Holocene vegetation, climate and human impact in steppes around Lake Sevan (Armenia) based on a multiproxy approach: Pollen, NPPs and brGDGTs

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In the Caucasus Mountains, the role of human influences and climate changes on steppes expansion over the Holocene is still discussed because this region is poorly documented. This study investigates (1) modern pollen-vegetation relationships in Armenia and (2) changes in vegetation, human activity and climate in the Holocene record of Vanevan peat (south-eastern shore of Lake Sevan) located in Armenia. The last 9700 years are recorded in the Vanevan core. We used a multiproxy approach including XRF, Pollen, Non-Pollen Palynomorphs (NPPs) and branched glycerol dialkyl glycerol tetraethers (brGDGTs) to reconstruct changes in vegetation, human impact and climate. The combination of these proxies is innovative and aims to distinguish the impact of human activities and climate change on vegetation. Modern pollen assemblages from semi-desert/steppe regions of Armenia show an abundance of Chenopodiaceae while meadows steppes, subalpine and alpine meadows are dominated by Poaceae. The Holocene vegetation at Vanevan is characterized by steppes dominated by Poaceae, Artemisia and Chenopodiaceae. However, several arboreal taxa, such as Quercus, Betula, Carpinus betulus and Ulmus, are more developed on slopes between 8600 and 5100 cal BP. Regarding the human impact, the presence of agriculture is attested since 5200 cal BP, largely increases during the last 2000 years cal BP (high percentages of Cerealia-type pollen) and correlates with the occupation periods reported in archeological studies. Palaeoclimate changes at Vanevan are estimated from (1) water level changes (2) temperature reconstructions based on brGDGTs (3) climate reconstructions based on pollen (through a multi-method approach: Modern Analogue Technique, Weighted Averaging Partial Least Squares regression, Random Forest, and Boosted Regression Trees). Climate reconstructions based on pollen and brGDGTs are rare and the multi-method approach...
using pollen data is innovative in the region. The results of Vanevan give evidence of high temperatures from 7900 to 5100 cal BP and arid events at 6000, 5000-4500 and 4200 cal BP, in agreement with other regional records.