Artisanal Sapphire Mining in Madagascar:
Environmental and Social Impacts
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Madagascar 2005-2006

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Within the past 20 years Madagascar has emerged as a major player in the international trade in precious colored gemstones. Most notably, in 2002 an estimated 50% of the world’s sapphires came from Madagascar. Production still relies heavily on artisanal miners and archaic methods, as formalized and large-scale mining of sapphires has been hampered by corruption, government bureaucracy, start-up risks, and other factors. While this situation allows for Malagasy from all ranks of society to become involved in the potentially lucrative sapphire market, it also creates a setting where the negative environmental and social effects of artisanal mining are left virtually unchecked.

This article will examine artisanal sapphire mining in Madagascar in four sites throughout the country (one in the northern province of Antsiranana, and three in the southern province of Toliara). Attention will be paid to mining techniques and tools, as well as the environmental sensitivities of each site and any social impacts and/or benefits that the sapphire trade has brought to each area. The article will also discuss new Malagasy governmental mining laws and regulations, and non-governmental initiatives to improve the sapphire trade. The authors will also make their own recommendations for additional ways that could ameliorate negative environmental and social impacts currently associated with sapphire mining in Madagascar.

General Context: Madagascar – conservation importance and social setting

Madagascar is the fourth largest island in the world, located in the Indian Ocean and across from continental Africa along the Mozambique Channel. Its total land area is 581,540 square kilometers, slightly less than double the size of Arizona. The climate and geography is varied, with tropical rainforest in the north and east, a temperate climate in the central mountainous areas, and an arid southern region.

Madagascar was originally part of the large Gondwana landmass 120 million years ago, joined to mainland Africa, Antarctica, South America, and the Indian subcontinent. Continental shift eventually deposited Madagascar in its current location 60 million years ago. Evolution from then on proceeded in isolation except for the rare addition of plants and animals who had survived an ocean journey from nearby islands or

mainland Africa. Coupled with its varied climate and terrain, this isolation resulted in species endemism rates of 80 to 99%.

Madagascar is a major conservation priority worldwide, not only due to its rich natural resources but the high threat to their continued existence. It is classified as one of eight “hottest hotspots” of 25 total hotspots, or “areas featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat.”

Table 1: Hotspot Statistics for Madagascar, 2000

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original extent of primary vegetation (km²)</td>
<td>594,150</td>
</tr>
<tr>
<td>Remaining primary vegetation (km²)</td>
<td>59,038</td>
</tr>
<tr>
<td>(% of original extent)</td>
<td>9.9%</td>
</tr>
<tr>
<td>Area protected (km²)</td>
<td>11,548</td>
</tr>
<tr>
<td>(% of hotspot)</td>
<td>19.6%</td>
</tr>
<tr>
<td>Plant species</td>
<td>12,000</td>
</tr>
<tr>
<td>Endemic plants</td>
<td>9,704</td>
</tr>
<tr>
<td>(% of global plants, 300,000)</td>
<td>3.2%</td>
</tr>
<tr>
<td>Vertebrate species</td>
<td>987</td>
</tr>
<tr>
<td>Endemic vertebrates</td>
<td>771</td>
</tr>
<tr>
<td>(% of global vertebrates, 27,298)</td>
<td>2.8%</td>
</tr>
</tbody>
</table>


It is estimated that Madagascar has approximately 25,000 endemic species total, and 24 endemic families, many of which represent “ancient lineages.” And other tantalizing statistics abound: all 101 of the native mammal species are endemic to Madagascar, and each of the four major lineages (lemurs, carnivores, rodents, and tenrecs) seem to have arrived in Madagascar in single colonization events.

Conservation efforts received attention and a major boost in 1990, with the passage into law of the Environmental Charter. The goals of the charter, which stress human reconciliation with the environment and sustainable development, are strategized in the National Environmental Action Plan (NEAP); the country commenced the third phase in 2005 (NEAP III). Conservation efforts in Madagascar attempt to protect remaining intact habitats, but also often try to reduce human impact and stress on these habitats. The human activity mainly responsible for decline in biodiversity is

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3 Hawkins, Frank – Technical Director, Center for Biodiversity Conservation, Conservation International Madagascar Program. Personal Communication. 25 November 2005
deforestation, either to clear land for agriculture (particularly hillside tavy, or slash and burn cultivation), for grazing land to support herds of zebu and other domestic animals, or to extract fuel or construction materials. We will now turn our attention to the human dimensions of Madagascar.

Humans arrived on the island only recently, between one and two thousand years ago. These early settlers were a combination of Indonesian, Bantu (central African), and Islamic ancestries. Though there are 18 politically recognized “tribes,” their historical roots and time of origin may vary and tribal identity for many Malagasy is rather fluid. Nevertheless, regional differences are evident, whether based on tribal status or other factors, and are shown by such markers as distinct dialects of the Malagasy language, customs, fady (taboos), dress and hairstyle.

The current population of Madagascar is about 18 million (2005 estimate), with nearly 45% younger than 15 years old. The population growth rate of 3% is relatively high. 80% of the population is rural and relies on agriculture for its livelihood. By most standards it is a very impoverished country. A report\(^5\) written by the government of Madagascar highlights some of the more distressing statistics:

- nearly half of the school age children are not enrolled in schools;
- illiteracy affects more than half of the population (of which 56.5% of women) with a higher rate among the youngest;
- nearly one third of the Malagasy population's life expectancy is below age 40;
- more than three quarters of the Malagasy people have no access to drinking water;
- energetic food intake of three Malagasy out of four is below the minimal 2133 cal/day standard.

On average, 71.3% of the Malagasy population was classified as monetarily poor\(^6\) in 1999. Moreover, 76% of the rural population was poor, versus 52% of urban residents, and poverty is most pronounced in families whose breadwinner works in agriculture or stockbreeding, particularly for small-scale farmers.

Beyond monetary poverty measures, health and education indicators are also disheartening and show the particular disadvantages faced by rural Malagasy. Nearly half the population in 1999 was illiterate; illiteracy rates were 61% in rural areas, versus 33% in urban areas. Life expectancy was about 57.5 years in 1999, yet a third of the population can only expect to live to age 40.\(^7\) Infant mortality (77 deaths in 1,000 live births) is also high. Health infrastructure and services are also poor in Madagascar. Only 23.6% of total households, and only 10.4% of rural households, have access to drinking


water. The only encouraging health statistics are related to AIDS, since Madagascar has managed to escape much of the high transmission and prevalence rates of mainland Africa, with a 1.7% adult prevalence rate in 2003. Overall, Madagascar’s Human Development Index (HDI) rating is 0.453 on a scale of 0 to 1, giving it a rank of 150 out of 177 countries in 2001.

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The Malagasy Economy – General Traits and the Role of Gemstone Mining

Madagascar was a French colony between 1896 and 1960. After independence, the country’s second president (Didier Ratsiraka) imposed socialist reforms that today are viewed as partially responsible for a downturn in economic stability and growth. Since the 1980s the economy has experienced some growth, due in part to reforms initiated by the International Monetary Fund and World Bank. This growth has periodically been hampered by political crises, the most recent of which occurred in 2002 after a contested presidential election pitting the incumbent Ratsiraka against Marc Ravalomanana. (The latter eventually came into power and was reelected in 2006). After this crisis the GDP dropped by 12.7%, but rose by 9.8% in 2003.

Agriculture, including fishing and forestry, dominates Madagascar’s economy, accounting for more than one-fourth of gross domestic product (GDP) and employing 80% of the population. Farmers grow traditional crops to be consumed locally, such as rice, cassava, corn, and vegetables, as well as cash crops for export to international markets, such as vanilla, cloves, peppercorns, ylangylang, and lychees. Non-agricultural sectors of the economy, such as service industries and manufacturing, employ less people but together contribute more to the country’s GDP (16.5% for industry, 54.8% for services, 2005 estimate). Mining, energy and manufacturing accounted for 11% of the GDP in 2002. Madagascar’s mining sector is largely based on the production and export of chemical and metallurgical-grade chromite ore, granite, and mica. Production of other mining resources is smaller scale, including industrial commodities like cement, feldspar, quartz, and salt, as well as beryllium, gold, and precious and semi-precious gemstones.

Since the early 1990s when exploitation of sapphires commenced in Madagascar, their role in the Malagasy economy has increased with each passing year. Yet accurate figures for the role they play in the economy are hard to obtain, and the few sources that do exist sometimes report conflicting data and often lack a consistent timeline series. Accurate estimates of the role sapphires play in the Malagasy economy are also hard to determine because of the prevalence of smuggled sapphires that are traded and exported outside of legal channels.

According to a 2005 estimate, the mining sector (including exploitation of precious stones like sapphires, as well as semi-precious and industrial materials) accounted for 3% of the country’s gross domestic product (GDP) and 1% of its export revenues. During 2002, approximately 9,500 kilograms of rough sapphire and 10kg of cut sapphires were exported legally from Madagascar. In 2005 the overall value of precious stones produced in Madagascar was $7.63 million USD, up from $5.84 million USD.

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USD in 2001 and $2.61 million USD in 1998.\(^{16}\) It is important to note, however, that these numbers do not include smuggled sapphires.

**Figure 1: Kilograms of sapphires exported per year in Madagascar.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Kilograms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>3957</td>
</tr>
<tr>
<td>1998</td>
<td>2874</td>
</tr>
<tr>
<td>1999</td>
<td>3810</td>
</tr>
<tr>
<td>2000</td>
<td>9536</td>
</tr>
<tr>
<td>2001</td>
<td>8470</td>
</tr>
<tr>
<td>2002</td>
<td>9000</td>
</tr>
<tr>
<td>2003</td>
<td>6000</td>
</tr>
</tbody>
</table>

N.B. Total of *reported* sapphire exports; does not include smuggled sapphires (Yager 2001 and Yager 2003)

Smuggling continues to be a serious problem in Madagascar, and thus the country’s production of precious stones is most likely worth much more than the official figures. A 2005 article in *The Economist* estimated that 50 kilograms are smuggled to Thailand each week.\(^{17}\) Some Malagasy working as translators for foreign buyers have reported that some may keep sapphires in their underwear to avoid detection and smuggle gems out of the country.\(^{18}\) Others simply avoid regulatory hassle by bribing government officials at various stages in the buying and exporting process. The same article in *The Economist* estimates that 90% of the people in the mining sector, “especially those in authority,” are corrupt to some degree.\(^{19}\) Recent changes to the national mining laws are meant to curb smuggling by encouraging formalization of the mining sector and reducing red tape for foreigners who wish to export. These changes will be discussed later in this document.

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**M pangady, Mpihady: Malagasy Miners or “Diggers”**

Malagasy people are involved at various stages in the sapphire trade, from digging pits to uncover the raw materials to selling cut stones in the world market. By some estimates, about 500,000 people in Madagascar gain seasonal or full-time employment from the sapphire trade, out of a total population of about 18 million people.\(^\text{20}\) This paper, however, will focus mainly on the role Malagasy people play at the earliest stages – digging in pits or riverbanks and sieving dirt to find raw sapphires. In the north of Madagascar miners call themselves *mpangady*, and in the south *mpihady* – both terms mean literally “digger.” These tasks are almost exclusively done by Malagasy people and use artisanal methods; the trade, finishing, and export of sapphires is dominated by foreigners from Sri Lanka, Thailand, and West African countries, as well as some from Israel, Europe and North America.

**Income and Expenditure**

It is extremely difficult to estimate the economic impact on Malagasy people from their involvement in the lowest stages of the sapphire trade. One factor is that Malagasy miners often focus on the potential and maximum profits to be made, and not their own actual average income. When asked to estimate the typical income of a digger, most miners focused on the enormous potential profits to be made, often from finding a particularly large and high-quality single stone. Thus, when asked about their livelihood from the sapphire trade, Malagasy miners would often first respond by saying that one person could potentially earn 10 million, 50 million, or even 200 million Malagasy Francs (fmg) in a single day (equivalent to approximately 1000, 5000 and 20,000 USD) and often told stories of a person that they knew or had heard about who had done just that. Many newspaper articles reporting from sapphire rush towns note the same propensity of miners to focus on potential instead of actual earnings.

Although there are no official figures, rough estimates suggest that 30 billion Malagasy francs, or 4 million USD, in cash change hands every day in the local gem market [in Ilakaka, southern Madagascar]. Everyday there is someone who has found a sapphire of 15 million or 20 million fmg. This is about 2,075 to 2,766 USD or the equivalent of 10 years work for the average Malagasy. These stories of big finds are fuelling the fever.\(^\text{21}\)

The same journalist interviewed a miner who “boasts that his crew once found 300 grams of gems – worth $50 to $200 a gram depending on quality – in a single day,”\(^\text{22}\) or between 15,000 and 60,000 USD total.

When pressed, however, most miners followed tales of enormous earnings by saying that they had not personally gained nearly as much from their involvement in the

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trade. As Andrew Walsh, an anthropologist who has done extensive work in one of Madagascar’s sapphire mining regions, explains,

Single stones can and do sell for what these migrants might earn from a month’s labor elsewhere. This is not to imply, of course, that all who have come to this place have made their fortunes. Indeed, many seem worse off when they leave. Still, stories of the fortunes to be made in the sapphire trade have remained compelling enough to draw a steady stream of newcomers, even as their dejected predecessors make room for them.23

As Heather Bourbeau notes, “for every get-rich-quick story, there are dozens of tales of failure” and most miners are more likely to find small stones of little value, or nothing at all, for days or months at a time.24 Most of the miners interviewed for this study noted the inconstant nature of their income. Their lives are made up of series of days, or even months, of finding nothing at all or stones of very little value (5 USD and under), punctuated by occasional finds of high value stones if they are lucky.

Estimating the economic impact the sapphire trade has on Malagasy miners is further complicated by a second factor. Miners are highly transient and often view sapphire mining work as only one of the many jobs they will do throughout their life; it is rarely viewed as a long-term career. As Andrew Walsh notes of miners in the north of Madagascar,

For many of the young men and women who have come to dominate [Ambondromifehy], involvement in the sapphire trade and its attendant pursuits is only the latest in a series of short-term migratory labor experiences that have led them through settings as diverse as gold-mining towns, fishing villages, plantations, and urban centers throughout Madagascar.25

Interviews conducted for this study support Walsh’s observations. Of 50 miners in all four study sites, a majority had worked in more than one job before becoming a sapphire miner. 54% of the miners had previously been farmers, in addition to various other jobs: 18% in factory jobs processing sisal, fish, cotton, and sugarcane; 4% in government service, 8% in trades like carpentry, mechanical repair, and butchery; 12% in commerce; 4% growing cashcrops like vanilla; and 6% in other mining activities like gold. 4% of miners also had previously been in school. (These percentages total over 100%, since most miners had worked two or more jobs). Miners were also asked in interviews for this study what they planned to do with their earnings. Their responses show that for most, mining was not viewed as a lifetime career. Only 17% planned to invest the money in

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equipment to help their sapphire work, whereas 38% planned to buy land and zebu in their homeland\textsuperscript{26} and 20% planned to build a house in their homeland.

Table 2: Miners anticipated use of sapphire earnings

<table>
<thead>
<tr>
<th>What do you plan to do with the money that you make? (47 total respondents)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. buy equipment to help my work with sapphires</td>
<td>8/47 = 17%</td>
</tr>
<tr>
<td>b. invest in a non-mining business</td>
<td>9/47 = 19%</td>
</tr>
<tr>
<td>c. support or distribute amongst my family members</td>
<td>11/47 = 23%</td>
</tr>
<tr>
<td>d. personal enjoyment</td>
<td>2/47 = 4%</td>
</tr>
<tr>
<td>e. other</td>
<td>34/47 = 72%</td>
</tr>
</tbody>
</table>

>18 (or 38% of total miners responding) planned to buy land and/or zebu and return to their homeland,

>10 (20% of total miners responding) planned to build a house in their homeland

>other possibilities included using the money to pay for education, giving it to one’s children, or buying weapons for self-defense against bandits.

Since miners are a transitory group it is difficult to get a full picture of the Malagasy who have been involved in the sapphire trade. Even if one had the time and resources to speak with every miner in a given mining site at one time, these people would still only partially represent all the miners that had at some point visited and worked in that particular site. Miners may leave the mining area for various reasons – if they have succeeded and wish to invest the money in their homeland or if they have not succeeded and have moved on to seek wealth in other occupations. Out of 39 miners interviewed for this study, the median time since arrival at the sapphire mining site was only 5 months, and the mode only 4 months. Some miners had only been there less than a week! Clearly, since some of the sapphire sites have been in existence since the mid 1990s, those interviewed at the time of this study do not account for many other Malagasy people who came and left since the start of the rush. In other words, those Malagasy miners interviewed were either relatively recent arrivals still learning the trade and waiting for a big find, or miners who had arrived less recently but were still there for one of two main reasons: they had either not seen much earning beyond that which provided for basic subsistence, or they had seen large earnings but had not saved or invested them wisely.

The latter category of miners – those who earn the high sums of money quoted by optimistic miners but do not save or invest it – has received scholarly interest. It is a phenomenon noted by both Rosaleen Duffy in the southern sapphire town of Ilakaka,\textsuperscript{27} and Andrew Walsh in the northern sapphire town of Ambondromifey.\textsuperscript{28} In an article devoted to the topic, Walsh speculates on the reasons why a miner would waste huge sums (equivalent to one month’s or one year’s salary for the average Malagasy, or more) in a matter of days. Some miners explained to him that money earned through digging

\textsuperscript{26} tanindrazana in Malagasy


sapphires was “hot money” that by its very definition could not be invested but had to be spent quickly and on luxury items like clothes, stereos, bikes, beer and marijuana, and prostitutes. He also emphasizes the important role that peer support networks play for sapphire miners, and how one is expected to use any monetary windfall to pay back “debt” incurred by someone else’s past kindness, or to create future debt where one is assured of being supported by indebted peers later on.

Additionally, it was observed in interviews for this study that such conspicuous consumption was more prevalent in young men (who by their age and status did not have family obligations or ties like older men), in more recently arrived miners, and at the earlier stages of a rush town. In the northern mining town of Ambondromifehy, for example, I met some older miners and traders who had been there since the start of the rush in 1996. They recounted tales of their own wild spending in those early years, and told me that at the time, everyone expected sapphires to be plentiful, easy to find and valuable forever. They spent their earnings with no thought of the future, and eventually sapphires became harder to find (up to 50 meters below the ground surface now instead of in the top 3 meters in 1996) and more difficult to sell at a good price (due to market fluctuations and the increased supply of raw stones as more miners came to the area). Now, conspicuous consumption of “hot money” is markedly less visible in Ambondromifehy, as well as Andranodambo in the south, mining towns whose rushes started in 1996 and 1992 respectively. As towns 10 years or more into the sapphire mining cycle, this is due just as much to reduced production of rough sapphires and thus incomes of miners as it is to the process miners go through as they age, learn to manage their money, and develop familial obligations and ties to channel their money through.

Artisanal Mining Tools and Work Techniques

To evaluate the environmental and social impacts of small-scale sapphire mining in Madagascar, a firm understanding of the tools and techniques used by artisanal miners is essential. The strata and morphology of a given area (e.g. solid limestone versus sandy soil substrate) dictate the appropriate tools and work methods to mine it. When the four field sites investigated in this study are described later in this document, it will also be made clear which tools and techniques were more predominant in that area, as dictated by the substrate and local geology.

Despite these regional variations, a few general points can be made about artisanal mining tools and techniques. First, there are seasonal variations to mining techniques and tools used that follow the rainy and dry seasons. From November to March, the rains loosen the substrate where miners work, and digging in deeper holes is limited because it becomes more dangerous as the threat of falling rocks and earth increases. Yet as work in deeper holes becomes less accessible or safe, other shallow areas become easier to access. Deforested fields become muddy or filled with shallow pools, and miners dig and sieve directly in these areas without needing to travel to rivers to sort out sapphires. Women and children’s participation increases as these sites become accessible. During the dry season from May to September, work in deeper holes is safer as the substrate is more stable, and direct digging and sieving in shallow areas occurs less.

29 vola mafana in Malagasy
Second, mining tools are simple, and mining work still relies heavily on brute force and labor. Miners are reluctant to invest money in higher-quality tools, such as stronger rope, as their income is variable and their commitment to working as a miner often transient. And even if miners wanted to invest in better tools (safer, more efficient, etc), there are a number of factors preventing them from doing so. With a variable income, a miner is understandably averse to using money from a sale of rough sapphire towards replacing old or broken equipment or upgrading to better equipment, as they are unsure of gaining money in the near future. Additionally, the Malagasy mining code classifies artisanal miners as those who mine with artisanal tools and techniques. Mechanized tools might increase revenue and health of Malagasy miners, but it would also necessitate them getting more expensive permits and following different rules.

The following chart (Table 1) shows the main tools used throughout Madagascar by artisanal miners, with equivalent Malagasy and French terms, and a short description of how each tool is used.

### Table 3: Tools used by Artisanal Miners in Madagascar

<table>
<thead>
<tr>
<th>Tool</th>
<th>Translation (M=Malagasy, F=French)</th>
<th>Techniques for use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tools used to remove dirt and rock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shovel, Spade</td>
<td>Angady or Lapely (M), la Pelle (F)</td>
<td>A common farm implement that has been adapted to dig holes of various lengths in loose sand and dirt. The metal spade tip is attached to a wooden pole, though sometimes the tip alone is used as a short hand-tool.</td>
</tr>
<tr>
<td>Metal Bar</td>
<td>Baraminy (M), la Barre à Mine (F)</td>
<td>Used to break through tough or very rocky soil. A metal bar of varying lengths (30 to 160 cm) and a diameter of 4-6 cm.</td>
</tr>
<tr>
<td>Sledgehammer and Spike</td>
<td>Lamasy and Gila (M), la Masse and l’Aiguille (F)</td>
<td>Used to chip away at bedrock to dig holes in hard substrate, or to break up rocks to search for imbedded sapphires. Spikes have a pointed tip and a larger head, and sledgehammers have short wooden handles.</td>
</tr>
<tr>
<td>Fire</td>
<td>Afo, Môtro (M), le Feu (F)</td>
<td>Fire is used in two ways – to clear surface vegetation to make finding and accessing digging sites easier, and to burn hard substrate to make removal easier as the burnt rock is more brittle and cracks easier.</td>
</tr>
<tr>
<td><strong>Tools used to remove water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bucket</td>
<td>Siao or siô (M), le seau (F)</td>
<td>For holes that fill with water past a certain depth, removal is done with a bucket on a rope in the same fashion that people gather water from a village well. Excess water is emptied often nearby in a separate hole or area. Digging is carried out before the water fills back and removal is again needed.</td>
</tr>
<tr>
<td>Mechanized Water Pump</td>
<td>la Pompe d’Eau (F)</td>
<td>Though not technically “artisanal,” mechanized water pumps are sometimes used by teams of miners. Power is provided by generators (gasoline or diesel powered), and various hoses (even garden hose) are used to pump the water out.</td>
</tr>
</tbody>
</table>

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30 *tady sambo* (rope used in boating), which is stronger than “regular” rope made of sisal or other weaker materials.
**Tools used to “pump” air underground**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wind-Tunnel Hand Pump</strong></td>
<td>In holes of a certain depth, available oxygen is low and miners must supplement it from above-ground sources. The non-mechanized method requires a second person above-ground to trap air in a large plastic sac that resembles a wind-tunnel. This sack is connected via a long hose (often hand-made from plastic material or old plastic bags) to the miner underground. Air is forced through the hole by the person above-ground rolling and squeezing air from the plastic sack, thus forcing it through the hose to the miner below. To provide a continuous supply of oxygen, these actions are repeated in a rhythmic fashion.</td>
</tr>
<tr>
<td><strong>Mechanized Air Pump</strong></td>
<td>Though not technically “artisanal,” mechanized air pumps are sometimes used by teams of miners. These may be large pumps powered by diesel- or gasoline-generators, or smaller air tanks like those used by scuba divers.</td>
</tr>
</tbody>
</table>

**Tools used to sieve**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conical sieve</strong></td>
<td>Used to separate dirt and rock from rough sapphires. Conical sieves are made from the tops of oil drums which have been shaped and then holes hammered out. They are used by one person, and are small enough for children to manage. Approximate dimensions: diameter 50-60 cm, depth 20-30 cm.</td>
</tr>
<tr>
<td><strong>Rectangular sieve</strong></td>
<td>Used to separate dirt and rock from rough sapphires. Made from tin sheets that are cut and hole-punched, then attached to a wooden frame with handles. It can be used by one or two people at once. Approximate dimensions: length 80-100 cm, width 50 cm, depth 10-15 cm.</td>
</tr>
</tbody>
</table>

**Miscellaneous**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rope</strong></td>
<td>Used for a variety of purposes – to lift out bags of dirt and rough sapphires (by hand or with the aid of a crank-pulley), to lower supplies down a mine hole, and to help miners descend down a hole. Though strong rope is available, often weaker ropes are used because they are less expensive.</td>
</tr>
<tr>
<td><strong>Rice Sack</strong></td>
<td>Plastic sacks are used to transport dirt and rough sapphires to sieving stations at rivers or waterholes away from mining sites. Sacks of the same size and make are ubiquitous throughout Madagascar, and are used for a variety of purposes. When full they contain about 50 kilos of rice; miners usually fill them a quarter of their capacity to reduce weight.</td>
</tr>
<tr>
<td><strong>Candle; Flashlight</strong></td>
<td>Candles or battery-operated flashlights are used to provide light in deep holes and horizontal tunnels. Candles compete with the miner for oxygen and are less safe, but flashlights are more expensive and thus used less in holes. Flashlights are used more extensively by middlemen and buyers to evaluate a sapphire’s worth and detect flaws.</td>
</tr>
<tr>
<td><strong>Barrel, Wooden Support</strong></td>
<td>To prevent tunnels and mine-shafts from collapsing, miners may use empty barrels for support, or make</td>
</tr>
</tbody>
</table>
Miners may dig and work alone, but more often work with others in ways that they hope will increase their success or reduce risks. Malagasy miners create various working groups, which are explained below.

The simplest grouping of miners is formations of small groups (typically two to ten people) whose members have equal status. If miners have family members in an area (wife and children, siblings, cousins, and so on) they will often form such working groups. Miners without family will find other links to form a bond, such as immigrant miners with a common homeland (eg miners from the Fianarantsoa province working together in the southern mining site of Ilakaka). Sapphire production and profits in small equal-status groups are divided in two ways – members may split all profits equally, or they may choose to let each digger keep his or her own sapphires found when they were personally digging in a shared hole. Both strategies involve some risk and rely on trust amongst members. A certain amount of cheating is expected, even tolerated, however. As anthropologist Andrew Walsh notes,

> Another recipe for success in the sapphire trade suggests that miners must at times behave antisocially, as “daring” individuals in pursuit of personal gain. They should trust no one, least of all the people working alongside them ... Even miners who dig in teams and agree to split their combined earnings are aware of and joke about this paradox. When they gather to drink, the one among them who has hidden the most sapphires from the others in their parties must confess and buy the first round.31

The technicalities of artisanal mining provide an ideal situation for cheating amongst members, as usually only one digger can fit in a hole at once, often out of view from his peers. Miners interviewed for this study often joked about the many ways one could hide sapphires from others he was working with, such as putting a rough sapphire in one’s ear or mouth. Yet despite deception there are advantages to working in small equal-status groups. Some tasks require at least two or more people; digging time until a layer or vein containing sapphires32 is reached is reduced; group members can help in emergency situations like dirt collapsing; and larger groups may provide safety against theft or attack by other miners or criminals, or can look out for police or authorities in areas where mining is illegal.

A more complex grouping of miners involves a small group of miners of equal status led and supported by a man of higher status. This group leader is variously called a boss, patron, or deba, and is described as someone who “makes others work.”33

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32 Lalambato, literally “path of the rocks/sapphires”
33 mampiasa olona
group leader takes on the role of ensuring that their work proceeds with few obstacles. Profits are usually split so that the group leader gets between 40 and 50%, and the group members split the remainder amongst themselves.

If a group leader is Malagasy, his responsibilities may include finding a mining site, providing simple equipment like candles and rope, feeding his workers, and securing buyers for their stones. Foreigners who act as group leaders are less intimate with the other group members, and may not even travel to the mining site. Yet they can afford to provide additional services, such as furnishing mechanized equipment. As an alternative to splitting profits, they may agree to buy all sapphires found by the group, or request that all sapphires are shown to them first. Though miners led by a Malagasy or foreign leader may see a smaller share of the profits from their labors, they still find advantage in these arrangements due to the guarantee of basic necessities being met, particularly food, and spending less on equipment. It is important to note that at all four sites of this study, miners never entered agreements to earn a fixed salary for their work.

Groups of miners may enter additional agreements with other people. First, owners of expensive equipment such as mechanized water and air pumps may lease these to miners for a flat fee, or for a share of the profits. Second, miners may also give a share of their profits to people with pre-established land claims to their mining holes or the larger area where it is found. The latter people rarely have official claim to the land nor are owners of mining permits, but have come to an area first and established claim in an informal but recognized manner.

Women and small children employ an additional work technique by re-sieving discarded waste rock at rivers. Once someone has sorted through the dirt and rock brought to a sieving station, they leave the unwanted waste there where it then becomes common property for anyone who cares to lay claim to it. Those who do search for sapphires that may have been missed on the first round of sifting, or low-quality sapphires that someone may not have taken the time to remove if they were focused on finding larger high-quality stones. Though profits are markedly lower, this work is less physically taxing and safer.

**Bringing Rough Sapphires to Market**

After sapphires are found through digging and sieving, these stones must make their way to the local gem market and beyond. While this paper’s main focus is not the sapphire trade, a brief description will be given as it gives context to factors affecting diggers.

The value of sapphires is somewhat subjective, with no fixed rate per carat, and thus the price a stone may fetch depends not only on larger market forces but the ability of buyers and sellers to scrutinize the faults and merits of a particular stone. The major qualities of a sapphire that affect price are: color (blue and pink are valued higher than clear, green, brown, yellow, and orange); size or weight (larger stones are more valuable than a comparable smaller stone); and clarity (opaque stones may be less valuable than transparent ones, and fissures decrease value). Inclusions also affect value, and are defined as follows:

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34 tain’sivana
Broadly defined, an inclusion is any irregularity observable in a gem – by the unaided eye or [using] some tool such as a hand lens or microscope. The ‘irregularity’ may be a substance, such as a solid mineral crystal or a fluid filling a cavity, or it may be an unfilled cavity, a fracture, or a growth pattern that produces some optical effect.\(^{35}\)

In general inclusions may reduce value, unless they produce a desirable pattern. “Star” sapphires result from light reflecting off “fine, oriented, rutile needles”\(^{36}\) within the stone, and are valued highly. The last major factor affecting sapphire value is heat treatment. Heat treatment changes the color of a sapphire, and can thus turn relatively invaluable orange or brown stones to a higher valued hue of blue. Though not generally known to consumers, heat treatment is quite common, and can only be detected with microscopic or laboratory analysis. In general, natural untreated stones are valued more highly, yet a stone’s unresponsiveness to heat treatment can also decrease value. For example, one of the main factors that led to a decline in sapphire prices in the north of Madagascar was that stones there were opaque and green- or dark-blue. No reliable heat treatment method for clarifying and eliminating green overtones was found after a couple years of experimentation. As a result one large-scale mining operation in the area went bankrupt, others left, and many individual foreign buyers abandoned the area or started paying a much lower price for sapphires.\(^{37}\)

A factor that further complicates accurate valuation of sapphires, is the risk involved in cutting and polishing these stones. A stone of valuable color, size and clarity may be devalued by an unskillful cutter, or hidden inclusions may be revealed when the stone is polished. More discussion of the value adding processes that a stone must go through on its journey from rough markets to jewelry-ready will be given in the next section.

Unlike the sale of most commodities, where goods and sellers are in a fixed place that mobile buyers visit, sapphires are sold by mobile people who try to find the best price amongst relatively fixed buyers at local Malagasy markets. A stone may be sold directly from the person who dug it to the person who will export it to overseas markets, though more often a stone goes through many more hands and transactions in between. Middlemen (called demarcheurs or businessmen in Madagascar), buy stones from Malagasy diggers and then re-sell them to other middlemen or foreign buyers. They may work independently using their own capital to buy stones, or may have an agreement with a buyer (or several buyers) to find particular kinds of stones for which the buyer has agreed to pay a pre-established price. However, middlemen may not remain loyal to one buyer if they feel that the price being offered is too low. In general, larger stones are traded individually. Small and low-quality stones are often bought individually from diggers by middlemen, and then sold in bulk (eg, by the kilogram) with stones of similar


size and quality to other middlemen or foreign buyers. Women middlemen almost exclusively deal in the trade of bulk low-end stones. Middlemen make profit by paying a lower price than what they hope to sell a stone for, and thus their income depends on luck and bargaining skills as well as their ability to evaluate stones. For example, a middleman in the northern town of Ambondromifehy was interviewed after buying an individual sapphire for 10,000 Ariary. He hoped to re-sell it for 20 or 30,000 Ariary, but the following day reported that he had only sold it for 12,000 due to fissures that the foreign buyer detected upon closer examination. His profit was only 2,000 Ariary (approximately 1 USD), not an anticipated 10 or 20,000 Ariary (approximately 5 or 10 USD).

Middlemen are mainly Malagasy, though some Africans also take on this role. Middlemen are especially predominant in new sapphire rush towns, arriving before foreign buyers. They also are a dominant force in more rural mining areas as foreigners are often reluctant to travel to such places. (These rural middlemen may have agreements with foreign buyers in more central trading towns though, as was observed in Sept Lacs mining towns.) Furthermore, a recent trend in the south of Madagascar is that Sri Lankan buyers have found ways to eliminate working through middlemen, in some cases by taking off-road vehicles and trucks to rural mining sites to buy from diggers directly. Clearly both middlemen and foreign buyers vie for access to diggers’ stones and employ strategies to reduce cost and increase profit. Diggers however rarely have the time or capital to find the ideal buyer. They will often sell quickly as an unsold stone is a financial burden, not an investment. Fulfilling basic necessities like food and shelter usually take precedence over searching or bargaining for the best price.

**The Sapphire Value Chain**

The majority of Madagascar’s rough sapphires are exported to Asia where they will be treated, cut and polished before they are sold to jewelry manufacturers. However, there is an emerging domestic stone processing industry, due in large part to the Mineral Resource Governance Project (PRGM). One focus of the PRGM has been on building the gemstone value chain through training gemologists and lapidary artists at the new Gemology Institute of Madagascar (IGM). In conjunction with a growing supply of labor for identification, marketing, cutting and polishing of stones, local entrepreneurs have engineered a variety of low-cost lapidary tools (such as stone cutting wheels) that are essential for graduates of the IGM who wish to start their own workshops. One new stone-cutting and retail gemstone business in Antananarivo caters to foreign tourists by giving them a detailed presentation on the geology and mining of rubies and tourmalines in Madagascar followed by a full working tour of their cutting and polishing workshop. The industry is not developed enough to support/fulfill large orders on a regular basis and secondary support sectors, such as reliable overseas shipping contractors, are also lacking. However, the IGM has plans to expand its program and to circulate policy recommendations to catalyze the development of a strong, sustainable jewelry economy. Future directions that have been discussed at the IGM include cooperation with donors for rural extension classes, additional teacher trainings, a public cutting workshop, a

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jewelry school, an ornamental and industrial lapidary school, a gem and lapidary training for African and Indian Ocean students in French and English, a cooperative project to establish a gem institute in South Africa, and cooperation and exchanges with Mauritius for gem and jewelry education. Tom Cushman, a World Bank consultant and the current director of the IGM, is also working toward policy recommendations for the establishment of a local small-scale gold refinery, a development-oriented/socially responsible gold brand for Madagascar, and cutting and jewelry factories in the Direct Foreign Investment (DFI) Free Trade Zone (Zone Franche) of Antananarivo. By coupling gemstone education and the growth of a cutting and polishing sector, with gold processing and jewelry manufacture, Mr. Cushman hopes that Madagascar can create and market its own brand of fine jewelry worldwide. This would ensure that all of the value from the process of converting raw precious minerals into finished jewelry remains in Madagascar and enriches the quality of life of its people.
Study Sites

Four study sites were chosen for this study based on four criteria: representation of communities at different chronological stages in the mining “rush” cycle; level of sapphire production and importance in the market; representation of diverse areas of Madagascar; and areas with environmental importance and sensitivity. The four sites in this study are identified with the major town of each area which are: Andranodambo (southeast); Ambondromifehy (north); Ilakaka-Sakaraha (southwest); and Ifanato (southwest).

Figure 2: Map of Madagascar showing the four study sites

(adapted from shaded relief map of Madagascar, 2003 at http://www.lib.utexas.edu/maps/madagascar.html)
Other sites of artisanal sapphire mining in Madagascar include: Fenerive-Est (north-central coast); Manantenina (southeast coast); Bekily and Betroka (southeast); Ambilobe, Milanoa, and within the Anjanaharibe-Sud Special Reserve (north); and Antanifotsy (central highlands).  

The following chart (Table 2) illustrates characteristics of each site that pertain to mining history and environmental significance. It should be noted, however, that the environmental statistics refer to the biodiversity within the original primary habitat of the region. Thus they do not always apply to the areas actually mined if sapphire exploitation occurs outside of protected areas and/or in degraded locales (eg, some mining in the Andranodambo and the Ilakaka-Sakaraha regions). Also, since scientific studies of the four sites vary in depth and breadth, these environmental statistics should only be used as a general guide.

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<table>
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<tr>
<th>Study Site</th>
<th>Initial Sapphire Exploitation</th>
<th>Mining Substrate</th>
<th>Local Environment</th>
<th>Environmental or Species Importance</th>
<th>Neighboring Protected Area</th>
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| Andranodambo    | 1992                          | Hard limestone                    | Primary: dry spiny forest; gallery forests bordering rivers. Secondary: anthropogenic savannah and non-native cactus scrub. | • Southern spiny and gallery forests are the most threatened ecosystem in Madagascar.  
  * Mammals: 130 total recorded, M=12, E=2  
  * Birds: M=74, R=23 | none                          |
| Ambondromifey   | 1996                          | Mixed: hard limestone, natural underground caves, and some rocky soil | Primary: dry deciduous forest; xerophytic plants growing over eroded limestone pinnacle formations (Tsingy); underground caves and rivers. Secondary: anthropogenic savannah | • Mammals: 11 lemurs, 14 bats, 4 carnivores; R=8  
  • Birds: 96 total recorded, R=1, E=8  
  • Reptiles and Amphibians: 60 total recorded, R=12  
  • Plants: 330 spp in 77 families; R=10 | Ankaran National Park          |
| Ilakaka-Sakaraha| 1998                          | Sandy soil                        | Primary: tapia woodland; dry deciduous forest. Secondary: anthropogenic savannah | • Mammals: 8 lemurs, 2 carnivores; R=1  
  • Birds: at least 85, M=37, R=22, 1 locally endemic to Zombitse-Vohibasia N.P.  
  • Reptiles and Amphibians: 48 total recorded; R=2  
  • Plants: several locally endemic | Isalo National Park (to the east) and Zombitse-Vohibasia National Park (to the west) |
| Ifanato         | 2004                          | Hard limestone                    | Primary: dry spiny forest; gallery forest along the Onilahy river; sacred lakes (Sept Lacs). Secondary: non-native cactus scrub or forest | • Southern Spiny and Gallery forests are the most threatened ecosystem in Madagascar.  
  * Mammals: 26 total recorded; M=21, E=4  
  * Birds: 79 total recorded; M=33, E=2  
  * Reptiles: 55 total recorded; M=50, E=4  
  * Amphibians: 6 total recorded; M=5  
  * Plants: 142 total recorded; M=16 genera | Sept Lacs GELOSE (Community-Managed Forest) |

M = number of species endemic to Madagascar found in the study site region  
R = number of species endemic to the region of the study site  
E = number of species classified as endangered or threatened found in the study site region
The village of Andranodambo is found in the southeast of Madagascar. It is a six-hour journey of approximately 210 kilometers from the small coastal city Taolagnaro. In the rainy season it takes longer, since roads become muddy and rutted, and river crossings precarious. The name means literally “Place of the Pig Water,” and refers to local legends that in the past wild boars came here to drink. The Antandroy are the local ethnic group.

Sapphires from this locale were first described in the 1950s by French geologist Paul Hibon who was in the area to mine mica, which still litters the ground of the villages in the area today. Yet it wasn’t until 1992 that sapphires from the region were first brought to be traded in Antananarivo. Thai gem traders soon discovered that these pale milky-blue stones reacted very well to heat treatment and thus were valuable. News spread, and foreign traders rushed to Madagascar to buy more rough sapphires. Thousands of Malagasy immigrants settled in the Andranodambo area, eager to dig sapphires to supply the new demand. Some of these immigrants were inexperienced farmers and herders from the area, while others had been miners in other regions of the country. For example, production of tourmaline and aquamarine, and even emeralds from the Mananjary region, dropped dramatically after the sapphire rush began in Andranodambo. In 1994, the peak of the sapphire rush, about 10,000 miners were estimated to live and work there. Yet the following year less than half remained, and the number of miners has declined steadily since. Reasons for the decline are attributed to movement of miners within the local area to find new deposits (such as Antsiernene, 12 kilometers north of Andranodambo); new sapphire sites in other regions (near the Ankarana National Park in the far north in 1996, and near the Isalo National Park in 1998, the latter of which has more valuable stones); and the difficulty artisanal miners face trying to dig in the hard limestone substrate. Many miners also moved away undoubtedly because they had failed to make an income or profit from working in the Andrandambo mines. Today the population of Andranodambo is approximately 1000 people, of which a fair number are still sporadically involved in digging sapphires.

Sapphires are found in meandering thin veins in the metamorphic limestone substrate, and seem to “start and stop without any real geologic definition. An American mining engineer working in the area describes the occurrences as a ‘pea soup’ mixture of minerals.” This makes mining economically risky, both for small-scale miners and for the few companies who tried to mine sapphires there on a larger scale. The hard substrate also dictates certain tools and mining methods. Sledgehammers and spikes as well as small underground fires are predominantly used to break through the substrate. Deep pits are difficult and time-consuming to dig. One miner reported that his 13-meter pit took a

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40 Most major towns and cities in Madagascar have two names, often used concurrently – a French name from colonial times, and a Malagasy name. For simplicity the Malagasy place names will be used in the main body of this paper. Taolagnaro’s French name is Fort Dauphin.
team of miners one month to dig. Once chunks of limestone are broken and brought to the surface with ropes, they are crushed further with hammers and then sieved for sapphires.

No intensive studies were conducted of how miners worked and organized themselves at the start of the rush. But based on interviews with miners in 2005, it seems that in the early days foreign traders from Thailand, Sri Lanka, Israel, and other countries traveled to Andranodambo to buy rough stones directly from miners. However, 13 years on, the scene is much different. During a visit in December 2005, no foreigners were present in town and villagers reported that they only visit sporadically. More often miners sell to local Malagasy middlemen, and once these middlemen have amassed enough stones they travel to larger towns to re-sell them – Amboasary (100 km to the south), Fort Dauphin (210 km away on the coast), or further.

Small-scale mining continues to the present day, though at a sluggish and fitful pace. Artisanal miners work in loosely organized groups. Miners who were interviewed for this study often do not devote all their working hours to mining, and may also work as mechanics, farmers, or vendors to support themselves. Some had been to mines in the Ilakaka-Sakaraha region at the start of the rush there (1998-1999), but had returned to Andranodambo for economic, safety, or family reasons. For example, some miners complained that the sandy soil of Ilakaka mines made them more prone to collapse, and others said that they felt more comfortable in Andranodambo because it was close to their homeland. Almost all said that they were still waiting for that big find that would allow them to buy zebu or other goods and return to their homeland to settle down. As one woman told me, “As soon as we find [sapphires], then we’ll go home.”

Commercial exploitation of sapphires was attempted by at least three companies at the start of the sapphire rush, and their equipment, buildings, and work sites are still visible though they have long since left. Currently there is one company (SIAM) headed by Ken Aylward of Australia that is going through official channels and permit processes in order to mine in the area.

The environment around Andranodambo is typical of the arid south of Madagascar. As noted in Table 2, the original habitat is dry spiny forest accentuated by wetter gallery forest bordering rivers. The diverse plant and animal life of the region have adapted to thrive with little water and high temperatures. Prime spiny forest of the southeast boasts 12 mammals endemic to Madagascar, and 2 that are classified as threatened by the IUCN. 74 birds found in the arid southeast are endemic to Madagascar, and 23 just to the southeastern region. Yet one difficulty in discussing the natural environment of the Andranodambo site is that no previous botanical or animal surveys were done of the area before mining activities started in 1992. Thus it is unknown how intact the spiny and gallery forests were in the immediate area before miners arrived, and so how biodiverse in terms of plant and animal life it was. Yet by the time an environmental impact study (EIS) was conducted in 2004 the area was highly degraded and any remaining forest was fragmented. Only 14 birds were observed or collected, of which four were endemic to Madagascar. (By contrast, in Andohahela National Park to the southeast within a comparable ecoregion, 130 bird species have been recorded.)

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45 *Mahavaky vao mody*
lemurs were observed, though local inhabitants reported they could be found in forests to the north of the site, near Andranomiboaka.46

II. Ambondromifehy

The village of Ambondromifehy is located about 70 kilometers south of the Provincial capital of Antsiranana.47 The trip takes about an hour or more along RN6, a paved road. The town name means “The place of Twisted or Tied Vondro” referring to long water reeds called vondro that grow in wet areas and ponds nearby. The dominant ethnic group of the region is the Antakarana.

Before the sapphire rush began, Ambondromifehy was a small village of about 400 farmers who grew rice and cash crops. Around 1996, sapphires were discovered, and attempts were made by some companies to mine them on a commercial scale. News soon spread, according to some sources via an announcement on the national radio station, and thousands of Malagasy people immigrated to the site to mine sapphires artisanally. By 1998 at the peak of the rush about 14,000 miners were digging for sapphires in the surrounding region. Since then there has been a slow decline in population as mining becomes more difficult, prices for sapphires of that region have fallen, and newer sapphire sites have been discovered in the south of the country. The current population is estimated at around 3000 people by the current village president, with a majority of them implicated either directly (as diggers, middlemen, or traders) or indirectly (as hotel and restaurant owners, equipment renters, or vendors) in the sapphire trade. Other towns in the nearby vicinity also share similar histories – Mahatsara and Andranonakoho along RN6 to the south contain diggers and traders, while other more rural towns like Maromakotra, Maventibao, Amboangimamy, Andasoa, Besaboba, and Antserasera are mainly digging locales. This paper will use Ambondromifehy as an all-encompassing term to refer to the general area where all of these towns are found.

As noted in Table 2, the mining substrate in the Ambondromifehy region is mainly hard limestone with some rocky soil and underground caves. As a result mining relies heavily on sledgehammers, spikes, long metal bars, and underground fires to weaken and break the rock. Holes vary in length, though recently depths of up to 200 meters have been reported, as miners are able to take advantage of underground cave systems. Often the holes do not descend in a straight path, but meander because of how the rock substrate splits and is removed. Bags of rock and dirt are pulled to the surface by hand or with the aid of a crank-pulley (the latter is rare, since the mine shafts do not often follow a straight line). These bags are carried to nearby rivers, and the contents are sieved in the water to isolate rough sapphires.

Miners in the Ambondromifehy region work in a variety of social arrangements. The most common are as small groups made up of equal-status members or as small groups led by a Malagasy leader who has more responsibility and takes a greater percentage of the group’s profits. Larger towns along the main road are trading centers, where Malagasy and foreign buyers sit in small booths and buy from mobile diggers or

47 Antsiranana’s French name is Diego Suarez.
middlemen. Some middlemen, and a few foreigners, may also travel to sieving sites or rural villages nearby to buy stones.

Commercial exploitation of sapphires was attempted between 1996 and 2000 by companies of various origins – Thai, Israeli, American, French, and Canadian. These companies are hard to track, as they have since changed their names and working operations, but the following names were reported by miners, traders, and government officials: IMA Group/Suzannah, ABFG/BFGA, Victory, Dove, and Adam-Co. Most left the area in the late 1990s, and some went bankrupt. Some varied reasons for this include that water and electricity may have been difficult to access; prices for sapphires of that region declined as heat-treatment efforts were ineffective at increasing gem quality; and a 1998 temporary ban on sapphires from the region aimed to stop illegal mining activities within the nearby Anakarana National Park. In 2005 there were no more large-scale mining operations of sapphires in the Ambondromifey region.

The natural environment of Ambondromifey is extremely biodiverse and important. High rates of national and regional endemism are observed for both plants and animals as is evident in that five plants and 16 animals are found only within the boundaries of the local protected area, Ankarana National Park. The area is most well-known for its tsingy (eroded limestone pinnacles) and cave ecosystems that harbor uniquely-adapted flora and fauna.

Mining in the Ambondromifey area is particularly contentious, since a majority occurs within the Ankarana National Park boundaries (18,225 hectares) or the protective buffer zone (48,301 hectares). Estimates of the area affected by sapphire mining vary from less than 1% (24-27 hectares according to Jaotera, the park director) to 10% (according to Julien Befourouack, the regional technical director of the national park association, ANGAP). Interviews with heads of various environmental organizations working in Madagascar showed a general agreement that sapphire mining in the Ambondromifey area is of the most concern environmentally out of all sapphire sites in the country. Damage to the park is so severe that consideration is being given to de-gazette some areas from protected status. This is not only important environmentally but economically as well, as Ankarana is one of the top ten most visited parks in Madagascar, with about 5750 visitors in 2004.

Miners interviewed for this study knew that mining within park limits was illegal, yet still openly acknowledged that they did so regardless. They often justified their actions by saying that sapphires are better quality and easier to dig for within the reserve. Some miners also claimed that the sapphires were a national Malagasy resource that should be the (open) property of all Malagasy people, located in a protected area or not. Park and government authorities also speculated that miners preferred digging sapphires within the park because the area is forested, and thus shadier and cooler.

Numerous strategies have been employed to expulse miners from the park and prevent further areas from being exploited. A gendarme post was built just outside the eastern park border in 1998, and regular patrols of the park were made by teams of gendarmes with park agents. Yet this strategy was ineffective, mainly because of corruption among the gendarme ranks and the inability of the two groups to work well

together. In 1998 the government issued a ban on the sale of sapphires from the north of Madagascar, though it was repealed in September of that year. Since 1996 there have been irregular attempts to fill in mining pits and/or forcefully remove miners from within the park. For example, during a site visit in October 2005, ANGAP paid 4,000 Ariary (about 2 USD) to miners for a day’s work of filling in mine pits. Yet most people, from park agents to miners, agreed that as soon as the work was done everything would return to normal and the filled pits would soon be re-dug. Among various environmental and mining groups, it is generally believed that sapphire mining continues relatively uninterrupted in the Ankarana National Park because of involvement of key regional and provincial officials who have a vested interest in sapphire mining.

III. Ilakaka-Sakaraha

The town of Ilakaka is about 250 kilometers northeast of the provincial capital city of Toliara. The journey takes 4-6 hours along a RN7, a paved road. The local ethnic group is the Bara, who are predominantly dependent on subsistence agriculture for survival. Most are corn and manioc farmers or zebu herders.

The town of Ilakaka was once a small village of fewer than 100 people. Sapphires were first discovered in the region in 1998, and soon thousands of immigrants arrived to try their luck at mining. Population estimates for Ilakaka vary from 100 to 150,000 people at the peak of the rush in 1999, and have declined to the present day estimates of 20-25,000. This has remained one of the largest sapphire mining and trading regions of the country, since it is easily accessible and new deposits are continually being explored and detected up to 150 kilometers east and 50 kilometers north. Now mining is also conducted in nearby rural towns off RN7 like Isoko, Maromiandra, Andoharano, Manaboay (all bordering the Zombitse-Vohibasia National Park) and Vohimena, Mahasoa, Pisopiso, Antsakavy, Ampasikira, Analasoa, Ambalavy, and Sakalama.

Towns along RN7 are home to trading as well as mining, such as Sakaraha, Andranomaitso, Antsohamadiro, and Manombo. Throughout the paper this will be called the Ilakaka-Sakaraha region, after the two major towns that form its western and eastern borders.

As noted in Table 2, the mining substrate in the Ilakaka-Sakaraha region is sandy soil, distinguishing it from the other three study sites. Mining relies more heavily on shovels and spades to create mining shafts, which drop in straight vertical lines and thus allow greater use of crank-pulleys to help hoist bags of dirt and rock to the surface. The sandy soil is much easier to dig, though collapses easily especially during the rainy season. Bags of dirt and rock are carried to local rivers where they are sieved to find sapphires.

The Ilakaka-Sakaraha region hosts the greatest variety of working methods, from small groups of equal-status members, to groups led by Malagasy or foreign leaders. These leaders in turn use a variety of means to direct the group, from providing

49 Toliara’s French name is Tuléar. Both are pronounced the same.
rudimentary equipment or food, to buying all the sapphires that the group-members find. Sri Lankan buyers have also found ways to eliminate Malagasy midlemen by traveling directly to rural mining sites in all-terrain vehicles. Trading is at its most sophisticated in this region, with many foreigners building large and secure cement buildings and creating name recognition by establishing “chain” trading shops in many towns. Another distinctive feature of sapphire trading in Ilakaka is its prominent female gem traders, who line the main roads in droves in the early morning to buy small and low-quality gems that they will later re-sell in bulk.

The natural environment in the Ilakaka-Sakaraha region is generally quite degraded, and even its intact ecosystems are not as biodiverse as other areas of the country. The region has two national parks: Isalo and Zombitse-Vohibasia. Impacts of sapphire mining on Isalo are surprisingly light, especially since this park’s western border is adjacent to the limits of Ilakaka. Park staff and environmentalists attribute this to being well prepared and vigilant, the lack of hampering by local or regional authorities, and the relatively vast availability of land that can be mined outside park boundaries. Isalo is also the most-visited park in Madagascar, receiving 24,098 visitors in 2004. Local communities are more supportive of protecting the park from sapphire miners because they see economic benefit from continued nature tourism to the area. Still, sapphire mining is one of the greatest pressures on the park, along with brushfires and zebu herding.

Sapphire mining has proved a notable problem for the Zombitse-Vohibasia National Park, which is more species-rich and smaller than Isalo. In late 2005, a Sri Lankan company actually announced on national television that they had paid corrupt park and government officials to be able to mine within the park. Sapphire miners and their pits have been found in five areas within the park or its buffer zone, though park agents have responded with programs to fill in holes and forcefully evict miners. Since these encroachments are more recent than in Ankarana, it remains unclear how successful the park and other groups will be in resolving the problem.

**IV. Ifanato**

The village of Ifanato is situated along the Onilahy River, and is about 45 kilometers southeast of the provincial capital of Toliara. Though considerably closer than the Ilakaka-Sakaraha mining site, travel can take a full day because of difficult conditions. A rough road leads from Toliara to the small village of Mahaleotse; from there, travel either continues on foot or by zebu cart on a rough track, or by dugout canoe up the Onilahy River. This area was once more accessible, but the road that follows the river was severely damaged in cyclones Ernest and Felapi in 2004, which destroyed bridges, reduced the track width, and felled huge trees that still blocked the path during a visit in December 2005. The area is populated by people of the Mahafaly and Masikoro tribes, who are mainly subsistence farmers and zebu herders. The floodplain villages along the Onilahy River cultivate many vegetable crops that cannot be grown in the rest of the arid southwest, as well as sugarcane to be made into alcohol.

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Before becoming the latest sapphire rush town, Ifanato was a small village of about 280 people. Sapphires were first discovered around September 2004. Miners passing through the area recognized the presence of rocks normally associated with sapphire deposits. The presence of sapphires was confirmed by digging some exploratory pits. News spread quickly and thousands of immigrants came to the area, often from the Ilakaka-Sakaraha mines. Some local people also joined in the fever and started digging for sapphires, too. No accurate census has been conducted yet of the numbers of people now living in the area, though the village president of Ifanato estimates that now over 2000 people are living in that one village. Other towns in the area, such as Agnena, Antaly, and Anja, have also become involved in the sapphire rush and have experienced similar influxes of people.

Most signs show that the Ifanato rush has still not reached its peak as of the end of 2005. First, the initial discovery was only made in mid-2004. Second, the numbers of miners are still relatively low. For example, the Andranodambo mining site which is similarly rural and difficult to access had about 10,000 miners at its peak. And lastly, during a visit in December 2005, miners were still prospecting new sites within the region for sapphire deposits, showing that the location and extent of the Ifanato deposits are still unknown. Whatever the case, Ifanato is definitely distinct from other mining sites currently being exploited in Madagascar. Miners are full of excitement and optimism54, as well as a little desperation. Activity runs at a frenzied pace night and day. The area is full of energy and noise: people selling clothes, suitcases, and shoes in makeshift stalls; women selling simple meals of boiled manioc or peeled mangoes; vendors offering beer and rum; stereos blasting Malagasy music and televisions blaring music videos and kung foo movies late into the night. And under it all the constant 'plink plink' of miners chipping away at rock and dirt to get to the sapphires.

Like the Andranodambo and Ambondromifehy sites, the substrate in the Ifanato area is mainly hard limestone. Digging relies heavily on breaking off rock with spikes and sledgehammers once the thin layer of topsoil has been removed with a shovel. Rock fragments are pulled to the surface with ropes by hand (crank-pulleys are rare) and hammered into smaller pieces. Rock pieces and any accompanying dirt or pebbles are carried to the riverbank to be sieved.

Miners work either in small groups of equal-status members, or groups led by Malagasy leaders who provide very basic equipment or provisions. Because this site is new and rural, trading and selling takes place mainly at the sieving sites. No stands or other trading structures had been built at the time of the December 2005 visit. Few foreigners, if any, currently live in or visit Ifanato, and thus do not act as group leaders or trade directly with miners. However, some Malagasy middlemen represent large foreign-owned trading centers based in the Ilakaka-Sakaraha region, which in some cases was even indicated by wearing T-shirts from these centers. Interviews with Sri Lankan traders in Sakaraha and Ilakaka indicated that they preferred to let Malagasy middlemen travel the difficult journey to Ifanato for the time being, especially since the value and extent of the deposits there are still unknown.

The natural environment of the Ifanato region is in some ways typical of the arid southwest, with spiny forest in most areas or gallery forest in wetter areas bordering rivers. Yet the Ifanato region also has major sources of water – the Onilahy River, as well

54 Ambony moraly, or literally “high spirits/morale"
as a series of sacred lakes inland of the river – that have created a unique and important wetland area. Not only have these wetlands proved useful for agriculture, but they support a diversity of plants and animals that are still understudied. The one major scientific survey of the area was conducted between July 2001 and September 2002 by volunteers from the British organization Frontier, with the help of the regional WWF office and the University of Toliara. This survey identified 26 mammal species, 55 reptile species, 6 amphibian species and 79 bird species, many of which were endemic to Madagascar and considered rare or threatened.55

The Ifanato area is the site of a community-managed forest (GELOSE, from *Gestion Locale Securisée*, or Local Secured Management). Before the road was damaged by cyclones, and before the sapphire rush, the area received a steady but small stream of tourists, and plans were underway to boost ecotourism in the region as a mode of sustainable development. The region is also being considered for potential declaration as a national protected-area, which would increase the area under protection and possibly change its use and regulations.56 The status of this protected area remains unclear now with the advent of sapphire rush towns. Artisanal sapphire mining currently takes place within the GELOSE area, and community support for its protection has diminished as local people become involved in the sapphire trade as diggers or vendors profiting from the mining.
Environmental Impacts of Artisanal Sapphire Mining

Small-scale sapphire mining in Madagascar currently creates a number of environmental problems. These problems are both direct (resulting directly from mining activities and artisanal techniques) and indirect (negative impacts associated with the presence of large populations of artisanal miners in an area, often related to filling basic needs of shelter, food, heat and fuel).

Deforestation

Trees, shrubs, and other vegetation is often removed or highly degraded in areas of sapphire mining. The results are loss of rare plant species; destruction of habitat for animals and other species dependent on the plant base; and overall ecosystem loss and fragmentation. Deforestation also contributes to soil erosion, for which Madagascar’s soils are infamous. Many mining activities contribute directly to deforestation:

- Miners cut trees to access the topsoil and substrate where sapphires are found.
- Miners may also dig holes near tree roots where the soil is looser and easier to work. Mine pits, which are generally 1 meter in diameter and vary in length from 3 to 200 meters, dry out the soil and plant root systems, which also lead eventually to plant loss.
- Trees are used to make some mining materials, such as rectangular sieve frames and crank-pulley systems.
- Tree limbs and shrubs are used to cover mine pits for a variety of reasons: to show that an empty hole already has ownership claims; or to show a pause in mining activity; or to warn miners not to descend holes because danger or the use of underground fire.
- Trees are used as fuel for underground fires, which are lit in holes to make hard substrate brittle and thus easier to remove. (Does not apply to the Sakaraha-Ilakaka area.)

Non-mining activities also contribute to deforestation:

- Miners cut down trees, palm leaves, and vines for construction materials.
- Miners use trees to meet fuel needs in variety of ways: burned directly or made into charcoal for personal use or sale to others.
- Cutting of valuable precious wood (Rosewood, Ebony, etc) often increases in sapphire mining areas. Officials of the Ankarana National Park think that their inability to stem the flow of miners into the reserve has allowed the illegal trade in precious woods to flourish, perpetrated both by miners and others.

Sedimentation and Siltation

Waterways in sapphire mining areas also suffer negative impacts. Because sapphire mining does not require the use of chemicals to separate or prepare the rough stones, luckily there is very little chemical pollution that enters the water. (On the contrary, artisanal mining of gold is often associated with arsenic and mercury pollution.) Yet rocks, small pebbles, and dirt do enter rivers and lakes in large amounts, mainly from the sieving process which takes places directly in waterways. This leads to sedimentation of the water on-site and downstream, and clogging of waterways as piles of discarded rock and pebbles build up.
Sedimentation generally disrupts water ecosystems, as it blocks sunlight from reaching plants and photosynthetic organisms and can clog the filters that other organisms use for feeding or respiration. It is also a significant concern for agriculture since it can block traditional irrigation systems. Two artisanal mining sites are particularly sensitive to sedimentation:

- In the Ambondromifely area, rivers used for sieving rough sapphires flow into subterranean caves and rivers in the Ankarana National Park. Sedimentation harms these underground ecosystems and damages mineral formations like stalagmites and stalactites.
- The Onilahy River that is used to sieve for rough sapphires in the Ifanato area empties into the Bay of Saint Augustin where the Tulear barrier reef is found. Sedimentation causes coral die-off. While the barrier reef is already highly degraded and effected by sedimentation from other sources (deforestation for agriculture or making charcoal), sapphire mining in the Ifanato area will no doubt contribute negatively.

_Hunting_

One of the main activities associated with artisanal mining is hunting. Miners enter protected areas (Ankarana, Isalo, and Zombitse-Vohibasia National Parks, and the Sept Lacs GELOSE) to access sapphire deposits, and these areas also often contain high levels of animals not found elsewhere. Hunting is mainly used to supplement the meager diets of miners, particularly if miners are working far from towns and villages with food readily available. Lemurs, especially nocturnal species, are the main concern, though birds, wild boars, rodents, fish and small invertebrates are also eaten. Tenrecs are hunted, but not as effected by hunting due to their high reproduction rates.\(^57\) Hunting is a major concern for most sapphire mining sites except some parts of the Ilakaka-Sakaraha region (the Isalo National Park, and degraded unprotected areas) because there were few animals to hunt even before sapphire miners came to the area.

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Social Impacts of Artisanal Sapphire Mining

The social impacts of small-scale sapphire mining in Madagascar are mixed. Positive impacts, like income generation for miners and people who provide services or goods to them, are difficult to measure but still extremely important. For miners who have the foresight to invest their earnings wisely, the economic windfall created from the find of a valuable sapphire provides many opportunities that normally are out of reach for rural Malagasy people. Miners have used their earnings to fund education, to buy land and zebu, or start up other businesses like small stores. They have also moved up in the mining business, becoming group leaders, equipment leasers, middlemen, or traders. Non-miners also profit from the sapphire trade by selling goods and services in trading and digging towns, like the hotel and bar-owner Jean-Claude in the town of Ifanato:

The five rooms of my hotel are always occupied. Every night I earn at least 20,000 Ariary from showing movies and music videos. When someone finds a beautiful [valuable] stone, I sell up to 4 cases of beer at 2,000 Ariary per bottle, versus just one case other days.\(^{58}\)

This hotel owner rented small rooms in mud huts without running water before the sapphire rush for 3,000 Ariary; now the price is double. Others in Ifanato have profited from the presence of miners with ready cash. One farmer claimed “Before I made at best 40,000 Ariary from my harvest. Now I am a millionaire!”\(^{59}\) The possibility of making money from selling goods to miners is so high that it has created a class of traveling vendors who follow rush towns. Besides selling goods, Malagasy people earn income by translating for foreign traders or working as security personnel and guards.

Yet besides the numerous opportunities to earn income, sapphire mining has many negative social impacts. Some of these impacts affect all people living in the rush area, regardless of their involvement in the sapphire trade. The main concern in many rush towns is poor public health from lack of proper sanitation and hygiene. Without running water or a constant electricity supply, people defecate at best in latrines, or worst in open spaces or near rivers. No garbage collection or sewage treatment facilities exist in sapphire mining towns. Though typical of most rural areas of Madagascar, the situation is exacerbated by huge influxes of immigrants in sapphire rush towns. This is illustrated by the annual cholera outbreaks in Ilakaka before Catholic Relief Services’ health campaign there.\(^{60}\) People from all four sites complained of common ailments like diarrhea, and spoke of the difficulty of finding clean water to drink, bathe, or cook with.

Another general negative impact on sapphire mining areas is its disruption of the local economy. Before the discovery of sapphires, most villages were made up of subsistence farmers and herders, as well as some people peripherally involved in the ecotourism industry. Once sapphires are discovered, many local people join the ranks of diggers and leave their former work behind. As a result, more food must be imported,
which coupled with the sapphire fever creates inflated food prices that are out of reach for most Malagasy people. Sapphire mining may also disrupt local agriculture when holes are dug in fertile agricultural land. And as a majority of sapphire miners and traders are men, often who immigrate to rush towns without their family, their presence has led to a demand for prostitutes. Women and girls from local villages and towns further away meet this demand, which also carries with it health concerns of sexually transmitted infections (STIs) and HIV/AIDS. Though a taboo subject among miners, the presence of these diseases was confirmed by interviews with health workers in the regions, and is now the focus of a health campaign by Catholic Relief Services in Ilakaka.

Fires are an additional safety problem in sapphire rush towns, due to the high numbers of houses built closely together out of flammable materials. Without fire protection services fires spread quickly; and because community members are unrelated people without close ties or obligations, people are more likely to save their possessions rather than sacrifice them so that the fire will not spread. This was observed in a fire that burnt the southern third of the village of Ambondromifehy during a visit in October 2005, and confirmed in later interviews. Fires may also spread more in rush towns because so many community members are far away, working in digging or sieving sites. A second fire in the same region a week later was rumored to have started when a man left food to cook while he was away.

Crime, from violent murder to petty theft, is a major concern in sapphire mining towns. It is committed both by miners (in some cases out of desperation when mining work doesn’t provide sufficient income) and non-miners who take advantage of the “Wild West” atmosphere in rush towns and the lack of police and government officials. Many individuals in all four mining sites were observed carrying weapons, such as machetes, shotguns, pistols, and military-issued rifles. People who commit crimes are called dahôlo or dahalo generally, though the term is often used in cases of zebu rustling.

Another common concern in sapphire mining towns is negative cultural impacts. Most villages in Madagascar have certain fady, or taboos, which must be followed to please ancestors, who in turn assure the well-being of descendants. Fady are often rules for where certain activities can or cannot take place (such as areas where one should not defecate), as well as dietary rules that exclude certain plants or animals from being consumed or grown. Most villages also have sacred areas where tombs, the houses of the ancestors, are located. In one extreme example, the caves in Ankarana National Park are sacred to the entire Antakarana tribe, because of their historical role and presence of ancestral bones. Immigrants or visitors to villages are expected to follow the local fady out of respect, but often sapphire miners do not. This leads to tension between the original inhabitants and new immigrants, though in some cases locals will also break fady to mine sapphires. One local resident-turned-miner remarked in Ambondromifehy, “nobody has a taboo against money,” even though he was working in an area clearly against local fady.

**Occupational and Health Hazards**

Aside from negative impacts that affect all people living in sapphire mining towns, miners face additional problems that result directly from their work. Artisanal

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sapphire mining is a dangerous and risky job. Most miners are aware of these risks, and sometimes even joke about them. For example, during a visit to mines within Ankarana National Park diggers laughingly indicated a pit named *Veloma Baba*, or “Goodbye Father,” because of its precarious depth. Though miners accept dangerous conditions out of desperation or foolhardiness, they are still cause for concern.

Hard limestone substrate is predominant in Andranodambo, Ambondromifey, and Ifanato mining sites. It presents a unique set of dangers to miners. Chipping away at the hard rock with spikes and sledgehammers can jar wrist and arm joints, and rock shards can spin off and penetrate skin or eyes. Rocks can also fall from any height in unstable mine shafts, injuring diggers below or blocking their exit. Underground fires are commonly used to make the limestone brittle and easier to remove, but pose many health hazards. Miners may suffer from smoke inhalation by digging in pits where fires have not been completely extinguished, or in nearby pits that are connected by underground rock fissures or artificial tunnels.

Sandy or loose soil is predominant in Ilakaka-Sakaraha mining sites, and carries with it its own set of dangers to diggers. This substrate is more prone to collapse, particularly during the rainy season. This is a major concern in horizontal mine shafts, which are dug to follow the sapphire vein. Miners may use some supports, such as wooden poles or an old oil drum, but these do little to improve safety. Soil collapse can injure miners, or kill them by trapping them underground.

Deep mine pits are most prevalent in the Ambondromifey region because of underground cave systems. Since miners use only rudimentary ladders, if anything, to descend the 20 to 200 meters, injury from falling is a concern. Deep mine pits also lack sufficient oxygen, and without proper air pumps miners can suffer from dizziness to asphyxiation. This safety hazard is augmented when miners use candles to light underground mine shafts.

Underground water can also pose safety hazards to miners. This may be in holes that are deep enough to reach the water table (e.g. some Ambondromifey mines), or in holes that are dug close to water sources (e.g. mines in Ifanato dug close to the Onilahy River bank or in the floodplain). Water is often removed with buckets, as well as mechanized water pumps. If these methods are not carried out consistently, any miner underground is in danger of drowning.

Occupation hazards of artisanal miners are often intensified by their lifestyle. Many miners have a diet lacking important nutrients or sufficient calories. They also have little access to healthcare, since clinics and doctors rarely are located in rush towns and miners lack the funds to use their services. Mining towns also have poor sanitation and hygiene, which makes miners prone to diarrhea and other easily transmitted diseases. All these factors weaken miners so that they are more accident-prone, and prevent speedy recovery once they have been injured.
Governmental Regulation of Mining Activities

All mining in Madagascar falls under the general jurisdiction of Ministry of Energy and Mines. Under this ministry’s General Management there are numerous departments and programs including: Mining and Geology Office, Le Bureau Cadastre (Mining License Office), Six Provincial Mining offices located in Antananarivo, Antsiranana, Fianarantsoa, Mahajanga, Toamasina, and Toliara, and “Sector Projects” such as Mineral Resource Governance Project (PGRM).

Figure 3: Organization of the Ministry of Energy and Mines

* refer to Diagram 2 for further details of organization within the Department of Mines and Geology
Figure 4: Organization of the Mines and Geology Department

(adapted from a DMG pamphlet, 2004)
Laws that Affect Gemstone Mining

Madagascar’s Code Minier, or Mining Code, was established in 1896 and rewritten and amended thereafter until the most recent publication in 2000 (Loi° 99-022 et Décret n° 2000-170). The document is meant to address mining issues and needs for all scales (artisanal to industrial) and resources (gemstones to petroleum and industrial minerals).

Madagascar’s total area is divided into squares (carrés) of land that are 2.5 square-kilometers. Each square potentially holds with it mining rights, which can be accessed by purchasing a mining permit. Some squares have no mining rights, due to previous established uses like human habitation or conservation. There are currently four types of mining permits in Madagascar:

1. **Autorisation Excluse de Réservation de Périmètre (AERP)** – Exclusive Authorization for Reservation of Area
   - Validity: 3 months, non-renewable
   - Permitted Activities: Prospection and exploration; making contacts with local authorities and landowners.
   - NO mining or commercial activity allowed

2. **Permis de Recherche (PR)** – Research Permit
   - Validity: 10 years, 1-time renewal
   - Permitted Activities: limited exclusively to research and exploration

3. **Permis Réservé aux Petits Exploitants Nationaux (PRE)** – Small-Scale Mining Permit Reserved for Malagasy Citizens
   - Validity: 8 years; renewable
   - Permitted Activities: exploration and non-mechanized mining, limited to artisanal equipment (shovels, metal bars, wheelbarrows, etc)

4. **Permis d’Exploitation (PE)** – Large-Scale Mining Permit
   - Validity: 40 years; renewable
   - Permitted Activities: Mechanized mining


The following are sections of the mining code that pertain to artisanal sapphire mining with the PRE status:

**Code Minier – Selections from the 2000 Malagasy Mining Code**

**General:**
- “PRE” Permits are reserved for the research and exploitation of a mining site by small-scale miners. *L, Title I, Chapter IV, Article 39*
- If a PRE permit holder ceases to use “artisanal techniques” to mine, he/she must transform his/her permit to a “standard” permit instead of “small-scale” permit. *L, Title I, Chapter IV, Article 39*
- If a permit holder does not conform to their obligations outline in the Code Minier his/her operation will be suspended and in cases of infraction he/she will be taken to court. *L, Title 5, Chapter 1, Article 97*
• Any person involved in the following infringements are subject to 1-5 years imprisonment and 1,000,000-25,000,000 FMG (100-2,500 USD):
  - to buy, sell, or transport mineral substances without legal right (papers)
  - to use any type of false permit to buy, sell, transport mineral substances.
  - failure to claim any fossil discoveries inside the exploited terrain.
    \[\text{L, Title 9, Chapter I, Article 169}\]
• Anybody who wants to collect mined products must submit a written declaration to the Ministry of Mines Provincial Direction. The person must be based, or have their headquarters, in Madagascar (siège sociale). \[\text{R, Title 12, Chapter IV, Article 323}\]
• All exported gemstones must pass by the Mining Laboratory for quality analysis in addition to having the nature of the stones, tonnage, value of collected stones, their origin, characteristics and any other useful information. \[\text{R, Title 12, Chapter IV, Article 325-326}\]

**Environment:**

• PRE miners must conform to the mining sector’s environmental laws and submit an Environmental Commitment Plan (Programme d’Engagement Environnemental or PREE) to the Ministry of Mines office for approval before starting research or exploitation. \[\text{L, Title 1, Chapter IV, Article 39; R, Title 6, Chapter V, Article 110; R, Title 10, Chapter I, Article 192}\]
• PRE permit holders have the rights to use wood and water or other resources on their property for their work needs. \[\text{L, Title 1, Chapter IV, Article 39; R Title 11, Chapter I, Article 250}\]
• Any miner must minimize and repair any damage, including environmental degradation, done by their activities. \[\text{Title 5, Chapter II, Article 99}\]
• Titleholders are responsible for paying for the environmental impact study or environmental compatibility plan. \[\text{L, Title 5, Chapter II, Article 101}\]
• Titleholders must have an “in situ” assessment of his/her rehabilitation project before disengaging from his/her obligation of environmental rehabilitation. \[\text{L, Title 5, Chapter II, Article 103}\]
• All prospecting, mining research and exploitation is forbidden in the inside of parks, reserves, classified zones, forest stations, or any protected areas. The “Decentralized Territories Collective” authorities follow up any infraction. Punishment is 5-10 years of forced labor, and 5,000,000-50,000,000 FMG (500-5,000 USD). All substances taken from the protected area will be confiscated. \[\text{L, Title 5, Chapter II, Article 104; L, Title 9, Chapter I, Article 165; R, Title 10, Chapter II, Article 198}\]
• All prospecting, mining research and exploitation is forbidden within 80 meters of properties closed by walls, equal devices, or with an understood marked limits such as villages, group habitations, wells, sacred sites, archeological sites, classified cultural or tourist sites, and art masterpieces… \[\text{L, Title 5, Chapter III, Article 105; R, Title 10, Chapter II, Article 198}\]
• Additional protected zones may be added with the jurisdiction of the Ministry of Mines for cases such as water sources, communication lines, places of public use. In these cases, a title holder has rights to compensation equal to the value of the rights to the land if he/she can prove there was prejudice against him/her in the establishment of this new protected zone. \[\text{L, Title 5, Chapter III, Article 106}\]
Where text lacks formalizing a supplementary protected area or sensitive zone, laws protecting the environment may be extended to these zones. *L, Title 5, Chapter III, Article 107*

**Security, Hygiene, and Work Accidents:**

- Titleholders must exploit the resources as efficiently as possible. *L, Title 5, Chapter IV, Article 108*
- The titleholder must respect all the rules of hygiene, cleanliness, public health, work security, and the rights of individual or collective property. *L, Title 5, Chapter IV, Article 109*
- Whether beginning or ending all mining, underground work, and geological research must be reported to the Ministry of Mines. *L, Title 5, Chapter IV, Article 110*
- Titleholders are responsible for any accident in the perimeters of their titled area and are obliged to contact the Ministry of Mines, of Ministry of Work and Public Health, and the local military unit. *L, Title 5, Chapter IV, Article 111*
- The Ministry of Mines, Ministry of Work, local Public Security authorities, mining operators, and local authorities are in charge of establishing worker’s security norms. The Ministry of Mines and Ministry of Work are in charge of the subsequent inspection and control measures for the safety of any mining activity including: mine construction, transportation of equipment, inspection of materials, evaluation of the oxygen and temperature in the mines, mine ventilation, correct waterway management and drainage, waste treatment, land slide prevention, marking with signs the presence of obstacles or danger, and controlling access to a mining site. *R, Title 10, Chapter IV, Article 206-208*
- The population living near or around a mining area have the right to solicit help from the Ministry of Mines to protect themselves (as a community) against any mining activities that present a danger (i.e. the adulteration of a water source, disruption of a communication line etc.). *R, Title 10, Chapter II, Article 201*
- It is the responsibility of the Ministry of Mines and the Ministry of Work in conjunction with mining sector professionals and local authorities to establish the mining sector’s health and cleanliness norms. The Ministry of Mines and Ministry of Work are in charge of the inspection and control of these norms. *R, Title 10, Chapter IV, Article 211*
- Title holders and miners must conform to these health measures concerning:
  - preventative individual and family healthcare
  - first aid care and evacuation in cases of health emergency
  - provision of potable water for workers and their families
  
  *R, Title 10, Chapter IV, Article 213*

The cost of a PRE is 33,700 Ariary per 2.5 km² square (2005; approximately 16 USD). This cost then doubles in the second year, triples in the third year, and so on. According to several permit holders interviewed for this study, additional administrative costs may be added, the amount of which seems to vary at the whim of the government official who processes the permits.
According to the Mining Deeds office in the Malagasy Ministry of Energy and Mines, 899 people were licensed as small-scale miners (petits exploitants) in April 2005. These 899 people hold a total of 1,668 permits (PRE) to exploit a total of 8,760 square-kilometers of land in 3,504 squares.

Figure 4: “Small-scale” mining licenses (PRE) issued in Madagascar, 2001-2005


It is important to note, however, that the number of PRE issued is not an accurate predictor of the number of actual artisanal miners working in Madagascar. Most artisanal miners do not have any permits, PRE or otherwise, and often PRE permit-holders are not involved in mining activities. Government officials regard the former as a problem resulting from the high expense of mining permits. In an attempt to formalize the artisanal mining sector the Ministry of Energy and Mines has put forth a proposal to the Parliamentary Assembly to decrease the size of squares and the expense of Research (PR) and Small-Scale Mining (PRE) permits. This might encourage more artisanal miners to obtain permits, thus becoming legal miners in the formal sector. Squares would decrease to 0.625 km², and costs would be reduced to 5,000 Ariary (2.5 USD) for a PRE. It is important to note however that reduction in cost and size for PRE will do little formalize small-scale miners who exploit sapphires in protected areas, as no permits are available for squares with conservation protection status.

The government is also planning other changes to its mining code to formalize the gemstone mining sector and decrease smuggling and corruption. Such changes are especially desirable to the government, since over $50 million worth of gemstones annually exported mainly leave through illegal channels and add nothing to the national budget. The focus of these changes is simplifying procedures for exporting stones, which will in turn allow easier collection of taxes to boost government coffers. As Tom Cushman, consultant to the Mineral Resource Governance Project (PGRM), explains, no one wants to export illegally, but “people smuggle out of convenience.” In other words,

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with a simplified and clear system for gem traders to buy, declare, pay taxes, collect documents, and finally export their stones, smuggling will be greatly reduced.
**Programs to Improve Mining in Madagascar**

Despite the attention sapphire mining has received in the Malagasy and foreign press, little work is being done that directly affects small-scale sapphire miners in Madagascar. The following programs are the exception, and do some work in sapphire rush areas or the gemstone mining sector more generally:

**Mineral Resource Governance Project (PGRM)**
*(Programme de Gouvernance des Ressources Minérales)*

The PGRM is an initiative funded by the World Bank for a total of 39.6 million USD. It began in September 2003, and will continue until December 2008. Its mission is “To assist the Malagasy government in implementing strategy to accelerate the sustainable development of the mining sector and contribute to reducing poverty in Madagascar by improving management and transparency of mineral resources, particularly pertaining to traditional and small-scale mining activities.”

**Objectives:**
1. Improving transparency and governance in the mining sector
2. Institutional reform for the decentralized management of mineral resources
3. Promotion of private investments and added value
4. Rapid and sustainable growth of the mining sector and increase of economic impacts for the population in the context of the fight against poverty
5. Improving natural resources management to prevent the degradation of the environment

**Major Activities:**
- Input into legislative reform and changes to the *Code Minier*.
- Creation of Mining Administration Offices (BAM).
- Institutional reinforcement of decentralization of the mining administration.
- Creating a detailed and updated database of Madagascar’s mineral resources by mapping and on-the-ground analysis.
- Grants for micro-projects through the Tan-Tsoroka project. Projects may encourage formalization of small-scale mining, provide technical assistance, educate artisanal miners, or introduce activities that reduce environmental impacts. Individuals are not eligible though groups of varying nature are, from miner cooperatives, NGOs, to local governments.
- Creation of the Gemology Institute of Madagascar (IGM, or *Institute de Gemologie de Madagascar*) to teach gemology and lapidary arts. Various courses are offered: an 8-month intensive courses to receive an internationally-recognized FGA certificate, which takes place in Antananarivo; 2-week Practical Gemology courses, also in Antananarivo; and regional “Gemology for Everyone – *Gemologie Pour Tous*” 1-day courses that are tailored to regional needs and interests. Lapidary, or stone-shaping, courses are also offered as a

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way to increase value-added production in Madagascar and make professionally shaped stones available for export.\textsuperscript{66}

- Environmental dispute resolution through participation in multi-sector planning group. This group evaluates areas slated for protection under the Durban Vision permit with previous mining permit claims, often with site visits and mediated meetings with stake-holders.

The PGRM has recently shifted its focus from small- to large-scale mines, and thus its future involvement in artisanal sapphire mining will be reduced.

\textit{Business and Market Expansion program (BAMEX)}

The second main program involved in small-scale mining in Madagascar is BAMEX, funded by USAID for $250,000 and implemented by Chemonics International. The overall program aims to develop Madagascar’s private sector in a market-led but sustainable and environmentally sensitive manner. Its goals are to “generate sales, promote trade, attract investment, create employment, and help the government … to improve the business environment in Madagascar.”\textsuperscript{67} BAMEX focuses on business growth in four main sectors of the Malagasy economy: agricultural products (spices, essential oils, fruits and vegetables, cash crops, and other items like silk and honey), ecotourism, handicrafts, and precious stones.

The BAMEX precious stones program began in 2004, and will end in September 2006 unless it is renewed. Its funds come from a program for improving good governance and reducing corruption, and are relatively limited. BAMEX does not intervene at the production level, but instead focuses its efforts on increasing value-added activities in later stages of the sapphire trade.

\textbf{Activities:}

- Input into legislative reform and changes to the \textit{Code Minier}.
- Institutional reinforcement of decentralization of the mining administration.
- Installation of a Gemstone Market, which is held regularly at the Gare Soarano in downtown Antananarivo. Gem dealers rent tables to sell their wares, and representatives from the IGM are on hand to verify the authenticity of stones.
- Establishment of regional “Business Centers” to support fledgling businesses and investors.
- Training and micro-credit financing to increase local value-added products and activities, such as lapidary arts and stone processing.
- Participatory Rural Appraisal (PRA) to study the gemstone mining sector of the Ilakaka-Sakaraha region, conducted in mid 2005. Results from this study may lead to further projects in this region.

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\textsuperscript{67} BAMEX: le Rendez-Vous des Affaires. Undated pamphlet.
**Ameliorating Impact: Additional Suggestions**

Much work remains to be done to improve the gemstone mining sector in Madagascar. In particular, programs that directly impact *artisanal* miners – either by improving their work conditions or ameliorating their negative impact on the environment – are desperately needed. The following suggestions are directed at three main stakeholder groups: the Malagasy government, environmental organizations, and small-scale miners.

**Government**

The Malagasy government as a stakeholder in the sapphire mining trade has two main interests. First, as all governments, it concerns itself with providing basic services and safety to all its citizens. Regarding mining, it must ensure that the negative results of mining, from environmental degradation to theft and crime, are minimized, and that its laws are enforced and implemented. Second, it wants to increase the monetary benefits received from the sale of mining permits and taxes on stone sales and exportation.

As a whole the government has not fully realized its own interests. According to some in the mining trade, the government has been reluctant to enforce its own laws for fear of looking like they are targeting some of the more impoverished members of its citizenry. Further, its mining laws were developed to apply to many kinds of mining and often to not apply to the vagaries of artisanal sapphire mining. Ironically, as the government fails to control and formalize sapphire mining, it not only decreases the security and welfare of its citizens, but also reduces its own budget and capacity as taxes and permit fees are minimal in an unregulated rush environment. Following are several suggestions for the Malagasy government.

First, the government should enforce existing laws, especially regarding the ban on mining activities within protected areas. While this may seem obvious, it bears repeating. Currently it is illegal to mine within all national parks and reserves managed by ANGAP, the national parks association. Mining regulations for potential new protected areas to be created under the Durban Vision, as well as community managed land under the GELOSE program, are not clear and need to be established soon. Once clear use rules are established for all protected areas, these must be enforced for Malagasy and foreigner alike.

Mining in the Ambondromifehy region illustrates why it is critical to differentiate activities between areas where all mining is illegal because of conservation conflicts, and areas where mining could become legal with the proper permits. The majority of sapphires from this region still come from within the Ankarana National Park. Various efforts have been implemented in the area to try to help miners improve safety conditions and income. The regional mining office has encouraged miners to form associations, and plans are in place to create a single buying station to stabilize prices and increase income to diggers. Yet efforts to remove miners from within the park have failed because of weak implementation or lack of follow-through. All other efforts are for naught if this single issue is not addressed first. What use are trained digging cooperatives if they still illegally enter and mine within the Ankarana National Park?

Second, the government should change mining regulations to truly encourage participation and formalization of artisanal miners. An interview with Pamphile
Rakotoarimanana, DMG director, suggests that the government is already considering ways to directly address this issue. The main thrust of these new efforts is to formalize artisanal mining by reducing cost and size for artisanal mining permits (PRE). For now it remains to be seen if these changes will be effective. Yet there is reason to doubt that this will be a good solution for the Malagasy people who dig and sieve sapphires. Site visits to various sapphire mining areas showed that most of these miners worked on areas between 1 and 9 square-meters, which are significantly less than the 625 square-meters of a PRE. Permits are for at least one year, an investment or commitment of time that may not appeal to transient miners. One basic suggestion would be to further reduce the size, cost, and time-commitment of PRE permits which may in turn attract more artisanal miners.

A more dramatic alternative would be for the government to set aside squares of land in sapphire mining regions for exclusive use by artisanal diggers. Miners would have to pay a small short-time fee to access these squares – small enough to encourage participation. The fee would allow access to the plot for a short time period – instead of a one year commitment, perhaps for only one month of less. It might also be beneficial to not distinguish exact digging locations for each miner, since miners sometimes change digging locations or work at multiple locations at once. The money collected from artisanal miners could then be used to fund rehabilitation of the site. This might also be a means to actively promote mining in certain areas (such as squares outside of protected areas), which might “lure” miners to areas of less environmental importance or sensitivity.

**Environmental Organizations**

The main concern of environmental organizations is to protect the Malagasy environment by promoting conservation and beneficial activities while discouraging harmful or destructive behaviors. Most environmental organizations see mining and environmental protection fundamentally at odds. Indeed, there is a feeling within the mining community that they are unwilling to compromise and allow for any mining activity. Yet there is room for some cooperation with miners and mining proponents without completely sacrificing environmental concerns.

One model that has worked for large-scale mining of industrial minerals has been the establishment of a Multi-Sector Planning Group. This group has representatives from both environmental interest groups (mainly staff of WWF, and government employees of environmental ministries) and mining interest groups (such as the PGRM). Its main focus is to quickly resolve conflicts over areas of land that conservationists and miners have both laid claims to. The planning group will typically use field visits to establish up-to-date assessments of an area’s ecological state and then work on a mining permit that reduces activity or impact in sensitive or intact areas. While this working group model has been used mainly for large-scale mines of industrial minerals, it could be applied to new sapphire rush towns. When environmental organizations hear of a new artisanal mining site, they could send representatives there to complete a quick survey of the area’s environmental condition. This survey should be done in conjunction with mining representatives, who can tell where areas of high sapphire deposits are likely to be found and thus compared to sites of high environmental value. Environmental efforts could then
be concentrated preventing mining in areas of true ecological worth with existing ecosystems, while allowing mining in areas that are already badly degraded.

Another avenue for environmental organizations to pursue is creating a certification program for sapphires mined in an environmentally-sound manner. Consumers, if educated about the potential negative impacts of sapphire mining, may be willing to pay a premium for stones that come from equitable and “green” sources. Criteria of what constitutes “environmentally-sound sapphires” would need to be created, as well as methods of certifying and enforcing these criteria. Lessons could be drawn from the certification of conflict-free diamonds, as well as the emerging market of “green” gold.

Miners

As a stakeholder group, miners are often interested maximizing their earnings from their involvement in the sapphire trade at whatever personal, societal, or environmental cost. Currently most miners focus on short-term gains, often ignoring longer-term needs of themselves and others. For example, a miner will earn more in the short-term by cutting costs and buying poor-quality safety equipment. This is not cost-efficient in the long-term, as injuries resulting from these choices reduce productivity and life expectancy. Yet convincing miners of the need to think long-term is a daunting task, one which many development agencies struggle with in all sectors of the economy.

Miner cooperatives may be one avenue for miners to increase their earnings while improving their safety. (In French these are called groupements, and in Malagasy fikambanana.) Cooperatives offer numerous advantages. First, by pooling resources of its members, a cooperative is more able to buy permit fees, efficient tools, or safety equipment. Cooperatives also may have stronger political and bargaining power than individual miners, which puts them at an advantage when interacting with foreign buyers or the government. Cooperatives are also easier for the government to regulate, since they can streamline their work to educate a small number of groups versus large numbers of individual miners.

Miners already form loose informal associations on their own in their working groups, but encouraging them to create more official and registered organizations might be difficult. Care must be taken to encourage cooperatives to form organically and in a way that makes sense to miners, without imposing irrelevant structures or rules.

One major concern is that associations take time to form, which doesn’t match the fast pace of sapphire rushes. For example, during a visit to the village of Ambondromiféhy in December 2005, a collector’s association had only recently formed, 10 years after the start of the sapphire rush in that area. Even then it was difficult to find people beyond the association president who claimed membership or knew about its existence.

A second concern is that miners see the government push to form cooperatives as self-interested and purely money-driven. This concern is partly based on truth since cooperatives currently must pay registration fees to the government and taxation, monitoring and enforcement of fees associated with environmental issues is made easier by the formation of cooperatives. The leaders of a 300-member gem-miners’ cooperative were interviewed in November 2006 and voiced their concerns that the benefits they accrued by registering have not yet proved worthwhile. Although they were invited to
participate in a bi-monthly gem market for tourists in Antananarivo that is organized under the auspices of PGRM, they felt that participation may actually be decreasing their economic opportunity: they have to pay a small booth set-up fee, and their members lose valuable working time at the mines when they are traveling to and working at the market, but have no guarantee that they will actually sell any gems to the tourists. Educating miners on the positive benefits of forming cooperatives may decrease their suspicions, as well as ensuring that tax revenue collected in turn goes to fund activities that directly benefit artisanal mining communities and that programs designed for their benefit fit well with their concerns.
**Conclusion**

Madagascar is now a major source of sapphires for the international gemstone market, and production still relies heavily on miners who use artisanal methods. These methods create many health and environment problems, yet sapphire mining remains an important source of income for miners and neighboring communities. Solutions must be explored to ameliorate negative environmental and social impacts while recognizing the distinct nature of artisanal sapphire mining in Madagascar. The fast pace rush towns develop once sapphire deposits are discovered and a class of miners who are transient, poorly educated, financially impoverished, and willing to risk everything in the hope of finding one big blue stone are the driving labor behind the nation’s stone supply. A few innovative policy-entrepreneurs are attempting to build physical, regulatory, and education infrastructure that may begin to unlock a new promise of sustainable mineral development for Madagascar. Nonetheless, eco-tourism and conservation are widely framed as goals that are at odds with sapphire mining in Madagascar. A whole systems approach to bolstering the jewelry economy cannot leave out the lemurs, coral reefs and other gems of nature that make Madagascar so unique.
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