Mercury contamiation to the environment and health impacts by small and large scale Hg mining activties in China

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China currently is one of the largest mercury (Hg) consumers and Hg producers worldwide. From the perspective of the global plate tectonics, Guizhou province is situated in the center of the circum-Pacific mercuriferous belt [1]. Therefore, Guizhou was one of the world's important Hg production centers. So far, at least 12 large and super-large Hg mines have been discovered in the province. Currently all large scale Hg mining activites in Guizhou were completely stopped, but small scale Hg mining activites are still on-going. The Xunyang Hg mine situated in Shaanxi Province is presently the largest active Hg mining district in China[2]. We have conducted detailed studies to investigate Hg contamiantion to the envirnment and health impacts to local inhibitants at both large scale Hg mining and small scale (artisanal) Hg mining areas.

Our study revealed a significant contamination of Hg in soil, sediment, water, and rice in both Hg mining areas in Guizhou and the Xunyang Hg mining district. The highest concentrations of Hg in riparian soil, sediment, water and rice were found at the areas in the vicinity of the Hg retorting and mining sites. Moreover, GEM concentrations in ambient air exhibits a local spatial pattern indicating Hg^0 emission during the process of cinnabar ores retorting. Elevated concentrations of MeHg in rice also were found. The sources of MeHg in rice mainly derived from the soil MeHg, which is likely related to the deposition of GEM [3]. High concentrations of THg in surface water and stream sediment are mainly constrained by the calcines introduced during the retorting activity, which represents the major source of Hg contamination to the local ecosystems in the region. The mining waste piles in the study region must be appropriately disposed of and the mine runoff from those calcine piles should be properly treated and not be used as irrigating water to the paddy field. Our study showed that artisanal Hg miners exposed to high levels of Hg vapor and urine Hg concnetrations in Hg miners were two to three magnitudes higher than the control groups. Our data showed a serious adverse effect on renal system for the smelting workers. The workers were exposed to mercury vapor through inhalation, and the exposure route of Me-Hg was through intake of rice. Meanwhile, rice consumption is the primary MeHg exposure route for the local population in Hg mining areas.

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Zircons in the T-Zone, Thor Lake rare element deposit: implications for deposit genesis

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The Thor Lake Y-REE-Nb-Ta-Zr-Be deposit, NWT, Canada, one of the largest known rare-element deposits hosted by alkaline-peralkaline igneous complexes, comprises two main mineralized zones: the Nechalacho deposit and the T-Zone. The T-Zone is hosted by granite and syenite, and is a pegmatite that has a significant hydrothermal overprint. It is zoned, comprising, from rim to core, a Wall Zone, Lower Intermediate Zone (LIZ), Upper Intermediate Zone (UIZ), and Quartz Core Zone.

We have investigated the morphology, internal textures and chemistry of hydrothermal zircon from the UIZ and magmatic zircon from the host granite and syenite, combining LA-ICP-MS analysis with petrography, CL imaging, SEM-EDS and EMPA. Based on the morphology and associated mineral assemblages, zircon can be broadly classified into three types. Type 1 is fine grained (< 50 μm), euhedral, well-zoned, hydrothermal zircon and mainly occurs in pseudomorphs that have a prismatic to rhombic habit. Type 1 zircon can be subdivided into two subtypes: 1a, which is hosted by massive quartz, and 1b, which is associated with fluorite and sulfides. Type 2 zircon is anhedral, unzoned, and fine-grained, and is associated with rutile, quartz, magnetite, and hematite in the LIZ. Type 3 is magmatic zircon from the host igneous rocks, that is coarser grained and (50 ~ 300 μm) and also exhibits oscillatory growth zoning.

Type 1 zircon was affected by Ca metasomatism that altered the zircon and precipitated REE-bearing minerals, such as xenotime. Ti and REE concentrations in Type 1 and 3 zircons were obtained by LA-ICP-MS (Type 3 zircon was also analyzed by EPMA). The Ti in the unaltered magmatic zircon yields apparent Ti-in-zircon temperatures of ~ 614 to 860°C. In contrast, hydrothermal zircon has unreasonably high Ti concentrations and therefore calculated temperatures. This type of zircon contains high concentrations of REE and other HFSE, such that the coupled substitutions involving Ti may be affected to such an extent to invalidate the established geothermometric calibrations. Alternatively, the assumptions regarding Ti activity are invalid under hydrothermal conditions [1]. Both magmatic and hydrothermal zircon are generally HREE-enriched and exhibit negative Eu anomalies, however, the former is distinguished by a pronounced positive Ce anomaly. In addition, significant tetrad effects observed in the REE patterns of Type 1a zircon, but not Type 1b zircon, suggest that the nature of coprecipitated minerals play an important role in controlling zircon REE chemistry.

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