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The global uranium rush and its Africa frontier. Effects, reactions and social movements in Namibia

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ABSTRACT

Uranium mines are the often forgotten source of nuclear power. This article studies impacts and social movements at a uranium mining frontier looking at the interaction between the global social metabolism, industrial dynamics and local ecologies of resistance. Namibia, the world's fourth largest producer of uranium, stands at the vanguard of the global uranium rush with 66 granted prospecting licenses and two operating mines. We focus on three generic attributes that help to explain the emergence and intensity of resistance by local communities to uranium mining: the ecology and geography of the resource; the degree and type of political and economic marginalisation of the community; and crucially, the connection and integration of local concerns with broader social movements and political demands. We show with the use of empirical material how these factors play out differently in five Namibian communities that have been, or stand to be, affected by uranium mining, and explain how local ecologies of resistance shape, or fail to shape, the global uranium rush. Our work offers an example of an integrative approach for the analysis of the global–local dynamics of environmental change in relation to the extraction and flow of the essential materials that fuel industrial economies.

1. Introduction

In January 2012 President Obama introduced a 20 year ban on new uranium mining claims covering one million acres of land around the Grand Canyon. This comes after the Pew Environment Group and other US environmental groups denounced the threat to America's most important natural heritage sites through thousands of mining claims, many in search of uranium, surrounding the Grand Canyon, Mount Rushmore, Joshua Tree and Yosemite national parks (Pew Environment Group, 2011). One year earlier in the town of Arlit in the Sahara desert of Niger, seven employees of the French construction company Vinci and the French nuclear energy firm Areva were kidnapped by Al-Qaida (BBC, 16 September 2010) leading to a temporary stop of construction in the mega uranium mine at Imouraren. An anxious Minister of Mines and Energy assured the international community that Niger will "maintain output and not be discouraged by these dramatic events" (The Guardian, 15 October 2010). What connects such disparate events in distant – geographically and socio-economically – parts of the world is the global uranium rush (MME, 2010; Pew Environment Group, 2011). This is the subject of this article.

Uranium mining is the often forgotten first step in the production chain of nuclear power. Its risks on health and biodiversity are not as grave as those of a radiation leakage from a melting nuclear reactor, but they too can be dramatic (Brugge, 2005; IEER, 2006; ECRR, 2003; Kuletz, 1998). Given the low concentration of uranium in natural ore, considerable quantities of residues are produced during extraction and processing, including heavy metals and radioactive decayed elements. Such residues, contained in ponds or dams near the mill, can leach to underground and surface water sources. Worse still, they can escape to the environment if dams break, as happened in New Mexico in 1979 when over 1000 t of radioactive mill waste were released into the Puerco River, a radiation release greater than the Three Mile Island disaster (Kuletz, 1998). Most of the radiation typically emitted in a mining site is considered low level radiation (<100 millisieverts-mSv). Regarded as harmless or even beneficial by some scientists (Sanders, 2009), others such as the International Commission for Radiological Protection (ICRP), which sets the radiological limits adopted by the International Atomic Energy Agency (IAEA) contend that "it is scientifically plausible to assume that the incidence of cancer or hereditary disorders will rise in direct proportion to an increase in the equivalent dose in the

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relevant organs and tissues, below about 100 mSv" (Wrixon, 2008). And the National Research Council in the US (IEER, 2006) reminds that although cancer risk is expected to decline along with declining dose rates, "it is unlikely that there is a threshold below which cancers are not induced". External radiation (alpha, beta and gamma) as well as internal radiation received through radon gas, dust and water constitute major hazards in uranium mines. Many epidemiological studies carried out, among others in the Navajo population in the US and former workers of the Wismut mine that operated until 1990 in Germany, have shown links between exposure and diseases such as bronchial and lung cancer (see among others, Gilliland et al., 2000 for the US and Kreuzer et al., 2010 for Germany).

Social reaction and stricter environmental regulation of uranium mining in countries such as Australia and the US, coincide with a shift of mining activities to poorer countries with less restrictive legislation (Campbell, 2009; MMSD, 2002; Otto, 1998). In the context of a pre-Fukushima global boom in uranium prospecting driven by the re-emergence of nuclear power as the energy option of choice, Africa quickly became a global uranium frontier (Financial Times, 1 May 2009; OECD, 2009). Namibia is the world's fourth largest producer of uranium, accounting for 8% of global supply and about 5% of estimated global reserves (WNA, 2011b; OECD, 2009). Since 2005, 66 exploration licenses have been granted and three to four new mines are likely to open (MME, 2010). Drawing from the concrete reality of Namibia this article seeks to understand how global patterns and local – natural and social – ecologies combine to shape the expansion of the uranium frontier. Our aim is analytical, we focus on explaining a contemporary socio-environmental phenomenon, i.e. uranium rush, the territorial forms it takes, and the actual or potential rise of social resistance and in turn, its effects on the global patterns of expansion.

2. Theory and method

Our research is positioned within a growing literature at the interface of ecological economics and political ecology, concerned with the expansion of the global social metabolism of material and energy flows and the impacts and reactions this creates in territories and communities at the so-called extraction or commodity frontier (Moore, 2000). This is a relatively new line of interdisciplinary research (Martinez-Alier et al., 2010). It is of relevance to global environmental studies since it offers an integrative, multi-scalar (often called glocal) approach to the analysis of resource changes and related socio-environmental impacts. Whereas global environmental studies have advanced understanding of climate change, natural hazards, regional and local vulnerabilities and adaptation options, they have paid less attention to material flows and the social impacts and implications of intensifying extraction in the global periphery to fuel growth at the industrial core or at consumption centres. This is a gap addressed by the present article.

Ecological economics has shed light on the role of ecological limits and material throughput in the functioning of the economy. Analysing the patterns of expansion of material flows to new territorial frontiers and their socio-environmental impacts, political ecology has developed a better understanding of how uneven power relations within late capitalism affect differential access to resources and sinks along lines of class, race, ethnicity or gender, shaping the changing social metabolism and the distribution of its costs and benefits. The two together offer a more complete view of the drivers of change of complex socio-environmental systems.

Fig. 1 illustrates in a simplifying graph an integrative ecological economics–political ecology analytical approach to the study of a resource frontier, in our case uranium. Rather than focussing only at the local level and the impacts or grievances there, we position and explain local issues within the broader global commodity chain of extraction-transport-production-consumption and disposal of the materials at stake, itself driven by consumption and geo-political and geo-economic market forces within a globalising, capitalist world. This allows us to understand local problems in their global and political context, illuminating both the causes and the possible political interventions needed at broader scales beyond the territories of extraction. For example by shifting interest from managerial or regulatory interventions at the extraction side alone to the role of faraway consumers and advertising, global geo-economics and trade relations or to the corporations dominating the commodity or product market. Vice versa, global changes and their territorial manifestations are

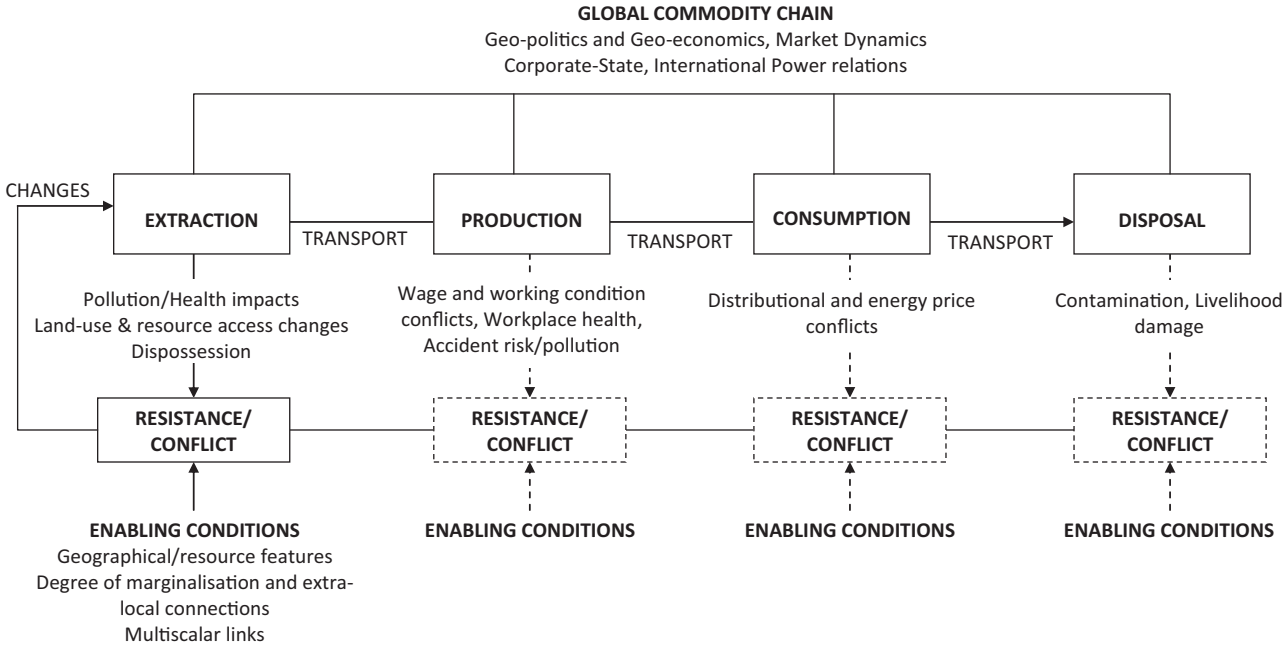


Fig. 1. The global commodity chain and resistance and conflict at the extraction frontier.

themselves the outcome of myriad local specificities and struggles. A successful social movement in a particular territory may shift mining activity elsewhere or make it so expensive as to delay or even stop it. Note that our focus in this article is on extraction in relation to global dynamics, but our general approach could be extended to studying impacts, conflicts and movements at the production, transport, consumption or disposal stages (see Martinez-Alier et al., 2010). Understanding historical, social and power relations at the local level and the ways in which these shape resistance and conflict is vital for understanding the particular shape a frontier takes, and for speculating about its future evolution. We therefore argue that the geographical pattern of global material flows is shaped by the social dynamics of resistance at the local level. In this article we try to probe this relationship between global material flows and social dynamics of local resistance.

For this latter task of explaining the conditions under which effective resistance against a commodity resource frontier emerges – or does not emerge – and the forms it takes, we draw and expand upon social movement theory. During the 1970s social movement scholars focused on resource mobilisation theory analysing **how** organisations and networks interact and mobilise (McCarthy and Zald, 1977). In the 1980s, with the study of New Social Movements (NSM) the focus of theory turned to **why** new social actors emerge (Crossley, 2002). Different currents of social movement scholarship (Cohen, 1985) have converged over time to form a more holistic explanation (Melucci, 1999 quoted by De Echave et al., 2009; Dwivedi, 2001). NSMs have been attributed to new grievances marked by a shift from economic to cultural identities, in comparison to the old class-based politics of the labour movement (Melucci, 1989). According to Bebbington et al. (2008), historically the strongest movements around extraction conflicts emerged to address issues of exploitation such as miners' working conditions and health claims. However, as technology advanced, the number of workers diminished and the environmental footprint of the mines increased, creating conflict over dispossession of land, water and other resources and loss of way of life. From an ecological economics perspective there is a direct link between the increase of such conflicts and the vast increase in the tonnage of minerals extracted, transported and used around the world (Martinez-Alier, 2002).

The causes for the emergence of social movements has been addressed by Habermas (well summarised by Crossley, 2002) as a reaction to threatened forms of life and social organisation (lifeworlds), and by Escobar (1995) who, closer to third world movements, argued social movements emerge as a reaction to the inequality and abuse caused by adverse social relationships and capital accumulation. Compared to first world environmental movements, often driven by a cult of wilderness (Martinez-Alier, 2002), third world movements have distinct causality and concerns; actors often react against the encroachment and degradation of environmental resources such as land and water that constitute the basis for their livelihoods (Redclift, 1987; Guha and Martinez-Alier, 1997) in what has been called an environmentalism of the poor and the indigenous, whose actors are often not self-conscious environmentalists (Martinez-Alier, 2002).

Social reaction and resistance to uranium extraction by indigenous environmentalists is not new. Australian aboriginal communities such as the Mirrar have been fighting the Ranger and Jabiluka uranium mining projects (Fagan, 2002) and so have, for decades, aboriginal Canadian communities in Saskatchewan (Harding, 1988). The Tuareg rebels have reacted against French Areva's mines in Niger (Keenan, 2008), the 'Jharkandi Organization Against Radiation' formed in Jharkhand, India (Ramana, forthcoming) and there is the more publicised fight of the Navajo in the US (Eichstaedt, 1994; Shuey, 2001). However, for each uranium mining project that created resistance and made it to the news, there are several others that passed unnoticed, without open reaction and conflict, or with oppression and silencing. Which are the factors that make some groups resist against resource frontier expansion, and others not?

Some authors have already pointed out some enabling conditions for the emergence of resistance movements. Peet and Watts (1996) highlight the importance of the perception and interpretation of an adverse situation, the sense of collective identity and the linkages between different social movements. Similarly, De Echave et al. (2009) link perceptions of impacts and of effects on identities and pre-existing practices with the capacity to organise in a collective way. Social Movement theory has highlighted how group size and the distribution of costs, benefits and transaction costs determine the feasibility of collective action; marginalisation of certain disadvantaged groups in this sense, is seen as a deterrent for effective collective action, though this often depends upon the perception of the gravity of the concern. Our interest however here is also on the interaction of socio-political, bio-physical and geographical factors, the last two seldom looked upon in the social movement literature which is dominated by sociologists. For instance, the combination of very low population density in a large, resource-scarce and hence uninhabited territory linked to very strong state repression might leave conflicts in a latent state for a very long time or indeed forever.

In our analysis and drawing from the social movement literature informed by an ecological-economics understanding of mining frontiers and material flows we propose three decisive enabling conditions. The first concerns the particular 'spatial ecology' of the mining resource at stake and the surrounding human and livelihood resource landscape. This includes factors such as the form and nature of impacts (visible vs. non-visible, immediate vs. slow-onset, future risk vs. acute health impact) and the location of the mine with respect to settlements and alternative livelihood resource uses that may be affected by mining activities. The perceived degree of threat to livelihoods is related to the speed and strength of the reaction (Peet and Watts, 1996). Unless there are mechanisms to understand that there is a threat, there is no possibility of reaction to it (Blaikie and Brookfield, 1987). We hypothesise that the more direct, visible and immediate the impacts on health or livelihoods are, the more likely mobilisation is. Visibility is of course socially constructed. Nuclear radiation is not visible to the naked eye, one needs instruments to detect it. But one could argue that the risks from cyanide in the leaching of gold ore are also invisible to the untrained eye. Technical risks are always subject to a process of social training.

The second condition concerns the marginalisation of the community affected and its relationship with the territory (Robbins, 2004). We focus on marginalisation to minimise the association with purely economic deprivation, emphasising marginalisation as a process where communities are excluded from the mainstream of interests and power (Jeysens, 2006). These communities lack the time and resources to participate, and the capacities to make their voices heard in the debates and arguments that lead to the formation of movement discourses (Bebbington, 2007; Blaikie and Brookfield, 1987). At one extreme one finds politically disenfranchised communities which are supposed to be 'too poor to be green' and at the other, strong, politically organised communities with broader historical-political demands. Attachment to the place and the existence of a material or symbolic economy relying on local resources are important variables in this respect (Escobar, 1995; Martinez-Alier, 2002).

Internal divisions in affected communities may produce finer lines of marginalisation. Those at the top of the power hierarchy can be bought off whilst those further down the structure are

further marginalised. The special interests of community chiefs and Union or government representatives to gain more power, alliances, contracts and money can create internal divisions and stop the flow of information to the more disenfranchised community members and particularly to women, undermining the emergence of a movement.

The third set of enabling conditions concerns connections between local inhabitants and extra-local actors, generally national or international NGOs. These often play an important role in bringing knowledge to the local level, making connections to movements elsewhere, mobilising extra-local resources for local action, and acting at different scales, turning local conflicts into glocal conflicts (Bebbington et al., 2008; Keck and Sikkink, 1998; Urkidi, 2010; Swyngedouw, 1997). Such extra-local actors are vital in forging links and exchanging knowledge among participants in conflicts at different stages of the commodity chain (hence the broken horizontal line of Fig. 1), and generate a broader awareness about the position of the particular problem or conflict within the broader commodity chain and market-geopolitical dynamic.

Our main case study is the uranium rush in Namibia, and within it we look at five sub-case-studies of projects/territories to enrich understanding of how different communities react to uranium mining. The communities examined represent different socio-economic, environmental and historical uranium mining landscapes emerging in Namibia. Note that the three aforementioned theoretical propositions did not formally precede the empirical research; we adhere instead to a grounded theory approach, whereby theory is continuously reworked as a result of empirical observation. In this sense, the three propositions identified above are the distilled outcome of our research which started with a less clear and different set of propositions and which evolved into the three propositions drawing on pre-existing social movement and political ecology theory. It rests upon further cross-comparative, and possible large-N statistical research, to test the general relevance of our propositions.

Empirical research was conducted over a period of two years, including interviews, participation in meetings, exchange of information with NGOs and other researchers. The main part of the research was carried out during three months of field work in Namibia (May–July 2009). Conde visited the capital Windhoek, and the communities analysed in this article conducting 161 semi structured interviews and two informal focus groups with different stakeholders such as community members, mine, government and union representatives, consultants to the mining industry and journalists. In interviews with policy makers and corporations we discussed the regulatory framework, the monitoring of impacts and technical aspects of mining planning and regulation. Interviews and focus groups with individuals and workers from the affected communities focused on livelihoods, perceptions and knowledge of the mining industry and reactions. Some interviewees wish to remain anonymous so interviews have been numbered for reference. A second three-week visit to Namibia in September 2011 allowed Conde to update the research, carrying out interviews with new and old contacts. Collaborative research with local NGOs has been carried out over this two year period.

The paper is structured as follows. Section 3 looks at the commodity chain of uranium, focusing on exploration, extraction, consumption and market patterns, explaining how these interact with regulatory forces that shift the extraction frontier to Africa. Trends before and after the Fukushima accidents in 2011 have been taken into account. Section 4 presents the body of the empirical research at the national and local levels. First, we explain the geographical and political-economic context of Namibia and the governance vacuum that the uranium mining industry takes advantage of. Next, we document the history of the most emblematic uranium mine in Namibia, Rössing, developed by Rio Tinto at the end of the 1970s and to this day one of the world's largest uranium mines. Next, we move to the recent rush and analyse the plans for four new uranium mines in different geo-political settings, presenting the perceptions and reactions of the communities that stand to be affected. Section 5 pulls together the various threads of this research–global and local, historical and contemporary, environmental and social–to assess and theorise the resource extraction conflicts at the uranium mining frontier.

3. The global metabolism of uranium

3.1. The commodity chain

The global metabolism of a material resource can be conceptualised in terms of a commodity chain starting with exploration and extraction and ending up with consumption and disposal. U235, the isotope required for the production of a fission chain reaction, constitutes less than 1% of natural uranium (IAEA, 2009). The first step for obtaining U235 is the mining of economically viable ores. Traditionally this has been done with either open-pits or under-ground mines. The ore extracted is crushed, ground and leached with sulphuric acid, undergoing a process of ion exchange before being dried at high temperatures to obtain yellow cake powder that is finally packed in steel drums. This process is generally carried out in a uranium mill. The yellow cake is then transported via truck, train or ship to a processing facility, where it is transformed into Uranium Hexafluoride and enriched to increase the proportion of U235. It is then turned into a hard ceramic oxide (UO_2) for assembly into rods specifically designed for each type of reactor. The rest of the yellow cake, mostly U238, is considered depleted uranium, and can be used with reprocessed plutonium extracted from nuclear waste to produce MOX, which is an alternative nuclear fuel. Enrichment facilities are only found in 11 countries, Iran being the latest addition, as countries are discouraged from developing them to avoid nuclear military proliferation. Uranium fuel rods are then transported to the various nuclear power plants (WNA, 2011a; IAEA, 2009).

The consumption and production of a resource coevolves, regulated by market forces and propelled by capital flows and the actions of corporations and investors. For the remainder of this section we look in turn at the demand, production and market forces of the uranium chain.

3.2. Demand patterns

The evolution of uranium consumption from 1945 to 2005 and the shift from military to civilian electricity uses is shown in Fig. 2. The global distribution of uranium consumption largely corresponds to nuclear energy production, with the US being the largest consumer with 104 reactors, followed by France with 58 reactors and Japan with 54 reactors operating before the Fukushima accident (WNA, 2011c).

The metabolism of uranium is driven today by an inexorably growing demand for electricity, expected to increase at an annual rate of 2.2% globally to 2035. Most of this increase in demand is expected to come from Asian countries such as China and India (IEA, 2010). Rising electricity demands coupled with international commitments to mitigate carbon dioxide emissions and climate change have been taken up by the nuclear lobby, which has successfully remarketed nuclear energy as a clean alternative (Combs, 2010; OECD/NEA, 2009; IEA, 2010). Nuclear energy is also benefiting from the possible extraction peak of oil (OECD, 2009) and the geo-political instability in Northern Africa and the Middle East. Prominent intergovernmental organisations such as the

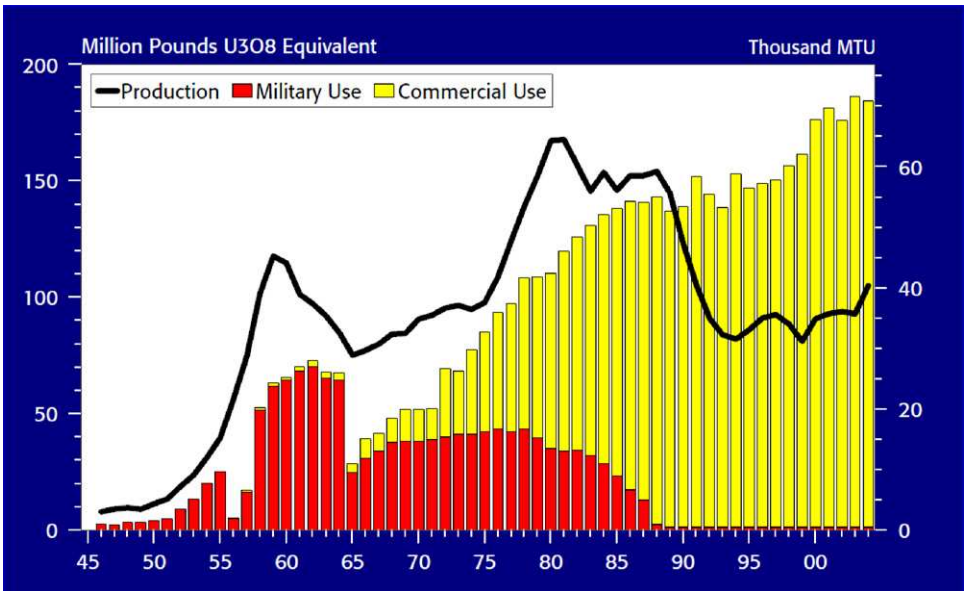


Fig. 2. Production of uranium from uranium mines.
Source: Klingbiel (2005).

OECD and the International Energy Agency see nuclear energy together with renewables as an essential component of future energy portfolios (IEA, 2010; OECD, 2009). In his 2010 State of the Union address President Obama called for "a new generation of safe, clean nuclear plants" (CRS, 2010), while even some environmentalists have joined the chorus (Lovelock, 2007; Monbiot, 2011).

With 57 new reactors under construction and 210 more on order or planned (WNA, 2011c), before Fukushima an estimated 44 countries intended to introduce new nuclear power facilities or expand existing ones in the foreseeable future. The Nuclear Energy Agency (an OECD organ) predicted an increase by a factor of 1.5–3.8 by 2050 from 441 units in operation today (OECD/NEA, 2008). The nuclear lobby claimed a "nuclear renaissance" was underway (WNA, 2011d). However partly as a result of financial difficulties and construction delays, it has proven difficult to increase or even maintain the existing number of nuclear power plants (The Economist, 14 October 2010 and 10 March 2012; Bradford, 2010; Schneider et al., 2011). The Fukushima accident further altered the course of nuclear energy expansion, with Germany being the first country to halt construction of new nuclear plants, and Japan closing down almost all (undamaged) nuclear plants for testing. Other countries with ageing reactor fleets such as the UK and France are also facing increased civil opposition (Schneider et al., 2011). After Fukushima, Russia, China, South Korea and India might slow down the rate of construction of new plants, though their nuclear plans are still underway.

Even so, this somewhat limited "nuclear renaissance" did translate into increased uranium exploration efforts, which soared between 2003 and 2009, with 400 exploration companies forming or changing their orientation to raise US$ 2 billion for uranium exploration (MEG, 2010). Pre-Fukushima predictions expected global uranium consumption to increase by 54% by 2030 (WNA, 2010). Even with much lower rates of growth, one can expect the expansion of the commodity frontiers of uranium extraction.

3.3. Production

Some 53,663 t of uranium were produced globally in 2010 from uranium mines, accounting for 78% of global consumption. Secondary sources such as civil stockpiles, decommissioned nuclear weapons, reprocessed natural and enriched uranium and re-enriched depleted uranium tailings, account for the remaining 22%. Kazakhstan is presently the leading producer of mined uranium, followed by Canada, Australia and Namibia (WNA, 2011b). Fig. 3 shows the distribution of total mine production and reserves between different countries. Production is very concentrated: the largest five uranium mines in the world – McArthur River in Canada, Ranger and Olympic Dam in Australia, Rössing in Namibia and Kraznokamensk in Kazakhstan – account for 43% of world uranium production (WNA, 2011b). Reserves are also concentrated with Australia, Kazakhstan and Canada holding 51% of reserves (OECD, 2009).

Countries such as Canada and Australia not only have larger identified reserves than Africa, but their uranium is also of better quality and economically less costly to extract. Uranium concentration in the ores generally varies between 0.1% and 0.5% (IAEA, 2009), with high concentrations of average 1.1% found in Canada at the rich Athabasca basin (Mudd and Diesendorf, 2008), compared with concentrations as low as 0.01% found in Namibia's deposits (WNA, 2010). Such ores require the use of more water and energy (Mudd and Diesendorf, 2008) and the use of alternative techniques such as heap leaching, where sulphuric acid is sprayed over piled-up-crushed ore and the solution with uranium oxide is collected below. This process allows more cost-effective extraction of uranium from lower grade ores (IAEA, 2005). However its environmental impact is greater as the piles take up more land creating a bigger hazard, releasing dust, radon gas and leaching liquid seepage (Wise uranium, 2010). The method that is becoming most dominant is In Situ-Leaching (ISL), which injects sulphuric acid solution into underground deposits to dissolve uranium, which is then pumped up and processed in the mill. This technique avoids the creation of open-pits, but there is a risk of contaminating groundwater (Mudd, 2001).

There has been a notable shift in mine investment from countries in the developed world, such as Australia and Canada, to Kazakhstan and Africa, despite the fact that the former hold most of the high quality reserves (E&MJ, 2006, 2009; MEG, 2010; Combs, 2010; Financial Times, 1 May 2009). Australia, which holds 31% of known recoverable uranium reserves followed since 1984 a 'Three Mines only Policy', in effect a moratorium on all new uranium mines (Panter, 1991). The moratorium was accompanied by strong

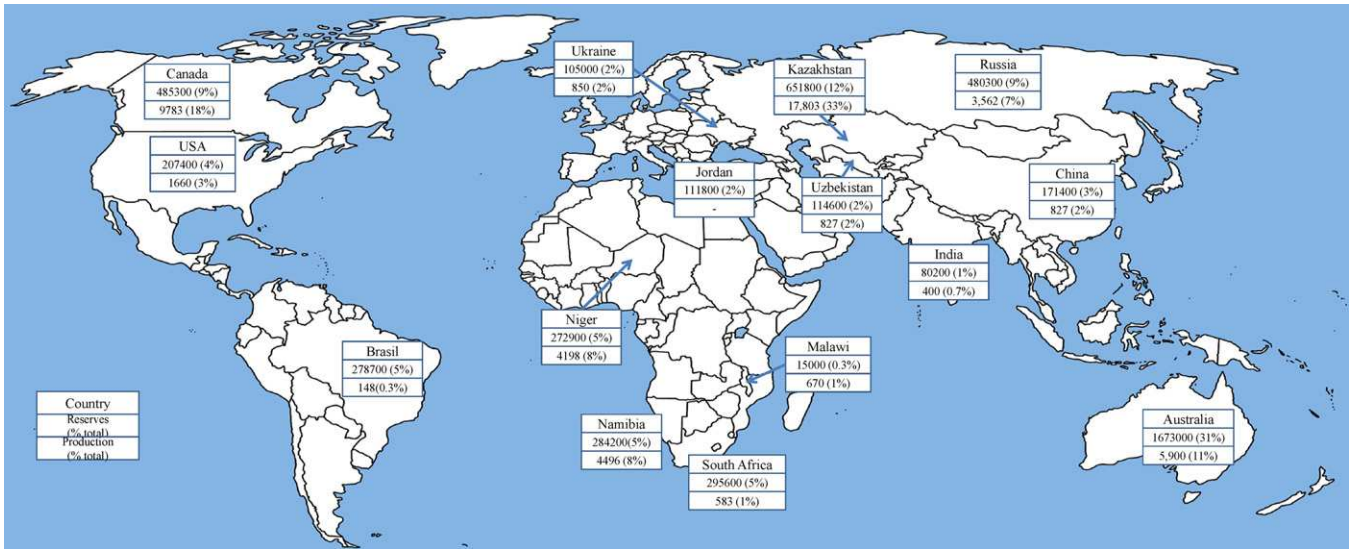


Fig. 3. Major uranium producers and major world reserves of uranium (cost of extraction at less than US$130/kg U).
Source: WNA (2011b) and OECD (2009).

anti-nuclear and aboriginal movements demanding land rights (Adamson, 1999). Although legislation in countries such as Canada or Australia is not necessarily prohibitive, environmental regulation and enforcement are much tougher than in other parts of the world. The combination of this regulatory effort with effective social resistance and lengthy legal challenges can slow down the opening of a mine considerably, and make investments in Africa advantageous. As noted by John Borshoff, head of an Australian uranium mining company called Paladin Energy Ltd: "Australia and Canada have become overly sophisticated. (...) there has been a sort of overcompensation in terms of thinking about environmental issues, social issues, way beyond what is necessary to achieve good practice" (abc, 2 April 2006). As a result, several Australian mining companies such as Paladin have displaced their uranium production to places like Namibia and Malawi (OECD, 2009; RCR, 2011). Globally, of the 31 mines that were planned to open from 2009 to 2012 only five were located in Australia, the US and Canada (OECD, 2009). Thirty-four countries in Africa have already granted exploration licenses (Wise uranium, 2011) with Niger issuing more than 100 exploration permits in two years and Botswana issuing 138 (MME, 2010). During the period 2009–2012, uranium production was expected to increase 118% in Niger, Namibia, Malawi and South Africa (Kate and Wilde-Ramsing, 2011).

3.4. Industry and the market

The uranium mining industry is heavily concentrated, ten companies accounting for 87% of the world's uranium production in 2010. The French state nuclear giant Areva, the Canadian Cameco, Anglo-Australian Rio Tinto, and the Kazakhstan state company, KazAtomProm (WNA, 2011b) are the main players in this cartel-type industry. These corporate players are rooted in the major consuming countries – France, Russia, USA – or in developed countries such as Australia and Canada with considerable reserves that fed much of the early demand (Amundson, 2002; Combs, 2010; OECD, 2007). Some of these companies, such as Areva and Rosatom, are active in the whole uranium commodity chain, being major players in mining, enrichment and nuclear plant construction and operation.

While all mining commodities are susceptible to market fluctuations and concomitant booms and busts in production and investment, uranium has the exceptional feature of a very constrained range of uses and users. This makes the uranium market stable in the short-term, and extremely unstable in the longer-term. Unlike gold for example, whose prices depend on a variety of economic factors and the tastes of millions of people; or copper, which is used in a variety of industrial applications, uranium is basically used for two purposes: bombs, to a decreasing extent, and power stations, both dependent on political circumstances and vulnerable to inherently unknown events, such as a referendum or a nuclear accident. It was the Three Mile Island accident in 1979 for example that led to the spectacular bust of the 1970s boom that stopped the commissioning of nuclear plants in the US. The price plummeted to $10/lb, a level at which it stayed until the early 2000s. Fig. 4 shows the fluctuations in prices and the links to key political and industry events.

The uranium market works on the basis of bilaterally negotiated contracts between uranium producers and buyers, i.e. nuclear utilities, with a number of intermediaries including traders and hedge funds. The vast majority of contracts are transacted under long-term, typically 3–15 year contracts directly between a mine and a nuclear plant (WNA, 2010). The remainder are traded through spot trading, up to 12 month delivery, accounting for less than 20% of supply (WNA, 2010). Two features are important: first, since it takes considerable time to expand production at existing mines or through development of new mines, prices can increase for an extended period of time before production can grow to satisfy demand. Vice versa, the long-term nature of contracts means that production may continue at some level, even as prices fall, i.e. there is a time lag between price and production, though price and prospecting are more closely correlated. The cost structure of nuclear power generation, with high capital and low fuel costs, means that once power generators are in place, demand is relatively predictable, more so than for other mineral commodities.

In the 2000s, uranium price trends followed those of other commodities with a spectacular price increase up until the economic crisis of 2007/08, from just $7 a pound in 2003 to $140 in June 2007 (Fig. 4 shows yearly prices). This was provoked partly by two mine accidents lowering envisaged production, the entry in the market of hedge and investment funds and the growing perception of diminishing secondary resources, with the end in 2013 of the "megatons for megawatts" programme between Russia and the US, whereby the US supplied 50% of its requirements buying military stockpiles from Russia. This was

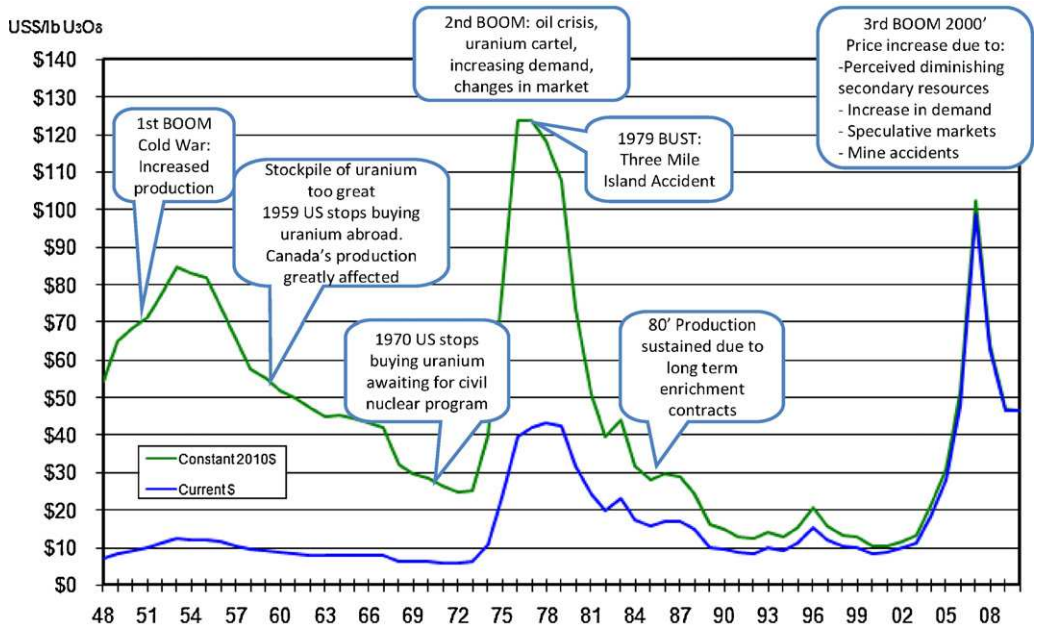


Fig. 4. Evolution of uranium price (annual average).
Price sources: 48–68 US/AEC, 69–86 Nuexco EV, 87–Present Ux U3O8 Price. Info provided by The Ux Consulting Company, LLC. *History sources*: Amundson (2002), Combs (2010), and Radetzki (1981).

reinforced by the 2007 edition of the Red Book, the authoritative publication of the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency, published annually since the 1960s about uranium supply and demand: "given the long lead time typically required to bring new resources into production, uranium supply shortfalls could develop if production facilities are not implemented in a timely manner" (OECD, 2007). However, after a spectacular rise, the price fell down to $40–50 per pound and was on a recovery path reaching $73 just before the Fukushima accident, when it fell again to $55 per pound (UxC, 2011). It has stabilised at that range ($51 in March 2012), a very high level compared to the 1990s and early 2000s.

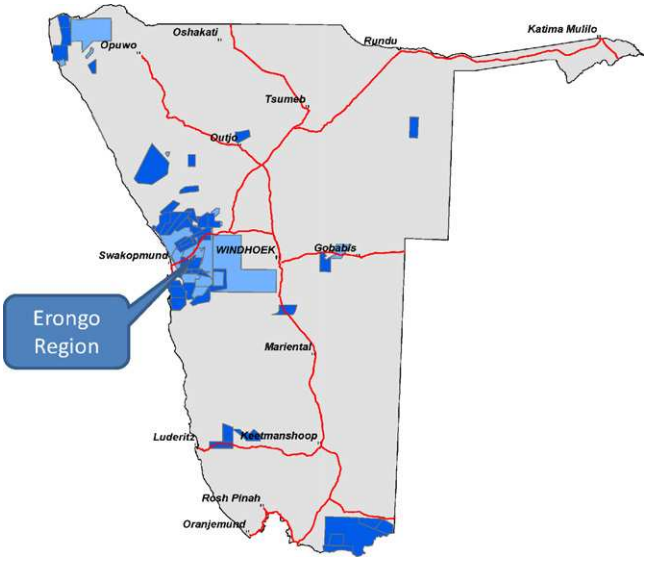
Despite the high costs of nuclear power in a context of stressed public finances and the reduction of electricity demand in countries hit by the crisis, some analysts maintained that by 2020 there would remain a substantial imbalance (of approximately 80 million pounds) between supply and demand requiring high prices to give incentives to new mining (Financial Times, 20 April 2010).

4. The effects of the global uranium rush in Namibia

4.1. Namibia's uranium rush

Why a uranium rush in Namibia? Namibia has considerable reserves, some 284,000 t, about enough to supply four years of the world's demand at 2010 levels, but they are of low-concentration and therefore expensive. Namibia's attractiveness is a function of geographical, political and social factors. Namibia has a large territory, where 2.2 million people share 824,292 km^2. This results in a low population density of 2.77 people/km^2 (World Bank, 2010). Most of central and southern Namibia is suitable only for cattle herding or small-scale horticulture and is inhabited by white big-farm owners and scattered, small ethnic tribes. It is in central Namibia, in the Erongo region, that uranium prospecting is concentrated (see Map 1). The low population density diminishes both health concerns and possible resistance that may delay the development of mines.

Namibia offers a good stable business environment. The World Bank (2009) praises Namibia as a success case with income growth of 4.5% per year since 1990. Politically Namibia is stable, governed since independence from the South African apartheid regime in 1990 by the liberation party, South West Africa People's Organisation (SWAPO), which has won all five free parliamentary elections. SWAPO quickly abandoned plans for the nationalisation of foreign corporations, opting for market-oriented policies and an investor-friendly tax regime, more accommodating than even that of neighbouring South Africa (Rakner, 2001). The royalty for uranium is currently set at 3% of revenue, a low rate by international standards (MME, 2010). Companies can apply for deferment or reduction of royalty payment; as a result uranium royalties account for only 0.08% of total government revenue in



Map 1. Map of Namibia with the 66 exclusive prospective licenses (boxes in the map).

2008 (US$2.5 m compared to the desired US$43.7 m; MME, 2010). The corporate tax rate for mining is 37.5% of profits, but several exemptions are often taken advantage of by corporations (MME, 2010), including 'Export Processing Zones', such as the one offered to Areva's Trekkopje uranium mine, free from corporate, import or sales taxes, in exchange for "technology transfer, capital inflow, skills development and job creation" (MME, 2010: 7–109).

Another attraction for investors is the lack of restrictive environmental regulation. Apart from a binding constitutional clause for ecosystem maintenance, the only other concrete body of law is the 1992 Minerals Act (currently under revision), which asks for a cursory Environmental Impact Analysis, and lacks important provisions such as mining closure and rehabilitation requirements. An Environmental Act with requirements for an EIA applicable to all mining projects was approved in 2007 but so far has not been implemented, hampered by a weak administration. Indicatively, in the Ministry of Environment, there is only one person in charge of revising all EIAs for the whole country (Interviews#138, 166); in the Ministry of Water only five people monitor the water quality of all 13 regions of the country (Interview#165). Approved uranium mining EIAs have been widely criticised by local and international NGOs (Schmidt and Diehl, 2005; Wise uranium, 2011; Interview#1). Environmental management is largely left to voluntary industry self-regulation such as ISO and corporate responsibility standards or to the Namibian Chamber of Mines programme, that is neither legally binding nor independently monitored.

Corruption in Namibia is relatively low (61st out of 180 countries in the global Corruption Perception Index), however according to the Afrobarometer (IPPR, 2008), 49% of respondents inside Namibia felt officials were corrupt. Critics contend that there is an emerging black elite based around SWAPO's control of the growing public sector (Melber, 2003; Bauer, 2001), which gives work to 22% of the employed population spending more than 30% of GDP (Sherbourne, 2009), channelling public funds to privileged interests in defence, paramilitary security and intelligence (Mbai and Sherbourne 2004 cited by Melber, 2007). Mineral exploration licences are protected by a secrecy clause in the 1992 Minerals Act and the Minister has much leverage for the terms of agreement with foreign corporations, with no public oversight (IPPR, 2010).

Namibia's low education quality (see Table 1) reflects the legacy of a two-tiered apartheid education system (Cohen, 1993). Spending in crucial sectors like health and education has declined since the mid-1990s (Sherbourne, 2009). There is a marked discrepancy in the position of the country in the global ranking of income per capita at PPP compared to its position in the Human Development Index (Table 1). This reflects a level of inequality amongst the highest in the world (Table 1).

The government maintains a focus on overall economic growth with mining at the forefront. Mining (including diamonds and other minerals) produced 10% of economic output in 2009 compared with 17% by tourism (NTB, 2008). Mining is responsible for 43.7% of export earnings (BoN, 2010) and uranium alone could in theory add 3–9% of total government revenue by 2015 (MME, 2010). There is much lip-service paid to mining as a source of employment, but the sector employs only 7500 workers (0.02% of the employed population, Sherbourne, 2009), ten times less than tourism (NTB, 2008).

Table 1
Some socioeconomic indicators in Namibia.

Indicator	Score	Source
GNI per capita PPP (2010)	US$ 6420	World Bank (2010)
Human Development Index	120th (out of 187)	UNDP (2011)
Inequality (Gini Coefficient)	0.73	HDR (2007)
Unemployment (2008)	50%	NFLS (2009)
Population living in poor conditions	27.6%	NPC (2008)
Life Expectancy	51.2 years	OECD (2008)
Education for All Development Index	83rd (out of 127)	UNESCO (2011)

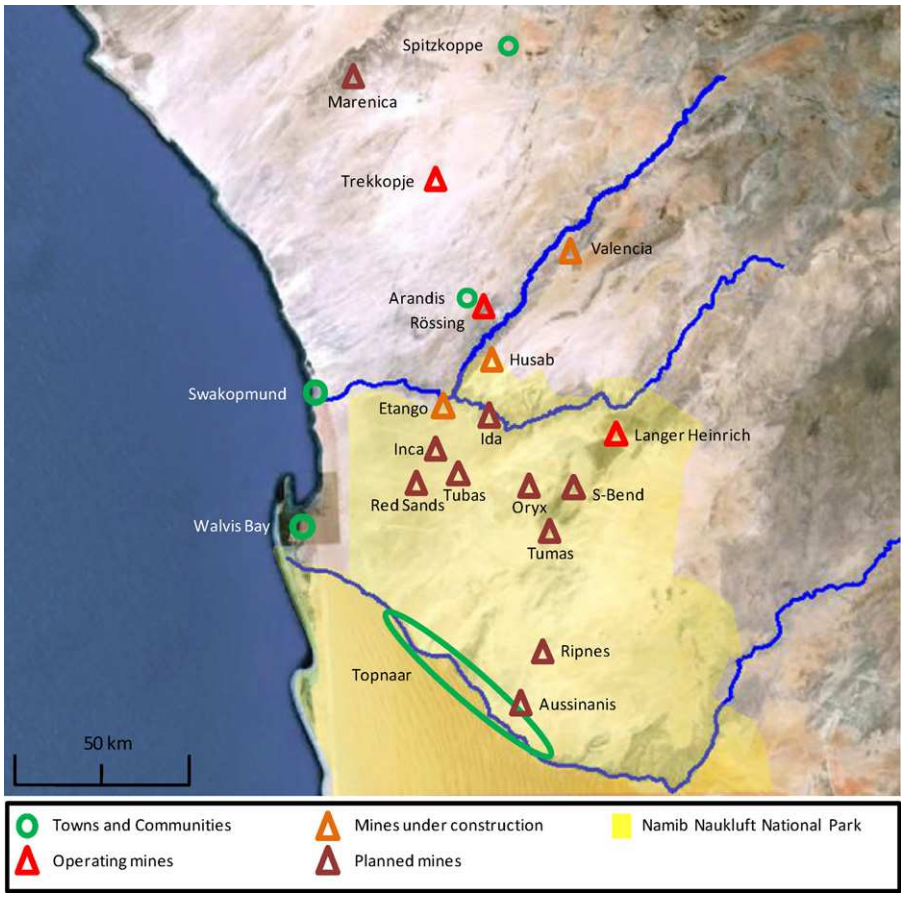
Namibia has relatively good infrastructure that facilitates material export with the mines connected to port facilities (Map 2). However, isolation, aridity, and the use of water-intensive techniques to extract the low-quality ore require new water supplies for the mines and the government is in search of funds for a new desalination plant (Interview#139). Mining also puts a strain on the electricity system, which faces periodic power shortages due to its dependency on South Africa (Sherbourne, 2009). Electricity demand by uranium mining alone may reach 200 MW by 2015 (Interview#160) compared to current demand of 564 MW in 2010 by the country as a whole (NAMPOWER, 2010); a 25 MW emergency diesel generator has been constructed, with plans for a coal-fired power plant in Arandis and the development of the offshore Kudu gas project (Interview#162).

In 2007 the government enacted a moratorium on new Exclusive Prospective Licenses (EPL) to allow environmental regulation and infrastructures to catch up. Nonetheless, at least 12 more mines are in the pipeline (Map 2). In the remainder of this section we investigate the social responses, actual and potential, to the expansion of the uranium frontier. We start from Rössing, Namibia's first and the world's 3rd largest uranium mine, and then compare four diverse cases of prospective mines with different socio-environmental settings.

4.2. The Rio Tinto mine in Arandis

The Rössing mine was founded by Rio Tinto in 1976. Rio Tinto is one of the biggest mining companies in the world with earnings of $1.19 bn for its energy (coal and uranium) segment in 2010 alone. Total production of uranium oxide from Rio Tinto's uranium mines in Australia and Namibia in 2010 was 16.6 million pounds (Rio Tinto, 2010). The Rössing mine is located in the middle of the Erongo Region, 60 km from the nearest town of Swakopmund (Map 2). Rio Tinto built Arandis at a stroke in the middle of the desert to house workers. Most came from far away, often without their families: in 1977 only 550 of the 1600 black workers were from the local Damara ethnicity, others coming from as far as South Africa or Malawi (Moody, 1992). After a long period of downscaled production, the mine in the last few years has again ramped up its production from 2000 t in 1993 to 4150 t in 2009 (Chamber of Mines, 2009). Furthermore, French Areva started building a new mine nearby Rössing and three to four new mines stand to open soon. How do locals perceive these developments? Our interviews suggest that many people in Arandis are welcoming this revival of mining activity. As interviewees stated, uranium mining means "more money into the country" (Interview#98), reopening "a bank branch, a hospital and a petrol station" and turning the town hopefully into "an industrial hub" (Interview#16) with "permanent jobs" (Interview#120).

The lack of reaction against this expansion represents a change that contrasts with Arandis' historic emblematic position internationally in social resistance against uranium mining (Hecht, 2010; Moody, 1992). The history of this resistance is worth recapping. The mine started during the 1970s global uranium boom, with a fixed contract between Rio Tinto and the British Government, which used uranium for military and civilian purposes (Avery Joyce, 1978; Roberts, 1980). By the early 1980s, the UK was importing nearly half its requirements from Rössing alone (Moody, 1991). The deal induced an international Campaign Against the Namibian Uranium Contract (CANUC), which brought together the Namibian independence movement, the anti-apartheid movement



Map 2. Main uranium mines in the area (operating, under construction and planned) and town and communities most affected by the uranium expansion. *Source*: Authors with Google Earth map and data from MME (2010) and Reptile Uranium.

(the deal was in breach of UN decisions), and Partizans (People Against Rio Tinto Zinc and Subsidiaries), a London-based grassroots organisation. The movement held a number of direct actions and demonstrations in the UK, Germany and Japan in the process mobilising students, anti-nuclear groups, campaigners and trade unions for nuclear disarmament. In 1984, the biggest contract between Rössing and a UK nuclear power plant was not renewed, partly due to weakening demand and partly due to the activists pressure. Flows of uranium from Namibia to the UK continued, despite being delayed and rerouted on several occasions as during the Liverpool dockworkers' strike in February 1988, who refused to handle 13 containers of uranium coming from Namibia (Dropkin and Clark, 1992).

The international campaign highlighted the appalling living, wage and worker rights' conditions in Arandis (Dropkin and Clark, 1992; Roberts, 1980). Rössing's workers also mobilised and held strikes in 1976 and 1978 (Hecht, 2010; Moody, 1992). The crackdown was fierce, as the Apartheid regime prohibited unionising and in 1980 closed the main workers' Union of Namibia, imprisoning much of its leadership without trial. Still, the combination of local and international pressure partly paid off, as Rio Tinto in the early 1980s set up a special foundation investing in improvements for the Arandis community. As one of the initial settlers recalls from those years: "We didn't have to pay for housing, water or electricity, everything was provided for us, we even had a social centre and sports facilities" (Interview#97). Still, in 1989 half of Rössing's workers lived in hostels without their families, while whites continued having the better jobs (Moody, 1992). In 1988, with independence around the corner, workers formed Rössing's Mining Workers Union and fought to end racism in the workplace, extending their demands on safety and health issues (Hecht, 2010; Interview#125). Hecht (2010) gives an excellent historical account of Rössing's workers' struggle for health rights and the micro-politics of science-and-technology involved. Local struggles were linked to the international movement, which after Namibian independence gave priority to health issues, with the publication in 1992 of 'Past Exposure' (Dropkin and Clark, 1992), a report that denounced the high levels of radiation and pollution in the mine, documenting a huge seepage of 780 m gallons of radioactive tailings prior to 1980. Rössing invited experts of the IAEA for inspection, who concluded that the mine had an outstanding track record and that radiation was well below safety limits (Hecht, 2010). The Union and the international campaign hired a black Namibian medical student working in Germany to conduct a health assessment of Rössing's workers, who concluded that miners had increased risks of genetic damage and a worrisome reduction in testosterone levels (Zaire et al., 1996, 1997). Rio Tinto disputed his findings with two internationally recognised scientists who concluded that there was "no chromosoma aberration" (Lloyd et al., 2001). The campaign came to a peak and then receded after 1998, when an ex-mineworker with cancer won the right to bring his US$650,000 compensation case in the UK (the Connelly case), but his case was dismissed because the time limit expired (Meeran, 2011; Hecht, 2010).

What happened to this struggle? We hypothesise that the disappearance of resistance relates to the three enabling conditions mentioned in the introduction to this article; the natural and social ecology of Arandis, the deepening process of economic marginalisation of the community, and the weakening

of the multi-scalar ties between workers and the international movement that mobilised resistance in the 1970s and up until the 1990s. First, the workers, settled in the middle of a desert, have no alternative source of livelihood other than working in the mines. Declining profitability in the 1980s and 1990s strengthened Rio Tinto in its negotiations with SWAPO, which gave up its initial plans to nationalise the mine. Rio Tinto stayed but began operating the mine in sleep mode, diverting money from a future restoration fund to keep mining operations, and cutting down on community expenses, handing the responsibility for the town to the government in 1992. Almost 70% of the workforce was fired in the 1990s (Chamber of Mines, 2009). Since Rössing was the only employer and there were no alternative employment opportunities, many people fled the town. Arandis lost many of its facilities, including the bank, the petrol station and the hospital, which was reduced to a clinic. Residents found themselves having to pay for services such as electricity, water, schooling and housing. The local authority was stripped of its revenue base, while facing increasing demands from an impoverished population (Interview#16). While marginalisation deepened, the international movement against Rössing waned. Pro-independence groups had achieved their purpose and the anti-nuclear movement subsided with the retreat of nuclear energy in the 1990s. As for Partizans, we can speculate they abandoned activities in Namibia due to internal changes, an already debilitated Rössing and the disappointing result of the Connelly case (Rössing however never ceased to appear in the black list of the group's publications).

Presently Arandis houses some 4500 people, Rössing remaining the largest and almost only formal employer providing work to 494 people in 2008. Six to eight people are dependent on each mineworker in Arandis (Hoadley et al., 2005). Although Rössing's salaries are relatively good for Namibia (they start from US$1000/year), 88% of Rössing's mine workers in 2008 were subcontracted to companies that do not offer benefits or labour security.

The revival of mining appears therefore as the only hope for the town's residents and its local authority. Yet the first signs of a renewed local–international campaign may be found in the awareness activities carried out since 2008 by Earthlife Namibia and the Labour Resource and Research Institute (LaRRI), who disseminated interviews with sick ex-workers of Rössing who link their health problems to the mine. The health impacts to workers are becoming more acute now, with many of the old workers becoming sick (Interviews#96, 98, 99, 109, 110). Assessing the full-scale of such claims is nearly impossible, as many ex-workers die unregistered at their places of origin, whereas Rössing refuses to make public any data related to the health condition of its workers not only to us but also thus far to the regional health authorities (Interview#11).

4.3. Snapshots from Namibia's current uranium rush

Whereas the community of Arandis lived through the typical boom and bust cycle of the uranium industry, the following four cases have not had previous contact with uranium.

1. The Spitzkoppe community is located in the northern part of the Erongo region, 50 km from the site where Areva obtained a mining license in 2009 to build a mine (see Map 2) and inside a conservation area. 2. The resident Topnaar community belongs to the Nama ethnic group, and live along the Kuiseb River, where two Australian corporations, Reptile and Toro Uranium, are undertaking exploration (see Map 2: Aussinanis and Ripnes). 3. In the Valencia farm area, five white land-owners have bought land as a second residence; this is the site of a new mine owned by the Canadian Forsys Metals. 4. Finally, Swakopmund is a coastal town with 29,000 inhabitants living mainly from tourism where several mines are in the process of obtaining a license in the nearby National Park. Compared to Swakopmund, Spitzkoppe and Topnaar are much smaller communities with around 1600 and 1000 people each.

Table 2 compares the four cases and Arandis. Differing levels of perception and reaction towards uranium mining are observed. In Spitzkoppe where we talked to 22 people, nobody was aware what radiation means or of the potential impacts of uranium mining. People were very enthusiastic about the arrival of mines, a woman commenting: "[The opening of the mine] it's my dream, our people must be given a job, training, we must change our living standards" (Interview#40). The headman of the community stated: "228 applications have been presented [to the mining company] and I think most of them will get a job," however due to low education levels few in fact will be able to work in the mines. Areva fuelled expectations of development by drilling a village borehole for potable water in 2008. "If they have power to bring us water, they can also develop the community," an interviewee told us enthusiastically (Interview#22).

With the Topnaar, the situation is different. While a large part of the community, especially elders, are ignorant of the nearby mining explorations and their potential impacts and many express similar sentiments as in Spitzkoppe about jobs and development, a significant proportion of the population, particularly those more educated and further up in the hierarchy of the community, are aware and concerned with impacts. Many seem to hold views similar to those voiced by interviewee 69: "I don't mind the mines, but not here, not in the Kuiseb. They can be located there (points out), in the gravel plains, away from us" because "they will impact on our grazing areas, they create too much dust and noise and the [wild] animals will go" (Interviews#47 and 73). Others, complaining about the arrival of mines told us "I like our way of living, here is peace and quiet" (Interview#66). "I will never die of hunger here, I can kill a goat if I am hungry, there will always be something to eat" (Interview#63). The Topnaar community is the only community in Namibia that has publicly expressed its concern about the mining expansion. Statements by their Chief Seth Kooitjie appeared in a national newspaper (New Era, 13 October 2008). Yet, the Chief sounded more pragmatic to us than in public: "We have no power to stop the mines, nobody asks us, nobody has ever asked us permission for anything" but added that "at least they should give us something, we want jobs and development" (Interview#46).

In the city of Swakopmund in turn, there is awareness that the uranium mines are going to damage the tourism industry, either due to the visual impact of the mines and the associated infrastructure, the blocking of routes and access to often visited places in the National Park, or the influx of migrant workers that could increase insecurity (Interview#144b) and the nearby development of a new chemical industry complex that would fabricate reagents for the mines (MME, 2010). The tourism industry is controlled by whites; and although most of them realise the importance of conserving the park (Interviews#130, 129, 129b), few have ventured to voice their complaints outwardly and more hope for sustainable, mutually satisfactory solutions through the information sessions that are held with the mining companies. Few complaints about uranium mining have reached national newspapers (The Namibian, 12 August 2010; 31 October 2008). However in 2011, some Swakopmund residents, mostly white, realising the chemical industrial complex would be located right at their doorstep, raised their voices and created a strong opposition (The Namibian, 2 October 2011). However government officials believe that mining and tourism can co-exist (Interviews#142, 138), since many areas of visitors' interest will remain unaffected by the infrastructure. The tourist operators hope the same.

Table 2
Comparison of cases based on data from the mines and the communities near them, including economic, social and environmental characteristics as well as absence or not of conflict.

Case studied (community)		Arandis	Topnaar		Spitzkoppe		Swakopmund			Valencia
Mine(s) associated		Rössing	Aussinanis	Ripnes	Trekkopje	Marenica	Etango	Omahola	Langer Heinrich	Valencia
Basic Data	Main owner of the mine	Rio Tinto	Reptile Uranium	Toro Energy Limited	AREVA	West Australian Metals/ Hanglong Energy Limited	Bannermans	Reptile Uranium	Paladin Energy	Forsys Metals
	Owner nationality	Australia/UK	Australia	Australia	France	Australia/China	Australia	Australia	Australia	Canada
	Start of project (expected)	1978	Exploration phase	Exploration phase	2010	Exploration phase	2013	2014	2007	2012
	Duration of project/ closure date	12 years	na	na	11	na	16 years	12 years	15 years	17 years
	Location (distance from the mine)	5 km	5 km (approx)	30 km (approx)	50 km	55 km	36 km (approx)	45 km (approx)	82 km	5 km (approx)
	Location (near river)	Khan River	Kuiseb River	Kuiseb River	No	Omaruru River	Swakop River	Swakop River	Swakop River	Khan River and aquifers
	Location (National Park, Conservancy Area)	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Economic	Resource quantity (t U)	113.4	8203	na	103,000	na	68,900	23,043	74,500	38,100
	Estimated mine output/year (t U)	4500	na	na	3200	1000	2300–3200	1000	1700	1600
	Type of company (junior/senior)	Senior	Junior	Junior	Senior	Junior	Junior	Junior	Junior	Junior
	No employees	2384	na	na	na	na	na	na	852	na
	Subcontracted (% total employees)	969 (88%)	na	na	na	na	na	na	637 (75%)	na
	Economic advantages	Rössing Foundation	None		CRS by AREVA	None		Influx of people and business		None
	Tourism	No	Yes (two camp sites)		Yes (one camp site)			Yes		Planned
Social	Indigenous community	No	Yes		No			No		No
	Sacred value	No	Yes		No			No		No
	Prior information consent	No	No		No (Areva consultation through Env&Social Impact Assessment)			No		No
	Historically marginalised	No	Yes		Yes			No		No
	Perceived health risk	Yes	Yes		No			Mixed		No
	Health impacts	Yes	No		No			No		No
	Powerful chief	No	Yes		Yes			No		No
Environmental	Water issues (present and potential)	Yes	Yes		Yes			Yes		Yes
	Water scarcity	Yes	Yes		Yes			Yes		Yes
	Impacts on environment (present and potential)	Yes	Yes		Yes			Yes		Yes
	Type of environmentalism (Martinez-Alier, 2002)	Too dependent to be green	Environmentalism of the poor		Too poor to be green			Cult of wilderness		Cult of wilderness
	Closure Plan/Closure Fund	Yes/yes	na	na	Yes/no info	na	na	na	Yes/no info	na
Conflict	Voiced discontent	Yes	Yes		No			Few		Yes
	Legal challenge	Yes	No		No			No		Yes
	Demonstrations	No	No		No			No		No

Source: the authors' interviews, mining companies' websites and Chamber of Mines (2009).

Interestingly, the only effective legal challenge to the national uranium rush comes from a white land-owner holding a vacation farm near Valencia uranium mine (see Map 2). The complaints there were motivated out of nature appreciation and the beauty of wilderness. In the words of a farmer: "look at the view and [you] see what it was like years ago; no paths, no telephone, we want to keep it like this for those after us" (Interview#157). Valencia farm-owners perceive that the mine "will have an impact not only on the water, but on the animals, on the air, on the landscape, (...) people will come to the area to work, it will stop being the way it is now" (Interview#157). One owner among those who shared this view, challenged in court the groundwater permit that was given to the mine for its construction phase (Court Case, 2008). The case is still in the courts, but in the meantime the mine's water permit is on hold. Together with the fall in uranium prices and the low uranium ore concentration in the area, this has slowed down the plans of Forsys to develop the mine in Valencia.

How can we make sense of these differences in perception and in the strength, or absence, of opposition? Looking first at the spatial geographical context, all projects are located in the remote arid territory of Erongo, yet there are different degrees of conflict with alternative uses of the territory. Whereas the Spitzkoppe barely subsist and do not use extensively the local environment, the Topnaars rely on herding and the melons that grow on the riverbed, with their survival intimately linked to the river. For Swakopmund, the mines are something happening far away, even though it will visually impact on a considerable part of the territory that provides them with wealth through the tourism industry. These are still tentative links, and there is hope that given the vastness of the area, tourism can continue unimpeded in other areas of the national park. More worrisome are the changes that might take place in the city itself given the possible inflow of workers, but these are also uncertain and not immediate. It is only when residents perceived the impacts of a future chemical plant would be close to them that they reacted. In the Valencia farms, the conflict is more direct: between the leisure use of the area by the white land-owners, which is evidently incompatible with the mining of a radioactive substance.

Secondly, these communities have different degrees of power to challenge mining development. Spitzkoppe belongs to the Damara ethnic group who were used as slaves by the Nama and Herero for centuries and did not experience the process of ethnic self-definition and coherence of other tribes (Henschel and Wenning, 2009). As part of South African colonial policies of dispossession, the Damara, along with other tribes in Namibia, were dispossessed of their land 40 years ago, which passed to whites for farming, and they were confined to native reserves in marginal, semi-deserted lands. Their community remains economically marginalised even by Namibian standards, with an average annual income per person of US$150–US$300 with more than 75% being unemployed or living off selling gemstones obtained by small–scale mining. The literacy rate is considerably lower than the average for the region with over 50% not completing primary education (Areva, 2008).

Although education levels and incomes are also low in the Topnaar community, they are a much more ethnically cohesive and politically empowered community with a strong attachment to their land in the vicinity of the mouth of the Kuiseb River, where they have lived for centuries. Although the area was declared a Game Reserve in 1907 by the Germans and a National Park in 1979 by the South Africans, the Topnaars resisted repeated plans for their eviction and were eventually granted semi-permanent communal land tenure rights in 1979 (Henschel and Wenning, 2009). In later years many Topnaars migrated to the coastal cities, succumbing to government harassment and in search of jobs, but those who remain maintain a subsistence-based living relying on local resources and a strong communal structure, controlled hierarchically by the Chief and his family.

The Valencia land-owners and the Swakopmund tourist operators live a world apart from the Topnaars and Spitzkoppe. They form part of the educated white elite of Namibia. This explains why the former have been the only ones who have successfully accessed the Courts and managed to stop, at least temporarily, a mine. During SWAPO rule, the white community maintained most of the economic privileges; they still control great part of the land and the economy. They have however lost political influence. Many of them are hesitant to confront the SWAPO government and its development plans, preferring to stay on their own turf. This might partly explain why in the case of Swakopmund, the tourist operators are less willing to challenge head-on the mining plans and why they retain a more fatalistic, 'wait and see' approach. Similarly, in the Valencia court case, this might explain why the demand was put forward by only one land-owner, others hesitating to join the legal process.

Thirdly, links with external actors also influence the differing levels of reaction. While Spitzkoppe has remained largely isolated and people there have heard nothing about uranium mining or nuclear energy, awareness by the Topnaars owes a lot to a tour presentation in 2008 by two foreign environmentalists who gave several public talks on nuclear energy and uranium mining and showed dramatic pictures of health impacts of radioactivity elsewhere. Many of our interviewees remembered the presentation and although they did not fully comprehend the nature of the impacts, they understood that uranium mining would pose a health threat and decided to oppose it. In the Valencia case also, the success of the plaintiff would have been difficult without the collaboration with the Legal Assistance Centre, an independent legal NGO based in the capital, which takes on legal challenges against human rights abuses.

If we were to predict the prospects of resistance, we would state that Namibia as a whole is a country of least resistance, given its geography, low population density and social structure, and this explains the ease with which the global uranium rush has expanded in the territory, displaced from traditional source countries despite their larger and higher quality reserves. True, uranium mining is not something that one would easily recommend to any country. There are real costs in terms of (scarce) water and energy. We have also emphasised that damages to health from radiation are not unknown in the country because of Rössing mine. Nevertheless, save for the Valencia farms, where a strong white individual with the help of an NGO managed to mount a legal challenge to a uranium mine, the only other case where resistance may challenge the expansion of the uranium frontier is with the Topnaars. Their dependence on local resources that stand to be impacted by uranium suggests a potential for a resistance stemming from an environmentalism of the poor and the indigenous. Internal community power dynamics will be important in the Topnaars' case. The chief of the Topnaar community has already met with mine representatives, having decided to collaborate with them in exchange for money and development for his community. Since everything will be channelled through him, he is likely to favour the mines to earn more power and money. Some Topnaars interviewed questioned the honesty of the chief, claiming that he "is in favour of the mines because he receives money from them" given that he let the companies drill for prospecting (Interviews#77, 78, 84 and 85). The attitude of the chief will most likely deter resistance within the community. However, the Chief's rule is disputed by contender King Khaxab, who opposes the mine expansion. He is not alone in thinking that the mines will destroy their traditional way of life. This internal division in the community might be the initial step in a process of resistance that could rely on King Khaxab, who

coincidentally has already developed international connections, such as with the foreign couple of experts who made the uranium tour at his request.

In the Swakopmund case, the opposition has so far focused on the industrial chemical complex and not on the mines themselves. However, given the importance of the tourist economy, we can speculate that if the first mining activities in the Park start having an impact on the sector, this might slow down subsequent ones. Another limiting factor for the expansion of the uranium frontier in Namibia is the sheer amount of infrastructure, especially water, that needs to be mobilised, the cost of which is prohibitive for most private operators, and difficult for the State to take up. The financial crisis and the Fukushima disaster, coupled with the declining price of uranium, may do more to halt the uranium frontier than local resistance, though they may at some point coalesce, making some investments too expensive to undertake.

5. Conclusions

The world's growing social metabolism in terms of energy and materials is producing new geographies of extraction, production, consumption and waste disposal and resistance in different parts of the world. This article investigated the expansive extractive geographies of an important energy resource for powering modern society, uranium, and the forms of resistance it meets in a specific territory, Namibia. Our task was both empirical and theoretical: empirical in terms of collecting information about the trends of the uranium mining industry and in documenting the forms and consequences of its expansion in a specific place; theoretical in terms of formalising and using accumulated knowledge from previous ecological economics, social movement and political ecology studies to understand the initial and subsequent conditions under which resistance is likely to emerge in this extraction frontier. We also looked at the forms such resistance can take in terms of social class, ethnicity, and scale, and the ways that this may in turn shape the frontier and the territory.

What is the main contribution of our research? Firstly, the rush for uranium mining and its socio-environmental impacts is too little known and often ignored in the debates about nuclear energy. We claim that problems and concerns with nuclear energy start from the point of extraction. Not only production and disposal should be considered when evaluating the socio-environmental life-cycle costs and benefits of this source of power.

Second, we analysed a broader phenomenon, i.e. impacts and conflicts at the extraction frontiers of global material flows. This is of obvious relevance to the understanding of global environmental change. Yet it has received relatively less attention than natural/climatic hazards and regional/local vulnerabilities. Global environmental studies at their best offer integrative conceptual frameworks combining qualitative, grounded case-study analysis with quantitative data. We developed and applied an integrated framework for the study of our topic, using elements from ecological economics, political ecology and social movement theory. Our approach depicted in Fig. 1 is open, yet also general enough to be applied elsewhere offering a set of analytical entry points for studying frontier expansion and resistance/conflict at the various stages of a material/commodity chain.

Third, we extended environmental social movement theory enriching sociological analyses which look only at the limits posed by marginalisation in collective action. We shifted attention to the geographical and bio-physical specificities of the resource and territory at stake, and cross-scalar links between local and international actors. Communities are neither 'too poor to be green' nor do they automatically resist State or corporate projects in their territory. It is the interdependent set of socio-economic, biophysical, geographical factors that determine where resistance emerges and where not. We have not offered an (impossible?) general theory of environmental social movements in the third world. We have demonstrated however how the above three – among many possible – factors provide a good explanation for reaction/movement formation within Namibia. We welcome research to test the importance of these factors in different settings, ideally through cross-comparative research.

Our analysis does not offer easy predictions or prescriptions about what will or should happen with uranium mining in Namibia, much less elsewhere. It does however offer the basis for an informed debate of possible developments. It is through the changing dialectics of expansion and resistance that the new uranium landscape in Namibia and the rest of the world will be determined. In 2006, the Navajo hosted the first Indigenous World Uranium Summit with indigenous delegates participating from around the world. They called for a ban on uranium mining in native territories. Participants formed a coalition of anti-mining, anti-nuclear and indigenous movements in North America and Australia. Their activism, coupled with strengthening environmental regulations, has resulted in delays of uranium mining projects in these countries. In contrast, given its geographical, socio-economic and governance conditions, Namibia thus seems to present itself as a path of least resistance and one may expect it to be at the vanguard of the expanding global uranium frontier.

There is however no pre-determined trajectory. The nuclear disaster in Fukushima in 2011 changed once again the dynamics of the nuclear industry, and by extension its source commodity, uranium. Even if the effect on uranium production expansion and prices were not to be as dramatic as in the preceding Chernobyl and Three Mile Island accidents, the uranium rush is likely to slow down despite plans for many more nuclear power stations in China, India and other countries. The most expensive, more problematic, or locally more resisted projects are likely to be trimmed down, such as the Valencia mine. An important related development is the reawakening of the anti-nuclear movement and the strengthening of alliance-building between movements along the uranium chain. An expression of this is the recently created African Uranium Alliance. This brings together several African NGOs denouncing the impacts of uranium mining. Earthlife and LaRRI from Namibia, members of this Alliance, staged a renewed campaign denouncing Rössing's impacts on the environment and the health of workers. The Uranium Alliance is reinvigorating ties with anti-mining movements elsewhere as well as nuclear energy campaigners like the International Physicians for the Prevention of Nuclear War. It remains to be seen whether white activists and environmental NGOs will build effective bridges with discontented workers, and indigenous marginalised communities, to challenge the industry and re-shape the uranium frontier in Namibia.

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