The Giant Kidd Creek Volcanogenic Massive Sulfide Deposit, Western Abitibi Subprovince, Canada

MARK D. HANNINGTON AND C. TUCKER BARRIE, EDITORS
The Kidd Creek open pit (top photo: looking south) with Shafts 1 and 2 in the background. Mining from the open pit began in the spring of 1966. The first of three shafts was sunk in the stratigraphic hanging wall of the deposit on March 15, 1970, and operations were started underground below 800 ft in 1972. A second shaft to access ore to a depth of 4,600 ft was introduced in 1974. The pit floor was blasted in 1977, and all subsequent concentrator feed was supplied from the underground mine. Sinking of a third internal shaft began in 1990–1991 and was completed to 6,900 ft in 1992.

The first concentrate from Kidd Creek was produced on November 16, 1966. The refined products currently produced at the smelter include Cu, Zn, Ag, Cd, and In (lower photo). Zn metal is pressure-leached from concentrate and roaster products, followed by plating from solution onto cathodes. The pure Zn cathodes are melted and recast into salable form. The Zn smelter reached a peak capacity of 140,000 t in 1995. The Cu smelter and refinery has a capacity of 119,000 t per year. Nearly 3.7 Moz of Ag are also produced annually. Total revenues from the sale of metal from the mine in 1995 were nearly $500 million, making it one of the most valuable mining operations in Canada.
Contents

Introduction
The Giant Kidd Creek Volcanogenic Massive Sulfide Deposit, Western Abitibi Subprovince, Canada: Preface and Introduction ................................................................. M. D. Hannington, C. T. Barrie, and W. Bleeker 1
Discovery of the Kidd Creek Massive Sulfide Orebody: A Historical Perspective ................................................................. Wouter Bleeker and Brian W. Hester 31

Geology of the Kidd Creek Deposit
High-Precision U-Pb Geochronology of the Late Archean Kidd Creek Deposit and Kidd Volcanic Complex .................................................................................................................. Wouter Bleeker, Randall R. Parrish, and Anne Sager-Kinsman 43
Structure, Stratigraphy, and Primary Setting of the Kidd Creek Volcanogenic Massive Sulfide Deposit: A Semi-quantitative Reconstruction ............................................................................................................ Wouter Bleeker 71
Anatomy, Lithogeochemistry, and Emplacement Mechanisms for the QP Rhyolite, Kidd Creek Mine, Timmins, Ontario ................................................................. Glen J. Prior, Harold L. Gibson, David H. Watkinson, and Ron E. Cook 123
Komatiite Flows of the Kidd Creek Footwall, Abitibi Subprovince, Canada ........................................................................ C. Tucker Barrie 143
Sulfide Mineralogy, Geochemistry, and Ore Genesis of the Kidd Creek Deposit: Part I. North, Central, and South Orebodies .................................................................................................................. M. D. Hannington, W. Bleeker, and I. Kjarsgaard 163
Sulfide Mineralogy, Geochemistry, and Ore Genesis of the Kidd Creek Deposit: Part II. The Bornite Zone .................................................................................................................. M. D. Hannington, W. Bleeker, and I. Kjarsgaard 225
Petrology and Geochemistry of Proximal Hydrothermal Alteration in the Mine Rhyolite at Kidd Creek .................................................................................................................. E. R. Koopman, M. D. Hannington, F. Santaguida, and B. I. Cameron 267
Mass Change Profiles in the Footwall of the Kidd Creek Orebody .................................................................................. E. M. Marnie Muirhead and R. W. Hutchinson 297
A Systematic Study of Rare Earth and Trace Element Geochemistry of Host Rocks to the Kidd Creek Volcanogenic Massive Sulfide Deposit .................................................. Eva S. Schandl, Michael P. Gorton, and Wouter Bleeker 309
Genetic Significance of Oxygen and Hydrogen Isotope Variations at the Kidd Creek Volcanic-Hosted Massive Sulfide Deposit, Ontario, Canada .......................................................... David L. Huston and Bruce E. Taylor 335
Regional 18O Zoning and Hydrogen Isotope Studies in the Kidd Creek Volcanic Complex, Timmins, Ontario .................................................................................................................. Bruce E. Taylor and David L. Huston 351
Hydrothermal and Metamorphic Fluids of the Kidd Creek Volcanogenic Massive Sulfide Deposit: Preliminary Evidence from Fluid Inclusions .................................................................................. Eva S. Schandl and Wouter Bleeker 379
Mineralizing Fluids in the Kidd Creek Massive Sulfide Deposit, Ontario: Evidence from Oxygen, Hydrogen, and Boron Isotopes in Tourmaline .................................................. Bruce E. Taylor, Martin R. Palmer, and John F. Slack 389
Cassiterite at Kidd Creek: An Example of Volcanogenic Massive Sulfide-Hosted Tin Mineralization .................................................................................................................. Quinton Hennigh and Richard W. Hutchinson 431
Carbon Isotope Geochemistry of Archean Carbonaceous Horizons in the Timmins Area .................................................................F.-W. Wellmer, U. Berner, H. Hufnagel, and H. Wehner 441

Rare Earth and High Field Strength Element Geochemistry of the Kidd Creek Rhyolites, Abitibi Greenstone Belt, Canada: Evidence for Archean Felsic Volcanism and Volcanogenic Massive Sulfide Ore Formation in an Iceland-Style Rift Environment .................................................................................................................Glen J. Prior, Harold L. Gibson, David H. Watkinson, Ron E. Cook, and Mark D. Hannington 457

Sm-Nd Isotope Study of Rhyolites from the Kidd Creek Mine Area, Abitibi Subprovince, Canada ..........................................................Glen J. Prior, Harold L. Gibson, David H. Watkinson, Brian L. Cousens, Ron E. Cook, and C. Tucker Barrie 485

Lead and Neodymium Isotope Systematics of the Kidd Creek Mine Stratigraphic Sequence and Ore, Abitibi Subprovince, Canada ..................................................................................................................................................C. Tucker Barrie, Brian L. Cousens, Mark D. Hannington, Wouter Bleeker, and Harold L. Gibson 497

A 2.7 Ga Komatiite, Low Ti Tholeiite, Arc Tholeiite Transition, and Inferred Proto-Arc Geodynamic Setting of the Kidd Creek Deposit: Evidence from Precise Trace Element Data .............................................................................................................Derek A. Wyman, Wouter Bleeker, and Robert Kerrich 511

Finite Element Heat and Fluid-Flow Computer Simulations of a Deep Ultramafic Sill Model for the Giant Kidd Creek Volcanic-Associated Massive Sulfide Deposit, Abitibi Subprovince, Canada ..................................................................................................................C. Tucker Barrie, Lawrence M. Cathles, and Alex Erendi 529


Related Studies of Mineral Deposits in the Kidd-Munro Assemblage and Timmins Region

The Pb Isotope Linear Array for Volcanogenic Massive Sulfide Deposits of the Abitibi and Wawa Subprovinces, Canadian Shield ..........................................................................................................................Ralph I. Thorpe 555

Fe-Ti Basalts, High Silica Rhyolites, and the Role of Magmatic Heat in the Genesis of the Kam-Kotia Volcanic-Associated Massive Sulfide Deposit, Western Abitibi Subprovince, Canada ..........................................................................................................................C. Tucker Barrie and John Pattison 577

Geology and Geochemistry of the Potterdoal Cu-Zn Deposit, Munro Township, Ontario ..................................................................................Mark Epp and James H. Crocket 593

Geology of the Mann Intrusive Complex and Evidence for Pt-rich Hydrothermal Platinum-Group Elements ..........................................................................................................................D. J. Good and J. H. Crocket 613

Role of Pyrite in the Formation and Localization of Gold Mineralization at the Owl Creek Mine, Timmins, Ontario ..................................................................................................................Ian R. Jonasson, David M. Kingston, David H. Watkinson, and Sally R. Elliott 627

Summary and Synthesis

The Giant Kidd Creek Volcanogenic Massive Sulfide Deposit, Western Abitibi Subprovince, Canada: Summary and Synthesis ..........................................................................................................................M. D. Hannington, C. T. Barrie, and W. Bleeker 661