When and how did dextral strike-slip movement of the Tanlu Fault Zone in the late Cenozoic occur?

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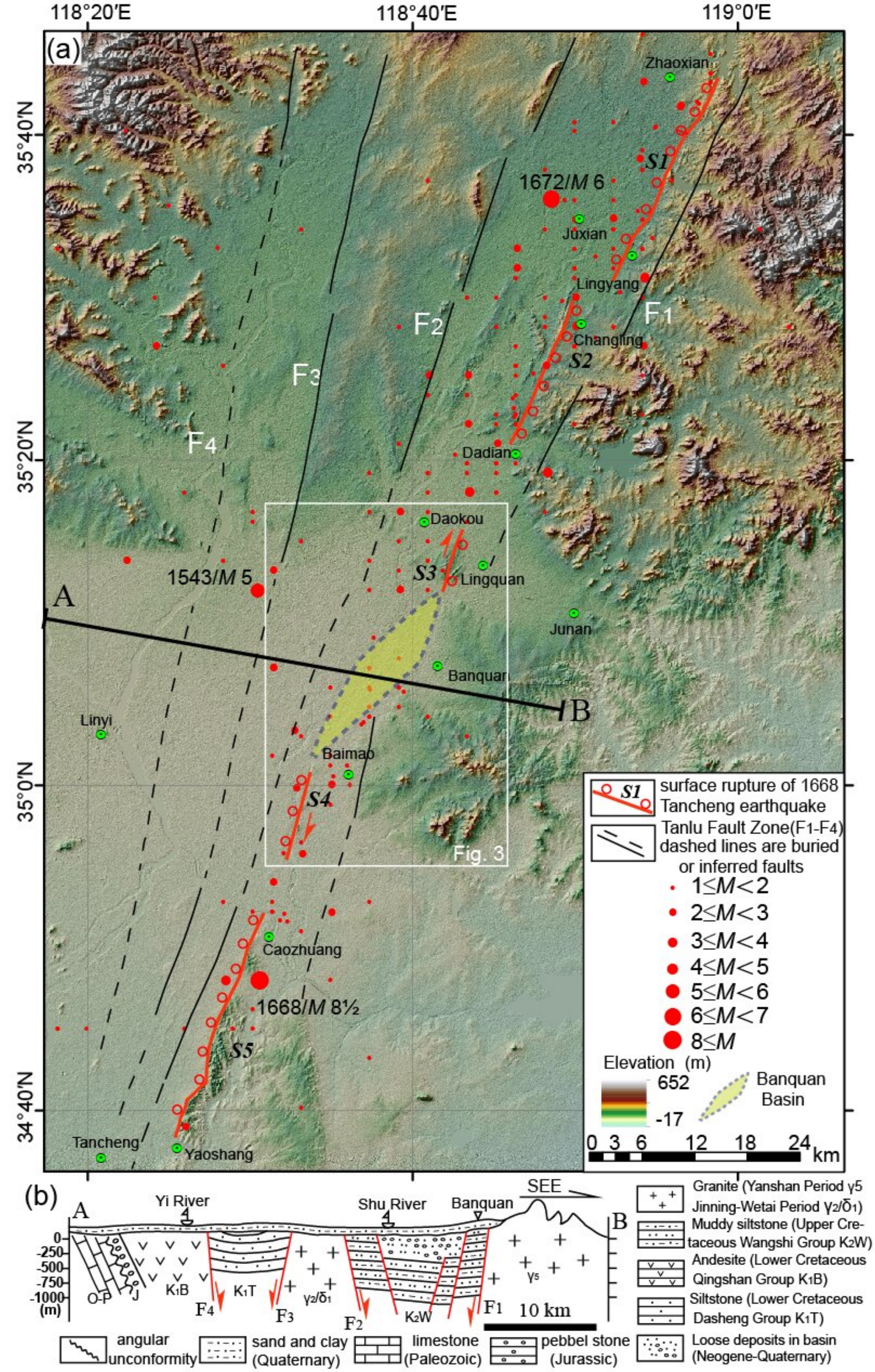


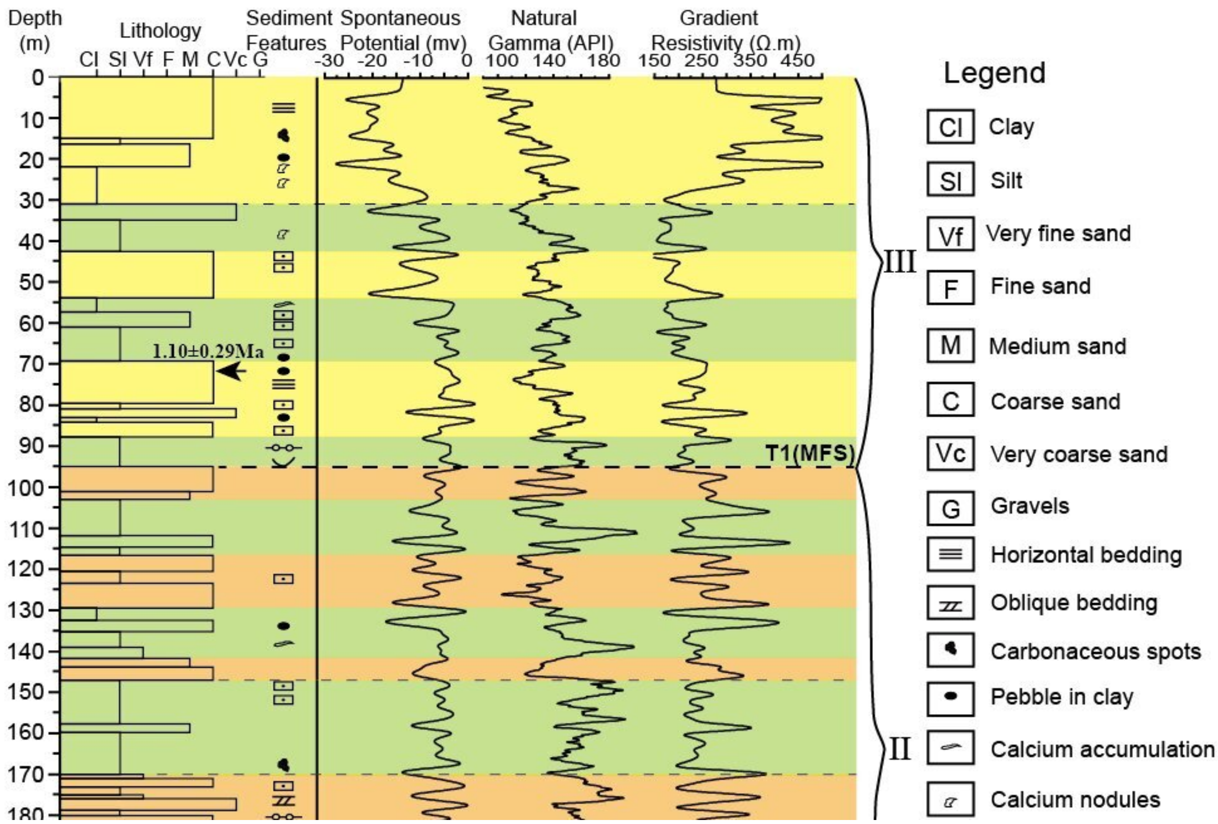
118°20′E
118°40′E
119°0′E
35°40′N
35°20′N
35°0′N
34°40′N
(a)
Zhaoxian
S1
1672/M 6
Juxian
Lingyang
F1
F2
F3
F4
Changling
S2
Dadian
Daokou
S3
Lingquan
1543/M 5
A
B
Junan
Banquan
Linyi
Baimao
S4
Fig. 3
Caozhuang
1668/M 8½
S5
Tancheng
Yaoshang
surface rupture of 1668 Tancheng earthquake
Tanlu Fault Zone(F1-F4) dashed lines are buried or inferred faults
1≤M<2
2≤M<3
3≤M<4
4≤M<5
5≤M<6
6≤M<7
8≤M
Elevation (m)
652
-17
Banquan Basin
0 3 6 12 18 24 km
(b)
A
Yi River
Shu River
Banquan
SEE
B
0
-250
-500
-750
-1000
(m)
O-P
J
K1B
K1T
γ2/δ1
K2W
γ5
F4
F3
F2
F1
10 km
Granite (Yanshan Period γ5 Jinning-Wetai Period γ2/δ1)
Muddy siltstone (Upper Cretaceous Wangshi Group K2W)
Andesite (Lower Cretaceous Qingshan Group K1B)
Siltstone (Lower Cretaceous Dasheng Group K1T)
angular unconformity
sand and clay (Quaternary)
limestone (Paleozoic)
pebbel stone (Jurassic)
Loose deposits in basin (Neogene-Quaternary)

The surface rupture zone of the 1668 Tancheng M8½ earthquake is divided into five sections from north to south, namely the Zhaoxiantuling-Lingyang section (S1), Shijin-Dadian section (S2), Zuoshan section (S3), Tengma-Zhonghuashan section (S4) and Huaqiao-Yaoshan section (S5). The Banquan pull-apart basin is located between the S3 and S4 segment. Credit: Science China Press

The sedimentary history of the pull-apart basin faithfully records the strike-slip process of the faults that control the development of the pull-apart basins. The Banquan Basin is the largest and most typical pull-apart basin along the surface rupture zone of the 1668 Tancheng *M*8½ earthquake where the TLFZ shows the strongest seismic activity.

The researchers (Peng Shu, Xiwei Xu, Shaoying Feng, et al.,) studied the sedimentary and tectonic evolution of the Banquan Basin by seismic reflection exploration, borehole detection and cosmogenic nuclide chronology, analyzed the coupling relationship between the pull-apart basin and the strike-slip fault and discussed the start time and tectonic significance of the right-lateral strike-slip of the TLFZ. The researchers recently published their study results in *Science China Earth Sciences*. The following are several major conclusions of this study.

The study showed that the Banquan basin has undergone three main evolutionary stages. During the pre-pull-apart period, the TLFZ that controls the evolution of the basin showed very weak activity, and then fault activity intensified and led to two periods of pull-apart and extension of the basin. During these two periods, especially in the second period of pull-apart and extension, fault activity migrated to the central basin. Then, the basin expansion reached its peak.

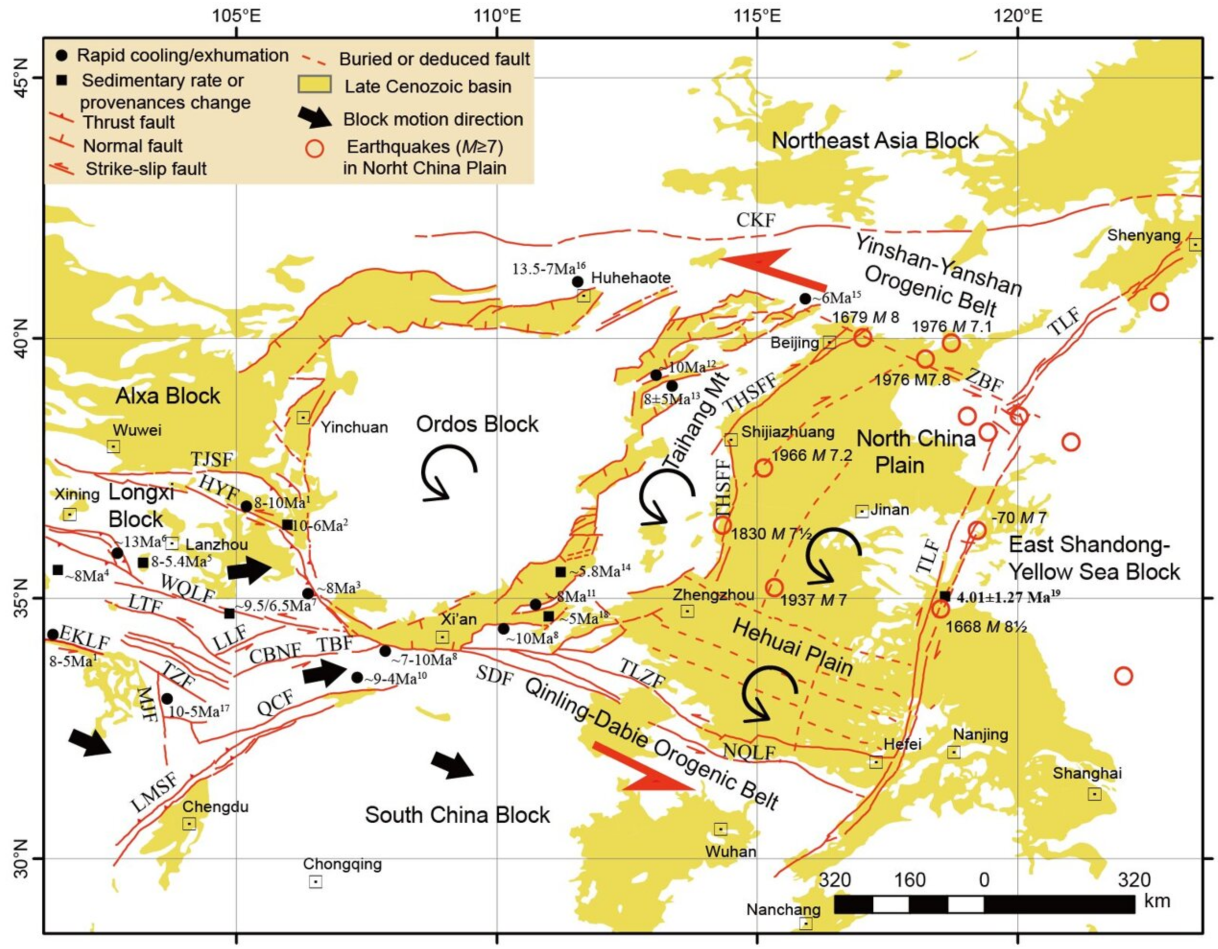


Lithology, sample locations, log curves and sedimentary facies classification of the borehole in the deposition center of the Banquan basin. Credit: Science China Press

Following that period, the basin entered the subsidence stage. New strike-slip fault formed in the center of the basin, which effectively accommodated normal faulting of the boundary faults of the basin and caused the basin to shrink and die out.

The sedimentary filling and depositional cycle of the basin has strong response to the episodic pull-apart and extension of the basin. Before the intense pull-apart, a thin layer of Miocene mudstone slowly accumulated in the basin due to local rifting. In the early and late stages of pull-apart and extension, the basin was successively filled with coarse-grained alluvial fan facies (sedimentary system I) and braided river-meandering river facies (sedimentary system II) with frequent facies changes.

During the subsidence stage of post-pull-apart, the basin was filled with a set of floodplain facies deposits (sedimentary system III).



The faults and their properties are based on Deng et al. (2007) and Xu et al. (2016); fault architecture in the North China Plain is mainly according to Yin et al. (2015), Xu et al. (2019) and Zhang et al. (2019); main fault abbreviations are as follows: EKLF-East Kunlun fault, TZF-Ta Zang fault, MJF-Min Jiang fault, LMSF-Longmenshan fault; QCF-Qing Chuan fault, LDF-Lintan-Dangcang fault, LLF-Lixian-Luojiabao fault, CBNF-Chengxian Basin Northern fault, TBF-

Taibai fault, WQLF-West Qinling fault, HYF-Haiyuan fault, TJSF-Tianjingshan fault, SDF-Shangdan fault, TLZF-Tieluzi fault, THSFF-Taihangshan frontal fault, NQLF-Northern Qinling fault, TLF-Tanlu fault, ZBF-Zhangbo fault; literature sources for the time constraints of tectonic events of orogenic belts or basins are as follows: (1) Duvall et al. (2013), (2)Wang et al. (2013), (3) Zheng et al. (2006), (4) Fang et al. (2005), (5) Zheng et al. (2003), (6) Lease et al. (2011), (7) Wang et al. (2012), (8) Heberer et al. (2014), (9) Liu et al. (2013), (10) Enkelmann et al. (2006), (11) Su et al. (2021), (12) Clinkscales et al. (2020), (13) Zhao (2016), (14) Su (2019), (15)Wu et al. (2000), (16) Xu et al. (2017), (17) Tan et al. (2019), (18) Liu et al. (2019), (19) this study. Credit: Science China Press

The sedimentary and tectonic evolution of the Banquan Basin was directly controlled by strike-slip movement of the TLFZ. The latest tectonic movement of the TLFZ in late Cenozoic was dominated by episodic dextral strike-slip movement that started at 4.01±1.27 Ma. By comprehensive analysis of dynamic background of eastern China, the authors held that the latest tectonic deformation of the North China Plain has been governed by the eastward tectonic extrusion and orogenesis of the eastern margin of the Tibetan Plateau since late Miocene.

The eastward thrusting of the Liupanshan fault zone and sinistral shearing of the Qinling fault zone led to anticlockwise rotation and pushing of secondary blocks in North China, resulting in a planar bookshelf faulting and rotation pattern. This unique deformation pattern transferred eastwards to the North China Plain at ~4.01 Ma and the process continues to the present time.

This planar bookshelf rotation, accompanied with regional sinistral strike-slip movement of the ~EW-trending boundary fault zones to the north and south of the North China Block and dextral strike-slip motion of the

NNE-trending boundary faults between secondary blocks, is likely to be the long-range effect of the strong extrusion of the eastern margin of the Tibetan Plateau.

More information: Peng Shu et al, Sedimentary and tectonic evolution of the Banquan pull-apart basin and implications for late Cenozoic dextral strike-slip movement of the Tanlu Fault Zone, *Science China Earth Sciences* (2023). DOI: 10.1007/s11430-022-1028-5

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