Behaviour of heavy metals in tailings drainage

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The given work covers studying heavy metal migration in the Ob river basin that is situated in an industrial zone where waste products contact river water. The sulfide tailings of the lead-zinc concentration plant (LZCP), known as Talmovaya Sands, are stored in a channel of the M.Talmovaya river (Kemerovo region, Russia). Waste products of the Belovo zinc processing plant (BZPP) are located near the Bachat River. Drainage from these tailings discharges into the river system M.Talmovaya → Talmovaya → M.Bachat → Bachat → Inja → Ob.

Heavy metal concentrations in tailings are tens and hundreds times higher than the background values. There are intensive processes of substance transformation and redistribution of metals in the tailings that result in increasing Zn, Cd and Cu mobility. At the same time Pb, Fe and Ba re-precipitate in a body of tailings in inert forms (anglesite, ferrihydrite, goethite, jarosite, siderite, barite). Sulphate complexes and aqua-ions ($Me(SO_4)_2^0{}_{aq}$, $Me(SO_4)_2^{2-}$, $Me^{2+}{}_{aq}$) are the basic chemical forms of BZPP settling and Talmovaya Sands pore waters. In addition, carbonate, hydrocarbonate and hydroxide complexes of metals ($MeCO_3^0{}_{aq}$, $MeHCO_3^+$, $Me(OH)_2^0{}_{aq}$, $MeOH^+$) get a greater value in river water, though Zn and Cd prevail in more dangerous aqua-ionic forms. Large amount of metals release into the surface waters, despite of the available geochemical barriers inside tailings body. Zn and Cd mainly migrate as dissolved species, Ba, Fe, Pb - onto suspension particles (exchangeable forms), Cu distributes approximately fifty-fifty between these forms. The order of metal mobility in man-caused streams was obtained: Ba, Fe<Pb<Cu<Zn, Cd. Metals are strongly retained by bottom sediments and practically don't cause secondary pollution of river water (low percentage of water-soluble forms <1%). Unfortunately, metals (especially Cd, Zn, Cu, Pb) intensively pass into solution at acidification (high percentage of exchangeable forms 7.7-25%), and thus can cause pollution to river water. The influence of waste products on vegetation is gradually reduced downstream the rivers. Water of the Bachat River pollutes water of the Inja River and then the Ob River especially bottom sediments. Ba, Zn, Cd and Pb are the most dangerous metals for the population of the Salair and Belovo town. Concentration of Ba in drinking water exceeds maximum allowable concentration (MAC) in 2-3 times, that is caused by water chlorination. Zn and Cd concentrations in well water of the Salair town exceed MAC in 1.8 and 5.3 times, accordingly. Concentrations of Zn, Cd and Pb in dairy products exceed appropriate MAC. Though Pb and Ba are poor mobile metals in waste products and surface waters, it is evidently dangerous for human and animals. This work was financed by the RFBR # 03-05-64529, 01-05-65294

Origin of iodine and ^{129}I in volcanic and geothermal fluids from the North Island of New Zealand

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The mobilization of volatile elements during the subduction of marine crust and sediments is an important question for the understanding of the marine element budget. Geochemical behavior and half-life (15.7 Ma) of ^{129}I make this isotopic system a useful tracer for processes associated with the subduction and recycling of marine sediments. The North Island of New Zealand is particularly suited for testing this system because samples of volcanic and geothermal waters are accessible from a variety of settings across the volcanic arc. We report here on waters recently collected from locations sampled earlier by Giggenbach et al. (1993), specifically from the East Coast, the Taupo Volcanic Zone (TVZ), and the Northland, representing the fore arc, main arc, and the zone behind the volcanic arc, respectively. Although a significant number of the samples showed the presence of anthropogenic ^{129}I, pre-anthropogenic ratios could be determined for waters from the East Coast and the TVZ. Waters from the TVZ had the lowest iodine concentrations and $^{129}I/I$ ratios close to $300x10^{-15}$. In contrast, waters sampled in the East Coast had the highest iodine concentrations coupled with $^{129}I/I$ ratios as low as $55x10^{-15}$. While samples from the Northland had intermediate values in iodine concentrations, the initial $^{129}I/I$ ratios for this set of samples could not be determined due to the presence of anthropogenic ^{129}I. The ratios for the TVZ are compatible with iodine derived from marine sediments, mobilized from the entire sediment column undergoing subduction in this area. The ratios in the East Coast indicate a substantially older component,

also of marine origin, but related to the tectonic overpressuring of fluids in the accretionary wedge.

References

Giggenbach, W.F., et al., 1993, Geochim. Cosmochim. Acta, 57, 3427.