First finding of Cr-rich magnetite from Liconi mine (Cogne) - Geological and mineralogical features

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Recent analyses of magnetite from the Cogne mining area have shown a relevant Cr content (Cr_2O_3 up to ~12 wt%). These Cr-rich magnetites were found in serpentinitic rocks from the Liconi mine at 2504 m asl (Monte Creya), near Cogne. Liconi is the oldest mining site in this area and has been exploited since 1400 A.D. The Liconi magnetite-rich serpentinite is the largest and longest mineralized lens in the Cogne mining area (up to 150 m in thickness and 300 m in length, Stella, 1916). The mineralized serpentinite is transposed with metadolomite, marble and calcschists (Elter, 1960; 1971; 1987) at the northern boundary of the Gran Paradiso and Grivola ophiolite units.

The magnetite-rich serpentinite and the associated rocks suffered eclogite alpine metamorphism, as indicated by the presence of antigorite in the serpentinite, of lawsonite in the calcschists, and of other high-T minerals, such as vesuvianite, andradite, grossularite, clinozoisite and diopside, in magnetite-bearing rodingites. The eclogitic mineral associations overprinted serpentine, chlorite, zeolites and epidote, which were related to oceanic metamorphism. Magnetite occurs as: (i) micrometric (3-50 μm), idiomorphic, disseminated, Cr-bearing crystals in serpentine matrix, with phantoms of primary silicate minerals; (ii) lenses and bands of Cr-free, very fine aggregates in serpentine matrix; (iii) Cr-free lenses within calcschists and ophicalcites; (iv) Cr-free elongated crystals in a whitish matrix composed of Ca-rich rodingite minerals.

The typical Cogne magnetite is Cr-free (Stella, 1921; Compagnoni et al., 1979; Diella et al., 1994), with Fe_2O_3 + FeO up to 96-98 wt% and MgO and MnO in small but significant concentrations. Recent SEM and X-ray powder diffraction analyses carried out at the Val d'Aosta ARPA laboratory (Martin et al., 2005) confirmed a Cr-free composition for magnetite in rodingites (e.g. our sample Co14), carbonate rocks and mylonitic serpentinites, whereas they indicated the presence of Cr in the disseminated magnetite in serpentinites (e.g. our sample Co15). The Cr-rich disseminated magnetite is associated with Cr-enriched serpentine minerals and, sometimes, chlorite, and with minor pyrite, pyrrhotite and pentlandite.

Quantitative electron microprobe chemical analyses of the Liconi magnetites were carried out at the IGG, CNR, Padova. The composition of magnetite in sample Co15 is as follows: Cr_2O_3: 0 to ~12 wt%; MnO: 0.2 to 3 wt%; MgO: 1 to 3 wt%; ZnO: 0 to 0.7 wt%. Cr_2O_3 shows a strong positive correlation with MnO and ZnO, a weak positive correlation with MgO, a clear negative correlation with FeO and no evident correlation with TiO_2. In sample Co14 and in the mylonitic serpentinites, the magnetite compositions are Cr-free and very similar to those reported in the literature for the Cogne ore mineral. The evolution from Cr-rich to almost pure magnetite involves substitution of Cr by Fe^{3+}, and substitution of Mg and Mn by Fe^{2+}. Compared with analogous magnetites from the Mt. Avic massif within the Piemonte ophiolite nappe (Diella et al., 1994; Fontana et al., 2008), the most Cr-poor among Cogne magnetites show higher MgO (2.5 wt% vs. 0.4 wt%) and lower TiO_2 contents (<0.1 wt % vs. >0.1 wt%).