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Review

Prevention of future legacy sites in uranium mining and processing: The South African perspective

Khodani Matshusa *, Mosidi Makgae

Council for Geoscience, 280 Pretoria Street, Silverton, Pretoria 0184, South Africa

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ABSTRACT

South Africa holds some of the world's significant uranium deposits. There has, however, been a constant decline in uranium production due to a low demand. A recent increase in the energy demand in South Africa and increased concerns regarding climate change have rejuvenated the interest in uranium and the processing of uranium. South Africa depends on coal for the generation of its electricity and additionally the government of South Africa has prioritised nuclear and renewable energy sources to supplement the national based energy grid. There are growing global concerns regarding the environmental impacts associated with uranium mining and processing and legacy sites. This paper identifies the sources of uranium contamination and their impacts on the environment and provides the best strategies for preventing a negative legacy from future sites of uranium mining and processing. It gives an international perspective on the economic, social and environmental impacts of the legacy of uranium mining and processing. It examines the examples, guidelines and best practices that could improve the governance of uranium mining and exploration in South Africa.

Contents

* Corresponding author at: Private Bag X112, Pretoria 0001, South Africa.
E-mail addresses: kmatshusa@geoscience.org.za (K. Matshusa), mmakgae@-geoscience.org.za (M. Makgae).

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1. Introduction

South Africa has a long history of uranium mining that dates back to the 1800s but little has been done to address the impacts associated with mining and the processing of uranium. Historical mining records from Council for Geoscience (CGS) indicate that between 1888 and 2016, approximately 400 t of uranium was produced by the Dominion Reef mine in the North West Province. In the 1950s and 1960s, uranium production served mainly military purposes. This resulted in a growing state supported uranium mining industry in the West and East. Major producers during that time were the USA, Canada, the USSR, the GDR, the Czech Republic and the Republic of South Africa (Barthel and Mager, 1994).

Uranium mining and processing in South Africa has a declining public acceptance owing to negative environmental and health impacts. South Africa has significant uranium reserves; however, the production of uranium has decreased over the years because of the declining number of nuclear power plants built globally. The main environmental impacts associated with uranium mining are acid mine drainage (AMD) and the release of radioactive and toxic elements such as radon, aluminium, manganese and arsenic. In recent years, various studies have characterised the distribution (Sami and Druzynski, 2003) and impacts (Scholtz et al., 2006) of uranium mining and processing.

From 2006, the Council for Geoscience has embarked on studies relating to uranium resources in South Africa, and the results are promising. It shows that South Africa will be in a position to support the future national nuclear programme as part of the energy mix strategy. Unfortunately, there are no sufficient strategies available to prevent environmental contamination at future legacy sites from uranium mining and processing. Worrall et al. (2009) defined legacy mine land as a general term, referring to land which has been mined and is now being used for another purpose, or is orphaned, abandoned or derelict and in need of remedial work. In this paper the term legacy is defined as negative impacts of derelict and ownerless mines or processing sites. The Department of Energy (DoE) plans to increase the country's nuclear power generation capacity by 9 600 MW, which is equivalent to about a quarter of the current power supply or equivalent to the power production of about six nuclear plants by 2029, to reduce the heavy carbon emissions from coal fired power plants (Mining Weekly, 2012). According to statistics, South Africa's uranium production, which decreased from 711 t in 2000 to 579 t in 2010, is expected to increase from the 930 t recorded in 2011 to 2 000 t by 2020 at a compound yearly growth rate of 8.9% (Mining Weekly, 2012). The expected increase in production is mainly attributed to two mining projects, the Areva owned Ryst Kuil mine in the Karoo in the Western Cape, and Namakwa Uranium's Henkries deposits in Namaqualand in the Northern Cape (Global Data, 2011).

At the current production level, the uranium reserves in the country are expected to last for more than 750 years, making it a favourable uranium mining environment (Global Data, 2011). South Africa is among the top countries in the world regarding uranium reserves and accounted for a significant reserve base of an estimated 433,364 t of uranium, or around 7% of global proven reserves in 2010 (Mining Weekly, 2012).

The country contributes over 45% to the total African uranium reserves. Despite hosting substantial uranium reserves, South Africa only produced about 579 t or 1.1% of the total global production in 2010 (Global Data, 2011). The Department of Energy, in 2008, reported that the 1 800 MWe Koeberg nuclear power plant contributes approximately 6% of the total electricity generation in South Africa (Department of Energy, 2008), whereas coal-fired power plants contribute more than 90% and non-coal energy sources account for the remainder (Fig. 1). It is estimated that Koeberg has produced more than 80,000 GWh of electricity since 1984 using about eight tonnes of uranium (Eskom, 2016). The Global Data (2011) report further states that the major threat of uranium mining is the discharge of acid mine drainage (AMD) consisting of hazardous, radioactive and toxic waste materials such as aluminium, manganese, iron and vanadium, which are not recommended for human intake.

In order to minimise and prevent environmental impacts and associated financial liabilities, effective strategies for the rehabilitation of uranium sites have to be developed and implemented. The aim of this study is to review and ascertain the most effective strategies for preventing future legacy sites of uranium mining and processing. This aim will be achieved by reviewing best international practices and guidelines in order to recommend the most effective methods for preventing future legacies of uranium mining and processing in South Africa. This study will also serve as a guideline for future uranium projects.

2. The impacts of uranium mining and processing

This section explains the environmental impacts and economic or financial implications of rehabilitation of uranium mining and processing.

2.1. The impacts of uranium mining and processing on the environment

Similar to any mining and processing of other minerals, uranium mining and processing has devastating impacts on the environment. The Organisation for Economic Co-operation and Development (OECD) and Nuclear Energy Agency (NEA) reported that, mining of uranium remains controversial, principally because

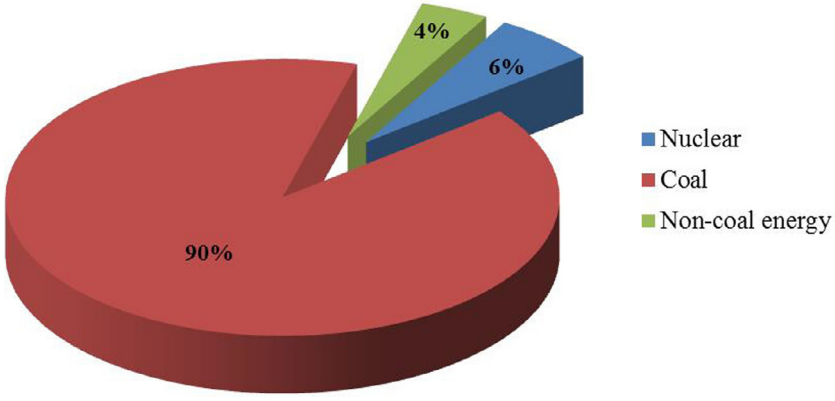

Fig. 1. Sources of energy in South Africa.