

Iron Deposit in Africa including BIF

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Introduction

- Iron deposits are natural concentrations of iron rich minerals (e.g. hematite, magnetite, goethite etc.) formed in marine or marginal marine environments through chemical sedimentation and are extracted at a profit depending on the degree of concentration and locality.
- We have different kinds of iron deposits namely Bog Iron deposit, Ironstone deposit and Banded Iron deposit
- On the African platform we have these deposits on which the banded Iron formation is the most common and important one

Where do we find these deposits in Africa?

- Iron ores deposits are found throughout the African continent
- The current largest ore deposit is in Sierra Leon
- Some major iron deposits are found in Nimba in Liberia, Penge, Griqualand and the Transvaal in South Africa.

Focusing on South Africa

- The main iron ore producing areas are Sishen in the Northern Cape which has an estimated ore reserve of 4200Mt,
- Thabazimbi in the Limpopo province with an estimated ore reserve of 100Mt,
- The Maremane Dome which is also in the Limpopo province and the Bushveld complex in the Mpumalanga province

The Transvaal Supergroup

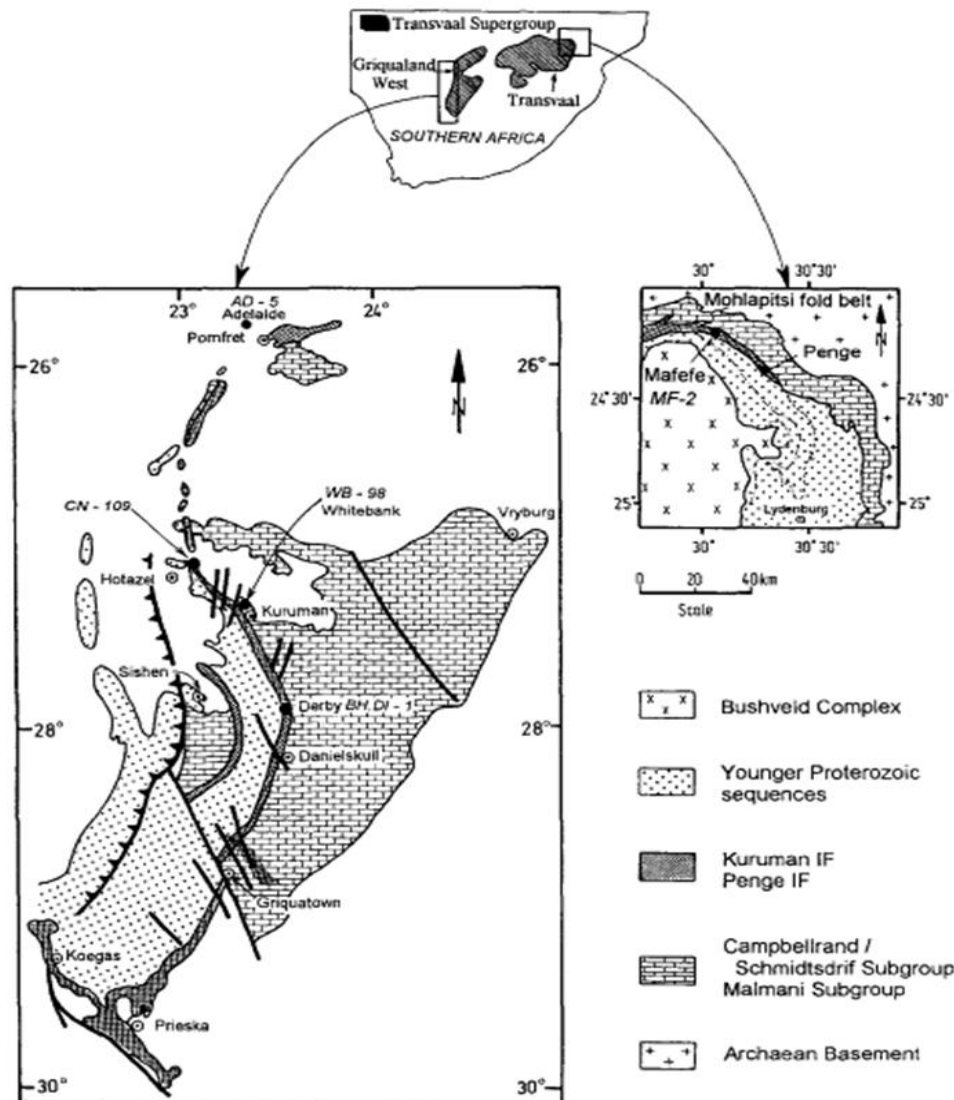
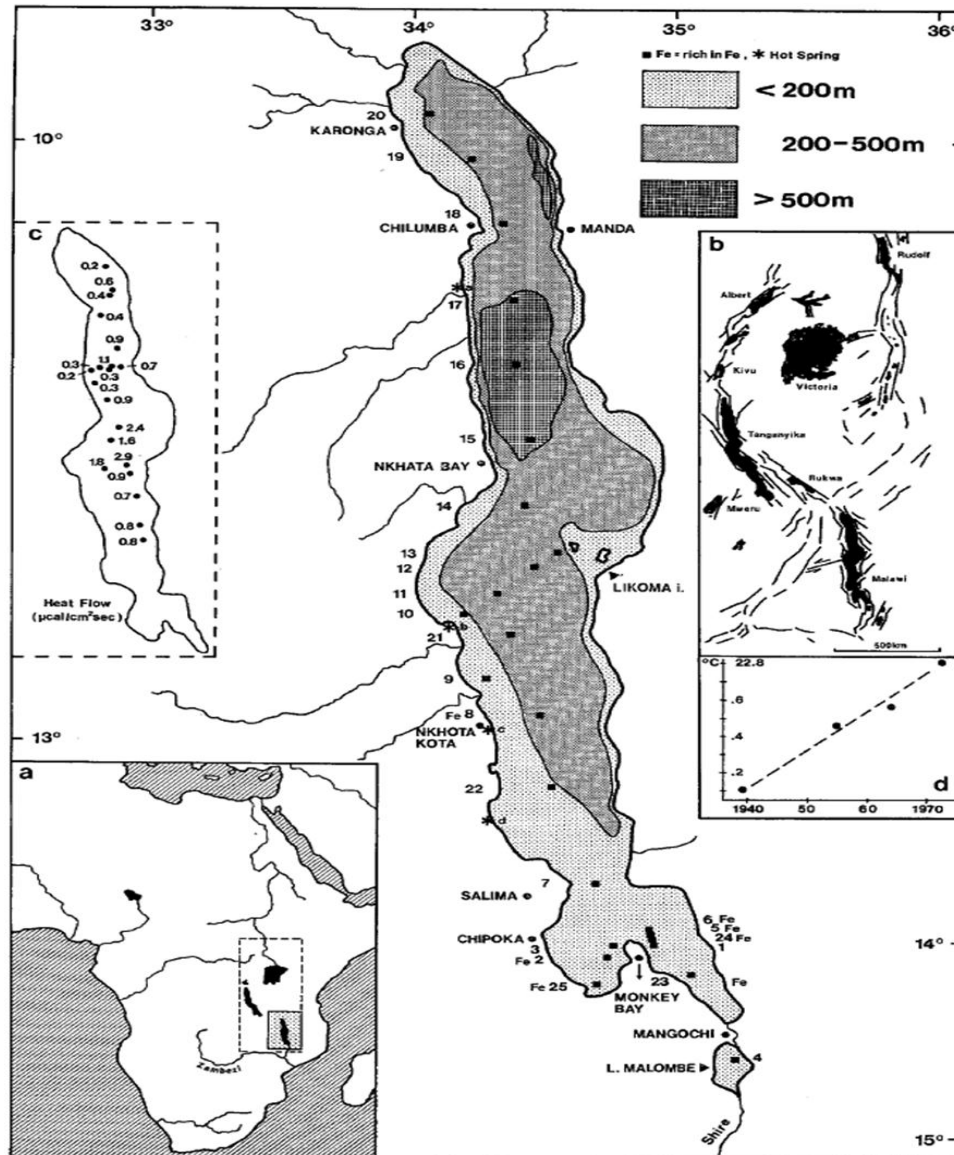


Fig. 1. Simplified geological maps showing distribution of the Transvaal Supergroup (simplified after Beukes, 1983; Miyano and Beukes, 1987; Klein and Beukes, 1989) and locations of boreholes from which samples are discussed in the text.

Strata of the Transvaal supergroup, which is deposited on the kaapvaal craton, are preserved in two structural basins which are referred to as the eastern Transvaal sub-basin and the Griqualand west sub-basin

Lake Malawi



Iron-rich sediments were encountered as distinct layers in the Malawi lake where they form the youngest sedimentary unit. The thickness of the iron-rich sediments ranges from 13cm to at least 80cm.

These sediments can be subdivided into three mineralogical facies types

1. Notronite-rich sediments
2. Limonite-rich sediments
3. Vivianite-rich sediments

Mount Nimba



Mount Nimba is a one mile high Iron ore mountain with the highest grade iron deposit in the world
Iron ore mining on mount Nimba accounts for approximately one percent of the world production. Currently set at around 900 million tons

Origin and formation

The processes by which iron ore concentrations form are controlled by parameters such as:

- Oxidation-reduction
- pH
- Climate

Different iron ore deposit types can illustrate different types of ore forming processes.

There are three main types of iron ore deposits

- Bog iron deposits
- Ironstone deposits
- Banded iron-formations (BIF)

Bog iron deposits

- Are iron deposits typically small, thin and comprise of concentrations of goethite (α -FeOOH) and limonite (γ, δ Fe(OH)₃).
- Formed in swamps and lakes environment of the interglacials in the northern hemisphere.
- Fe concentration occurs when Fe²⁺ (ferrous iron) is oxidised to Fe³⁺ (ferric iron) and precipitated as limonite or goethite from a relatively reducing meteoric water, at contact to relatively oxic ground water. This usually happens at the ground water table.
- The Bog iron deposits are associated with organic-rich shales.

Ironstone deposits

- Ironstone deposits are Phanerozoic in age
- They were formed in shallow marine and deltaic environments and typically consist of goethites and hematites that have been rolled into oolites or pellets, suggesting the action of mechanical abrasion.
- These deposits contain little or no chert.



Banded Iron Formation (BIF) deposits

- Are chemically precipitated sediments, consisting of repeated thin layers of iron oxides, either magnetite (Fe_3O_4) or hematite (Fe_2O_3), alternating with bands of chert, quartz and shale.
- BIFs are much older and formed in essentially three periods of Archean and Proterozoic Earth history, namely 3500–3000 Ma, 2500–2000 Ma, and 1000–500 Ma.





Ocean contains dissolved silica and Fe^{3+}

Types of Banded Iron Formation

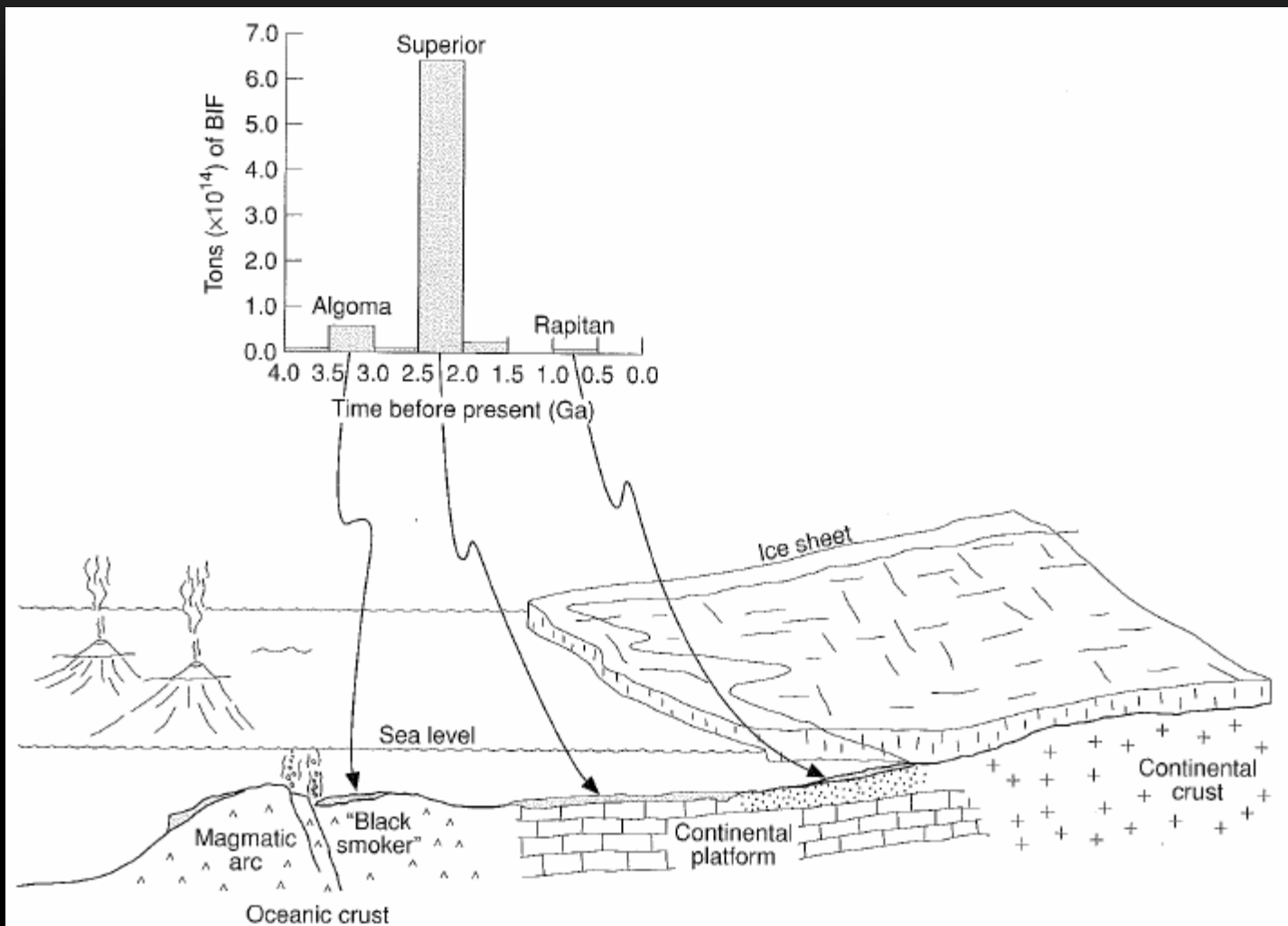


Figure 5.16 Tectonic and environmental model showing the depositional settings for Algoma, Superior, and Rapitan type BIFs (after Clemmey, 1985; Maynard, 1991). The inset histogram illustrates the approximate tonnages of BIF resource for each of the three major types as a function of time (after Holland, 1984).

Algoma-type banded iron formations

- Algoma type BIFs are associated with volcanic arcs and are typically found in Archean greenstone belts.

Lake Superior-type banded iron formations

- The majority of Lake Superior, or simply Superior, type BIFs are located on stable continental platforms and were mainly deposited in Paleoproterozoic times.
- Most of the major currently producing iron ore districts of the world fall into this category.
- E.g. The Transvaal Basin of South Africa

Rapitan-type banded iron formation

- They represent occurrence of iron ores associated with glaciogenic sediments formed during the major Neoproterozoic ice ages.
- Example is the Rapitan Group in the McKenzie Mountains of northwest Canada.

Mining and production



Classification of Iron ore

➤ **By minerals**

Magnetite, Goethite, Hematite, Limonite, Siderite, Pyrite, etc.

➤ **By harmful Impurities**

S, P, V, Sn, Ti, As, Zn, Pb, Cu ratios

➤ **By Grades**

% of Fe (high >65, Med 62-65, low <62)

➤ **By Ore Structure**

Banded, kidney-shaped, disseminated, powdery, Striped, etc.

➤ **By Special form**

Lumpy, natural pellet, blue dust

➤ **By Gangue Mineral**

Divided into quartz-based minerals, amphibole, pyroxene type, etc.

Iron ore processing

- Drilling & Blasting
 - Excavation (shoveling) & Moving
 - Iron ore crushing
 - Iron Ore Grinding
 - Separation
 - Iron Ore Beneficiation
 - Agglomeration (Sintering and Pelletizing)
 - Shipping
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Uses of special Iron

- Typically produced to make steel

Steel is used to make locomotives, ships, automobile, beams, etc.

- Powdered iron

Metallurgy products, magnets, auto parts, etc.

- Black Iron Oxide

Medicine , metallurgy, etc.

- Iron blue

Paints, plastics, cosmetics(eye shadow),paper dyeing, artist colors, printing inks

- Radioactive Iron(^{59}Fe)

Medicine, tracer element in biochemical and metallurgical research

Industrial Application

➤ Micaceous iron oxide

Manufacture of welding rods, coating of welding rods

➤ Magnetite

Preparation of heavy media in coal washing plants

➤ Bog iron ore

Purifying and desulphuring material of producer gas and municipal gases

➤ Spathic ore

Production of hydrogen by steam iron contact processes

Uses



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Economic significance

- Africa may turn major iron ore exporter after 2020
- "China is expected to increasingly turn to Africa to satisfy its iron ore needs ... (as) more Chinese companies look to invest or partner in mines," Yaoyun Xin, managing director at independent metals consultancy SMM Information and Technology
- "By 2025 we see it is possible that Africa can supply 200 million tonnes per annum of additional iron ore into the iron ore market," said Ernst Venter, a manager at Exxaro (EXXJ.J: Quote).

Conclusion

- Iron deposits are mostly formed by the oxidation of ferrous Iron into ferric Iron
 - Main Iron deposits are the Bog ores, Ironstone and Banded Iron Formation
 - Banded Iron Deposits are the most abundant and mainly distributed throughout Africa,
 - Banded Irons can be classified into Algoma, Superior and Rapitan types
 - Africa is yet to see more economic and social growth as a result of iron demand in the steel and other industries
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Thank you...
