Ore Geology Reviews 155 (2023) 105369

Contents lists available at ScienceDirect

Ore Geology Reviews

journal homepage: www.elsevier.com/locate/oregeorev

The Dugald River-type, shear zone hosted, Zn-Pb-Ag mineralisation, Mount Isa Inlier, Australia

Pieter K. Creus [a,*], Ioan V. Sanislav [a], Paul H.G.M. Dirks [a], Corey M. Jago [b], Brett K. Davis [c]

[a] Economic Geology Research Centre (EGRU) and Department of Earth and Environmental Sciences, James Cook University, Townsville, Queensland 4811, Australia
[b] MMG Rosebery, PO Box 21, Rosebery, Tasmania 7470, Australia
[c] Olinda Gold Pty Ltd, 131 Vines Avenue, The Vines, Western Australia 6069, Australia

ARTICLE INFO

Keywords:
Zn-Pb-Ag Mineralisation
Mount Isa Inlier
Shear Zone Hosted Mineralisation
Durchbewegung Texture
Epigenetic Breccia Ore

ABSTRACT

The Dugald River Zn-Pb-Ag mine is situated in the Mount Isa Inlier, a globally significant base metal province. Zn-Pb deposits in the Mount Isa Inlier are stratabound with four main genetic models, including SEDEX-style, remobilised SEDEX, epigenetic and Broken Hill-type mineralisation applied to interpret their formation. We propose that the Zn-Pb-Ag mineralisation at Dugald River represents a unique, shear zone hosted deposit type that formed through a series of successive deformation events during the Paleoproterozoic Isan Orogeny that concentrated the mineralisation within the Dugald River Shear Zone during two main mineralising phases. The first phase of mineralisation occurred during regional D_2 shortening, which is associated with the formation of large-scale F_2 folds and a regionally penetrative S_2 fabric. During this phase, progressive tightening of upright F_2 folds resulted in several sets of secondary space accommodating quartz-carbonate veins that were progressively rotated into parallelism with the pervasive, steep, W-dipping S_2 cleavage. The quartz-carbonate veins were coevally replaced by sulphides, which migrated to extensional sites (boudin necks and fold hinges) in tight folds. Thereby creating a sulphide-rich horizon within a developing high strain zone, which during D_4 developed into the Dugald River Shear Zone. The second phase of mineralisation occurred during the regional D_4 transpressional deformation event and resulted in significant metal enrichment and the current geometry of the ore bodies. The significant enrichment of the mineralisation during D_4 resulted from further fold tightening within the high strain zone, which resulted in the attenuation and dismembering of folds and produced a transposed fabric (S_4). The sulphide veins were transposed into parallelism with S_4 forming sulphide-rich planar ore textures. Strain partitioning at the contact between the ductile deforming sulphide horizon and the brittle deforming slates resulted in the development of an anastomosing shear zone, known as the Dugald River Shear Zone. A right-handed releasing bend in the shear zone produced a dilational jog and a thick, high-grade ore body. The mobilisation of sulphides within the dilational jog involved fragmentation of sulphides and wall rock, brecciation, rotation and rolling of fragments, and the formation of durchbewegung texture.

1. Introduction

The Mount Isa Inlier, located in NW Queensland, is a globally significant base metal province (Fig. 1). World-class Zn-Pb deposits (Fig. 1c) include the Mt Isa deposit (e.g., Smith et al., 1978; Gulson et al., 1983; McGoldrick and Keays, 1990; Perkins, 1997; Davis, 2004; Cave et al., 2020), the Cannington deposit (e.g., Bodon, 1998; 2002; Roache et al., 2004; Walters and Bailey, 1998), the George Fisher and Hilton deposits (Valenta, 1994a; b; Perkins and Bell, 1998; Chapman, 2004; Murphy, 2004; Cave et al., 2020) and the Dugald River deposit (Newbery et al., 1993; Xu, 1996; 1997; 1998a; b; Creus, 2022). The Zn-Pb mineralisation style extends further north to the McArthur Basin to include Century, McArthur River (HYC) and Teena deposits (Broadbent et al., 1998; Feltrin et al., 2009; O'Rourke et al., 2017; Sheldon et al., 2021). Together these deposits form the largest Zn-Pb province in the world (Huston et al., 2006).

Although the deposits display similarities in primary metal content (Zn-Pb), ore mineralogy (namely sphalerite and galena) and host rock type (mainly siliciclastic metasediments), the structural and metamorphic settings are variable. As a result, genetic models for the deposits vary as well. For example, in the Mount Isa town region in the west, the metamorphic grade of host lithologies varies from sub-greenschist facies

* Corresponding author.
E-mail address: pieter.creus@my.jcu.edu.au (P.K. Creus).

https://doi.org/10.1016/j.oregeorev.2023.105369
Received 22 October 2022; Received in revised form 21 February 2023; Accepted 23 February 2023
Available online 28 February 2023