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Middle Pleistocene climate changes in the Central Mediterranean as recorded by soil weathering profiles from the archaeological site of Valle Giumentina (Italy)

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The central and southern parts of Italy contain major Lower Palaeolithic sites with lithic assemblages documenting the appearance of the first human settlements during the early Middle Pleistocene in southern Europe [1, 2, 3]. Amongst these ones, the site of Valle Giumentina (VG) is an exceptional sedimentary and archaeological-rich sequence in the eastern Apennines with ten in-situ Clactonian and Acheulean archaeological layers with flake and/or handaxe industries [2]. This sequence corresponds to a succession of paleosols with lithic industries interbedded within fluvio-glacio-lacustrine deposits. Some paleosols developed on tephras deposited from the Pleistocene volcanic districts along the Tyrrhenian Sea margin of Italy. The cross-study analysis of the palaeoenvironmental and tephrochronological data from a lacustrine sequence may be used: (1) to produce regional proxies tracking the continental climate changes, and (2) to compare these proxies with ice and marine records [4]. In this perspective, the VG sequence was investigated with a 45 m-depth core and a 17 m-high cross-section. It was undertaken ED-XRF geochemical analyses on ca. 600 samples each 3 cm on average along the cross-section, and field magnetic susceptibility (MS) with a 1-cm vertical resolution. The geochemistry of the VG sequence shows an anti-correlation between the Ca and Sr elements, on the one hand, and the Si, K, Ti, Cr, Mn, Fe, Co, Cu, Zn, Rb, Zr, Ba, Pb elements, on the other hand. The high contents of the former elements indicate sedimentary detrital fluxes in the watershed, which is mainly composed of carbonated rocks, during cold periods, while the high concentrations of the latter elements are representative of soil weathering during mild to warm climate. The geochemical ratios Rb/Sr, Ba/Sr and K/Ca were used to track the intensity of soil weathering [5, 6]. From our data, the Rb/Sr ratio is the most sensitive elemental ratio to characterize the intensity of soil weathering, detecting some incipient soils (tundra gley) not evidenced by other ratios. The MS shows high values between ca. 200 and 300×10^{-5} SI for three dark brown levels corresponding to weathered tephras (andosol) issued from three large volcanic events possibly originating from the Colli Albani stratovolcano complex. These tephras were dated by $^{40}Ar/^{39}Ar$ between ca. 560 and 450 ka. From the $^{40}Ar/^{39}Ar$ chronology the sediments in the lower and central parts of the cross-section extends from the end of the MIS 15 interglacial period to the end of the MIS 13 interglacial period. The glacial till in the upper part of the VG sequence was probably deposited during the MIS 12 glacial period, which is synchronous with a regional major glaciation in southern Europe [7]. The thick red colluvial soil with many Fe-Mn concretions at the summit of the sequence, which exhibits the highest weathering from the geochemical ratios, is possibly related to the MIS 11 interglacial period. The comparison with marine or ice global (EPICA, $\delta^{18}O$ Benthic stack) and regional (ODP965, KC01B) records shows that the continental climate changes evidenced by the VG sequence are in good agreement with the global climate changes, except for the highly weathered paleosoil underlying the glacial till in the upper part of the VG sequence, corresponding possibly to a regional climate anomaly in Central Italy at the MIS13/12 transition.

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