ABSTRACT

Acid sulfate soils (ASS) from creeks, dams, seeps, springs and wetlands were sampled in an area 25 x 40 km in the eastern Mount Lofty Ranges, between Mount Torrens in the north and Strathalbyn in the south. Acid sulfate soils are common in landscapes with relief and can occur in seeps or springs (on mid to upper slopes of valleys) or in creeks and wetlands, typically in narrow valleys. Acid sulfate soils contain sulfidic materials (Fe and other sulfides; pH >4), which may form continuous layers (up to 30 cm thick), or consist of a series of discontinuous layers, normally below water level, associated with decaying vegetation and algae. Acid sulfate soils appear to be absent from broad valleys, which contain relatively thick accumulations of alluvium and where drainages may be ephemeral.

Sulfidic materials may contain two types of iron sulfide: pyrite and Fe monosulfides (such as greigite or mackinawite). The matrix to the sulfides is dominantly quartz, with variable minor amounts of mica, plagioclase, potash feldspar, calcite and kaolinite. In drained or disturbed ASS, several rare to accessory phases such as gypsum, halite, jarosites, ferrihydrite and/or schwertmannite and Fe oxides occur in sulfuric horizons (pH <4). However, in the vicinity of mineralized zones in bedrock, sulfidic materials may also contain sphalerite, galena, chalcopyrite, native gold, barite and Mn oxides (with minor Co, Zn and I). These minerals tend to be intimately associated with, and incorporated in, organic matter. In particular, sphalerite and galena tend to occur in very fine (<1 μm diameter) spherical grains and have been precipitated as a result of biomineralization. The compositions of the sphalerites in sulfidic material are relatively Fe-poor, in contrast to the relatively Fe-rich sphalerite from the nearby primary mineralized zones.

Acid sulfate soils proximal to mineralized zones in bedrock are anomalous in a range of elements, including Ag, As, Au, Bi, Cd, Co, Cu, Hg, In, Ni, Mo, Pb, Sb, Se, Tl and Zn, for example, at Wheal Ellen, Glenalbyn, the Mt Torrens and Monarto prospects, and in the Kanmantoo area. Several anomalies also occur in locations not associated with known mineralization. These materials may also record geochemical differences in parent bedrock, such as Na and K being positively correlated to the west of the Bremer Fault, but are negatively correlated and have greater absolute Na contents to the east of the fault. These differences may relate to regional fluid flows, possibly related to the relatively intense mineralizing event to the west of the fault, or to regional metamorphism, or to granitoid intrusion in the east. A soil-landscape model has been developed for the soil, regolith and hydrogeochemical processes and explains geochemical dispersion from mineralized zones into acid sulfate soil seeps.

Surface waters, collected at many of the acid sulfate soil sample sites, vary considerably in composition from non-saline to extremely saline, and from weakly acidic to alkaline. Values of electrical conductivity (EC) closely follow concentrations of Na^+, K^+, Ca^{2+}, Mg^{2+} and SO_4^{2-} ions.

Thus this study confirms that acid sulfate soils are a new sampling medium for mineral exploration.