Carbon and Oxygen Isotopes in Sediment-hosted Stratiform Copper Deposit, in Nahand- Ivand Area, NW Iran

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Sediment-hosted copper deposits are known from several points of Miocene geological units in East Azarbaijan province. The Nahand-Ivand area is located in the north of Tabriz, NW Iran. In the classification of the structural units of Iran, this area is situated in the western Alborz-Azarbaijan zone. The Tabriz basin is an intra-mountain basin which included the formation of organic-rich, laminated sandstone occurred repeatedly during the Miocene usually interpreted as a product of anoxic/euxinic conditions. The Upper Red formation with 1200 m thickness, include alternations of red oxidized (iron oxide minerals) sandstones and conglomerates that partly convert to light grey colored varieties (with plant fossils) and make reduced horizons. In addition, this unit has considerable deposits of evaporates, such as gypsum and salt. Also Miocene salt domes are related to this unit.

Mineralization is localized in the organic-rich gray rocks that replace the red rocks along the vertical and lateral directions. The main ore minerals in the deposit are copper carbonates such as malachite, azurite and some copper sulfides such as digenite. Copper precipitation was possibly promoted by reduction zones from organic matter such as woody fragments and plant fossil. It seems that during the formation of the copper deposits, organic matter played an important role in adsorbing and gathering metallic elements. Finely laminated nature of organic matter and their concordance to sedimentary bedding suggest that organic matter in the examined samples is essentially synsedimentary.

The carbon and oxygen isotopes composition of the major deposits and host geological units has been analyzed by Leco C244 in 6 Malachite samples, 1 calcite sample and 1 organic matter sample. The results show that $\delta^{13}C$ values change in range of -9‰ to 3‰ (for malachite sample), -4.7‰ (for calcite) and -24.7‰ (for organic matter) and $\delta^{18}O$ values range from 12 ‰ to 34‰. Inorganic substances commonly have higher ^{13}C content than reduced organic substances. Extreme carbon isotope fraction occurs in biogenic systems with biogenic substances commonly being depleted in ^{13}C. C depletions could be related to organic matter oxidation during bacterial and/or thermochemical sulfate reduction, or related to normal maturation of organic matter. It is believed that $\delta^{18}O$ values could be increased because of their circulation in the shallow sea sediments. Decrease of $\delta\ ^{13}C$ ratio in one sample to -9‰, supports this theory. The distinctive light carbon values would support a meteoric origin. This carbon isotope ratio is likely to have been precipitated from circulating meteoric water, which followed circulation paths similar to those in existence today.