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Comparison of Holocene temperature data (Boomplaas Cave) and oxygen isotope data (Cango Caves)

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Boomplaas Cave is situated near the town of Oudtshoorn in the Western Cape Province, South Africa. It was excavated by Hilary Deacon[1] in the 1970s, yielding not only Late Quaternary artefacts that were of archaeological importance but also fossils of rodents and insectivores (analysed by Margaret Avery[2]) as well as bovids and equids (analysed by Richard Klein[3]) that were important for the reconstruction of palaeoenvironments in the context of changes in climate within part of the Late Pleistocene (12 000–80 000 years BP) and Holocene (younger than 12 000 years BP). Also of palaeoclimatic importance is a stalagmite from the adjacent Cango Caves, analysed by John Vogel and Siep Talma. In 1992, Talma and Vogel[4] used a transfer function to estimate Holocene temperatures from oxygen isotope data from the Cango speleothem. Their basic oxygen isotope data (Figure 1) can be compared to temperature estimates obtained from Thackeray's[5] multivariate analysis of fossil rodents and insectivores represented in the late Quaternary sequence from Boomplaas Cave (Table 1). Here, for the first time, a comparison is made between the results obtained by Talma and Vogel[4] with those obtained by Thackeray[5], both of which relate to temperature but use independent sources of data.

The oxygen isotope values for the Cango stalagmite are shown in Figure 1a. These values can be compared to the relative changes in Thackeray's temperature estimates for the Boomplaas sequence (Figure 1b). The implication is that there is remarkably good agreement between the *raw* oxygen isotope data from the speleothem[4], and the calibrated temperature curve for the Boomplaas Holocene sequence, based on Thackeray's[5] multivariate analysis of fossil rodents and insectivores.

It would appear that the *raw* oxygen isotope data reflect variation in mean annual temperature, without using a complicated transfer function of the kind employed by Talma and Vogel[4].

Using data from the correlations indicated in Figure 1, the following regression equation can be obtained for a relationship between mean annual temperature (MAT) and oxygen isotope ratio (OIR):

$$MAT = -0.557\ OIR + 13.55$$

($r = 0.93$)

These results are potentially relevant to interpretations of oxygen isotope ratios from other speleothems, at least for part of the Quaternary in regions adjacent to Boomplaas Cave and the Cango Caves.

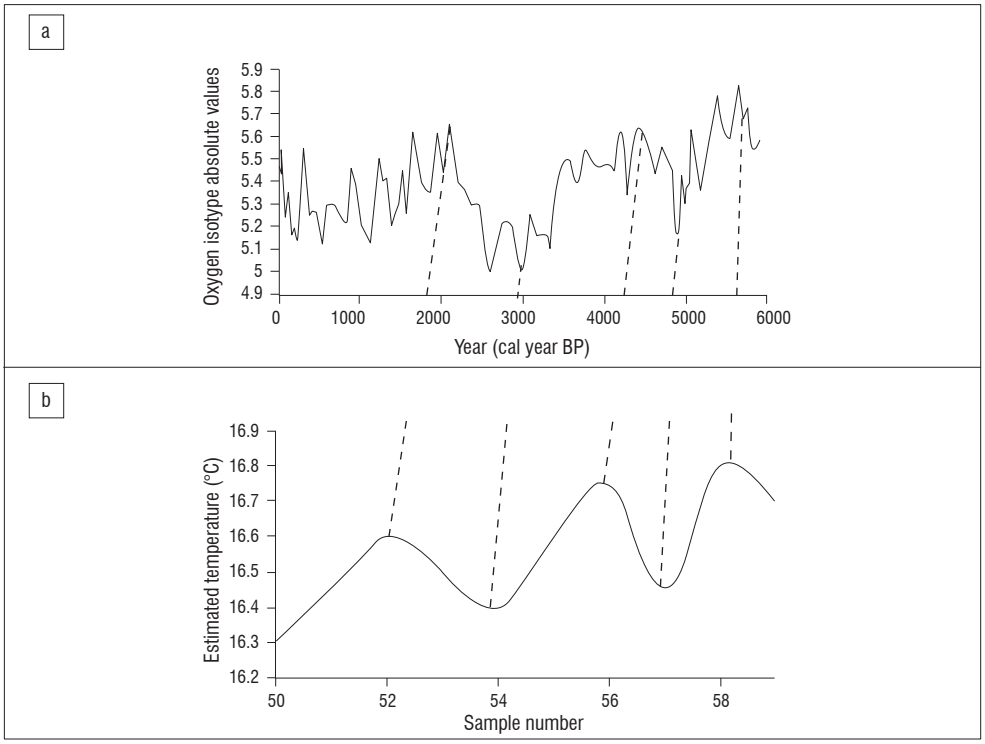


Figure 1: (a) Raw oxygen isotope data from a speleothem in the Cango Caves, obtained by Talma and Vogel[4] with calibrated radiocarbon dates within the past 6000 years. Data were provided for this study by Talma. (b) Holocene mean annual temperature curve for samples 50–59 from Boomplaas Cave, as calculated by Thackeray[5]. These Holocene samples are dated between circa 1000 and 6000 BP (see radiocarbon dates in Table 1). The two curves appear to be correlated (dashed lines).

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Table 1: Calibrated temperatures for a set of Boomplaas Holocene samples (numbered from 50 to 59), with radiocarbon dates[2]

Boomplaas sample	Calibrated temperature (°C)	Date (BP)
50	16.3	1630
51	16.45	
52	16.6	
53	16.5	
54	16.4	
55	16.6	
56	16.75	
57	16.45	6400
58	16.8	
59	16.7	

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