# LATE PLEISTOCENE AND HOLOCENE TEPHROSTRATIGRAPHY AND CHRONOLOGY IN SOUTHERN PERU

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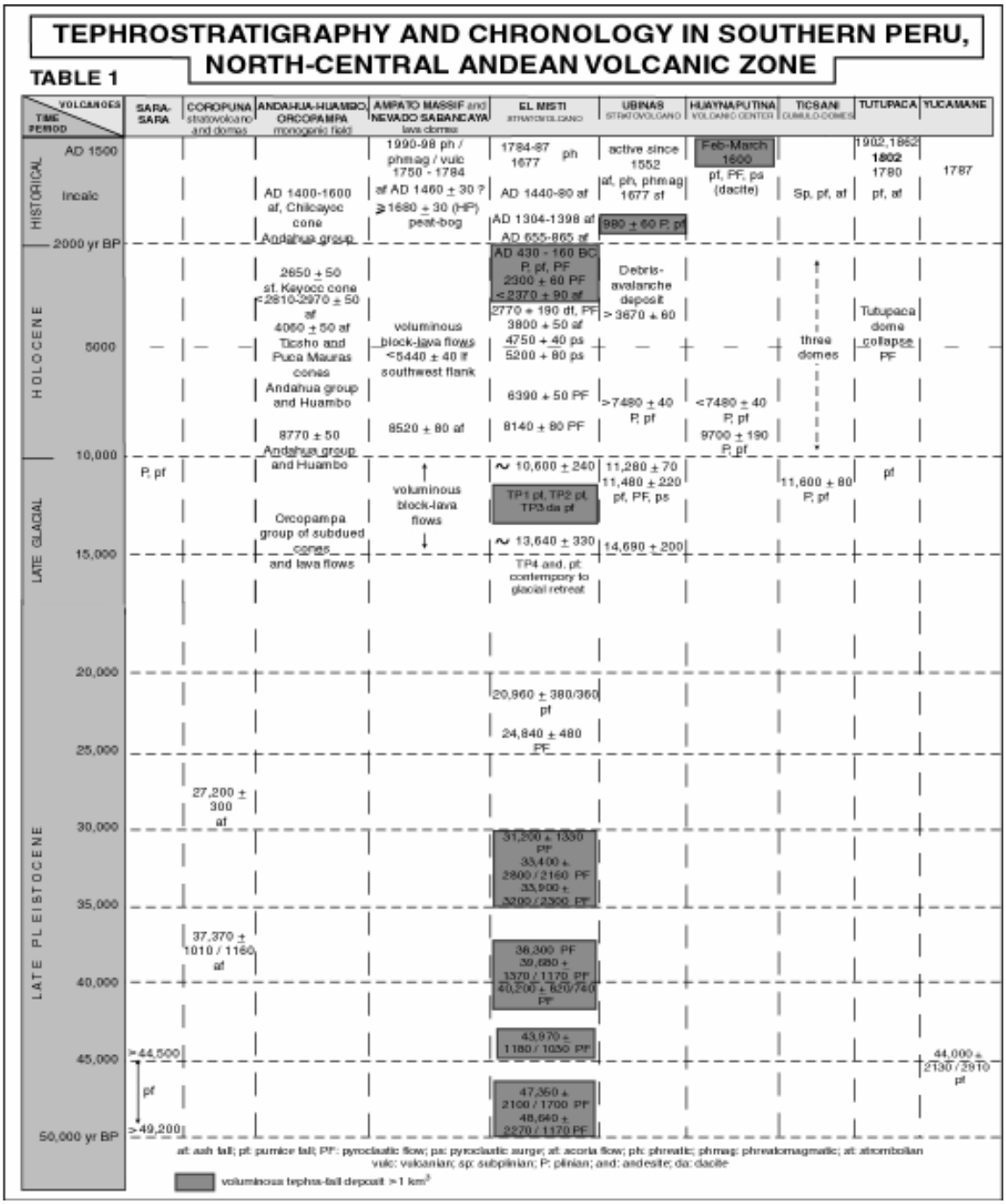
## INTRODUCTION

Multidisciplinary investigations of stratigraphic sections and cores extracted from peat-bogs and lakes in the Western Cordillera of the southern Peruvian Andes, have enabled us to trace more than 40 tephras over the past 50,000 $^{14}$C years. At least eight pumice-fall deposits are widespread (>1,000 km$^2$) and voluminous (≥1 km$^3$), as shown in bold squares in Table 1.




**LATE PLEISTOCENE TEPHRA**

Late Pleistocene tephra have been dated on the west flank of Nevado Sara Sara between ca. 49,200 and 44,500 yr BP and ca. 44,000 yr BP on the south flank of Yucamane. Nevado Coropuna has probably been active before the Late Glacial; ashfalls in a soil section outside of the Last Glacial Maximum moraines yielded $^{14}C$ ages of ca. 27,200-37,370 yr BP. The composite Misti edifice comprises a stratovolcano termed Misti 1, partially overlapped by two stratocones termed Misti 2 and 3 (≤112 ka), and a summit cone Misti 4 ≤11 ka. Sustained explosive eruptions have delivered at least 12 pumice falls during the past ca. 50,000 years (Thouret et al., 2001b).

## LATE-GLACIAL AND HOLOCENE TEPHRAS

Two cores extracted from the *salar* of Laguna Salinas, 35 km east of Arequipa, include 7 tephra-fall deposits from Huaynaputina, Misti, and Ubinas over the past 15,000 years (Juvigné et al., 1997). Two recent tephra falls are found around the Ticsani domes: a dacitic pumice-fall deposit of 0.4 $km^3$ has been dated ca.11, 600 yr BP; bombs and pumice preceding the youngest dome overlie the AD 1600 Huaynaputina ash. The recent explosive behaviour of Ubinas produced several tephra falls, including two widespread plinian pumice falls. The pumice-fall deposit >7840 yr BP and the ca. 980 yr BP-old pumice-fall deposit have a volume >1 $km^3$ and may be linked to the formation of the summit caldera (Rivera et al., 1998). The peat sequence in the Sallalli peat-bog 10 km SE from the Nevado Sabancaya includes 4 tephra-fall layers: the AD 1600 Huaynaputina ash, an AD 1200-1400 Sabancaya/Ampato ash, a thin black ash probably from Misti ca. 2,370 yr BP, and a Sabancaya/Ampato ash of ca. 8,550 yr BP (Juvigné et al., 1998).

## HISTORICAL TEPHRAS

The last subplinian explosive episode ca. 2,300-2,050 yr BP at Misti produced pumice-fall and flows ca. 1 $km^3$ in volume. Spanish chronicles refer to an explosive eruption ca.AD 1440 and 1470: the small volume 'Pachacútec ash' affected the Incaic towns of Cayma and Chiguata (Thouret et al., 1999a, 2001a). The AD 1600 Huaynaputina plinian eruption produced the most widespread and voluminous (12 $km^3$) pumice-fall deposit in the Andes in historical times (Thouret et al., 1999b). Tephra falls, pyroclastic flows, and surges disrupted life ~60 km around the volcano and ashfall was reported 250-500 km away in south Peru, west Bolivia and north Chile. Persistent eruptions of Nevado Sabancaya have dispersed a small volume of ash from May 1990 until 1998 as far as 20 km towards the east (Thouret et al., 1995, 2001b).

## CONCLUSIONS

In sum, 1) heavy ashfall can recur every 500 to 1500 years on average but small ashfall can occur on a 100-years basis; 2) voluminous pumice-fall deposit can occur every 2000 to 4000 years on average; 3) three voluminous (≥1 $km^3$) plinian eruptions occurred over the past 2,000 years; (4) the large-scale plinian and ignimbritic eruption of Huaynaputina produced 12 $km^3$ of tephra and caused havoc and famine in southern Peru 400 years ago.

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