



## The “green stones” of Valtellina and Valchiavenna (central Alps, northern Italy)

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Valtellina and Val Chiavenna (Sondrio, Central Alps, northern Italy) are traditionally areas of production of building and ornamental stones (e.g. Serizzo Ghiandone, Serizzo Valmasino, San Fedelino Granite), and among these the "green stones" have a leading position. These stones had an extensive use in Lombardy, as well as abroad (e.g. Switzerland). The "green stones" are related to the two mafic-ultramafic bodies of Valmalenco and Chiavenna, where the two largest quarrying districts of the Province of Sondrio are located. Until the early decades of the XX century, serpentinites (and other lithologies from Valtellina) were also extracted from the erratic boulders of Brianza (north of Milan), but at present time the law protects the few remaining boulders. The extracted and processed materials are various: serpentinites, opicalcites, soapstones.

Even the "Stone of Tresivio", used in the past in important monuments of Valtellina, could be classified among the "green stones" in a broad sense: it is a green chloritic schist with scarce and thin ferri-ferous calcitic veins, pertaining to the sedimentary "Servino" Formation. In recent times, the ancient quarries of this stone were rediscovered near the homonymous village, a few kilometers from Sondrio. There are also historic reports about other "green stones", used in ancient times, such as the "Stone of Grosio", a chloritic schist, and the "Bormio Prasinite". Currently the extraction and processing of "green stones" occurs mostly in Valmalenco, with 22 active serpentinite quarries and a gross volume of 70000 m<sup>3</sup> extracted per year, with a yield of about 50%. The Malenco serpentinite (interpreted as sub-continental mantle rocks) forms a 1-2 km thick tabular body, outcropping over an area of about 170 km<sup>2</sup>, almost entirely confined within the boundaries of the valley. The antigoritic serpentinites (with variable amounts of olivine, clinopyroxene, chlorite and magnetite) are moderately up to strongly foliated, sometimes folded, and are processed in two main commercial varieties: schistose ("serpentinoscisto") and massive ("serpentino da taglio"). In Valmalenco, the extraction and processing of schistose serpentinites for the production of slabs ("piode", splitted by hand with hammer and chisel), used in roofing and flooring, dates back at least to the XIV century. From the traditional underground extraction, the quarrying activities moved to the modern open-cast extraction in the seventies. The renowned quality of the secular serpentinite roof coverings is related to the excellent physical and mechanical properties, especially the flexural strength (average values around 90-100 MPa), very low porosity and the thaw/freezing resistance. The "massive" serpentinite achieved a special place in the national and international market of ornamental stones: the several extracted varieties (Serpentino Classico, Verde Vittoria, Verde Perlato, Verde Mare, Verde Principe, Verde Torre S. Maria), in addition to the excellent technical properties (flexural strength and thermal properties) that promote specific uses, make these stones much appreciated worldwide (e.g. Bundestag in Berlin, Germany). As part of the "green stones" of Valmalenco, two currently abandoned opicalcite quarries have been active in the recent past. The extraction and processing of soapstone ("pietra ollare" or "pietra laugera", a talc and/or chlorite rich ultramafic/mafic rock) in Valmalenco and Valchiavenna probably dates back to the Iron Age; in Valchiavenna it is documented with certainty since Roman times and the Middle Ages. The extraction and processing of soapstone peaked around the middle of the XVIII century, with a dozen quarries and about 300 workers involved, between Chiavenna and Piuro. A limited production of soapstone is still active in the municipalities of Piuro (talc-olivine-tremolite fels) and Chiesa in Valmalenco (chlorite schist), where in addition to the traditional cooking pots ("Lavecc"), there is a growing art work and gift items production. With the exception of two companies that have reached an industrial production level, the remaining 24 companies operating in Valmalenco are on an artisan level, and are grouped in the "Consorzio Artigiani Cavatori Valmalenco". The consortium, already engaged in the management of a permanent storage of explosives at the service of the quarries, promotes and subsidizes economically various initiatives aimed at the enhancement of stone products and the development of this craft. The consortium is a promoter of a cultural initiative aimed at the restoration of an underground quarry and the ancient paths of "Giovello", a historic site for the extraction and processing of serpentinite.