Reply to comment by Liu and Liu on "$^{40}Ar/^{39}Ar$ dating of ignimbrite from Inner Mongolia, northeastern China, indicates a post-Middle Jurassic age for the overlying Daohugou Bed"

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[1] *Liu and Liu* [2005] have questioned our conclusion of the post Middle Jurassic age for the Daohugou bed [*He et al.*, 2004], and instead suggested that the same deposit is equivalent to the Tiaojishan Formation of the late Middle Jurassic. Their arguments were mainly based on their own understanding of the Daohugou Biota-bearing sequences and a series of SHRIMP U-Pb ages of the zircon from the igneous rocks in the Daohugou area. Unfortunately, their comments have provided neither any new direct evidence from the field observation to falsify our sequence of the Daohugou Bed, nor any of the new dating which is in direct conflict with our dating results of the ignimbrites.

[2] First, although there exists dispute over the interpretation of the Daohugou Biota-bearing sequence, there is little dispute over the $^{40}Ar/^{39}Ar$ age of the ignimbrite in the Daohugou section by *He et al.* [2004]. *Liu and Liu* [2005] provided a series of SHRIMP U-Pb ages of the zircon ranging from 152–165Ma, which is, however, generally consistent with our dating result [*Chen et al.*, 2004; *He et al.*, 2004; *Liu et al.*, 2004; *Ren et al.*, 2002].

[3] Second, *Liu and Liu* [2005] referred one SHRIMP U-Pb zircon age (164–165Ma) of the tuff interbedded in the fossil-bearing shale [*Yang and Li*, 2004]. We had dated by ourselves the interbedded tuffs (arguably the same tuff as by Yang and Li) by $^{40}Ar/^{39}Ar$ step-heating (Table 1 and Figure 1) and single crystal fusing by CO_2 laser (Table 2 and Figure 2) on K-feldspars. Our dating results indicate that the tuffs were heavily contaminated by old crystals, thus explanation of the dating result should be made with caution.

[4] Third, *Liu and Liu* [2005] also questioned our explanation of the sequence of the ignimbrite overlying the Daohugou deposits, and cited some references to argue that the deposits overlies the ignimbrites. Unfortunately, none of these authors has provided any evidence of direct contact between the ignimbrite and the Daohugou deposits in their papers [*Liu et al.*, 2004], and neither have Liu and Liu done so in their comment. On the contrary, the weathered layer shown in our paper (the direct contact) between the ignimbrite and the fossil bearing shales [*He et al.*, 2004] had, for the first time, provided convincing evidence to reveal the stratigraphic sequence in this region, which unambiguously indicated that the fossil bearing shales are younger than the dated ignimbrite as mentioned in our original paper [*He et al.*, 2004].

[5] Fourth, our recent field investigation has clarified some observations while providing more evidence in support of our original opinion [*Wang et al.*, 2005]. We have discovered a new locality (Jiangzhangzi, Wuhua, N 41° 24′ 26.8″; E 119° 15′ 31.6″) in Ningcheng, Inner Mongolia, where the fossil-bearing Daohugou bed deposits are found to be directly overlying the ignimbrites, indicates that the Daohugou bed is younger than the ignimbrite (Figure 3). The red or greenish shales and mudstone that were previously referred to the Tuchengzi Formation near the Daohugou village are now recognized as representing the lowermost deposits of the Daohugou bed (contrary to *Liu and Liu*'s [2005] suggestion of the upper or top part of the section), with a broad distribution than previously understood.

Table 1. $^{40}Ar/^{39}Ar$ Step Heating Data for the K- Feldspars From Interbedded Tuff L3007 in Daohugou Bed[a]

T	$^{40}Ar/^{39}Ar$	±	$^{37}Ar/^{39}Ar$	±	$^{36}Ar/^{39}Ar$	±	$^{40}Ar^*/^{39}Ar$	±	Age, Ma	±
700	12.73	0.06	0.06	0.00	0.0028	0.0000	11.9	0.1	169.2	1.2
750	12.11	0.01	0.05	0.00	0.0014	0.0000	11.7	0.0	166.6	1.0
800	11.55	0.01	0.06	0.00	0.0008	0.0000	11.3	0.0	161.3	1.0
850	11.71	0.01	0.08	0.00	0.0027	0.0000	10.9	0.0	155.7	0.9
900	11.96	0.01	0.13	0.00	0.0005	0.0000	11.8	0.0	168.0	1.0
950	14.10	0.01	0.23	0.00	0.0006	0.0000	13.9	0.0	196.4	1.1
1000	15.24	0.01	0.35	0.00	0.0008	0.0000	15.0	0.0	211.0	1.2
1050	16.10	0.01	0.33	0.00	0.0009	0.0000	15.8	0.0	221.7	1.3
1100	16.97	0.01	0.23	0.00	0.0012	0.0000	16.6	0.0	232.2	1.3
1150	17.81	0.01	0.16	0.00	0.0006	0.0000	17.6	0.0	245.5	1.4
1200	19.10	0.01	0.11	0.00	0.0005	0.0000	19.0	0.0	262.7	1.5
1230	20.12	0.01	0.07	0.00	0.0005	0.0000	20.0	0.0	275.5	1.5
1250	21.32	0.02	0.07	0.00	0.0006	0.0000	21.2	0.0	290.7	1.6
1280	21.55	0.01	0.10	0.00	0.0007	0.0000	21.3	0.0	293.0	1.6
1320	22.30	0.02	0.18	0.00	0.0016	0.0000	21.8	0.0	299.0	1.7
1380	25.25	0.04	0.35	0.00	0.0023	0.0000	24.6	0.0	333.6	1.9
1500	36.20	0.07	0.60	0.00	0.0037	0.0001	35.1	0.1	459.5	2.6

[a]Note: All the uncertainties are 1 s.d. L3007-Kfs nw = 30.24mg, J = 0.008264 ± 0.000050.

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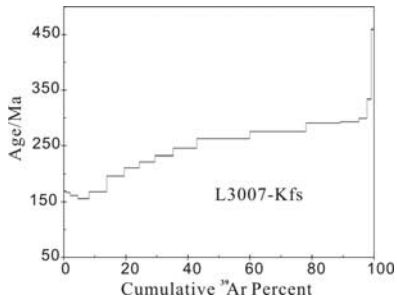

Figure 1. The age spectrum of the K-feldspars from interbedded tuff L3007 in Daohugou Bed indicates old crystals contamination.

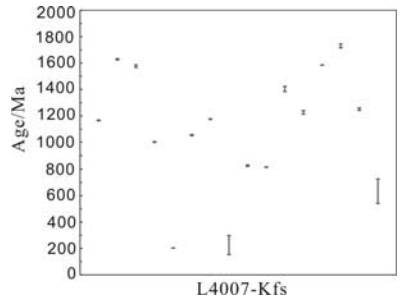

Figure 2. $^{40}Ar/^{39}Ar$ single crystal fusion data for the K-feldspars from interbedded tuff L4007 in Daohugou Bed indicates old crystals contamination.

Table 2. $^{40}Ar/^{39}Ar$ Single Crystal Fusion Data for the K-Feldspars From Interbedded Tuff L4007 in Daohugou Bed[a]

$^{40}Ar/^{39}Ar$	±	$^{37}Ar/^{39}Ar$	±	$^{36}Ar/^{39}Ar$	±	$^{40}Ar^*/^{39}Ar$	±	Age, Ma	±
87.44	0.27	0.00	0.00	0.0002	0.0000	87.4	0.3	1165.4	7.1
141.13	0.58	0.01	0.00	0.0001	0.0000	141.1	0.6	1628.3	9.4
145.73	1.32	0.15	0.07	0.0386	0.0012	134.3	1.3	1576.1	12.8
71.68	0.24	0.02	0.00	0.0008	0.0000	71.5	0.2	1001.7	6.5
12.06	0.02	0.10	0.00	0.0019	0.0000	11.5	0.0	203.5	1.5
76.91	0.36	0.06	0.00	0.0019	0.0001	76.4	0.4	1053.7	7.2
88.64	0.24	0.01	0.00	0.0007	0.0000	88.4	0.2	1175.6	7.1
74.81	10.04	3.52	0.79	0.2097	0.0310	12.8	4.4	225.8	72.8
68.82	0.33	0.26	0.07	0.0433	0.0012	56.0	0.4	827.6	7.2
55.29	0.08	0.01	0.00	0.0006	0.0000	55.1	0.1	816.8	5.2
138.06	2.68	0.77	0.08	0.0837	0.0026	113.3	2.3	1403.9	21.1
115.47	1.46	0.04	0.06	0.0736	0.0022	93.7	1.3	1226.6	14.4
135.50	0.10	0.01	0.00	0.0000	0.0000	135.5	0.1	1585.3	8.2
155.64	2.07	0.51	0.01	0.0027	0.0001	154.8	2.1	1729.9	17.1
96.43	0.89	0.19	0.00	0.0006	0.0001	96.2	0.9	1250.5	10.8
46.76	7.35	1.46	0.19	0.0212	0.0038	40.5	7.0	633.6	92.1

[a]Note: All the uncertainties are 1 s.d. L4007-Kfs single crystal fusion, J = 0.01039 ± 0.00008.

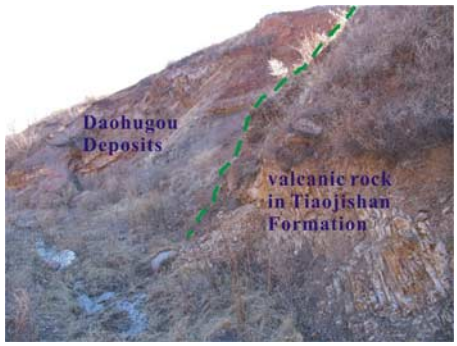

Figure 3. Field photo showing the direct contact between the lowermost Daohugou deposits and the underlying ignimbrites at the Jiangzhangzi locality (N 41° 24′ 26.8″; E 119° 15′ 31.6″), indicates that the Daohugou bed is younger than the ignimbrite.

[6] Finally, *Liu and Liu* [2005] have shown in their Figure 3 four field photos to indicate the Daohugou deposits underlying the Yixian Formation, which support one of our conclusion that the Daohugou bed is older than Yixian Formation. However, These photos are completely irrelevant to the topics discussed in their comment. With all the arguments in their comment, we are puzzled why they cannot just provide a single field photo showing the direct contact between the Daohugou deposits and the ignimbrites, the age of the latter is now generally concurred by all of us.

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