

GEOLOGICAL SURVEY OF TANZANIA



REPORT ON MINERAL OCCURRENCES WITHIN ILEJE, MBOZI, MOMBA AND SONGWE DISTRICTS IN SONGWE REGION



Authors: G.J. Mallya, & D. Mujuni

Contact:

Chief Executive Officer
Geological Survey of Tanzania (GST)
P.O. Box 903, Dodoma, Tanzania
Tel: +255262323020
E-mail: madini-do@gst.go.tz
Web: www.madini-do@gst.go.tz

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1. INTRODUCTION

Songwe Region is located in southern highland of Tanzania between 32 °to33°40' east and 6° 55 To 9° 38'south (Figure 1). It covers an area of 24601.4km².The region has land borders with three regions; including Tabora to the north, Rukwa to the West through North West, Mbeya to East. The region border Zambia to the south. Lake Rukwa in the west is the large water body in the region. Songwe Region is divided into four districts namely; Songwe, Ileje, Mbozi and Momba.

Geologically, Mineral occurrence in Songwe region can be separated into eight major groups based on their physical and chemical properties:- Base Metals (Copper), Energy Materials (Coal), Construction Raw Materials/Aggregates(Pozzuolana –Cement), Decorative and Dimension stones (Granite and Travertine), Gemstones (Diamond and Tourmaline), Industrial Minerals (Mica, Phosphate, Fluorite, Diatomite, Foide Minerals, and Zeolithes), Mineral and Thermal Water(Associated with Helium, halite and thernadiate), Other Natural Gases (Carbon Dioxide), Precious Metals (Gold associated with Silver, Tungsten and Molybdenum) and Rare Metals (Niobium associated with Fluorite).

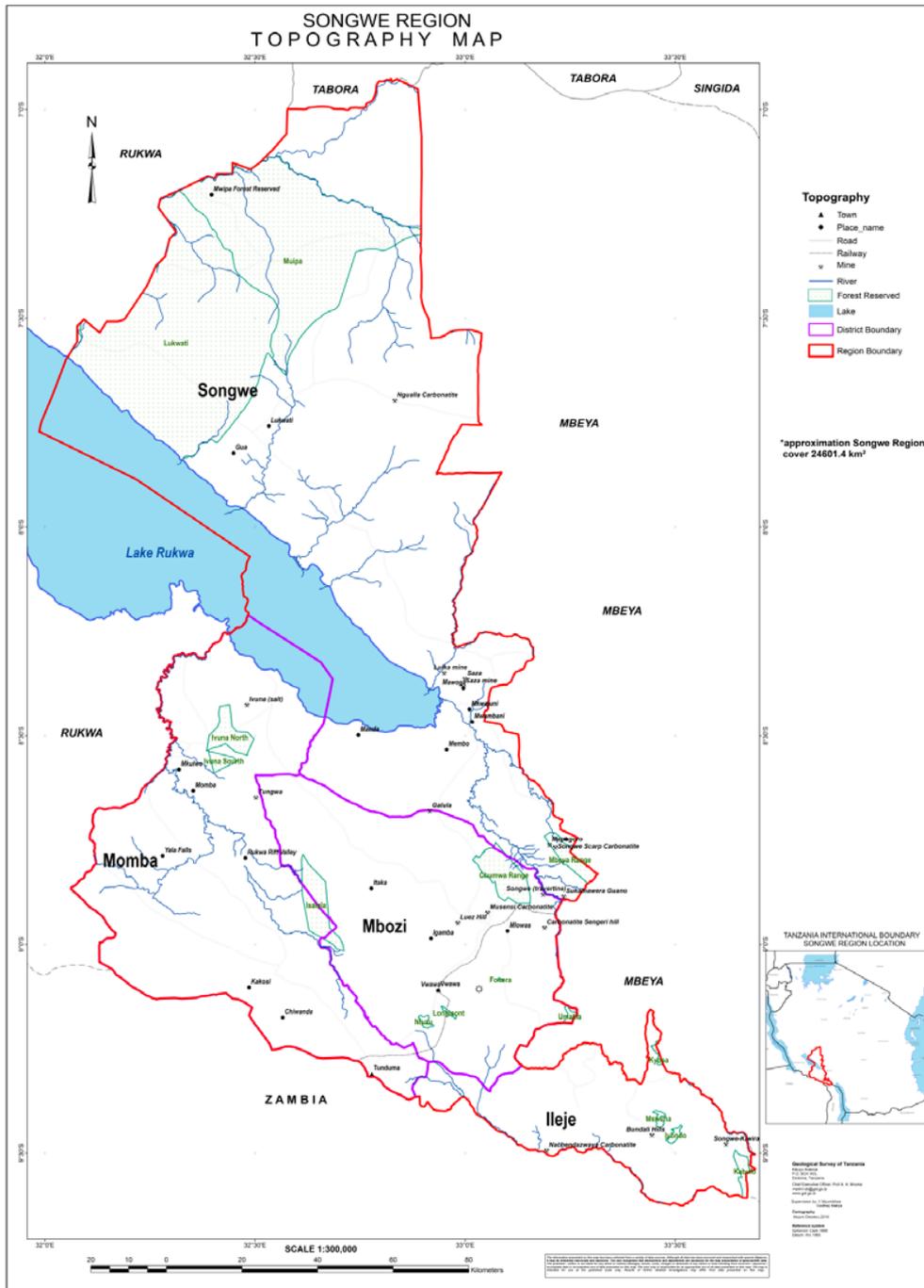


Figure 1: Topographical Map of Songwe Region Showing Location of Major Mines

2. GEOLOGY AND MINERAL OCCURRENCES

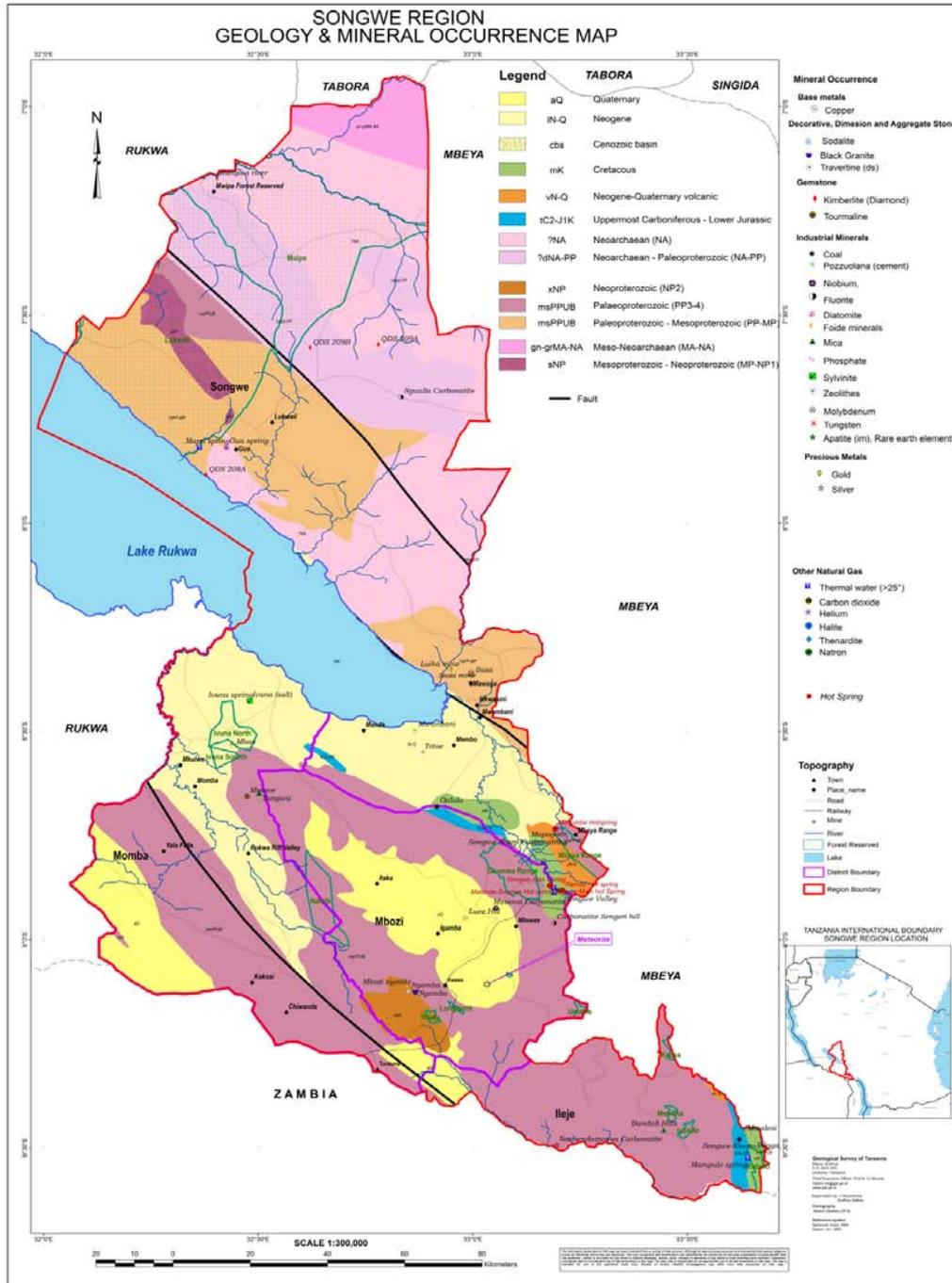


Figure 2: Geological Map Of Songwe Region Showing Location Of Mineral Occurrences

2.1 Base Metals (Copper)

Copper occurs in two localities at Songwe region, in Mao area north of Momba district town and Luez Hill in Mbozi district. These occurrences lie within the Lapa gold field and found in association with auriferous quartz veins.

All US coins are now copper alloys, and gun metals also contain copper. Most copper is used in electrical equipment such as wiring and motors. This is because it conducts both heat and electricity very well, and can be drawn into wires.

Copper is tough, malleable and highly conductive, making it one of the world's most important metals.

Copper is essential to all living things and plays an important role in modern technology. It has served humanity for 7,000 years, yet is still a modern metal. Electric power and electronics, the basis of today's society, are founded on the excellent ability of copper to conduct electricity. Nearly half of all copper is used for this purpose. Other important areas of consumption are the building, workshop and processing industry. The primary use for copper within the car industry is for car radiators and electronics. Shipbuilding, the offshore industry and desalination plants are other copper markets. There is also a very useful alloy of copper and zinc that is brass.

In addition, Copper is a very big recycling metal. Nearly 90 per cent of the available scrap is recycled.

Pure copper oxidizes very slowly. Copper cylinders are therefore used to store spent nuclear fuel. A copper cylinder with 10 cm thick walls will last for one million years before oxidizing through.

Copper is shipped to fabricators mainly as cathode, wire rod, billet, cake (slab), or ingot. Through extrusion, drawing, rolling, forging, melting, electrolysis, or atomization, fabricators can form wire, rod, tube, sheet, plate, strip, castings, powder, and other shapes. These copper and copper-alloys are then shipped to manufacturing plants that make products to meet society's needs.

2.4 Decorative, Dimension and aggregates Stones

Dimension and decorative stones are hard, non-slatery natural stones either mechanically and/or manually worked into more or less regular geometrical shapes with specific dimensions. If they have less irregular shapes they are called ornament stones.

In Today's life, dimension and decorative stones are used in making slabs, gravestones, window sills, stair treads, floor tiles and wall tiles. They are also used in making high quality aggregates for contraction purposes.

2.4.1 Black Granite

As Dimension stone, granite displays a remarkable range of colours, patterns and textures, and is notable for its hard-wearing qualities and ability to sustain qualities when exposed to other elements. Geologically, there is wide spectrum of rocks representing the commercial term "granite", and these include gabbro, dolerite, syenite, charnokite and gneiss. Such rocks tend to be

concentrated within either high grade metamorphic terrains or intrusive igneous complexes of predominantly Precambrian age. Granite of Songwe region is black granite (gabbro) that lies within Syanitic-gabroic complex

At Namkwele in the Ileje District, Songwe Region, a big deposit (12.5 km x 1.1km) of coarse black gabbro can also be proposed for use as “black granite”

2.4.2 Travertine

Travertine is located in Songwe River of Mbozi district; about 800m south west of the district border of Songwe, its commercial name is called Songwe River Travertine. Geologically, travertine containing calcareous onyx occurs at Songwe in Neocene volcanic of Rungwe. The Travertine is quarried since 1991,

By consolidated Mines (T) Ltd using the wire sawing method and natural Stone Products Ltd processes the material at Mbeya. Reserve are claimed to be in the order of 72 Mt and sized blocks are available.

2.4.3 Sodalite

Sodalite occurs at Nankwele hill in the southern Ileje District and N’gambe, which is just north of Malonje village in the Mbozi District., The N’gamba sodalite is a part of Mbozi-Syanite complex. Other locations which have been mentioned regarding sodalite occurrences in Songwe region are Ihanda and Msangano in Mbozi District.

Sodalite is blue mineral, which in masses makes a very valuable dimension Stone, occurs as primary euhedral crystals or as veins of in a medium to coarse grained nepheline syenite together with feldspar, nepheline, and mafic minerals

2.5 Gemstones

2.5.1 Kimberlite (Diamond)

There are three known occurrences of Kimberlite in Songwe district. Diamond is genetically bound to diamondiferous Kimberlite extrusive rocks mostly occurring in a Craton environment. Secondary diamond deposits are related to various placers without any relation to known Kimberlite pipes.

Diamonds are perhaps best known as gemstones used in jewelry, they also have numerous industrial applications because of its hardness and durability, they are ideal for grinding, cutting, drilling, and polishing. When used as an abrasive, very small pieces of diamond are embedded into grinding wheels, saw blades, or drill bits.

2.5.2 Tourmaline

Tourmaline associated with pegmatite rocks have been reported to occur in Msawe area of Momba district in Songwe Region. In pegmatite tourmaline can occur together with other gemstones such as emerald, garnet, rutile sapphire, ruby, topaz, zircon etc.

Tourmaline gemstone is a semi-precious mineral with colors ranging from magenta to teal-blue, meadow-green to vibrant yellow, and even black, tourmaline gets its name from the Sinhalese phrase “tura mali,” which means, “Stone mixed with vibrant colors.

2.6. Industrial Minerals

Industrial minerals In Songwe region are scattered in three districts namely, Ileje, Mbozi and Momba. There are ten known occurrences of industrial minerals in these districts and these are Mica, Phosphate, Fluorite, Diatomite, Pozzuolana, Foide minerals, Halite, Apatite, Zeolithes, and Sylvinite, Molybdenum, Tungsten and Niobium.

2.6.1 Micas

The Songwe Mica occurrences are located in Bundali and Tungwe hills within Ileje and Momba Districts. Geologically, mica in Songwe region is associated with pegmatite, together with such minerals as quartz and feldspar.

The common types of mica mineral group are biotite, muscovite and phlogopite. Biotite has not yet found commercial application. Muscovite and phlogopite have similar properties however muscovite is less heat resistant than phlogopite. The commercially important micas are muscovite and phlogopite, which are used in a variety of applications. Mica's value is based on several of its unique physical properties.

Mica is stable when exposed to electricity, light, moisture, and extreme temperatures. It has superior electrical properties as an insulator and as a dielectric, and can support an electrostatic field while dissipating minimal energy in the form of heat; it can be split very thin (0.025 to 0.125 millimeters or thinner) while maintaining its electrical properties.

The main consumers of muscovite are electrical engineering, radio engineering and television manufacturing sectors.

Phlogopite is used in plastic, as replacement for asbestos, for deep oil drilling muds, insulation materials in electronics and pigment in paints. Milled micas is used for roofing felt, in drilling muds, paints, as filler in plastics, rubber and gypsum plates, special papers, mortar etc.

2.6.2 Phosphate

In Songwe region, small phosphate deposit is known to occur in Sukamawera guano area in Ileje district. In Sukamawera, phosphate originated from young sedimentary rocks formed from Guano, (excrement of birds), developed in sedimentary environment of these formation.

About 90% of phosphates are used for the production of fertilizers and close to 10% are used to manufacture pure phosphate and phosphoric acid for production of cleaning agents, cosmetics, food stuff, fodder and similar commodities.

2.6.3 Fluorite

Fluorite is known to occur in Carbonatites of Ngualla and Sengeri hill. These deposits lie in Ileje and Mbozi district. Fluorite in these areas occurs as accessory mineral in carbonatites rocks.

Fluorite is widely used in the iron and steel metallurgical industry for reducing the melting temperature of slag. The chemical industry uses fluorite for production of various products. Fluorite is also used in ceramic, glass and optical industries. Fluorite is used for aluminum metallurgy in aluminum industry.

2.6.4 Diatomite

Diatomite, also known as diatomaceous earth, is the naturally occurring fossilized remains of diatoms. Diatomaceous earth consists of fossilized remains of diatoms, a type of hard-shelled algae. Diatomite is found in Totoe area which about 15km north Galula coal mine in Mbozi district.

It is used as a filtration aid, mild abrasive in products including metal polishes and toothpaste, mechanical insecticide, absorbent for liquids, matting agent for coatings, reinforcing filler in plastics and rubber, anti-block in plastic films, porous support for chemical catalysts, cat litter, activator in blood clotting studies, a stabilizing component of dynamite, and a thermal insulator.

2.6.5 Foide Minerals

Mbozi Syanite located in Mbozi district is the source rock for foide minerals. Syanite is feldspar bearing acid and alkaline intrusive rocks that consist of Foide minerals. Laucite is one of the foide rocks that mainly consists commercially economic minerals called Potassium feldspar and potassium foide.

About 85% of feldspar is used in ceramic and glassy industry. It is also used in construction industry as well as in the manufacture of abrasive, filler in plastics, paints and rubber, as metallurgical flux. Potassium feldspar and potassium foide rocks can be used as long-acting fertilizer.

2.6.8 Zeolithes

Zeolite is formed by the reaction of pore water with volcanic rocks or clays. While only eight of these minerals can be found in commercial deposits, all of them have large open "channels" in their crystal structure that provide a large void space for the adsorption and exchange of cations

The mapogoro Zeolite occurrence lies within the Rukwa rift valley close to the Mbalizi-Mkwajuni road. It is 5km NW of Njelenje Village. Here, the zeolite mineral phillipsite was identified in lake beds together with feldspar and in places, chabazite. In places three phillipsite layers can be traced along strike for 4 km. The thickness of each of these layers varies from 0.6 to 2.0 m. The minimum Resources easily mineable by open cast mining were calculated as 84 kt. The total geological resources are at least one order of magnitude larger.

Here, the zeolite mineral phillipsite was identified in lake beds together with feldspars and, in places, chabazite. Two, and in places three phillipsite layers can be traced along strike for 4 km. The thickness of each of these layers varies from 0.6 to 2.0 m.

Due to this property zeolites are increasingly being used in aquaculture, agriculture, horticulture, the chemical industry, waste management and for domestic use. While the chemical industry prefers artificial zeolites to natural zeolites due to their more uniform structure and properties, in the agricultural field nearly all zeolites can be used as animal feed additives, as soil and compost additives, as potting media and as a medium for nitrogen capture, storage, and slow release.

2.6.9 Coal

Coal is an important source of fossil energy. It is used mainly for generating electrical energy, production of coke for metallurgical use, for heating purposes and for the production of synthetic fuels in a coal hydrogenation process. There are two main well known occurrences of coal in Songwe Region that lies in Ileje (Songwe-Kiwira coal Deposit) and Mbozi (Galula Coal Deposit) Districts.

The Songwe-Kiwira coal deposit is the important coal field is located 40 km west of Lake Nyasa at the border of Malawi, It was discovered in 1896 by the German geographer BORNHARDT. In the 1930s, 1940s and 1950s detailed investigations were undertaken and mining started at Ilima in 1953. In the 1980s, the **Kiwira** coal mine was developed with Chinese assistance, to re-place the former Ilima mine. Recently, it was planned to expand the existing underground production to 300 kt/y. new open cast pit is planned to be opened (1.2 Mt/y) to provide coal to a planned 200 MW power plant (SOURCE WATCH, 2014a; SOURCEWATCH, 2014b). A modern geological description is provided by SEMKIWA, KALKREUTH et al. (2003).

The Galula coal is the small deposit preserved in the Galula Sub-Basin, a half- graben structure, 15 km southwest of Lake Rukwa. It is located 60 km northwest of the town of Mbeya. The Galula coal field was found in 1934. The coal field is bound to the margin of a fault block formed in the Western Rift. The coal is of moderate quality with low sulphur content. Reserve of 53 Mt are reported by MEM (2005)

3.0 Pozzolana

In Mbozi District, natural pozzolana deposit occurs at Mwanbana about 2.5km south of the southern boundary of Lake Rukwa. Pozzolana is a porous variety of volcanic tuff or ash used in making Portland cement and Construction raw materials. Pozzolana is a natural material containing silica in a reactive form. It may be further discussed as siliceous or siliceous and aluminous material which in itself possesses little, or no cementations properties but will in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperature to form compounds possessing cement properties.

3.1. Molybdenum

Molybdenum is a chemical element with symbol Mo and atomic number 42. The name is from Neo-Latin molybdenum, from Ancient Greek molybdos, meaning lead, since its ores were confused with lead ores. Small amount of Molybdenum have been recorded in Saza mine of Songwe District. Molybdenite (MoS₂) is significant economic ore mineral of molybdenum. The minimum minable grades amount to 0.3% Mo, in large deposits but in Sanza mine Mo is mined as byproduct of Au and its grade is anticipated to be much lower.

Generally, Minor amount molybdenite and chalcopyrite occurs in Sanza mine with sulphide minerals dominated by less than 1% pyrite and rare amount of galena and scheelite also associated with mineralization.

Molybdenum is used in steel industry, chemical industry and ceramic industry. More than three quarters of the world molybdenum production is used in steel industry. In chemical industry molybdenum is used as catalyst and lubricant and ceramic industry is used as pigment and glazes.

3.2. Tungsten

Tungsten has been reported in Rungwa River in Songwe District close to the northern boundary of the district. Tungsten in the area occurs together with Gold but gold being the major commodity. The occurrence is within mwipa forestry reserve and geologically lies in meta-igneous rocks of Paleoproterozoic tectonic unit. Tungsten is strategic metal that is valuable due its hardness in various alloys.

Tungsten is used for manufacturing of tungsten carbide, cutting and drilling tools. Due to its high melting point it is also used in electrical industry.

3.3 Niobium

Niobium is the Rare earth element associated with carbonatite intrusive rocks and has been reported at three localities in Songwe Region: Nachendazwaya, Musensi and Ngualla. Generally,

economic rare earth elements require a minimum content of 2-6%.The minimum mineable grade of niobium amount to 0.3%.

REEs are essential components of new materials. They are used in hybrid cars, energy saving bulbs, LCD screens, Solar panels etc., in special products, for chemical catalyst, in the glass and ceramic industry as well as for the production of special magnetic materials.

More than 80% of Niobium world production is used for special steel and high performance alloys. Niobium combined with Tantalum (Nb-Ta alloys) is used in the manufacturing of superconducting magnetic materials.

2.7 Mineral and Thermal Water

There are eight known geothermal hot springs in Songwe Region. These are Songwe miyanga spring, Gua spring, Songwe river spring, Ivuna spring, Songwe rambo spring, Mapu spring, Mampulo spring and Songe main spring. Four of these thermal springs produce gases as well and these are Gua Spring (helium), Ivuna Spring (Halite), Songwe Rambo Spring (Nitrogen) and Songwe main spring (thernadite).

All of the geothermal spring in Songwe Region have greater than 25 degree in Songwe region is capable of The main use of geothermal energy is the production of electricity to light homes and streets.

From hot springs, geothermal energy has been used for bathing since Paleolithic times and for space heating since ancient Roman times, but it is now better known for electricity generation. Worldwide, 11,700 megawatts (MW) of geothermal power is online in 2013.^[6] An additional 28 gigawatts of direct geothermal heating capacity is installed for district heating, space heating, spas, industrial processes, desalination and agricultural applications in 2010.^[7]

Geothermal power is cost-effective, reliable, sustainable, and environmentally friendly, ^[8] but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating, opening a potential for widespread exploitation. Geothermal wells release greenhouse gases trapped deep within the earth, but these emissions are much lower per energy unit than those of fossil fuels. As a result, geothermal power has the potential to help mitigate global warming if widely deployed in place of fossil fuels.

2.8 Natural Gases (Helium and Carbon Dioxide gases)

The Noble gas helium is the second most abundant element in the solar system. Due its volatile helium is also found in the atmosphere. Presently the world's supply of Helium comes almost exclusively from natural gas production where a major by-product is. Yet due to hydrothermal reservoir related to African rift structure Tanzania is rich in hot spring production gas of which two groups can be distinguished:

1. Hot spring with high Nitrogen released often enriched in Helium
2. Hot springs releasing highly Carbon dioxide enriched gases.

In Songwe Region, Much more are Songwe River hot springs which are known for their high carbon dioxide contents of > 95% at gas flow of 1,000 l/h.

In Songwe Region, Gua Spring located in Songwe District, 82 km North West of Saza Mine release helium.

Helium is used for wide range of applications such as welding and thermal cutting, laser technology, magnetic resonance imaging, semiconductors and in the research and development of materials and cryogenic physics.

Carbon dioxide is mainly used for producing sparkling soft drinks like Coca-Cola.

While helium is highly in demand in developed countries, potential investors should be aware that all the discharge data from Tanzania hot spring is pretty old and gas flow and composition if known may have changed considerably in the meantime. In general natural gas sources are considered to be profitable with helium content of >0.3% and discharge of >2,500,000m³ helium/year.

2.9 Precious Metals

2.9.1 Gold

Gold in Songwe Region of Southern Tanzania is known to occur in two districts, Songwe and Ileje. In general there are four known occurrences of Au in the region.

In Songwe District, well known are the famous two gold mines of Luika and Sanza. Sanza Mine is active whereas Mining at Luika has stopped. Both Mines are located on the south-East of the District. The Mines are about 600m apart and bound to Metasedimentary-Meta-Igneous Complex of Paleoproterozoic age.

Five other Important Au occurrences located in Mwalesi and Ikinga areas of Ileje District in Songwe Region are known from Terrestrial clastic sediments and continental marine sediments of cretaceous and uppermost carboniferous- lower Permian respectively.. Here more work is needed to investigate the rocks units that host gold. The other two occurrences are located between Saza and Luika Gold Mines with last occurrences in Rungwa River.

Gold is extremely malleable, conducts electricity, doesn't tarnish, alloys well with other metals and is easy to work into wires or sheets. Since then most *gold* used to make jewelry is an alloy of gold with one or more other metals such as copper, silver, and platinum would increase its durability. The world consumption of new *gold* produced is about 50% in jewelry, 40% in investments, and 10% in industry.

2.9.2 Silver

Silver is found in Sanza area of Songwe District. Mining is taking place at Sanza mine; here Silver is mined as by product of Au mining. In most cases the minimum minable grades of Silver are 450g/t.

Sanza mine is located within Lupa gold field. Between 1939 and 1956 Sanza mine was in operation and produced 1.1 Mt yielded 7,531kg Silver averaging 6.8g/t Ag in the ore.

At Sanza mine the Ore minerals for silver are sulphide mineralization that mostly consists of pyrite with subordinate chalcopyrite and galena.

Silver has many industrial uses, accounting for more than half of annual demand worldwide over the last five years.

Silver is mainly used to make Jewelry and Silverware. Jewelry and silverware are two traditional uses of silver. Malleability, reflectivity, and luster make silver a beautiful choice. Because it is so soft, silver must be alloyed with base metals, like copper.

Silver is also used in photographic and electronic industries. Approximately 33% of the silver is used to make coins, jewelry, coins and table ware.

Geologically silver occurs in many different genetic types of deposits that include epithermal-hydrothermal and often accompany other metals such as Cu, Pb, Zn, Au, Sn, W, Co, Ni, U.

3. CONCLUSION AND RECOMMENDATION

So far Mineral development activities are focusing on precious, base metals and gemstones. On other end industrial minerals are located in many areas within the Songwe region and can be pillar for industrial development of the region but have been given minimum attention throughout the country.

Industrial minerals are not only useful and can be easily extracted by local communities for improvement of livelihoods and direct poverty reduction, they can also generate a good profit when mined sustainably and used and marketed professionally.

It is extremely important for all investor to confirm all types of data from Geological Survey of Tanzania, located in Dodoma before applying for exploration licenses. Geological Survey of Tanzania (GST) is responsible for storage of geoscientific data and information used in the mineral resources sector, all investors in mineral sector are welcome to visit this government agency for information related to mineral occurrences before they put boots on ground for mineral searching. In Songwe Region more research and Investigation of Mineral Occurrences is still required because some the mineral information data is old. Having said that, in Songwe region there is great possibility to discover more minerals by using modern mineral exploration methods.

4. REFERENCES

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