

The Geodiversity of the Ligurian DOC Vineyards and Its Relationships with the *Terroir*

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Abstract—The Liguria region (NW Italy) is characterized by a wide geodiversity, which is strictly correlated with a huge variety of landscapes. This article reports and discusses the results of a multidisciplinary research performed to investigate the relationships among the “geological fingerprint” of soils and the quality of wines, going beyond the classical Italian quality labels, such as the DOC (Controlled Designation of Origin), the DOP (Protected Designation of Origin) and the IGP (Protected Geographical Indication) labels. We applied an innovative multidisciplinary approach (geological, geomorphological, geochemical, mineralogical, ecological and vegetational) aimed to demonstrate the close relationships between the “geological fingerprint” of an area and the organoleptic properties of agricultural products..

Index Terms—DOC Ligurian vineyards, FP-EDXRF, geological label of the product®, terraced landscapes.

I. INTRODUCTION

Among the agri-food products it is necessary to distinguish between those for the food industry and those intimately linked and deeply rooted with the territory. The last ones, including the wines, are those that better comply with our project aimed to determine the peculiar geo-pedological features that could represent the fingerprint of high-quality and guaranteed agri-food products. In particular, as outlined by [1] “*wine is undoubtedly the agricultural product that best mirrors the environmental, social, and economic conditions under which the grapes grow*”.

The geo-pedological characterization of vineyards represent a good tool for the development and the promotion of *terroir*. The idea originates from the concept of pedogenesis, *i.e.* the set of processes which progressively transforms the parent rocks (bedrocks) to soils; during these processes the soil inherits unique features resulting from the interaction of several factors including the mineralogy and chemistry of the bedrock, the geographic location, the climate, the geomorphological context, and the biological activity.

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Several questions have been at the base of our project: if soil has unique characteristics then has the agricultural product inherited specific peculiarities? What are the main geo-pedological features of the best *terroir*? Is it possible to correlate the geological and physico-chemical characteristics of soils to the organoleptic properties of the product? Based on these assumptions our research focused on the importance of geodiversity on the quality of Ligurian DOC wines.

II. ANALYTICAL METHODS

Sixty soil samples and a variable number of outcropping rocks were collected for each selected DOC vineyard. Each sampling point was geo-referenced using a global positioning system (GPS) and mapped using open source geographical information systems softwares (QGIS and GRASS). About 1 kg of soil were collected with hand soil auger and sieved *in situ* to remove the fraction > 2 cm. Several aliquots for granulometric, mineralogical and chemical analyses were obtained by quartering. Soil color were determined *in situ* and in laboratory (on dry samples) by comparison with Munsell Soil Color Charts. The chemical composition of soils was determined by means of Field Portable X-ray Fluorescence Spectrometer (FP-EDXRF) X-MET7500 Analyser (Oxford Instruments) on the granulometric fraction < 2mm. At the used analytical conditions, quantitative analyses were obtained from trace level (ppm) to 100% for elements with atomic number ≥ 12 (Mg). Selected samples were also analyzed by ICP-MS and ICP-AES for calibration purpose. Mineralogical analyses were assessed by polarized light optical microscopy (PLOM) and scanning electron microscopy (SEM) and microanalysis (EDS).

The results were inserted in the GIS database and used either to produce contour maps for the evaluation of the spatial distribution of selected chemical elements, minerals as well as agronomic and environmental parameters. Selected results were also reported in illustrative brochures as well as retrieved from the Geospectra s.r.l. website using a QR-codes or NFC Tags.

III. LIGURIAN'S VINEYARDS

The methodology described above was applied to selected Ligurian DOC vineyards aiming to determine the geological variability and its relationship with agricultural soils. As reported in Figure 1, Liguria has eight DOC appellations corresponding to the excellence of the regional wine production and located in geographical areas (Fig. 1) characterized by high geodiversity (Fig. 2). The eight Ligurian DOC appellations are: *Dolceacqua*, *Pornassio*,