©2004 by Economic Geology
Vol. 99, pp. 761–788

Controls on Skarn Mineralization and Alteration at the Cadia Deposits, New South Wales, Australia

David B. Forster,† Philip K. Seccombe,

Tectonic and Earth Resources Research Group, University of Newcastle, Callaghan, New South Wales 2308, Australia

and David Phillips

School of Earth Sciences, University of Melbourne, Melbourne, Victoria 3010, Australia

Abstract

The Cadia Fe-Cu-Au skarns in eastern New South Wales, Australia, are associated with the Late Ordovician, shoshonitic Cadia Intrusive Complex, which hosts the largest mineralized, intrusion-related system in eastern Australia. Both the Big Cadia and Little Cadia skarns are developed within a ~40-m-thick volcanic-derived calcareous sandstone and adjacent units, which represent the most important control on skarn formation. The ore zones have undergone postore displacement along steeply dipping, predominantly reverse faults, without significant remobilization of ore. Chalcopyrite and minor native gold formed in intimate association with epidote > chlorite-quartz-calcite and in the interstices of bladed hematite and magnetite aggregates. The age of the Au-Cu mineralizing event at Cadia is constrained by $^{40}Ar/^{39}Ar$ dating of accompanying muscovite at 438.2 ± 4.2 Ma (1σ). Gold to copper ratios within the skarns are generally lower than for porphyry Au-Cu deposits at Cadia, particularly the high tonnage, low-grade Cadia Hill deposit. Ore and calc-silicate gangue mineralogy are similar to other oxidized Fe-Cu-Au skarns associated with porphyry deposits.

Iron skarn at Big Cadia occurs several hundred meters distant from the margin of a mineralized intrusion of quartz monzonite porphyry. Magmatic-dominated fluids reacted with carbonate in the wall rocks and produced classic skarn zonation over an 800-m interval from the intrusive contact, located at Cadia Quarry, toward more distal environments at Big Cadia. Skarn zonation comprises (1) proximal garnet >> pyroxene, (2) intermediate garnet > pyroxene + scapolite, and (3) distal Fe-Au-Cu skarn. Alteration of noncalcareous metavolcanic rock units (fine-grained pyroxene-phyric volcanic rocks and volcaniclastic rocks) adjacent to the mineralizing quartz monzonite porphyry includes hydrothermal biotite-K-feldspar-quartz hornfels and magnetite-quartz-biotite hornfels. Gold-copper mineralization formed adjacent to garnet-bearing veins peripheral to the main garnet-rich zone, indicating that garnet-forming fluids carried the ore metals. At Little Cadia and Cadia East, mineralization and skarn zonation similar to Big Cadia developed above additional intrusions of quartz monzonite porphyry. Retrograde hydrous alteration replaced much of the prograde garnet-dominant mineralogy at Cadia, with the strongest overprint at Little Cadia.

The styles and distribution of alteration and mineralization suggest that the Big Cadia skarn formed from fluids that migrated laterally within calcareous units from strongly altered quartz monzonite phases of the Cadia Intrusive Complex at Cadia Quarry. At Little Cadia, skarn formation was probably related to fluids derived from the Cadia Intrusive Complex that migrated vertically and laterally within permeable calcareous units. Structural controls were important in focusing fluids and localizing the emplacement of late mineralizing phases of the Cadia Intrusive Complex.

† Corresponding author: email, David.Forster@newcastle.edu.au