Vol. 81 No. 6 pp. 917–924 ACTA GEOLOGICA SINICA Dec. 2007

Late Cretaceous Foraminiferal Faunas from the Saiqu "mélange" in Southern Tibet

LI Guobiao[1, *], WAN Xiaoqiao[1], JIANG Ganqing[2], HU Xiumian[3],
GOUDEMAND Nicolas[4], HAN Hongdou[1] and CHEN Xi[1]
1 *Departmemt of Earth Sciences, China University of Geosciences, Xueyuan Lu 29, Beijing 100083, China*
2 *Department of Geosciences, University of Nevada Las Vegas, Las Vegas NV89154-4010, U S*
3 *Departmemt of Earth Sciences, Nanjing University, Nanjing 210093, China*
4 *Insitute of Paleontology and Museum, University of Zurich, Karl Schmid-Strasse 4, Zurich CH-8006, Switzerland*

Abstract: As one of the mélanges in the southern side of the Yarlung-Zangbo suture zone, the Saiqu mélange in southern Tibet is important for understanding the evolution of the Neo-Tethys ocean. The age of the Saiqu mélange, however, has been debated due to the lack of reliable fossil evidence in matrix strata. Based on lithological similarities with platform strata in southern Tibet and limited fossils from exotic blocks, previous studies variously ascribed the Saiqu mélange to be Triassic in general, Late Triassic, or Late Cretaceous. Here we reported planktonic foraminiferal faunas from the matrix strata of the Saiqu mélange. The new fossils yield a Late Cretaceous age, which is so far the best age constraint for the mélange. Regional stratigraphic correlation indicates that the Cretaceous Oceanic Red Beds (CORBs) in Saiqu may be time equivalent to the CORBs of the Zongzhuo Formation in neighboring regions. Thus the Saiqu mélange should be correlated to the Upper Cretaceous Zongzhuo Formation rather than the Triassic Xiukang Group, as previously suggested.

Key words: Saiqu Mélange, Planktonic Foraminifera, Late Cretaceous, Red Beds, Zongzhuo Formation, Tibet

1 Introduction

A series of mélange complexes occur along the southern side of the Yarlung-Zangbo suture zone (Fig. 1). The age of these mélanges and their regional correlation are important for understanding the evolution of the Neo-Tethys ocean in southern Tibet. As one of the mélanges, the Saiqu mélange in Sa'gya, southern Tibet consists of matrix strata and exotic blocks. In the lack of reliable fossils from both matrix strata and exotic blocks, the age and stratigraphic correlation of this mélange have been debated (Gansser, 1974; Chen, 1980; Qian, 1982; TBGMR, 1983, 1993; Wang et al., 1983). Based a general stratigraphic comparison, it has been considered as equivalent to the upper Cretaceous Zongzhuo Formation (TBGMR, 1983). In contrast, on the basis of a few fossils from the exotic blocks within the mélange, it has been assigned as Triassic in general (TBGMR, 1983) or Late Triassic (TBGMR, 1993). In this later suggestion, the Saiqu mélange was correlated to the upper Triassic "Xiukang Group" in the neighboring regions.

Away from the age of Saiqu mélange itself, two general problems existed regarding the age and regional correlation of the mélanges in southern Tibet. First, the lack of fossils in general has led to uncertainties on the age of mélanges and their correlation, resulting in arbitrary age assignments on the basis of lithological similarities. Second, many previous studies used fossils from exotic blocks as the formation age of mélanges, leading to different age assignments even for the same mélange. This has caused serious problems for the regional correlation of mélanges in orogenic belts in general (Guo et al., 2006). Particularly, the great differences regarding the ages of the mélanges along the southern side of the Yarlung-Zangbo suture zone prevent a better understanding of the history of the Neo-Tethys ocean in this region.

* Corresponding author. E-mail: shaowuren@tom.com.

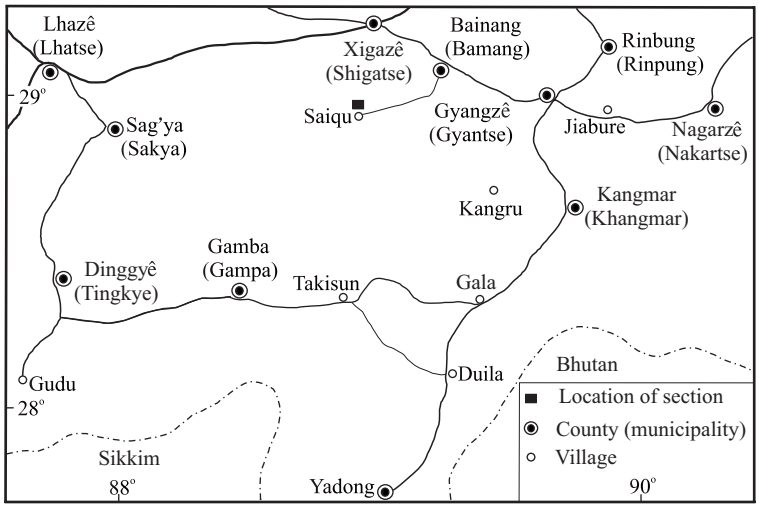

Fig. 1. Schematic map showing the location of the section.

For the purpose of better defining the age of the Saiqu mélange and its regional correlation, in this paper we report the foraminiferal fossils collected from the matrix strata of the mélange. The fossils reveal a Late Cretaceous age, different from those of the exotic blocks. The new data highlight the need to distinguish the fossils from exotic blocks and matrix strata and support the view that the age of the Saiqu mélange and other mélanges should be determined by fossils from the matrix strata rather than those from the exotic blocks.

2 Material and Methods

Samples for this study were collected from the mélange at the Saiqu section (88˚53′28″E, 28˚52′56″N) in Sa'gya, southern Tibet (Fig.1). A total of twenty-two limestone and shale samples were collected from the section.

The foraminifera were processed and determined at the Fossil Identification Center of China University of Geosciences in Beijing. For shale samples, 200 grams of sample were crushed into pieces of 2 mm dimensions or less. Crushed samples were disaggregated by repeated soaking and drying in 10% Na_2SO_4 solution and then wet-sieved through a 0.5 μm mesh. Residues were dried, weighed, and sieved using a series of sieves of 0.5, 0.25 and 0.16 μm mesh. Residues comprising particles greater than 0.5 μm in diameter were regarded as unprocessed. Specimens from the fraction of 0.5–0.16μm were picked. For harder samples such as limestone, multiple oriented thin-sections were prepared for each sample. A total of 17 limestone samples were analyzed.

All foraminiferal specimens are deposited in the Fossil Identification Center of China University of Geosciences in Beijing.

3 The Age of Foraminiferal Assemblage

3.1 Foraminiferal assemblage

Planktonic foraminifera are the only, or the dominating, element of the foraminiferal assemblages examined in this work. The state of preservation is relatively good, but examination of specimens under a scanning electron microscpe revealed considerable recrystallisation and traces of corrosion.

The assemblages are dominated by the following genera: *Globotruncana*, *Globotruncanella*, *Globotruncanita*, *Heterhelix* and *Rosita*, with *Globotruncana bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanella havanensis*, *Globotruncanita calcarata*, *G. elevata*, *G. stuarti*, *G. stuartiformis*, *Heterhelix globulosa* and *Rosita fornicata* being the important and represented species (Fig.2). Most of them are the common elements of the Late Cretaceous planktonic foraminifera *Globotruncana* fauna widespread in the Tethyan Ocean.

3.2 Age assignment

G. bulloides is restricted to the latest Santonian to Middle Maastrichtian, i.e., from top *D. asymmetric* Zone to middle *A. mayaroensis* Zone in Caron's planktonic foraminiferal zonation (Caron, 1985). *G. lapparenti* ranges from the latest Santonian to Middle Maastritian, i.e., from the top of *D. asymmetric* Zone to the middle of *G. aegyptiaca* Zone. *G. linneiana* ranges from the latest Santonian to middle Maastritian, i.e., from the top of *D. asymmetric* Zone to the bottom of *G. gansseri* Zone. *G. ventricosa* defines the *G. ventricosa* Zone, which is Campanian to Maastrichtian in age. *G. havanensis* defines the *G. havanesis* Zone, which is the latest Campanian to the end of Maastrichtian in age. *G. calcarata* defines the *G. calcarata* Zone, which is limited to late Campanian in age. *G. elevata* defines the *G. elevata* Zone, which is the latest Santonian to the late Maastrichtian in age, i.e., from the top of *D. asymmetric* Zone to the middle of *G. calcarata* Zone. *G. stuarti* ranges from the latest Campanian to the end of Maastrichtian in age, i.e., from the middle of *G. havanensis* Zone to the top of *A. mayaroensis* Zone. *G. stuartiformis* is restricted to the latest Santonian to Late Maastrichtian, i.e., from top *D. asymmetric* Zone to lower *A. mayaroensis* Zone. *H. globulosa* ranges from the earliest Campanian to Middle Maastrichtian and *R. fornicata* ranges from Middle Santonian to middle Maastrichitian.

Based on the above-mentioned characteristics of the planktonic foraminiferal assemblage, this assemblage is

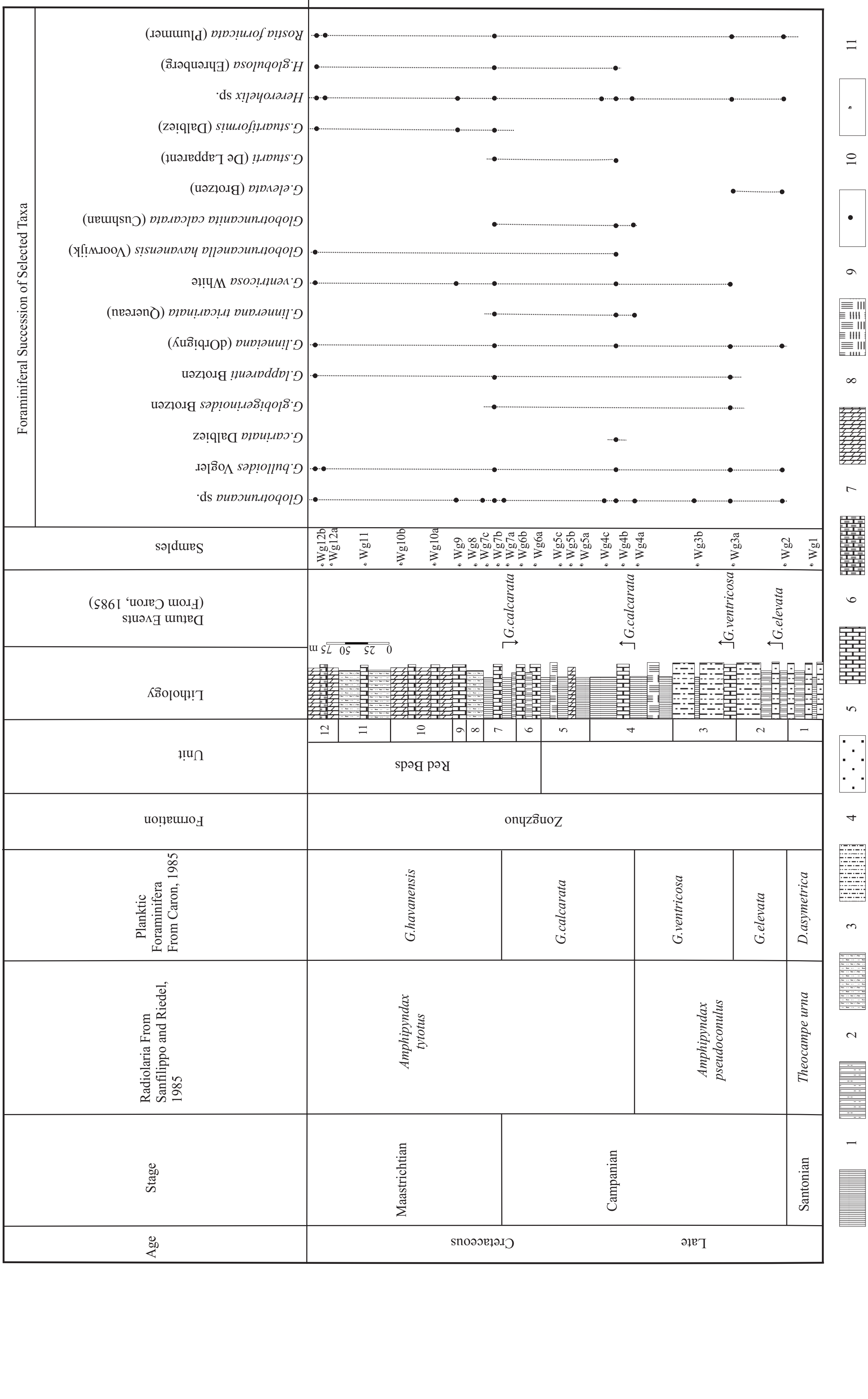

Fig. 2. Foraminiferal species ranges and datum events of the Saiqu section.
1. Shale; 2. Silty Shale; 3. Calcareous Siltstone; 4. Siltstone; 5. Sandstone; 6. Limestone; 7. Siliceous Limestone; 8. Marlite; 9. Silicolites; 10. Fossils from Single Sample; 11. Location of Collection.

considered to be Campanian-early Maastrichtian in age.

4 Planktonic Foraminiferal Stratigraphy

Based on the compilation of Caron (1985), several planktonic foraminiferal zones have been determined in this paper in the Saiqu section. In an upward biostratigraphic order they are the *Globotruncanita elevata*, *Globotruncana ventricosa*, *Globotruncanita calcarata* and *Globotrunca- nella havanensis* zones (Fig.2).

4.1 *Globotruncanita elevata* Zone

Globotruncanita elevata Zone is a Partial Range Zone (PRZ) of Early Campanian named by Postuma (1971). It is characterized by the appearance of *Globotruncanita elevata* and encompasses the interval from last occurrence of *Dicarinella asymetrica* to the first occurrence of *Globotruncana ventricosa*. In the Saiqu section, this zone is represented by the Unit 2. The *Globotruncanita elevata* and four other species of planktonic foraminifera (*Globotruncana bulloides*, *G. linneiana*, *Rosita fornicata* and *Heterhelix* sp.) were preserved in this Unit. The top of this zone is delineated by the first occurrence of *Globotruncana ventricosa*. The age of this zone is early Campanian of Late Cretaceous.

4.2 *Globotruncana ventricosa* Zone

Globotruncana ventricosa Zone is an Interval Zone (IZ) named by Dalbiez (1955) and encompasses the interval from first occurrence of *G. ventricosa* to first occurrence of *Globotrunca- nita calcarata*. In the Saiqu section, this zone encompasses the interval from the Unit 3 to the lower part of Unit 4. The first occurrence of *G. ventricosa* marks the base of this zone. The top of this zone is delineated by the first occurrence of *G. calcarata*. Except for *G. ventricosa*, the presented elements occurring in this zone also include: *Globotruncana bulloides*, *G. globigerinoides*, *G.* cf. *lapparenti*, *G. linneiana*, *G. ventricosa*, *G. elevata*, *Heterohelix* sp., *Textularia* sp. and *Rostia fornicata*. The age of this zone is upper part of Early Campanian to Late Campanian.

4.3 *Globotruncanita calcarata* Zone

Globotruncanita calcarata Zone is Total Range Zone (TRZ) named by Herm (1962) and encompasses the interval of total range of *Globotruncanita calcarata*. In the Saiqu section, this zone spans the interval from the upper part of the Unit 4 to the lower part of Unit 7. The first appearance of *G. calcarata* marks the base of this base. The top of this zone is delineated by the last occurrence of *G. calcarata*. Apart from *G. calcarata*, the presented elements occurring in this zone also include: *Globotruncana bulloides*, *G. globigerinoides*, *G. lapparenti*, *G. linneiana*, *G. linneiana tricarinata*, *G. ventricosa*, *Globotruncanita calcarata*, *G. stuarti*, *G. stuartiformis*, *Heterohelix globulosa*, *Heterohelix* sp. and *Rosita fornicata*. The age of this zone is upper part of Late Campanian.

4.4 *Globotruncanella havanensis* Zone

Globotruncanella havanensis Zone is Patial Range Zone (PRZ) named by Caron (1978) and spans the interval from last occurrence of *G. calcarata* to first occurrence of *Globotruncana aegyptiaca*. This zone is characterized by the appearance and bloom of the nominated species (*G. havanensis*). In the Saiqu section, this zone spans the interval from the upper part of the Unit 7 to the Unit 12. The base of this zone is delineated by last occurrence of *G. calcarata*. Apart from the nominated species, the presented elements occurring in this zone also include: *Globotruncana bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanita stuartiformis*, *Heterohelix globulosa*, *H*. sp., *Nodosaria* sp. and *Rosita fornicata*. The age of this zone should be lower part of Early Maastrichtian.

5 Discussion

Abundant planktonic foraminifera were discovered from the matrix of the Saiqu mélange, which indicates a Late Cretaceous age for the mélange. The Red Member of this mélange can be correlated with the "Upper Cretaceous Ocean Red Beds (CORBs)", the Chuangde Formation (Li et al., 1999), by their lithologic similarities. Based on the age of the planktonic foraminifera and the lithological sequences, the matrix strata of the mélange should be part of the Late Cretaceous Zongzhuo Formation, in contrast to previous interpretations in which the mélange was considered as either broadly Triassic or equivalent to the Triassic Xiukang Group.

The "Red Member" of the Zongzhuo Formation, which has been raised to the formation status — the Chuangde Formatiom (Li et al., 1999; Wang et al., 2005), has been used as a marker to recognise the Zongzhuo Formation during our mapping in southern Tibet. This unit is widespread in southern Tibet and its time-equivalent units were reported globally (e.g., Schlanger and Jenkyns, 1976; Görür et al., 1993; Bak 1998; Eren and Kadir, 1999; Wan et al., 2005a; Wan et al., 2005b; Wang and Hu 2005; Wang et al., 2005; Hu et al., 2005). This unit and its equivalents were possibly deposited in response to a global oxygenation event. The Chuangde Formation consists of red marine mudstones intercalated with pelagic marlstones, limestones and radiolarian cherts (Wang et al., 2005) and should be part of the Zongzhuo Formation. The red

mudstones reflect deposition below the carbonate compensation depth (CCD) in a deep oceanic basin. The intercalated, thin-bedded marlstones represent fine-grained turbidites that were derived from the upper slope and transported into the adjacent deep basin. The red beds of the Chuangde Formation were deposited in a highly oxygenated deep-sea environment. Their deposition coincided with a Santonian–early Campanian diversity peak of planktonic foraminifera. The deposition of the Chuangde Formation is similar to that of the Upper Cretaceous oceanic red beds (CORBs) in Western Europe such as the Scaglia Rossa in Italy (Lehner et al., 1987) and Austrian Alps (Wagreich, 1995), Western Asia such as Eastern Pontides in Turkey (Görür et al., 1993), and Ladakh-Zanskar Himalayas (Robertson and Degnan, 1993; Robertson and Sharp, 1998).

Studies of the planktonic foraminiferal fauna of the Zongzhuo Formation in the Gyangtzê area revealed five planktonic foraminiferal assemblages (Wan et al. 2005a, b). In an ascending order these include: (1) *Dicarinella asymetrica Zone*; (2) *Globotruncanita elevata Zone*; (3) *Globotruncana ventricosa Zone*; (4) *Globotruncanita calcarata Zone*; *and* (5) *Globotruncanella havanensis-Globotruncanita aegyptica* assemblage. The first four zones are present in the oceanic red beds and indicate an age from Late Santonian to Middle Campanian. The fifth zone occurs above the red beds in the Changde section, which may indicate a Masstrichtian age. The planktonic foraminifera from the Saiqu mélange are quite similar to those of the Zongzhuo Formation in Gyangtze area, except that the representative elements of Dicarinella asymetrica Zone were not found in Saiqu. The red beds in the Gyirong-Saga region also contain abundant planktonic foraminifera of late Campanian-Maastrichtian age, including species of four genera: *Globotruncana aegyptiaca*, *G. arca, G. bulloides, G. ventricosa, Globotrunita stuarti, Gansserina gansseri and Abathomphalus mayaroensis* (Wan et al. 2005a, b).

Upper Cretaceous multi-coloured pelagic marly limestones (grey, red, green) of the Fatu La Formation cropped out widely in the Zanskar Himalaya (Gaetani et al., 1985; Garzanti, 1993) are also rich in planktonic foraminfera. Premoli Silva et al. (1991) dated the Fatu La Formation as early Turonian-early Campanian on the basis of planktonic foraminiferal fossils and considered it to have been deposited in a deep, opened shelf/slope environment under oxygenated conditions.

6 Conclusions

The planktonic foraminifera retrieved from the matrix strata of the Saiqu mélange at the Saiqu section in southern Tibet indicate that this mélange is late Cretaceous in age. The red beds of the Saiqu mélange are of Campanian-Middle Maastrichitian age, as indicated by the presence of abundant planktonic foraminifera including *Globotruncana bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanella havanensis*, *Globotruncanita elevata*, *G. stuarti*, *G. stuartiformis*，*Heterhelix globulosa* and *Rosita fornicata*.

A lithological and microfaunal comparison of the Saiqu mélange with formations in neighbouring regions in southern Tibet indicates that the matrix strata of the Saiqu mélange should be part of the Cretaceous Zongzhuo Formation rather than the Triassic Xiukang Group, as previously concluded. The red beds in the mélange are widespread in southern Tibet and globally, likely recording deposition in response to a global Late Cretaceous oxygenation event.

Acknowledgements

This research was financially supported by the National Basic Research Program of China (973 Program; Grant No. 2006CB701400), the Project of the Geological Survey of China (Grant Nos. H45C004004, G45C001004) and the National Natural Science Foundation of China (Grant No. 40472011).

Appendix.

List of species

Abathomphalus mayaroensis (Bolli, 1951)
Dicarinella asymetrica (Sigal, 1952)
Gansserina gansseri (Bolli, 1951)
Globotruncana aegyptiaca Nakkady, 1950
G. arca (Cushman, 1926)
G. bulloides Vogler, 1941
G. lapparenti Brotzen, 1936
G. linneiana (d'Orbigny, 1839)
G. ventricosa White, 1928
Globotruncanella havanensis (Voorwijk, 1937)
Globotruncanita calcarata (Cushman, 1927)
G. elevata (Brotzen, 1934)
G. stuarti (de Lapparent, 1918)
G. stuartiformis (Dalbiez, 1955)
Heterohelix globulosa (Ehrenberg, 1840)
Rostia fornicata (Plummer, 1931)

Manuscript received Aug. 26, 2007
accepted Sept. 25, 2007
edited by Jiang Shaoqing

References

Bak K, 1998. Planktonic foraminiferal biostratigraphy, Upper

Cretaceous red pelagic deposits, Pieniny Klippen Belt, Carpathians. *Studia Geologica Polonica*, 111: 7–92.

Bolli H, 1951. The genus Globotruncana in Trinidad, B.W.I. J Paleontol., 25 (2): 187–99.

Brotzen F, 1934. Foraminiferen aus dem *Senon Palästinas. Zeitschrift des deutschen Vereins zur Erforschung Palästinas*, 57: 28–72.

Brotzen F, 1936. Foraminiferen aus dem schwedischen untersten Senon von Eriksdal in Schonen. *Sver. Geol. Unders*., 30 (3): 1–206.

Caron M, 1978. Cretaceous planktic foraminifera from DSDP Leg 40n Southeastern Atlantic Ocean. *Initial Rep. Deep Sea drill. Proj*., 40: 651–678.

Caron M, 1985. Cretaceous planktic foraminifera. In: Bolli H M, Saunders J B, Perch-Nielsen K (Eds.). *Plankton Stratigraphy*. Cambridge: Cambridge University Press, 17–86.

Chen Guoming, 1980. Main features of the ocean-crustal depositions and mélange of northern Himalayan folded belt. In: *Contribution to the Geology of the Qinghai-Xizang (Tibet) Plateau*. Beijing: Geological Publishing House, 124–138 (in Chinese).

Cushman J A, 1926. Some foraminifera from the Mendez Shale of Eastern Mexico. *Contrib. Cushman Lab. Foramin. Res.*, 2: 16–28.

Cushman J A, 1927. An outline of a reclassification of the foraminifera. *Contrib. Cushman Lab. Foramin. Res.*, 3: 1–105.

Dalbiez F, 1955. The genus Globotruncana in Tunisia. *Micropaleontology*, 1 (2): 161–171.

d'Orbigny A, 1839. Foraminifères. In: R. de la Sagra (ed.), *Histoire physique, politique et naturelles de l'île de Cuba*, Bertrand,Paris,224pp.

Ehrenberg C G, 1840. Über die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen. *Abh. K. Akad. Wiss. Berlin, Physik., Berlin, Deutschland* (1838), p.135.

Eren M, and Kadir S, 1999. Colour origin of Upper Cretaceous pelagic red sediments within the Eastern Pontides, northeast Turkey. *International Journal of Earth Sciences*, 88 (3): 593–595.

Gaetani M, Casnedi R, Fois E, Jadoul F, Nicora A, and Tintori A, 1985. Stratigraphy of the Tethys Himalaya in Zanskar, Ladakh. *Rivista Italiana di Paleontologia e Statigrafia*, 91 (4): 443–478.

Gansser A, 1974. The ophiolitic mélange, a world-wide problem on Tethyan examples. *Eclogae Geologicae Helvetiae*, 67 (3): 479–508.

Garzanti E, 1993. Sedimentary evolution and drowning of a passive margin shelf (Giumal Group; Zanskar Tethys Himalaya, India): palaeoenvironmental changes during final break-up of Gondwanaland. In: Treloar, P.J., Searle, M.P. (Eds.), Himalayan Tectonics. *Geological Society, London, Special Publication*, 74: 277–298.

Görür N, Tuysuz O, Aykol A, Sakinç M, Yigitbas E, and Akkök R, 1993. Cretaceous red pelagic carbonates of northern Turkey: their place in the opening history of the Black Sea. *Eclogae Geologicae Helvetiae*, 86 (3): 819–838.

Guo Xianpu, Wang Naiwen, Ding Xiaozhong, Zhao Min and Wang Daning, 2006. Discovery of Paleogene sporopollen from the matrix strata of the Naij Tal Group-complex in the eastern Kunlun orogenic belt. *Acta Geologica Sinica* (English edition), 80 (4): 490–497.

Herm D, 1962. Stratigraphische und miktopaläontologische Untersuchungen der Oberkreide im Lattengebirge und im Nierental. *Abh. bayer. Akad. Wiss.*, *Munchen*, *new ser*., 104: 1–119.

Hu Xiumian, Jansa Luba, Wang Chengshan, Sarti Massimo, Bak Krzysztof, Wagreich Michael, Michalik Jozef and Soták Ján, 2005. Upper Cretaceous oceanic red beds (CORBS) in the Tethys: occurrences, lithofacies, age, and environments. *Cretaceous Research*, 26 (1): 3–20.

Lapparent J de, 1918. Etude lithologique des terrains crétacés de la région d'Hendaye. *Mémoire pour servir à l'éxplication de la carte géologique de la France*, 115pp.

Lehner B L, Knappertsbusch M W, and Heer P H, 1987. Biostratigraphy, lithostratigraphy and sedimentology of the Maiolica Lombarda and the Scagia Lombarda on the west side of Lake Garda (north Italy). *Memorie di Scienze Geologiche*, 39: 1–24.

Li Xianghui, Wang Chengshan, Wan Xiaoqiao and Tao Ran. 1999. Verification of stratigraphic sequence and classification of the Chuangde section of Gyangzê, south Tibet. *Journal of Stratigraphy*, 23 (4): 303–309 (in Chinese with English abstract).

Nakkady S E, 1950. A new foraminiferal fauna from the Esna shales and Upper Cretacous chalk of Egypt. J. Paleontol., 24 (6): 675–692.

Plummer H J, 1931. Some Cretaceous Foraminifera in Texas. *University of Texas Bulletin*, 3101: 109–203.

Postuma J, 1971. *Manual of Planktonic Foraminifera*. Amsterdam: Elsevier Publishing Co., 1–420.

Premoli Silva I, Garzanti E, Gaetani M, 1991. Stratigraphy of the Chikkim and Fatu La formations in the Zangla and Zumlung units (Zanskar Range, India) with comparisons to the Thakkhola region (central Nepal): mid-Cretaceous evolution of the Indian passive margin. *Rivista Italian di Paleontogia e Stratigrafia*, 97 (3-4): 511–564.

Qian Dingyu, 1982. The discovery of mélange of Zazala,Tibet. In: *Contribution to the Geology of the Qinghai-Xizang (Tibet) Plateau*. Beijing: Geological Publishing House, 166–168 (in Chinese with English abstract).

Robertson A and Sharp I, 1998. Mesozoic deep-water slope/rise sedimentation and volcanism along the North Indian passive margin: evidence from the Karamba Complex, Indus suture zone (western Ladakh Himalaya). *Journal of Asian Earth Sciences*, 16 (2-3): 195–215.

Robertson A H F and Degnan P J, 1993. Sedimentology and tectonic implications of the Lamayuru Complex: deep-water facies of the Indian passive margin, Indus suture zone, Ladakh Himalaya. In: Treloar P J, Searle M P (Eds.), Himalayan Tectonics. *Geological Society, London, Special Publication*, 74: 299–321.

Schlanger S O, and Jenkyns H C, 1976. Cretaceous oceanic anoxic events: cause and consequence. *Geologie en Mijnbouw*, 55 (3-4): 179–184.

Sigal J, 1952. Aperçu stratigraphique sur la micropaleontology du Cr é tac é. *XI X e congres geologique international*, *Monographies regionales*, *1 ere serie*: *Algerie*, 26: 3–43.

TBGMR (Tibet Bureau of Geology and Mineral Resources), 1983. *A report on the regional Report of Geological Mapping (Xigazê-Yadong, 1:1 000 000)*. Unrepublished report: 286 (in Chinese).

TBGMR (Tibet Bureau of Geology and Mineral Resources), 1993. *Regional Geologic Records of Xizang Autonomous Region.*

Beijing: Publishing House, 459 (in Chinese).
Vogler J, 1941. Ober-Jura und Kreide von Misol (Niederländisch-Ostindien). *Palaeontographica*, 4 (suppl.): 243–293.
Voorwijk G H, 1937. Foraminifera from the Upper Cretaceous of Habana, Cuba. Proc. Koninkl. Nederl. Akad, Wetenschappen, 40: 190–198.
Wagreich Michael, 1995. Subduction tectonic erosion and Late Cretaceous subsidence along the northern Austroalpine margin (Eastern Alps, Austria). *Tectonophysics*, 242 (1-2): 63–78.
Wan Xiaoqiao, Lamolda Marcos A., Si Jialiang and Li Guobiao, 2005a. Foraminiferal stratigraphy of Late Cretaceous red beds in southern Tibet. *Cretaceous Research*, 26 (1): 43–48.
Wan Xiaoqiao, Li Guobiao and Si Jiangliang, 2005b. The distribution and ages of Late Cretaceous-Paleocene oceanic red beds in southern Tibet. *Earth Science Frontiers*, 12 (2): 31–37 (in Chinese with English abstract).
Wang Chengshan and Hu Xiumian, 2005. Cretaceous world and oceanic red beds. *Earth Science Frontiers*, 12 (2): 11–21 (in Chinese with English abstract).
Wang Chengshan, Hu Xiumian, Sarti Massimo, Scott R W, and Li Xianghui, 2005. Upper Cretaceous oceanic red beds in southern Tibet: a major change from anoxic to oxic, deep-sea environments. *Cretaceous Research*, 26 (1): 21–32.
Wang Naiwen, Liu Guifang and Chen Guoming, 1983. Regional geology of Yamzho Yumco in Tibet. In: *Contributions to the Geology of the Qinghai-Xizang (Tibet) Plateau (3)*. Beijing: Geological Publishing House, 1–20 (in Chinese with English abstract).
White M P, 1928. Some index foraminfera of the Tampico embayment area, part 2. J. Paleontol., 2 (4): 280–313.

Plate explanation

Plate I

Figs. 1–3. *Globotruncanita stuarti* (De Lapparent).
1. Axial section. Collection no.: Twg4. Catalogue no: Ts1.
2. Axial section. Collection no.: Twg4. Catalogue no: Ts2.
3. Axial section. Collection no.: Twg7. Catalogue no: Ts3.

Fig. 4. *Rostia fornicata* (Plummer).
4. Axial section. Collection no.: Twg3. Catalogue no: Ts4

Fig. 5. *Globotruncanella havanensis* (Voorwijk).
Axial section. Collection no.: Twg4. Catalogue no: Catalogue no: Ts5.

Fig. 6. *Globotruncana bulloides* Vogler.
Axial section. Collection no.: Twg4. Catalogue no: Catalogue no: Ts6.

Fig. 7. *Globotruncana* cf. *ventricosa* White.
Collection no.: Twg3 (P18-47-4). Catalogue no: Ts7.

Figs. 8–10. *Globotruncana linneiana* (d'Orbigny)
8. Collection no.: Twg4. Catalogue no: Ts8.
9. Collection no.: Twg4. Catalogue no: Ts9.
10. Collection no.: Twg4. Catalogue no: Ts10.

Figs. 11–12. *Glonotruncana linneiana tricarinata*(Quereau).
11. Collection no.: Twg4. Catalogue no: Ts11.
12. Collection no.: Twg4. Catalogue no: Ts12.

Figs. 13–14. *Globotruncana carinata* Dalbiez.
13. Collection no.: Twg4. Catalogue no: Ts13.
14. Collection no.: Twg4. Catalogue no: Ts14.

Fig. 15. *Globotruncana* cf. *ventricosa* White.
Collection no.: Twg4. Catalogue no: Ts15.

Fig. 16. *Heterohelix globulosa* (Ehrenberg)
Collection no.: Twg4. Catalogue no: Ts16.

Figs. 17–18. *Heterohelix* sp.
17. Collection no.: Twg4. Catalogue no: Ts17.
18. Collection no.: Twg4. Catalogue no: Ts18.

Fig. 19. *Globotruncanita calcarata* (Cushman)
19. Collection no.: Twg4. Catalogue no: Ts19.

Plate I