

EGU2020-3211

<https://doi.org/10.5194/egusphere-egu2020-3211>

EGU General Assembly 2020

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## How did the Middle Reach of the Yellow River Connect and Form?

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The Yellow River, as the one of the largest rivers in the world, is considered to be formed by connection of several gorges and basins in between triggered by uplift of Tibetan Plateau. The Junshan Gorge with 600km length is the longest one and its lower gorge, the Senmen Gorge, is the last one for the River feeds into the great north China fluvial plain. These two Gorges used to be the last obstacle for the river running into the sea. In order to better understand the river processes, the Hetao Basin-Jinshan Gorge-Fenwei Basin-Sanmen Gorge-fluvial plain is taken as a whole river-lake system. Under this idea, the unexpected but reasonable complex evolution history of the river-lake system has been reconstructed, and more general evolutionary laws for the big river under the tectonic activity and climate change regimes are revealed. In the study area, the terraces can be classified into iso-chronological and meta-chronological ones. Tectonic uplift results in knickpoint headward migration and forms meta-chronological terraces covered by increasing younger paleosol-loess sequences upstream but in most cases by paleosol in Quaternary because of faster and stronger carving during interglacial than glacial periods. The connection between the paleo-lake and its lower gorge forms iso-chronological terraces along the gorge but meta-chronological terraces ahead of the gorge. The drainage for the Fenwei paleo-lake into the Sanmen Gorge was earlier (ca. 200ka) than that of the Hetao paleo-lake into the Jinshan Gorge (ca. 100ka), leading to the iso-chronological terrace covered by the paleosol  $S_2$  along the Sanmen Gorge while iso-chronological terraces covered by the paleosol  $S_1$  from the Jinshan Gorge, Fenwei Basin to Sanmen Gorge. Drainage of the Fenwei Basin resulted in the base level lowering and affected all the rivers that fed into the basin, while drainage of the Hetao Basin only affected the main course of the Jinshan and Sanmen Gorges, resulting in many "suspended valleys" along the gorge where the tributaries fed into because they could not keep pace of the main course incision. The Yuncheng Salt Lake is a relic of Fenwei paleo-lake after the drainages. The Jinshan Gorge is superposed by the broad, V-shape and vertical valleys, respectively. The broad valley was formed by the ancient meandering channel shifting in Pliocene and initially incised in late Pliocene to early Pleistocene, leaving relic meta-chronological terraces covered by the late Pliocene red clay or early Pleistocene loess, and forming popular incised meanderings. The V-shape valley was formed by increasing down cutting initially in middle Early Pleistocene, leaving series of meta-chronological terraces covered by loess-paleosol sequence. The vertical valley was formed by the connection between the gorges and their upper paleo-lakes, leaving iso-chronological terraces covered by  $S_2$  or  $S_1$ . Before river-lake connection, the Jinshan and Sanmen Gorges were affected by slowly tectonic uplift plus periodic climate changes, forming several levels of meta-chronological terraces

while after the connection, they were cut down quickly since sharp discharge increased. Comparing with this down cutting, the tectonic uplifts and periodic climate changes could be neglected.

**How to cite:** Zhang, K., Liang, H., and Li, Z.: How did the Middle Reach of the Yellow River Connect and Form?, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-3211, <https://doi.org/10.5194/egusphere-egu2020-3211>, 2020