Economic Geology

BULLETIN OF THE SOCIETY OF ECONOMIC GEOLOGISTS

VOL. 98 August 2003 NO. 5

The Nickeliferous Late Archean Reliance Komatiitic Event in the Zimbabwe Craton—Magmatic Architecture, Physical Volcanology, and Ore Genesis

M. D. PRENDERGAST[†,*]

1 Carson Close, Greendale, Harare, Zimbabwe

Abstract

The widespread komatiitic Reliance lithostratigraphic unit of the late Archean Bulawayan Supergroup consists of many submarine flow fields directly or indirectly overlying the sedimentary Manjeri unit, which varies from a generally carbonaceous, sulfide-rich, deep-water, basinal facies in the north and west parts of the Zimbabwe craton to a generally sulfide poor, shallow-water, platformal facies in the south and east. The flow fields are associated with high-level subvolcanic feeder sills, intruded into pre-Manjeri basement made up of the conformable, sulfide-bearing, felsic Koodoovale unit and older, barren, granitoid-greenstone crust in the north and west, and south and east, respectively. The sills and flow fields together constitute largely discrete sill-flow complexes, very approximately 100 km in diameter, of which five are well preserved in the north and west, and three in the south and east parts of the craton. The Reliance sills, up to 40 km in diameter and 2,000 m thick, some composite and locally overlapping to slightly discordant, mostly comprise a thick lower dunite-peridotite and a relatively thin to intermittent upper pyroxenite-gabbro. Other larger, probably related, sills intruded at greater structural depths link adjacent complexes and form midcrustal magma chambers. The Reliance sills are interpreted as an interconnected system of "flow-through" feeders at different crustal levels. The Reliance flow fields are 33 to 85 km in diameter and up to 2,500 m thick, dominantly of komatiitic basalt composition, of very low height/breadth aspect ratio, locally linked to the sills via structures interpreted as fissure vents and partly extrusive cryptodomes, and thin out toward their lateral margins. Most display a simple, coherent, volcanological growth sequence (from sheet and/or channelized sheet flows and lava channel complexes in lower and proximal positions to marginal lava lobes in upper and distal positions), comparable in general organization and probable emplacement processes to those of Hawaiian and flood-basalt flow fields. Flow-field development was influenced by episodic eruption, preexisting topographies, and penecontemporaneous sedimentation and felsic and mafic volcanism, and some flow fields in the south and east were partly emergent. Sills in the north and west are weakly mineralized, but those in the south and east are barren. The principal Reliance nickel sulfide deposits are confined to flow fields in the north and west, occur within lava channel complexes (Trojan and Shangani mines, Damba-Silwane and Hunters Road prospects) and a fissure vent (Epoch mine), and include type 1 basal sequences of massive to matrix to disseminated sulfides (lowermost flows Trojan, Shangani) and type 2 central accumulations of weakly disseminated sulfides (Hunters Road, upper flows Trojan, Shangani). Epoch and Shangani occupy central flow-field positions, whereas Hunters Road and Damba-Silwane are proximal; Trojan may be either distal or proximal. Field evidence does not directly support the origin of the Reliance deposits solely by magmatic erosion of sulfidic substrate during flow emplacement, as proposed for komatiite-hosted nickel deposits elsewhere. Instead, the deposits' origin and asymmetric distribution across the craton may be mainly due to assimilation of sulfidic felsic wall rocks during magma passage through the subvolcanic sills in the north and west, possibly combined with sulfur degassing, due to very shallow water lava emplacement in the south and east.

[†] E-mail, marprend@hotmail.com

[*]Present address: Guesachan, Shielhill Road, Northmuir, Kirriemuir, Angus DD8 4PA, Scotland, U.K.

Vol. 98, 2003, pp. 865–891

0361-0128/01/3358/865-27 $6.00