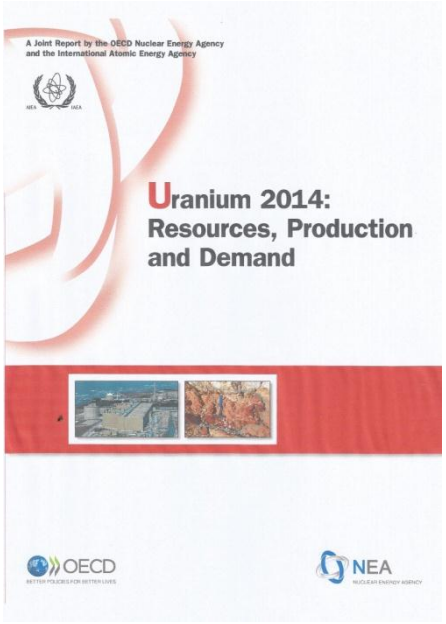
Uranium Resources of Africa



Undiscovered Resources

2014 Red Book

J. R. Blaise Johannesburg November 2014

Resource terminology

Resource estimates are divided into separate categories reflecting different levels of confidence in the quantities reported.

Reasonably Assured Resources (RAR)
Inferred resources (IR)
Prognosticated resources (PR)
Speculative resources (SR)

The resources are further separated into categories based on the cost of production.

<USD 40 / kgU
<USD 80 / kgU
<USD 130 / kgU
<USD 260 / kgU

Resource terminology

Uranium resources are broadly classified as either conventional or unconventional.

Conventional resources are those that have an established history of production where uranium is a primary product, co-product or an important by-product (e.g. from the mining of copper and gold).

Very low-grade resources or those from which uranium is only recoverable as a minor by-product are considered unconventional resources.

Resource terminology

Prognosticated resources (PR) refers to uranium, in addition to inferred resources, that is expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralisation with known deposits.

Estimates of tonnage, grade and cost of discovery, delineation and recovery are based primarily on knowledge of deposit characteristics in known deposits within the respective trends or areas and on such sampling, geological, geophysical or geochemical evidence as may be available.

Less reliance can be placed on the estimates in this category than on those for inferred resources.

Prognosticated resources are normally expressed in terms of uranium contained in mineable ore, i.e. *in situ quantities.*

Resource terminology

Speculative resources (SR) refers to uranium, in addition to prognosticated resources, that is thought to exist, mostly on the basis of indirect evidence and geological extrapolations, in deposits discoverable with existing exploration techniques.

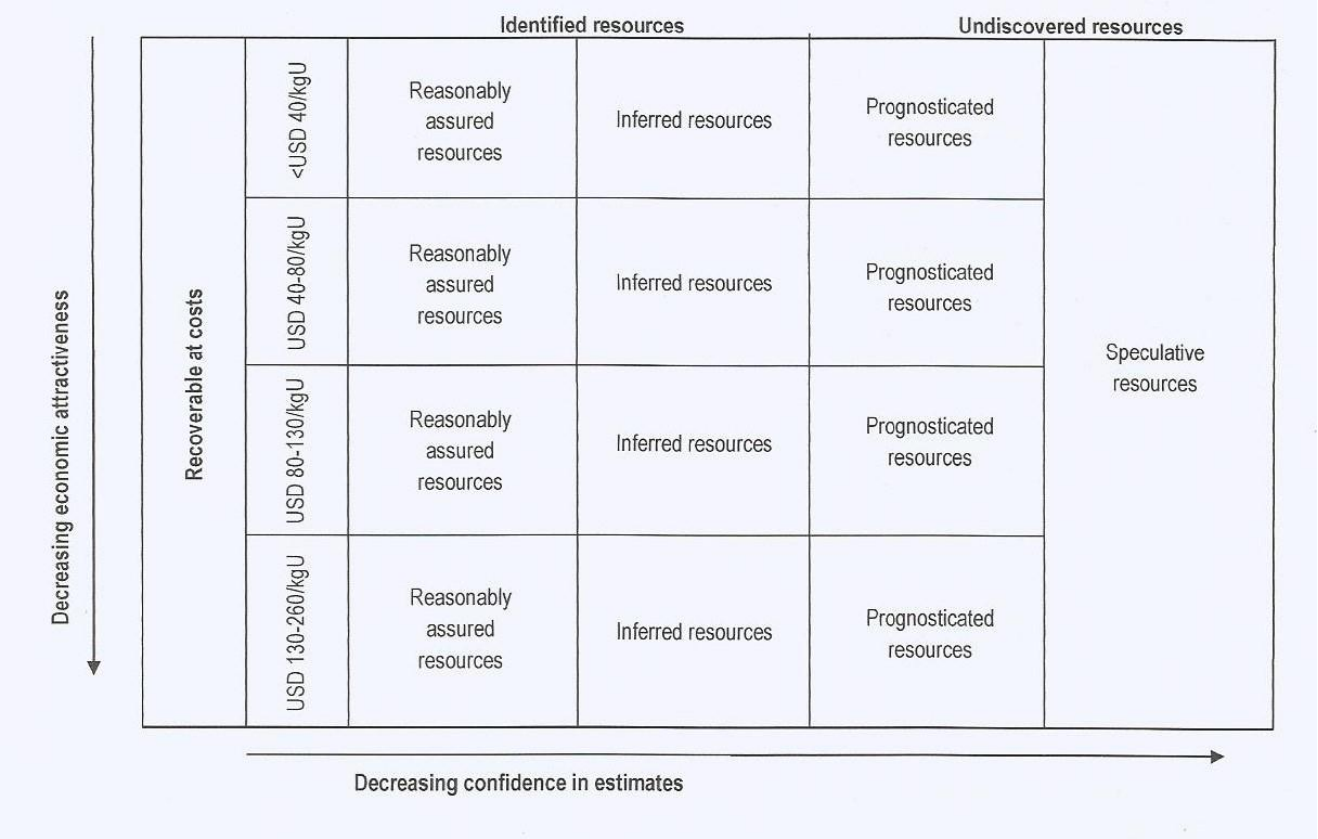
The location of deposits envisaged in this category could generally be specified only as being somewhere within a given region or geological trend.

As the term implies, the existenceand size of such resources are speculative.

SR are normally expressed in terms of uranium contained in mineable ore, i.e. *in situ quantities.*

Resource terminology

NEA/IAEA classification



Resource terminology

Approximate correlation of terms used in major resources classification systems

	Identified resources			Undiscovered resources		
NEA/IAEA	Reasonably assured		Inferred	Prognosticated		Speculative
Australia	Demonstrated		Inferred	Undiscovered		
	Measured	Indicated				
Canada (NRCan)	Measured	Indicated	Inferred	Prognosticated		Speculative
United States (DOE)	Reasonably assured		Estimated additional			Speculative
Russian Federation, Kazakhstan, Ukraine, Uzbekistan	A + B	C1	C2	P1	P2	P3

Undiscovered Resources

Mapping of NEA/IAEA uranium resource Categories to UNFC-2009 Classes and Sub-classes.

UNFC Classes and Sub-classes		UNFC Categories			NEA/IAEA Classification	
Class	Sub-Class	E	F	G	Status	IAEA-NEA Costs Categories
Commercial Projects	On Production	1	1.1	1,2	Existing	Reasonably Assured Resources (RAR) <USD 130/KgU <USD50/lb U3O8
	Approved for Development	1	1.2	1,2	Committed	
	Justified for Development	1	1.3	1,2	Planned	
Potentially commercial projects	Development Pending	2	2.1	1,2,3	Prospective	Identified Resources RAR <USD 130/KgU <USD50/lb U3O8 IR* <USD 130/KgU <USD50/lb U3O8
	Development On Hold	2	2.2	1,2,3		
Non-commercial projects	Development Unclarified	3.2	2.2	1,2,3		Identified Resources RAR >USD130/KgU >USD 50/lbU3O8 IR* >USD130/KgU >USD 50/lbU3O8
	Development not Viable	3.3	2.3	1,2,3		
Exploration projects		3.2	3.1	4		Prognosticated Resources
		3.2	3.2, 3.3	4		Speculative Resources

Uranium 2014

PR (tU)

	<USD80/kgU	<USD130/kgU	<USD260/kgU
World	665 400	1 222 800	1 755 500
Africa	34 900	123 900	180.9
Africa/World (%)	5.2	10.1	10.3

PR are reported by only 3 African countries: Namibia, Niger, South Africa.

Uranium 2014

SR (tU)

	<USD130/kgU	<USD230/kgU	Cost Range Unassigned	Total SR
World	2 639 300	2 946 500	2 995 700	5 942 200
Africa	25 000	76 300	1 223 700	1 300 000
Africa/World (%)	0.9	2.6	40.8	21.9

SR are reported by only 4 African countries: Namibia, Niger, South Africa and Zimbabwe.

Uranium 2014

Worldwide, reporting of PR and SR is incomplete, as only 26 countries have historically reported resources in this category.

A total of 20 countries reported undiscovered resources for th2 2014 edition, compared to the 37 with RAR. Only 12 countries of those reporting provided updated undiscovered resource figures for this edition.

Twenty-one countries report both prognosticated and speculative resources

Some of the countries that do not report undiscovered resources, such as Australia, United States are considered to have significant resource potential in as yet sparsely explored areas.

Namibia

PR

<USD 80/kgU	<USD 80/kgU	<USD 80/kgU
0	0	57 000

SR

<USD 80/kgU	<USD 80/kgU	Unassigned	Total SR
0	0	110 700	110 700

Undiscovered resources are estimated in areas adjacent to deposits with identified resources in Happy Valley, Etango, Tumas , Husab and Ida. (Intrusive type deposits, similar to Rössing, Husab)

Niger

PR

<USD 80/kgU	<USD 80/kgU	<USD 80/kgU
NA	13 600	13 600

SR

<USD 80/kgU	<USD 80/kgU	Unassigned	Total SR
0	51 300	NA	51 300

Undiscovered resources are estimated in areas adjacent to known deposits within the Tim Mersoi sedimentary basin (sandstone type deposits).

South Africa

PR

<USD 80/kgU	<USD 80/kgU	<USD 80/kgU
34 900	110 300	110 300

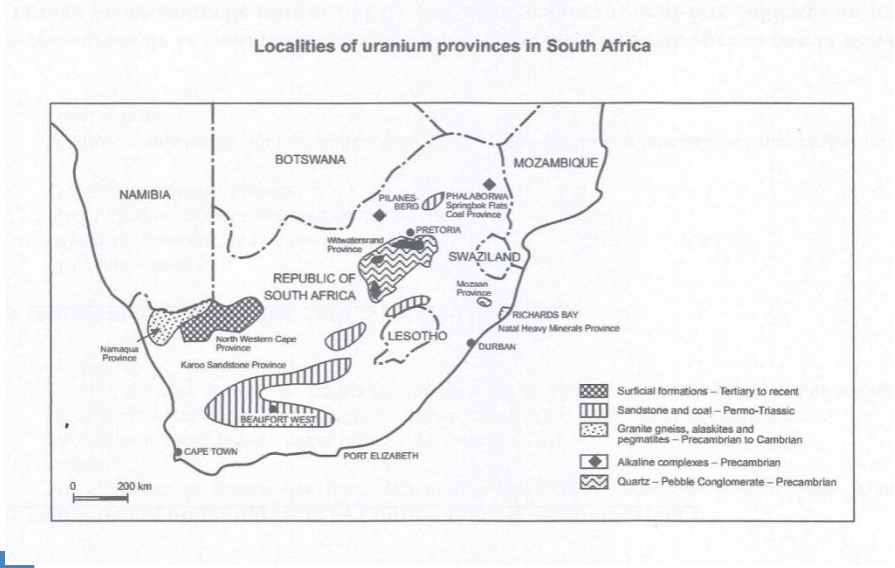
SR

<USD 80/kgU	<USD 80/kgU	Unassigned	Total SR
0	0	1 113 000	1 113 000

Undiscovered conventional resource figures have not been updated since the 1990s.

Undiscovered Resources

South Africa



Type of deposit	SR (tU)
Quartz-pebble conglomerates	635 000
Sandstone	190 000
Coal hoasted	62 000
Surficial	9 000
Phosphates	179 000
Granites	100 000
Total	1 175 000

Speculative resources as reported in the 1993 edition of the Red Book: Distribution by geologic type

Zimbabwe

PR

<USD 80/kgU	<USD 80/kgU	<USD 80/kgU
0	0	0

SR

<USD 80/kgU	<USD 80/kgU	Unassigned	Total SR
25 000	25 000	NA	25 000

Speculative Resources are associated with sedimentary rocks of the Permian-lower Jurassic Karoo System.

Potential for new resources (WUEPRA)

World Uranium Exploration, Production and Related Activities

Potential based on a review of the geology of the country
(Rock types, structures, environments, …)

Past exploration works

Qualitative estimation of the potential
(None, Limited, Low, Moderate, High).

Potential for new resources (WUEPRA)

Country	Potential	Geological type of deposit
Algeria	Mod. to High	Vein, Sandstone
Angola	Moderate	Unconformity, Sandstone, Vein
Benin	Limited	Unconformity
Botswana	Mod. to High	Calcrete, Unconformity,
Burkina Faso	Low	Sandstone
Burundi	Low	Phosphates
Cameroon	Moderate	Vein, Granitic, Peribatholitic
Cape Verde	Very limited	Recent basic volcanics
Central Africa	Moderate	Sandstone, Unconformity
Chad	Moderate	Sandstone, Vein
Comoros	Very limited	Volcanics

Potential for new resources (WUEPRA)

Country	Potential	Geological type of deposit
Congo	Moderate	Sandstone, Unconformity
Cote d'Ivoire	Moderate	Granite environments
D R of Congo	Mod to High	Sandstone, Vein
Djibouti	Very Limited	No favorable geology
Egypt	Moderate	Vein, sandstone
Equatorial Guinea	None	No favorable geology
Eritrea	Low	Sandstone, Calcrete
Ethiopia	Mod to High	Unconformity, sandstone
Gabon	Mod to High	Sandstone
Gambia	Moderate	Sandstone
Ghana	Moderte	Metasomatite

Potential for new resources (WUEPRA)

Country	Potential	Geological type of deposit
Guinea	Moderate	Sandstone
Guinea-Bissau	Very limited	No favorable geology
Kenya	Limited	Sandstone, Volcanics
Lesotho	Low	Sandstone
Liberia	Moderate	Quartz pebble conglomerate
Libya	Moderate	Sandstone, Vein, Unconformity
Madagascar	Mod. to High	Vein, Sandstone
Malawi	Mod. to High	Sandstone
Mali	Moderate	Sandstone, calcrete
Mauritania	Moderate	Calcrete, Vein, Unconformity
Mauritius	None	No favorable geology

Potential for new resources (WUEPRA)

Country	Potential	Geological type of deposit
Morocco	High	Phosphates, Vein
Mozambique	Moderate	Vein, Unconformity
Namibia	High	Intrusive, Calcrete, Sandstone
Niger	High	Sandstone
Nigeria	High	Sandstone, Vein, Phosphates
Rwanda	Moderate	Pegmatite
Senegal	Low	Vein, phosphates
Seychelles	None	No favorable geology
Sierra Leone	Low	Vein
Somalia	Moderate	Sandstone, calcrete
South Africa	High	Sandstone, Calcrete

Potential for new resources (WUEPRA)

Country	Potential	Geological type of deposit
Sudan	Moderate	Sandstone, unconformity
Swaziland	Limited	Sandstone
Tanzania	Moderate	Sandstone
Togo	Moderate	Unconformity
Tunisia	Moderate	Phosphates, vein, sandstone
Uganda	Moderate	Unconformity
Western Sahara	Limited	Unconformity, Phosphates
Zambia	Mod. to High	Sandstone, Metamorphic, Calcrete
Zimbabwe	Mod. to High	Sandstone

Potential for new resources (WUEPRA)

18 of 53 countries where potential is “none”, “limited”,or “low”;

-Inadequate or lack of exploration (Eritrea, Western Sahara)

-Potential limited by rock types (Seychelles, Lesotho, Cap Verde, Kenya)

-Non economical mineralization (up to now)

Potential for new resources (WUEPRA)

35 of 53 countries where there is potential for discovery of additional uranium resources.

Morocco, Namibia, Niger, Nigeria and South Africa rated as having a “high” potential

Potential for new resources (WUEPRA)

Sandstone type deposits: Algeria, Angola, Chad, Eritrea, Ethiopia, Gabon, Ghana, Libya, Mali, Niger, Nigeria, Somalia, Swaziland, Tunisia, Zambia.

Vein type deposits: Algeria, Burundi, Chad, D R Congo, Egypt, Ethiopia, Libya, Madagascar, Mali, Mozambique, Nigeria, Tunisia.

Quartz pebble conglomerates: Botswana, Liberia, South Africa.

Unconformity type: Botswana, Cameroon, Central Africa, Congo, Ethiopia, Mauritania, Mozambique, Togo, Uganda.

Phosphorites: Angola, Central Africa, Morocco, Nigeria, Senegal, Tunisia, Western Sahara