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Hi resolution tracing of ore mineralization in the Río Odiel and Río Tinto region (Spain) using NEWTON magnetic instrument

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The Iberian Pyrite Belt in Huelva, southernmost Spain, is characterized by a primary hydrothermal mineralization (e.g. Tornos et al 2015). Cenozoic surface weathering processes of these ore deposits led to a remobilization of iron and heavy metals along highly acid drainage and river systems. In the context of scientific magnetic prospections it has been tested the capability of mineral and rock determination complementing vector magnetic signatures with susceptibility measurements using the magnetic multi-sensor instrument, NEWTON. The test has been performed along a 12 km transect parallel to the Rio Odiel which cross-cuts different Variscan lithological units, including metaplutonic and metavolcanic rocks of intermediate to acid chemical composition (dacitic to rhyolitic). Along the transect we detected nine pronounced and well-defined magnetic anomalies (up to +600 nT). These zones are 15 to 80 m wide and are aligned parallel to the lithological units. They represent iron-bearing hydrothermal mineralization zones which contain abundant pyrite as well as Fe oxides formed in surface alteration horizons as it has been recently described from the nearby Concepción mine by Yesares et al. (2017). Two of the observed magnetic anomalies are associated with outcrops around the ancient San Platon mine. XRD measurements of rocks from the observed mineralization veins indicate pyrrhotite as most important magnetic carrier. Rocks of this mineralization zone have significantly higher magnetic volume susceptibilities (0.8 to 1.2 x 10-2 SI) compared to the values of surrounding weak metamorphic rocks (0.7 to 1.2 x 10-4 SI). Since magnetite is very rare and often not present in these mineralization zones, we have calculated that an amount of 3-4 vol. % pyrrhotite can explain the measured magnetic susceptibilities. Our results document that a hydrothermal mineralization which only contains pyrrhotite as magnetic carrier can be mapped with a vector magnetometer with a very high spatial resolution, even in a decimeter scale as recently documented from the Southernmost Andes by MOURA instrument (Diaz-Michelena et al. 2016). Further in situ magnetic mapping of the susceptibilities and vector magnetic properties have been performed with NEWTON instrument next to the Zarandas mines (5 km to the East of Rio Tinto). The outcrops include pyrite-dominated ore deposits exposed in-between gabbroid Variscan basement rocks which have comparatively low volume magnetic susceptibilities (0.1 – 9.6 x 10-5 SI) and weak magnetic anomalies (+ 10 to +200 nT). The ore deposits have most variable magnetic anomalies of + 100 to +2200 nT, depending on the amount of its ferromagnetic carriers magnetite and/or pyrrhotite. Volume susceptibilities of 0.5 – 0.6 x 10-2 SI characterize these highly iron ore-bearing hydrothermal mineralization veins. It can be concluded that the methodology: vector and susceptibilities (NEWTON) measurements provides an advanced high-resolution in-situ characterization of mineralization areas on Earth, but also in the context of future extraterrestrial exploration missions.

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