

## Research Advances

## Newly Discovered Fluvial-Lacustrine Sediments in the Western Yangtze Block and their Geological Significance for the Emeishan Large Igneous Province

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### Objective

The Emeishan large igneous province (ELIP) in SW China is the only one large igneous province in China recognized by international geologists. Previous studies of ELIP over past two decades indicate that the ELIP age, duration, scale and generation mechanism are still controversial. Among those scientific topics, some scholars suggest that ELIP is an example of up-doming prior to LIP formation, which was evidenced by: (1) The thickness of the Yangxin Formation ( $P_2y$ ) limestone unit, which lies directly beneath ELIP, reduces from the center of erosional area to the outer edge. (2) Paleo-karst surfaces are present. (3) The clastic rocks of alluvial fan deposits, from the eroded materials in the maximum uplifted area, developed surrounding the inner zone. However, other scholars urge that those so-called “alluvial fan” deposits are “hydromagmatic deposits”, erupted or emplaced at or near sea level, and conclude that there was no pre-eruptive uplift in ELIP.

In order to constrain the above-mentioned scientific issue, we conducted detailed field geological investigations and systematically measured geological sections to provide new evidence by using sedimentary data.

### Methods

This study used conventional geological methods to collect the Permian period sedimentological data and to constrain the relationship between the limestone and basalt. A west-east bed-by-bed traverse cross section, along an outcrop well-exposed river that allows vertical section to be measured in detail, was measured in the Xinluo area of Puge County, Sichuan Province. Rocks from the Permian Liangshan Formation ( $P_2l$ ) to the

Emeishan Basalt ( $P_3e$ ) were measured. The outcrop distribution and strata thickness were investigated and measured using GPS positioning and a compass. To establish sedimentary successions and reconstruct the depositional history, the lithology, strata contact relationships were observed in the field and the samples were collected from the measured outcrop section through a bed by bed sampling approach.

### Results

In this study, the following main sedimentary successions are present from bottom upwards:

A: up to 11 m, mainly consists of quartz sandstone, shale and siltstone.

B: Conformable contact with A. 257 m thick, characterized by shallow-water depositional environment and consisting mainly of yellow thin-bed quartz sandstone, light-gray massive limestone and gray-white coarse grain dolomite.

C: Unconformably overlies the limestone, 4.15 m thick, comprises conglomerate, siltstone and shale.

D: Unconformably overlies C, 506 m thick, which can be divided into two units: the lower unit consisting of green amygdaloidal basalt, tight basalt, massive basalt and stomatal basalt; the upper unit is thin-bed basaltic breccia.

According to the sedimentary analysis, including lithofacies, rock colors, grain-size variation, and sedimentary structures, the sedimentary successions in this study comprise four facies: (A) littoral marsh facies; (B); neritic facies; (C) fluvial-lacustrine facies; and (D) continental eruption facies.

The fluvial-lacustrine sediments, which we defined as the Xiluo Layer, was newly discovered on the top of Yangxin Formation ( $P_2y$ ) which was traditionally considered to be only comprised of a sequence of carbonate rocks.

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Strata contact relationships can reflect tectonic setting directly. Erosional and sharp contact are probably caused by different degrees of tectonic uplift. The Xiluo Layer unconformably overlies the limestone of Yangxin Formation ( $P_2y$ ) and unconformably underlies the Permian Emeishan Basalt ( $P_3e$ ). It is about 4.15 m thickness and consists of, from bottom upwards, yellow-green thin-bed fine-grain conglomerate and calcareous siltstone interbedded with thin-bed gray marl, gray-green thin-bed shale, with fossil plants and Lamellibranchiata, such as *Lepidodendroid*, *Oculusfelis*, *Calamites* and *Pecopteris*. sp (Fig. 1).

The analysis of vertical successions of depositional facies revealed the history of depositional environments

that continuously underwent the shallow-water environment of carbonate platform, fluvial-lacustrine environment and continental environment. Such evolution was accompanied with relative sea-level lowstand, and suggested that regional domal uplift prior to LIP formation had occurred in the western Yangtze Block during the Permian period.

## Conclusions

Different origins of LIP were proposed, including mantle plumes. The clearest evidence for the involvement of mantle plumes is associated regional domal uplift. In addition, the timing and duration of surface uplift associated with LIPs provide important constraints on mantle convection processes. Therefore, the newly discovered Xiluo Layer in the western Yangtze Block is not only testified that there is pre-eruptive uplift in the ELIP, but also can provide evidence for constraining the origin and geodynamic process of ELIP in the further study.

## Acknowledgements

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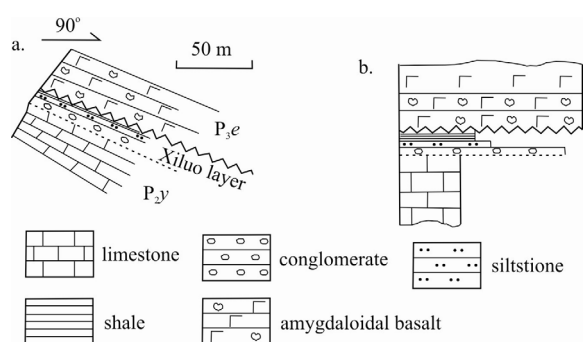


Fig. 1. Cross-section (a) and stratigraphic column (b) of the Xiluo layer at the Puge County, Sichuan Province.