

Geoenvironmental characterisation of the King River Delta: A combined geophysical, geochemical and mineralogical approach

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The Mount Lyell Mining and Railway company, Queenstown, Tasmania, discharged nearly 95 Mt of tailings and 1.4 Mt of slag from its copper, gold and silver production into the Queen River from 1916 to 1994. As a result, approximately 87.4 Mt of tailings has accumulated at the King River Delta. This research presents a multidisciplinary approach to characterise tailings deposited at the King River Delta, combining geophysical, geochemical and mineralogical data.

Apparent resistivity and shear wave profiles suggest 4 layers in the delta: i) dry unconsolidated tailings; ii) saturated unconsolidated tailings; iii) salt water saturated unconsolidated materials; iv) fluvial sediments and/or Volcanic bedrocks.

Tailings are composed of pyrite, chalcopyrite, muscovite, quartz, chlorite and secondary mineral and contain high concentrations of Fe (average~77,500 ppm), Cu (average~1,400 ppm) and trace elements such as Co (average~350 ppm). Prolonged exposure of tailings created an oxidized surface layer across the entire delta, extending up to 20 cm depth. This hardpan is comprised of secondary iron oxide-hydroxides and sulphates which host an abundant variety of trace elements. Below this upper oxidized profile, two distinct zones were observed across the delta (Figure 1): i) zone A is the inner portion of the delta where unoxidized tailings are abundant; ii) zone B, next to the river mouth and harbour where hydrodynamics has contributed to the development of an oxidized profile. Pyrite concentration increases at depths below 20-30cm.

Within the tailings, Co is predominantly hosted in pyrite while chalcopyrite is the main Cu-bearing mineral. NAG and paste pH tests indicated that tailings in the delta are acid forming. Pore water collected from delta ranges from pH 3-6 contains elevated concentrations of dissolved Fe, Cu, Co and Zn.

Concentrations of Co and Cu could imply a viable option for reprocessing of these sediments that would provide benefits from both an economic and environmental perspective.

Figure 1 – King River Delta showing tailings stored at the south lobe, the King River mouth, and Macquarie Harbour. Two different zones were detected in the delta. Zone A comprises tailings with little to no oxidation observed while Zone B contains tailings in advanced stages of oxidation.

