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https://doi.org/10.15184/aqy.2025.10157

Project Gallery

# Pulei Cave: the first Palaeolithic cave site found in the Eastern Tianshan Mountains of Xinjiang

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Large-scale field investigation in the Eastern Tianshan Mountains of Xinjiang identified 108 Palaeolithic/microlithic surface findspots. Pulei Cave reveals the first well-preserved spelean sediment record containing Upper Palaeolithic cultural remains in eastern Xinjiang, dating from *c.* 45–43 ka BP.

Keywords: Asia, China, Tianshan Mountains, Upper Palaeolithic, lithic artefacts, blade

## Background

The Eastern Tianshan Mountains of Xinjiang, north-western China, have served as a communication junction between the Altai Mountains, the Tibetan Plateau and East Asia throughout human history. While current evidence suggests the early peopling of this region (Yu *et al.* 2018; Feng *et al.* 2021), a scarcity of Palaeolithic/microlithic sites with reliable stratigraphic records leaves the local Palaeolithic cultural framework largely unexplored. Between 2022 and 2024, our investigation identified 108 Palaeolithic/microlithic findspots in the region, collecting a total of 11 522 lithic artefacts. Within Pulei Cave lithic artefacts and well-preserved stratigraphic layers were identified, allowing the first reliable absolute dating of Upper Palaeolithic human activities in the Eastern Tianshan Mountains.

## Field investigation

The surface lithic assemblages from the Eastern Tianshan Mountains reveal two dominant techniques, simple core-flake and microblade (Figure 1), both of which were common in China during the Upper Palaeolithic (from *c.* 50–12 ka; Gao *et al.* 2013; Zhao *et al.* 2023). The microblade tools can be further classified into three types: the initial microblade technique, the Yubetsu technique and the developed cone-shaped microcore technique

Received: 10 April 2024; Revised: 20 April 2025; Accepted: 7 May 2025

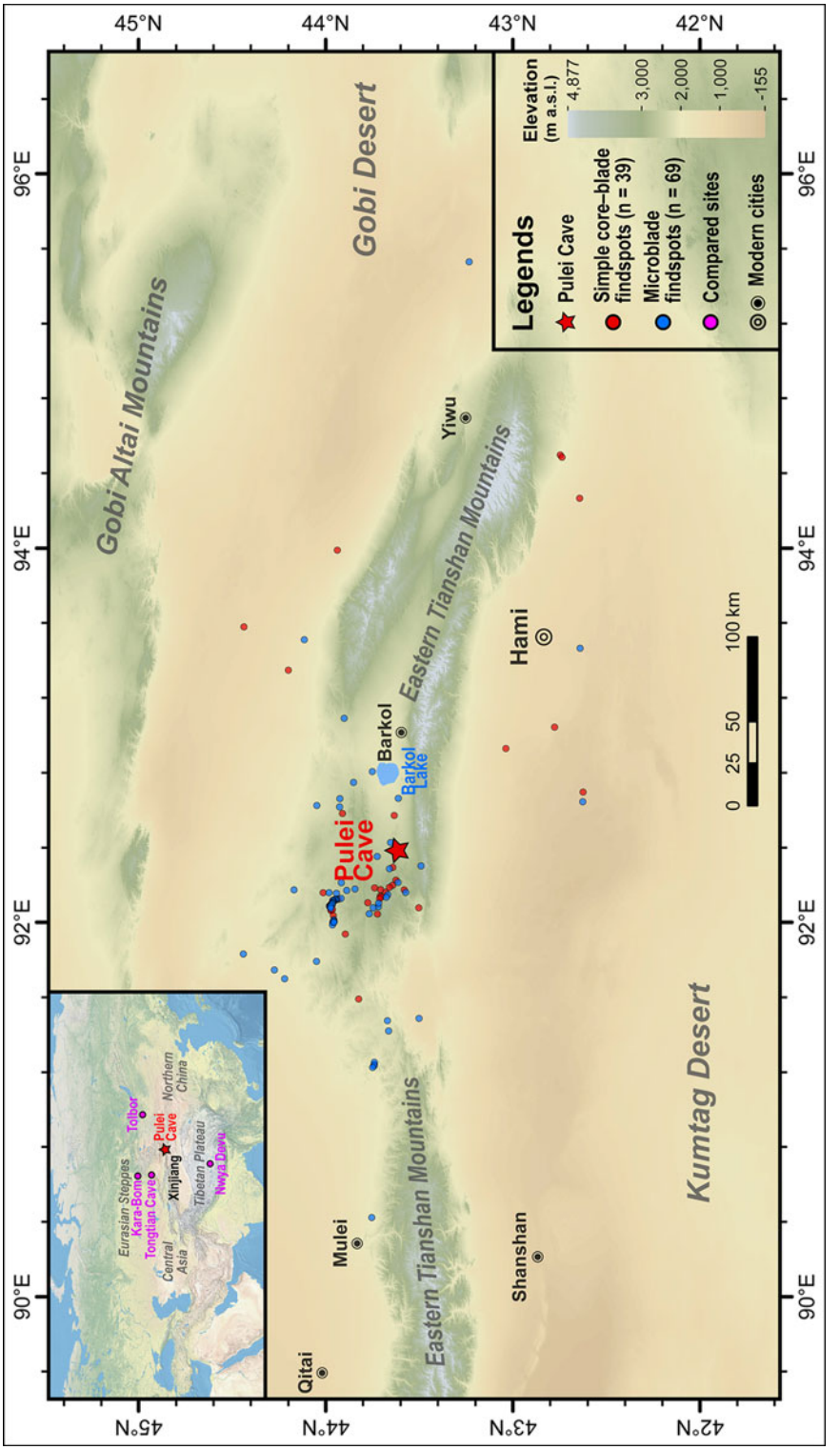


*Figure 1. Map showing the geographic setting of the Eastern Tianshan Mountains and the locations of findspots and Pulei Cave (figure by authors).*





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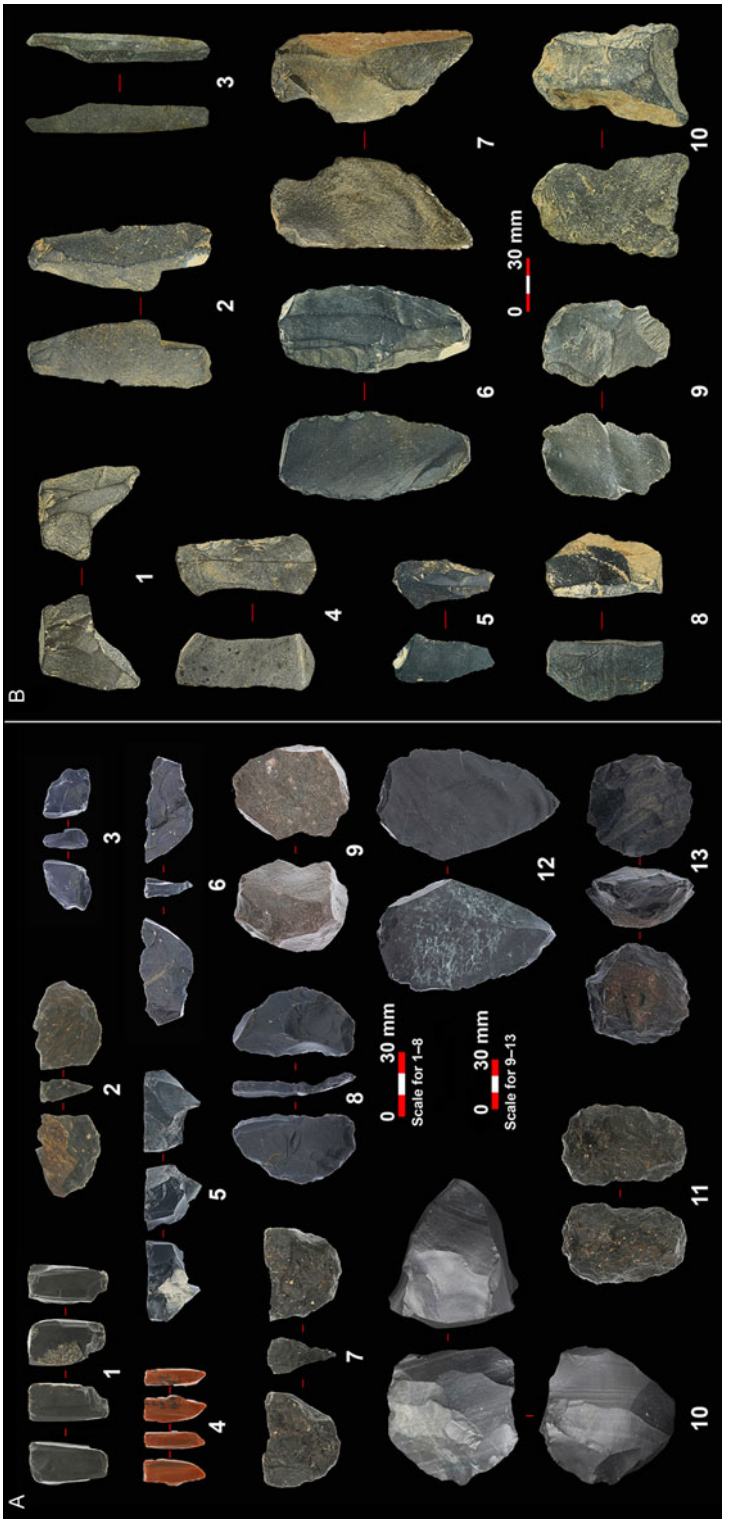


*Figure 2. Lithic artefacts collected from: A) investigated localities (1–8: microblade cores; 9: discoid core; 10 and 13: Levallois-like cores; 11: biface; 12: Levallois point) and B) Pulei Cave (1: flake; 2–3: blades; 4–9: scrapers; 10: adze-shaped object) (figure by authors).*





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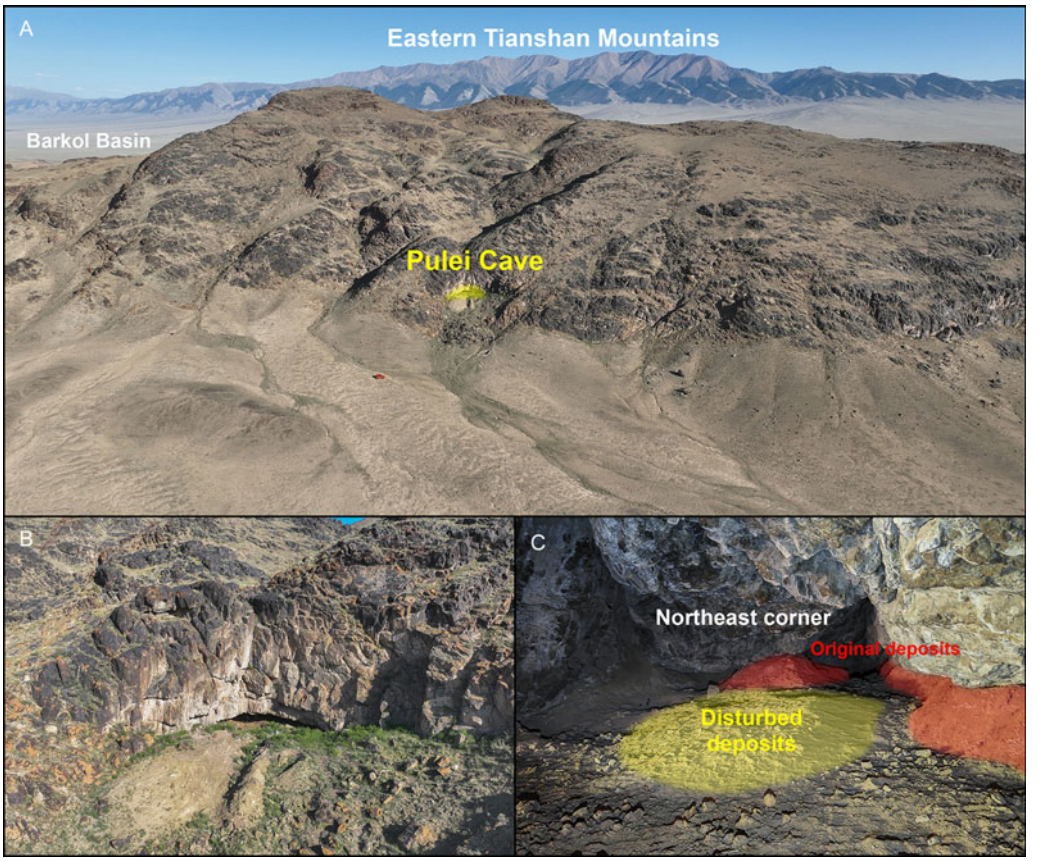


*Figure 3. Images of Pulei Cave: A) aerial photograph of the landscape; B) exterior view; C) north-east corner and the deposits.*

(Figure 2). These assemblages, along with the discovery of Levallois-like cores and points and bifacial tools at some microlithic sites, demonstrate the technological complexity of Xinjiang (Figure 2) and differentiate these sites from those of the Bronze and Iron Ages (from *c*. 4000–2200 cal BP), which are dominated by ground stone tools.

## Pulei Cave

Pulei Cave (43°37′23.5″N, 92°23′43.8″E, 2004m), located on the western margin of the Barkol Basin in the north of Eastern Tianshan Mountains, features a half-round entrance 16m wide, opening to the west under a sheer cliff. The interior of the cave forms an irregular space measuring 36.1 × 19.3 × 3.5m (Figure 3A & B).

The north-eastern corner of the cave retained cultural deposits. Survey of disturbed deposits yielded 19 lithic artefacts and some animal bones (Figure 3C). The south and north walls of the corner are approximately two metres apart, with comparable stratigraphic layers preserved at their bases, measuring approximately 0.5m and 0.7–1.2m in total depth,





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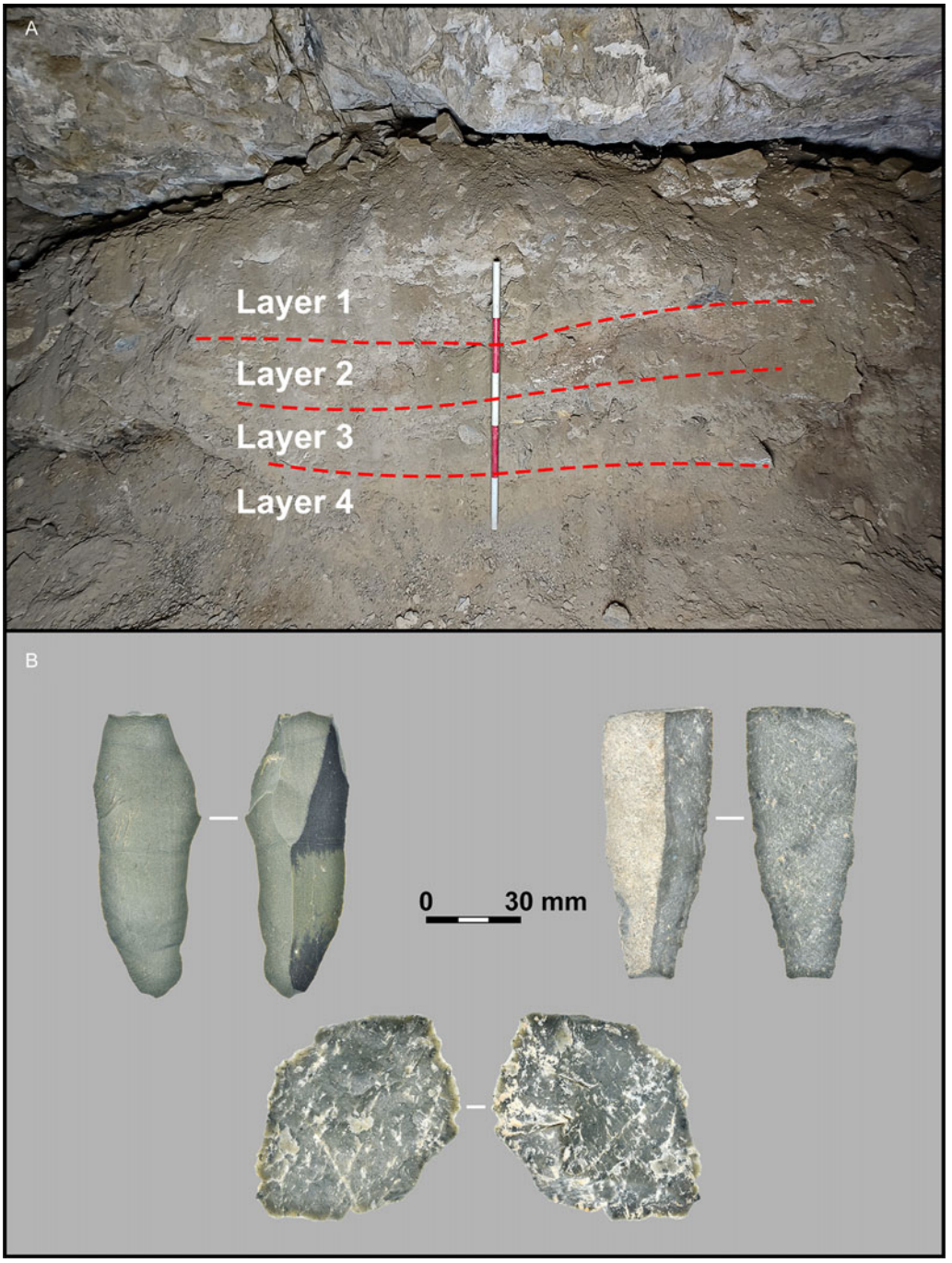


*Figure 4. A) Stratigraphic layers from the north-east corner; B) lithic artefacts collected from layer 3 (figure by authors).*





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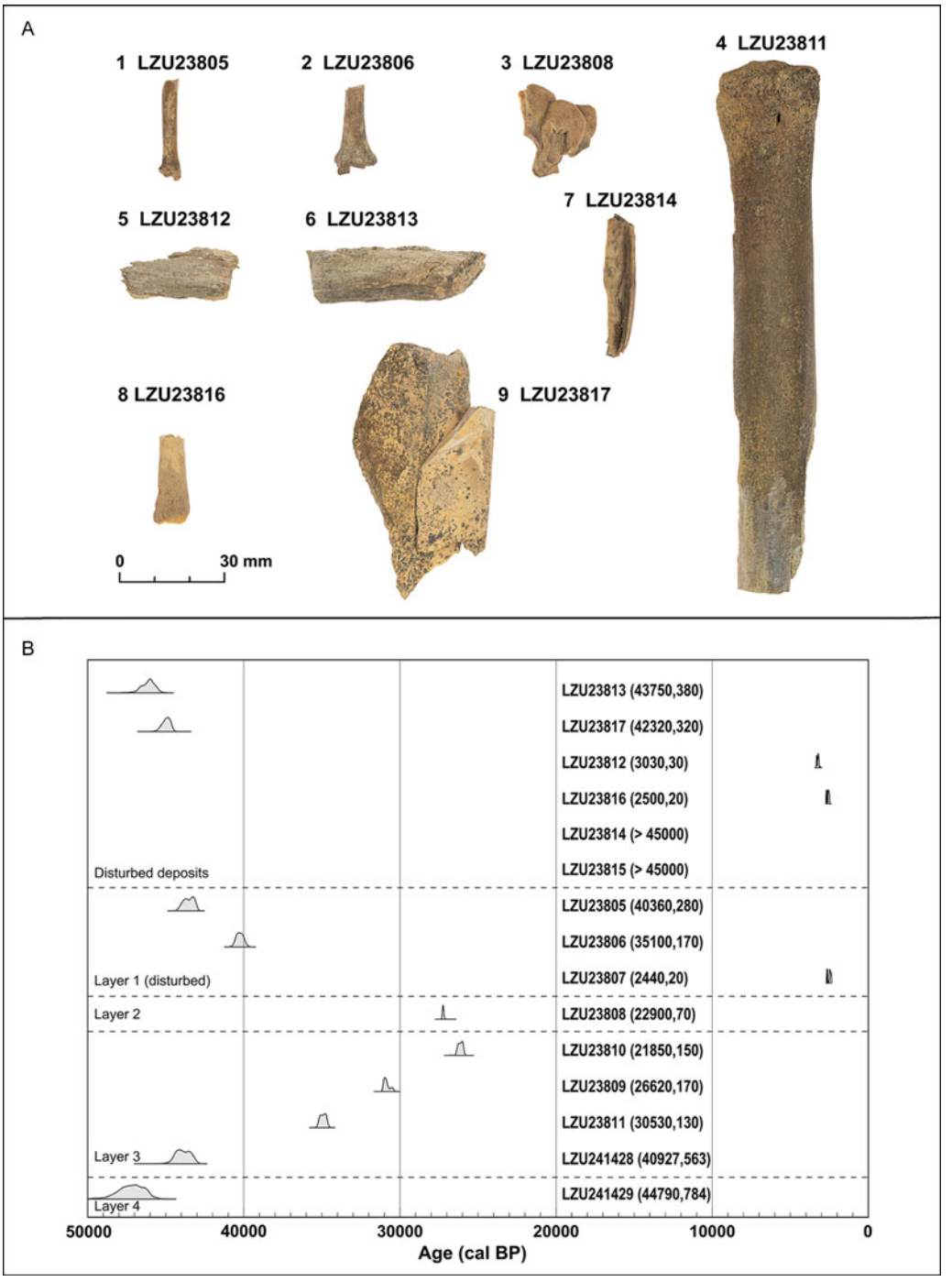


*Figure 5. A) Animal remains collected from the cave; B) plot of radiocarbon dates calibrated using the IntCal20 curve (Reimer* et al. *2020) and OxCal 4.4.4 (Bronk Ramsey 2009) (figure by authors).*





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respectively. Layer 1 is disturbed loess sediment, about 0.2m deep, containing stones and animal bones (Figure 4A). Layer 2 (0.1–0.34m deep) is composed of undisturbed, loose brown soil and also contains animal bones. Layer 3 is another undisturbed loess layer, 0.2–0.4m deep, with some stones; three lithic artefacts and animal bones were collected from the northern portion of this layer (Figure 4B). Layer 4, a sandy layer approximately 0.3m thick, lies beneath the north side of Layer 3 and contains stones and animal bones.

Including the two lithic artefacts found outside the cave, a total of 24 lithic artefacts were collected from Pulei Cave: four made of quartzite, 19 of siliceous rock and one of siliceous mudstone. These differ from the rough metamorphic rock found in the cave, suggesting an external source for the raw materials (Figure 2B). The collection includes blades (n = 2), a blade core and tools (n = 13, mostly scrapers and adzes crafted from blades). These features generally indicate an Upper Palaeolithic blade industry, similar to those of the Nwya Devu site on the central Tibetan Plateau (*c.* 40–30 ka BP; Zhang *et al.* 2018), the Tolbor-16 site in Mongolia (*c.* 45 ka BP; Zwyns *et al.* 2014) and the Kara-Bom site in the Altai (49–46 ka BP; Rybin *et al.* 2023), characterised by the dominance of the prismatic blade-core technique. This technological consistency suggests that the Eastern Tianshan Mountains were woven into a geographically broad tech-complex and hints at the possibility of population migrations (Derevianko *et al.* 2012; Li *et al.* 2016).

Of the animal bones collected from the layers (n = 36) and disturbed deposits (n = 32), 14 pieces could be morphologically identified as deer, hare, equid and small bovids (Figure 5A). Bones from different layers were selected for radiocarbon dating at Lanzhou University (Cao *et al.* 2023). The calibrated radiocarbon dates reveal two periods of deposition during *c.* 48–27 ka BP and *c.* 3300–2400 cal BP (Figure 5B). The first period corresponds with the Upper Palaeolithic and aligns with lithic ages reported from neighbouring regions (ranging from 49–30 ka BP). The second period corresponds with an increase in local settlements during the Bronze and Iron Ages. One bone sample (lab code: LZU-241428), found close to the lithic artefacts in layer 3, was dated to 44 727–42 997 cal BP, providing a secure chronological reference for human occupation of the cave. However, the possibility of human occupation during other periods requires further validation in future excavations.

## Conclusion

The identification of surface lithics featuring the Yubetsu technique and Levallois-like style in the Eastern Tianshan Mountains opens up new perspectives for understanding the geographic expansion of these technologies in eastern Xinjiang. Pulei Cave documents a typical Upper Palaeolithic blade industry, and yields the first well-preserved spelean cultural deposit in the region, directly dated to 45–43 ka BP. These discoveries push back the known framework of the Eastern Tianshan Mountains as a communication pathway connecting Siberia and the Altai with northern China and the Tibetan Plateau to 45 ka. This not only significantly enhances our understanding of early human occupation in the Xinjiang region but also provides critical materials for studying technological interactions between Central and East Asia. Future systematic excavations will be dedicated to further revealing the





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taphonomic and environmental contexts of the cave and the possible makers of these artefacts.

## Funding statement

This work was supported by the National Social Science Fund of China (23BKG020) and the National Key Research and Development Project of China (2022YFE0203800).

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