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Primitive way of Opal Mining and its Impact on Environments Case study in WegelTena, Wollo, Ethiopia.

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Abstract

Gem mineralextractionactivities have been practiced widely in prospected area. Primitive opal gem mining by caving become source of livelihood and employment for many landless and unemployed citizens and important source of hard currency. This work was initiated to assess the status of miners and evaluate resulting impacts on environments in WegelTena. Approach methods including field observations, interviews, discussions, and reviewing of existed evidences were employed. From analyzed data the majority of the miners were adults, unemployed, and landless. They practiced old methods and arbitrary approaches to dig and access the opal gem from subsurface which leads to an inevitable natural resource's degradations. Land disturbances and severe soil erosion, vegetation and biodiversity lose were the serious threats primitive mining method. The local communities have to come up with toothed and sustainable strategies to make it environmentally friendly with optimum benefits. Further studies were also recommended on impact of primitive mining on loss and gain balance for future society.

Key words: *primitive, opal, impact, mining*

1. Introduction

Mining activities are the integral part s of societal development. Mining is the extraction of minerals and other geological materials of economic value from deposits on the Earth. Mining

adversely affects the environment by inducing loss of biodiversity, soil erosion, and contamination of surface water, groundwater, and soil. Mining can also trigger the formation of sinkholes. The leakage of chemicals from mining sites can also have detrimental effects on the health of the population living at or around the mining site.

In early 2008, a new source of play-of-color opal was discovered by farmers near Wegel Tena in northern Ethiopia (Fritsch and Rondeau, 2009; Mezzo et al., 2009; Rondeau et al., 2009). Since January 2009, the deposit has been worked by about 200 local miners. The opals are mostly white, which is uncommon for play-of-color volcanic opal, and may resemble material from Australia or Brazil. Wegel Tena opals differ from those found at Mezzo, in Ethiopia's Shewa Province, or in neighboring Somalia, which are mostly orange to red to brown (Koivulaeal.,1994;Gauthieretal.,2004).

Fig 1: Extracted delanta opal.

1.1 Environmental Impacts of Mining

1.1.1Air Pollution

Air quality is adversely affected by mining operations. Unrefined materials are released when mineral deposits are exposed on the surface through mining. Wind erosion and nearby vehicular traffic cause such materials to become airborne. Lead, arsenic, cadmium, and other toxic elements are often present in such particles. These pollutants can damage the health of people living near the mining site. Diseases of the respiratory system and allergies can be triggered by the inhalation of such airborne particles.

1.1.2 Water Pollution

Mining also causes water pollution which includes metal contamination, increased sediment levels in streams, and acid mine drainage. Pollutants released from processing plants, tailing ponds, underground mines, waste-disposal areas, active or abandoned surface or haulage roads, etc., act as the top sources of water pollution. Sediments released through soil erosion cause siltation or the smothering of stream beds. It adversely impacts irrigation, swimming,

fishing, domestic water supply, and other activities dependent on such water bodies. High concentrations of toxic chemicals in water bodies pose a survival threat to aquatic flora and fauna and terrestrial species dependent on them for food. The acidic water released from metal mines or coal mines also drains into surface water or seeps below ground to acidify groundwater. The loss of normal pH of water can have disastrous effects on life sustained by such water.

1.1.3 Damage on landscape

The creation of landscape blots like open pits and piles of waste rocks due to mining operations can lead to the physical destruction of the land at the mining site. Such disruptions can contribute to the deterioration of the area's flora and fauna. There is also a huge possibility that many of the surface features that were present before mining activities cannot be replaced after the process has ended. The removal of soil layers and deep underground digging can destabilize the ground which threatens the future of roads and buildings in the area.

2 Materials and Methods

2.1 Location and Access

The opal mining area lies in Amhara region (WolloProvince, ~550 km north of Addis Ababa and ~200 km north of the Mezzo opal deposit (Shewa). The locality has also been referred to as "Delanta, its town is named Wegel Tena (fig1) which corresponds to a former subdivision (or "Awraja") of Wollo Province. The region containing the deposit is called TsehayMewcha, a large area that encompasses scattered farms and a small village, about 17 km northeast of the village. TsehayMewcha is situated on a plateau at an altitude of about 3,200 m. The opal occurs in a horizontal layer that is exposed on a cliff above a canyon tributary of the Blue Nile River. This layer is ~350 m below the top of the plateau TsehayMewcha is accessible with a four-wheel-drive vehicle, and the various mine workings are reached by walking down the steep canyon for 30 minutes to more than one hour.

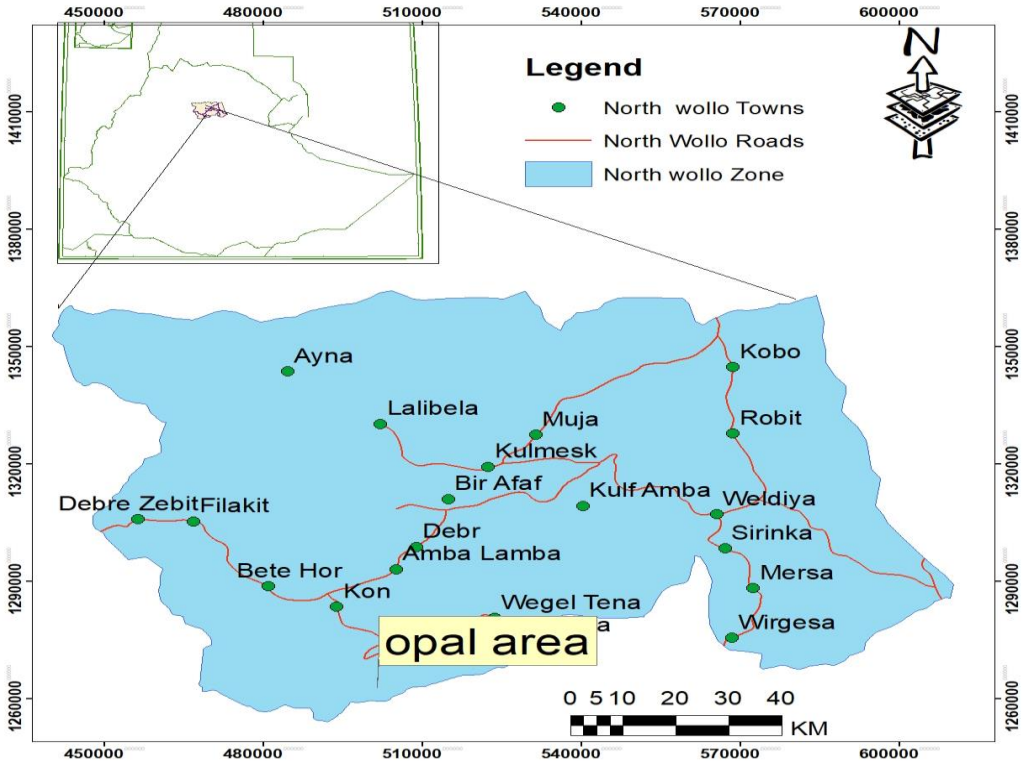

Fig: 2 location map of opal deposit and mine area

2.2 Geologic Setting

Basalts and ignimbrites form typical plateau topography, which is often extensively eroded and dissected by deep gorges. The maximum thickness of the plateau ignimbrites is extremely variable, ranging from 500 m in the north (Wegel Tena area), to 700 m in the southwest (Jima area), and to as low as 30 m in the Debre Birhan area (central plateau), close to the rift margin. Individual flow units vary in thickness from 3 m to 15 m. Several north-south trending micro granitic dykes crop out in the plateau, especially in the Woldia area. However, they are geochemically distinct from the ignimbrites, suggesting that these dykes are not feeder dykes (Ayalew, 1999). Oligocene ignimbrites of the western plateau cover an area of 7-104 km2, with an estimated volume of 43 - 104 km^3. McDougall et al. (1975) estimate that 105 km^3 of rocks were removed from the western part of the Ethiopian plateau. As the volume of the Oligocene ignimbrites represents on average 20% of the volcanic pile, the volume of ignimbrites removed by erosion can be estimated to be at least 2 -104 $km^{3.}$ Therefore, the initial volume of the Oligocene ignimbrites of the western plateau was probably at least 6.3 -104 km^3. This is a minimum estimate for the Oligocene silicic volcanics, because the Harar (eastern) plateau is not taken into consideration. Three regionally distinct Oligocene rhyolite units are recognized (1) the Lima Limo rhyolites in the northwest plateau forming several beds capping low-Ti basalt floods, (2) the Wegel Tena rhyolites in the east corresponding to very thick ignimbrites overlaying high-Ti flood basalts, and (3) the Jima rhyolites located in the southwestern plateau overlaying high-Ti flood basalts. The Miocene rhyolites are situated in the Molale-Debre Birhan area close to the rift margin and overlay Geology. Based on field geological data from regional the area comprises four major groups of the Cenozoic volcanic rocks: i) Eocene-

Oligocene, ii) Oligocene-Miocene, iii) Late Miocene and Quaternary volcanic rocks and associated lacustrine and superficial sediments. Previous formational names Ashangie basalt, Wegel Tena rhyolite, Dessie basalt, Tarmaber-Megezez Formation, Kemise Formation, Dalha Formation are adopted fromZanettin et al. 1974; Tefera et al., 1996; Hoffman et al., 1997; Ayalew et al., 2002 and Wolfenden, 2003.

2.2.1 Wegel Tena Rhyolitic Ignimbrite

It is exposed on Ajibar road, north of Wegel Tena town and Gishen Mariam and Ambassel sections. The ignimbrites like the mafic volcanics it forms typical plateau topography. North of Wegel Tena town it is extensively eroded and dissected by the deep gorges forming sharp cliffs. In the Mekdela and Gishen Mariam area, it is found on the hill top with sharp slopes overlying the Ashangie basalts. Along Wegel Tena-Beshsilo river road section it forms plains. It forms northwest - southeast trending hill at the Ambassel section. Densely welded ignimbrites have a glassy appearance and exhibit a well-developed columnar jointing The entire region around Wegel Tena consists of a thick (>3,000 m) volcano-sedimentary sequence of alternating layers of basalt and rhyolitic ignimbrite. The layers of basalt or ignimbrite are a few meters to hundreds of meters thick. (Ignimbrite is a volcanic rock of andesitic-to-rhyolitic composition that forms sedimentary-like layers after the volcanic plume collapses and falls to the ground. The particles that form this rock are a heterogeneous mixture of volcanic glass, crystals, ash, and xenoliths.) This volcanic sequence was emplaced with the opening of the East African continental rift during the Oligocene epoch (Cenozoic age), about 30 million years ago (Ayalew and Yirgu, 2003; Ayalew and Gibson, 2009).

3 Result and Discussion

3.1 Participation on primitive opal mining

The result proved that the participation of people on primitive gem mining was downscaled to the households of a family. In general speaking though variations in number of households which participate primitive mining, there was no family which didn't participate in primitive opal mining practices in the district. Majority of the miners were adults unemployed, landless and below elementary school completed educational status. The operations were known with both legal and illegal miner operating systems.

3.2 Processes and Methods Primitive Opal Mining

3.2.1 Mining and Production

Miners at Wegel Tena often use rudimentary tools, such as the hammer and chisel to extract the opal from the exposed seam along the flank of the canyon and picks, by shovels. The mineralized layer extends for hundreds of meters along the flank of the canyon, but the excavations only penetrate 1–2 m into the mountain. Because the diggings are not supported by timbers or other means, mining is very dangerous in some extensively worked places. Tragically, many miners have died from collapsing rock. The hard rock with holes is sunk to intercept the reefs and when accomplished, the reefs are worked along the strike. Where such reefs are weathered, small-scale miners use chisels and hammers to break host rock. It was more or less similar with

Ghanaian traditional mining method (Benjamin et al., 2003). Hazardous conditions are created by cliffs in the digging areas, as well as by falling rocks due to mining activities

3.2.2 Land Disturbance and Vegetation loses

Respondents agree that all operations of small-scale miners lead to considerable land disturbance. For such primitive operations, the digging up of surface trenching, using picks and shovels were common practice. In some cases, the mining requires the stripping of overburden to expose the mineral bearing horizons. As a result, degradation of grazing areas for domestic and wild animals were common phenomenon in the district. The observations of the researchers were eye evidenced that extensive land shapes were changed. The primitive opal mining was rampant factor for deforestation. Observing dried and root exposed indigenous big trees were very common in the mining sites. The deforestation was driven by the taking off the soil which gives anchorages and the need for underground support props and use of fuel wood leading to vegetation loss. Biodiversity was also further threatened by habitat destruction and uncontrolled hunting. The land disturbances and loss of biodiversity commonly leads to tension between miners and local communities. Deforestation loosens up the soil and allows free movement of water hence high velocity which may further damage the landscape. All these hazardous conditions are present in the study area and if primitive small scale opal mining is allowed to persist with its cascading effect coupled with lack of mitigation measures the district faces a high risk of being hit by numerous natural degradations in the future of which some of them are already encroaching slowly.

Fig 3: horizontally caved rhyolite ignimbrite section in mine area on left and right side

Fig 4: when fall of drilled pyroclastic material joined river rive

3.2.3 Impacts on Society

A negative economic impact on workers and families is that Opal mining is no longer an economically sustainable industry, resulting in many miners not being able to attain a stable income from mining opals. This is because opals/opal deposits are very difficult to find and are spread out scarcely through the environment. This impacts the miners because they only receive an income from the opals they find and sell themselves. As it is extremely difficult to find opals and miners only make money off the opals, they find themselves majority of the workers and families struggle to obtain enough money to live off just mining opals.

4 Conclusion and Recommendation

Inferences from data analysis indicated that primitive opal mining in wegeltenadistrict poses a serious threat to the environments which in turn jeopardizes human lives and their livelihoods if the problem remains unsolved. The activity has been attributed to promote, extreme land disturbance and soil erosion, reasonable destruction of vegetation and biodiversity loss. From the study, stopping of primitive opal mining seems impossible measure, as this does not solve any problem as long as the operation remains with high economic value. However, itis recommendable that the government needs to protect and empower diggers /miners so that they carry out their activities sustainably and environmentally friendly. Licensing, mechanization or (method of mining techniques), training, raising awareness education on environmental issues were some of the suggestions raised that can be used to empower primitive opal miners. Further studies on the impact of primitive opal miningeffecton environments and method of rehabilitation were recommendable by the authors.

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