Retention and mobility of heavy metals in the carbonate-rich sulfide tailings in Dachang mine (Guangxi, China)

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The tailings in Bali impoundment of Dachang tin-polymetallic sulfide mine, which is located at Guangxi Zhuang Autonomous Region of P. R. China, are rich in carbonate($CaCO_3$ 30.2 wt%; $CaMg(CO_3)_2$ 4.4 wt%) and sulfide(Total-S 15.7 wt%). By observing and sampling successively on a plumb profile of the tailings pile and using the modified BCR (European Community Bureau of Reference) procedure for element extraction, and the secondary mineralogy and the element geochemistry etc, we have gained following conclusions: (1)Most of pyrrhotite, galena, calcite and sericite, while part of sphalerite, arsenopyrite and pyrite, were consumed in the tailings by oxidation. Sulfide oxidation resulted in generating acid mine drainage, as well as releasing heavy metals (such as Zn, As, Cd, Pb). Zinc and As were moved out from the tailings more easily and larger in quantity than Cd and Pb. (2)A hardpan with greater thickness, cemented by secondary gypsum and lepidocrocite, was formed on the tailings surface due to long-term oxidation. The hardpan could be concentrated with heavy metals which released from the original tailings through oxidation. Zinc and As appeared as active acid extractable speciation in the hardpan were prone to remigration and released in large amounts, implying that both may be key factors of heavy metals pollution in Dachang mine district. And Pb and Cd may cause less impact for the mine environment due to their lower contents as acid extractable speciation in the hardpan. However, the condition of the tailings stacking would be changed if the tailings were restored by coverage (resulted in reducing environment) or phytoremediation (resulted in development of organic matter). In these cases, heavy metals (As□Pb□Zn and Cd), which appeared as Fe-Mn oxide bound speciation and sulfide/ organic bound speciation in the tailings, may be removed and produce the environmental effect.

Consequently, the carbonate-rich sulfide tailings may be similar to many other types of sulfide tailings in retention and mobility of heavy metals. It means the carbonate-rich sulfide tailings may also have the potential of releasing heavy metals.

The early Paleozoic magmatic arc of the Central Tianshan, NW China

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Located in the Xinjiang province, NW China, the Central Tianshan zone is an important component of the Central Asian Orogenic Belt (CAOB) and crucial linkage between the Siberian, Kazakhstan, Turpan-Hami and Tarim blocks, and played a key role in the crustal evolution and collisional tectonics of the CAOB. We studied a series of the early Paleozoic igneous rock of the Central Tianshan in an attempt to understand the magmatism and tectonic setting of the early Paleozoic Central Tianshan. LA-ICP-MS zircon U-Pb dating yields 424.9±5.8 Ma for the Xingxingxia granodiorite, 445.3±4.6 Ma for the ore-bearing granite of Tianhudong Fe-Mo ore deposit, 466.7±4.2 Ma and 452.0±2.8 Ma Ma for the meta-volcanic rocks hosting the Tianhu iron deposit in the Central Tianshan. Geochemical analyses show these rocks are generally enriched in large ion lithophile elements (LILE) such as Rb, Ba, Sr and LREE, but depleted in typical high field strength elements (HFSE) such as Nb, Ta, Ti, Y and HREE, consistent with the geochemical characteristics of typical arc igneous rock, indicating these rocks have genetic relations to volcanic arc and have been formed in a magmatic arc environment. This is also demonstrated by a number of early Paleozoic granites with ages mainly between 470 and 420 Ma which have been defined by high-precision zircon U-Pb chronology recently in Central Tianshan, such as the Hongliuhe pluton (441.4±1.6 Ma), the north Xiaoyanchi monzodiorite (427±8 Ma), the East Tianhu gneissose granite (466.54±9.8 Ma), the mylonitized Tianger granite (441.6±3.8 Ma), and the Gangou granite (428±10Ma). The geochemical and isotope features of all these granites also show calc-alkaline arc affinity. Combined with the regional geological characteristics and all the available data, it is suggested that the Central Tianshan was a magmatic arc during the early Paleozoic. The mechanism of the early Paleozoic Central Tianshan arc can be ascribed to the southern subduction of the ancient Tianshan ocean located between the Tuha block and Tarim block.

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