Geophysical Research Abstracts
Vol. 12, EGU2010-11000, 2010
EGU General Assembly 2010

The volcanic-sedimentary sequence of the Lousal deposit, Iberian Pyrite Belt (Portugal)

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The Iberian Pyrite Belt (IPB) is a massive sulfide province that is located in the south of Portugal and Spain, and hosts more than 90 massive sulfide deposits that amount to more than 1850 million metric tonnes of sulfide ore (Tornos, 2006). The ore deposits size, vary from ∼1Mt to >100Mt (e.g. Neves Corvo and Aljustrel in Portugal, and Rio Tinto and Tharsis in Spain). The ore deposits are hosted by a submarine sedimentary and volcanic, felsic dominated, succession that constitutes the Upper Devonian to Lower Carboniferous Volcanic and Sedimentary Complex (VSC). The VSC ranges in thickness from approximately 600 to 1300 m (Tornos 2006). The VSC overlies the Phyllite-Quartzite Group (PQ) (Upper Devonian, base unknown) and is overlain by the Baixo Alentejo Flysch Group (Lower to Upper Carboniferous).

The Lousal massive sulfide deposit is located in the western part of the IPB and occurs mostly interbedded with black mudstone. The VSC sequence at Lousal mine consists of a mudstone and quartzite sequence (PQ Group) in the lower part of the succession, over which a thick sequence of rhyolitic lavas (>300 m) occurs. Above the rhyolitic lavas there is a thick sequence of black and grey mudstone that hosts the massive sulfide ore bodies, and a rhyolitic sill. The upper part of the VSC sequence consists of a thick mudstone interval that hosts two thick basaltic units, locally with pillows.

The rhyolites have small coherent cores, locally with flow bands, that grade to surrounding massive clastic intervals, with large lateral extent. The clasts show jigsaw-fit arrangement in many places and have planar or curviplanar margins and locally are perlitic at the margin. The top contact of these units is in most locations not exposed, which makes difficult to interpret the mode of emplacement. However, the thick clastic intervals, above described, are in accordance with quenching of volcanic glass with abundant water and therefore indicate that quenching of the rhyolites was the dominant fragmentation mechanism. Unlike many locations of the IPB, fiamme-rich pyroclastic units were not identified at Lousal.

The ore deposits occur in close proximity with this volcanic centre that may have driven hydrothermal circulation that led to ore formation. The volcanic rocks show intense chloritic alteration, indicating that the mineralizing event occurred after most of the rhyolitic units have emplaced.

The massive sulfides show abundant sedimentary structures which is not typical in the massive sulfide deposits of the IPB. The Lousal 50 Mt massive sulfide deposit consists of at least 11 ore bodies and was exploited until 1988 mainly for pyrite. The ores mined averaged 0.7% Cu, 0.8%Pb e 1.4%Zn (Strauss, 1971). These relatively low base metal grades led to an evaluation of the contents and distribution of high-tech element in the ore bodies, which would improve the economic viability of mining the deposit. This evaluation is currently focusing on the distribution and mineralogy of selenium, as ores mined in the past were known to be rich in this element.

This work benefits from research projects INCA (PTDC/CTE-GIN/67027/2006; Characterization of crucial mineral resources for the development of renewable energy technologies: The Iberian Pyrite Belt ores as a source of indium and other high-technology elements) and project ARCHYMEDES II (POCTI/CTA/45873/2002), both funded by the Fundação para a Ciência e Tecnologia.

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