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The geofingerprint of Pyroclastic Rocks/Typic Herorthents/Piedirosso chain surveyed in the Roccamonfina terroir, northwest Campania region, Italy

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Investigations were carried out to evaluate the geofingerprint of Piedirosso wine produced in the volcanic areas of Campania region (Southern Italy). The research was focused on the terroir located in the southern area of the Roccamonfina volcanic complex according to a procedure developed by the Authors. The protocol accounts for a careful sampling of the soil and the grapes (branches, leaves) within the vineyards of "Masseria Felicia" farm, located in Carano di Sessa Aurunca (Caserta), followed by a Piedirosso wine production (monocultivar) on a pilot plant scale (grape harvest 2009). Samples were digested by using strong acids (HF, $HClO_4$) and suitably selected digestion programs. Only soil samples were analysed after treatments with NH_4NO_3 in order to simulate the labile fraction of metals in soil useful to estimate the $^{87}Sr/^{86}Sr$ isotope ratio.

ICP-MC-MS analyses allowed to determine the $^{87}Sr/^{86}Sr$ isotopic composition whereas ICP-QMS were carried out 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 Rare Earth Elements. Finally, XRPD analyses provided qualitative and semi-quantitative evaluations of the mineral phases occurring in soil samples. Suitable agronomic analyses allowed a careful soil classification.

The soil profile exhibits an A_p1-A_p2-A_p3-C1-2C2-3C3-4C4 horizonation. The color varies from dark brown in A_p horizons to light yellowish brown in C horizons.

Rock fragments distribution varies irregularly along soil profile. Texture is loam in all horizons, except A_p1, C1 and 3C3 that show a sandy loam texture. Mottles are evident in all horizons except in 3C3 with a contrasting colors as reddish yellow or strong brown.

Redoximorphic features occur in poorly (C1) and very poorly (2C2, 4C4) drained horizons as coatings of iron and manganese oxides. Their color ranges between very dark gray and reddish brown. Water pH is neutral-subacid in the whole soil profile. For all horizons the Cation Exchange Capacity and the content of allophanic materials are very low. The profile is classified as Typic Xerorthents (USDA-NRCS, 2010). By Land Suitability analysis, soil belongs to S1 class highly suitable for vineyards.

Although the site is located on the southern slope of the Roccamonfina volcanic complex, mineralogical data along with the survey investigation account for a substrate constituted by deposits of the Campania Ignimbrite eruption (39.000 ka). However, we cannot disregard the hypothesis that autochthonous pyroclastic products could have affected the pedogenetic process, as the sampled site is placed on the borders of a fluvial axis, thus allowing the deposition during flood periods of oldest deposits pertaining to the Roccamonfica volcanic activity (0.58-0.1 Ma).

As far as the ICP analysis are considered it should be remarked that trace elements do not provide useful information as possible geotracers. In fact, as already discussed in previous researches, the artificially induced processes, such as fractionation and/or enrichment of specific elements, occurring during the growth of the grapes and the wine production (pruning, fertilization, manuring, wine production and bottling) preclude that trace and ultratrace element concentrations transfer to the final product (wine) information univocally linked to the substrate.

The whole $^{87}Sr/^{86}Sr$ compositional range, here defined as the geofingerprint of the investigated chain, is within 0.7076 and 0.7088 with the highest values showed by the wine. By contrast, the lowest ratios were measured in the leaves (0.7076-0.7077). These data compared with those of the pyroclastic products of Roccamonfina (typical

range 0.7066-0.7099) and Campi Flegrei (0.7065-0.7086) enable to confirm that, also for the investigated terroir, the $^{87}Sr/^{86}Sr$ isotope ratio can be positively considered as geotracer of wines produced on volcanic areas. Since the isotopic range for both volcanic districts shows a partial overlap it was not possible to associate the investigated chain to a precise petrological context. Specific-site investigations could provide a solution to this issue.

Finally, the present study is a further evidence that a multidisciplinary approach enables to lay the foundations for the implementation of a powerful tool of geographic food farming geotracer for typical products widespread in the Italian perithyrrhenic volcanic areas.