

# CAMECO AUSTRALIA PTY LTD

# Annual Report – GR 043

## CONFIDENTIAL

EL 24291 EL 26796 Date: September 2014 **Reporting Period:** 4 July 2013 to 3 July 2014 **Amalgamated/Combined Report No.:** GR 043/09 **Target commodity:** Uranium **Authors:** Ekaterina Savinova, Geologist Ben Wyke, Project Geologist Tim Dunlevie, CAD-GIS Specialist **Contact Details:** PO Box 748 Osborne Park BC, WA 6916 Ph. 08 9318 6600 **Email for further technical details:** Daniel\_Hawkins@cameco.com **Email for expenditure:** ratih\_sagung@cameco.com Datum/Zone: GDA94 (Zone 53) **Map Sheets:** 1:250,000 Alligator River SD-5301 1:100,000 Howship SD-5572 Tenement manager: Austwide **Drafting** Tim Dunlevie

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#### **SUMMARY**

The Beatrice project comprises two exploration licences (EL 24291 and EL 26796), located in western Arnhem Land, approximately 250 km east of Darwin. The exploration licences were granted to Cameco Australia Pty. Ltd. (Cameco) on 04 July 2008. The Beatrice project tenements (EL 24291 and EL 26796) were granted amalgamated technical and expenditure reporting status by the Northern Territory Department of Resources (now the Department of Mines and Energy) on 9 November 2011. The approved and allocated group reporting ID is GR 043.

The focus of Cameco's exploration strategy in Arnhem Land is the discovery of unconformity-related uranium deposits. The archetype unconformity-style uranium deposits are found in the Athabasca Basin of northern Saskatchewan, Canada. The prospective nature of the Alligator Rivers region is demonstrated by the presence of nearby deposits at Ranger, Jabiluka, Koongarra, and the now depleted Nabarlek Mine. These major deposits appear to have a common position relative to the base of the Kombolgie Subgroup i.e. the Paleoproterozoic unconformity, or to its erosional margin, and serve here as exploration models.

The Beatrice project is considered to be prospective for uranium mineralisation because of the proximity to the unconformity between metasedimentary packages and the overlying Kombolgie Subgroup, and association of chlorite and hematite altered breccia with fault structures. In addition, alternative mineralisation styles are also known to be present in the area, such as the shear-zone hosted mineralisation at the Beatrice Prospect.

Desktop studies and research of historical data were the main focus of work in 2013. No fieldwork was completed and there were no site visits.

The total reportable 2013/2014 expenditure for EL 24291 and EL 26796 during the reporting period was \$25,760 and \$4,565 respectively.

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### 1.0 INTRODUCTION

The Beatrice project comprises two exploration licences (EL 24291 and EL 26796), located in western Arnhem Land in the Northern Territory, Australia.

The 2013 exploration activities consisted of desktop studies and historical literature research.

### 2.0 TENURE HISTORY

The exploration licences 24291 and 26796 were granted on 4 July 2008 for a tenure period of six years. At the time of grant, the total area covered by the two licences was 356.99 km² (131 subblocks), comprising 337.21 km² (121 sub-blocks) on EL 24291 and 19.78 km² (10 sub-blocks) on EL 26796. The Beatrice project tenements (EL 24291 and EL 26796) were granted amalgamated technical and expenditure reporting status on 9 November 2011. The approved and allocated group reporting ID is GR 043. Cameco is the tenement holder and sole operator of both tenements.

In May 2011 a waiver of reduction was submitted to the Department and subsequently approved on 29 July 2012. In June 2012 another waiver of reduction was submitted and also approved.

### 3.0 LOCATION AND ACCESS

The Beatrice project is located in western Arnhem Land in the Northern Territory of Australia (Figure 1). The project area is centred about 260 km east of Darwin, 230 km northeast of Katherine, and 45 km east of Jabiru.

The tenements are located on map sheets:

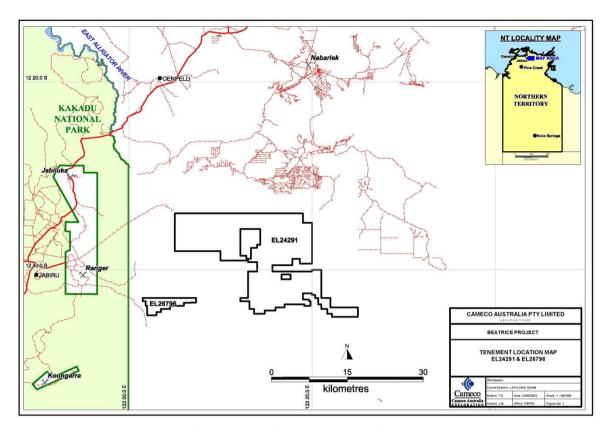
1:250,000: Alligator River (SD-5301)

1:100,000: Howship (SD-5572)

1:50,000: Mount Howship (5572-4)

There are no current access tracks to the area and the tenements are only accessible by helicopter.

Exploration in the 1970s was via a track that was constructed from the Nabarlek mine site through the East Alligator River valley to the Beatrice Prospect. This track no longer exists.



**Figure 1: Beatrice Tenement Location Map** 

## 4.0 PHYSIOGRAPHY

The topography in the south of EL 24291 is dominated by deeply jointed Kombolgie Subgroup sandstone plateau, bisected on the eastern side by the southeast trending East Alligator River. The sandstone locally forms escarpments up to 80 m high. High sandstone escarpments to the east and west predominate over the northern portion of the tenement, with smaller rounded hills in the central area.

Vegetation varies with geology and topography but generally consists of eucalyptus scrubland, isolated remnants of monsoonal forest confined to deep gorges, and grassland dominating the north-central hills.

EL 26796 is dominantly covered by Kombolgie Subgroup sandstone with deeply incised valleys. A creek bisects the northeastern portion of the tenement. The northwestern corner comprises undifferentiated Cainozoic sediments.

## 5.0 REGIONAL GEOLOGY

The regional geology of Arnhem Land has been systematically and intensely studied and described in detail since 1946, including work from the Bureau of Mineral Resources (BMR) (1972 – 1988), the Northern Territory Geological Survey (late 1990's to 2008), Geoscience Australia (2004) and many previous reports for Cameco Exploration Licences in the western Arnhem Land area. Historical studies in the area included geological mapping and reconnaissance, as well as regional-scale and deposit-scale metallogenic research. Only a brief summary and overview of the geology is provided

in this report. The regional geology section is largely based on the work by Needham et al (1980 and 1983) and Needham and De Ross (1990). All other information is appropriately referenced.

The Beatrice project area is located at the northeast margin of the Neoarchean and Paleoproterozoic Pine Creek Orogen, which has been subdivided into the Nimbuwah Domain of the Alligator Rivers region.

The Bureau of Mineral Resources (BMR), now Geoscience Australia, completed 1:250,000 geological maps of the Pine Creek Orogen between the 1940s and 1960s, following the discovery of uranium at Rum Jungle, near Batchelor. The Alligator Rivers region was systematically mapped by the BMR and the Northern Territory Geological Survey between 1972 and 1983. This later work produced 1:100,000 geological maps and reports for the region from Darwin to Katherine to the Alligator Rivers region (Figure 2).

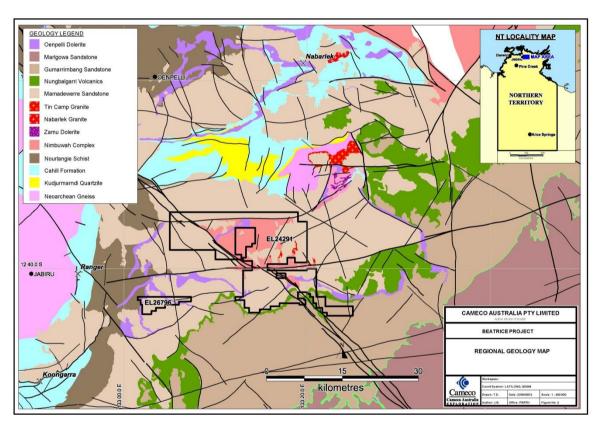


Figure 2: Regional geology of the Beatrice Project area

The oldest exposed rocks in the Alligator Rivers region are those of the Neoarchean (ca. 2500 Ma) Nanambu Complex, Kukalak Gneiss, Njibinjibinj Gneiss and Arrarra Gneiss composed of a range of paragneiss, orthogneiss, migmatite, and schists. These Archean rocks are unconformably overlain by the Paleoproterozoic Kakadu Group and Cahill Formation; the latter was formerly included in the Pine Creek Geosyncline (PCG). Recent U-Pb age dating by the NTGS and Geoscience Australia (GA) of rocks from the Myra Inlier (Myra Falls metamorphics), previously mapped as part of the Paleoproterozoic PCG, indicates that they are in fact Neoarchean in age (Hollis et. al, 2009a, Hollis et. al, 2009b, Hollis and Glass, 2012). These units have, thus, been re-mapped as rocks of the Nanambu Complex, Kukalak Gneiss, Arrarra Gneiss and Njibinjibinj Gneiss.

The Paleoproterozoic Kakadu Group, comprising the Kudjumarndi Quartzite, the Munmarlary Quartzite and the Mount Basedow Gneiss overlies Neoarchean basement and is composed of

quartzite, amphibolite, leucocratic paragneiss, meta-arkose and minor chlorite-biotite schist. The Kakadu Group previously included the Mount Howship Gneiss which has since been re-mapped throughout the Myra Falls and Caramal Inliers. It has been reinterpreted as Neoarchean basement and, therefore, abandoned as a specific stratigraphic name (Hollis & Glass, 2012).

The Cahill Formation (1870 Ma) is interpreted to paraconformably overly units of the Kakadu Group based on U-Pb dating of detrital zircons of Kudjumarndi Quartzite and a maximum-age difference of approximately 160 Ma. The Cahill Formation is separated geologically into two groups: the Lower Cahill Formation consisting of calcareous marble and calc-silicate gneiss, overlain by pyritic, garnetiferous and carbonaceous schist, quartz-feldspar-mica gneiss, and minor amphibolite, and the more psammitic Upper Cahill Formation consisting of feldspar-quartz schist, quartzite, lesser proportions of mica-feldspar-quartz-magnetite schist, and minor metaconglomerate and amphibolite.

Conformably overlying the Cahill Formation is the Nourlangie Schist (1870 Ma). The Cahill Formation and the Nourlangie Schist have the same minimum age and share the same exotic provenance. The Nourlangie Schist comprises predominantly garnetiferous quartz-mica schist with locally distributed staurolite, kyanite and magnetite, with all rocks notably lacking carbonate members. These Paleoproterozoic metasediments are intruded by later Proterozoic mafic sills and dykes, assigned to the Caramal, Birraduk or Namarrkon Amphibolites. These mafic units were intruded prior to metamorphism during the Nimbuwah Event of the Top End Orogeny.

During and following cessation of the Top End Orogeny, the A-type Nabarlek and Tin Camp Granites of the Jim Jim Suite (sometimes referred to as the David Suite) intruded. These intrusive units have been dated at 1818 Ma and 1846 Ma, respectively and comprise relatively undeformed, pink-cream, coarse biotite granite and trondhjemite. The emplacement of these granites during this period is interpreted to be indicative of the waning stages of subduction-related magmatism. In outcrop, the granites are observed intruding Kukalak Gneiss and Nimbuwah Complex granitoids, faulted against Oenpelli Dolerite and unconformably overlain by the Mamadawerre Sandstone of the Kombolgie Subgroup.

Overlying the Proterozoic metamorphic and intrusive units and marked by a regional unconformity, is the Kombolgie Subgroup, the basal unit of the late Paleoproterozoic to Mesoproterozoic Katherine River Group of the McArthur Basin (Sweet et al., 1999a and b). The Subgroup comprises almost entirely sandstone dominated formations (oldest to youngest): the Mamadawerre Sandstone, the Gumarrirnbang Sandstone, and the Marlgowa Sandstone which are divided by thin basaltic units – the Nungbalgarri Volcanics and Gilruth Volcanics, respectively. Based upon stratigraphic relationships the Mamadawerre Sandstone has a minimum age of ca. 1723 Ma. Detrital zircon SHRIMP data from the GA OZCRON database constrain the maximum age of the sandstone at ca. 1810 Ma.

The Oenpelli Dolerite is the most pervasive mafic intrusive suite to affect the Alligator Rivers region. It intrudes the majority of the Neoarchean and Paleoproterozoic units, as well as the Kombolgie Subgroup, forming magnetic sills, dykes, lopoliths, and laccoliths. The Oenpelli Dolerite has a U-Pb baddeleyite date of 1723 ± 6 Ma (Ferenczi et al., 2005); however, geochemical and geophysical data suggest several phases of intrusion throughout the region. These intrusive events are interpreted to have had a pronounced thermal effect on the Kombolgie Subgroup, with the promotion of fluid flow through the dynamic system of aquifers within the sandstone. Localized alteration effects in the sandstone attributed to the fluid flow associated with the intrusion of the Oenpelli Dolerite include silicification, desilicification, chloritisation, sericitisation, and pyrophyllite alteration. A characteristic mineral assemblage of prehnite-pumpellyite-epidote is developed in the quartzofeldspathic basement rocks adjacent to these mafic intrusions.

Deformation since deposition of the Katherine River Group includes transpressional movement along steep regional-scale strike-slip faults and possibly shallow thrusting. These regional faults follow a pattern of predominantly north, northwest, and northeast strikes, giving rise to the characteristic linearly dissected landform pattern of the Kombolgie Plateau. Another significant structural trend strikes east – west and includes both the Ranger and Mount Howship Faults.

The northwest striking Bulman Fault Zone is the principal regional feature and is considered to represent a long-lived deep crustal structure. However, it appears that post-Kombolgie displacements along this and other faults have not been great (the Kombolgie Subgroup is dextrally offset by approximately 500 m along the structure (Hollis and Glass, 2012)) because the Arnhem Land Plateau is essentially coherent and offsets along lineaments are overall minor. Field investigations of many interpreted fault-like structures, including those with a marked geomorphic expression, show no displacement, and are best described as joints or lineaments.

Erosional remnants of flat-lying Paleozoic Arafura Basin and Cretaceous Carpentaria Basin are present as a veneer throughout the coastal zone. Various regolith components are ubiquitous as cover throughout much of the Arnhem Land region.

### 6.0 LOCAL AND PROJECT GEOLOGY

The Beatrice tenements lie to the south of the Myra Falls Inlier. EL 26796 is almost entirely covered by the Mamadawerre Sandstone, a unit that is typically deeply jointed and faulted. The area in the northwest corner of the tenement contains undifferentiated Cainozoic sediments (Figure 3). The north part of EL 24291 is bisected by the east trending Beatrice Fault, to the north of which lies the Mamadawerre Sandstone, and to the south is the Beatrice Inlier. The Beatrice Inlier comprises outcropping Nimbuwah Complex gneisses and granites, intruded by the Oenpelli Dolerite, and bounded to the southwest by the Bulman Fault Zone. The Mamadawerre Sandstone overlies the remainder of EL 24291 (see Figure 3).

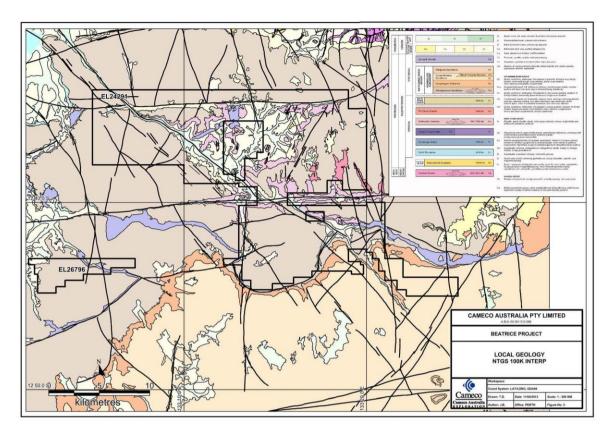


Figure 3: Beatrice tenement geology map

## 7.0 PREVIOUS EXPLORATION

## 7.1 Queensland Mines Limited

Limited exploration work was conducted by Queensland Mines Limited (QML) between 1970 and 1973 before the cessation of exploration in Arnhem Land with the introduction of the Aboriginal Land Rights Act in 1973. Mapping, airborne and ground radiometric and magnetic surveys in 1970 and 1971 led to the identification of the Beatrice Prospect (Robinson 1971, Lockhart 1974).

In 1971 radiometric surveying and costeaning of the most anomalous zones at the Beatrice Prospect was conducted, followed by topographic and surface geological mapping. Trenches at the prospect were bulldozed for mapping. A track was bulldozed from the west, from the Nabarlek mine site, along the East Alligator River valley into the Beatrice Inlier to permit truck-mounted drill rig access. Diamond drilling in 1971 included eight drillholes for a total of 490.7 m. Low-grade secondary sooty pitchblende was intersected below the surface anomalies. Despite intersecting 7 m at 3.3% U<sub>3</sub>O<sub>8</sub>, at the completion of the program, it was suggested that all prospective sites had been tested and there was no further exploration potential.

In 1973, a grid-based mapping, radiometric and soil-sampling survey was conducted over the Beatrice Prospect. Lockhart (1974) noted that the mineralisation is restricted to an area of chloritised gneiss, spatially associated with a series of northeast trending quartz stockwork breccia. QML's exploration was curtailed in early 1973 by the Federal Government imposed moratorium on exploration pending a resolution of the issue of Aboriginal Land Rights, and no further on-ground exploration work was conducted by QML.

Reinterpretation of results by QML geologists in 1982 (Foy, 1982a) concluded that potential remained within the prospect area based on the intersections from the 1971 drilling. However, reexamination of drillcore failed to confirm the presence of the previously reported "sooty pitchblende". However, as a result, further drilling and surface investigations were still recommended by Foy (1982b).

## 7.2 Cameco Exploration

Afmeco Mining and Exploration Pty Ltd (AFMEX) acquired the exploration licence application from QML in 1998 and formed part of the joint venture partnership between AFMEX (25% operating partner), Cameco (50%) and SAE Australia Pty Ltd (25%).

Following the dissolution of the joint venture agreement in 2003, the exploration licence application was transferred to Cameco. The original exploration licence application area (EL 24291) was split by non-consent areas as determined by an anthropological survey conducted prior to grant, forming the two non-contiguous licences EL 24291 and EL 26796. Grant of licence was given on 4 July 2008, for a period of six years.

### 7.2.1 2008 - 2009

The 2008 exploration program consisted of airborne geophysical surveys and helicopter-supported ground activities, comprising geological mapping, reconnaissance, and outcrop sampling.

Air photography over the Beatrice project area produced a digital image which was geometrically corrected to create an ortho-photograph and a digital elevation model. Two airborne geophysics surveys were flown over the Beatrice project area. These were a helicopter-borne VTEM (time domain electromagnetic system) and magnetic data, and fixed-wing radiometric and total field magnetic surveys.

Ground investigations consisted of reconnaissance and sampling of the identified airborne radiometric anomalies, geological reconnaissance across the tenement, with focus given to the Beatrice Prospect. Outcrop sampling returned a best assay result of  $0.15\%~U_3O_8$  in a strongly chlorite altered and sheared granite from the Beatrice Prospect.

A large radiometric anomaly identified in the northwest of EL 24291, sited within a shallow gully to the south of and parallel to the Beatrice Fault, near the intersection with the Bulman Fault Zone returned elevated uranium results. The best assay result of 8.8 ppm  $U_3O_8$  was intersected in hematite altered, fine- to medium-grained sandstone. This anomaly was named the Violet Prospect.

## 7.2.2 2009 - 2010

Work conducted in 2009 consisted of an airborne radiometric and magnetic survey, an airborne hyperspectral survey, a ground-based sub-audio magnetic (SAM) survey over the Beatrice Prospect,

5 diamond core drillholes and 272 auger holes at the Beatrice Prospect, and rock outcrop sampling in conjunction with reconnaissance mapping over the two exploration licences.

Helicopter-supported drilling and other work were conducted at the Beatrice Prospect from 27 May to 23 July 2009. Five diamond core drillholes for a total of 730.5 m and 272 auger holes were completed. The diamond drillholes were completed at variable azimuths and dips as conditions and targeting warranted. All auger holes were completed adjacent to the Beatrice Prospect, with a portable track-mounted machine and a detachable auger bit. Auger holes penetrated the top 1.2 m of the soil horizon, and samples were collected of the bottom of hole from the auger flyte.

In addition, during the 2009 – 2010 field season 105 ground stations were recorded, including 10 mapping points and 95 rock sample sites. On EL 24291, 98 sites were recorded with 9 mapping stations and 89 rock samples collected. Lastly, on EL 26796, 7 sites were recorded with 1 mapping station and 6 rock samples collected for geochemical analysis.

#### 7.2.3 2010 - 2011

Work conducted in 2010 consisted of a ground-based resistivity survey, airborne electromagnetic (TEMPEST) survey and helicopter-supported activities that included diamond core drilling, geological mapping and outcrop sampling.

In total, 6 diamond core drillholes were completed at the Violet Prospect for a total of 1,836.7 m. The most significant uranium interval was intersected in BTD0278 with 20.6 m at an average grade of 850.6 ppm  $U_3O_8$  from 30.1 to 50.7 m.

Outcrop sampling in conjunction with reconnaissance mapping were conducted across EL 24291 and EL 26796 with 234 sites recorded in total. On EL 24291, 217 sites were recorded with 164 mapping stations and 53 rock sample sites. Lastly, on EL 26796, 17 sites were recorded with 3 mapping stations and 14 samples collected for geochemical analysis.

### 7.2.4 2011 – 2012

Helicopter-supported tree leaf vegetation sampling was conducted over the Beatrice Prospect to test this surface sampling technique over known uranium mineralisation. In total, 18 samples were collected at a nominal spacing of 50 m along a northwest trending line. Results of the survey did not become available until after the reporting period, and were included in the 2012 – 2013 annual report.

During late June archaeology site clearances were completed for drilling target areas located on EL 24291 and EL 26796. As a result, 1 helicopter-supported drill site was prepared and poly-pipe waterline was laid out for the drilling water supply.

## 7.2.5 2012 - 2013

During the 2012 field season, diamond drilling was the focus of exploration activities and additional desktop studies were completed after the field season. During July – August 2012, one diamond core drillhole, BTDD0001, was drilled to 206.8 m. The drillhole targeted an interpreted steep north-

trending structure in a previously untested area approximately 500 m north of the Beatrice Prospect. Radioactivity was background throughout the drillhole.

## 8.0 2013 EXPLORATION PROGRAM ACTIVITIES

In 2013 exploration activities were limited to desktop studies and detailed analysis of previously collected data. Historical data was re-visited, re-interpreted and properly categorised.

### 9.0 CONCLUSIONS AND RECOMMENDATIONS

Future exploration may involve:

- GIS and geophysics data interpretation and processing
- Heli-supported diamond drilling (additional 1 2 drillholes)
- Mapping and surface sampling

Desktop studies and review of all available geophysical data have highlighted new areas of interest for exploration on the main Beatrice tenement, EL 24291. Presence of the Cahill Formation metasediments below the Kombolgie Subgroup sandstone cover has been confirmed in the area to the north of the Beatrice tenement. These findings warrant a more in-depth investigation of the area to the north of the Beatrice Fault. Specifically, the eastern section of the tenement has exploration targets where northwest trending structures intersect metasedimentary units of the Cahill Formation. As well, a second area on EL 24291 has been highlighted for its potential to host uranium mineralisation. This area is located approximately 2.5 km to the southeast of the historic Violet Prospect and to the south of the Bulman Fault. Analysis of the Resistivity Inversion (1D inversion of regional TEMPEST data) and new interpretation of the VTEM data suggest a significant uplift of the area south of the Beatrice Fault and, as such, the presence of Cahill Formation metasediments is possible. Areas highlighted for future exploration are indicated in Figure 4.

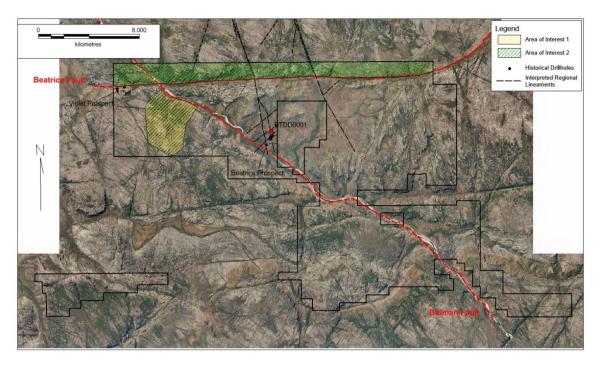


Figure 4: Areas highlighted for future exploration on Beatrice tenement (EL 24291)

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