Miocene (23–13 Ma) continental paleotemperature record from the northern Mediterranean region (Digne-Valensole Basin, SE France) within a global climatic framework

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During the Middle Miocene, the Earth's climate transitioned from a warm phase, the Miocene Climatic Optimum (MCO, 16.9–14.7 Ma), to a colder phase associated by formation of major ice sheets on Antarctica. This climatic shift, the Middle Miocene Climatic Transition (MMCT, 14.7–13.8 Ma), considerably impacted not only the structure and formation of major ecosystems (e.g. Jimenez-Moreno & Suc, 2005) it also affected global ocean circulation (Holbourn et al., 2014), terrestrial temperatures as well as precipitation patterns (e.g. Methner et al., 2020). While the MCO and the subsequent MMCT are well described in marine records, knowledge about the magnitude and rate of terrestrial paleoclimate changes is often limited by lack of temporal resolution and reliable quantitative proxy records (Steinthorsdottir et al., 2021).

Here, we present a long-term (23–13 Ma) biostratigraphically-controlled terrestrial stable ($\delta^{18}O$, $\delta^{13}C$) and clumped (Δ_{47}) isotope paleosol carbonate record from the northern Mediterranean region (Digne-Valensole basin, SE France).

When comparing the northern Mediterranean $\delta^{18}O$, $\delta^{13}C$ and Δ_{47} record with age-equivalent counterparts from central Europe (Northern Alpine Foreland Basin, Switzerland), our Δ_{47} results from the Digne-Valensole basin reveal two important features: 1) Relatively warm and constant carbonate formation temperatures (ca. 30°C) for the Early Miocene (23–18.6 Ma) followed by 2) intensified temperature fluctuations with high values (ca. 37°C) at the onset of the MCO, most probably amplified by changes in seasonality of pedogenic carbonate formation.

The combined Northern Alpine foreland and northern Mediterranean records display a coherent climate pattern for the Middle Miocene circum-Alpine foreland. In both records, high-amplitude, rapid changes in Δ_{47} temperatures (ca. 18°C within 400 ka) characterize the onset of the MCO and MMCT. We furthermore identify warm peaks during the MCO and a distinct fall in apparent Δ_{47}-based temperatures at ca. 14 Ma that is in very good temporal agreement with oceanic isotope records and coincides with the documented global cooling following the MCT. Collectively, these data contribute to understanding of the dynamics and variability in atmospheric circulation controlling Middle to Late Miocene temperature dynamics in the Northern Mediterranean region.

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