X-Ray diffraction results from the weathering zone above the Bisha volcanic-hosted massive sulphide deposit, Eritrea

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Weathering of the Bisha volcanic-hosted massive sulphide (VHMS) deposit has produced: (i) a gossanous oxide Au zone above (ii) a supergene zone of chalcocite replacement of sulphide minerals, over (iii) hypogene sphalerite-chalcopyrite-bearing massive sulphide. These enrichment zones differ from those developed over other VHMS deposits (Ladysmith, Wisconsin; Caribou, New Brunswick; Las Cruces, Spain; Golden Grove, Western Australia) in that supergene Pb mineralization (galena, siderite) occurs immediately above the Cu-enrichment zone, and oxide Au grades are ten times that of hypogene mineralization (in contrast to the two-fold Au enrichment typically observed at other deposits). To understand how these anomalous zones developed, X-ray diffraction analyses were undertaken on samples from two cross-sections to gain insight into the mineralogical changes that took place during weathering. Lithologies within the weathering zone consist of: (i) gossan (principally in situ and transported Fe-oxy-hydroxide minerals), (ii) acid leached rocks (mostly silica), (iii) saprolite (quartz and clay minerals), (iv) supergene sulphide mineralization (chalcocite replacing pyrite, sphalerite, and chalcopyrite), and (v) hypogene massive sulphide (pyrite, sphalerite, and chalcopyrite). Using lithogeochemical compositions of these rocks, ordinary least squares regression methods were used to obtain 'best fit' mineral modes for each weathering zone. These data have been plotted on cross-sections to define the weathering patterns present in these rocks, and indicate that lateral groundwater flow is likely responsible for an asymmetric distribution of these zones. With these mineralogical constraints, chemical reactions have also been identified that explain the bulk material transfers that occurred to create each weathering zone.

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