Quaternary Science Reviews 105 (2014) 239–243

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

Short communication

Discovery of Youngest Toba Tuff localities in the Sagileru Valley, south India, in association with Palaeolithic industries

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ARTICLE INFO

Article history:
Received 7 July 2014
Received in revised form
24 September 2014
Accepted 25 September 2014
Available online 18 October 2014

Keywords:
Youngest Toba Tuff
South Asia
Sagileru Valley
Palaeolithic archaeology

ABSTRACT

The Indian subcontinent contains a number of volcanic ash deposits representing the Youngest Toba Tuff (YTT) volcanic eruption of 75,000 years ago, though relatively few localities have been reported in detail. Here, we identify tephra deposits in the Sagileru Valley, south India, in association with Palaeolithic industries. The glass shard and biotite composition of the Sagileru tephra matches that of the YTT from other terrestrial sites in India and from the Toba caldera, and are distinct from earlier large eruptions from Toba. Moreover, our survey identified rare associations between lithic artefacts and YTT deposits, making the Sagileru Valley one of the few globally identified locations with both ash and archaeology. The identification of ash deposits and stone tool assemblages in the Sagileru Valley provides another source of information for understanding Late Pleistocene climate change, depositional environments and hominin occupations of South Asia.

1. Introduction

Volcanic ash horizons play a critical role for comparing regional and global sedimentary sequences, patterns of palaeoenvironmental variability, and trends in hominin behaviour. The Toba super-eruption *ca*75 ka (Mark et al., 2014) resulted in the deposition of the Youngest Toba Tuff (YTT) in the South China Sea, the Indian Ocean, and at terrestrial locations in South and South-East Asia (Fig. 1a). A recent report places ash as far afield as Lake Malawi, in East Africa (Lane et al., 2013). The duration and degree to which this eruption impacted on global climates, terrestrial palaeoenvironments and hominin populations has been subject to intense debate (e.g. Ambrose, 1998, 2003; Gathorne-Hardy and Harcourt-Smith, 2003; Petraglia et al., 2007; Williams et al., 2009; Haslam and Petraglia, 2010; Jones, 2012; Williams, 2012). A growing number of studies suggest that the most recent eruption of Toba did not have millennial scale impacts upon the global climate, and that its effects are most likely restricted to a decadal-timeframe (Timmreck et al., 2012; Costa et al., 2014; Mark et al., 2014).

A number of ash deposits are known throughout the Indian subcontinent (Acharyya and Basu, 1993), though most were previously found in redeposited contexts (Jones, 2007). Geochemical analyses of India tephra deposits have confirmed the presence of YTT in the Jurreru, Son, Purna, Mahanadi, Kukdi, Vansadhara, Barakar and Narmada Valleys (Acharyya and Basu, 1993; Shane et al., 1995; Westgate et al., 1998; Petraglia et al., 2007, 2012; Pearce et al., 2014). Ash deposits identified in a number of other valleys are assumed to also comprise YTT horizons, such as in the Indravati, Brahmani, and Nagavali valleys (Acharyya and Basu, 1993), although some investigators consider that ash in some sites in India correlate with the 0.84 Ma Older Toba Tuff (OTT) (Westaway et al., 2011). Yet, assertions about the presence of OTT deposits in India have been called into question on the basis of Argon–Argon dating (Mark et al., 2014), differences in geochemistry, including distinctions of biotite crystals (Pearce et al. 2014; Smith et al., 2011), and area density of spontaneous fission tracks in glass shards (Westgate et al., 2014).

Ash deposits in India typically occur in thick, reworked stacked sequences, complicating the use of these deposits as an isochron.

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http://dx.doi.org/10.1016/j.quascirev.2014.09.029
0277-3791/

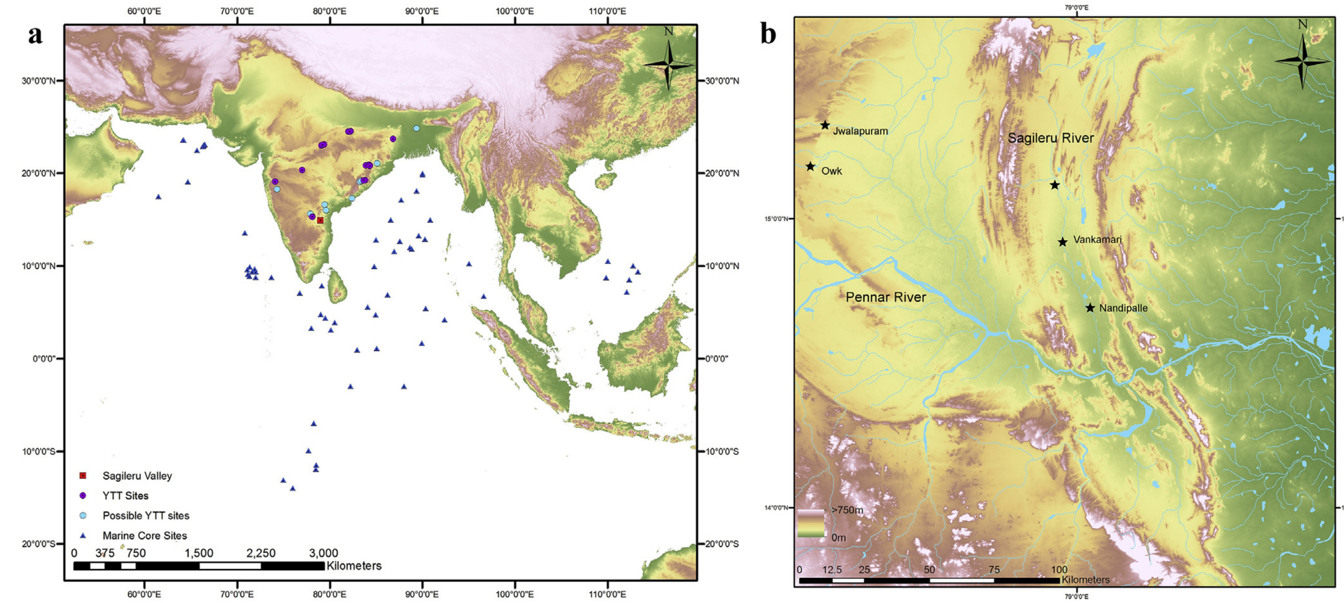

Fig. 1. a: Tephra localities in South Asia, the Indian Ocean and the Bengal Sea (after Jones, 2007). b: Map of Sagileru Valley illustrating the location of tephra near Vankamari. Stars represent main ash locations with multiple occurrences. Ash has also been identified at Owk, near the YTT deposits in the Jurreru Valley.

More recently, primary YTT air-fall layers have been identified in the Son and Jurreru Valleys, underlying thick, stacked sequences of redeposited ash, indicating that with suitable study YTT deposits can offer a robust isochron (Petraglia et al., 2007; Jones, 2010; Gatti et al., 2011; Blinkhorn et al., 2012; Lewis et al., 2012; Matthews et al., 2012). With the exception of a cryptotephra horizon of YTT in the Billa Surgam cave complex (Lane et al., 2011), all occurrences of YTT in India are known from river valley contexts. Notably, Palaeolithic artefact assemblages are frequently located in the same valleys that preserve YTT deposits, though with the exception of the Son and Jurreru Valleys, there has been little research that links stone tool assemblages with primary air-fall ash deposits. Here we report findings from the Sagileru Valley, where ash deposits have recently been identified in association with stone tool industries.

2. The Sagileru Valley

The Sagileru River rises near Cumbum, Kurnool District, and flows between the Nallamalai and Velikonda ranges of the Eastern Ghats, joining the Pennar River as a tributary in the adjacent Cuddapah District (Fig. 1b). The Sagileru Valley falls within the Cuddapah Supergroup, a Proterozoic age crescent shaped basin consisting of alternating sandstones, shales and limestones that have undergone varying levels of metamorphism and deformation (Lakshmi and Babu, 2002; Saha, 2002; Gupta et al., 2003).

Volcanic ash was first briefly reported from the Sagileru Valley in the early 1990s, found occurring along a 90 km stretch of the valley, and assumed to represent the YTT (Basu and Biswas, 1990; Acharyya and Basu, 1993; Anonymous, 1991). The same valley has also been subject to archaeological surveys, resulting in the reporting of stratified archaeological deposits (Reddy and Sudarsen, 1978), some of which appear in association with fossils of *Antilope cervicapra*, *Bos*, *Cervus*, and *Equus* (Shankar et al., 2006). Previous research has not related the ash with archaeological deposits.

We undertook new survey work in the Sagileru Valley in order to locate ash deposits and to refine earlier stratigraphic information. Our field work resulted in the identification of previously reported locations as well as new ash localities, some of which were found to contain stone tool assemblages. A number of tephra exposures were found close to Vankamari village (E78.94481°; N14.93589°), concentrated in small-scale quarry pits and riverside cliff sections. Additional tephra exposures were identified north of Vankamari (E78.93608°; N15.10203°) and close to Nandipalle (E79.01879°; N14.71916°), corroborating reports by Acharyya and Basu (1993) that ash deposits could be found throughout the Sagileru Valley. As part of our larger ranging survey, a fourth main ash deposit, outside the Sagileru Valley, was identified west of the town of Owk. The ash deposit was in a depression on a quartzite plateau, a distinct topographic context in comparison with all other occurrences in India. The finding of ash in multiple locations north of the Pennar River Valley indicates the potential of finding tephra across the region.

Samples of ash were collected from a thick exposure near Vankamari, from a section measuring 2.3 m in depth (Table 1). Limited lateral variability was observed in the sediment sequences around Vankamari (Fig. 2). All examined sections contained reworked grey/white ash horizons stratified above, below or between reddish-yellow to reddish-brown silty sands, with some mixing evident at the upper contact of the ash. The ash preserved

Table 1
Description of sediment sequence near Vankamari.

Depth from surface (cm)	Description
0–25	Reddish yellow silty sand containing a 10 cm thick reddish brown silty sand; 7.5YR 6/6
25–45	Mixed ash and reddish silty sand with vertical root casts puncturing the lower mixed ash layer; 7.5YR 8/2 to 8/4
45–55	Laminated hard pan of ash layers forming a 10 cm thick band
55–95	Cross stratified ash with climbing ripples, bark brown specks of biotite with gradational contact with underlying horizon with devitrified patches of ash including mica and evidence for bioturbation; 5YR 7/1
95–190	Ash, with a more fine grained deposit occurring in basal 8 cm exhibiting a sharp contact with underlying deposits; 5YR 8/1; highlighted in Fig. 2.
190–230	Reddish brown sandy, silty clay; 5YR 4/6
>230	Reddish brown silty sand grading into gravel and boulder clast supported horizons