42.71	45.72	38.79	24.81	16.69	11.65	7.83	5.59	5.36
DW Embryo Avg	3.45	5.37	9.72	14.31	22.97	34.71	47.13	56.44	33.25	26.33	19.38	8.60	6.76	6.04
YM Adult-1	31.00	63.78	89.97	107.40	116.28	134.71	149.02	180.75	158.80	150.66	127.83	88.53	59.87	37.01
YM Adult-2	16.39	33.37	41.73	65.46	139.37	222.73	281.91	337.17	262.21	216.72	163.21	103.08	75.75	55.49
YM Adult Avg	23.69	48.58	65.85	86.43	127.82	178.72	215.46	258.96	210.50	183.69	145.52	95.80	67.81	46.25
DW Adult Avg	34.94	52.71	75.97	156.23	578.27	417.30	623.68	447.62	369.16	226.93	187.37	130.46	86.34	71.27
DW Embryo Avg	3.45	5.37	9.72	14.31	22.97	34.71	47.13	56.44	33.25	26.33	19.38	8.60	6.76	6.04
YM Adult Avg	23.69	48.58	65.85	86.43	127.82	178.72	215.46	258.96	210.50	183.69	145.52	95.80	67.81	46.25
YM Embryo	5.47	4.58	8.05	9.17	11.48	10.17	13.90	9.69	10.15	5.78	6.07	5.76	5.29	4.67

Note:

1. Yellow cells: CBS normalized Dawa *Lufengosaurus* adult and embryo averages
2. Green cells: CBS normalized Yimen *Yimenosaurus* adult and embryo averages

## Supplementary Table 3

*Lufengosaurus* P and total La\_REE concentration of Dawa Dinosaur bones

Dawa dinosaur bones	P	$\Sigma$ La_REE
Adult-1	23,487.00	1,284.93
A-Der Adult	60,677.00	2,982.22
Small limb	19,546.00	1,562.99
Tibia	11,805.00	951.28
Humerus	16,537.00	1,270.11
Centrum	14,629.00	1,092.03
Misc B	116.93	48.28
Misc A	244.10	60.90
Adult-2	6,696.00	215.11
Embryo	192.90	17.88

Note:

1. These various size fragments of the *Lufengosaurus* dinosaur bones were all collected at Dawa Dinosaur Hill. They were dissolved for elemental analyses.

## Supplementary S1, Methodology

### Sampling

Yimen adult *Yimenosaurus* specimen's number YM180324A1, YM180324A2, embryo specimen number YM180324EM, at N: 25°10'17.25", E: 102°6'15.81" were studied here. 10mg ground dinosaur bones were digested following the procedure of GB/T 14506.19. Then, the concentration of <sup>31</sup>P, <sup>40</sup>Ca, <sup>48</sup>Ti were measured by ICP-OES (PerkinElmer Optima 5300 DV) and the concentration of Rare Earth Elements were measured by ICP-MS (PerkinElmer ICP-MS element 2).

### Reagents

Analytical reagent grade chemicals: HNO<sub>3</sub>, HCl, HF, and HClO<sub>4</sub> were purchased from Sigma-Aldrich (Saint-Quentin-Fallavier, France). The Rare Earth Elements standard solution was from J&K Scientific Ltd (China). Ultrapure water (18 MΩ cm) was obtained from a Thermal Fisher ultrapure water supplier (USA).

### Sample preparation

We followed the procedure of GB/T 14506.19. Two pairs of dinosaur embryo-adult bones were digested as indicated below:

1. Precisely weighted 10mg grounded dinosaur bone were placed in the Teflon flask.
2. 1 mL 70% HNO<sub>3</sub> and 3 mL 36% HCl were added and heated at 110°C for 1h.
3. 3mL 40%HF and 1 mL 70% HClO<sub>4</sub> were added and heated at 130°C for 3h.
4. The digests were transferred to a volume flask and brought to 50mL waiting for ICP-MS detection.

### Instrumentation

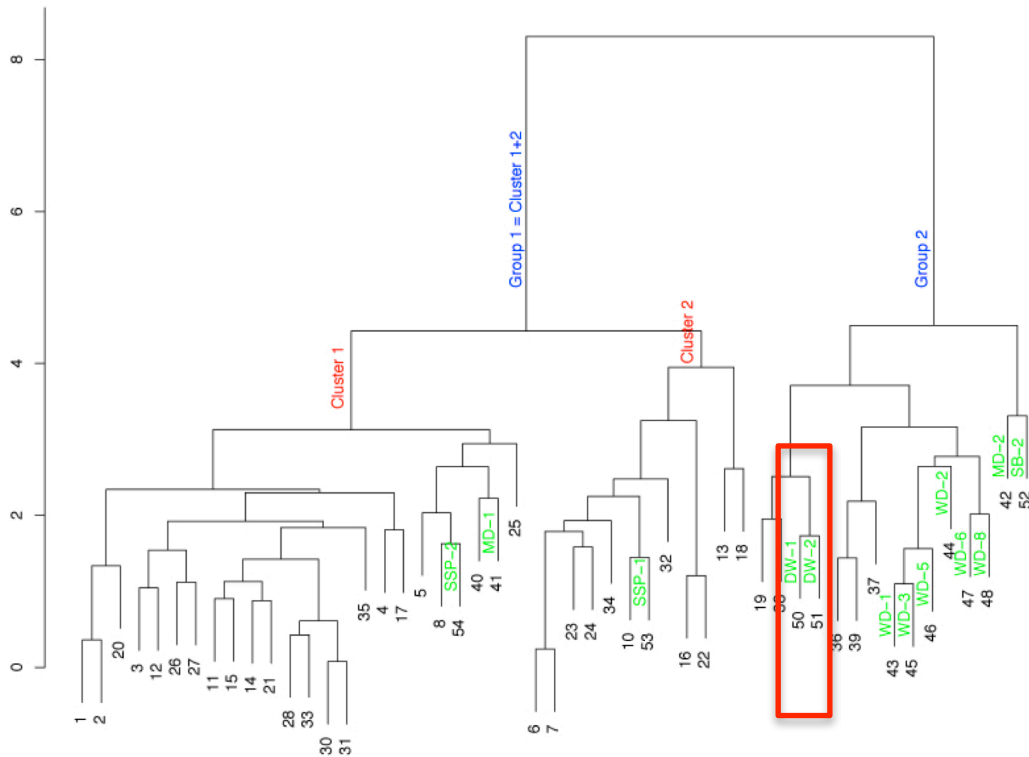
#### ICP-OES

The more abundant elements <sup>31</sup>P, <sup>40</sup>Ca, <sup>48</sup>Ti were measured by ICP-OES under the following operating parameters. Output power of generator, 1300 W. Plasma gas flow rate, 15.0 L min<sup>-1</sup>. Nebulizer gas flow rate, 0.75 L min<sup>-1</sup>. Auxiliary gas flow rate, 0.2 L min<sup>-1</sup>.

#### ICP-MS

The ICP-MS conditions were optimized daily to obtain the highest intensities and lowest interferences using a standard built-in software procedure using a tune solution containing 1 µg/L each of Li, Mg, Y, Ce, Tl and Co in a matrix of 2% HNO<sub>3</sub>. The concentration of the Rare Earth Element was measured by inductively coupled plasma-mass spectrometry (ICP-MS) under the following operating parameters. Skimmer/sampler cones, Ni. Operation mode, inorganic. Output power of generator, 1217 W. Plasma gas flow rate, 15.0 L min<sup>-1</sup>. Nebulizer gas flow rate, 1.01 L min<sup>-1</sup>. barrier gas flow rate, 0.69 L min<sup>-1</sup>. Nebulizer, concentric.

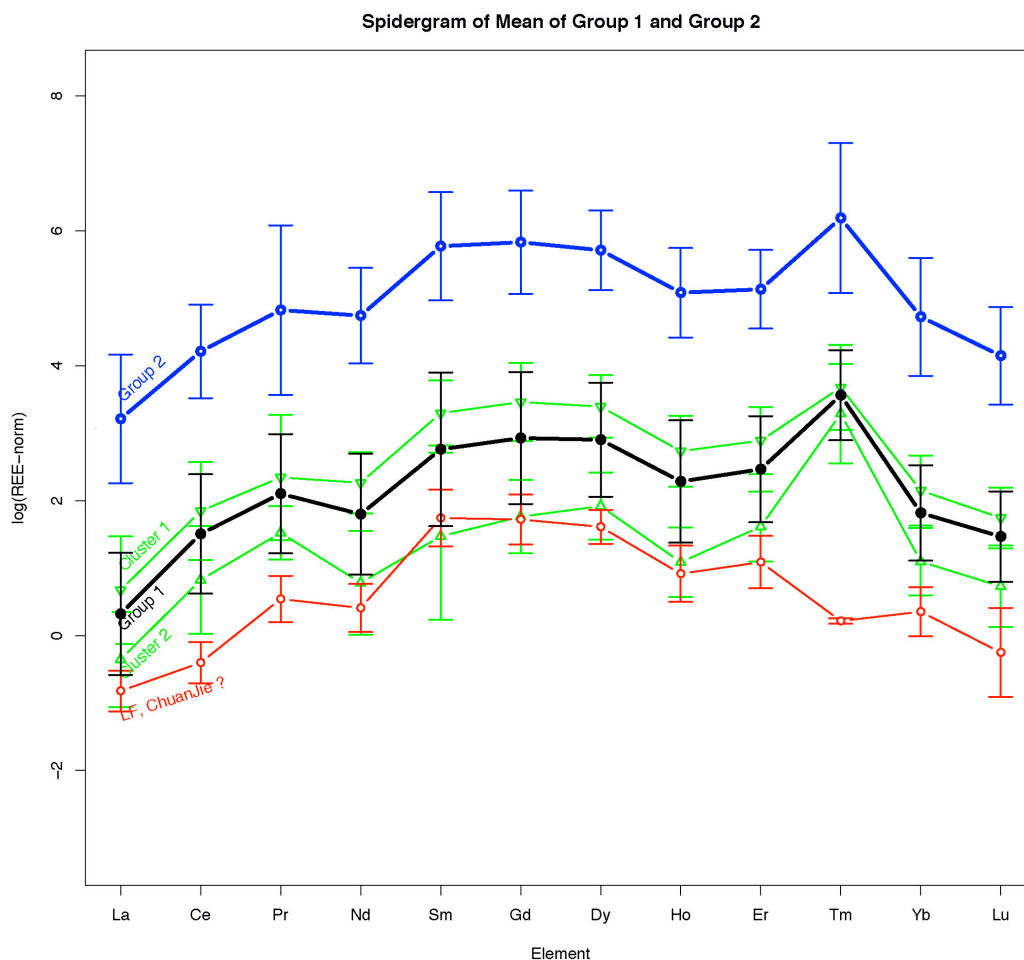
Figure S2-1 La\_REE Cluster Analysis of 54 dinosaur sites in Chuxiong Prefecture of Yunnan Province



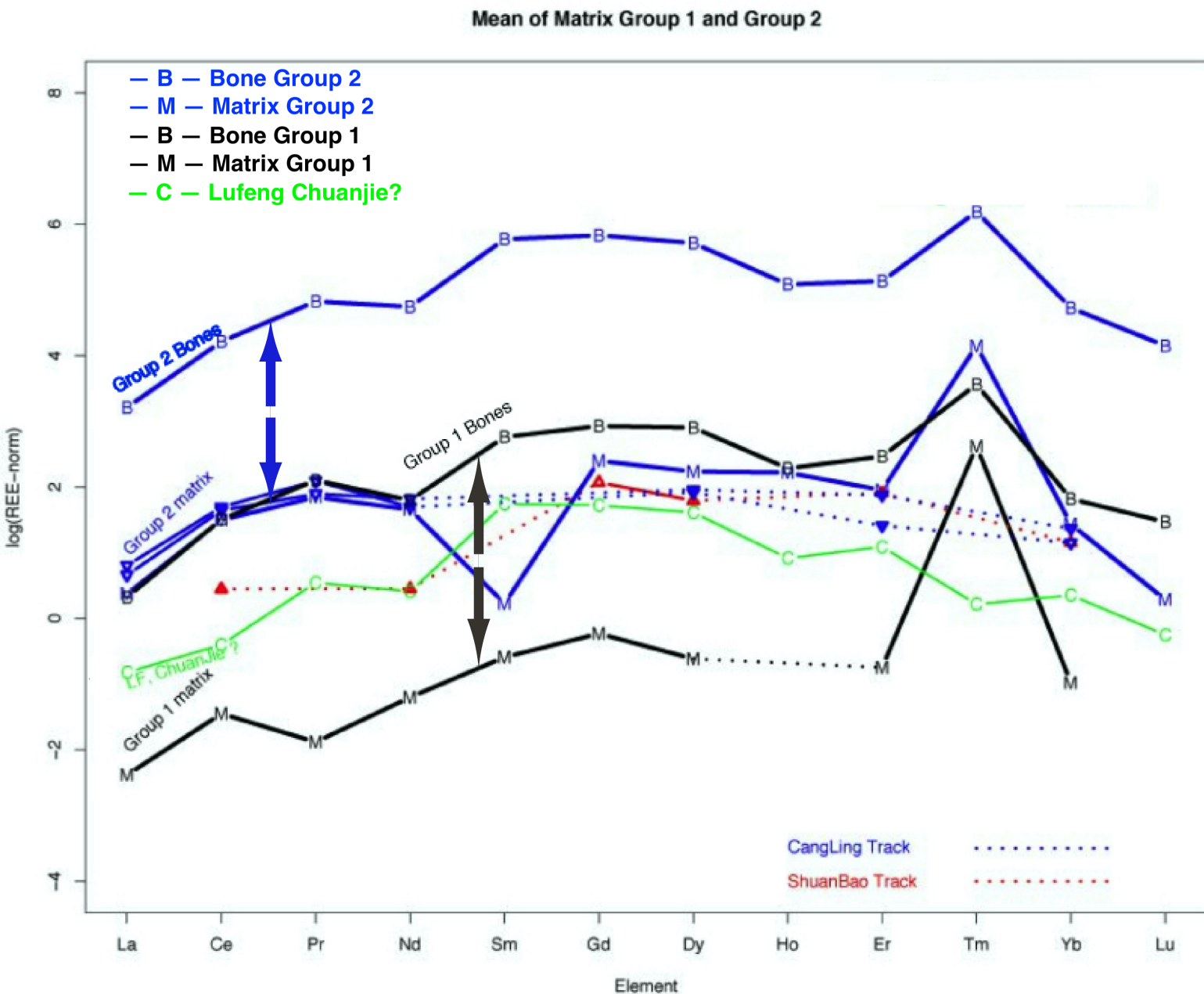
This Dendrogram was drawn by using Agglomerative Nesting (Hierarchical Clustering) of R to compute the agglomerative hierarchical clustering of the dataset of the La\_REE of 54 dinosaur sites in Chuxiong Prefecture of Yunnan Province. The height of the fusion, provided on the vertical axis, indicates the (dis)similarity/distance between two objects/clusters. The higher the height of the fusion, the less similar the objects are. At first, each observation is a small cluster by itself. Clusters are merged until only one more massive cluster remains, which contains all the observations. At each stage, the two *nearest* clusters are combined to form one larger cluster. The numbers are the site numbers. From the bottom left to right, three major clusters can be seen: Cluster 1 of mainly Jiangyi dinosaur sites (with two exceptions), Cluster 2 of mainly Jiangyi sites (one exception). These can be combined to form a group named Group 1 (“Jiangyi Layer”), and Group 2 (“Dawa Layer”). It is interesting to note that the Moding site, #41, MD-1 (“Jiangyi Layer”), is at a lower level than at MD-2, #42 (in “Dawa Layer”), pointing out a high angle tilting (N 80° E/ 10° SE).

The red box contains two Dawa dinosaur spots, name DW-1 (50) and DW-2 (51). The adult bones of these two spots were used in this study. This is taken from (Huang et al., 2009).

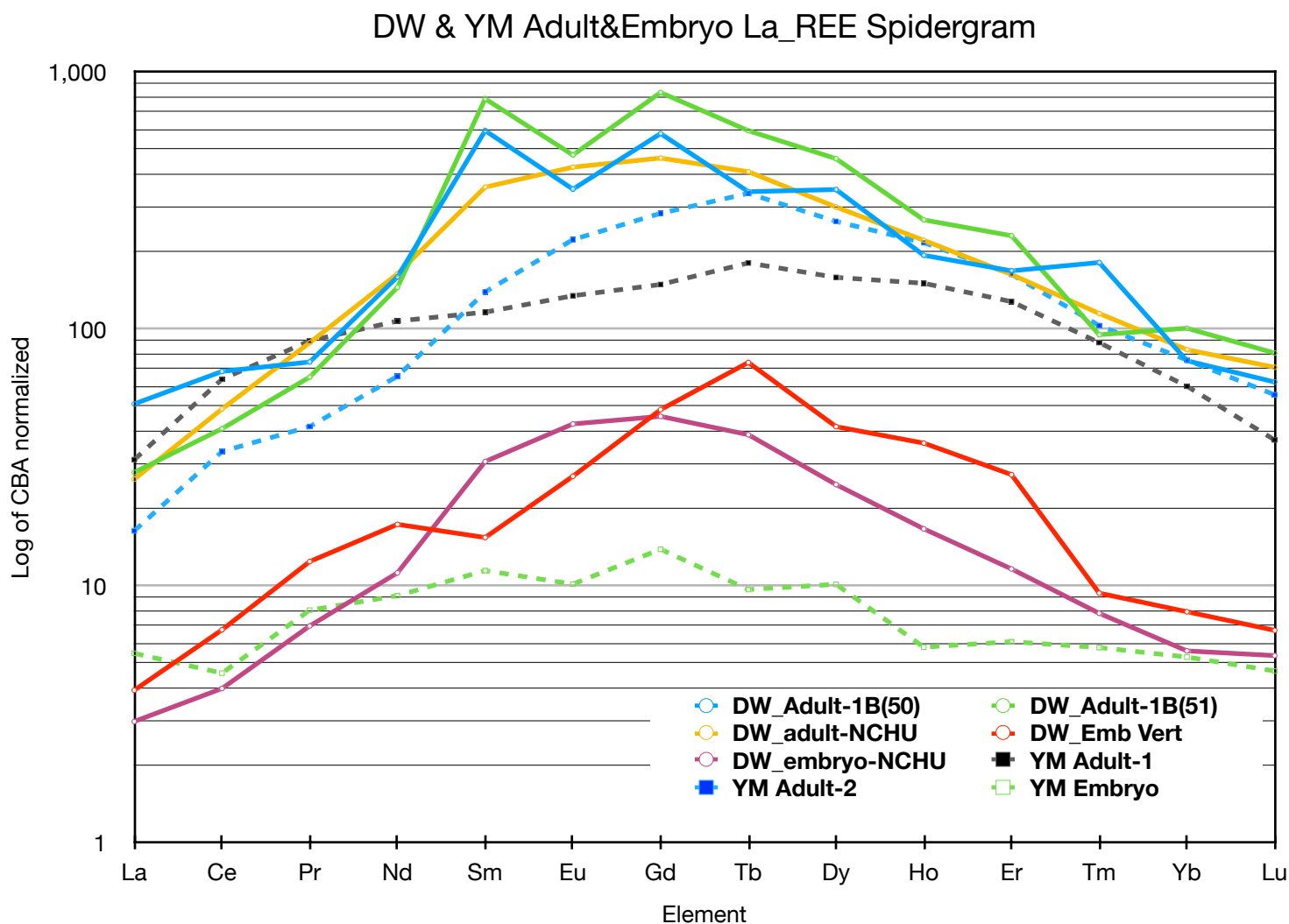
Supplementary Figure S2-2 La\_REE Spidergrams of three dinosaur ‘layers’ of Chuxiong Prefecture



Average La-REE spidergrams of dinosaur bones in Chuxiong Prefecture show three dinosaur strata, normalized with REE Chinese Background Average (CBA). In this chart, Group 2 is the Dawa Layer, Group 1 Jiangyi Layer, and the red curve is the Chuanjie Layer. The Dawa *Lufengosaurus* sites #50 and #51 are in the Dawa Layer spidergrams. Their curve shapes showed very similar ‘bell’ shape, meaning Mid-REE elements were more concentrated than the Light-REEs and Heavy-REEs. However, local variations also exist. This is taken from (Huang et al., 2009).



Spidergrams of the matrix of dinosaur strata of Chuxiong prefecture, Yunnan, vertical double arrow lines mark the distances between the bone and immediate surrounding matrix. They were normalized with La-REE Chinese Background Average (CBA). It shows huge La-REE concentration differences between the fossil bones and their immediate surrounding matrix, meaning that the high REE inside the bones were not caused by the inclusion of the matrix La-REE recently. The samples were from Supplemental S2-1. This is taken from (Huang et al., 2009).



This is the La\_REE spidergram chart of all Dawa *Lufengosaurus*, Lufeng, and Jiaojiadian, Yimen *Yimenosaurus* Adult/Embryo bones. In our view that there are too many spidergram curves on the same chart, which could make reading difficult. Thus, average values were used to minimize the complication in Figure 3 of the main text.