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Climatic changes during the Plio-Pleistocene transition as recorded by the isotopic composition of pedogenic carbonates.

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Plio-Pleistocene continental deposits in south-eastern Buenos Aires province (Argentina), correspond to fluvio-alluvial deposits interbedded with palaeosols. The Pliocene units show little participation of carbonatic features in their palaeosols, which are classified as Argillisols. The late Pliocene-Pleistocene palaeosols show a much higher participation of pedogenic carbonates and are classified as Calcisols. Could this change from Argillisols to Calcisols be related to the global-scale climatic change during the Plio-Pleistocene boundary?

For the pedogenic carbonates here-by studied, the $d^{13}C$ values range between −9.92 and −5.62‰ and the $\delta^{18}O$ values range between −4.19 and −2.80‰. These values are typical for calcretes, and particularly the $\delta^{18}O$ values indicate formation under the influence of meteoric water. If we consider that soil carbonate $d^{13}C$ values higher than −8‰ are indicative of the presence of C_4 plants, then the obtained $d^{13}C$ curve can be divided into a lower and an upper section, the boundary between both of them suggestively coinciding with the Plio-Pleistocene boundary (Fig. 1). Most of the average $d^{13}C$ values of the lower section are lower than the −8.00 ‰ $d^{13}C$ threshold, (−9.72, −9.67 and −8.32 ‰ PDB), which could be related to a plant community dominated by C_3 vegetation. In contrast, the average $d^{13}C$ values of the upper section are higher than the −8.00 ‰ $d^{13}C$ threshold (−6.80, −6.65, −7.20, −6.02, −6.86, −7.87 ‰ PDB), which could be related to a plant community dominated by C_4 vegetation.

$\delta^{18}O$ values can be related to climate, especially to mean annual temperature. For the studied palaeosols, $\delta^{18}O$ values show little variation (Fig. 1), except for a negative excursion during the late Pliocene, interpreted as a cold event. Although MAT and MAP values for the middle and late Pleistocene are still being analysed, the values for the late Pliocene and lower Pleistocene show a cooling and drying trend, and the abundance of Calcisols suggest the continuance of this trend up to the late Pleistocene. When comparing the $\delta^{13}C$, $\delta^{18}O$, MAT and MAP curves, positive and negative excursions of all 4 values coincide among them (Fig. 1) and also with well-known climatic events in the region: till deposits in Patagonia of ~3,5 Ma and ~1,8 Ma and the Middle Pliocene Climatic Optimum between 3,3 - 3 Ma.

In summary, for the Pampean Region, climatic conditions changed since the Pliocene from warm and humid to more cold, dry and seasonal. This change is reflected in the transition from Pliocene Argillisols to Pleistocene Calcisols and in the plant community, which changed from C_3-dominated to C_4-dominated, in accordance to worldwide records.

Figure 1. Schematic sedimentological profile of the studied units. $\delta^{13}C$, $\delta^{18}O$, MAT and MAP curves and their suggested correlation with regional climatic events.