

# U-Pb and Re-Os Geochronologic Evidence for Two Alkalic Porphyry Ore-Forming Events in the Cadia District, New South Wales, Australia

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## Abstract

The Cadia district, located in the eastern Lachlan fold belt of New South Wales, Australia, comprises four gold-copper porphyry deposits (Ridgeway, Cadia Quarry, Cadia Hill, and Cadia East) and two related iron-copper-gold skarn deposits (Big Cadia and Little Cadia). These deposits formed along a northwest-striking, arc-transverse structural corridor within the intraoceanic Macquarie arc. This arc is composed of a belt of Early Ordovician to Early Silurian mafic to intermediate volcanic, volcanoclastic, and intrusive rocks of calc-alkalic to alkalic composition. The Cadia porphyry deposits are temporally and genetically associated with composite intrusive complexes of alkalic monzodiorite to quartz monzonite.

U-Pb dating of igneous minerals from the intrusions and Re-Os dating of hydrothermal molybdenite from the deposits has revealed the presence of two temporally discrete events of magmatism and related porphyry-style mineralization in the Cadia district. The monzonitic intrusive complex related to mineralization at Ridgeway and a quartz monzonite porphyry stock that lies immediately southwest of the Cadia Quarry deposit are early Late Ordovician (456–454 Ma). In contrast, the quartz monzonite porphyry stock that hosts the Cadia Quarry and Cadia Hill orebodies and an intermineral quartz monzonite porphyry dike at Cadia East are Early Silurian (~438 Ma). Re-Os molybdenite ages determined for quartz-sulfide veins within the early Late Ordovician quartz monzonite porphyry confirm multiple episodes of mineralization associated with the Cadia Quarry deposit, suggesting a complex history between 460 and 450 Ma. At Cadia Hill, Cadia Quarry, and Cadia East, a widespread event of porphyry gold-copper mineralization is recorded at about 443 to 441 Ma, based on three Re-Os molybdenite ages from sheeted quartz sulfide veins. Similar ages for magmatic zircon from the host intrusions support a link between dated intrusions and mineralization.

These new ages are in general agreement with the ages of other porphyry gold-copper and related epithermal deposits of the Eastern Lachlan fold belt and help to constrain the relationship between the Cadia region and the evolution of the Lachlan fold belt. It is notable that the high-grade Ridgeway deposit is up to 18 m.y. older than any alkalic porphyry deposit yet discovered in the Macquarie arc, a feature that may be important for continued exploration success in this region.

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