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Structural controls on mineralisation at the Namib Lead and Zinc Mine, Damara Belt, Namibia

I.J. Basson[a,c], M.-J. McCall[a,*], J. Andrew[b], E. Daweti[b]

[a] Tect Geological Consulting, Unit 3 Metrohm House, 20 Gardner Williams Ave, Somerset West, South Africa
[b] North River Resources, 84 Dr. Frans Indongo Street, Windhoek, Namibia
[c] Department of Earth Sciences, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

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ABSTRACT

The Namib Lead and Zinc (Pb-Zn) Mine is hosted within the Karibib Formation of the Swakop Group, Damara Sequence. The host marble contains sulphide-rich beds and is locally Pb- and Zn-rich over a strike extent of > 100 km. Mining took place in the upper portions of a remobilized MVT or SEDEX orebody, which may occur adjacent to a reactivated major structure. Pb and Zn show locally anomalous copper, tin, indium and fluorine concentrations. Based on the position of gossans, individual orebodies comprise discrete elongate shoots around an antiform and its meso-scale parasitic folds, within calcitic marble. Non-coaxial flattening of the fold-cleavage geometry reflects a series of non-coaxial deformation events, recorded in the Southern Central Zone of the Damara Belt which were superimposed on a NE-SW structural grain and pre-existing fold axial planes. Non-coaxial flattening resulted in further remobilization of sulphides into dilational rhombs which formed from shearing along overlapping axial planar cleavage, in concert with the dilation of banding in the host marble.

1. Introduction

The Namib Pb-Zn Mine, previously known as the Deblin Mine, is situated east of Swakopmund in the Rössing Mountains Area, Swakopmund District, Erongo Region (Fig. 1). The deposit was discovered in the 1930s and operated from 1968 to 1991, before being abandoned. According to Hunter (1981), the mine and the Usakos Pb Mine are situated on the "Central Shelf" region of the Southern Central Zone, between Karibib and Swakopmund. Locally, ore is hosted by the Karibib Formation of the Swakop Group (Damara Sequence) near to the contact with the Arandis Formation, immediately south of the Omaruru Lineament. The host marble shows sulphide-rich beds which are thought to be Pb- and Zn-rich over a strike extent of > 100 km, with locally anomalous concentrations of copper, tin, indium and fluorine.

Granulite facies metamorphic conditions prevail in the area, with mineralisation distributed around the hinge zone of a regional antiform with a NE-SW trending axial plane. Three orebodies have been exploited, (South, Junction and North), with the bulk of historic production coming from the South and Junction orebodies, which were developed to approximately 225 m depth. Ore is confined to a variety of prolate and rhomb-shaped "shoots", with minimum down-plunge extents, determined from drilling and downhole geophysics, of 210 m. The Namib Pb-Zn Mine has historically been compared to Pb-Zn deposits in the Otavi Mountain Land (OML), which also hosts the Tsumeb and Kombat deposits, approximately 500 km to the northeast. Further analogues may comprise the "along-strike" Navachab Gold and Rössing Uranium mines. The elucidation of the structural setting and evolution of these ore-shoots, in the context of regional deformation, metamorphic and mineralisation events, is the focus of this contribution.

2. Geological setting

The triple-junction Damara Orogenic System (DOS) comprises the coastal NNW-SSE-trending Kaoko and Gariep Belts, and the ENE-trending Damara Belt that extends from the Atlantic Coast through Namibia into Botswana (Martin, 1983; Miller, 1983a). The orogenic belts and related plutonic rocks of the Damara Orogenic System evolved during successive stages of intracontinental rifting, continental rupture, spreading, subduction and polyphase continental collision between the Congo, Kalahari and Rio De La Plata cratons (*ca.* 1000–460 Ma), forming part of the larger Pan-African orogen (Smith, 1965; Miller, 1983; Prave, 1996; De Kock et al., 2000; Gray et al., 2008; Frimmel and Miller, 2009; Goscombe et al., 2017; Longridge et al., 2017). Typically, the Damara Belt is subdivided into several orogen-parallel tectonostratigraphic zones, namely the Northern Platform, Northern Zone,

* Corresponding author.
E-mail address: mjmccall99@gmail.com (M.-J. McCall).

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