CHAPTER II

CORUNDUM DEPOSITS IN ILAKAKA AND SAKARAHA

2.1 Introduction

Madagascar is the fourth largest island in the world; it is located about two hundred miles east of the African mainland. Varieties of gemstones have been discovered with enormous reserves in this country, therefore it can reasonably be called as a gemstone-rich island. Geology of the Madagascar island is very similar to East Africa, because they were the same continent before the part of Madagascar has been drifting eastwards into the Indian Ocean. Precambrain basements of Madagascar appear to have formed as crystal segment during Archaean to mid-Proterozoic age. Subsequently, they were experienced by main thermo-tectonic evolution during the Pan-African event, that was affecting large parts of Africa. High-grade metamorphic rocks of Madagascar consequently formed as eastern part of Mozambique belt within periods of reconstruction of the Gondwana supercontinent. Collision structures have been observed and suggested as indication of collision between East Gondwana (India-Antarctic-Australia) and West Gondwana (Africa-South America) about 600 Ma ago (Milisenda et al., 2001). The Morandava sedimentary basin in the western to south-western Madagascar formed as part of a larger basin that extends onto the East African continent. Sediments in this basin appear to have been deposited continuously from Carboniferous (approximately 345 Ma ago) to Tertiary (less than 60 Ma). Basin separation was consequently occurred as a result of Gondwana segregation and continental drifting about 165 Ma ago (Milisenda et al., 2001). However this basin is a significant place of gem deposits including Ilakaka - Sakaraha deposits.

In Africa, a thick continental succession of rocks ranging in age from Upper Carboniferous to Lower Jurassic is commonly defined as Karroo Supergroup (Milisenda et al., 2001). It can be subdivided into three units as described below.

The Sakoa Group is the base unit ranging in age from Carboniferous to Middle Triassic; it contains predominant sandstone and argillitic layers as well as coal

beds.

The Sakamena Group of Upper Permian to Middle Triassic is characterized by alternating argillitic and sandstone layers.

The Isalo Group varies in age from Upper Triassic to Upper Jurassic; this unit significantly consists of alternating sandstone and red argillitic layers. In addition, it should be noted that Ilakaka gemstones have been discovered from Isalo sediments that appear to have been deposited about 200 Ma ago.

Madagascar is extremely rich in minerals and gemstones; numbers of mineral occurrences run into thousands. Mineral productions of the country are enormously exporting ores, gold and precious stones to the world market. Many varieties of gemstones have been exploited for a long period. They are composed of apatite, beryl (emerald, aquamarine and morganite), chrysoberyl, corundum (ruby and sapphire), feldspar (amazonite, orthoclase and labradorite), garnet (rhodolite and spessartite), quartz (rock crystal, amethyst, citrine and agate), tourmaline, spinel, zircon, and others rare gemstones (e.g. kornerupine, epidote, kyanite, hambergite). Occurrences of these stones distribute throughout the country as shown in Figure 2.1.

2.2 Corundum Deposits in Madagascar

Madagascar is one of the most significant gem producing countries. The most important product among many gemstone varieties is corundum. Most corundum deposits have been exposed in the south of the island (see Figure 2.1). Corundum deposits in Madagascar could be divided into 2 types, primary crystalline deposits and secondary sedimentary deposits. Intasopa (2001) reported that corundum deposits in Andranondambo region, Toriara province in east of Madagascar were primary deposits. The sapphires were found in marble and gneiss (cal-silicate gneiss). In addition, some basaltic type deposits are also reported in Diego province in the north of the country (Hansawek, 2001) that are reasonably included into primary source. According to Gem Mining Resources, 2002; cited in Pattamalai (2002), corundum and associated minerals deposits in Ranohira, Ilakaka and Sakaraha regions are mostly alluvium type. They are

found in the upper and lower terraces. They are some examples of secondary sedimentary deposits.

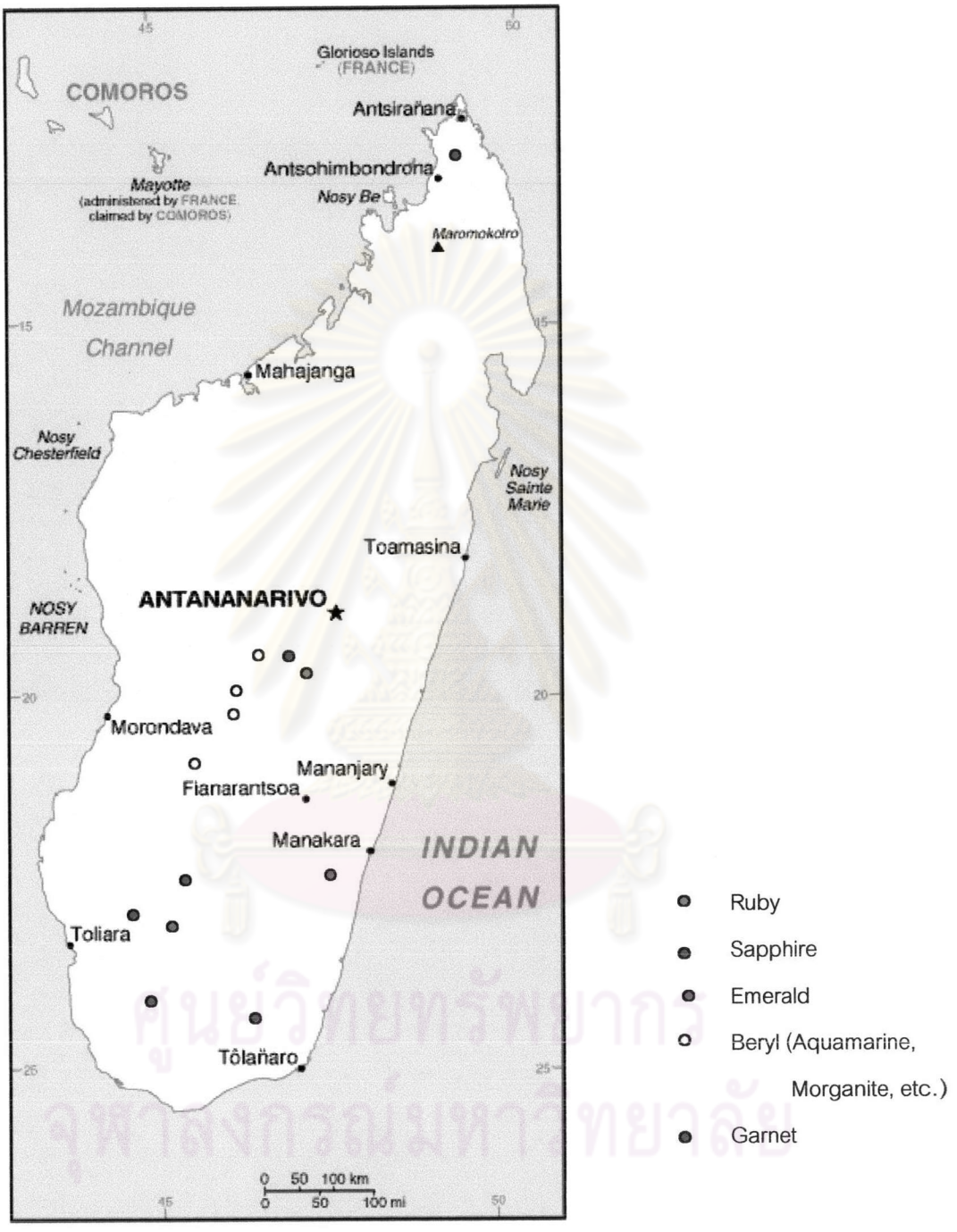

Figure 2.1 Gemstones occurrence in Madagascar (applied from geographyiq.com and Hansawek, 2001)

2.3 Ilakaka – Sakaraha Deposits

Corundum deposits and mining in Ilakaka-Sakaraha (Figure 2.2) are very well known as production source of corundum varieties; they are located in Tulear Province about 80 kilometers south west of Madagascar (Figure 2.3). The Ilakaka gem deposits are hosted by conglomeratic layers within the Paleozoic-Mesozoic Isalo Formation, Karoo Supergroup, which covers an enormous portions of southern and eastern Madagascar. Rubies and sapphires from Ilakaka-Sakaraha area are generally similar to those found in Sri Lanka (Hansawek, 2001).

The Ilakaka gemstones are discovered in sediments of the Isalo-Group which were deposited about 200 Ma ago. Sediment should be supplied from the initial Precambrain basement (Milisenda et al., 2001).

Hansawek, 2001; cited in Pattamalai (2002), reported that Ilakaka-Sakaraha sapphires are found as secondary deposits in alluvial plain and river terrace. The averages of paydirt thickness vary from 0.5 to 1.5 meters and up to 3 to 5 meters in some places. These paydirts are usually overlain by sediments and underlain by unconsolidated bedrock of Triassic sandstone.

Figure 2.2 Mining activities in Ilakaka corundum deposit (Pezzotta, 1999)

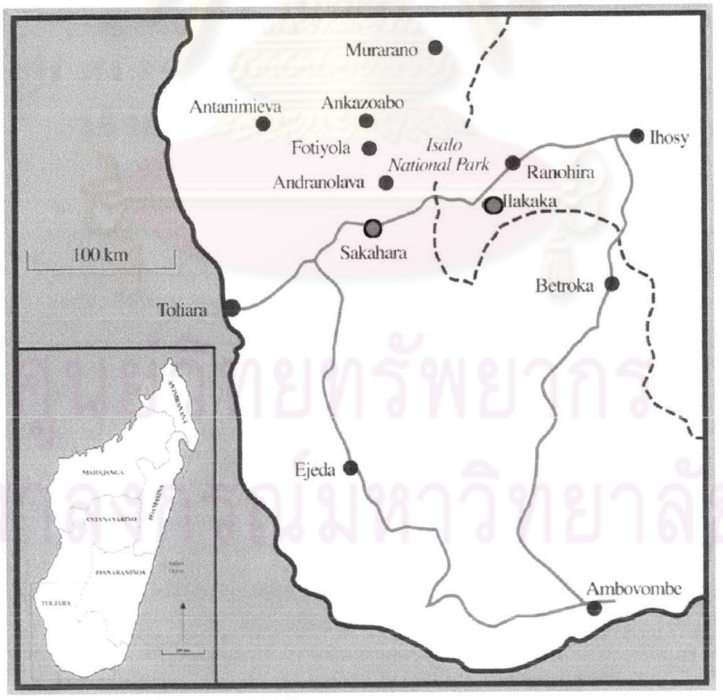

Figure 2.3 Location of Ilakaka-Sakaraha area, southwestern Madagascar (from Milisenda et al., 2001)

2.4 Mining and Production

Mining activities in south-western part of Madagascar have been increasing in three particular areas. First mining area covers about 30 x 20 km^2 around Fotiyola and Andranolava, south of Ankazoabo in which is crucial occurrences of pink sapphire. Second region is in Murarano, where many deposits of blue and pink sapphires as well as alexandrite have been discovered. The last locality, covering area of about 90 x 20 km^2, is located between Ranohira and Sakaraha. However, crowded gem mines have been operated within the Ilakaka's village (Figure 2.3) which is very well known for blue sapphire production (Milisenda et al., 2001).

Sapphires along Ilakaka river were discovered initially in the summer of year 1998, consequently local people began digging sediments (Figure 2.4) and searching for gemstones. In addition, sapphire and other gemstones have also been found abundantly in many spots of the whole region. A lot more prospectors started to own land, constructing huts and small houses along both sides of the Loshy-Tulear road.

Figure 2.4 Local miners are digging and washing sediments along side of Ilakaka river (Pezzotta et al., 1999)

The Madagascar government and the Service des Mines set up an administrative office and extended boundaries of Isalo National Park to protect the area. Parts of the Ilakaka river were officially reserved for only native Madagascans, whereas remaining areas were allowed for private companies. The mining areas have been widely extended from north to south with distance of about 200 km, encompassing the area between Isalo Mountains in the east and Sakaraha in the west. To restrict illegal sales, the Service des Mines built an official marketplace (Figure 2.5); therefore, trafficking gemstones outside this market is strictly prohibited. Security of the market is taken care by government armed soldiers.

Figure 2.5 An official marketplace, the 'Service des Mines' for gemstone trading in Madagascar (Pezzotta et al., 1999)

High activities of exploration and mining lead to earning more geological information particularly in Ilakaka deposits. It is now clear that fossil gemstone placers are hiding in coarse-grained lenses and strata of Permain and Mesozoic graywacks. The oldest sedimentary series are over 250 Ma and known as a continental deposit in mid-Cretaceous (about 100 Ma). During that time, sedimentation was likely related to marine

origin. From Permian to mid-Cretaceous (a.v.150 Ma) the crystalline basement were suffered by deep erosion.

Subsequently, the weathered products were transported westwards by rivers and deposited into a sedimentary basin connected to the Mozambique Channel. Only the most resistant minerals would survive in the subtropical climate, foremost types among them are quartz, corundum and garnet.

In the mining province, groups of workers pit horizontally into the gem-bearing strata, and mixed sediments are then taken onto the surface. Sands and gravels are subsequently separated. Sands will be removed, on the other hands gravels will be placed into sacks that are carried and then washed in the river. Eventually, corundums and other gemstones are searched and picked up from the washed gravels (Figures 2.6 - 2.8) (Pezzotta et al., 1999).

Figure 2.6 Panning and washing gravels along the Ilakaka river (Pezzotta et al., 1999)

Figure 2.7 Miners are searching for gemstones after panning and washing (Pezzotta et al., 1999)

Figure 2.8 Ruby samples from the Ilakaka river (Pezzotta et al., 1999)