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## The Zn-Nonsulphides district of Bongarà (Northern Peru)

Arfé, G.<sup>1</sup>, Boni, M.<sup>1</sup>, Mondillo, N.<sup>1,2</sup>, Balassone, G.<sup>1</sup>, Di Palma, T.<sup>1</sup> and Castro Medrano, E.<sup>3</sup>

<sup>1</sup> Dipartimento Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli, Italy ([boni@unina.it](mailto:boni@unina.it))

<sup>2</sup> Department of Earth Sciences, Natural History Museum, London, United Kingdom

<sup>3</sup> The Inka Consultant, Peru

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The Bongarà complex of deposits consists of a stratabound Pb-Zn Nonsulphide/Sulphide mineralization located in the Amazonas District, near the Yambrasbamba village (Peru) [1]. The deposits (Mina Grande, Mina Chica, and Rio Cristal) are hosted by Mesozoic limestone (Toarcian) of the Pucarà Group (Condorsinga Fm.), locally dolomitized and brecciated. The primary mineralization is considered a MVT, similar to the San Vicente deposit in Central Peru. There are multiple distinct ore concentrations scattered over a large area; the mineralization appears to be open-space filling and/or manto replacement associated with karstification. The economic value is currently considered as related to the concentrations of nonsulphide Zn minerals [2].

The Mina Grande deposit consists of several, partly exploited mineralized areas, where the ore consists of masses of nonsulphides (mainly hydrozincite >> smithsonite) mixed with brown soil. The mineralized body is 1.5 km long, 0.4 km wide, and extends to depths of 20 to 60 m below surface. The economic mineralization is concentrated in karstic cavities and earthy-looking mantos. The zinc "oxides" form a residual cap along the crest of an anticlinal structure [1]. This mineralization can be classified as belonging to Type 3 (residual in karsts cavities) among the supergene nonsulphide deposits [3]. The Rio Cristal prospect [1] is probably the most extensive area of zinc mineralization occurring at Bongarà to date. Diamond drilling has encountered both near-surface primary base metal sulphides (only in traces), and oxidized mineralization at depths of over 50 m down-hole, with grades of up to 20 to 30% Zn. The mineralization occurs in a sigmoidal zone, approximately 1.5 km long by 0.5 km wide. Several sub-horizontal manto-like bodies have been detected, which dominantly consist of masses of orange-brown and white zinc "oxides", which include smithsonite, hydrozincite, cerussite and Fe-hydroxides.

A mineralogical, petrographic, and isotope geochemical study of the Bongarà complex of deposits is being conducted by our research group. The ore grade is quite high (up to 35% Zn), with the metal mostly contained in hydrozincite (Mina Grande), smithsonite and hemimorphite (Rio Cristal). To calculate the temperature of smithsonite precipitation at Rio Cristal, a mean  $\delta^{18}\text{O}$  value has been considered between those of rain- and groundwater in the area. To calculate the temperature of calcite (and co-genetic hydrozincite) at Mina Grande, the mean  $\delta^{18}\text{O}$  annual value of the meteoric water (IAEA) has been considered. The temperatures resulting from stable isotopes geochemistry are comparable with the mean annual temperature values in the Bongarà district (21-23°C).

At Bongarà there is considerable economic potential both for nonsulphides (occurring in the surficial karst network throughout the whole district, as at Mina Grande) and for sulphides (along several structures detected in the Rio Cristal area). The supergene mineralization is possibly related to weathering episodes (Tertiary to Recent) occurring under a climate not very different from today.

*References:*

- [1] Wright C (2010) NI 43-101 Technical Report: 102 pp.
- [2] Boni M and Mondillo N (2015) Ore Geology Reviews 67: 208-233.
- [3] Hitzman MW et al (2003) Econ Geol 98: 685-714.

