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## New views of tectonic evolution in the Tonghua, Liuhe and Hongmiaozi residual faulted basins, Northeast China

Dan-dan Wang, Qing-shui Dong, Jiao-dong Zhang, Xin-gui Zhou, Wen-hao Zhang, Wei-bin Liu

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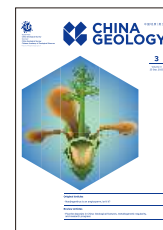
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## Research Advances

# New views of tectonic evolution in the Tonghua, Liuhe and Hongmiaozi residual faulted basins, Northeast China

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## 1. Objectives

The research and prospecting degree of these Mesozoic residual faulted basins located in Tonghua and its peripheral areas, such as Tonghua basin, Liuhe basin and Hongmiaozi basin is low. And these basins are considered to be unified sedimentary basins during the Mesozoic (Fig. 1). For example, Zhang FQ et al. (2012) believe that the Liuhe basin, Tonghua basin and Yangzishao basin belong to “Great Liuhe basin” which developed under the Xilonggang nappe. According to the research of Xu HL et al. (2013), the Tonghua basin and Liuhe basin began to connect and then formed a unified sedimentary area during the sedimentary period of Linzitou Formation (equivalent to the Xiahupidianzi Formation); then the basin was uplifted and structural damaged, and finally became a residual basin today. Based on the recent studies, this paper considers that the Tonghua, Liuhe and Hongmiaozi basins are independent faulted basins during the Mesozoic sedimentary period, and there is no unified sedimentary basin.

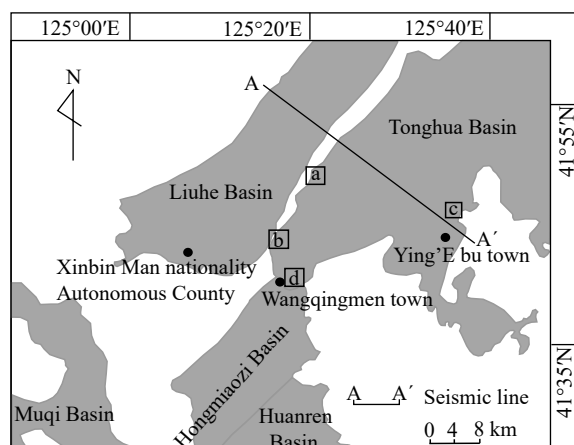
## 2. Research methods

Combined with the magnetotelluric of the study area, the re-fine interpretation of the seismic section across the Tonghua and Liuhe basins, the methods of field geological survey, large-scale section survey, the geological survey drilling well and detailed core observation of the main outcrops was been used to study the developmental characteristics and scale of the basin of Tonghua, Liuhe and

Hongmiaozi and the surrounding areas in the Mesozoic Era, and evolutionary relationship of these basins during the Mesozoic sedimentary period.

## 3. Results

The Tonghua basin and Liuhe basin are two independent basins and there is no thrust nappe structure between them. The reinterpretation of the seismic line profile (Fig. 2) across the Liuhe and Tonghua basin reveals that the Mesozoic sedimentary strata in Liuhe basin have typical braided structural features, and the strata thickness developed in the eastern of basin is larger than that in the western of basin. That is to say, the Liuhe basin is a typical trends west faulted basin with the east side of the basin is a fault, the west side is the slope with relatively slow settling velocity; and there is no obvious thrust feature in the Mesozoic sedimentary strata in Liuhe basin. Tonghua basin is a half-graben faulted basin with



**Fig. 1.** Simplified location map of Tonghua, Liuhe and Hongmiaozi basins

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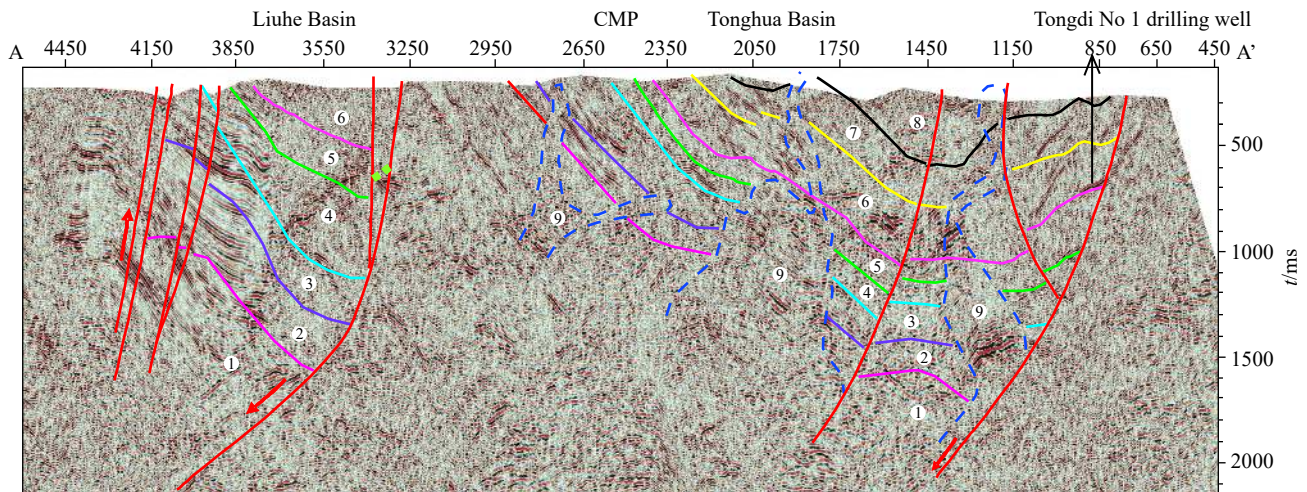


Fig. 2. Reinterpretation of the seismic section in the Tonghua-Liuhe Basin.

a braided structure and the fault trending western, and the eastern boundary is a controlled basin fault, and the west side is a gentle slope. The Mesozoic strata in this basin also have no obvious nappe structure. There is a northeast-trending rooted bulge between Tonghua basin and Liuhe basin, which is not the low-angle thrust nappe structure considered by the former researchers. It is not excluded that the marginal normal fault has been subjected to reversal or partial reversal of high angle faults due to strike-slip shearing.

The margin of Tonghua, Liuhe and Hongmiaozi basins are deposited the Jurassic-Cretaceous marginal facies deposition such as typical fan delta during the sedimentary periods of Houjiatun Formation, Xiahuapidianzi Formation and Hengtongshan Formation, and all of them had relatively independent provenance. They were independent faulted basins in the Mesozoic sedimentary period, and there was no unified sedimentary basin (Figs. 3a-d).

#### 4. Conclusions

Based on the above analysis, it can be concluded that the Tonghua basin and Liuhe basin are remnant basins in the Paleozoic. During the Mesozoic period, there is a northeastern trending salient not a low-angle thrust nappe structure as considered by the predecessors, between the mentioned basins, which have obvious independent source supply at the margin, so that are relatively independent basins.

#### CRediT authorship contribution statement

Dan-dan Wang, Qing-shui Dong, Jiao-dong Zhang and Xin-gui Zhou conceived of the presented idea. Dan-dan Wang, Qing-shui Dong, Wen-hao Zhang and Wei-bin Liu to investigate the observing outcrops and Sedimentary facies analysis, and supervised the findings of this work. Qing-shui Dong conducted new correlation and interpretation of the seismic profile. Dan-dan Wang wrote the manuscript with the support from Qing-shui Dong, Jiao-dong Zhang and Xin-gui Zhou. All authors provided critical feedback and helped shape the research, discussed the results and contributed to the final manuscript.

#### Declaration of competing interest

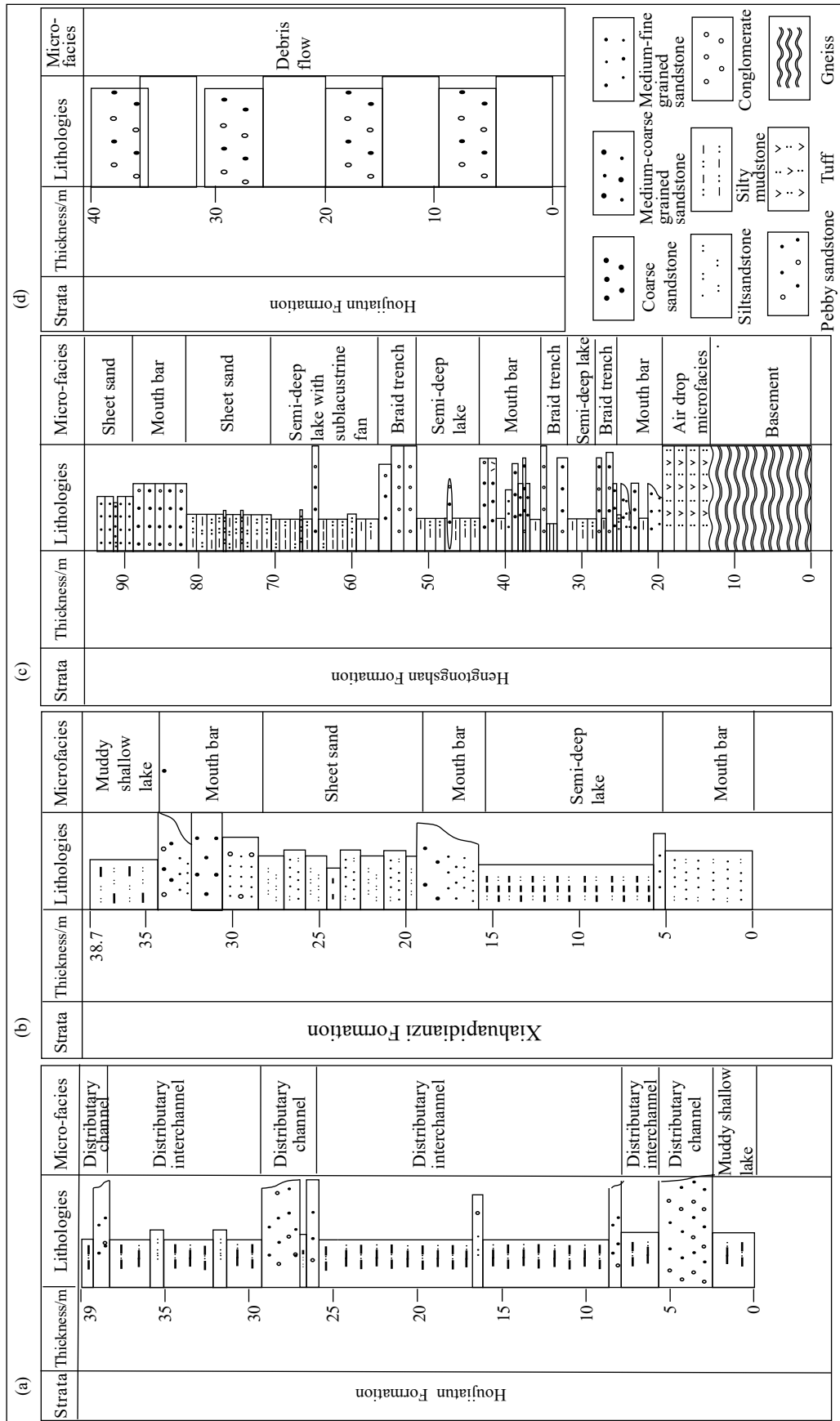
The authors declare no conflicts of interest.

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**Fig. 3.** Histograms of sedimentary facies in typical section of the basin margins. (a)–marginal facies sedimentary histogram of Houjiatun Formation developed in Jiabe North village, southwest of Tonghua basin; (b)–marginal facies sedimentary histogram of Xiahuapidianzi Formation developed in Zengshenggouli village between Tonghua basin and Liuhebasin; (c)–marginal facies sedimentary histogram of Hengtongshan Formation developed in Dadaomu village of Tonghua basin; (d)–marginal facies sedimentary histogram of Houjiatun Formation developed in Wangqingmen Town between Tonghua basin and Liuhe basin