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THE NATURE AND ECONOMIC SIGNIFICANCE OF BANDED IRON FORMATIONS IN THE SOUTHERN MARGIN ZONE OF THE DAMARA OROGEN

Progress Report for 1982/83

by

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1. OBJECTIVES

The southern portion of the Damara Orogen contains banded iron formations (BIF) through parts of the stratigraphic sequence. In the Matchless Amphibolite Member of the Kuiseb Formation, iron formations (magnetite quartzite) are closely related to massive sulphide deposits, such as at the Matchless and Otjihase mines, but the economic potential of BIF elsewhere is not known. This project aims to determine the mineralisation potential of the BIF in the Southern Margin Zone by studying their mineralogy, geochemistry and geological setting, and comparing them with known ore-bearing banded iron formations.

2. SCIENTIFIC PROGRESS

2.1 Field Relationships

2.1.1 Southern Margin Zone

The BIF in the Southern Margin Zone south and southeast of Windhoek occurs as a 0.1-10 m thick nearly continuous band following the general strike of the NE trending Damara orogen. In places the band pinches out over short distances. The appearance of the BIF ranges from iron oxide bearing micaceous schist (e.g. on Regenstein 32) to a well banded iron-formation with alternating layers of magnetite or hematite (bands up to 5 mm thick) and quartz in the area of the Townlands farms south of Windhoek and on a number of farms around and east of the tar road to Dordabis (e.g. Hohewarte 76, Hohenau 81, Elisenhöhe 88, Otjimukona 120, Rainhof 123, Tsatsachas 87, Stolzenfeld 89). At the Townlands farm east of the road from Windhoek to Rehoboth, the BIF crops out over a distance of about 100 m as a disseminated magnetite-bearing quartzite.

Group	Subgroup	Formation	Lithology
Swakop	Khomas	Kuiseb	Mica schist, amphibolite (Matchless Member); "Besshi-type" Cu-Pyrite deposits with assoc. magnetite quarzite
	Vaalgras	Kleine Kuppe Gomab River Melrose Chuos	Quartzite, schist, marble, amphibolite Schist, mixtite, amphibolite, BIF
	Kudis	Hakos/Auas Blaukrans Waldburg	Quarzite, mica schist, Graphite-mica schist, marble
Nosib		Kamtsas/ Duruchaus	Quartzite, phyllite

Stratigraphy of the Damara Sequence in the Southern and Southern Margin Zones of the Damara Orogen (after Hoffmann, 1983.)

The often rapid change of thickness of the unit and the changes of composition are considered for the most part as primary depositional features, although in places it is evident that a thickening is due to intense intraformational folding. Where the BIF shows these tectonic features, the iron oxide mineral present is mainly specularite, the original fine banding becomes disrupted and the depositional features destroyed.

The BIF of the Southern Margin Zone is accompanied by, and interbedded with, amphibolite, greenstones, mica schist with quartzite layers, and dolomitic rocks. The generally intimate occurrence of an ortho-amphibolite in the hangingwall and/or in the footwall of the BIF is especially noteworthy. On the other hand, a BIF horizon was found without association with amphibolitic rocks in a clastbearing schist ("pebbly schist", "mixtite", "tillite") on Stolzenfeld 89 and Tsatsachas 87.

The deposition of BIF in the Southern Margin Zone seems to be confined to the Chuos Formation.

2.1.2 Southern Zone and Matchless Member

"Magnetite-quartzites" (BIF) are again found in the Kuiseb Formation in a stratigraphically higher(?) position in the Damara Sequence. Clustered around the ortho-amphibolites of the Matchless Member, a number of Cu-Pyrite-deposits occur associated with magnetite quartzite (i.e. Hope, Gorob, Matchless, Kupferberg,

Otjihase, Ongombo, Ongeama). The magnetite quartzite in this area appears as either a well banded iron formation (e.g. Otjihase) or as a quartzite carrying variable amounts of disseminated magnetite (e.g. Matchless). The magnetite quartzites in the vicinity of the Matchless Amphibolite Belt generally occur in the form of lensoid bodies elongated parallel to the NE-trending amphibolite belt.

Sulphide (py-cpy-(pyr)>> sph) mineralisation is always associated with the magnetite quartzite lenses.

The magnetite quartzite bodies are mainly interbedded in Kuiseb schist (mica schist, often garnet-bearing) in the structural footwall of the main amphibolite belt. Minor occurrences of amphibolites and metagabbros are often immediate associates of magnetite-quartzite and sulphide mineralisation.

2.2 Petrography of Southern Margin Zone Banded Iron Formation and Country Rocks

Microscopic evaluation of thin sections and polished thin sections of BIF samples from the Southern Margin Zone showed the following preliminary results.

The main constituents of the BIF are quartz and varying amounts of magnetite, martite or hematite, the percentages of iron oxide minerals in the sections varying from 15-80 per cent. The major iron oxide mineral is magnetite (Fe_3O_4) which commonly shows a moderate to advanced stage of martitisation starting from fractures and grain boundaries penetrating the grains along (111). Rarely the magnetites are totally transformed into martite. Hematite (mainly as specularite) is less commonly developed.

Minor constituents (mostly < 10 per cent) are biotite, amphibole (mainly actinolite, less commonly grunerite or hornblende), and, in accessory amounts, clinozoisite, epidote, carbonate (dolomite?) chlorite and apatite. A few samples showed varying amounts of garnets.

The associated amphibolites consist mainly of amphiboles (hornblende and actinolite) and untwinned plagioclase, with minor amounts of clinozoisite, epidote, biotite, chlorite, carbonate, apatite, rutile, opaque minerals and garnet. The amphibolites show a schistose foliation and are fine to medium-grained. Banding of amphibole-rich and plagioclase-rich layers occurs. Due to post-tectonic recrystallisation some amphiboles and biotites have grown across the foliation.

In the mica schist, biotite is the most common mineral. Carbonate, garnet, muscovite and chlorite were observed. As an accessory, apatite was noted.

3. FUTURE PROGRAMME

At the University of the Witwatersrand, chemical and mineralogical analyses of the samples collected will be carried out during the coming months. It is anticipated that the analytical results and data from the literature will allow conclusions to be made concerning mineralogical and geochemical indicators of base metal deposits hosted by BIF. Results of the studies will then be applied to the banded iron formations of the Southern Margin Zone.

It is planned to sample and map minor exposures of BIF occurring in the Vaalgras Subgroup later in the coming year, with the aim of achieving a more complete lithological and sedimentological understanding of BIF throughout the stratigraphy of the Damara sequence in the Southern Margin Zone. In addition a visit to a possible Chuos-age BIF in the vicinity (SE) of Walvis Bay is planned.

A synthesis of field and laboratory data will result in the presentation of a thesis.

4. REFERENCE

Hoffmann, K.H. 1983. Lithostratigraphy and facies of the Swakop Group of the southern Damara Belt, SWA/Namibia, p. 43-63. *In:* Miller, R.McG. (Ed.), *Evolution ofthe Damara Orogen in South West Africa/Namibia*. Spec. Publ. geol. Soc. S. Afr., **11**, 515 pp.