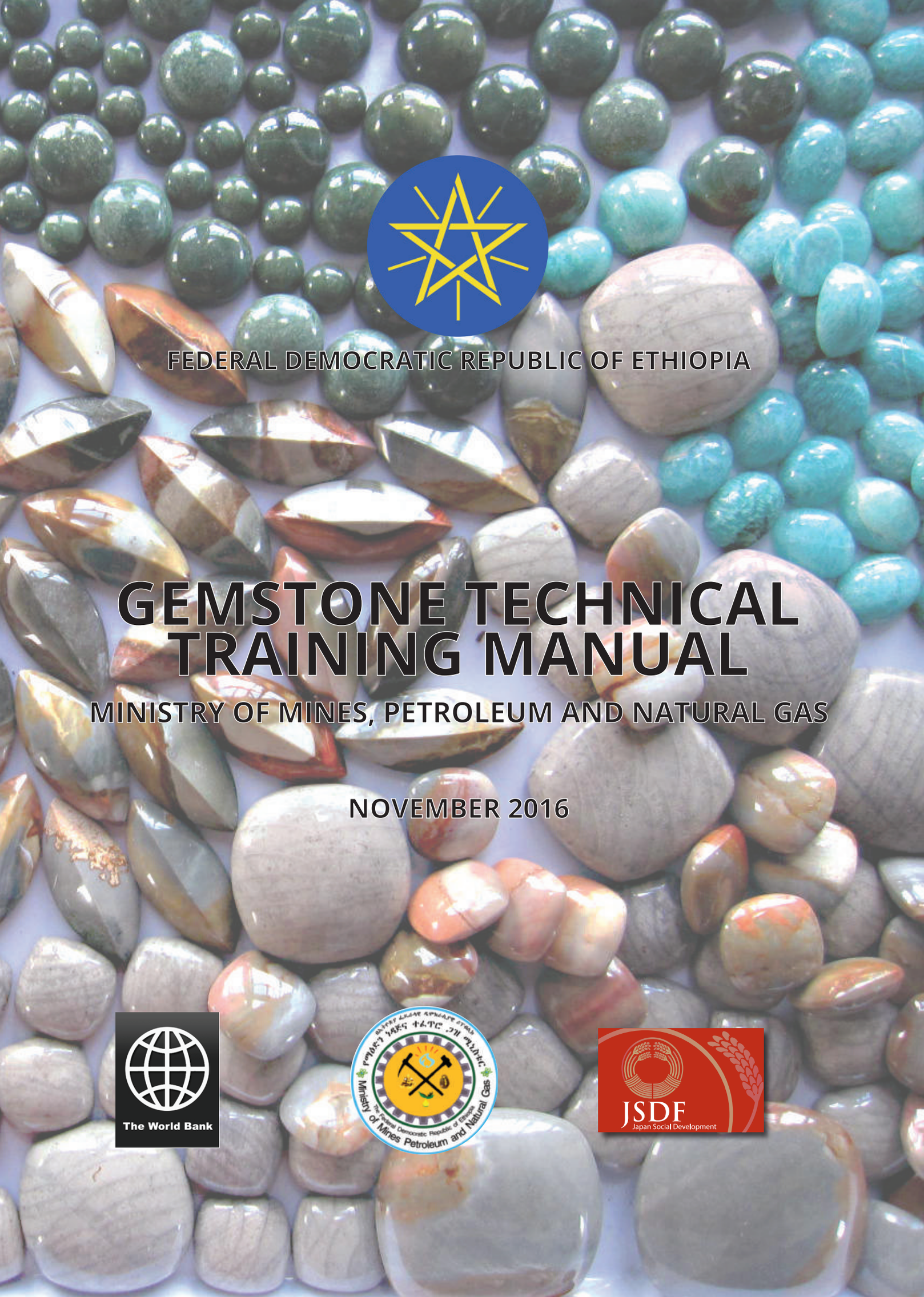


FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

GEMSTONE TECHNICAL TRAINING MANUAL

MINISTRY OF MINES, PETROLEUM AND NATURAL GAS

NOVEMBER 2016

The World Bank

Ministry of Mines, Petroleum and Natural Gas

JSDF
Japan Social Development

FOREWORD

Estelle Levin Limited (ELL) and Sudca Development Consultants (Sudca) developed this training manual for the JSDF Project and the Government of Ethiopia's Ministry of Mines, Petroleum, and Natural Gas (MOMPNG). It was financed by the World Bank administered JSDF grant for support to improve the economic, social, and environmental sustainability of artisanal miners, with a particular emphasis on empowerment of women.

The JSDF Project is coordinated by the Women and Youth Directorate of the MoMPNG.

ELL Gemstone Expert Herizo Harimalala Tsiverisoa, authored the report, with contributions from: ELL Training Expert, Dr. Jennifer Hinton ELL Team Lead, Dr. John Tychsen; Sudca Gender Expert, Yimegnushal Takele; Sudca Environmental Expert, Andualem Taye; and ELL Project Manager, Adam Rolfe.

The publication of this manual is the product of an extensive participatory research and practical training process, which ran from April to November 2016. An initial needs assessment visit (April – May) focussed on the physical infrastructure of lapridary centres in Kambolcha and on lapidary skills of women in Delanta and Wadlain in the Amhara region. This informed the design of draft training materials that were used to deliver a training to cooperatives / Women's Economic Strengthening Groups and relevant government personnel (June). Feedback from the participants and the client was incorporated into the training material and subsequent design of the training manual.

The manual prioritises:

- Adult learning techniques that maximise participation and learning-by-doing; and
- A Knowledge, Skills and Attitudes (K-S-A) approach to build capacity in technical content while empowering participants by increasing their Knowledge and Skills to create gender-responsive trainers with the Attitudes necessary to support future actions.

The manual is intended for use by a variety of audiences to guide and supplement their work, whether directly or indirectly related to Artisanal and Small-scale Mining (ASM). A non-exhaustive list of the potential users is as follows:

- The ASM Department of the MoMPNG
- MoMPNG Directorates working closely with the ASM, Environment & Community Development, Gender, Artisanal Mining Production and Marketing, Public Relations and Communications Directorates
- Regional Mining Bureaus
- Local Woreda and Kabele Officers (Gender, Mining, Environment)
- Artisanal and Small-scale Mining Cooperatives / Women's Economic Strengthening Groups
- Artisanal and Small-scale Communities

CONTENTS

SECTION 1: GUIDELINES FOR TRAINERS

Any woman or man can become an excellent trainer! You *don't* need to be an expert on a topic to help others learn new skills and ideas and improve their lapidary and value addition activities.

Training is not just about giving information in a lecture. Training is about using different techniques and methods to positively change the behaviour and practices of the women and men you are training. To do this, a good trainer will use different techniques and methods to build upon trainees' existing Knowledge, Skills, and Attitudes ("K-S-A"):

- **K = Knowledge.** *This is the facts or information that women and men know.* For example, someone may *know* where salt is located but may not know how to mine it.
- **S = Skills.** *This is the ability to do something.* For example, someone may know *how* to mine salt but may not know enough about how to improve its quality and sell it at a better price.
- **A = Attitudes.** *How women and men act in or feel about a situation.* This also includes the values that people have. For example, someone may have skills and knowledge about salt mining, but doesn't have the initiative to learn how to improve salt quality.

This chapter describes: important characteristics of a good trainer; how a trainer can identify and respond to the different K-S-A needs of trainees; and different methods trainers can use to build K-S-A.

1.1 WHAT MAKES A GOOD TRAINER?

A good trainer will:

- Respect the existing knowledge, skills, and attitudes of people you are training and **build-upon** this by introducing something *new* (an idea, method, or way of working).
- Be encouraging, supportive, and patient. Understand that each person might have different training needs. Some women and men miners will need more time and encouragement than others.
- Help the women and men you are training by finding the solutions themselves.
    - Ask questions about what they know and how they think a problem can be solved.

  - Introduce new ideas and methods using your coaching and mentoring skills.
  - Talk about what they learned and how it can improve people's lives.
  - Talk about possible unintended impacts of the new method and how you can manage this.
- Remember that women and men may face different challenges speaking up or participating. A good trainer will adapt by taking steps to ensure *all* trainees benefit from training. Remember that different people have different K-S-A and you may need to adapt your methods for women, men and other groups (and may even need to train them separately).
- Keep a positive attitude! It takes time to change behaviours of trainees and a lot of practice to become a good trainer.

1.2 IDENTIFYING THE TRAINING NEEDS OF MINERS

To identify the training needs of women and men miners, you will need to:

- Decide what women and men miners *should* know and be able to do, and the attitude needed to increase their incomes, mine more safely, protect their health and the environment, and support the development of their families.
- Understand what women and men *already* know, can do and how they act or feel. Is this different for women's and men's groups? Will you need to adapt your training approach for each?

Using each section of this manual, **make and complete a table like the one below** to decide what to focus on when you are training women and men miners:

Topic	Knowledge			Skills			Attitudes		
	What miners need to KNOW about	What MEN miners already KNOW about	What WOMEN miners already KNOW about	What miners need to be able to DO	What MEN miners can already DO	What WOMEN miners already DO	What kind of attitude miners need to have	What MEN miners already know	What WOMEN miners already know
Legal Rights:									
Gemstone Identification:									
Materials and Equipment:									
Cut and polish a cabochon:									

Cut and polish opal:									
Safety:									
Environment:									

Table 1: Men and Women KSA Analysis

For each topic, decide what *new* knowledge, skills, and attitudes your trainees need. Use this training guide to help you find the information you need to help train others.

For each topic, decide what *new* knowledge, skills, and attitudes your trainees *need*. Use this training guide to help you find the information you need to help train others. Review the differences between the men and women you will train, as well as any intra-gender particularities. How can you address these differences?

To address training needs, particularly of women trainees, you should also consider the following issues:

- Where will the training be done? Is it easy and inexpensive for trainees to access the location? How will it affect the trainees' day-to-day lives?
- When will the training be done? How long or how often will you do it? Could this create a household conflict or inconvenience for trainees? How will you address this?
- What are the costs of the training for the trainee? Think about all costs (lost income, transport, accommodation). Will they be able to afford to participate? How will you address this

1.3 TRAINING METHODS

Use a combination of methods depending on whether you want to build Knowledge (**K**), Skills (**S**), or Attitudes (**A**).

KIND OF LEARNING	TRAINING METHODS
KNOWLEDGE [Facts, Information]	• Lectures and presentations • Readings • Songs, Films, TV, and Radio • Brainstorming, group, or one-on-one discussions
SKILLS [How to do something]	• Demonstrations • Instructions followed by hands-on practice.
ATTITUDES [Values, what people think about things, how they react to things]	• Posters and visual aids • Discussion • Role plays and simulations

Table 2: Types of learning and methods for training

You don't need to organise a training workshop to be a 'trainer'. Sometimes, the best training is done at the mine site. The most important field techniques you can use are as *coaches* or *mentors* of women and men miners. Because women and men may have different training needs, it may be useful to coach or mentor them separately.

To be an effective **coach** of artisanal miners:

1. *Focus on one method, skill, or way of working that you learned about during the training:* Think about what you learned during this training. Pick one topic that you think other miners would benefit from learning about. Remember that women and men miners might have different needs!
2. *Work with 1-3 miners at a time to teach them about the activity.*
    - Talk to the miners about why it would be useful to learn this new task or skill.
    - Demonstrate and instruct the miners on the task or skill – do it together.
    - Talk about what worked well, what did not and how they could improve next time.
3. *Once the miners are comfortable using the new skill or methods,* then introduce it to *other* miners OR focus on teaching miners about a *different* method or topic.
4. *Re-visit the miners you trained later* to make sure that they are using the method in a proper way (or perhaps have improved on the method by adapting it).

To be an effective **mentor** of artisanal miners:

1. *Give advice to women and men miners on a regular basis.* Talk to individual miners about what they think they need to know to improve their mining activities. Remember that women and men miners might have different needs!
2. *If you know about the topic* then give the miners advice on the issue on a regular basis. Work with them to find solutions together.

If you don't know about the topic then ask for advice from those that do: for example mining officers at the Woreda Regional Mining Bureau (RMB) or Ministry of Mines. They may need to do some research to help you advise fellow miners.

SECTION 2: GENDER EQUITY, RIGHTS & RESPONSIBILITIES IN ARTISANAL AND SMALL SCALE MINING

The purpose of the present training manual is to improve the position of women miners in the mining production cycle and to enhance their benefits from mining activity.

The focus of the following sections is the improvement of **technical skills** and the **introduction of modern, efficient, environmentally friendly and gender sensitive technologies**. However, for this to contribute to impactful, meaningful, and sustainable change for women, it is integral that trainees are trained in the importance of gender equity as well as their rights, roles, and responsibilities.

By developing a better understanding of the present position of women in mining, as well as legal provisions and government responsibilities to protect and promote the role of women, this section will complement the skills learned in later sections and provide trainees with a basis for realising the benefits of the training programme when applying their new skills.

The introduction of new technologies and skills to operate them will only provide trainees with the *potential* to improve their livelihoods and the benefits of mining; an understanding of gender equity and their rights and responsibilities will permit the trainees to apply these skills in a way that *maximises their potential*.

2.1 GENDER AND DEVELOPMENT

Introduction

Women constitute 26% of the mining households in Ethiopia (ASM Baseline Survey, Sudca, 2013). When we look at the gender distribution by mineral type, women hardly participate in salt extraction and dimension stone production. They likewise have a very limited role in gemstone mining. Thus, the only area where women engage as recognised miners is gold mining, which also varies from region to region. For example, in Benshangul-Gumuz Region, females [including girls] are very actively engaged and make up 51%; while in Tigray, they represent 39% of the mining workforce. However, even in these regions, where women constitute a considerable size of the mining workforce, the gender disparities between men and women as well as boys and girls are considerable.

Does gender equity matter?

Gender equity is not just a question of being fair to women and girls or narrowing the economic and social gaps between male and females. It is a matter of national and community development. For instance, The Global Hunger Index indicates that countries with the highest levels of gender inequality show the highest levels of hunger. Thus, con-

fronting gender inequality stands out among the key elements of reducing hunger and, hence, of reducing poverty (USAID, 2011).

Domains for analyzing gender inequality

ASPIRATIONS:

Children constitute a significant, although diminishing, proportion (5-10% depending on the region) of the ASM labour force in Ethiopia (EITI, 2016). Children, especially girls, are prone to high levels of non-enrolment, absenteeism, and school dropout. This has a profound impact on the aspirations of children of the present generation and the development of their communities, in much the same way as it did for previous generations.

Figure 1: Children in mining communities, particularly girls, are vulnerable to school dropout, absenteeism or getting no education at all. (Photo – Amhara Region, Wadla / Delanta area)

GENDER DIVISION OF LABOR:

Women report spending two thirds of their time in mining / mining related activies and the rest on crop production, domestic chores and discharging their child care responsibilities. Despite these additional burdens, women typically spend almost as much time as men mining.

All of the above factors result in a disproportionate work burden for women and girls, impacting their development and aspirations. In turn this can also determine their social status. Often the problems detailed above are confounded in female-headed households.

Figure 2: Most women participate in food vending and picking tailings at the mining sites (Photo - Amhara Region, Wadla / Delanta area)

ACCESS TO AND CONTROL OVER ASSETS AND RESOURCES:

Ownership of the majority of household assets such as family land holdings, houses, livestock, income, etc. in mining communities is primarily the reserve of men. In the case of access to mining areas in gemstone producing areas, it is men that control access to sites and women largely play a support role through provision of services and / or collecting low value "ajara" (off-cuts) that are very low value.

PARTICIPATION AND DECISION MAKING:

Women have the most decision-making power over income *they* have generated. Where they are not involved in income generating activities, whether from social or cultural exclusion, there is a risk that gains (including those resulting from increased productivity leading to higher income in ASM households) could be misused. This could actually worsen the existing situation of women and girls if they are obligated to take on additional work burdens but restricted from accessing the improved income. This risk could be heightened if, for instance, machinery were to be co-opted by men. Conversely, assessment demonstrates that ASM women who actively participate tend to have a stronger voice in community/collective issues, relative to their inputs at the household (HH) level.

INSTITUTIONAL CAPACITY AND COLLABORATION AMONG PARTNERS:

Some major factors slowing down the gender mainstreaming process in artisanal mining include: limited staff capacity in government to integrate gender; weak collaboration and interconnectedness across gender offices; and persistence of unorganised and highly individualised mining operations.

OTHER SOCIAL PROBLEMS:

Many women around the mining areas are engaged in low paying and/or risky livelihood activities including food vending, catering, sale of goods, and sex work. The resultant marginalisation can increase women and children's exposure to child abuse, human trafficking, HIV, gender-based violence, and/or harmful traditional practices. Lack of knowledge about safety rules and on the need to use safety equipment, accompanied with exposure to toxic and poisonous chemicals is also an issue. The domestic division of labour means the workloads of women are reportedly increased by deforestation and its associated impacts on availability of water and firewood.

GEMSTONE SPECIFIC GENDER CONSIDERATIONS:

One aim of this training manual is to empower women to increase their participation in the gemstone sector by improving their skills in value addition and processing of opal

and other gemstones. Skill development, paired with meaningful employment opportunities, will increase participation at high value stages of gemstone production. This will improve incomes, reduce work burdens, and most importantly empower women at the household and community level.

The gender inequality issues discussed above are common across most mining types, regardless of the material. Below we present some additional gender issues particular to gemstone supply chains, resulting from the needs assessment conducted prior to the elaboration of the manual.

- Women rarely participate in the *extraction* stage of gemstone production. This is not because they are uninterested or are incapable of doing the job; rather in many cases they are systematically excluded from the extraction stage. The reasons for exclusion are often complex and a woman who wishes to engage in gemstone production typically will have to overcome a number of obstacles including: cultural, practical, social, and technical.
- A dominant **cultural** norm can be an obstacle, for example: the opal business in Ethiopia has historically been dominated by men; that is simply '*the way it's always been done'*. **Practical obstacles** can include valid security concerns. For example, working hours are often cited as a reason women don't participate in the extraction stage of gemstones. Where gemstone extraction is performed after sunset – in the dark, with no electricity – the conditions are perceived as too dangerous for women. This perception is validated by women consistently reporting that night-time working hours of any kind increase their risk of sexual assault or attacks on their social status. **Social obstacles** that exclude women and girls from education can create low literacy or numeracy levels amongst women. This can preclude engagement in sectoral jobs that require bookkeeping, licenses, or paperwork. An example of a **technical obstacle** is when women lack the necessary skills to do a particular job in gemstone production. Technical training (like this one!) can help women identify or add value to the gemstones they are selling or processing. Increased technical knowledge equips women to receive appropriate payment for their time and labour.
- Typically several of these obstacles work together to restrict women from full participation in gemstone production and consequently restrict their ability to improve their incomes and standard of living. Nevertheless, a progressive approach is possible and useful: even targeting one or two of these obstacles (such as cultural and technical obstacles) can vastly improve opportunities and participation. This is one aim of this manual.
- This and other ongoing training programmes are contributing to this progressive empowerment work. All stakeholders – including the MOMPNG, women miners and civil society - can and must continue to improve safe working conditions for both women and men; reduce the specific risks

posed to women in and around the extraction sites, and address market related barriers to the participation of women in gemstone supply chains.

- A key indicator for monitoring the empowerment of women in the sector is to consider the decision making power of women. This means considering to what extent women – whether in their personal lives, homes, communities, or workplaces – have or are increasing access to productive assets, information, and markets; have agency over these things; and are free and empowered to make meaningful decisions related to these things.

2.2 LEGAL RIGHTS AND RESPONSIBILITIES OF WOMEN AND MEN MINERS

The development of you, your family, and your community depends on whether the rights of women, men, boys, and girls are **respected, protected,** and **fulfilled!** To do this, women and men miners have to fulfil *responsibilities* while the government needs to discharge its *obligations.*

What are the rights of women and men miners?

According to the Constitution and the Mining Proclamations of Ethiopia:

- **Eligibility for License:** No person is required to possess financial resources, technical, and professional competence in order to acquire an artisanal mining license. (Art.2, The Mining Proclamation, MOM 2010)
- **All nationals** can apply through their Regional Mining Bureau for an artisanal license (Proclamation No. 816/2013).

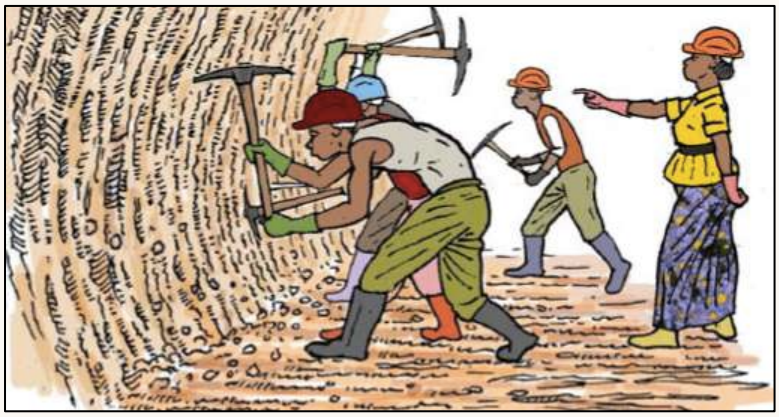


Figure 3: Both women and men have the right to work in different areas of the mine (Source: Hinton et al, 2009)

- An artisanal license is **valid for a period specified in the license (not exceeding two years)** and is non-renewable (Proclamation No. 816/2013).
- The **maximum area** to be covered by a single license shall be 5,000m^2 for artisanal mining operations.
- One can't be a holder of two licenses at a time. (Art. 10, Council of Ministers, 1994)

- **The right to be organised**: ASM workers have the right to form associations or cooperatives to improve their conditions of work and economic well-being.
- Women workers have the right to equal pay for equal work. (The Constitution Art. 42)
- **Small-scale and special small-scale mining licenses** are granted for an initial period of up to 10 years and can be renewed for 5 years (Proclamation No. 816/2013). Please consult with your Regional Mining Bureau for further information.
- **Environmental impact:** Artisanal miners are not required to submit an environmental impact assessment or to allocate funds to cover the costs of rehabilitation of environmental impact. (Art. 60, Council of Ministers, 1994)

Legal rights concerning equal opportunities, equal pay for equal work and non-discrimination

- Women shall, in the enjoyment of rights and protections provided for by the Constitution, have equal rights with men. Women have equal rights with men in marriage. (The Constitution Art. 35)
- Women have the right to acquire, administer, control, use, and transfer property. In particular, they have equal rights with men with respect to use, transfer, administration and control of land. They shall also enjoy equal treatment in the inheritance of property. (The Constitution Art. 35)
- Every Ethiopian has the right to engage freely in economic activity and to pursue a livelihood of his choice anywhere within the national territory. (The Constitution Art. 41)

Legal rights concerning safe working conditions

- To prevent harm arising from pregnancy and childbirth and in order to safeguard their health, women have the right of access to family planning education, information, and capacity. (The Constitution Art. 35)
- Workers have the right to enjoy a healthy and safe working environment.

Legal rights concerning access to justice

- Everyone has the right to bring a justiciable matter to, and to obtain a decision or judgment by, a court of law or any other competent body with judicial power. (The Constitution Art. 37)

The responsibilities of women and men miners

- **Royalty:** The amount of royalty payable by the holders of artisanal and small-scale mining licenses shall be at the rate fixed by the laws of the states. (Art. 63, Council of Ministers, 1994)
- **Order of Processing of Applications:** An application submitted for a large scale mining license shall take precedence over applications for small-scale and artisanal mining licensees, and an application for small-scale mining license shall take precedence over an application for artisanal mining license; (Art. 13, Council of Ministers, 1994)
- **Revoking a License**: The Licensing Authority may, after giving 90 days prior written notice, revoke an artisanal mining license, but preferential treatment or compensation shall be given to the licensee. (Art. 32, Council of Ministers, 1994)
- **Termination of a License**: Mining rights shall terminate if a license expires without being renewed or licensees acted unlawfully. (Art. 77, Council of Ministers, 1994)

Legal rights of children

- Every child has the right to life; to nationality; to know and be cared for by his or her parents or legal guardians; not to be subject to exploitative practices, neither to be required nor permitted to perform work which may be hazardous or harmful to his or her education, health or well-being; to be free of corporal punishment or cruel and inhumane treatment in schools and other institutions responsible for the care of children. (The Constitution Art. 36)

Figure 4: Children's Rights

- In all actions concerning children undertaken, the primary consideration shall be the best interest of the child. Children born out of wedlock shall have the same rights as children born in wedlock. The State shall accord special protection to orphans. (The Constitution Art. 36)

- Under special circumstances, children of age 14 and above can engage in safe paid works, but subject to limitations in working hours, not to work during week-ends, and not to work overtime.
- Alternative education should be provided for young girls and boys engaged in the mining activities;
- Parents/guardians are responsible for ensuring that both girls and boys enjoy their right to rest, play, and attend school.

2.3 OBLIGATIONS OF THE GOVERNMENT

The Government of Ethiopia has a legal obligation to **respect, protect,** and **fulfil** the rights of its citizens. A few examples of important obligations of government include to:

- Fairly and without discrimination - on the basis of gender, class, or ethnicity - ensure that mandates (including those mandates of Regional Mining Bureau and Woreda offices related to technical assistance and advice to artisanal miners) are fulfilled;
- The State shall enforce the right of women to eliminate the influences of harmful customs. Laws, customs, and practices that oppress or cause bodily or mental harm to women are prohibited (The Constitution Art. 35);
- Provide training on legal right of women artisanal and small-scale miners to apply human rights and gender equality principles (avoid physical harassments and psychological torture);
- Create awareness to protect against the sexual exploitation of women and girls by workers, traders and those who are engaged in other jobs around mining areas;
- Prevent harassment and discrimination;
- Strengthen the legal trading system in collaboration with responsible bodies such as police and trade bureaus to support women artisanal miners;
- Set-up mechanisms to protect the economic interests of girls who work for relatives, friends of the family, or guardians;
- Make sure women, women's organisations and associations are active participants in decision making, for example in consultations and meetings;
- Identify and address local and associational sources of conflict in artisanal and small-scale mining communities and promote conflict resolution, since women are often the prime victims of conflicts that arise. In addition, it must ensure active participation of women in resolving conflicts;

- Develop regular and gender sensitive assessment and monitoring techniques to overcome the hurdles to positive change and to support the development of women in artisanal mining;
- Ensure that the rights of other land users are protected; and
- **Provide Assistance -** The government may provide incentives and assistance to artisanal mining carried out by cooperatives. (Art. 75, Council of Ministers, 1994)

2.4 WHAT TO DO WHEN RIGHTS ARE NOT RESPECTED, PROTECTED, AND FULFILLED?

- **Appeal Procedures:** Any person who is aggrieved by any administrative decision of the Licensing Authority pursuant to Proclamation 816/2013 may apply to the officials of the Licensing Authority hierarchically [Woreda - Regional - Federal] (Art. 79, Council of Ministers, 1994).
- After one has exhausted the administrative remedies with the Licensing Authority, they may apply to the competent court for the review of an administrative decision contemplated in sub-article (1).
- In the case of any criminal act (such as sexual or physical violence or denial of payments), the victim may take their case to the local police or the relevant government administrative body for justice.

SECTION 3: INTRODUCTION TO GEMSTONES

3.1 WHAT IS A GEMSTONE?

A gemstone is the name given to a piece of mineral (or other rock or organic material) that after it has been cut and polished is made into a piece of jewellery or another accessory. Although gemstones are commonly made from minerals, material such as jet or amber or rocks like lapis lazuli can also be utilised in the creation of jewellery / accessories in a similar way to the above mentioned minerals. The majority of gemstones will be hard to the touch but depending on the piece of jewellery that is being created, some soft minerals are also utilised.

3.2 HOW ARE GEMSTONES FORMED?

Even though the vast majority of gemstones are created below the surface of the earth, there are a number of different ways that individual stones can be created. A great number of these precious stones are created when the minerals react with water that is found just below the surface of the earth and the minerals then dissolve before reforming in a hardened state. This process allows the minerals to form into gemstones like opals, agates, and amethysts, which form when the solution cools or evaporates.

Ethiopia has deposits of over 40 different varieties of coloured gemstones, including emerald, tourmaline, opal, aquamarine, jasper, agate, chrysoprase, peridot and amethyst (Yager, 2014). Ethiopia is one of the few countries in the world to have such abundant and diverse gemstone deposits within its borders. While the calibre of many of its coloured gems tend to be at the lower end of the scale, a few deposits produce stones that can compete with international industry leaders. A notable example of world class gemstone is Ethiopia's opal.

The vast majority of coloured gemstone mining around the world is performed by artisanal and small-scale miners (ASM); workers who are defined by their use of rudimentary technology, such as picks and shovels, to mine for minerals that are typically found in shallow deposits. The gemstone mining taking place across Ethiopia is no different: ASM produces most of its coloured gemstones. Opals are the most abundant gemstone in Ethiopia, as is discussed in detail later in this manual.

Figure 5: Opal mining in Ethiopia

Figure 6: Sapphire mining in Madagascar

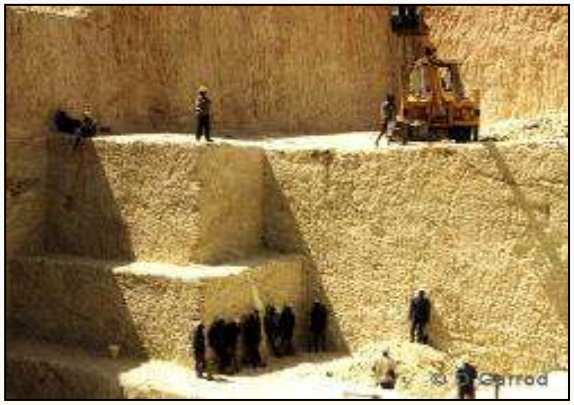


Figure 7: Mechanised ruby mining in Kenya

3.3 HOW CAN WE IDENTIFY DIFFERENT GEMSTONES?

The traditional classification of gemstones begins with a distinction between *precious* and *semi-precious*. In modern usage, the precious stones are diamond, ruby, sapphire, and emerald, with all other gemstones being semi-precious.

Gemstones are categorised by gemmologists, who describe gems and their characteristics using technical terminology specific to the field of gemmology. In this section we'll give you an introduction to the key characteristics of gemstones you should know about.

Colour

Figure 8: From Left to Right: ruby, emerald, and sapphire set in white gold with diamond

Hardness

The scientific definition of hardness is the ability to resist scratching. In 1812, the mineralogist Friedrich Mohs (1773-1839) established a reference scale of ten common minerals, ranked in order of increasing hardness. This scale, included below, is called the Moh's Scale of Hardness.

10	Diamond
9	Corundum (rubies and sapphires)
8	Topaz
7	Quartz [Example: It scratches window glass]
6	Feldspar [Example: A steel file will scratch it]
5	Apatite
4	Fluorite [Example: A knife will scratch it]
3	Calcite [Example: A copper coin will scratch it]
2	Gypsum
1	Talc [Example: A fingernail will scratch it]

Table 3: Moh's Scale

Optical phenomena of Gemstones

"Optical phenomenon" refers to the property of some minerals when exposed to light. The optical phenomena are as follows:

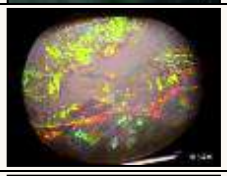
Chatoyancy – Cat's-eye-effect (for example: chrysoberyl, sapphire, ruby, and apatite)	
Asterism – Star effect (for example: sapphire, ruby, rose quartz, and garnet)	
Iridescence – Play of colour effect (for example: opal, or iolite)	
Fire – Dispersion of light (for example: diamond, demantoide, and zircon)	

Figure 9: Optical Phenomena of Gemstones

Heat sensitivity

The **heat sensitivity** defines the gemstone's capacity to resist a sudden change of temperature. Opal, apatite, emerald, and tourmaline are heat sensitive stones. Heat sensitive stones have to be handled with care and not be exposed to any heat processing.

Pleochroism

Pleochroism is a property of stones which means they display different tints or intensity of colour according to the direction of observation.

Cleavage

Some stones can have one or more breakable directions; these are known as **cleavage plans**. Cleavage plans are more pronounced in some stones such as topaz, orthoclase, and mica.

Transparency

Transparency is how we measure how clear a stone is. If a stone is perfectly clear it is transparent. If you cannot see through a stone it is opaque. There are varying levels of transparency between these two extremes; this is know as translucent.

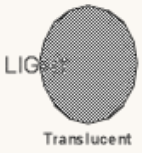
Transparent		
Translucent		
Opaque		

Figure 10: Transparency of Gemstones

3.4 WHAT CRITERIA ARE USED TO ASSESS THE QUALITY AND VALUE OF GEMSTONES?[1]

Colour

Colour is typically the most important value-setting factor for gemstones. All gems have a preferred colour or a relatively small range of preferred colours. The more a specimen's colour varies from this range – lighter or darker, more or less vivid – the less valuable the stone is.

Cut

The **Cut** refers to the shape or design of a stone, arrangement of facets, as well as the precision of the stone's proportions and finish. The cutting process reveals the beauty of a gem.

Carat Weight

Carat is used to deisgnate the *weight* of a gemstone. The size of a gemstone is measured, not by its dimensions, but by weight. One carat, the traditional unit of measurement for gemstones, is equal to approximately 0.2 grams. Up to a certain point, the larger a stone is and the rarer it is, the higher the price tag it will have.

Clarity

A gemstone's clarity grade is directly related to its rarity. **Clarity** refers to a gemstone's relative freedom from **clarity characteristics** (which are undesirable). Clarity characteristics include inclusions, which lie within the stone, or blemishes, which lie on the surface of a gem. The fewer clarity characteristics, the more valuable the gemstone.

3.5 WHAT ARE GEMSTONES USED FOR?

Gemstones are cut and polished and used in different ways. For example, as:

- **Jewellery:** Worn as an ornament
- **Decoration:** Displayed for decorative properties e.g. a crystal chandelier or a statuette

[1]Source: modified from www.gia.edu

- **Industry:** Valued for industrial properties such as hardness for cutting e.g. diamond for cutting, or ruby and quartz for the watch industry

Figure 11: From Left to Right: rough opal (Ethiopia), cut and polished, opal set in ring (Australia)

Before Gemstones are sold as final products they travel along a supply chain. Each stage of the supply chain provides a services en route to the production and commercialisation of the final product. This manual is principally concerned with manufacturing (quality assessment and cutting and polishing). However it is useful to understand the other steps of the supply chain, especially those that may act as your suppliers or potential buyers.

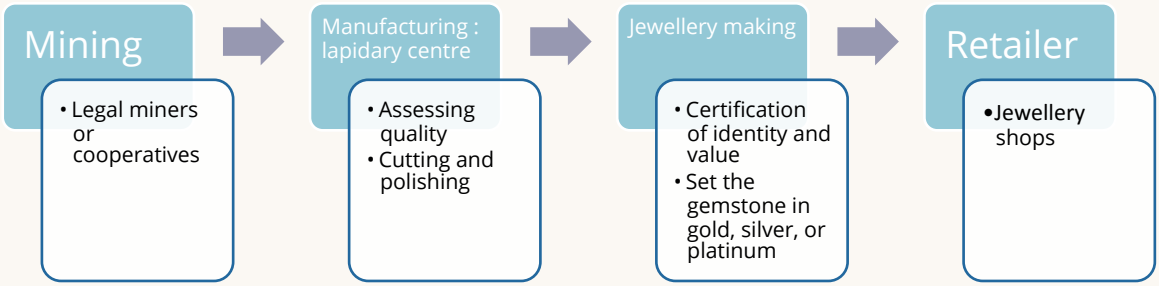


Figure 12: Typical Gemstone Supply Chain

Figure 13: From Left to Right: extraction of opal, processing in a lapidary workshop by a professional gem cutter, opal set in jewellery

3.6 WHAT IS LAPIDARY?

Lapidary is the art of cutting and polishing gemstones[2]. This term, as well as gem cutter, lapidarist, faceter, and cabber, is also used to describe the *person* who cuts and polishes gemstones. Lapidarists' work consists of cutting and polishing gemstones to improve their external appearance. The aim of cutting is to give specific shape and to obtain a smooth and brilliant surface.

Gem and ornamental materials can also be prepared and polished by carvers and other specialists (Foundation course in gemmology/ Gem-A). If an unfashioned material is considered to be worth making into an ornament, it is termed 'rough', however beautiful it may be. For most rough materials, their full glory is seen only after a lapidary expert has carved or cut and polished them in order to reveal their colour and optical effects to the greatest degree.

[2] Exclusive of diamond cutters, who are typically not referred to as lapidarists due to the distinct and specialised nature of their work.

SECTION 4: MATERIALS AND EQUIPMENT FOR LAPIDARY AND GEM PROCESSING

OVERVIEW OF LAPIDARY TECHNIQUES, PROCESSING STYLES AND LAPIDARY MACHINERY

There are a variety of different techniques and styles used in lapidary depending on the characteristics of the stone and the desired product. More detail is provided about each of the techniques, styles and machinery used to obtain the desired results.

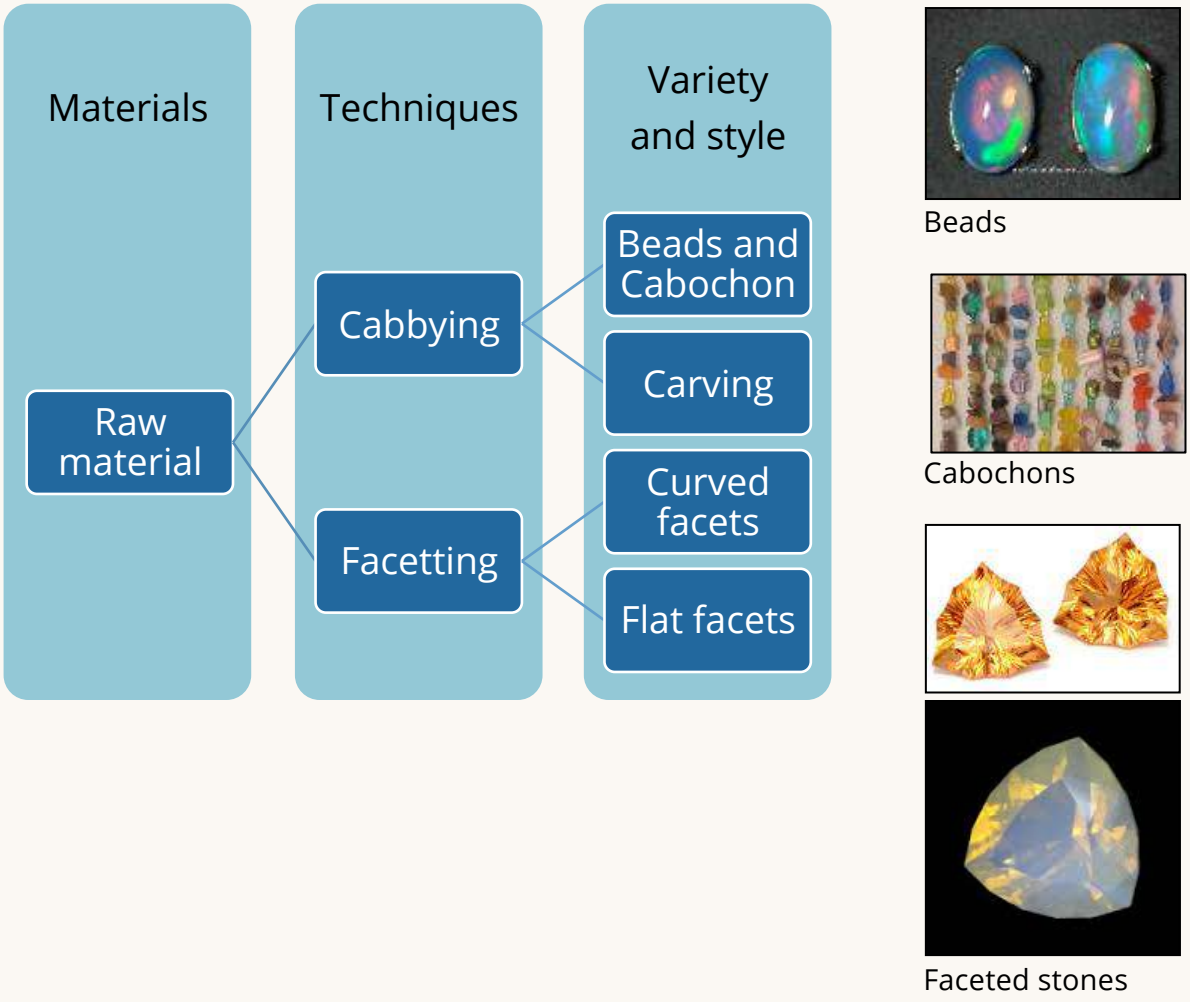


Figure 14: Different techniques of lapidary and gem processing from raw materials to different style of fashioned gemstones

Cabochon style

Cabochon is a way of cutting gemstones to create a smooth and polished curved surface. In its simplest form, this cut consists of a domed, polished top, with a flat unpolished back. Details about cutting cabochon is provided later on in this handbook.


Figure 15: Oval cabochons. Left: rose quartz, Right: emerald

Here are some examples of cabbying machines for making cabochons:



Figure 16: From Left to Right: hitech diamond All-U-Need model, the Diamond Pacific GENIE model, Hi-Tech Diamond Slant Cabber model

Faceting Style

Faceted: Distinct from a cabochon cut, faceting techniques give rise to highly polished and organised small faces, commonly known as facets, on the surface of the gemstones. Facets can be flat or curved.


Figure 17: Left: faceted pink sapphire, Right: curved facetted ametrine

Here are some examples of faceting machines for making faceted products:

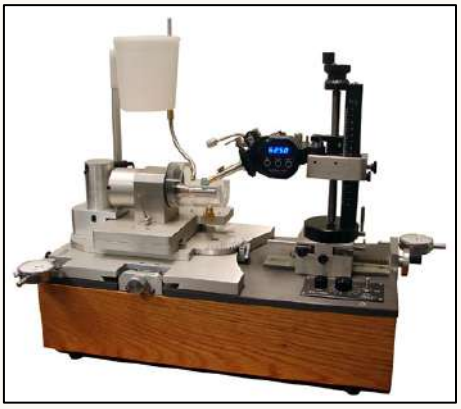



Figure 18: Left: the Facetron model; Right: the Raytech-Shaw model

Tumbled baroque and bead styles

Tumbled and baroque: This cut produces an undefined shape that is smooth and polished. Sometimes a hole is drilled into it for use with jewellery.

Beads: sphere shaped stones.

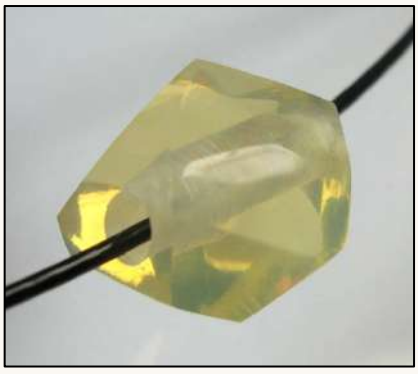



Figure 19: Left: opal beads, Right: common opal in baroque shape with drilled hole

Here are some examples of tumbling machines for making baroque and beaded products:


Figure 20: Left: rotary model (the Mini sonic Vibrating rock Tumbler), Right: hi-tech tumbling model

Additional frequently used machinery in a lapidary centre

Here are some examples of saw machines used to cut materials

Figure 21: Small sawing machine (the Raytech model)

Here is an example of a drill used to create holes in beads, tumbled styles and cabochons

Figure 22: An Ultrasonic drill model

SECTION 5: INTRODUCTION TO LAPIDARY TECHNIQUES

5.1 INTRODUCTION

Cabochon is a way to cut and polish opaque gemstones and those with inclusions. This cut consists of one or two domed surfaces, a polished top, with a polished or unpolished back. Cabochon is the appropriate cut to reveal optical effects such as asterism, play of colour, or labradorescence.

Every gemstone can be cut into a cabochon depending on its quality.

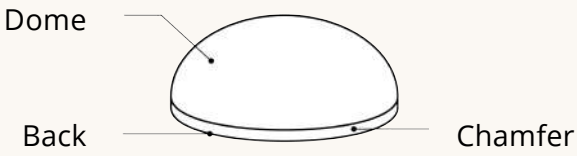


Figure 23: Example of the characteristics of a cabochon cut

There are a variety of different cabochon cuts that are possible.

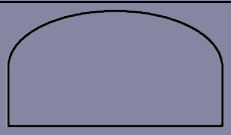
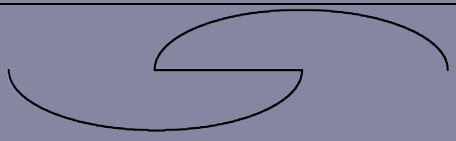
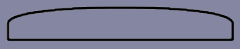
TYPE OF CABOCHON	GRAPHIC OF CABOCHON CUT
Common Cabochon: the height of the dome is around 50% of the diameter	
Domed or High Cabochon	
Double Cabochon: has two curved surfaces	
Hollow Cabochon: with a concaved polished back (to lighten the colour of deeply coloured gemstone).	
Flat Cabochon: large with low dome style	

Table 4: Cabochon Cuts

The final “look” of a gemstone will depend upon the quality / constitution of the raw material used and the skill of the lapidarist responsible for cutting and polishing the cabochon. There is therefore a great variety of different cabochon styles available.

5.2 HOW TO ASSESS AND PROCESS RAW MATERIALS

This section helps you to understand the value of your gemstones in their "pre-processed" state, and anticipate what value they could achieve through additional processing, as well as to consider how to cut them in a way that maximises this value. It further provides basic introductions to the techniques you can use to get the most value from your raw materials.

Please Note: Processing raw materials into gemstones requires specialised machinery, training in lapidary, and plenty of practice.

Several of these steps require operation of machinery or equipment, which, if used without proper training, could damage your gemstone or even cause bodily harm. You should receive additional training in each machine or technique before attempting (to use) them.

Step 1: Observing the Gemstone's Character

You first need to estimate the value of your materials. How you decide to process the gemstone should be informed by what form can retrieve the **highest value** for you.

For most gemstones, the first step is to select the cut. This means considering the most appropriate style and taking into account the quality and property of the materials:

- Step: 1: Observe the gemstone's character; check if the stone is transparent, translucent, or opaque; and detect cracks and the presence of optical effect(s).
- Step 2: Assess the gemstone's colour; use a channelled source of light to assess the quality of your raw materials.

Figure 24: Raw opal from Ethiopia

Observing a gemstone's character will help you select the appropriate style of processing:

- Transparent gemstones with no defaults are typically processed with faceting techniques.
- Transparent gemstones with inclusions, those that are translucent, opaque, and/or have an optical effect, are appropriate for cabochon techniques.

- Flat gemstones and those full of cracks are not worth cutting (they will not sell of a good price!). They may however be useful for practicing new techniques.

Step 2: Assessing the Gemstone's Colour to Determine the Grinding and Shaping the Cabochon

The objective of this step is to position the gemstone dome in order to achieve an attractive cabochon. You can detect the best and most vivid play of colour / best colour band by using a source of light to determine how best to grind and shape the gemstone. This is typically done in three simple steps:

- Step 1: Detect the best and most evident play of colour using a strong source of light by looking for the best orientation of the colour band (or the best colour for stones without play of colour);
- Step 2: Position the face up (dome) in alignment with the best colour formation, with the optical effect centred at the top of the dome;
- Step 3: Centre the play of colour at the top of the dome.

A gemstone can be oriented to get a **centred optical effect** by using the techniques described below:

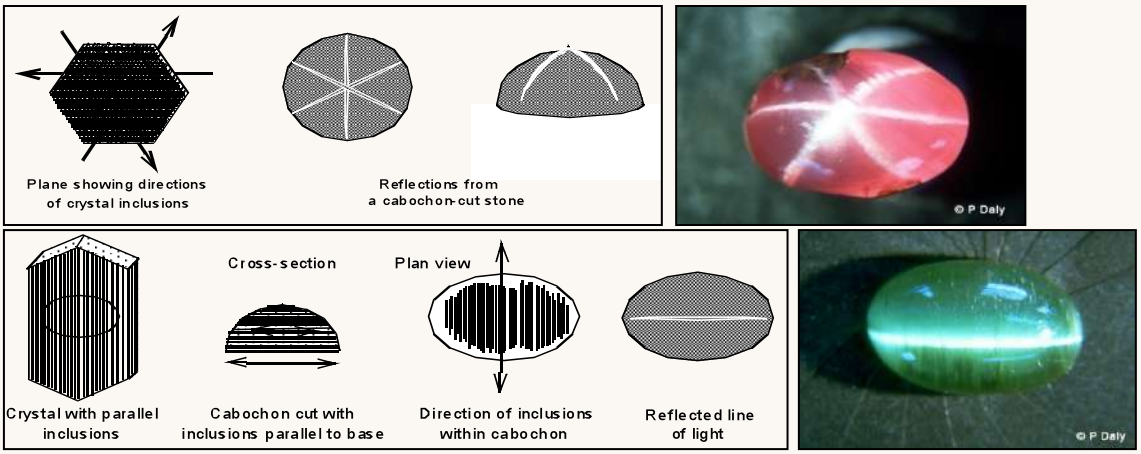


Fig 25: Orienting a gemstone to obtain a centred optical effect

Figure 26: From Left to Right: observation of raw opal with torch, orientation of the play of colour, and cabochon orienta-

tion according to the best play of colour.

Figure 27: Left: jasper raw material, Right: pattern for shape and size regarding the orientation of colour band

Step 3: Sawing

The process of dividing/slicing stones into pieces or removing the excess material from the rough stone is called sawing. A sawing machine is used for this step and lapidarists must wear protective equipment during this stage, including goggles, and masks. The process generally goes as follows:

- Step 1: Detect the part of the stone to be removed / sliced;
- Step 2: Draw a sawing line;
- Step 3: Double-check the water level of the sawing machine;
- Step 4: Saw carefully along the line that you have marked out.

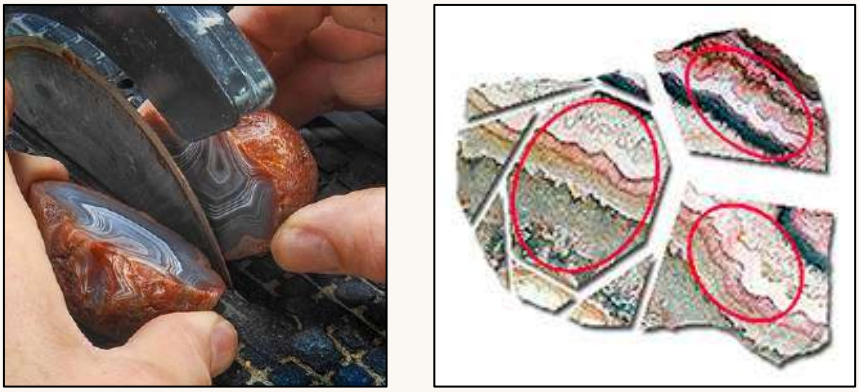


Figure 28: From Left to Right: sawing a piece of agate, suggested pattern for sawed materials

Step 4: Pre-forming

In the Pre-forming stage the lapidarist will shape the back and the dome of the gemstone. Lapidarists must wear protective equipment during this stage, including goggles and masks. The process typically includes three steps:

- Step 1: Flatten the back of the gemstone, curve the dome, and create chamfer using 80mesh and 220mesh wheels;
- Step 2: Use a template with a copper or aluminium pencil to draw lines in order to get the perfect shape; and then

Figure 29: Template models: fancy and basic shape for stones pattern

- Step Three: Focus on ensuring a symmetric and proportionate curved dome. See below:

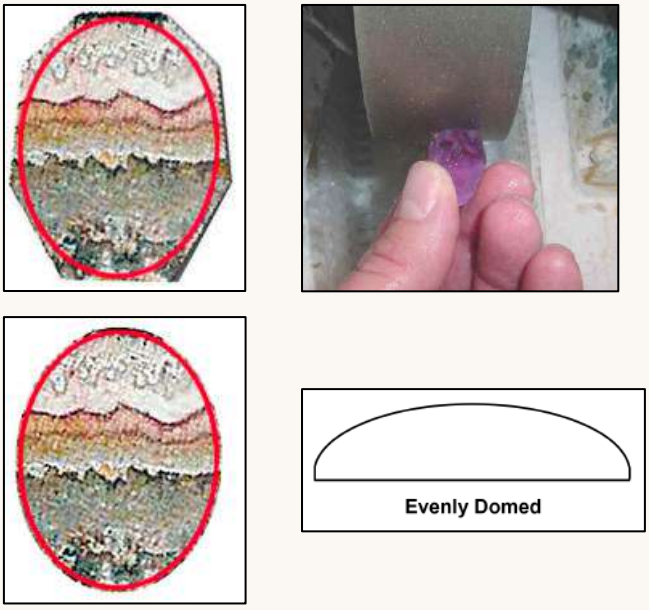


Figure 30: From Left to Right: raw material, grinding to remove extra-materials, shaped cabochon, side view of domed cabochon

Step 5: Pre-polishing and polishing

In this stage a lapidarist will creating the perfect polish on the gemstone. Lapidarists must wear protective equipment during this stage, including goggles, masks and ear protection. This is the final stage of the processing process. The aim is to get a brilliant surface: a gemstone will only sell well if it is smooth and well finished. This typically includes two steps:

- Step 1: Smooth the dome and the back of the gemstone before creating a chamfer by using 280, 600, 1200 and 3000 wheels. Do the processing step-by-step, improving the pre-publish with progressively finer tools in order to achieve the best final result
- Step 2: Use a polishing pad to buff or a piece of felt with cerium oxide to polish opal, quartz, jasper, agate, chalcedony, or cornaline.

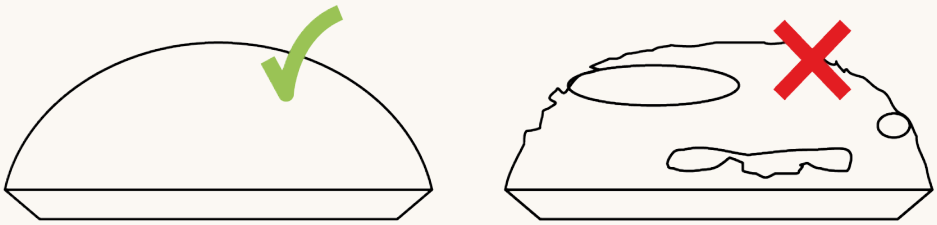


Figure 31: From Left to Right: smooth and regular dome; Right: irregular dome

Figure 32: From Left to Right: polishing buff pad set on Hi tech machine, polishing felt set on diamond pacific machine, steps of cabochon making

SECTION 6: OPAL

Ethiopia produces some of the finest opal in the world! This section features additional information about this gemstone, both generally and the specific characteristics of those found in Ethiopia.

6.1 PROPERTY OF OPAL

Opal is softer than most other gemstones. It has a hardness of about 5.5 to 6.0 on the Mohs hardness scale. Opal therefore works best in earrings, broaches, and other pieces that rarely encounter scuffs and bumps.

Opal's transparency can vary from transparent to opaque and its refractive index ranges from 1.44 to 1.46. A refractometer can be used to identify the refractivity of an opal, but you must **exercise caution**: the RI liquid can damage the opal as it is a porous mineral.

You will find that most opal is **common opal** or '**potch**' which has a milky or pearly lustre known as **opalescence**. Occasionally rare specimens of opal produce brilliant colour flashes when turned in the light. These colour flashes are known as a **play-of-colour**. Opal specimens that exhibit a play-of-colour are known as **precious opal**.

A **play-of-colour** in an opal can be observed under three situations:

1. When the stone is moved;
2. When the light source is moved; or
3. When the angle of observation is changed.

Figure 33: Left image: Ethiopian raw opal, milky with red play of colour, Right: opal with dominant blue

6.2 HOW OPAL IS FORMED AND MINED

Precious opal is very rare and found in a limited number of locations worldwide. Most precious opal has been mined in Australia. Secondary sources include Ethiopia, where it

was discovered in 2008 near Wegel Tena, a small village in the Tsehay Mewcha in the Southern Welo. Mexico, Brazil, the United States, Canada, Honduras, Indonesia, Zambia, Guatemala, Poland, Peru, and New Zealand are secondary sources as well.

Opal is formed from a solution of silicon dioxide and water. As water seeps down into the earth, it picks up silica from sandstone, and carries this silica-rich solution into cracks and voids, caused by natural faults or decomposing fossils. As the water evaporates, it leaves behind a silica deposit. This cycle repeats over very long periods of time, and eventually, opal is formed.

Opal is one of the few minerals that can be extracted economically by one miner working alone. Miners dig horizontal tunnels from the surface of the cliff. The rock is composed mainly of clays, hence it is quite easy to dig using hand tool such as shovels, pickaxes, hammers, and chisels. Opal samples are picked out with the eye or carefully withdrawn from the host-rock.

Figure 34: Left image: mechanised opal mining in Australia; Right image: artisanal mining in the Welo zone of Ethiopia

6.3 VARIETY OF OPALS

The Australian Gemstone Industry Council Inc., in collaboration with the Australian Gem Industry Association Ltd, the Gemmological Association of Australia, the Lightning Ridge Miners Association Ltd, and the Jewellers Association of Australia Ltd, has produced the following names for the classification of opal:

Precious opal

Precious opal can flash a number of colours such as bright yellow, orange, green, blue, red, or purple. This play-of-colour is what makes opal a popular gem. The desirability of precious opal is based upon colour intensity, diversity, uniformity, pattern, and ability to be seen from any angle.

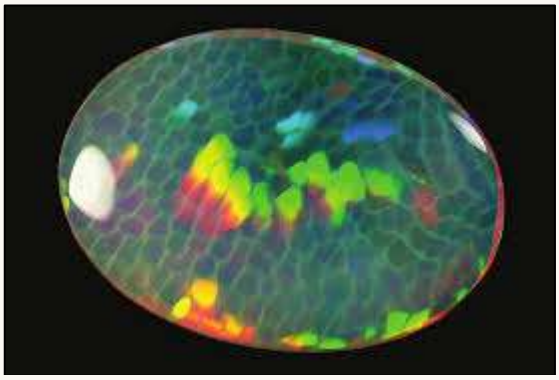



Figure 35: Left image: precious opal showing play of colour. Right image: cabochon with beautiful play of colour

Common opal and potch

Common opal does not exhibit a **play-of-colour**.


Figure 36: Left image: raw common opal, Right image: faceted common opal

Fire Opal

"Fire Opal" is a term used for colourful, transparent to translucent opal that has a bright fire-like background colour of yellow, orange, or red. It may or may not exhibit a "play-of-colour". Fire opal is simply a specimen of opal with a wonderful fire-like background colour. The colour is what defines the stone.

Figure 37: Faceted fire opals

Solid opal

Solid opal is a name used for a rough or cut stone that consists entirely of opal material without any host rock or other significant inclusions contained within the stone. Solid opal can be a combination of precious opal and common opal.

Boulder opal

"Boulder opal" is a term used for a rough or a cut gemstone that displays opal within its host rock. Opal often forms within voids or fractures in its host rock and specimens of boulder opal reveal this aspect of opal's origin.

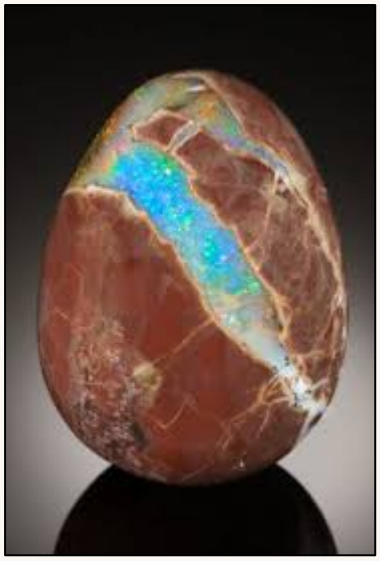


Figure 38: Boulder opal

Matrix opal

Matrix opals are rough or finished gemstones in which precious opal is in an intimate mixture with the parent rock instead of the opal being confined to seams and patches as in boulder opal.

Opal names determined by base colour: black, white, crystal

Some opals are named after the dominant colour that they exhibit. Here are some common examples:

Figure 39: From Left to Right: black opal, white opal and crystal opal

6.4 DIFFERENT OPAL ON THE MARKET

There are some materials that are marketed as opals. It is important to know the difference between genuine opal and other materials designated as "opal":

Natural opal

Natural opal is the name used for genuine opal that has been mined from the Earth. Genuine opal is made by nature and not by humans.

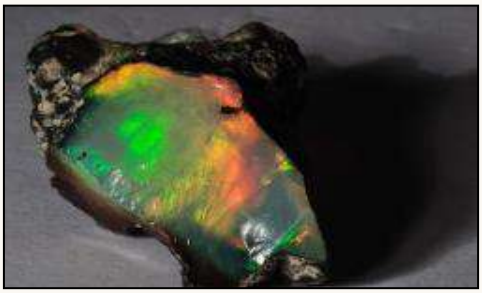


Figure 40: Natural opal from the Welo region

Synthetic opal

Synthetic opals or **lab-created opals** are those that have been created by humans. To be called "synthetic opal" they must be made from a material that has the same chemical composition (hydrated silicon dioxide) as natural opal. Some synthetics look very much like genuine opal.

Figure 41: Synthetic opal cut in oval cabochon shape

Imitation opal

Imitation opals are made from plastic or another glassy substance that is not silicon dioxide. They usually have a pearly opalescence rather than a genuine "play-of-colour". Plastic and glassy materials are sometimes called opalite when sold in stores.

Figure 42: Plastics to imitate opal

Assembled stones

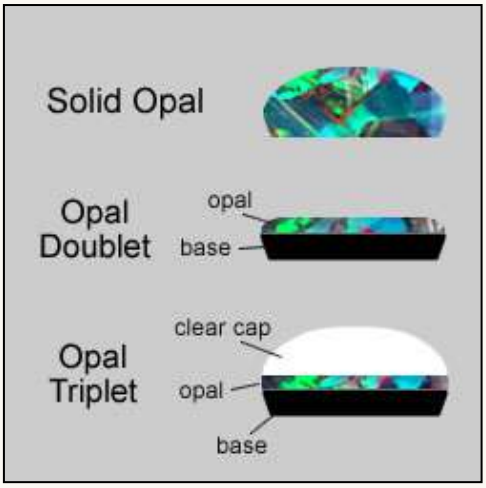


Figure 43: Opal doublets - a slice of natural opal is cemented to a base material. Opal triplets - a thin slice of natural opal is cemented between a dark base and a transparent top layer, usually glass or quartz.

6.5 TIPS FOR CUTTING AND POLISHING OPAL

A cutter will consider an opal's colour, pattern, and clarity when planning the finished gem.

A cutter must consider how to shape the opal in a way that saves weight and maximises colour to show off its spectacular play-of-colour.

Standard calibrated sizes: The dome should be well rounded and symmetrical. Domed surfaces give the best play-of-colour and makes the stone appear vivid from most viewing angles. If the cabochon is flat, it might be vulnerable to breakage, especially during its setting into jewellery. If it's too high, it might be hard to set in jewellery.

Figure 44: Example of an evenly domed surface of an opal

Special considerations when to cutting and polishing opals

- Protect the opal from heat and shocks. Opal is not very hard and is heat sensitive.
- Store the opal in a separate display box, or place in a padded cloth bag or in cotton wool then into a sealed plastic bag, to avoid abrasions following the cut.

- Opal is better set in earrings, pendants, or broach jewellery to avoid damage through use or frequent contact (such as that which is experienced by a gemstone set in a ring)

Cleaning your opal

- Solid opal should be cleaned gently with mild detergent in warm water and a soft toothbrush or cloth. Avoid bleach, chemicals and cleaners. Doublets & triplets may be wiped with a damp soft cloth and mild detergent, but should never be soaked or immersed.
- Never allow anyone to clean your opal in an ultrasonic cleaner, as the intense vibrations may cause cracking in a solid opal, and water penetration in a doublet or triplet.
- If your stone loses its shine or becomes scratched, bring it back to an opal cutter.

6.6 ETHIOPIAN OPAL

A Welo opal has some unique qualities that can cause a range of issues during cutting. For example, a decision to cut wet (as is done traditionally and keeps the opal from getting to hot and cracking) may come at the price of not being able to see what patterns / flashes of colour are being revealed. One mitigation of this challenge is to pause periodically to allow the opal to dry and re-orient as necessary. Some cutters choose to cut Welo opal dry, taking advantage of its greater softness in comparison to Australian opal. Nonetheless, this still requires a great degree of care as overheating can make a Welo opal crack, in the same way as it would all other varieties of opal. Having good ventilation and wearing a mask is particularly necessary during dry cutting due to the risk of Silicosis - permanent lung damage caused by breathing in microscopic silica particles which lungs cannot expel.

The Ethiopian opal is often found in its natural form (rough) in various shapes and sizes. Its volcanic origin explains irregular shapes of rough.

Figure 45: Varieties of Ethiopian opal

What Makes a Good Opal? How is Opal valued?[3]

The value of an opal depends on many factors, including:

- The type of opal: hard / soft; opaque / translucent etc.;
- Whether it is a solid opal, doublet, or triplet;
- The body tone: black, white or crystal;
- The quality-of-play of colour: must be vivid and have ranges across the entire spectrum; (red is considered the best prominent colour, orange the next most desirable, followed by green and blue);
- Clarity defined by transparency and quantity of inclusions: A cloudy or milky background colour lowers the value of any opal;
- The quality of the cut & polish (you have control over this!);
- The size of the stone; and
- The symmetry, thickness, polish, sizing, and calibration of a cut opal.

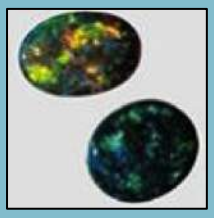
HOW TO EVALUATE AN OPAL				
Opal evaluation consists of five steps, which should be done under controlled lighting on a dark background. Rotating the opal against the background helps when you're determining its type and evaluating its play-of-color and cut.				
Type	Play-of-color	Transparency	Clarity	Cut
Determine the type of opal • Black • White • Crystal, etc. 	Determine the ratio and quality of the play-of-color • Percentage compared to background • Intensity • Dominant hues • Range of color • Patter 	Determine the opal's transparency • Transparent, opaque, etc. 	Determine the opal's clarity • Presence of matrix, crazing, pits, etc. 	Evaluate the cut • Symmetry • Thickness • Polish • Sizing and calibration 

Table 5: How to evaluate an opal

[3] This section is informed by (GIA 2016), for more detail please see their website.

SECTION 7: OVERVIEW OF A LAPIDARY WORKSHOP

7.1 HEALTH AND SAFETY

Some specific measures are required for a safe and healthy lapidary workshop.

Safety measures for a lapidary workshop: These include *inter alia*; accessibility to the workshop for disabled people and pregnant woman, high visibility and instructions on how to use materials and machinery, including warnings and safety measures to be taken (signage), use of Personal, Protective Equipment (masks, gloves, goggles, aprons), access to emergency first aid materials e.g. first aid boxes.

Workshop characteristics: The workshop must have a well-ventilated room with a good source of natural light. A machine for cutting and polishing generates noise and vibrations, therefore the lapidary workshop must to be set in an appropriate location to operate in harmony with its environment.

Specific settlement (interactions between lapidary materials to be aware of): Both a water source and an evacuation system for used water has to be available inside the workshop. Most lapidary machines are electronic devices, and use of water is a needed during the process for: keeping the stone at a cool temperature to avoid cracking, preventing the workspace from becoming too dusty, and also for cleaning equipment / to keep workspace clean and healthy.

Maintenance of materials: Regular maintenance and cleaning are compulsory to keep machines operating at high performance and to guarantee the safe use of equipment. Original, high-quality branded machinery with available and accessible spare parts is recommended to ensure the long life of the equipment. Lapidarists must also take care to use appropriate additives during processing to avoid damaging their machinery.

Risk	Level	Due to	Prevention
Electrocution	High	Electronic devices and the presence of water	• Caution and signage, • Quality and maintenance of electronic devices
Fire	Low	Use of flammable additives	• Caution and signage, • Fire safety procedures and materials
Injury	Low	Inattention	• Caution and signage • First aid box • Proper conduct in the workshop

Chronic disease (allergy, stress)	Low	Noise, use of additives with potential allergens	• Regular maintenance of machine • Appropriate safety equipment
Lung disease (silicosis) **Eye infection** **Skin irritation**	Low Low Low	Breathing of silica, Dust, and additives	• Safety equipment (masks, gloves, goggles etc.)

Table 6: List of safety risks and potential accidents in a lapidary workshop

7.2 TIPS FOR WOMEN IN, OR PLANNING ON FORMING, A MINING ASSOCIATION FOCUSSING ON LAPIDARY

Objective 1: Sustainable Activity

In order to ensure sustainability you must, amongst other things:

- Make provisions for maintaining machines with renewable, consumable and spare parts;
- Take into account overheads and other charges (water and electricity charges, taxes, rent etc.): These all cost money and will be deducted from any income generated through the sale of cut / polished gemstones! and
- Undergo continual skills development training to improve the quality of the product that you are producing – this will help you to access higher value markets and earn more money in the long-run.

Objective 2: Expansion of Activity

Development of your business may mean expansion of the activity to:

1. Complement the supply chain (mining, jewellery making, trading); and
2. Meet growing demand in core service provision (lapidary).

Rule 1: Implement rules, procedures, and guidelines

You must:

- Define who can use the workshops, when and how they can and any limitations of use there may be (conditions of use); and
- Implement clear financial regulations. For example, daily rental amounts (collective and individual). These have to be agreed on by all, reflective of the real expenses, and voted and based by the users.

Rule 2: Transparency. This should include transparency around the implementation of a registration system, and a transparent management system detailing (amongst other things):

- Income and expenses (and where possible a profit and loss account);

- List of the materials and the state (level of maintenance) of the respective equipment; and
- List of the consumables, updated regularly.

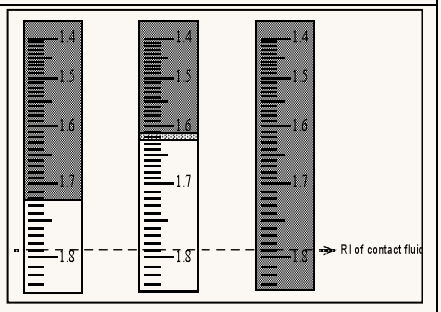
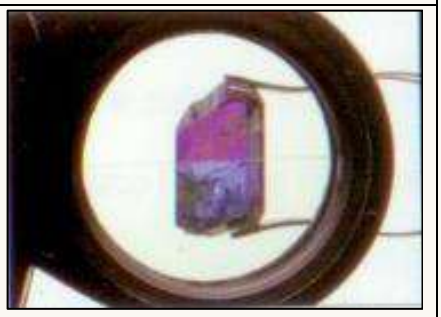
Reporting should be periodic and regular.

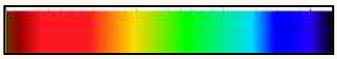
Rule 3: Strategy of the workshop and the cooperative

The strategy of the workshop and the long term vision for its development must be agreed upon by all members, communicated to all, and periodically reviewed in consideration of changing circumstances.

APPENDICES

Basic equipment used to identify gemstones

Equipment	Relevant Characteristic	Example
Magnifiers and optivisors  	The most used of all instruments to aid gemstone observation and identification. Used for the observation of external and internal features	
Refractometer 	The refractive index Light will refract to a particular degree as it enters or leaves a specific material. The laws of refraction and the ratio is known as *refractive index (RI).*	
Dichroscope 	Pleochroism Meaning 'many coloured', pleochroism is the phenomenon where an opal appears to be a different colour depending on the angle from which it is viewed.	

Microscope  	Inclusions/treatments To look into the gemstone to detect for example if the gemstone under examination is natural / synthetic, treated / untreated.	
Spetrometer 	Colour Spectrum This helps to identify stones 	Almandine garnet's spectrum 
Scale 	Weight can be displayed in carats or in grams A gram is used a measurement for rough or unprocessed gemstones, whilst processed gemstones are weigh in carat	

Polishing Material Key for Different Cabochons

STONE	POLISHING LAPS	POLISHING POWDER
Béryl	Felt or buff, leather	Linde A tin or cerium oxide
Corindon	Leather	Diamond
Feldspath	Feltor buff	Cérium Oxyde
Tourmaline	Leather	Cérium Oxyde, Linde A
Garnet	Felt or buff, leather	Cérium Oxyde, Linde A
Opal	Felt or buff, leather	Cérium Oxyde, Tin Oxyde
Quartz	Felt or buff, leather	Tin Oxyde

Templates for Cooperatives / Businesses to use for Reporting Purposes

Below is a suggested template to assist cooperative and / or a lapidary business with transparent reporting of production, running costs, income etc.

Cooperatives should register and record when their resources (equipment, workspace etc.) are rented out. For example:

DATE	NAME OF USER	RENT DURATION	CONSUMED/REST
01-01-2017	Ayana	8 hours (one day)	3hours

Likewise, they should keep track of all equipment and their condition in an inventory. For example:

ITEMS	QUANTITY	STATUS	DATE
Cabochon machine	2	Functional	

ITEMS	QUANTITY	STATUS	DATE
Wheels 3000mesh	2	Used (out of order)	

A cooperative should also keep careful records and accounting of their finances, including income (e.g. through the payment of rental and membership fees), expenses, and outlays. For example:

DATE	NAME	FEES	FOR
01-01-2017	Ayana	10 birr*	Membership fees
01-01-2017	Alemetshay	20 birr**	Daily rental
01-01-2017	Solomon	30 Birr**	1 kit of consumable

*: Members should vote to establish the membership fee amount

**: Daily rental amount and consumable quantity and fees based on the budget requirements to purchase new materials, as well as ensure the maintenance of the equipment.

REFERENCES

Federal Democratic Republic of Ethiopia., 1995.*Constitution of the Federal Democratic Republic of Ethiopia.*

Federal Democratic Republic of Ethiopia., 2013, *Proclamation No. 816/2013: A Proclamation to Amend the Mining Operations Proclamation.*

Federal Democratic Republic of Ethiopia., 2010, *Proclamation No. 678/2010: A Proclamation to Promote Sustainable Development of Mineral Resources.*

Federal Democratic Republic of Ethiopia., 1996, *Proclamation No. 23/1996: Mining Income Tax (Amendment).*

Federal Democratic Republic of Ethiopia., 1994, *Council of Ministers Regulation No. 182/1994: Council of Ministers Regulations on Mining Operations.*

Federal Democratic Republic of Ethiopia., 2009, *Proclamation No. 651 /2009: A Proclamation to Promote and Regulate Transaction of Precious Minerals.*

Federal Democratic Republic of Ethiopia., 2012, *Gender Mainstreaming Guideline,* Gender Mainstreaming Directorate Sponsored by the Ministry of Women, Children and Youth Affairs.

Foreign Affairs Trade Development Canada., 2004, *Ethiopian Gemstones: Maximising Potential.*

Foreign Affairs Trade Development Canada., 2004, *Scoping Study of the Mining Supply Chain in Ethiopia.*

GEM ASSOCIATION., 2015, *Guide to Gems*.

Harimalala Tsiverisoa, Herizo., 2012, *La Taille des Pierres en Cabuchon,* IGM.

Hinton, J., Okedi, J. et al, 2009, *Small Scale Mining Handbook: A Guidebook for Improving the Performance of Artisanal and Small Scale Mining in Uganda,,* New Vision Commercial Printers publ, Kampala, Uganda, 406p.

Ministry of Mines, Ethiopia., 2015, *Artisanal Opal Mining: Overview of the Global and Ethiopian Coloured Gems Market : Empowerment Program for Women in Ilakaka Area, Final Report*, SAFFJKM/IM4DC.

PAPEM., 2002, *Cahier Didactique pour l'Artisan Minier de Madagascar No. 8 et Traitement des Pierres Fines et Precieuse.*

PAPEM., 2002, *Cahier Didactique pour l'Artisan Minier de Madagascar No. 9 : La Gestion des Petits Entreprises Minieres et Lapidaires.*

Pogorzelski, Daniel., *Precis de Gemmogolgie.*

Pogorzelski, Daniel., *Precis de Lapidairie.*

Schmann, Walter*., Guide des Pierres precieuses*.

SUDCA Development Consultants., June 2013, Socio-Economic Baseline Survey of Artisanal and Small-Scale Mining Communities in Rural Ethiopia, SUDCA (World Bank).
UQ, World Bank, CSRM*., Mining Development in Madagascar: Artisanal and Small-scale Mining*.

USAID., Jan 2011, *USAID Office of Food for Peace*, Occasional Paper.

Tadess, Beyene., 2016, *Artisan Mining Operations: Its Economic Values, Ethiopia*, Extractive Industries Transparency Initiative (EITI) publ, Online, https://eiti.org/sites/default/files/documents/artisana_mining_3_0.pdf

Tewodros, Sintayehu., *Value Addition on Gemstones and its Impact on Ethiopia Economy,* ORBIT Ethiopia.

This training manual was developed by Estelle Levin Limited and Sudca Development Consultants for the JSDF Project and the Ministry of Mines, Petroleum and Natural Gas (MOMPNG) of the Government of Ethiopia. It was financed by the World Bank administered JSDF grant for support to improve the Economic, Social and Environmental sustainability of Artisanal Miners, with a particular emphasis on women's empowerment. The JSDF Project is coordinated by the Women and Youth Directorate of the MOMPNG.

The publication of this manual is the product of an extensive participatory research and practical pilot training programme. The technical training manual focusses on adult learning techniques that maximise participation and learning-by-doing, empowering participants with the Knowledge, Skills and Attitudes (K-S-A) to build capacity in technical content as well as increasing knowledge and skills to become gender-responsive trainers and have the attitudes needed to support future action by trainees.

The manual is intended for use by a variety of audiences: A non-exhaustive list of the potential users is as follows:

- The Artisanal and Small-Scale Mining Department of the MoMPNG

- MoMPNG Directorates working closely with the ASM, Environment & Community Development, Gender, Artisanal Mining Production and Marketing, Public Relations and Communications Directorates

- Regional Mining Bureaus

- Local Woreda and Kebele Officers (Gender, Mining, Environment)

- Artisanal and Small-scale Mining Cooperatives / Women's Economic Strengthening Groups

- Artisanal and Small-scale Mining Communities