



A geofingerprint of the parent material-soil-wine chain in a high quality terroir. A first approach on Piediroso vineyards, Campi Flegrei, southern Italy

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This work encompasses the results of an interdisciplinary research involving geologists, chemists and pedologists, aiming at identifying a 'geofingerprint' univocally linking the wine to its origin, namely, the Piediroso vineyards growing on Campi Flegrei volcanic area. Since ancient times vineyards were cultivated in this volcanic field as a consequence of its favorable climatic conditions and soil suitability, both contributing to the generation of a high quality wine terroir. The potassic alkaline volcanism of Campi Flegrei was characterized by the emplacement of a large amount of pyroclastic deposits and minor lava flows. Their genesis is mainly due to two caldera forming processes linked to two high energy events: the Campanian Ignimbrite eruption (CI) dated at about 39,000 ybp and the Neapolitan Yellow Tuff (NYT) eruption (15,000 ybp). The investigated site evolved on eruptive products following the NYT eruption and ascribed to the so-called Third Phlegraean Period (8,000-500 ybp). The focal point of this research was the identification of the soil-vineyard-must chain by correlating elements distribution and isotopic ratios from geological parent material to ending wine must. To this aim, a representative soil/Piediroso vineyard system was identified and characterized including soil profile horizons. Samples from each soil horizon as well as from vine branches, leaves, grapes and must were collected and analyzed. All samples were analyzed by MC-ICP-MS to determine their $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic composition, by ICP-QMS to measure Li, Be, B, V, Cr, Mn, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Mo, Ag, Cd, Ba, Tl, Pb, Bi, U and REE, and by XRD for the qualitative evaluation of the mineral phases occurring in soil samples. The soil profile exhibits an A_p - B_w -BC-CB-C horization. The color varies from dark brown in A_p to very dusky red in C. Rock fragments ($\varnothing > 2\text{mm}$) represent 10-15% of total volume. The texture is generally sandy loam. Water pH value ranges from weakly acid (5.2-5.8) in surface horizons to neutral (7.2) in depth along soil profile. For all horizons the phosphate retention, the Cation Exchange Capacity and the content of allophanic materials are very low, while the bulk density is high. The profile is classified as Vitrandic Haploxerepts (USDA-NRCS, 2010). By Land Suitability analysis, soil belongs to S1 class highly suitable for vineyards.

Our study clearly shows that any interpretation of the elements distribution from both geological and pedological standpoints was not possible so far, whereas the use of a petrogenetic tracer such as $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic composition provided encouraging responses. In fact, the values of such ratio within the entire chain studied vary from 0.7076 to 0.7084, thus falling in the typical range for volcanites of Campi Flegrei (0.7065-0.7086). These results currently represent the unique study focusing on a geotracer, such as the $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic ratio, useful to identify the Campanian wine-producing chains from soil to ending product.