# CAÑARIACO COPPER PORPHYRY PROSPECT

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#### ABSTRACT

The Cañariaco system lies within a belt of Oligocene to Miocene age porphyry copper deposits, which extends 350 km from Cajamarca, north-northwest to the Ecuadorian border. The mineralized systems known in this belt comprise two types: porphyry copper – molybdenum deposits (e.g. La Granja, Michiquillay) and porphyry copper – gold deposits (e.g. Cerro Corona, Minas Conga, El Galeno, La Carpa) and although no economic deposit has yet been developed, the mineralizing systems are large and contain significant amounts of copper, gold and molybdenum.

These systems are commonly associated with dacite – quartz monzonite (Cu – Mo) to dioritic (Cu – Au) stocks which intrude a sequence of Upper Jurassic to Lower Cretaceous quartzites, limestones and mudstones of the Goyllarisquizga Formation and Lower Tertiary sequences of andestic to dacitic lavas and tuffs of the Llama and Porculla Formations. Recent deposits of lavas and ignimbrites of Upper Tertiary Calipuy Formation overlie much of the area.

The geology in the immediate vicinity of the property is comprised of andesite to dacite volcanics, tuffs of the Calipuy Group, which were intruded by a series of porphyry stocks and dikes. Three porphyry centers have been identified on the property: Cañariaco Norte, Cañariaco Sur and Quebrada Verde.

At Cañariaco Norte, copper mineralization is present as hypogene chalcocite on pyrite/chalcopyrite mineralization in the upper part of the deposit and as hypogene pyrite – chalcopyrite – bornite in the deeper part of the deposit. At Cañariaco Sur and Quebrada Verde, copper mineralization is mainly chalcopyrite, with copper oxides near the surface.

Drilling to-date has identified Cañariaco Norte as being the zone with the best economic potential. The mining model that is being pursued at Cañariaco Norte is ether an open-pit, heap leach, SX-EW exploitation or a conventional milling operation.

The amenability of the Cañariaco Norte mineralization to heap leaching was tested by Billiton in 1999 and Candente in 2004 with a sequential leaching program. The Candente results showed copper mineralization, rich in chalcocite, to have a 92% recovery after 93 days.

A preliminary resource estimates has been completed for Cañariaco Norte. The inferred resource is 76.5 million tonnes grading 0.614 % Copper and 0.099 g/t gold at a 0.3 % copper cut-off.

#### INTRODUCTION

The Cañariaco Copper Porphyry Property ("Cañariaco") is located within the Western Cordillera of the Perúvian Andes in the Cañaris District, Province of Ferreñafe, Department of Lambayeque, Northwestern Perú. The property is located approximately 700 km northwest of the capital, Lima, and approximately 110 kilometres to the northeast of the city of Chiclayo, where mining supplies and services can be procured (Fig. 1). Geographic coordinates of the property are 70° 17' East longitude, 6° 05' South latitude.

The Cañariaco Property comprises 5,500 hectares in six contiguous concessions. Exploraciónes Milenio S.A., ("EMSA") a wholly owned Perúvian subsidiary of Candente Resource Corp. ("Candente"), holds a 100 % interest in the Cañariaco concessions. The Cañariaco concessions are currently in good standing and concession fees have been paid for calendar year 2005.



Access to the property from Lima, is via the city of Chiclayo, which is accessible by road, (a 637 kilometre, 11-hour journey), or by daily airline flight to Chiclayo and then by road to the property (a 149 kilometre, 6-hour journey) via either Pucara or Incahuasi. Supplies and other normal services are available in the city of Chiclayo, while specialist exploration services such as drilling and geophysical and geochemical analyses are normally contracted out of Lima. A twelve kilometre road could be constructed to connect the property to a major paved highway via the pueblo of Cañaris 8 km to the northeast of the property. (Currie, 2004)

The property is covered by tropical forest and pasture and the concessions lie at elevations ranging between 2,800 and 3,200 metres above sea level. Topography is generally steep. The temperature varies with altitude, ranging between 3.0°C and 20.0°C and the region receives between 830 and 1700 mm precipitation per year, with the rainy season occurring between November and March. The climate is not expected to affect ground-based operations.

The Cañariaco property is situated near the Cañariaco River and several creeks feeding the river drain the property. The waterways flow yearlong and are expected to be able to provide an ample water supply for exploration through mining stages. Energy could be provided by connecting into the regional power grid at Pucara. The closest port facilities are the ports of Pimentel and Eten, which are 110 and 115 kilometres away respectively. The port facilities would have to be upgraded in the event of a production decision and plans are in place by private developers to do so. Areas exist within the concessions for placement of waste dumps and location of leach pads and other process facilities. (Currie, 2004)

#### HISTORY

The Cañariaco Property was discovered in the 1970 during a regional exploration program conducted by the Perúvian Servicio Nacional de Geología y Minería ("INGEMMET") in cooperation with a British Geological Survey team. (Wilson, 1999) Exploration has been sporadic with phases of exploration and drilling in the 70's and 90's and then the current operator starting in 2001. The history is detailed in Table 1.

Table 1	History of the Cañariaco Property
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1971	INGEMMET - soil and rock chip sampling defined 4 centres of
	alteration and mineralization. Geologic mapping at 1:25,000 defined 9
	km <sup>2</sup> of alteration and mineralization.
1973	INGEMMET - 1,500 metres of diamond drilling in 5 vertical drill holes
	(S1 to S-5) to depths of 300m each in the Norte zone.
1974	INGEMMET carried out Induced Polarization (IP) geophysical surveys
	at Cañariaco Norte.
1994	Placer Dome Exploration Inc. ("Placer Dome") optioned the property
-	from the Perúvian Government. Exploration consisted of mapping, rock
1997	chip sampling and three diamond drill holes designated S-6 to S-8
	totalling 853.91m on the Norte Zone. Drooped option in 1997.
1999	Billiton Exploration and Mining Perú B.V. ("Billiton") optioned the
-	property from the Perúvian Government. Exploration comprised
2000	mapping, 3 km of road and camp construction, systematic soil and rock
	chip sampling, IP and ground magnetic geophysical surveys and a
	diamond drilling program of 958m in 7 holes. Dropped option in 2000.
2001	In February, Candente won an auction for the Cañariaco property and
	acquired 100% ownership with no royalty or net smelter return liabilities
	for a single payment of US\$75,000.
2004	January to October, Candente conducted geological mapping,
	prospecting, ground magnetic geophysics, rock chip sampling,
	petrographic studies, bulk sampling for leach column testing, re-logging
	of existing drill core and drilling 12 holes for a total of 2647.5m.

## **GEOLOGICAL SETTING**

### Regional geology

The oldest rocks in the region are Precambrian to Early Paleozoic pelitic schists of the Olmos Complex, which are unconformably covered by marine sediments intercalated with minor volcanic units belonging to the Late Triassic-Early Jurassic La Leche Formation (Fig. 2 & 3). These formations are capped by an Early to Late Jurassic volcano-sedimentary sequence, denoted as the Oyotún Formation. During the Latest Jurassic-Early Cretaceous the region was uplifted and eroded. By the late Early Cretaceous, the region had subsided and a regionally extensive quartz arenite (the lower part of the Goyllarisquizga Group) was unconformably deposited over the older formations. From the end of the Early Cretaceous to the middle of the Late Cretaceous, up to 1,500m of marls, shales and limestone were deposited over the region.

Sedimentation stopped abruptly at the beginning of the Early Tertiary with the eruption and deposition of volcanic units of the Llama and Porculla Formations, which together comprise the Calipuy Group. A period of uplift and erosion followed. Renewed volcanic activity commenced with the eruption of the Huambos Formation during the Late Tertiary, capping the stratigraphic sequence in the region. (Freeze et al, 2002)





## Property geology

#### General

The geology in the immediate vicinity of the property (Fig. 4) is comprised of andesite to dacite volcanics, and tuffs of the Calipuy Group, which were intruded by a series of porphyry stocks and dikes (Müller and Steiner, 1976). Three porphyry centres have been identified on the property: Cañariaco Norte, Cañariaco Sur and Quebrada Verde. (Freeze et al, 2002) This paper focuses on Cañariaco Norte only.

The property area is bisected by two parallel NW-SE trending district-scale faults. One bisects the Cañariaco property and the second occurs 7 km to the northeast of the property. These faults can be traced for distances in the order of kilometres and are likely reactivated faults that have inherited their length from underlying basement structures. In addition, a series of NE-SW medium range faults appear to transect the project area. These NW-SE and NE-SW faults may have formed as conjugate sets related to the common theme along the Cordillera of approximately ENE-WSW directed principal stress. In addition a series of N-S to NNW-SSE medium range structures occur between the two

district scale faults and seem to control the emplacement of the early phases of the Cañariaco intrusive complex in addition to late stage high sulphidation alteration and associated mineralization. These faults have a dextral kink whereby the faults change orientation from NNE-SSW to N-S where they cross the main NW-SE structure. (Caira, 2004)

A number of circular features/intrusions have been identified in the district. A single circular feature that measures 8x10 km encompasses all three mineralized centres including Cañariaco Norte, Sur and Quebrada Verde. The main feature is centred on, or close to major fault intersections suggesting that the emplacement of the intrusive complex has been localized by fault intersections where NW-SE faults intersect NE-SW faults. (Murphy, 2004)



## Cañariaco Norte

Recent geological mapping by Candente at Cañariaco Norte indicates that the Cañariaco intrusive complex forms a body that is elongated primarily along a NNW-SSE axis for a distance of at least 1.5 km and secondarily along an ENE-WSW axis and extends to a depth of greater than 300m. At least four igneous phases and three magmatic-hydrothermal breccia phases have been identified at Cañariaco Norte that vary in both intensity, type of veining and alteration in addition to mineralization styles. (Caira, 2004)

Phases, from (suspected) oldest to youngest (Fig. 5 and Table 2):

Table 2	Mineralization and Igneous phases at Cañariaco
	mineralization and igneous phases at ounarideo

Map Unit	Code	Description		
Early Mine	eral Phas	e		
1	APV	Fined grained andesite porphyry volcanics		
2	DTV	Fine grained dacite tuff		
Early Mine	eral Phas	e		
3	AM	Andesite Porphyry Volcanics (metasomatized)		
Inter-Mine	ral Phas	es		
4	CQFP	Crowded feldspar quartz porphyry		
5	CBX	Crackle breccia		
6	CQP	Coarse quartz porphyry		
7	BFP	Biotite feldspar Porphyry		
Late Mine	ral phase			
8	TBX	Tourmaline Breccia		
9	IBXm	Igneous breccia Monolithic		
10	IBXp	Igneous Breccia Polylithic		
Post Mine	ral Phase	9		
11	FP	Feldspar Porphyry Dyke		



Figure 5: Cañariaco Norte Geology Map

## MINERALIZATION

Mineralization on the Cañariaco property occurs in three porphyry copper centres: Cañariaco Norte, Cañariaco Sur and Quebrada Verde. The three

centres contain varying intensities of copper mineralization depending on intrusive association and alteration overprints. Candente's work to date has concentrated on the Cañariaco Norte area.

### Cañariaco Norte

At Cañariaco Norte, pyrite-rich copper (and gold) mineralization occurs within the Cañariaco intrusive complex which comprises at least four igneous phases and three magmatic-hydrothermal breccia phases. Mineralization varies in style and intensity in the different intrusive phases. In general, mineralization occurs primarily as disseminations and in quartz vein/fracture stockworks. Fault controlled mineralization is much less common. To a much lesser extent, mineralization can occur in the surrounding andesite to dacite volcanics. (Caira, 2004)

Alteration decreases in intensity from the centre to the margins of the deposit. The central zone of quartz-sericite (phyllic) alteration was noted to grade outward to a chlorite, epidote, carbonate (propylitic) alteration and encloses a central zone of biotite, orthoclase (potassic alteration) at depth demonstrating a lateral and vertical zonation typical of porphyry – hypogene alteration. (Caira, 2004)

The copper mineralization (Caira, 2004) appears to be comprised of four zones as follows:

- A sub-horizontal "leached zone" with copper values in the range of .03 .05% Cu with copper sulphates and varies in thickness from 6 72m;
- A Hypogene Enrichment zone that seems to be structurally controlled with copper values in the range of 0.6-1.5% Cu comprised of an assemblage of pyrite-chalcocite-covellite-digenite and to date has been recognized over a thickness of up to 116m;
- A "mixed zone" comprised of both primary chalcopyrite-bornite with an overprint of pyrite-chalcocite-covellite-digenite mineralization. Can range from 30 – 90m in thickness;
- A "primary hypogene zone" with disseminated and/or fracture-controlled chalcopyrite-bornite-pyrite of unknown thickness.

The Hypogene Enrichment zone is pyrite-rich copper mineralization that underwent a series of extensive pyrite-rich overprints including "intermediate argillic" (sericite-illite), "advanced argillic" with a final "phyllic" (quartz-sericitepyrite-tourmaline) alteration event. A high sulphidation overprint caused leaching of chalcopyrite and introduction of a high sulphidation assemblage of pyrite-chalcocite-covellite (digenite)-enargite-bornite. Copper contents were increased by greater than 50% by this high sulphidation overprint. (Caira, 2004)

Sillitoe (1999) has stated that the chalcocite-covellite-digenite mineralization seen in the Hypogene Enrichment and Mixed Zones is of hypogene, not supergene origin. The recognition of hypogene rather than supergene nature of the copper sulphides at Cañariaco Norte implies that the potential for such material is not just confined to a thin, variable blanket at the top of the sulphides but may extend to considerable depths as seen in Hole S-8 where hypogene chalcocite continues to a depth of 304m.

Recent drilling, 2004, has provided additional information on the nature of the copper-gold mineralization. The relation is not 1 to 1 but higher copper grades generally show higher gold grades and where there is copper mineralization there is gold mineralization.

The distribution of chalcocite and chalcopyrite in drill holes is shown in Figures 6 and 7. Figure 6 shows chalcopyrite dominant in the centre with chalcocite dominant to the east and west. Figure 7 shows chalcocite is dominant to the south and chalcopyrite is dominant to the north. Both figures show that centrally chalcocite extends to depth, which suggests a feeder system for the hypogene chalcocite mineralization.

#### **EXPLORATION BY CANDENTE RESOURCE CORP.**

Exploration by Candente Resource Corp., through its Perúvian subsidiary EMSA, has concentrated on the Quebrada Norte area of the Cañariaco Norte Zone and focused on the delineation of a resource amenable to heap leach SX/EW exploitation. Copper mineralization has now been delineated in outcrops and drill holes over a minimum aerial extent of 1 by 1.2km.



Figures 6 & 7: Cross sections showing mineralization

I.2 kilometres

	LE	GEND	
leached cap	>65% chalcocite	Mixed chalcocite	>65% chalcopyrite

### DRILLING

#### Cañariaco Norte

Four drill campaigns have been undertaken on the Cañariaco Norte prospect. All holes drilled at Cañariaco Norte were diamond core holes.

The first drill program was undertaken by INGEMMET. During this program, 5 vertical diamond drill holes (S-1 to S-5), each to 300m were drilled.

The second drill program was undertaken between 1994 and 1996 by Placer Dome who drilled three angled diamond holes (S-6 to S-8) totalling 853.91m. No other anomalies on the property were tested. (Currie, 2004)

The third drill program at Cañariaco Norte was undertaken during 1999 and early 2000 by Billiton, which completed a diamond drill program with a total of 555.7m in 3 holes.

Candente undertook the fourth drill program in late 2004. A total of 2648m were drilled in twelve holes. The twelve holes were drilled vertically as part of a systematic pattern on a grid with 100 metre centres to test the continuity of copper mineralization and provide sufficient information for Candente to prepare a preliminary resource estimate. Mineral resources for Cañariaco Norte are discussed in the resource and reserve section of this report.

Copper grades in the mineralized zones in the twelve holes average 0.7% Cu over an average width of 151 m with individual intersections ranging from 0.45%/137m; 0.71%/234m; 0.85%/205m; 1.01%/96m. All of the twelve holes bottomed in significant copper mineralization grading from 0.54% to 1.00% Cu. These figures do not include three lesser-mineralized zones, which intersected late mineral rock units. The copper mineralization is open in all directions both laterally and vertically.

Significant results from the Cañariaco Norte drilling programs are presented in Table 3, below:

Hole No.	From	То	Interval		Copper
	(m)	(m)	meters	feet	(total %)
73-001	70	300	230	754	0.65
includes	70	174	104	341	0.83

 Table 3
 Cañariaco Norte – Copper Grade Summary

includes	70	92	22	72	1.48
73-002	100	130	30	98	0.50
73-003	82	118	36	118	0.54
73-004	72	194	122	400	0.48
includes	78	92	14	46	0.79
95-006	56	176	120	394	0.37
includes	56	78	22	72	0.67
95-007	42	178	136	446	0.45
includes	46	90	44	144	0.61
99-001	36	197	161	528	0.57
includes	68	108	40	131	0.86
99-002	32	158	126	413	0.44
includes	40	52	12	39	0.84
99-003	12	167	155	507	0.45
includes	152	167	15	48	0.69
04-001	66	300	234	768	0.71
includes	66	162	96	315	1.01
04-002	60	248	188	617	0.68
includes	60	102	42	138	0.80
04-003	40	203	163	534	0.65
includes	40	80	40	131	0.89
04-004	8	166	158	518	0.64
04-005	36	202	166	544	0.74
includes	172	202	30	98	0.93
04-006	50	255	205	671	0.85
04-007	34	227	193	633	0.58
includes	34	110	76	249	0.87
04-008	46	260	214	702	0.64
includes	46	202	156	512	0.73
04-009	52	92	40	131	0.88
04-010	18	152	134	441	0.64
includes	18	56	38	125	0.74
04-011	44	212	168	551	0.63
04-012	64	201	137	449	0.45
includes	64	152	88	289	0.49

## MINERAL PROCESSING AND METALLURGICAL TESTING

In 1999, Billiton conducted sequential leach testing on twelve samples from Holes CN1 and CN3. The results from this testing are very similar to the results obtained by Candente.

Candente identified leachable copper mineralization at Cañariaco Norte over an area measuring 1 by 1.2 km in outcrop and by re-logging ten holes

drilled by previous exploration companies. Two column leach tests were conducted on samples ranging from 0.35% Cu to 0.76% Cu. The samples were crushed and submitted for total copper assays and for a sequential leach procedure to determine percentages of copper in oxide, chalcocite and chalcopyrite form

The copper extraction in column test one (85% chalcocite, 15% chalcopyrite), indicated excellent leachability of 92% after 93 days. The copper extraction on column test two (46% chalcopyrite, 54% chalcocite) returned 52% after 93 days.

### MINERAL RESOURCE AND MINERAL RESERVE ESTIMATES

### **Summary and Introduction**

The resource model for Cañariaco Norte included drilling completed during 2004 by Candente, Placer Dome in 1995 and Igemmet in 1973. The drilling consists of 14 NQ core holes and one BQ core hole. The 2004 drilling was completed on 100 x 100m spacing and the 300 x 300 area modeled contained 3 historic drill holes. The block model was created using 10x10x5 blocks to cover the area of 100 x 100 grid drilling.

### **Resource Tabulation**

The resource for the Cañariaco Property was tabulated under the current topography surface and with copper as the primary element. The resources for Cañariaco are classified as inferred and are based on a maximum distance (true) of 75m from the closest sample. The results are listed in Table 4.

Cutoff		Copper	Gold	Contained	Contained
Grade	Tonnes	Grade	Grade	Copper	Gold
(% Cu)	(Million)	(% Cu)	gpt	(Million lbs)	(Ounces)
0.5	58.5	0.672	0.104	866	195,000
0.4	71.0	0.634	0.101	992	230,000
0.3	76.5	0.614	0.099	1035	243,000
0.2	81.1	0.594	0.098	1062	2551,000

Table 4	Cut Copper Grade
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### INTERPRETATION AND CONCLUSIONS

Cañariaco Norte hosts to most attractive exploration target found to date. This zone shares a number of common characteristics with world-class porphyry deposits, including multiple porphyry intrusive phases and a 'high sulphidation' copper sulphide assemblage (i.e., hypogene chalcocite and covellite).

The 2004 drill program has further delineated the copper porphyry mineralization at Cañariaco Norte and allowed the estimation of a preliminary inferred resource of 76.5 million tonnes grading 0.614 % Cu and 0.099 g/t Au at a 0.3 % Cu cut-off. The area of the resource only covers an area 300 by 300m, which is approximately 15% of the known mineralized zone at Cañariaco Norte. The potential exists to expand the area of delineated mineralization in all directions and therefore increase the resource size.

There is evidence from early drill programs that a chalcocite rich zone exists in the southern half of Cañariaco Norte. This target will be tested as a priority in 2005 as it might be an area of copper mineralization amenable to open-pit, heap-leach, SX-EW exploitation. Leach testing has only been carried out on the mineralization at Cañariaco Norte with good results.

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