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Unusual mineralisations in ophiolite-related Volcanogenic Massive Sulphide deposits from the Modena Province (Northern Italy)

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Volcanogenic Massive Sulphide (VMS) deposits are stratiform accumulations of sulphide minerals associated with hydrothermal events in submarine environments [1], occurring at different stratigraphic positions in the Modena Province Northern Apennine ophiolites (Italy) [2]. They consist of crosscutting stockwork ore bodies emplaced into tectonic basalt fragments of the ophiolite sequence [2]. Forty samples from two historically dismissed mine districts of the area, Boccassuolo and Montecreto, were collected to determine the wall rock associations, the metallogenesis and critical metals concentration, through whole and *in-situ* petrographic, geochemical, mineralogical, and isotopic analyses.

Barren samples are variably weathered basalts and basaltic andesites with Ocean-Continent Transition Zone (OCTZ) features [3]. Albite, clinochlore-type chlorite, epidote, titanite and ilmenite are the main gangue minerals, and rare sulphides are still present. Instead, mineralised samples contain a sulphide association of pyrite, chalcopyrite, showing the so-called “chalcopyrite disease” [2], and sphalerite, with pyrrhotite traces. Whole rock trace elements analyses reveal the mineralised samples belong to the Pb-poor (up to 3 ppm) and Cu-Zn-rich (up to 0.6 wt.% and 0.3 wt%, respectively) VMS type deposit. Pyrite and chalcopyrite minerals are observed both in the Boccassuolo and the Montecreto mine districts, in the first area, they are tiny (~400 μm across) and more disseminated, while in the other, they are in the form of macrocrystals associated with sphalerite (up to 2 cm across). The intriguing aspect of this mineralisation is the presence of exotic (rare) mineral paragenesis associated to sulphides not so far reported in this area [*e.g.,* 2]. This includes Ag, Au, and Cd sulphides (*i.e.,* Au-rich pyrite, bornite, and greenockite), coexisting with Cr-Fe, and Pb-Se alloys. The nature and chemico-physical conditions of the circulation fluids responsible for this unusual mineralisation is under investigation.

[1] Piercey, S. (2011) Miner Deposita 46: 449-471

[2] Zaccarini F., & Garuti G. (2008) Miner Petrol 94: 61-83

[3] Saccani, E. (2015) Geosci Front 6(4): 481-501