Chapter 1

Introduction

1.1 Nsuta Manganese Deposit

The Nsuta manganese deposit is situated at approximately 5^{O} 20'N and 1^{O} 55'W in the Western tropical rainforest region of Ghana (Fig. 1.1). The deposit is located about 5km south of the town of Tarkwa and 62km north of the port of Takoradi.

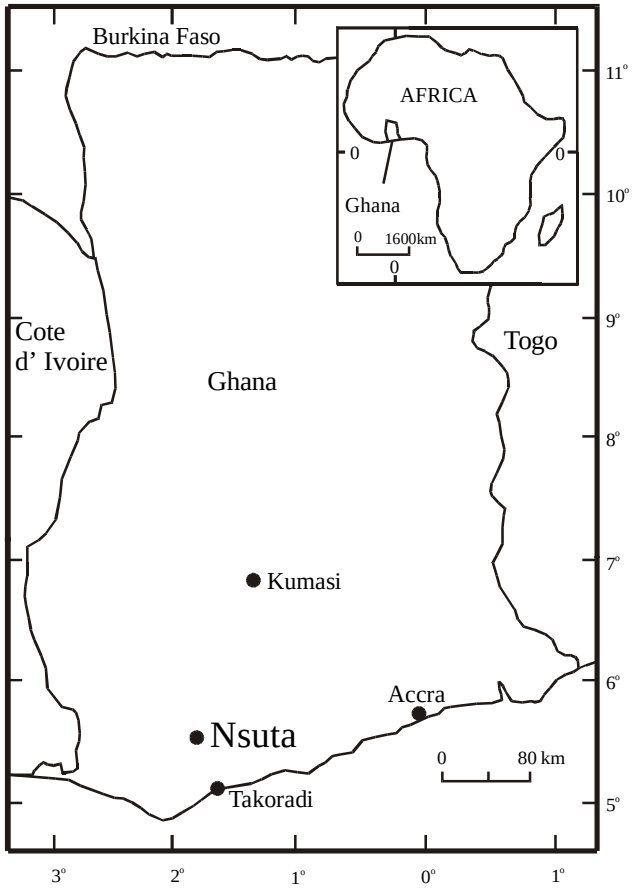

Fig.1.1. Location of Nsuta. Inset illustrates the position of Ghana in Africa (Nyame, 1998)

The Nsuta deposit is one of the largest and economically important manganese deposits in the world; it is a sedimentary manganese carbonate deposit hosted in a succession of metamorphosed volcanic and sedimentary rocks belonging to the 2.2 Ga Birimian Supergroup *(Kesse, 1985).* The surficial portion of manganese carbonate ore has been affected and upgraded by deep lateritic weathering to form

battery active oxide ore of exceptionally high grade. This was the main ore in the past, but presently only carbonate ore with an average Mn content of ~30 wt % is produced.

The Nsuta manganese deposit was discovered in May 1914 by A. E. Kitson *(Kesse, 1985),* the then Director of the Gold Coast Geological Survey, on a concession belonging to Fanti Consolidated Ltd. After the discovery, the Gold Coast Geological Survey and Fanti Consolidated Ltd. formed the Wassaw Exploring Syndicate to exploit the deposit. Commercial exploitation began in 1916. In 1923 the African Manganese Company (AMC) took over the concession and continuously mined the deposit until 1973 when the company was nationalized by the Government of Ghana. Subsequently, the Ghana National Manganese Corporation (GNMC) was established to operate the mine. Ownership again changed in 1995/96 and the mine has since then been operated by the Ghana Manganese Company Ltd *(Nyame, 1998).*

Initially high-grade battery active manganese oxide ore (>60 wt % Mn) was mined. At a later stage in the mining activity, lower grade carbox ore[1] (40-60 wt % Mn) was exploited. Finally in the late 1940's low-grade manganese carbonate ore (<40 wt % Mn) was discovered. At present, only manganese carbonate ore is mined, with subordinate amounts of carbox ore[1]. Reserves of high-grade battery active manganese oxide ore are now almost completely exhausted. Presently, the mine is rapidly expanding to reach a production of 1Mt of ore per year. Exploration activity outside of the active pits is very limited.

The deposit is situated on five hills (known as Hills A-E from south to North) and along a strike length of about 4 km (Fig. 1.2.). Hills C and D are both divided into two sections, namely C south, C north, D south and D north (Fig. 1.2).

[1] Carbox ore - local term used to describe a Mn-containing zone between Mn-carbonate and Mn-oxide.

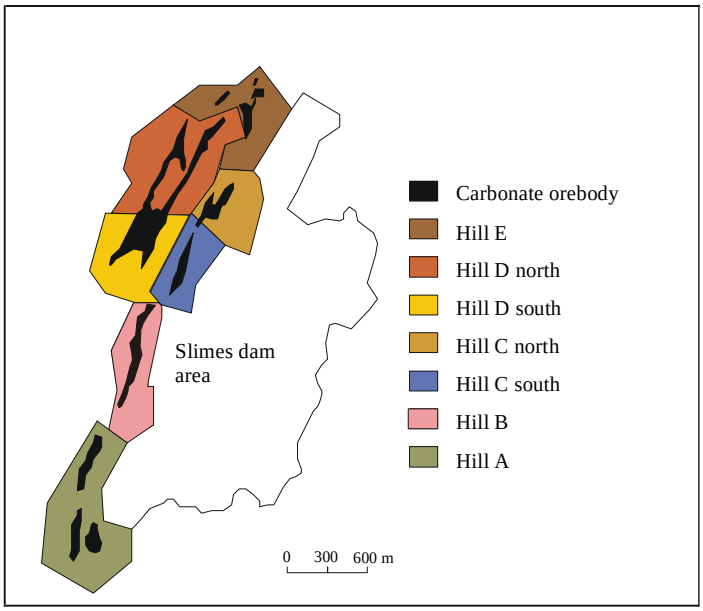

Fig. 1.2. Sketch map of the Nsuta manganese deposit. Note the location of the seven distinct parts of the deposit referred to as Hills A to E (modified after Kleinschrot et al. 1994)

1.2 Previous work

Previous work on the Nsuta manganese deposit has virtually all been on the geochemistry and petrography of the orebody and has never included a detailed structural and sedimentological study. The most extensive geochemical and petrographic studies on the Nsuta manganese deposit was done by Nyame *(1995, 1998)* who investigated the mineral chemistry, bulk rock chemistry, rare earth element and stable isotope (C, O) geochemistry of the rocks. Other, less detailed, geochemical studies have also been done by Yeh et al. *(1995)*, Kleinschrot et al. *(1994)* and Mücke et al. *(1999).*

Based on the geochemical/petrographic analyses, Mücke et al., *(1999)* come to the conclusion that the Nsuta manganese deposit is of submarine exhalative volcanic origin. They suggest that the continent-derived sediments were slowly and continuously deposited, while hydrothermal solutions of volcanogenic exhalative origin were rapidly supplied and deposited as chemical precipitates in the sediment. Yeh et al. *(1995)* draw similar conclusions to these, but their data are based on carbon- and oxygen-isotope evidence only. Kleinschrot et al. *(1994)* conclude that the metasediments are enriched in manganese and thus represent the

proto-ores of the Nsuta Mn-deposit. Nyame *(1998)* demonstrates that carbon derived from magmatic and/or sea water, as well as organic sources, may well have been involved in carbonate formation. Manganese-rich hydrothermal solutions generated by submarine rifting during early Birimian times may have largely served as the source of manganese for the mineralization *(Cozens, 1988)*.

1.3 Scope of dissertation

The aim of this dissertation is to provide a sedimentary and structural model of the Nsuta manganese deposit. This information is deemed essential for exploration for further manganese resources. In order to achieve the set goals, a detailed geological mapping project was undertaken over an area of about 4 km in length and 1.5 km width, with field work lasting for a period of two and a half months.

Access to all parts of the mine was reasonably easy, although not all open-pits were completely accessible due to flooding. To supplement outcrop-based field observations, a concurrent sedimentological study was undertaken based on logging of diamond drill cores. Information obtained from these field studies were supplemented by mineralogical and petrographic studies and evaluated with available literature and remote-sensing data. The data are presented in the following manner:

(1) Regional geology
(2) Lithofacies descriptions
(3) Stratigraphy
(4) Structure

All data presented are then utilized to produce a model for the genesis and geotectonic evolution of the Nsuta deposit. In broad terms this model is consistent with currently published ideas about the geological evolution of the Birimian Supergroup. Finally a target area for future exploration purposes is delineated.

1.4 General Information on Ghana[2]

Ghana is located on the West African coast, about 750 km north of the equator on the Gulf of Guinea. The capital, Accra, is on the Greenwich meridian. The country has a total land area of 238,305 km^2 and is bounded on the north by Burkina Faso, on the west by Cote d'lvoire, on the east by Togo and on the south by the Gulf of Guinea (Fig. 1.1).

Ghana has a tropical climate characterized by temperatures generally in the range of 21-32° C (70-90° F). There are two rainy seasons, from March to July and from September to October, separated by a short dry season in August and a relatively long dry season from mid-October to March. Annual rainfall in the south averages 2,030 mm but varies greatly throughout the country, with the heaviest rainfall in the western region and the lowest in the north.

The population of Ghana is estimated at about 19 million with 45 per cent under 15 years of age. The country has an average population density of about 52 persons per square kilometer and an annual growth rate of 3.2 per cent. Most of the population is concentrated in the southern part of the country. Highest population densities occur in urbanised and cocoa-producing areas. The largest regions in terms of population are Ashanti (about 2 million), Eastern (about 1.7 million) and Greater Accra (about 1.5 million).

[2] This information was derived from http://www.ghana.gov.gh/profile/clima.html