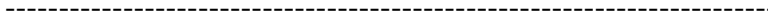


Newsletter of the Volcanology and Igneous Petrology Division
Geological Association of Canada

#52

April, 2001



**Volcanology and Igneous Petrology Division
Geological Association of Canada**

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Message from the chair, VIP division

By the time you receive *Ashfall*, it will be almost time for the GAC-MAC meeting in St. John's. I hope we will see many members of the Division at this meeting in the Far East. I am personally looking forward to the legendary Newfoundland hospitality and bracing for the legendary Newfoundland weather.

The St John's 2001 organizers have put on a broad program in volcanology and igneous petrology. The Division is sponsoring Special Session 1, Modern and Ancient Oceanic Ridge Processes and co-sponsoring Special Session 14, Proterozoic granitoids and anorthosites. There is a strong general session on Igneous Petrology and Volcanology.

The annual general meeting of the VIP Division will be held at lunch time on Wednesday May 30th. For those of you who do not attend regularly, I remind you that this is a light-hearted meeting over a free lunch which brings together our igneous community. We will award the Léopold Gélinas medals to our top students and the Career Achievement Award to a distinguished member of our profession, who I hope will continue the tradition of providing an informative and entertaining post-prandial talk. We will elect a new slate of officers and councillors of the Division. I encourage all members to attend and bring along any prospective new members and students who might be interested in the Division. Finally, I would like to note that this is the second last *Ashfall* to be produced by the present Secretary-Treasurer, Ned Chown. It is the Secretary-Treasurer who holds the Division together and I would like to thank Ned for his selfless service to our community over the past many years.

Georgia Pe-Piper

Election of new officers

The term of office for the present executive expires at this year's annual meeting, and the nominating committee proposes the following slate of new officers:

Past Chair: Georgia Pe-Piper

Chair: John Stix

Vice Chair: Wulf Mueller

Secretary-Treasurer: Brian Cousens

Councillor East: Don Francis

Councillor Central: TBA

Councillor West: Derek Thorkelson

**VOLCANOLOGY AND IGNEOUS PETROLOGY DIVISION
GEOLOGICAL ASSOCIATION OF CANADA
ANNUAL FINANCIAL STATEMENT, 2000**

		<i>Revenue</i>	<i>Expenditures</i>
Balance December 31, 1999	1,798.79		
Ashfall 50 postage			129.36
Ashfall 50 xeroxing			94.42
Dues	10.00		
Dues	12.00		
Photocopies, Annual Meeting			2.42
Engraving, Gelinas medals			81.86
Engraving, Career Achievement			42.52
Guidebook sales 94-99	879.61		
Dues, August, 00	888.00		
Dues	50.00		
GIC		2,000.00	
Ashfall 51 postage			92.07
Ashfall 51 xeroxing			52.33
Bank Charges			38.50
Balance December 31, 2000	1,104.92	1,839.61	2,533.48

Assets

GIC #LTGIC-00019 CIBC, 09/24/2001	2,097.56
Gelinas medals, Au, Ag	20
Gelinas Medals Cu	7
Career Achievement medals	2

<http://www.volcano.si.edu/gvp/index.htm>

VOLCANIC ACTIVITY REPORT CLEVELAND VOLCANO (CAVW #1101-24) 52°49'N 169°57'W Summit Elevation 5,674 ft (1,730 m) AVO detected an explosive eruption at Cleveland Volcano in satellite imagery that began about 2330 UTC (1430 AST). According to images from 0330 UTC (1830 AST) the ash cloud is V-shaped with one leg extending to the east 115 mi (185 km) and the other leg extending to the southeast about 125 mi (200 km). The National Weather Service estimates the top of the cloud to be 30,000 ft ASL. The eruption may still be continuing as of the latest satellite image from 0430 UTC (1930 AST). An observer in Nikolski reported about 0400 UTC (1900 AST) a strong haze resulting from the ash that extended to the southeast from the volcano, but no ashfall in Nikolski. Mt. Cleveland forms the western half of Chuginadak Island a remote and uninhabited island in the east central Aleutians. It is located 40 km (25 mi) west of Umnak Island and 75 km (45 mi) west of the community of Nikolski. A distinctively symmetrical stratovolcano, Cleveland has erupted at least 11 times since 1893. An explosive event on February 19, 2001 sent ash to 35,000 feet (10.5 km) ASL. The March 11, 2001 event produced an ash plume that reached a height of 20,000-25,000 ft (6.1-7.6 km) ASL. Eruptions of Mt. Cleveland are characterized by short-lived explosive bursts of ash, at times accompanied by lava fountaining and lava flows down the flanks. Cleveland is not monitored seismically, therefore we do not assign a level of concern color code.

2001

This lava flow (?) originating from the summit of Cleveland on February 2, 2001 was photographed by pilot Dean Cully. An explosive ash eruption occurred 17 days later on February 19, 2001, sending ash to 35,000 feet and disrupting air traffic across the North Pacific.

APRIL 17 11:00 (17:00 GMT)

In the last 24 hours Popocatepetl volcano has shown an increase in its activity. There were 5 small exhalations with some steam and ash, and 5 micro-earthquakes with magnitudes smaller than 2.5. Also, there were 7 hours of harmonic tremor. Since 00 hrs of yesterday, there was a seismic pulsating sequence that lasted until 12:00. These seismic signals had no external manifestation.

At 19:48, the volcano registered a moderate explosion that sent incandescent fragments up to 2 km from the crater,

to the North-East and North-West sectors, and an ash plume that rose 4 Km above the crater ([see image](#)). After the explosion, the volcano has had only 7 exhalations and 1 hour of harmonic tremor. At the moment of this report, the volcano shows no fumarolic activity.

FEBRERO 2001

Colima, Col., 22 de Febrero de 2001.

Yesterday morning, at 5.32 local time, a moderate magnitude explosive event took place which raised an ash column about 600 m over the summit crater and showered incandescent material over the high slopes of the volcano, principally in the North, Northeast and Southwest quarters without lowering the safety limits already established. This event had little energy compared to previous explosions. Nevertheless, there is still a danger of recurrence of a major event such as that of the 17 of July, 10th of May or the 10th of February 1999. An evacuation order for all areas from 6.5 to 8.5 km from the summit is maintained.

ÚLTIMOS DATOS:

La mañana de hoy, a las (5:32 hora local) tuvo lugar un evento explosivo de magnitud moderada que levantó una columna de aproximadamente 600 metros de altura sobre la cima del cráter y arrojó material incandescente sobre las pendientes altas del volcán, principalmente en las caras Norte, Noreste y Suroeste, sin rebasar los límites de seguridad establecidos.

La energía involucrada en el evento fue pequeña, comparada con explosiones anteriores. Sin embargo, aún existe la posibilidad de que ocurra un evento similar o mayor a los ocurridos el 17 de Julio, 10 de mayo y 10 de febrero de 1999.

El operativo de respuesta para la evacuación de las poblaciones ubicadas en un radio de 6.5 a 8.5 kilómetros de la cima se mantendrá en las instalaciones de las instituciones involucradas. El dispositivo está coordinado por los Sistemas Estatales de Protección Civil y el Ejército Mexicano.

En el domo también se producen explosiones. Entre las más recientes tenemos las ocurridas en 1987, la del 21 de julio de 1994, que dejó un cráter somero en la superficie del domo formado en 1991 y alcanzó un diámetro de 130 metros por 50 metros de profundidad y produjo una ligera lluvia de ceniza hacia el Oeste. El 10 de febrero de 1999 se presentó un nuevo evento explosivo en la cima del volcán, mismo que ha repetido con menor intensidad los días 18 de febrero y 10 de mayo de 1999. El 17 de julio de 1999 tuvo lugar una nueva y violenta explosión que arrojó una gran cantidad de material incandescente por los costados del volcán y levantó una columna de ceniza superior a los 8 km.

Merapi

Central Java; 7°32.5' S, 110°26.5' E

White thick solfatara activity is continuing, reached 850 m height above the summit and low in pressure. Glowing lava avalanche is ongoing filled the upstream of Sat, Senowo, Lamat and Bebeng river with maximum distance of 2.0 km to Sat river. Until the report, pyroclastic flow occurred 11 times, entered to Sat and Lamat river as far as 3.0 km. Avalanche earthquake still dominating seismic activity but amplitude and number less than previously. Observer reported there was thin ashfall which occurred on 13 April 2001 around Babadan Post Observatory. Merapi volcano is in level 2.

Lokon

North Sulawesi; 1°21.5' N, 124°47.5' E

There was no explosion activity has reported during the report, but observer noticed that white thin-medium plume activity is ongoing, rose 40-300 m height. Within the week seismograph did not record volcanic earthquake and number of tectonic decrease over last data. Complete seismicity record were: 30 events of tectonic earthquake and 2 events of tremor earthquake. Lokon volcano is in level 2.

Inelika

Central Flores; 8°44' S, 120°59' E

There was an increasing activity based on seismic records. Until the reporting time, seismograph showed 7 events of deep volcanic (A) and 4 events of shallow volcanic (A), also 6 events of tectonic earthquake.

Inelika volcano is in level 2.

Karangetang

Siau island; 2°47' N, 125°29' E

Visual observations noticed plume activity from main crater and crater II are continuing. Main crater plume rose about 200-350 m height and showed white medium - grey color, meanwhile the other one reached 200 m from crater rim with the same color. Red-colored reflection from the summit is ongoing, as height as 25-75 m. No data has reported from seismograph monitoring.

Karangetang volcano is in level 2.

Ijen

East Java; 8°3.5' S, 114°14.5' E

Ijen crater activity is more than normally, that was marked with shallow volcanic earthquakes which occurred along this reporting time although less in number. Visual observations could not be done because the weather was cloudy along the reporting time. Seismograph recorded 9 events of shallow volcanic (B) and 10 events of small explosion earthquake.

Ijen volcano is in level 2.

Semeru

East Java; 8°6.50' S, 112°55' E

Semeru activity is still more than normally. Visual observation to the summit often obscured by clouds. In any good weather observer could noticed minor explosion rose 300 m height. During the period seismograph recorded an increasing seismicity which listed as follow: 339 events of explosion earthquake, 51 events of avalanche and 3 events of tectonic earthquake. There was no volcanic earthquake has recorded within the report.

Semeru volcano is in level 2.

Anak Krakatau

Sunda Straits, 6°6'5.8" S, 105°25'22.3" E

There was an increasing activity in Anak Krakatau within the period, which reflected from an increasing number of volcanic seismicity. Along the period, observer reported 7 events of deep volcanic (A), 67 events of shallow volcanic (B) and 4 events of tectonic earthquake has recorded from seismograph. Visual observations obscured by cloud during the report.

Anak Krakatau is stated in level 2.

G. Sopotan

North Sulawesi, 124°41'12"N, 1°6'20"E

Discontinuous tremor earthquake are ongoing with amplitude of 0.5 mm. But in general Sopotan activity decreased compare to the week before. That was represents from number of seismicity which less than previously. Detail data listed below: 1 event of deep volcanic (A), 1 event of shallow volcanic (B), 17 events of tectonic, 51 events of avalanche and discontinuous tremor earthquake.

Sopotan is stated in level 2.

G. Batur

Bali Island

115.37° N, 8.24° E, summit elevation 1717 m

There was no a major changing based on visual observation. White thin plume activity from crater is ongoing. There is no shallow volcanic earthquake has recorded from seismograph. Complete seismicity were: 2 events of deep volcanic (A), 2 events of small explosion and 17 events of tectonic earthquake.

Batur volcano is in level 2.

Kelut

East Java; 7°56' S, 112°18.5' E

There was no major changing showed from the volcano by visual observations. Water lake temperature decrease than previous data. Measurement on 2 April 2001 was 48.5°C and on 9 April 2001 was 48°C.

Kelut volcano is in level 2.

06/00 (BGVN 25:06) Frequent ash explosions and acidic mudflows starting on 1 July

An eruption of Copahue (figure 11) began on 1 July 2000. Ash-and-gas emissions, which have continued into late July, are considered to be Copahue's most vigorous activity in the past century. Reports were received from geologists in Argentina and Chile. Except where otherwise noted, Argentine geologists Adriana Bermúdez (CONICET) and Daniel Delpino (Civil Defense of Neuquén Province) reported information for 1-9 July, and Chilean geologists José Naranjo and Gustavo Fuentealba (both of SERNAGEOMIN) reported information from 10-13 July. The scientists submitted joint reports beginning on 13 July. All time references are to Argentina local time; Chilean time is one hour earlier (GMT - 4 hours).

Figure 11. Preliminary geologic map of Copahue, showing outlines of Pliocene and Pleistocene calderas and post-caldera lava flows. Contour interval, 100 m. Modified from a previous map in Bulletin v. 17, no. 10. Courtesy of A. Bermúdez and D. Delpino.

Initial explosions, 1-2 July. Although visibility was poor in late June, at 0030 and at 0430 on 1 July local Argentine police and gendarmerie (National Guard) reported ash mixed with heavy snowfall, as well as a strong sulfur smell. At around 1145, lapilli and ashfall became heavier, eventually covering the snow and the products of previous eruptions around the summit. At 1200 the gendarmerie reported lapilli falling 7.5 km NE of the volcano, in the village of Copahue, Argentina. The alert status was set at yellow; the village's emergency committee restricted tourist access and helped to evacuate 200 people.

Explosions continued throughout 2 July with increasing intensity. Lapilli, ash, and sporadic bombs (15 cm in diameter) fell 8-9 km E on the town of Caviahue, Argentina, with up to 15 cm of materials from the day's explosions eventually being deposited in some areas (figure 12). Until 2345 there were explosions of varying intensities. Preliminary results of an examination of the deposits revealed that they were composed of a very fine silica, sulfur particles, accidental rock fragments from the conduit, and juvenile materials. In Caviahue, visibility was practically zero due to ash particles in the air, and heavy ashfall cut off power for several hours. By midday, eruption plumes blowing SE reached Loncopué, a small village 50 km from the volcano.

Figure 12. Ashfall from the frequent eruptions that began 30 June at Copahue and heavy snowfall have affected the reliability of power and potable water resources in the town of Caviahue, a popular ski area 8-9 km E of the volcano. Although the town is no longer under official evacuation, many inhabitants have not returned to battle current conditions. Courtesy of A. Bermúdez and D. Delpino.

Alert status was raised to orange on 2 July when ash was dispersed as far as 100 km away from the crater and the plume covered a total area of 2,000 km². Maximum ash accumulation of 3-5 cm occurred over an area of 6 km², including the town of Caviahue and the W sector of Lake Caviahue. Due to the ashfall, the surface of Lake Caviahue changed color from its normal deep blue to gray-green, and a water sample taken had a pH of 2.1.

Tests by Argentine geologists on ash samples deposited in Caviahue revealed a grain-size distribution of 15% coarse ash (> 1 mm), 80% fine ash (0.5-1.0 mm), and 5% fine ash dust (< 0.5 mm). The coarse ash contained a small quantity of juvenile and lapilli-sized (3-6 mm) accidental fragments; the juvenile materials were dark gray vitric scoria. Non-juvenile accessory materials accounted for 7-10% of the coarse ash and consisted primarily of white-

gray silica from the bottom of the crater lake. The fine ash-sized particles had similar components and characteristics.

Irregularly shaped dark gray scoriae, 3-8 cm in size, were found as far as 12 km N of the crater; scoriae completely covered the area within a 1.0-1.5 km radius around the crater. The scoriae contained spherical vesicles 3-5 mm in diameter. Cooling cracks marked the scoriae's surfaces and their shapes had been modified during flight.

Ashfall was also reported 60 km SE of the volcano in the town of Loncopué, where the stream closest to the volcano had cloudy brown-gray waters.

Continuing activity through 25 July. Activity decreased after 2345 on 2 July. The only explosion of 3 July, at 1720 in the main crater, deposited tephra on the flanks and generated a dense, dark gray ash plume that blew NW and produced a local ashfall. According to the Buenos Aires Volcanic Ash Advisory Center, the ash plume reached an altitude of 10.6 km and blew NE. On 4 July there were explosions at 1030, 1830, and 2000. In the town of Caviahue, Delpino noted a strong sulfur smell and great booming sounds that caused windows to shake. A dark gray ash plume rose 2 km above the summit. Bermúdez and Delpino reported that at 0020 on 5 July a new cycle of rhythmic explosions began; by 1325 a total of 37 explosions had occurred. The biggest explosion, at 0515, generated a pyroclastic surge down the E and N slopes.

A report was received on 5 July from Ralco-Lepoy, a town 30 km SW of the volcano, indicating that dead fish had washed up along the banks of the Lomín river. The Lomín, as well as the Agrío river, which drain the acidic, active crater, were marked by a deep, dark-colored gully but there was no evidence of lahars. However, it is possible that ashfall covered up the evidence. The dead fish found along the Lomín River on 5 July confirmed that acidic mudflows from the crater had been channeled down this river. Chilean geologists Naranjo and Fuentealba recommended that states bordering the Lomín river (to the SW) and Queuco to Trapa-Trapa (to the N) be alerted that an acidic mudflow was moving down the river. Accordingly, authorities noted that inhabitants should be evacuated outside of an enforced safety radius. It was also recommended that professionals regularly measure the pH of affected Lomín drainages, meteorological reports be kept up to date, and that town officials periodically reevaluate the yellow alert.

Naranjo and Fuentealba also noted that at 2030 on 5 July a patrol of carabineros (Chilean National Guard) approached the volcano on horseback and observed small dark ash emissions moving SE from the volcano.

Observers in Argentina during the night of 5-6 July reported an incandescent pyroclastic emission flowing down the cone and, at one point, a white light emanating from the crater for ~15 seconds. In the same time interval, gendarmerie officers from Copahue village described "an orange-red light coming up from the crater." It is thought that the light was produced when magma rose to the surface but did not spill over the crater walls. They also noted the vertical ejection of large incandescent blocks that fell back into the crater, as well as smaller incandescent fragments that fell onto the volcano's slopes, rolled downhill, and broke up into smaller pieces.

On 6 July, Delpino reported to Naranjo and Fuentealba from Caviahue that the eruption was Strombolian with explosion pulses every 1-2 hours. Winds blew ash S of Caviahue without any ashfall in the town. There was no evidence of lahars or floods. Throughout the morning of 6 July snow continued, and there was zero visibility of the volcano.

Bermúdez and Delpino reported that during 0100-1020 on 7 July, loud explosions and ash emissions occurred at 15-minute intervals. At about 2000, the wind changed, blowing W, and ash began falling over Caviahue. About 1 mm of ashfall was observed from 20 km W of the crater.

The same day, ice blocks 15-20 cm in diameter, as well as ash and lapilli, were carried down the swollen Agrío river from the volcano's permanent ice cap. At 1300, a sample of the river water taken at the bridge near Caviahue had a pH of 2, and at 2000 a sample from the same location had a pH of 1.5. The Dulce stream source lies 4.5 km E of the cone and it flows 5.5 km W of the cone into Lake Caviahue. Ashfall altered the stream's typical pH of 7 to a pH of 2.5. Preliminary investigations by Argentina's Provincial Water Division also indicated an increased iron content. A loud explosion summit at 0300 on 8 July awakened citizens of Caviahue; a day-long ash emission moved SE through clear skies. On 9 July at 0100 a glowing light was seen over the crater, but cloud cover obscured visual observations throughout the day.

Naranjo and Fuentealba reported that on 10 July, explosions were gray to dark brown and it is thought that the ash fell over a 25 km² area to the W, in the direction of Chile. Ash reached the summit of neighboring Callaqui volcano, covering it in gray ash. Samples from this ashfall taken 4 km W of the active crater were found to contain juvenile volcanic glass fragments, 0.3-0.5 mm in diameter.

During 1200-1230 on 12 July, a Chilean overflight revealed that explosions inside the active crater (El Agrío) occurred at 1- to 3-minute intervals, ejecting fine material up to 500 m above the crater. This material was dispersed via a plume of fine ash and gases moving NNE for more than 250 km. Observers reported that 1-2 mm of fine ash was deposited in the village of Copahue. Throughout the day, activity increased and, at 2300, there was an explosion heard in Caviahue that was thought to have deposited 1-2 cm of ash 5 km NNE of Copahue. On 12 July, scientists noted that Copahue was in an eruptive phase of lower intensity (a Volcano Explosivity Index, VEI, of 1) compared to that seen on 1-2 July (an inferred VEI of 2).

At 1100 on 13 July, explosions generated white-gray to bluish gas emissions rising 200-300 m over the crater. A gas cloud with a strong sulfur odor remained trapped in the Agrio valley over a 10 km² area; it later descended, and strong winds spread it over a 20 km² area. At 2310, an explosion produced a 1-km-high plume and incandescent fragments were ejected onto the flanks of the cone reaching up to 1 km from the crater. The plume covered Caviahue, obscuring the moon, but there was no ashfall on the town.

A Chilean helicopter flight on the morning of 13 July observed explosions emitting pale gray ash columns up to 300 m above the crater rim. Winds dispersed the ash ENE to Caviahue. Carabineros sampling water at the source of the Lomín river found it slightly acidic (pH = 5-6).

At 1250 on 13 July, an eruption plume that rose 3-5 km over the crater was reported by military and civilian pilots. The column dispersed to the NE and was a reddish-brown color. Reports from Caviahue stated that on 15 July the eruption stayed at the same intensity as previous days, and fine ash was dispersed to the N. Ash samples from 13 July were found to have an andesitic composition and to include juvenile fragments, the presence of which indicates the volcano's potential to produce even larger explosions. Water samples from the Lomín river on the same date revealed high fluorine and sulfate levels.

At 1700-1730 on 16 July, and also between 0300 and 0400 on 17 July, a dusting of ash fell over Caviahue and there was a strong sulfur smell in the air. At 0905 on 18 July, a civilian pilot reported a pale gray ash column at 3.5-4 km above sea level (just over the top of the cordillera) dispersed over 10 km to the volcano's NNW. At this time, the ongoing eruptions were considered to be of VEI 1. Ash from the weak explosions was dispersed by low winds as it escaped from the crater.

At 2206 on 19 July, members of the gendarmerie reported that a series of explosions continued to generate columns of ash and water vapor 0.5-1.0 km above the crater. The plumes dispersed to the NE depositing a fine dusting of ash over the village of Copahue. A strong sulfurous odor was reported at 2100 in Caviahue. On 20 July activity remained low, and no noises or odors were detected. Winds carried the gas-and-ash plume NNE, depositing a light ashfall over the N sector of Caviahue.

On 21 July, light ashfall dusted Caviahue and, although the crater was obscured, ash columns were sighted rising above the summit and through the clouds to heights of 700-1,000 m. At 1048 (Argentina), Caviahue residents heard a series of rhythmic explosions occurring every 2-5 minutes for one hour. The plume carried ash NNE toward Trapa-Trapa. The volcano was obscured by cloud cover on 22 July but intermittent explosions continued emitting ash plumes carried NE toward Trapa-Trapa.

A seismological team from the Southern Andes Volcanological Observatory (OVDAS) installed a portable seismic station on 21 July at a spot ~2 km NNW of the active crater in the vicinity of Trapa-Trapa, Chile. After taking 15 hours of readings, the team left on 23 July after cold temperatures had prematurely reduced battery power. These readings were fortunately during a time of elevated activity, and registered seismic events generally correlated with visual observations. Despite this similarity, it was impossible to establish an exact correlation between the periodicity of the explosions (occurring every 1-3 minutes) and their microseismic signals at distance.

During the stay of the seismic team, no ashfall was reported in the Queco river region and no correlation was established between seismicity and sporadic thundering sounds reported by villagers in the area. These sounds have been attributed to chunks of the ice cap breaking off and rolling down Copahue's flanks. Due to over 3 m of snowfall, access to the area is difficult.

Explosions of low to intermediate intensity continued emitting ash-and-gas plumes on 23 July. The clouds continued to partially obscure the volcano, but at 1930 an ash column blew E toward Caviahue. On 24 July, the active crater was producing small explosions and dark gray ash emissions; a dusting of ash fell over Caviahue. When the Argentina gendarmerie and the Chilean carabineros compared respective observations no discrepancies were found. Two pilots reported a strong sulfur odor at 1.8-2.1 km altitude, ~250 km WSW of Copahue on 25 July. At 1000 another pilot reported an ash plume extending 200 km WNW from the summit; plume height was ~2 km and width was 10-15 km. Although this explosion was not seen from Caviahue, a light ashfall fell over the town.

Due to the continued frequent ashfalls over Caviahue, town officials decided to reestablish a yellow alert. The prolonged fall of fluorine-rich ash has posed a possible problem for grazing animals in the affected fields, but heavy snowfall has made it less likely that vegetation will absorb the fluorine.

Background. Volcan Copahue is a composite cone constructed along the Chile-Argentina border. The cone lies within an 8-km-wide caldera formed 0.6 million years ago at a spot near the NW rim of the Pliocene, 20 x 15 km Del Agrio caldera. Copahue's eastern summit crater, part of a 2-km-long, ENE-WSW line of nine craters, contains an acidic crater lake (also referred to as Del Agrio) and displays intense fumarolic activity. Infrequent explosive eruptions have been recorded since the 18th century. Eruptions in 1992 and 1995 produced several phreatic and phreatomagmatic explosions and emissions that contained higher levels of water vapor but lower ash particle content than the current eruption. The current eruption has been of longer duration than either of the previous two.

The Agrio river emerges from a crack in the edifice of the volcano 50 m below the active El Agrio crater. The river water is highly acidic and has a yellow color. Near Caviahue, the Agrio river enters the Caviahue lake basin. The lake is formed by 2 glacial finger lakes over a 9.2 km² area and is a reservoir of acidic water.

Most residents of Copahue village leave each winter, but Caviahue's population of 400 can grow to 10,000 during the ski season. Eruption-related damage has cut off power and potable water, and there remains an inability to keep ski slopes cleared of ash. In late July there were reportedly only about 419 people staying in Caviahue.

Information Contacts: Adriana Bermúdez, National Council of Scientific and Technical Research (CONICET) and the National University of Comahue, Buenos Aires 1400, Neuquén Capital, Argentina; Daniel Delpino, Advisor to the Civil Defense of Neuquén Province, Argentina and the National University of Comahue, Buenos Aires 1400, Neuquén Capital, Argentina (Email: delpinus@neuquen.com.ar); José Naranjo, National Geology and Mining Service (SERNAGEOMIN), P.O. Box 10465, Avda. Santa Maria 0104, Providencia, Santiago, Chile (Email: jnaranjo@sernageomin.cl); Gustavo Fuentealba, Southern Andes Volcanological Observatory (OVDAS), SERNAGEOMIN, P.O. Box 10465, Avda. Santa Maria 0104, Providencia, Santiago, Chile (Email: ovdassis@chilesat.net); Buenos Aires Volcanic Ash Advisory Center, Argentina (URL: <http://www.ssd.noaa.gov/VAAC/OTH/AG/messages.html>).

[Jump to Index of Volcanic Activity Reports](#)

09/00 (BGVN 25:09) Continued ash explosions and tremor during August-October

The most vigorous eruptive activity at Copahue in the last century began on 1 July 2000 (*Bulletin* v. 25, no. 6). Lapilli, ash, and sporadic bombs fell within 9 km of the crater, and ash was dispersed as far as 100 km away on the second day of eruptions. Frequent explosions throughout July generated ash columns that often caused ashfall over the villages of Copahue to the N and Caviahue to the E.

Between 0700 and 1200 on 4 August, Ramon Ortíz and technician Erwin Medel (OVDAS) installed a portable seismic station in the Queuco river valley, 16 km N of Copahue. The instrument detected a fracture-type earthquake that probably originated from the volcano, but the depth could not be determined. During 3-5 August, explosions were not noted in the Trapatrapa sector, and acidic rainfall in the Queuco river valley has not occurred since mid-July. According to residents of Caviahue, on 5 August gray spots were observed on the snow, possibly caused by fine ashfall. Apparently, eruptive activity during the previous two weeks included a greater amount of steam as a result of melting snow. A strong sulfur odor was detected in Caviahue on the night of 7 August, but there was no ashfall.

Seismic data and observations from Caviahue indicated increased activity starting on 9 August. Explosions that morning generated columns up to 4,500 m altitude that dispersed W over Chilean territory, into the Trapatrapa valley area, and during afternoon towards the Lomín river valley. The elevated activity continued through at least 1600 on 10 August, with small explosions at intervals of 5-10 or more minutes. On the night of 15 August incandescence in the crater was observed from Caviahue. Up to fist-sized fragments ejected during explosions fell back into the crater. People who approached the crater reported steam explosions composed of white clouds alternating with dark-gray ash emissions. Explosions occurred every 4-5 minutes.

A ski instructor from Caviahue, Daniel Maniero, observed the volcano under clear conditions on the evening of 17 August. Around 2100 that night intermittent incandescence in the crater was followed by thundering noises at intervals of 5 minutes. Clouds reflected crater incandescence on the night of 19 August. Maniero also reported that loud explosions every 8-10 seconds were heard near the crater on 20 August. During 20-21 August intermittent black ash clouds rose not more than 300 m, causing local ashfall around the crater.

Scientists from SERNAGEOMIN-OVDAS, Eliza Calder and Ramon Ortiz, monitored seismicity in the Trapatrapa area, ~16 km NNW of the volcano, from the afternoon of 18 August to 1100 on 19 August. They observed low and weak gray clouds. Between 1839 on 18 August and 0940 on 19 August one long-period earthquake was detected at 0036 on 19 August. According to the Argentina Gendarmerie, during that night there was a strong explosion. Seismic registries showed low-level seismicity without high-frequency earthquakes.

On 19, 21, and 23 August there were strong explosions with dark ash clouds. On the morning of 22 August an observer using binoculars on a commercial flight noted steam clouds extending 5 km N and S of the crater area as well as explosions that rose up to 500 m above the cloud layer located at ~3,000 m altitude. Direct observations carried out at 1000 on 1 September indicated the development of small explosions in the interior of the crater, where an increase in both ash accumulation and the diameter of the explosion crater were observed. The crater measured ~50 m across. Another eruptive cloud was observed from a commercial aircraft (LAN flight 991) on the morning of 2 September; it dispersed toward the N at a height of 700-1,000 m above the crater (3,700-4,000 m altitude).

Data registered by the MEQ-800 seismic station maintained by Instituto Nacional de Prevención Sísmica (INPRES) of San Juan, Argentina during 11 August-4 September, and registries obtained by a digital seismic station at the Volcanológico Observatory (OVDAS) of SERNAGEOMIN, Chile, in the locality of Caviahue, Argentina, were used to correlate seismic and volcanic activity. Correlations were made between some periods of tremor, or periods of intense tremor separated by quiescent periods, that corresponded with later ash emissions. On 15 August rockfall events were detected. Long-period events were registered on 20 (140 seconds) and 21 August (120 and 104 seconds).

The new OVDAS station consists of an L4C seismometer with an analog-digital card converter, and a portable HP 2000 XL computer. The station was installed in Caviahue, 7 km from the crater, and buried to a depth of 70 cm to

protect it from wind effects. The registered microseismic activity in Caviahue was significantly better than data obtained in Trapatrapa, over 15 km NW of the volcano in Chile. Data collection began at 0900 on 26 September. The activity consisted of short-period events associated with volcanic activity. Some events were associated with small crater explosions. A long-period event at 1946 on 23 September was followed approximately 4 hours later by a small ash emission. Although it is not always possible to directly correlate the recorded seismicity with eruptive events, it is evident that there is a close correlation between long-period events and later ash emissions. The appearance of tremor bands is also important and considered precursory to ash emission.

At dawn on 23 September, observers in Caviahue saw intense gaseous emissions in pulses of 30-60 seconds that rose up to 150 m above the crater and dispersed NNE. During that night the crater appeared incandescent. On 24 September the presence of snow was verified in the crater interior, indicating a reduction in temperature. Activity with similar characteristics occurred during the first half of October. Seismographs installed in the area detected microseismic tremors on 17 October. Between 1145 and 1245 of 18 October, constant steam emission occurred along with some denser emanations of brown color and fine ash. The inner crater diameter had not changed noticeably since mid-September, except for a new levee that resulted from wall collapse. On 19 October a thermal anomaly was detected by the GOES satellite, but there were no explosions.

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From the deeper end of things:

Krista McCuish and D. Barrie Clarke wonder about structures found at the border of the South Mountain batholith. They call them Arocknids for their supposed resemblance to spiders. It may be my UBC upbringing, but they look like Archeocyatha to me.

Discussion on the granite network suggest these are internal magma flow structures and appear to be fairly common. Look for them in a granite near you.

For more pictures see their web site.

<<http://www.dal.ca/~granite/arocknid/arocknids.htm>>