

## **POST-NAPPE HYDROTHERMAL ACTIVITY IN THE NORTH-WESTERN ALPS: RELATIONSHIPS BETWEEN GOLD-QUARTZ LODES, LISTVENITES AND EXTENSIONAL FAULT SYSTEMS**

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During the Oligocene, the collisional Penninic-Austroalpine wedge of the north-western Alps was affected by short lived extension and differential uplift. The tectonic pulse was associated to thermal perturbation, partial melting of previously enriched (Alpine subduction) mantle sources and hydrothermal activity supplied by CO<sub>2</sub> and metamorphic crustal fluids. This is evidenced by intrusion of calc-alkaline to ultra-potassic bodies, gold-quartz lodes, and listvenitic breccias. Listvenites occur as large and hard fault breccias arranged in an orthorhombic system (E-W and NE-SW) and, in the Aosta Valley, developed only across mantle-derived serpentinites of the Piedmont ophiolitic nappe.

Listvenitic breccias consist of partly to completely carbonatized serpentinite fragments, cemented by a matrix of polyphase hydrothermal carbonate (mainly dolomite and magnesite) ± quartz. Cr-rich muscovite (fuchsite, after relict spinel), provides the typical green-colour of the fresh rock. Cu-Fe and Pb-Zn sulphides locally occur, together with traces of cryptic gold.

Gold-quartz lodes are mainly located in the axial sector of the belt, from the Gran Paradiso massif to the Simplon dome. The gold-quartz lodes may be subdivided in two main groups, based on their regional trend: i) the southern and central lodes (Gran Paradiso: GP, Traversella: T, Arcesa-Brusson: AB, Val Sesia) have the same orientation of the listvenitic fault breccias and calc-alkaline to ultra-potassic dykes (E-W and NE-SW); ii) the northern lodes (Val Quarazza, Valle Anzasca, Val Bianca, Valle

Antrona, Gondo and Crodo) show different orientations (NW-SE to NE-SW). In our opinion, the genesis of the GP-T-AB lodes are roughly coeval with the Oligocene igneous intrusions, on the basis of their areal distribution and structural similarities. Instead the Monte Rosa-Antrona-Simplon gold-quartz lodes are probably linked to the Neogene extensional and sinistral tectonics of the Simplon and Ospizio Sottile fault system. A similar distinction may be envisaged from the available geochronological ages: the T-AB lodes, as the listvenites and calc-alkaline to ultra-potassic bodies, show 33-30 Ma, while the Monte Rosa-Antrona-Simplon lodes show decreasing ages, from southwest to northeast, between 29 Ma and 11 Ma (PETTKE et al., 2000). As a whole, these gold-quartz lodes may be correlated to late metamorphic fluids generated by the devolatilization of the Lower Penninic nappe stack and related Antrona and/or Valais ophiolitic unit.

The E-W and NE-SW trending older group (GP-T-AB), listvenitic fault breccias and calc-alkaline to ultra-potassic bodies are related to the Oligocene extensional activity. The NW-SE to NE-SW trending younger group (Valle Anzasca, Val Bianca, Valle Antrona, Gondo and Crodo) is related to the extrusion of the Lepontine dome and lateral escape of the overlying Pennine-Austroalpine block. The interposed Val Sesia and Val Quarazza lodes display intermediate structural features (E-W and NW-SE trends) developed at around 29 Ma: they mark the change of the tectonic regime from Oligocene ephemeral wedge extension to tectonic denudation of the Lepontine

tine dome and lateral escape of the overlying Pennine-Austroalpine nappes.

### References:

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