



Were the MIS 11 and MIS 5e warmer and/or wetter than the Holocene? Test comparison of Interglacial intensities using stable isotope data from Northern France tufa deposits.

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Many recent palaeoclimatic studies have focused on MIS 5 (Eemian) and 11 as they are supposed to be the best analogues for our modern interglacial. As they are characteristic of temperate periods and result of calcite precipitation from meteoric water, tufas are key-deposits for palaeoclimatic reconstructions of these interglacials. Calcite oxygen and carbon stable isotopes ($\delta^{18}\text{O}$ and $\delta^{13}\text{C}$) are known since the 80s to be important palaeoclimatic proxies for the Holocene and we recently have shown their suitability in Pleistocene tufas. At decadal-scale sampling resolution, $\delta^{18}\text{O}$ of tufa records variations in $\delta^{18}\text{O}$ of regional rainfall, and in this way reflects source or amount effects (particularly continentality), and temperature depending on locality. $\delta^{13}\text{C}$ of tufa indicates moisture availability (linked to biomass type/abundance) and rainfall intensity.

Using our new results from the tufa of Saint-Germain-le-Vasson (Normandy) dated to the first half of the Holocene, and those from Caours (Somme) and La-Celle-sur-Seine (Seine-et-Marne) respectively assigned to MIS 5e and MIS 11, we investigate similarities or differences between these Pleistocene interglacials and the modern one. Comparison between the sites is relevant as these tufas developed in a similar geological area (the Paris Basin) and are nowadays in the same humid and temperate climatic area. The Caours tufa presents carbon and oxygen isotopic compositions similar to the Saint-Germain sequence. Comparable temperature and humidity conditions are thus recorded during the Eemian and the Holocene. However, $\delta^{13}\text{C}$ for the MIS 5e optimum are more negative than those for the Atlantic optimum (Holocene), which may indicate wetter conditions. In La Celle, slightly warmer conditions appear to be recorded for MIS 11 compared to the Holocene by higher $\delta^{18}\text{O}$ values than in Saint-Germain. Moreover, two very humid episodes are observed in the La Celle $\delta^{13}\text{C}$ profile whereas such wet conditions are not observed during the first half of the Holocene at Saint-Germain. One of the episodes is correlated to maximal temperatures and assigned to the MIS 11 optimum. Stable isotope data for this period clearly indicate warmer and wetter conditions compared to those during the Atlantic optimum recorded at Saint-Germain.

Tufa stable isotopes are thus suitable to compare MIS 11 and MIS 5e interglacials palaeoclimatic conditions to those prevailing during the Holocene. New investigations on recent and Pleistocene tufa deposits from France, Germany, England, etc. should lead to a more complete record of differences and similarities between interglacials, and allow including geographical parameters at European scale.