


SULFUR-ISOTOPE VARIATIONS IN SULFIDE MINERALS FROM MASSIVE SULFIDE DEPOSITS OF THE NORTHERN APENNINE OPHIOLITES: INORGANIC AND BIOGENIC CONSTRAINTS

Giorgio Garuti*, Pura Alfonso**, Joaquín A. Proenza*** and Federica Zaccarini*

* *Department Angewandte Geowissenschaften und Geophysik, Montanuniversität Leoben, Austria.*

** *Departament d'Enginyeria Minera i Recursos Naturales, Universitat Politècnica de Catalunya. UPC, Barcelona, Spain.*

*** *Departament de Cristal·lografia, Mineralogia i Depòsits Minerals, Universitat de Barcelona, España.*

 *Corresponding author, e-mail: giorgiogaruti@unileoben.ac.at*

Keywords: *Sulfur isotopes, copper sulfide deposits, Jurassic ophiolites, Ligurian Tethys. Northern Apennine, Italy.*

ABSTRACT

Sulfur isotope analysis of sulfide minerals has been carried out for the first time on ore samples from Volcanic-associated Massive Sulfide (VMS) deposits in Tethyan Jurassic ophiolites of the Northern Apennine. The average $\delta^{34}\text{S}$ value is +5.2‰ in pyrite (n. 22), +6.7‰ in chalcopyrite (n. 23), +6.1‰ in sphalerite (n. 9), and 4.6‰ in pyrrhotite (n. 2). The overall average $\delta^{34}\text{S}$ of +5.9‰ (n = 30, σ = 3.7) is consistent with data from other sulfide deposits of the Eastern Mediterranean Tethys, although the Apennine ores display a distinctive range from +11.4‰ to the negative field (min. -2.9). The highest $\delta^{34}\text{S}$ ‰ values are found in stockwork veins crosscutting basalt and gabbro, and in stratabound ores within basalt (av., +8.9‰). The $\delta^{34}\text{S}$ decreases in serpentinite-hosted stockwork veins (av., +5.8‰) and in stratiform deposits lying on ancient seafloors (av., +2.5‰), in which the negative values were detected. Inorganic reduction of seawater sulfate is assumed to be the primary source of sulfur in the deposits, with some exception however. The low $\delta^{34}\text{S}$ values of serpentinite-hosted veins indicate mixing with sulfur derived from the leaching of magmatic sulfides (av., $\delta^{34}\text{S}$ = +0.8‰). The negative values detected in seafloor-stratiform ores correlate with sulfide textures indicative of the activity of sulfate-reducing bacteria causing preferential fractionation of the light sulfur isotope. The sulfur isotope variations observed in the Northern Apennine VMS deposits reflect the influence of the different environments of sulfide deposition (seafloor vs. sub-seafloor) and different lithologies of the host rocks (basalt vs. serpentinite).