DRUG ENFORCEMENT ADMINISTRATION
Office of Forensic Sciences
Special Testing and Research Laboratory

Cocaine Signature Program Report
CY 2022
Final Reporting for CY 2022 U.S. Seizures and
1st Half CY 2023 Foreign Division Submissions

Summary

The United States Drug Enforcement Administration Special Testing and Research Laboratory's Cocaine Signature Program (CSP) provides scientific data and intelligence information on illicit cocaine. Submissions to the CSP are analyzed for purity, cutting agents, processing solvents, and classified to a geographic origin. CSP findings provide a snapshot of current cocaine processing and trafficking trends but may not reflect the domestic or global cocaine supply in its entirety.

This report summarizes the collective results of wholesale cocaine samples seized in or in transit to the United States (U.S.) during CY 2022. Results from samples seized outside the U.S. from DEA foreign divisions that were analyzed from January – June 2023 are also reported. Domestic and foreign cocaine trends observed by the CSP over the last five to ten years are also discussed throughout this report.

Key Findings

- CSP's geographic origin classification model was updated in 2023

- Approximately 97% of U.S. seized samples analyzed by the CSP were classified as originating from Colombian coca.

- The most prominent source of CY 2022 U.S. seized samples analyzed by the CSP was Southwestern Colombia

- The average cocaine hydrochloride (HCl) purity of U.S. seized samples analyzed by the CSP in CY 2022 was 84%.

- Adulteration of U.S. seized CSP samples remains at low levels with 79% of samples reporting no cutting agents present.

Coca field in Colombia

Cocaine HCl bricks
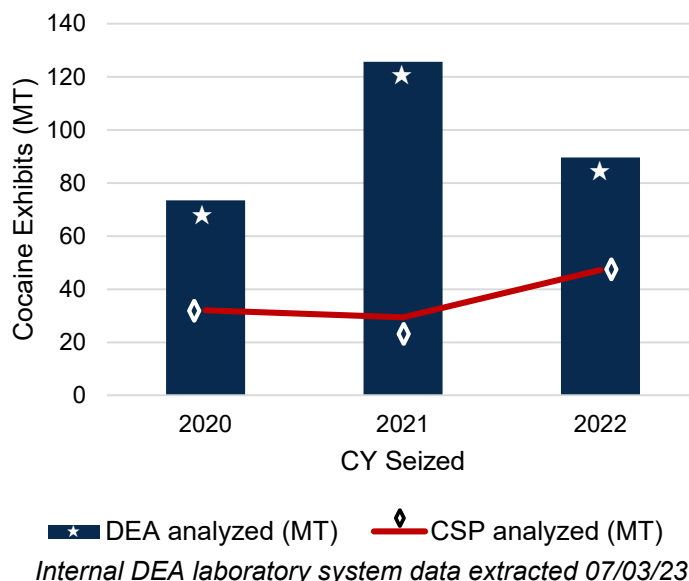
Domestic Submissions

In each of the last three years, CSP analyzed samples from U.S. seizures totaling between 30 – 50 metric tons (MT). This is approximately 20 – 50 % of similar seized exhibits analyzed by the DEA Laboratory System during the same reporting period. Results presented in this report are subject to change as they only account for the information available at the time of extraction from DEA laboratory databases.

The most prominent source of CSP samples has been, historically, from seizures in the Eastern Pacific Ocean (EPAC). Cocaine seizures in the EPAC tend to be larger in size compared to the Caribbean or CONUS which may have accounted for the higher number of samples compared to the other regions. Starting in 2019, the CSP observed an increase in the number of CONUS submissions from DEA regional laboratories, and this region has since provided the largest share of CSP samples. The increase in CONUS submissions to the CSP may allow stateside regional trends to be identified more easily. The number of Caribbean submissions also increased in 2022 compared to past years. For the first time in CSP's history tracking U.S. regional cocaine seizure trends, more samples were analyzed from the Caribbean compared to the EPAC. Changes in sample submissions may be related to the prioritization of cases at the DEA field laboratories.

Weight of Cocaine Exhibits Analyzed by DEA Laboratory System and CSP (MT)

*Internal DEA laboratory system data extracted 07/03/23*

The distribution of CSP samples from the major U.S. seizure regions is illustrated below. Differences between cocaine trafficked through these regions will be discussed in more detail over the next few pages.

CSP Analysis: Approximate Cocaine Seizure Weight (MT)			
CY Seized	CONUS	Caribbean	EPAC
2018	10	8	50
2019	13	6	16
2020	7	4	20
2021	8	7	15
2022	6	10	32

CSP Sample Distribution (U.S. Seizures 2018 – 2022)
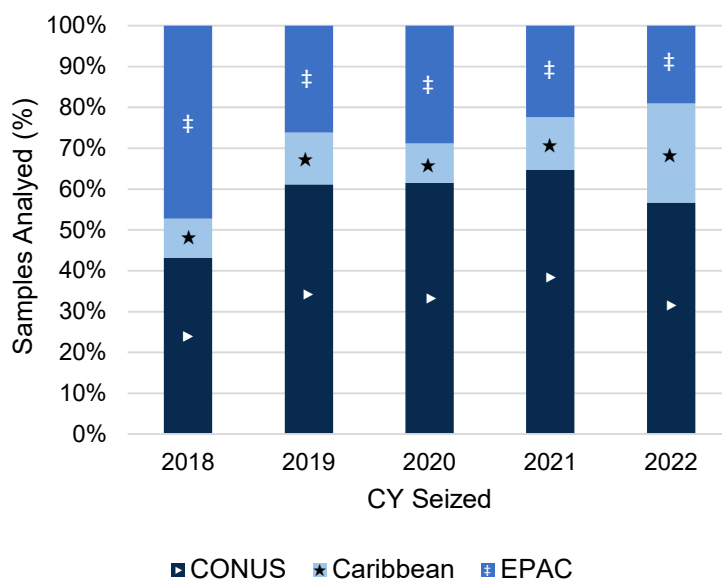
Domestic Results and Trends

Source Classification

DEA's CSP has identified Colombia as the primary source of cocaine in the U.S since 2000. Approximately 97% of samples this reporting period were classified as originating from Colombian coca. Peruvian coca leaf signatures were classified in approximately 1% of samples. Samples that do not contain signature results consistent with specific regions of origin were reported as Unknown (UNK). Samples that could not be sourced to a specific country of origin but contained characteristics of both Colombian and Peruvian grown coca were reported as "Colombia-Peru". Samples of this type had previously been reported as UNK by the CSP but have been reclassified to provide more nuanced geospatial results. Samples with extensive cutting agents and cocaine purities too low to complete the full signature analysis were reported in less than 1% of samples and classified as Not Determined (ND). Samples that were classified as ND were not included in the cocaine origin summary charts below.
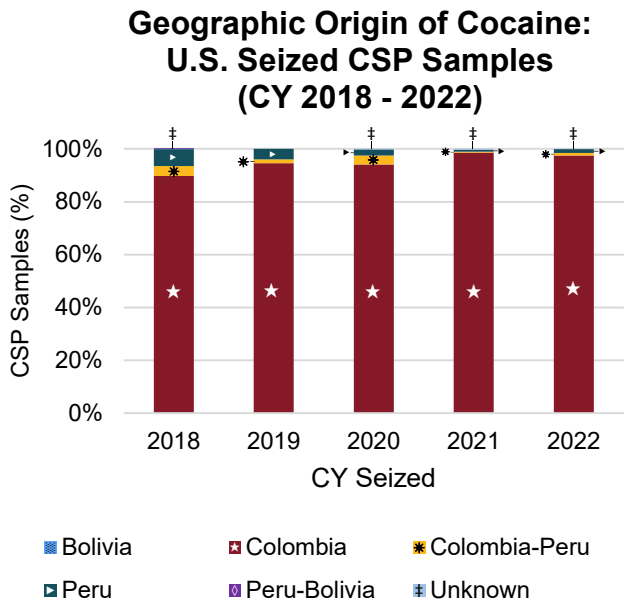

Primary CSP geographic origin classifications

In early 2023, CSP began using a new geographic origin classification model. End year reporting for all CY 2022 seizures has been updated to reflect the reclassifications.

Southwestern Colombia (Col-SW) was the most prominent source of cocaine in CY 2022 U.S. seizures, followed by Northern Colombia (Col-North). Samples that were obviously Colombian, but could not be regionally classified (Col-RND) accounted for 24% of samples. Cocaine geographic origin classifications from 2018 - 2022 are summarized in the tables below.

Geographic Origin of Cocaine: U.S. Seized CSP Samples (CY 2018 - 2022)

Legend: ■ Bolivia · ▨ Colombia · ✳ Colombia-Peru · ▤ Peru · ▨ Peru-Bolivia · ⊞ Unknown

| Sub-Region	CY Seized (% of Samples)				
	2018	2019	2020	2021	2022
Col-SW	46	54	52	38	49
Col-North	4	3	1	1	25
Col-RND	39	37	39	60	24
Peru	6	4	2	1	1
Colombia-Peru	4	2	3	<1	1
Colombia-Other	<1	<1	1	<1	---
Bolivia	<1	---	---	---	---
Peru-Bolivia	<1	---	---	---	---
UNK	<1	---	<1	<1	<1

New cocaine classification model used in CY 2022

Purity and Adulterant/Diluents

CSP analysis indicates that domestic cocaine HCl purity at the wholesale level has been fairly consistent over the last 6 years. In 2022, the average cocaine HCl purity was 84%. Adulterants and diluents are most often added to wholesale cocaine at the cocaine HCl laboratory before it is pressed into brick form. Although traffickers outside of South America have been known to dilute cocaine and re-press the bricks, CSP samples consistent with this type of preparation are rare. The CSP reports adulterants and diluents as cutting agents when they are present in a concentration at or above 1%. The percentage of samples without cutting agents this reporting period was 79%. A consistently low amount of cutting agents at the wholesale level has been observed since 2016.

Samples may contain multiple cutting agents, but the most prominent continues to be phenyltetrahydro-imidazothiazole (PTHIT, i.e., levamisole and/or levamisole mixtures containing its optical isomer dexamisole). Levamisole (*l*-isomer) and tetramisole (*d,l*-isomer), reported by DEA as PTHIT, are antihelmintic drugs used in veterinary medicine. Cocaine producers may use PTHIT as an adulterant because of its similar reactivity to a commonly used cocaine colorimetric field test, similar chemical solubility properties as cocaine, and it reportedly has the potential to enhance the euphoric effects of cocaine on users. PTHIT has been identified as the most prominent cocaine adulterant since 2009. From approximately 2010 – 2016, PTHIT was reported in 70 – 90% of CSP samples. A decrease in the use of PTHIT as a cocaine adulterant has been observed since 2015, only identified in 19% of samples examined this reporting period. The average concentration of PTHIT in cocaine samples was 10% (range 1% to 68%). Various other cutting agents such as creatine, dextrose, inositol, lidocaine, phenacetin, procaine, sodium bicarbonate, and talc were identified less frequently, for a combined total of 2% of samples.

CSP Sample Cocaine HCl Purity and Adulteration: CY Seized 2013 - 2022
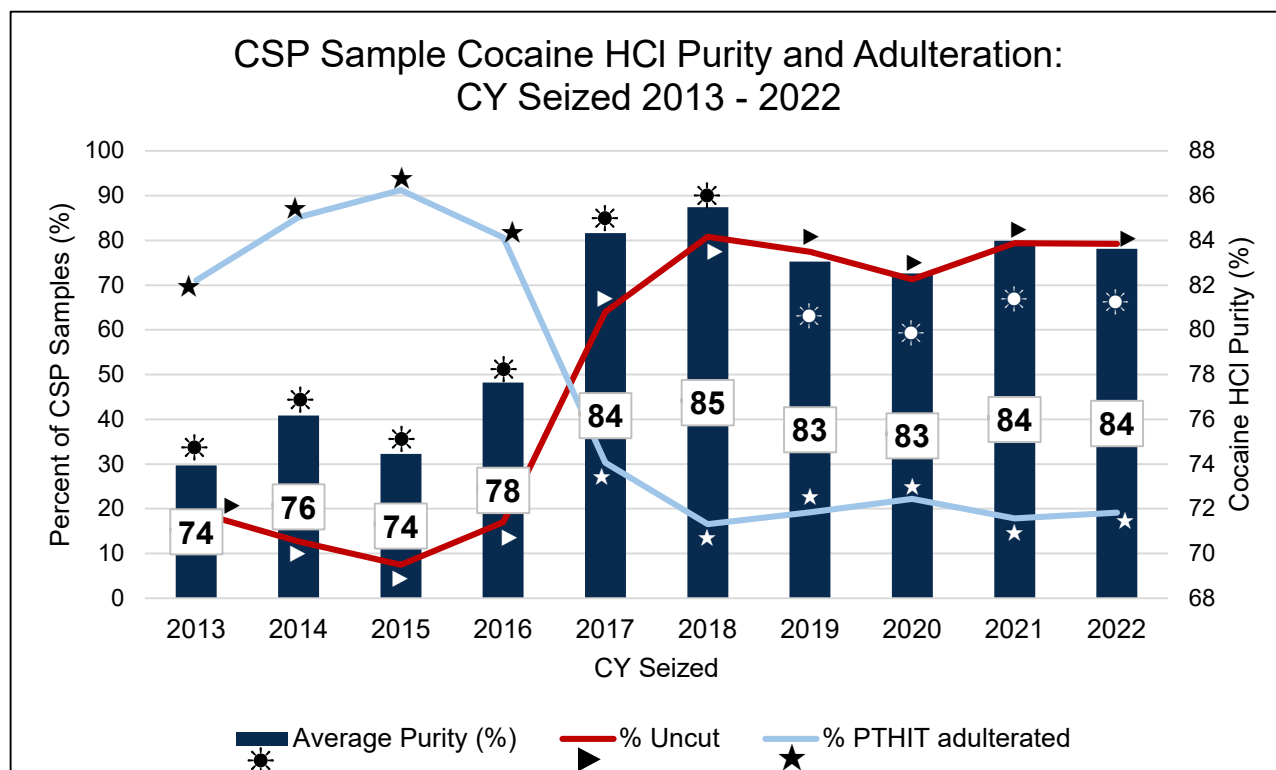
Processing Artifacts

CSP results continue to indicate the high availability of oxidizing agents such as potassium permanganate in illicit cocaine production. Over 99% of samples were highly oxidized (or re-oxidized). Less than 1% of samples were moderately or not oxidized.

Cocaine HCl Processing Solvents

The below chart summarizes cocaine HCl occluded solvent profiles from 2018 - 2022. Results are reported as the percent of samples in which the solvent was identified as one of the predominant solvents. Relatively minor changes have been observed from year to year; however, an increase in the identification of ethyl acetate has been observed since 2018, suggesting increased availability of ethyl acetate in Colombia.

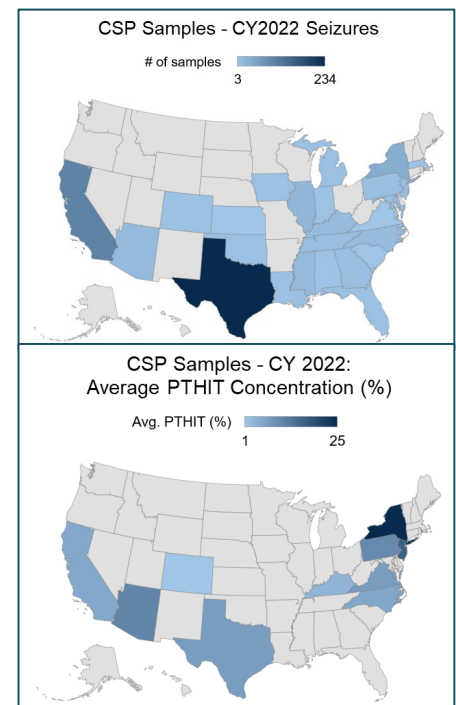| Primary Solvents	Primary Solvents in Cocaine HCl CSP Samples (% of Samples by CY Seized)				
	2018	2019	2020	2021	2022
n-Propyl Acetate	23	28	43	32	41
Mixed Acetates	53	51	41	50	35
MEK	30	46	30	28	25
Ethyl Acetate	5	9	7	11	22
n-Butyl Acetate	2	<1	<1	2	<1
Acetone	---	<1	---	---	<1
Methyl Acetate	18	12	8	5	<1
Ethyl Ether	<1	---	<1	---	---

CONUS Seizures (CY 2022)

609 samples representing approximately 6 MT were examined from CONUS seizures. California and Texas supplied the most samples, followed by New York. Some notable regional differences were observed. The combined average cocaine HCl purity in the Eastern states of New Jersey, New York, and Pennsylvania (77%) was lower than the CONUS average (84%). PTHIT adulteration was correspondingly higher in these samples than the U.S. average. PTHIT was identified in 28 – 58% of samples seized in New Jersey, New York, and Pennsylvania with an average PTHIT concentration of 18%. In comparison, CONUS samples were adulterated with PTHIT in only 13% of samples with an average concentration of 11%. A similar pattern of low cocaine purity and high PTHIT adulteration was observed in Caribbean seized cocaine suggesting a potential correlation to the cocaine trafficked to the Eastern U.S.

Southwestern Colombia was the most prominent source of cocaine in the CONUS region. See the tables and map below for detailed results.

State	Total Seizures	Total Seized (kg)	Total Samples	Average Cocaine HCl Purity (%)	Min. Cocaine HCl Purity (%)	Max. Cocaine HCl Purity (%)
TX	77	2135	234	83.9	18.1	94.6
CA	34	1154	102	83.3	trace	95.0
NY	12	383	39	76.8	20.2	95.7
IL	7	309	24	85.5	79.5	92.7
AZ	6	377	18	80.5	34.7[1]	89.6
MS	6	188	18	87.2	75.9	92.9
KY	5	107	15	86.4	83.7	89.5
NC	5	73	15	86.3	75.7	90.1
NJ	5	204	15	77.2	22.5	91.7
GA	4	114	12	87.1	83.6	90.5
MD	4	62	12	88.6	86.4	92.5
PA	3	70	12	78.4	65.0	87.8
TN	4	122	12	86.6	83.1	91.7
CO	3	56	9	85.9	82.1	88.8
FL	3	121	9	89.7	84.4	96.1
IA	2	180	9	88.9	85.0	91.4
LA	3	47	9	88.5	86.1	90.1
MI	3	51	9	89.3	85.5	92.4
OK	3	63	9	88.7	83.7	92.1
AL	2	22	6	83.7	81.4	84.9
IN	2	51	6	85.1	81.5	89.8
MA	2	25	6	86.0	82.2	89.5
KS	1	15	3	88.9	87.9	90.8
SC	1	14	3	87.2	84.7	91.6
VA	1	17	3	82.5	78.2	88.5

% of Samples

Geographic Origin	CONUS	CA	NY	TX
Col-North	20	22	23	12
Col-SW	53	52	41	60
Col-RND	25	21	28	28
Colombia-Peru	1	3	---	---
Peru	1	1	8	<1
Unknown	<1	1	---	---

CSP Samples - CY2022 Seizures
# of samples 3 — 234

CSP Samples - CY 2022: Average PTHIT Concentration (%)
Avg. PTHIT (%) 1 — 25

NOTE: Seizure amounts, reported as total kilograms (kg), are estimations. Samples with cocaine purities less than 1% are not included in the average cocaine HCl purity calculation.
[1]One sample was found to contain procaine with no cocaine present.
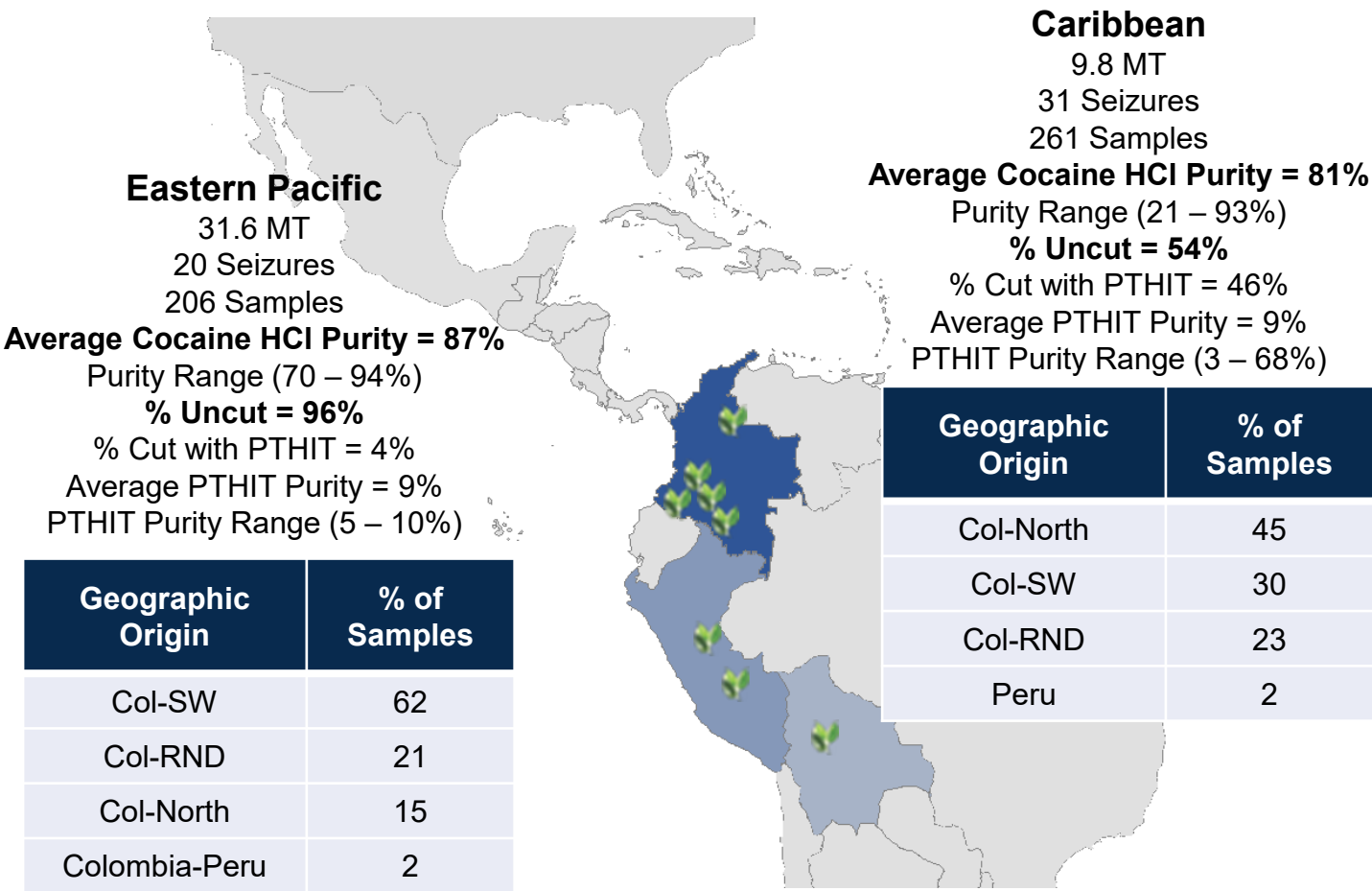
Eastern Pacific and Caribbean Seizures (CY 2022)

Two major cocaine trafficking routes are through the EPAC and Caribbean regions. Comparison of cocaine chemical and signature profiles between wholesale samples seized in these regions may indicate cocaine production trends and information on cocaine trafficking patterns.

The average cocaine HCl purity was higher in the EPAC compared to the Caribbean. Adulterants were also identified less frequently in EPAC trafficked cocaine. The sole cutting agent identified in EPAC and Caribbean samples was PTHIT. The average amount of PTHIT added to illicit cocaine bricks was similar for the EPAC and Caribbean; however, the range was quite large in the Caribbean compared to the EPAC with samples containing up to 68% PTHIT. This also corresponds to a wide range of cocaine HCl purity in the Caribbean.

Differences in the geographic origin were also observed between the two regions. Caribbean samples were most frequently sourced to Northern Colombia; whereas, EPAC samples were sourced most frequently to Southwestern Colombia. Northern Colombian classifications in the Caribbean were most consistent with Norte de Santander; whereas, samples in the EPAC classified as Northern Colombia were most consistent with Antioquia. Nariño was the predominant Southwestern Colombian classification reported in both trafficking routes.

Key findings this reporting period are summarized in the map and tables below.

Eastern Pacific
31.6 MT
20 Seizures
206 Samples
Average Cocaine HCl Purity = 87%
Purity Range (70 – 94%)
% Uncut = 96%
% Cut with PTHIT = 4%
Average PTHIT Purity = 9%
PTHIT Purity Range (5 – 10%)

Geographic Origin	% of Samples
Col-SW	62
Col-RND	21
Col-North	15
Colombia-Peru	2

Caribbean
9.8 MT
31 Seizures
261 Samples
Average Cocaine HCl Purity = 81%
Purity Range (21 – 93%)
% Uncut = 54%
% Cut with PTHIT = 46%
Average PTHIT Purity = 9%
PTHIT Purity Range (3 – 68%)

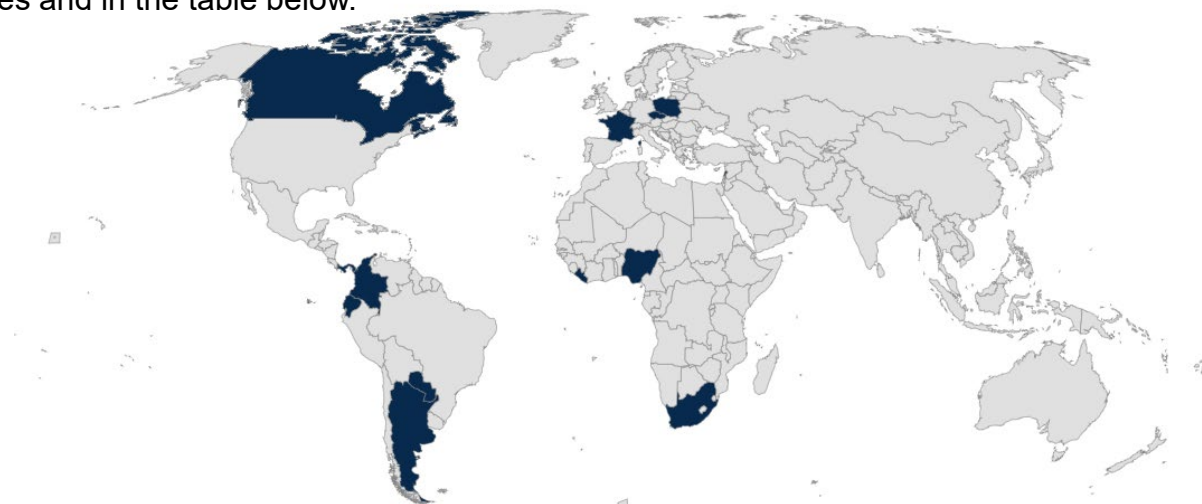| Geographic Origin	% of Samples
Col-North	45
Col-SW	30
Col-RND	23
Peru	2

Foreign Submissions (Samples Analyzed January – June 2023)

A total of 105 samples seized outside the U.S. were analyzed this reporting period. These samples differ from U.S. submissions as they are not necessarily from wholesale cocaine seizures, but also include samples seized at the street level or contain unusual samples of interest. While the total number of samples analyzed from each geographic region is limited, cocaine signature results may provide an indication of global cocaine trafficking trends. Regions and samples of note are summarized in the next few pages and in the table below.

Foreign Results and Trends

Country	# of Samples	Salt Form	Average Cocaine Purity (%)	Cocaine Purity Range (%)	Geographic Origin or Other Findings
Argentina	3	ND	43	N/A	Cocaine, salt form not determined with carfentantil Insufficient quantity of material for origin analysis
Canada	40	HCl	85	80 – 89	Col-North (18), Col-SW (11), Col-RND (11)
	1	Base	86	N/A	Col-SW (1)
	1	ND	4	N/A	Insufficient purity for origin analysis; also contains benzocaine
Colombia	18	HCl	80	64 – 89	Col-North (10), Col-RND (5), Col-SW (3)
Czech Republic	16	HCl	83	66 – 90	Col-RND (11), Col-SW (5)
Ecuador	3	HCl	88	86 – 90	Col-SW (3)
France	10	HCl	93	93 – 95	Peru (9), Bolivia (1)
Lebanon	1	Base	82	N/A	Col-SW (1)
Liberia	1	HCl	94	N/A	Peru (1)
Nigeria	4	HCl	79	49 – 91	Col-SW (2), Col-North (1), Col-RND (1)
Panama	1	N/A	N/A	N/A	No controlled substance
Paraguay	2	HCl	96	93 – 99	Peru (1), Bolivia (1)
Poland	3	ND	10	2 – 26	Liquid samples from cocaine concealed in fruit pulp
South Africa	1	HCl	59	N/A	Col-RND (1)

Africa

Liberia
One uncut cocaine HCl sample was analyzed from a 522-kg seizure in 2022. Cocaine was sourced to Peru. Ethyl acetate was the primary solvent used in the crystallization of cocaine HCl.

Nigeria
Four cocaine HCl samples were analyzed and geo-sourced to Colombia. Three samples contained uncut cocaine HCl with purities ranging from 86 – 91% and were sourced to Nariño (n = 1), Putumayo (n = 1), and Colombia-RND (n = 1). One PTHIT adulterated cocaine HCl sample was sourced to Norte de Santander with a cocaine HCl purity of 49%. Processing solvents reported in these samples were n-propyl acetate, ethyl acetate, acetate mixtures, and MEK.

South Africa
One cocaine HCl sample adulterated with phenacetin, caffeine, and benzocaine was analyzed. The cocaine was sourced to Colombia and processed using methyl acetate.

Asia

Lebanon
One cocaine base sample adulterated with caffeine was analyzed and sourced to Colombia.

North and Central America

Canada
Two exhibits of suspected crack cocaine were analyzed. One exhibit contained uncut cocaine base consistent with Nariño. The second exhibit contained benzocaine adulterated cocaine with a purity too low for salt form determination and origin analysis.

The CSP also analyzed 20 cocaine HCl samples from a tractor trailer seizure of approximately 117 kg that occurred in 2020 at the Ontario Port of Entry. CSP had previously analyzed 20 samples from this same seizure throughout 2022 and 2023. Since the samples analyzed during this reporting period used the new classification model described earlier in this report, previously analyzed samples were reclassified using the new model. Results for all 40 samples are included in the summary table on page 10. No substantial cutting agents were reported; however, PTHIT was detected in trace amounts (n = 8) suggesting contamination rather than adulteration. Based on the HCl processing solvent profiles and the geographic origin of the cocaine, cocaine HCl from different processing batches appear to have been trafficked together in this shipment. Cocaine signature profiles consistent with Norte de Santander (n = 18) were most frequently classified, followed by Nariño (n = 11), and Colombia-RND (n = 11).

Panama
One exhibit of suspected concealed cocaine was analyzed. No controlled substance was detected. The exhibit had physical characteristics consistent with cement, but the identity of the material was not confirmed.

South America

Argentina
Three exhibits from a case suspected to contain cocaine and carfentanil were examined. Insufficient sample was provided to conduct cocaine signature analysis, but cocaine and carfentanil were confirmed in each exhibit. One exhibit contained sufficient material for cocaine quantitation, with a reported purity of 43% (calculated as cocaine base). An accurate quantitation of the carfentanil was not obtained due to limited material available for testing. The purity of the carfentanil was estimated to be between 0.1 – 1.6%.

Colombia
Eighteen cocaine HCl samples from four different seizures in Colombia were analyzed. Samples were obtained from three seizures in Cartagena (n = 9) and one seizure in Barranquilla (n = 9).

Cartagena samples were uncut and resulted in an average cocaine HCl purity of 88% (range 87 – 89%). Northern Colombia was the most prominent origin of the Cartagena seized samples with signature profiles most consistent with Antioquia (n = 6). Three samples were classified as Colombia-RND. Mixtures of acetates and MEK were the most prominent solvent combinations used in the cocaine crystallization.

Barranquilla seized samples were obtained from one 20-kg seizure and contained cocaine HCl adulterated with PTHIT and dimethyl terephthalate. The average cocaine HCl purity was 72% (range 64 – 80%). The average amount of PTHIT in the samples was 11% (range 7 – 17%). Dimethyl terephthalate is not frequently observed by the CSP as a cocaine cutting agent and was not quantitated. All nine samples were classified as Colombian. Samples were most consistent with Norte de Santander (n = 4), followed by Putumayo (n = 3), and Colombia-RND (n = 2). N-propyl acetate and acetate mixtures were the most prominent solvents used in the cocaine crystallization.

Ecuador
Three uncut cocaine HCl samples consistent with Nariño in Southwestern Colombia were analyzed. N-propyl acetate was the primary crystallization solvent in all three samples.

Paraguay
Two uncut cocaine HCl samples were analyzed from two different seizures. One sample was obtained from a 5-kg seizure in Asunción. The bricks were reportedly wrapped in black rubber and cellophane with a depiction of the Bolivian Flag. Interestingly, cocaine signature analysis sourced the cocaine to Bolivia and confirmed the advertising. Ethyl acetate was the primary solvent used in the HCl crystallization. Peruvian and Bolivian cocaine converted to cocaine HCl with ethyl acetate is a commonly observed profile in cocaine departing the Southern Cone of South America to Europe, Africa, and other regions.

One sample from a 52-kg seizure in Luque was also analyzed and sourced to Peru. This sample was crystallized using acetone, the traditional solvent associated with Peruvian cocaine HCl labs.

South America Trends (CY 2018 – 2022)

Notable findings have been observed through the analysis of cocaine HCl samples submitted from DEA Foreign Divisions in South America. Samples (n = 429) collected from seizures during approximately 2018 – 2022 are summarized in the charts below. Accurate seizure dates are not always available to the CSP; therefore, results are summarized by seizure date or the date submitted to the DEA Foreign Division when the date of seizure is unknown.

The geographic origin of cocaine in DEA's Andean Region, which includes Colombia and Ecuador, was primarily of Colombian origin. Cocaine chemical and signature profiles that were sourced to Colombia were similar to those observed in the U.S. DEA's Southern Cone region includes Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, and Uruguay. In contrast to the Andean region, Peru was the most prominent source of cocaine analyzed from Southern Cone seizures.

Peruvian and Bolivian cocaine is rarely reported in U.S. seized samples; therefore, South American submissions help the CSP monitor trends in Peruvian and Bolivian cocaine production. Acetone was the predominant solvent observed in Peruvian seized samples; whereas, ethyl acetate was more frequently reported in Peruvian sourced samples seized in Brazil. These results are consistent with reporting that acetone is commonly used by Peruvian cocaine HCl lab operators. Cocaine HCl lab operators elsewhere in the Southern Cone such as Bolivia appear to use ethyl acetate frequently. The combination of ethyl acetate and Peruvian-Bolivian sourced cocaine is often observed in cocaine seized in Europe and Africa and is frequently observed in samples known to have departed Brazilian ports.

South America: Cocaine HCl Geographic Origin (CY 2018 - 2022)
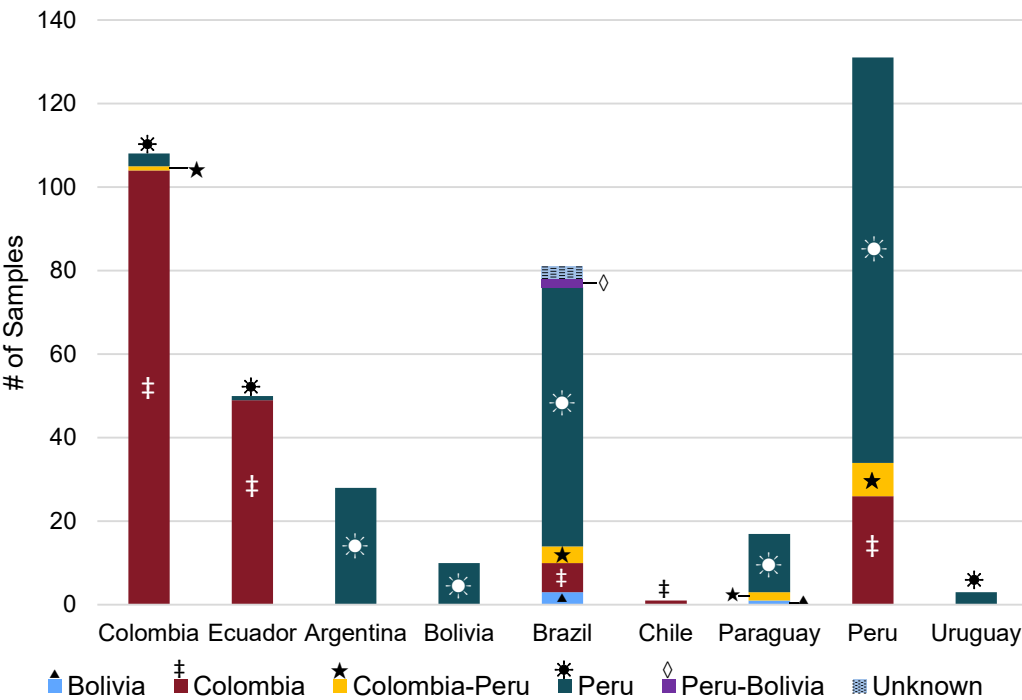
Region/Country	# of Samples
Andean	**158**
Colombia	108
Ecuador	50
Southern Cone	**271**
Argentina	28
Bolivia	10
Brazil	81
Chile	1
Paraguay	17
Peru	131
Uruguay	3

Legend: ▲ Bolivia   ‡ Colombia   ★ Colombia-Peru   ✳ Peru   ◊ Peru-Bolivia   ▦ Unknown

Europe

Czech Republic
Sixteen cocaine HCl samples were analyzed from two different seizures. One submission was obtained from a seizure of approximately 0.5 kg and contained cocaine HCl adulterated with phenacetin with a purity of 66%. The cocaine signature was consistent with Nariño in Southwestern Colombia.

The remaining 15 samples were obtained from a seizure of approximately 168 kg and contained uncut cocaine (n = 11) and PTHIT adulterated cocaine (n = 4). The average cocaine HCl purity was 84% (range 75 – 90%). Samples were sourced to Colombia-RND (n = 11) and Nariño (n = 4). All samples were converted to cocaine HCl using ethyl acetate and MEK.

France
Ten uncut cocaine HCl samples were analyzed from two different seizures. Nine samples were submitted to the CSP from a 1127-kg seizure that occurred in Nanterre on the commercial vessel "Trudy" in 2021. This seizure was mentioned in multiple media articles. The average cocaine HCl purity was 93% (range 93 – 95%), and all samples were sourced to Peru. Ethyl acetate was the primary HCl processing solvent (n = 7); however, acetate mixtures were also detected (n = 2).

One sample was submitted to the CSP from a 1173-kg seizure obtained in Houilles. The uncut cocaine HCl sample was sourced to Bolivia and crystallized into cocaine HCl using ethyl acetate.

Poland
Three exhibits were analyzed from a 930-kg seizure of fruit pulp. Cocaine salt form was not determined. Due to the sample matrix, there were challenges in accurately measuring the cocaine purity. Cocaine concentration in the liquid ranged from approximately 2 – 26%.

Europe Trends (CY 2018 – 2022)

European seized cocaine HCl samples (n = 991) are summarized in the charts on page 14. Colombia was the most prominent source, reported in 56% of samples. Peru was reported in 27% of samples, and Bolivia was reported in 4% of samples. Samples with characteristics of Colombia and Peru were reported in 7% of samples. Samples with characteristics of Peru and Bolivia were reported in 1% of samples. Samples of unknown origin were reported in 5% of samples.

The average cocaine HCl purity during this time was 89% (range 16 – 98%). Uncut cocaine was observed in 87% of samples. The most prominent adulterant in European cocaine, similar to the U.S., was PTHIT. Thirteen percent of samples contained the adulterant PTHIT. The average amount of PTHIT added to cocaine samples was approximately 8% (range 3 – 24%).

The CSP analyzed a large number of samples from wholesale cocaine seizures in Belgium, France, and the Netherlands from 2018 – 2022. Geographic origin results are summarized on page 14.

Europe: Cocaine HCl Geographic Origin (CY 2018 - 2022)

Legend: ▲ Bolivia ‡ Colombia ★ Colombia-Peru ☀ Peru ◆ Peru-Bolivia ▦ Unknown
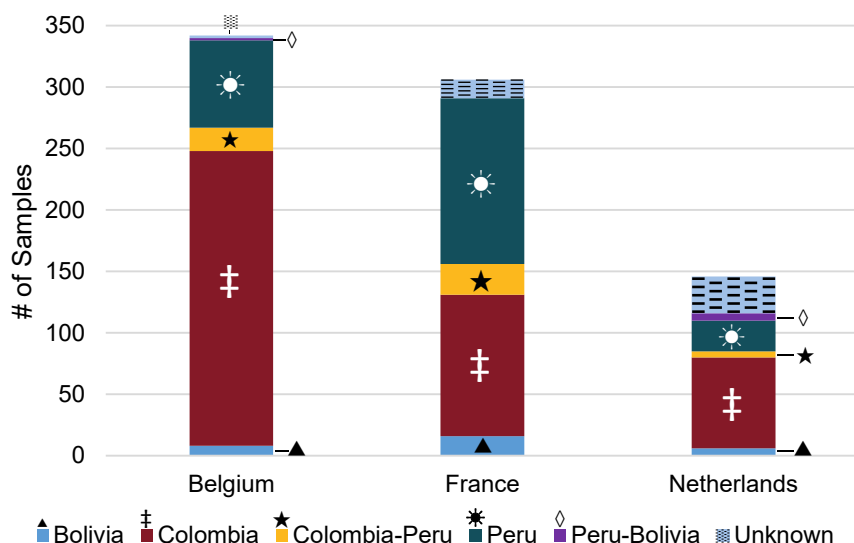
Country	# of Samples
Belgium	342
Croatia	1
Czech Republic	53
France	306
Greece	5
Hungary	2
Malta	26
Netherlands	146
Poland	13
Portugal	26
Romania	17
Serbia	1
Slovenia	9
Spain	3
UK	41

Geographic origin and cocaine HCl purity results for the entire European region were compared by seizure year/date submitted to the DEA foreign division. Considerably fewer samples were analyzed in 2021 - 2022 compared to 2018 - 2020. The observed decrease in average cocaine HCl purity may be due to a limited sampling rather than a true change in cocaine purity. More consistent sampling from year to year will be required for the CSP to monitor European wholesale cocaine purity and source trends by seizure year.

Europe: Cocaine HCl Geographic Origin and Average Purity (CY 2018 - 2022)

Legend: ▲ Bolivia ‡ Colombia ★ Colombia-Peru ☀ Peru ◆ Peru-Bolivia ▦ Unknown ● Average of Purity
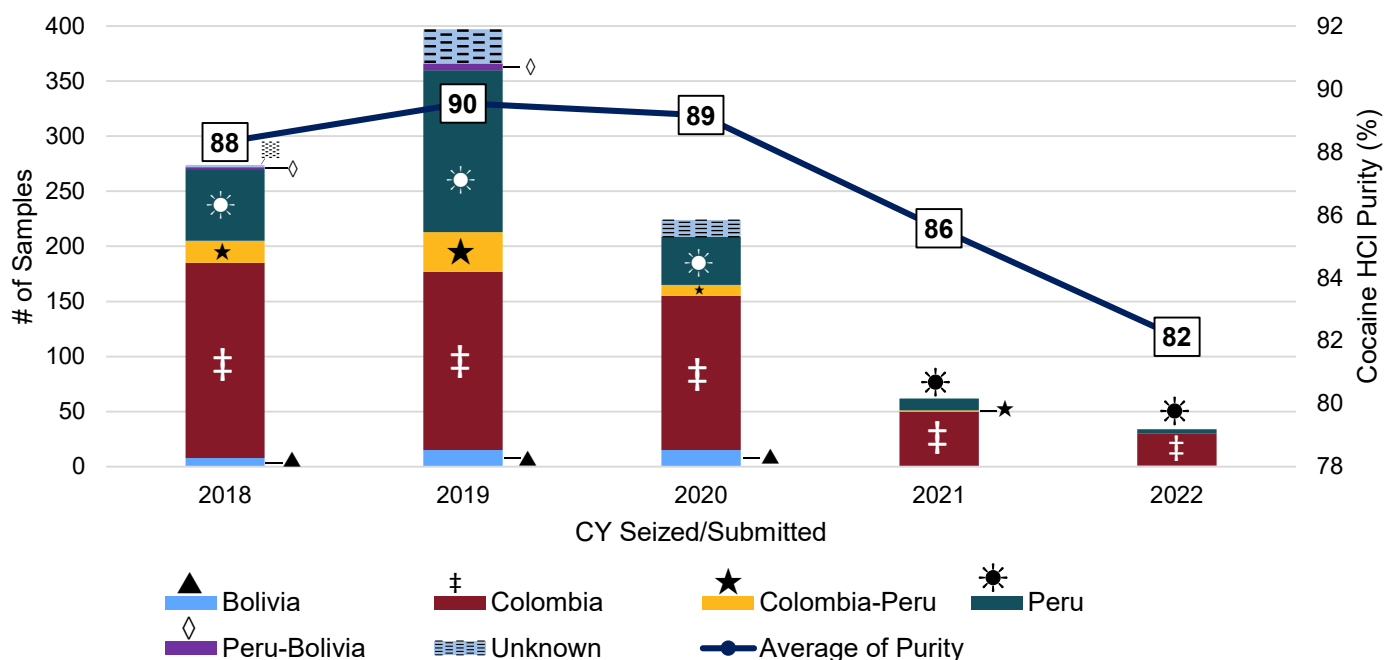
Background Information

Sampling Plan

DEA regional laboratories and other U.S. law enforcement agencies submit cocaine HCl samples to the CSP from seizures with a minimum net weight of 10 kg. Three units are sampled from seizures with a net weight between 10 and 100 kg. An additional three units are sampled for each 100 kg up to a maximum of 21 samples per seizure. Seizures within the continental U.S. (CONUS) and within major maritime corridors are sampled. A smaller number of samples are obtained in regions outside the U.S. by international law enforcement partners and submitted to the CSP through DEA foreign divisions.

Cocaine Classifications

Analytical methodologies used give evidence of where coca leaf was grown; and therefore, processed to cocaine base (geographic origin) and how cocaine base was converted into cocaine hydrochloride (processing solvents).

Coca crops grown in Colombia, Peru, and Bolivia are the primary sources of illicit cocaine. Since 2000, CSP classification models have accurately sourced cocaine to a country of origin with an accuracy exceeding 90%. In 2015, the CSP began sourcing cocaine to 19 sub-regions within Colombia, Peru, and Bolivia. During the last few years, however, cocaine classifications beyond the country of origin have become more difficult as the CSP observed an increase in the number of samples that were classified to a source country that did not meet the criteria for sub-regional delineation. This loss of geospatial granularity was documented in the July 2022 Cocaine Signature Program Report.

To improve CSP's cocaine classification model, geographically authenticated cocaine samples from Colombia and Peru were analyzed from 2020 – 2022. CSP geo-sourcing datasets were updated by combining these results with previously analyzed authentic samples. A new classification model was established in early 2023. Under the new methodology, cocaine samples are geo-sourced to a country of origin and, when possible, classified to a region within Colombia. Cocaine is classified regionally in Colombia to Northern Colombia (compared to Antioquia and Norte de Santander) and Southwestern Colombia (compared to Cauca, Nariño, and Putumayo). According to most recent U.S. government estimates, these five regions represent over 85% of the area of coca cultivation and potential cocaine production in Colombia. Other coca growing regions within Colombia are still represented in the authentic dataset used for sample comparison, but the current model requires a broader regional classification (Northern vs Southwestern Colombia) compared to the model developed in 2015.

Cocaine sourced to Peru cannot currently be classified sub-regionally; however, Peruvian datasets have been updated to include Puno and additional samples from the Apurimac River Valley.

Chapare is the primary region in Bolivia for coca cultivation. Cocaine samples analyzed by the CSP since 2014 indicate cocaine production may also occur in other regions within Bolivia. The full description of CSP geographic origin classifications is listed on page 16.

CSP Geographic Origin Classifications

Geographic origin classifications for each cocaine source country/region are listed in the table below. Authentic cocaine samples have been analyzed by the CSP from each of the below regions for sample comparison.

	Colombia-North (Col-North)	Colombia-Southwest (Col-SW)	Other Colombian Regions
Colombia	Antioquia Norte de Santander (NDS)	Cauca Nariño Putumayo	Arauca Bolívar (San Lucas) Choco Caquetá Guaviare Meta Santander Valle de Cauca Vaupes Vichada
Colombia-RND (Col-RND)	Characteristic of Colombian coca leaf signatures - regional classification not determined		
Peru	Apurimac River Valley Cusco Huallaga Valley Puno Ucayali Valley		
Bolivia	Chapare		
Colombia-Peru	Characteristics of Colombia and Peru cocaine signatures		
Peru-Bolivia	Characteristics of Peru and Bolivia cocaine signatures		
Unknown (UNK)	Cocaine signatures that do not fit a specific region of origin		
Not Determined (ND)	Cocaine signature analysis not completed		
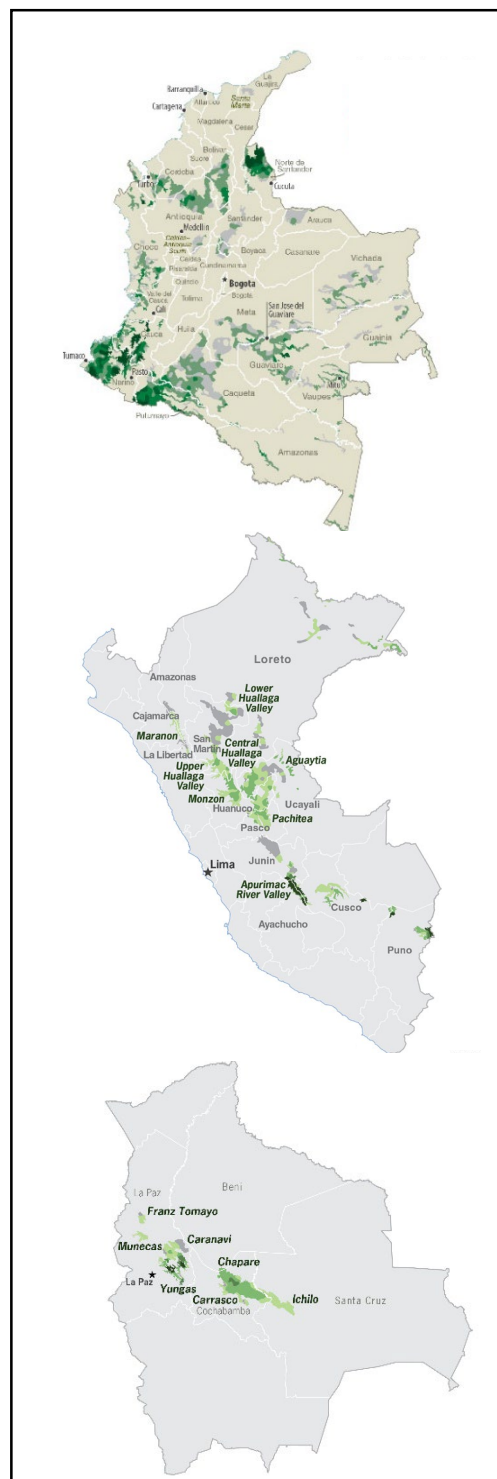
South American coca cultivation regions

Cocaine Processing Artifacts

Naturally occurring cocaine related alkaloids called cinnamoylcocaines are co-extracted with cocaine from coca leaf and will be present in the finished product unless removed in a process called oxidation. Potassium permanganate is the most common oxidizing agent in cocaine production. While CSP chemical analysis cannot determine the amount of oxidizing agent used per kilogram of cocaine, evidence of the extent of oxidation is tracked by monitoring the amount of cinnamoylcocaines in the finished product.

Cocaine HCl Processing Solvents Associated with Source Country

The conversion of cocaine base to cocaine HCl generally involves dissolving cocaine base in a water immiscible solvent or solvent mixture, heating the solution, then adding hydrochloric acid to produce cocaine HCl. Concentrated hydrochloric acid or an alcoholic solution of HCl is often combined with a water miscible solvent or solvent mixture prior to reacting with the boiling cocaine base solution. Colombian labs typically combine petroleum ether distillates, aliphatic hydrocarbon mixtures, or commercial thinners with various acetates such as ethyl acetate, n-propyl acetate, methyl acetate, and n-butyl acetate into their cocaine base dissolution solvent. MEK is also commonly used in Colombian labs. Bolivian labs historically used a combination of ethyl ether and acetone, but ethyl acetate is commonly used today. Acetone is the traditional solvent used in Peru; however, ethyl acetate is often identified in cocaine with signature profiles consistent with Peruvian coca seized outside Peru, indicating conversion of Peruvian cocaine base with ethyl acetate in Bolivia or other regions within South America.

Colombia

- **Primary Acetates or Acetate Mixtures**
  - Ethyl Acetate
  - Methyl Acetate
  - N-Propyl Acetate
  - N-Butyl Acetate
- **Methyl Ethyl Ketone (MEK)**
- Commercial aliphatic hydrocarbon mixtures ("10-20")

Peru

- Acetone (Traditional)
- Ethyl Acetate (European Export)

Bolivia

- Ethyl Ether-Acetone Mix
- Ethyl Acetate