Geophysical Research Abstracts, Vol. 9, 05551, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05551

3D modeling of gold-bearing quartz veins in the footwall of a major post-metamorphic normal fault (Aosta-Ranzola fault, Brusson, Valle d'Aosta)

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Structural data collected in the field (1:2.500 map and detailed outcrop descriptions) and detailed mine plans (1:500) have been integrated in a 3D geological model implemented in the gOcad geomodeling platform (Mallet, 2002). The model represents the geology and the fracture and fault network of the Fenillia gold mine, one of the most important gold deposits in the so-called Monte Rosa district (Pettke et al. ,1999). The deposit is localized in an Upper Penninic basement unit - the Arcesa-Brusson unit - outcropping at the footwall of a major post-metamorphic N-dipping fault, the Aosta-Ranzola fault, which has a well documented oligocenic extensional activity (Bistacchi et al., 2001).

The 3D model provides a deeper insight into the complex fracture and fault network, clarifying its architecture, which can only be partly understood in 2D. Gold-bearing quartz veins and hybrid fault-veins are kinematically and spatially linked to the master fault. Larger quartz masses occur along N-dipping hybrid fault-veins (or dilatant faults), which characterize the c.a. 500 m thick footwall damage zone of the Aosta-Ranzola fault. Gold-bearing quartz veins haven't been found in the hangingwall, but it is noteworthy to remember that the damage zone is strongly asymmetrical due to the occurrence, in the hangingwall, of calcschists showing a very different mechanical behavior with respect to gneiss outcropping at the footwall. Gold-bearing quartz masses show regular thickness variations with a positive relationship with dip angle,

which defines the relative importance of dilatant and shearing deformation in along-dip sections (more vertical fault sectors show a more dilatant behavior). Smaller-scale gold-bearing quartz tension gashes have been found, radiating from hybrid fault-veins, and always show an higher dip angle. In places, subhorizontal elongated idiomorphic quartz crystals visualize the larger incremental strain axis in veins characterized by syntaxial growth.

The fault and fracture network related to the Oligocene Aosta-Ranzola fault activity is crosscut by later NW-SE Miocene faults (Bistacchi & Massironi, 2000). These 100-metre-scale faults show moderate offsets, which can be neglected at common mapping scales (e.g. 1:10.000). Nevertheless, when implementing a detailed 3D model, the effect of these mesoscopic features is very important. From a mining point of view, a correct reconstruction of 3D relationships between Oligocene and Miocene faults would have been of the greatest relevance, since the younger faults crosscut the mineralized sectors of the fault and fracture network, preventing from following the ore deposits.

Geochemistry and grade data, taken from the literature (Richard, 1981), have been included in the model as spatial properties of hybrid faults an veins. This will allow to study the relationships between fluid flow and the fracture network, which is the goal of the next stage of this study.

References

Bistacchi A. & Massironi M. (2000). Post-nappe brittle tectonics and kinematic evolution of the north-western Alps: an integrated approach. Tectonophysics, 327, 267-292.

Bistacchi A., Dal Piaz G.V., Massironi M., Zattin M. & Balestrieri M.L. (2001). The Aosta-Ranzola extensional fault system and Oligocene-Present evolution of the Austroalpine-Penninic wedge in the northwestern Alps. International Journal of Earth Sciences (Geol. Rundsch.), 90, 654-667.

Mallet J.L. (2002). Geomodeling. Oxford University Press, Inc., New York.

Pettke, T., Diamond, L.W. & Villa, I.M. (1999). Mesothermal gold veins and metamorphic devolatilization in the northwestern Alps; the temporal link. Geology, 27/7, 641-644.

Richard A. (1981). Le district aurifère de Challant (Val d'Aoste – Italie): gîtologie, géochimie et métallogénie de l'or. PhD Thesis, Université Scientifique et Médicale de Grenoble.