Microprobe analyses indicate the presence of local concentrations of arsenic within the core of framboidal structures and also in fresh overgrowths on idiomorphic pyrite, probably inherited from the diagenetic phase.

Diagenetic pyrite in a petroleum reservoir in Cretaceous volcanics in the Andes replaced by hydrothermal copper

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El Soldado, Chile, is a giant stratabound copper deposit hosted in Lower Cretaceous basalt and rhyodacite. Previous work had suggested that copper was concentrated preferentially where hydrothermal copper-rich solutions replaced preexisting, low-temperature, diagenetic pyrite, which is generally associated with bitumen (solidified petroleum). Doubt remained on whether some deep zones with massive crystalline pyrite veins, and massive chalcopyrite, bornite and chalcocite ores, could represent a net input of sulphur from hydrothermal, magmatically-derived sources. Magmatic related sulphur has a $\delta^{34}S$ value close to zero per mil. Conversely, diagenetic, low-temperature crystallization of pyrite, especially with the aid of sulphur-reducing bacteria in a degrading petroleum reservoir, would have led to extreme fractionation of sulphur and a wide range of $\delta^{34}S$ values, which would be locally available to form Cu sulphides during the hydrothermal phase.

Polished sections of ores were studied under the reflected light microscope. There is textural evidence of pre-existing diagenetic pyrite, as well as textures indicative of new hydrothermal growth. Diagenetic pyrite is characterized by framboidal structures of ca. 16μm diameter or smaller; colloform textures found in pyrite also suggest a low-temperature genesis. Although controversial, the general consensus is that framboids may grow with bacterial involvement. A range of stages of development of massive crystalline aggregates is observed in the samples: individual microcrysts, framboids, framboid clusters, recrystallized megacryst overgrowths, and banded concentric zones. Hydrothermal or high-temperature textures are characterized by idioblastic pyrite cubes or pyritohedra suspended in late calcite matrix. Temperatures from fluid inclusions in calcite indicate maximum (pressure corrected) temperatures of ca. 300 °C, and minimum temperatures of over 100°C.

$\delta^{34}S$ values from analysis of sulphide separates have a range of 24.5‰, from −7.4‰ to + 17.1‰. This variation is characteristic of a compartmentalized system that has been incompletely fractionated, and is compatible with bacterial interaction. Several samples yielded $\delta^{34}S$ values overlapping with that characteristic of magmatic sulphur, thus allowing for the possibility of some degree of input of homogenized sulphur, perhaps (but not necessarily) from a magmatic source.