

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

#53

2001

Léopold Gélinas Medals

Silver Medal Ben Kennedy, McGill University

The Nature and Origin of Caldera Structure and Morphology, Using Results from Analogue Modeling.

The thesis is in two parts. Chapter one consists of a comprehensive review of current understanding of calderas and caldera models. It proposes a series of stages in caldera evolution, integrating ideas from field and model research. The second chapter presents the results and interpretations of analogue modelling varying four parameters; magma chamber depth, chamber pressure, chamber symmetry and surface topography. Calderas formed over shallow chambers were larger and more coherent than those formed over deep chambers. Surface relief appears to stabilize the main fractures on the subsiding block, and not surprisingly, tilted chambers resulted in highly asymmetric calderas. The jury found the thesis very informative and innovative.

1. 2001 Léopold Gélinas Bronze Medal

The Léopold Gélinas Bronze Medal for the best volcanology/igneous petrology B.Sc. thesis is awarded this year to Renée-Luce Simard, Université du Québec à Chicoutimi, for her thesis entitled, "Etude pétrographique et géochimique de trois intrusions porphyriques le long de la faille de Beniah Lake, Province de l'Esclave, Territoires du Nord-Ouest". The thesis was supervised by Professor Wulf Mueller. The author demonstrates that intrusive magmatism occurred at discrete times along the Beniah Lake fault over a period of 110 Ma. She shows that the intrusions occurred contemporaneous with volcanism at 2708 Ma, with tectonism at 2650 Ma, and during the development of a strike-slip basin at 2600 Ma. By use of trace element geochemistry, she demonstrates that each intrusive episode had a distinct geochemical character, the two oldest episodes showing variably steep rare earth element patterns, and the youngest episode exhibiting relatively flat patterns. She interprets these trends as an overall subduction signature with differences in the tectonics of the subduction zone. In summary, Renée-Luce's perceptive integration of geology, geochronology, and geochemistry and her well-reasoned arguments make this an impressive B.Sc. thesis, fully worthy of recognition by our Division. It therefore gives me great pleasure to award the 2001 Léopold Gélinas Bronze Medal to Renée-Luce Simard.

John Stix

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30 May 2001

2. Some future ideas and directions for our Division

Over the past several months, I have been thinking about some ideas and new directions which might benefit our Division. I would be interested in your feedback, so please feel free to contact me in this regard ([HYPERLINK](mailto:stix@eps.mcgill.ca) <mailto:stix@eps.mcgill.ca>) stix@eps.mcgill.ca). Here is my list of ideas:

Georgia Pe-Piper's initiative to develop a series of volcanology/igneous petrology articles for Geoscience Canada is truly important and fantastic. We all need to support her, particularly those of us who are writing articles. So get those articles submitted soon (I'm working on mine!). Send Georgia an email if you need assistance (gpiper@shark.stmarys.ca).

I feel that we need to increase our thesis submissions for the Gélinas medals. I think we all agree that this is one of the most important things we do as a Division. I know that there are worthy theses out there which are not getting submitted. We need to get the word out better, and Brian and I have been devising a way to target volcanology/igneous petrology professors in Canada.

I would like to see us develop a CD-ROM catalog of excellent photographs which document igneous features in the field. The CD-ROM could be used for many different purposes. It could be a great resource and give visibility to our division. It would not be that difficult to accomplish, if 10-15 people could contribute a bit of time. If each person chose 10-15 of their best slides, along with a caption for each, then we could develop a nice collection of 100-200 photos. Let me know if you could contribute to this effort.

Another possibility is to develop a series of igneous rock suites which could be sold or otherwise distributed. This would require more work and planning, and I throw it out simply for discussion's sake.

As a last point, I am helping co-organize a volcanic gas workshop, to be held in Nicaragua and Costa Rica in early 2003. If you are interested in participating, again let me know!

Lastly but most importantly, I would like to thank Georgia, Ned, and other members of the previous executive for the stellar work they have done for the Division. Thanks, everybody.

3. Current volcanological research at McGill University

The volcanology group at McGill currently is conducting a diverse range of studies which address important topics in volcanism. Ben Kennedy, a Ph.D. student, is examining caldera formation using a combination of field and experimental studies. Ben was the 2001 recipient of the Léopold Gélinas Silver Medal, and he was one of only fifteen Young Scientists invited to participate in the European Union Training Workshop on caldera unrest, held in Naples in May 2001. Sebastien Darteville, a Ph.D. student, is using a numerical modeling approach to examine the role of grain interactions in pyroclastic flows. Sebastien has been collaborating with Karim Kelfoun and Tim Druitt in Clermont-Ferrand, France. Crystal Mann, an M.Sc. student, is studying the dynamics of Ilopango caldera in El Salvador, a very active system which threatens the adjacent capital city of San Salvador. Crystal was awarded a large grant by the Canadian International Development Agency for her work at Ilopango. Oliver Schatz, an M.Sc. student, is studying the behaviour of boron in magmatic-hydrothermal systems using an experimental approach. Oliver was awarded a grant from the Society of Economic Geologists for his research. Yan Lavallée, a B.Sc. student, did his Senior Honours Project on the effects of topography during caldera development, using an experimental analogue approach. Yan will be joining Shan DeSilva's group at the University of North Dakota to do research on Peruvian volcanoes for his M.Sc. research. Mathieu Richer, a B.Sc. student, has been investigating the tectonics and volcanism associated with flat subduction beneath Ecuador, and he will be working with Crystal this summer at Ilopango as an NSERC Undergraduate Scholar. I am continuing my work on theoretical and field approaches to magmatic degassing, with forays into experimental density currents, microgravity studies of active volcanoes, and developing new remote sensing instrumentation for volcanic gases. For information on our activities, please contact me (stix@eps.mcgill.ca) or visit our web site (www.eps.mcgill.ca/groups/volcano).

So long and thanks for all the ash

This issue concludes my tenure as editor of Ashfall. Over the years I have not had a whole lot of feedback, by which I can only conclude at least I haven't stepped on too many toes (even though I may have tried). I have actually enjoyed the collating, reporting and so on, although I must confess that churning out the envelopes on my steam-powered computer and antiquated printer involved much blasphemy and bad vibes. Folding Ashfall and gluing the envelopes was time consuming (after I retired and left the University I had no access to a stamping and envelope-licking machine), but hey! all in a good cause. I derived a certain satisfaction in reading the addresses as I sent the issues out. Many friends, old and new, on the list. Some of you I haven't seen in years, but I relished what appeared to be a renewed contact.

On the executive, I had the privilege of working with Kelly Russell and Georgia Pe-Piper as successive Chairs. Kelly took the Chair without the customary indoctrination period of a term as Vice-Chair, and so we floundered a bit, but were well prompted by Past Chair Cathie Hickson. Also we were the first "electronic" executive, as previously it was customary to have most, if not all, the executive in one locale. With Kelly on the west coast, Georgia on the east, and me somewhere between (albeit on eastern tidewater) we relied on e-mail meetings. Kelly and Georgia have done the Division a great service in their tenures in office, and have endured my constant nagging with consummate good humour. I must also mention and thank outgoing Councillors Paul Metcalfe and Tom Pearce, both of whom helped me in countless ways. The nail-biting last minute shipment of engraved medals across the continent from Paul in Vancouver in time for the award ceremony became a part of annual meeting jitters for the Secretary, - but they always arrived!

And so we move on, the Division is in excellent hands with the new executive, we have a large membership. Brian Cousens will be sending you the next Ashfall, and I do not doubt he will make his mark on it, give him your support. I feel badly that we have never acknowledged the passing of Ted Groves, who was Secretary-Treasurer before Paul Metcalfe. His influence is very solid in the archives and organization of the Division's business. I will try to fit in his logo for Ashfall, - St. Exupery's Little Prince, somewhere in this issue as a remembrance.

EHC

R. F. Emslie Career Achievement Medal 2001

Ron Emslie is certainly Canada's "Mr. Anorthosite". He has worked with anorthosites and the problematics of their genesis for most of his professional life. His contributions to field geology in Canada and to petrology in general are numerous. Over his career his research covered high-pressure mineral studies, geochemistry and precise age dating of the components of the anorthosite suite. All this detailed work was founded on careful field mapping because, first and foremost, he is a consummate field geologist. Unflappable, always ready for an open-ended geological argument, he has worked solo and on numerous team projects, always in pursuit of new and more refined theories for the genesis of the anorthosite suite. His work in Canada led to invitations and opportunities to examine anorthosite complexes around the world, and many talks on anorthosites from around the world are illustrated with pictures featuring Ron and his famous pipe for scale.

The Division is proud to have chosen Ron Emslie for the Career Achievement Medal for 2001, and it is truly fitting that it be presented here in St. John's, in the Province where he has conducted so much of his field work, and whose mineral emblem is labradorite.

E.H.Chown

Anorthosite Massifs and Related Rocks - Then and Now

- R.F. Emslie

It is an honour and a pleasure to accept this career award from my scientific peers. Of course, realization that one is approaching the end of a career is reason to give anyone pause - but it also offers an opportunity to recall with warmth, some of the events and the people who influenced and shared my path.

Reflections

My introduction to, and interest in, basic igneous rocks as an undergraduate came from Bruce Wilson at the University of Manitoba and was later nurtured as a graduate student at Northwestern University with Arthur Howland who introduced me to the layered anorthosites of the Stillwater intrusion. I have always been convinced that a thorough grounding in structures and textures of layered cumulate rocks was an important preparation for attacking petrological problems of massif anorthosites.

A year of teaching at Queen's provided an opportunity to meet and subsequently collaborate with Peter Roeder who kindly furthered my interest in the possibilities of laboratory experiments to solve some of the petrological problems

of anorthositic rocks. We shared a field season visiting the Michikamau, Harp Lake and Kiglapait intrusions in Labrador where Pete briefly got to pursue his passion for fly fishing - unfortunately with limited success. Soon after, Don Lindsley advanced my interest in experimental petrology and introduced me to the capabilities of the 50 kilobar press. Don's experimental investigations and those of his students on a wide range of petrological problems have had an important influence on progress in understanding the AMCG (anorthosite-mangerite-charnockite-granite) suite of rocks.

The Nain Anorthosite Project, initiated by E.P. (Pep) Wheeler 2nd, Dirk de Waard, and Tony Morse who was the driving force, provided valuable leadership in research on these rocks in the seventies and eighties. Over the years I have had the good fortune to share field seasons with many personnel of the Newfoundland Department of Mines and Energy, notably Bruce Ryan and Charlie Gower. These occasions have been mutually beneficial and productive - as well as being enjoyable experiences. The opportunity in 1994 and 1996 to collaborate with a number of these Labrador "hands" in organizing and running field excursions in the Nain area is especially memorable despite some difficult logistics.

At present, an eager new crop of young investigators is producing exciting results in research on anorthosite massifs and related rocks. Among them are Jacqueline Vander Auwera, Mike Hamilton, Gregor Markl and James Scoates who I am very pleased to note, received the MAC Young Scientist award at this meeting. These are a few that come immediately to mind who have been making significant contributions to problems of petrology, geochemistry, and geochronology and isotope geochemistry of these rock suites.

Some Current Research

There are two broad aspects of active research on these rocks that I would like to comment upon briefly. One relates to sources of the magmas and the other to processes of fractionation, contamination, and hybridization that may play roles in explanation of the origins of these suites.

It seems clear to most workers now that a single parental magma that evolved in a closed system cannot account for the diverse suite of rocks observed in the larger AMCG complexes. Evidence to support this has been apparent for some time from the Nain Plutonic Suite (NPS) where isotopic tracers (Nd,Sr,Pb) show that mantle-derived basic and anorthositic rocks are much less affected by crustal contamination than are the associated monzonites, quartz monzonites and granites which display substantial components of crustally-derived isotopes. Furthermore, the isotopic tracers reflect whether the envelope rocks were Paleoproterozoic as in the western part of the NPS, or Middle Archean to Early Archean in the east. Additional evidence comes from the Mealy Mountains Igneous Suite (MMIS) and the Atikonak River Complex (ARC) to the south, in the Grenville Province. Both of these intruded Labradorian crust (about 1.7 Ga); the MMIS about 1.64 Ga and the ARC about 1.13 Ga. Accordingly the MMIS, being close in age to the crust it intruded, displays very few clear isotopic differences between the mantle-derived anorthositic rocks and the associated monzonites and granites. On the other hand, the granitoid rocks of the younger ARC clearly exhibit substantial incorporation of the more isotopically mature Labradorian crust (then some 600 m.y. old), whereas associated leucotroctolites, leuconorites and anorthosites are notably less affected by isotopes of crustal origin.

An almost universally present rock composition in AMCG complexes is ferrodiorite (jotunite), but always in small volumes. Typically, ferrodiorite occurs as dykes and small intrusive bodies in anorthositic host rocks. Ferrodiorite is known to form as a fractionation product from basaltic magma that crystallized under relatively reducing conditions (FMQ buffer or below). The granitoid rocks of most AMCG complexes are also relatively reduced with ferrous-rich silicates including pyroxene and fayalite and are K-rich, commonly with K₂O contents of 4.5 to 5.5 weight percent. The least-contaminated ferrodiorites of the NPS contain less than 1 percent K₂O but in places grade into monzodiorites with 2 to 2.5 weight percent K₂O. Because the K-rich monzonite (mangerite) and quartz monzonite (quartz mangerite) by volume always vastly overwhelm ferrodiorite in AMCG complexes, it is very difficult to argue that the former were derived solely by fractionation from ferrodiorite. However, good examples of mingling and mixing of ferrodiorite and granitoid magmas in the NPS have been well documented by Bob Wiebe. A potential solution to the apparent small volumes of ferrodiorite may be that much has been blended with crustally-derived granitoid melts to produce the characteristically relatively mafic, ferrous-rich, relatively reduced monzonites (mangerites) and quartz monzonites (quartz mangerites).

Minutes of the Annual Meeting

May 30, 2001,

Room 2101 Science Building, Memorial University of Newfoundland

Present: Georgia Pe-Piper (Chair), Michael J. Harris, David J.W. Piper, Jim Nicholls, Jarda Dostal, Jon Scoates, Chris Findlay, Brian Cousens, Charlie Roots, Renée-Luce Simard, Dominique Richard, Craig Scott, John Stix, Ron Emslie, Bruce Ryan, Leanne Mallory, John Greenough, E.H. Chown (Secretary).

- 1) The meeting was called to order at 12:25.
- 2) The proposed agenda was adopted, moved Jim Nicholls, seconded Jarda Dostal.
- 3) The minutes of the 1999 annual meeting, duly published in Ashfall # 51, were adopted, moved Mike Harris, seconded Jim Nicholls.
- 4) There was no business arising from the minutes.
- 5) The report of the chair was presented by G. Pe-Piper.
- 6) The Secretary-Treasurer presented the financial statement for 2000, published in Ashfall # 52. David Piper moved, Brian Cousens seconded the approval of the financial statement, Carried.

The Secretary-Treasurer presented a projection for finances in the coming year, noting that the membership was currently 138 paying and 124 student members. Regular expenses, Ashfall, pizza for annual meeting and engraving medals were more than covered by the membership dues. Foreseeable extra expenses include the restriking of the Career Achievement medal (1 left) and the purchase of a supply of the medals. As voted in the last annual meeting, the executive should proceed with an application to the Canadian Geoscience Foundation for a grant to cover the restriking of the medals and possibly the supply of new medals. Finances were reasonably sound and require no increase in membership dues.

7) Scheduled Activities

- Saskatoon 2002 J. Stix is organizing a session on “Relationships and links between tectonics and volcanism”. and John Greenough is organizing a session on “Applications of geology and geochemistry to Archaeology” with an associated field trip
 - Vancouver 2003 No report was available as to the progress in organizing Special Sessions for Vancouver (C. Hickson, K. Russell), although Kelly Russell advises by e-mail that a two day trip to Mt. Meager, and a one-day trip to the Squamish area are already planned.
 - Montreal 2004: The organizing committee for Montreal is not yet decided, but John Stix will monitor the situation.
- 8) Amendments to the constitution. The executive proposed a number of amendments to update the constitution reflecting changes that are already in practice.

Certain required changes in nomenclature, Chairman, Vice Chairman and Past Chairman to be replaced by Chair, Vice-Chair and Past Chair; Volcanology Division to become Volcanology and Igneous Petrology Division throughout the document. In addition the objectives under Article I be changed from “To advance the study of the processes and products of volcanism” be changed to “To advance the study of the processes and products of magmatism” moved by Mike Harris, seconded John Greenough, Carried

Article II Under eligibility to vote “only members and associate members in good standing who have paid annual Division dues are eligible to vote on Division business” be changed to “Members in good standing are eligible to vote on Division business”. moved by David Piper, seconded by John Stix. Carried.

Article IV “and one Councillor representing student members, the oceanic regions and/or geophysical disciplines” be changed to “and one Student Councillor to represent student members” moved by Brian Cousens, seconded by Charlie Roots. Carried.

This constitutes an agreement in principle to the proposed changes, and must be approved by a mail-in vote by the membership.

9) Election of new officers

The proposed slate for the next two years was presented as:

Past Chair, Georgia Pe-Piper, St Mary’s University

Chair; John Stix, McGill University

Vice Chair; Wulf Mueller, Université du Québec à Chicoutimi

Secretary-Treasurer; Brian Cousens, Carleton University

Councillor, East; Don Francis, McGill University

Councillor, Central, Penny King, University of Western Ontario

Councillor, West, Derek Thorkelson, Simon Fraser University

A student councillor was added from the floor

Councillor, Student; Renée-Luce Simard, Dalhousie University

moved by Jarda Dostal, seconded by David Piper

David Piper moved the nominations closed, seconded by Jim Nicholls, Carried

Jim Nicholls moved a vote of thanks to the outgoing executive, seconded by Jarda Dostal.

10) Léopold Gélinas medal presentations.

The Bronze medal for best Honours Bachelor's thesis was presented to Renée-Luce Simard (UQAC) by John Stix

The Silver medal for best MSc thesis was presented to Ben Kennedy (McGill) by Ned Chown.

- 11) Ned.Chown read the citation for the Career Achievement Medal, presented to Ron Emslie, who gave a short presentation.
- 12) The meeting adjourned at 13:43, Moved by Bruce Ryan.

Rabaul

New Britain Island, Papua New Guinea

4.271°S, 152.203°E; summit elev. 688 m

All times are local (= UTC + 10 hours)

This report covers the period from November 2000 through May 2001. Activity at Rabaul was relatively low through this period until 14 March, when low-frequency earthquakes resumed and continued to increase in number and amplitude throughout that month. These earthquakes were apparently precursors to an ash eruption at Tavurvur on 2 April after several months of relative quiet.

Occasional ash-laden clouds resulting from mild explosions occurred in January and February. White vapors were released in varying amounts from Tavurvur. Two large explosions occurred on 12 and 26 January producing a dark gray, billowing ash cloud that rose to ~1,000-2,000 m above the summit before dispersing W and NW. The explosions showered the flank of the volcano with rock fragments and deposited significant amounts of ash on Rabaul Town. For short periods during these months H₂S was smelled downwind of Tavurvur.

Seventeen high-frequency earthquakes were recorded in March, only five of which were determined as having originated from NE and ESE of the caldera. No high-frequency earthquakes have been recorded on the once-active ring-fault seismic zone since 1995. Between February and the end of March, GPS recorded ~1.5 cm of uplift in the central part of the caldera, while an electronic tiltmeter measured ~3-4 μ rad of inflation.

The caldera had previously subsided about 4 cm on 16 November 2000, associated with earthquakes N of Rabaul. According to the UN Office for the Coordination of Humanitarian Affairs (OCHA), two earthquakes, M 7-8, occurred in Papua New Guinea about 3 hours apart on 16 November. The first earthquake was ~50 km N of Rabaul and just S of New Ireland. The second earthquake struck ~100-150 km from Rabaul and N of New Ireland, near the Lihir, Tabar, and Tanga Islands. Both earthquakes occurred about 50 km below sea level. Tsunami of 1-2.5 m height caused damage on New Britain, New Ireland, and Bougainville, leaving thousands homeless; no casualties were reported. At least four other M ~6.5 aftershocks were reported in the following days. According to the BBC, recent tectonic activity has caused subsidence of coral islands between New Ireland and New Britain. As many as 40,000 people may need to be evacuated.

At 1300 on 2 April the number and amplitude of the low-frequency earthquakes increased again, culminating in the first ash clouds between 2100 and 2200. Figure 5 shows an ash eruption on 4 April 2001. Similar low-frequency earthquakes were noted a few days before the 28 November 1995 eruption. High-frequency earthquakes, another good indicator of eruptive activity, continued to occur on the NE side of the volcano during April 2001. Other parameters indicating signs of likely renewed eruptive activity were 3-4 months of slow inflation in the central part of Rabaul Caldera, GPS measurements that showed ~3-4 cm of uplift, and tiltmeter measurements near the GPS benchmark and ~2 km from Tavurvur that also indicated inflation. The smell of sulfuric gas was noted occasionally.

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Figure 5. Ash eruption on 4 April 2001 at the Tavurvur cone. This photo was taken looking from the NW and shows the SE side of the cone. Courtesy of RVO.

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From 2 to 24 April Tavurvur's ash emissions fluctuated between white to pale-gray ash clouds and sub-continuous ejection of pale- to dark-gray ash clouds. Beginning at about 1400 on 25 April, activity changed to short explosions that produced white to pale-gray mushroom-shaped ash columns and were usually accompanied by roaring noises. During the month ash clouds rose from a few hundred to ~1,000 m above the summit area. Variable winds blew the ash N and NW. Similar eruptive activity continued through the end of April.

During April, 1,089 low-frequency (LF) earthquakes were registered by the trigger system. Daily LF totals ranged between 0 and 291. High LF totals occurred on the 25th (172), 26th (291), 27th (228), and 28th (212). This period corresponded to the time when the mode of Tavurvur's eruptive activity changed from occasional sub-continuous ash cloud emissions to frequent, short-duration ash cloud expulsions. The totals for April 2001 were substantially higher than for the previous months of January (22), February (31), and March (13). During April, short duration, non-harmonic volcanic tremors were also recorded and were usually associated with the sub-continuous ash cloud emissions. On the other hand, during April the system recorded only six high-frequency earthquakes, fewer than in January (15), February (8), and March (17). Moreover, in April, half of the high-frequency earthquakes struck to the NE and outside the caldera.

During May, Tavurvur emitted pale gray to white ash clouds, sometimes accompanied by 0.5-2 minute periods of roaring. The ash clouds typically reached as high as several hundred meters above the vent. During the first half of May incandescent explosions were observed at night, but towards the end of May these explosions lessened in frequency and vigor. The roaring noises also lessened. On 30 May the roaring noises were replaced by stronger, discrete explosions. These produced dark ash clouds that rose to 1-1.5 km above the vent. In general, intra-caldera seismicity was low in frequency and associated with explosions. Almost 2,000 seismic events were recorded.

The unambiguous inflationary trend observed over the previous six months slowed in early May, and a period of relative stability occurred until the end of the month. The start of the darker emissions heralded a period of small-scale rapidly fluctuating vertical movements, but no overall inflationary or deflationary trend predominated.

Background. The low-lying Rabaul caldera forms a sheltered harbor once utilized by New Britain's largest city. The 8 x 14 km caldera is widely breached on the east, where its floor is flooded by Blanche Bay. Two major Holocene caldera-forming eruptions took place as recently as 3,500 and 1,400 years ago. Three small stratovolcanoes lie outside the northern and NE caldera rims. Post-caldera eruptions built basaltic-to-dacitic pyroclastic cones on the caldera floor near the NE and western caldera walls. Several of these, including Vulcan cone, which was formed during a large eruption in 1878, have produced major explosive activity during historical time. A powerful explosive eruption in 1994 from both Vulcan and Tavurvur cones forced abandonment of Rabaul city.

Information Contacts: Ima Itikarai, Rabaul Volcano Observatory (RVO), P.O. Box 386, Rabaul, Papua New Guinea (Email: rvo@global.net.pg).



Vailulu'u

American Samoa

14.215°S, 169.058°W; summit elev. -590 m

Recent work by Hart and others (2000) has described this volcano and identified it as the source of acoustic signals noted in July 1973 and an earthquake swarm during January 1995 (*Bulletin* v. 20, nos. 1-2). The following is from Hart and others (2000) except where noted.

Vailulu'u Seamount is located 45 km east of Ta'u island, the easternmost island of the Samoan chain, and defines the leading edge of the Samoan swell (figure 7). Mapped in March 1999 with SeaBeam aboard the R/V Melville during AVON cruises 2 and 3 (figures 7 and 8), Vailulu'u rises from an ocean depth of 4,800 m to its crater rim within 590 m of the sea surface, with a total volume of $\sim 1,050 \text{ km}^3$. The summit includes a 400-m-deep, 2-km-wide crater (figure 9). These cruises were motivated by the 1973 and 1995 acoustic and seismic events in this region, and were a direct attempt to find the current location of the Samoan hotspot.

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Figure 7. Bathymetry of Vailulu'u and nearby Ta'u Island, based on a SeaBeam bathymetric survey performed during R/V Melville's AVON 2 and 3 cruises, augmented with satellite-derived bathymetry from Smith and Sandwell (1996). The inset shows the general location of Vailulu'u with respect to the Samoan Archipelago; two other newly mapped and dredged seamounts (Malumalu and Muli, AVON 3 cruise) are shown as well. Scale: 10' = 18 km. From Hart and others (2000).

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Figure 8. Perspective view of Vailulu'u seamount looking NW, displaying three major rifts toward the E, SE, and W. The lower slopes of Vailulu'u and Ta'u merge along the western ridge, with a saddle at 3,200 m. Vailulu'u is $\sim 35 \text{ km}$ in diameter at its base. Scale: 10' = 18 km. From Hart and others (2000).

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Figure 9. SeaBeam bathymetry map of the summit crater of Vailulu'u, showing the crater rim with three peaks and three breaches, the location of CTDO (conductivity, temperature, depth, optical) casts 1 and 4, and the tow-yo track circumnavigated around the summit. Dotted azimuth lines are given every 30° along the track. Scale: 1' = 1.8 km. From Hart and others (2000).

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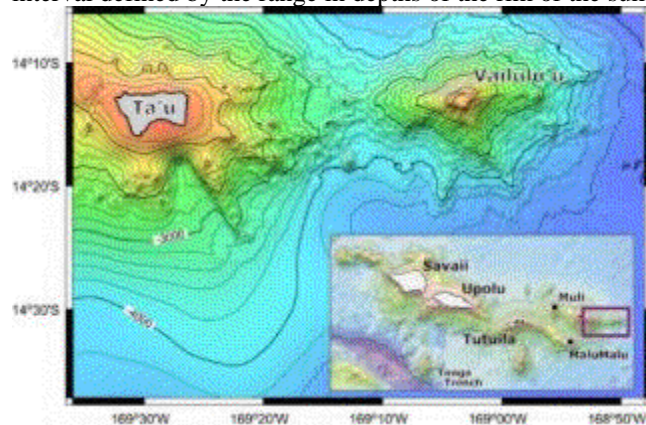
The overall shape of Vailulu'u is dominated by two rift zones extending E and W from the summit, defining a lineament parallel to the Samoan hotspot track. A third, slightly less well-developed rift extends SE from the summit, and several minor ridges extend out from the lower slopes, making an overall asymmetric, star-like pattern. Rift zones and ridges in the southern sector are more strongly developed than those on the N flank, giving Vailulu'u a stunning similarity to a juvenile Ta'u island (figure 7). The three major rift zones define three high points of the crater rim. The crater and rim are oval-shaped (figure 9), with two well-developed pit craters defining the northern two-thirds of the crater and two minor depressions on a bench in the southern third of the crater.

Several historical events suggest volcanic activity. There was a series of acoustically detected explosions on 10 July 1973 (Johnson, 1984), and during 9-29 January 1995 the global seismic network recorded a strong (M 4.2-4.9) earthquake swarm in the vicinity (*Bulletin* v. 20, nos. 1-2). While most of the 1995 earthquakes were formally located NW of the volcano, their uncertainty ellipses include Vailulu'u; a SeaBeam survey within the apparent earthquake area did not reveal any volcano-tectonic features. Dredges, especially those from the summit area, are dominated by fresh volcanic rock, with pristine volcanic glass, many original glassy surfaces, unaltered olivine phenocrysts, and a virtual lack of vesicle fillings. Extremely "bright" SeaBeam sidescan returns suggest that fresh volcanic rocks occur ubiquitously throughout the slopes of Vailulu'u and that sediment cover is largely absent. A detailed nephelometry survey of the water column shows clear evidence for hydrothermal plume activity in the summit crater. The water inside the crater is very turbid, and a halo of "smog" several hundred meters thick encircles and extends away from the summit for at least 7 km (see Hart and others, 2000, for details).

During the DeepFreeze 2000 cruise in March 2000, aboard the U.S. Coast Guard Icebreaker Polar Star, conductivity temperature depth optical (CTDO)/Niskin stations were occupied at three places within the summit crater and two outside the crater; in addition, the summit area was circumnavigated in tow-yo mode along the ~1,000-m contour (figure 9). Particulate distribution in the water column was studied using a light backscattering sensor (LBSS) attached to a CTD/Niskin water sampling rosette. At 600-m depth in the crater turbidity increased sharply and

continued to do so in a stepwise fashion to the bottom of the crater at 996 m. Turbidity near the bottom was greater than that associated with active venting and plume formation on ridge crests. At station 1, outside the crater, the LBSS "smog" layer starts at about the same depth (610 m) but returns to background values at 850 m. This depth interval is comparable to the elevation range of the crater rim, which has peaks at 590 m and a deepest breach at ~780 m (figure 9). At station 5, 7.5 km E of the crater rim, a small turbidity anomaly was observed at a depth of 600-720 m.

During a complete 360° circumnavigation of the summit crater, the plume was mapped from 500 to 900 m depth in tow-yo mode (figure 9). Overall, the hydrothermal plume was confined to a narrow depth interval bracketed between the breaches and summits of the crater wall. Its upper, neutral buoyancy, level corresponds closely with the heights of the peaks on the crater rim. Virtually no particulate matter appears to be ejected from the crater to heights above the peaks on the crater rim nor does any settle below the breach depth during its dispersion laterally away from the summit. Particulates are being generated within the crater and are subsequently carried away by ocean currents. Vailulu'u is clearly a young and active submarine volcano. Its activity is reflected in acoustic/seismic events in 1973 and 1995, the lack of any sediment cover, fresh basalt and pristine glass in dredges from all levels, and radiometric ages ranging from 5 to 50 years. The summit is marked by a sharply delineated crater over 400 m deep, filled with highly turbid water. This smog layer extends out as a halo for many kilometers in all directions, in a narrow depth interval defined by the range in depths of the rim of the summit crater.



Etna

Sicily, Italy

37.73°N, 15.00°E; summit elev. 3,315 m

As reported by Sistema Poseidon, activity at Etna during 9 April-13 May 2001 was chiefly characterized by typical episodic Strombolian blasts, ash emissions, and modest lava flows. The larger lava flows that emerged from new vents and grew during June and July will be discussed in later reports.

Activity during mid- to late-April 2001. During this time interval ash escaped at the Bocca Nuova (BN) vent. The weather thwarted direct observations of summit activity; however, later information was obtained through outings to intermediate elevations and from La Montagnola surveillance camera.

Lava continued to flow from a vent low on the NNE flank of the Southeast Crater (SEC) cone, as it has since approximately 20 January 2001. This lava flowed down the SEC's NE flank. During the nights of 18 and 21 April observers noted that the SEC produced flashing, denoting effusive activity. The SEC also continued to give off gray-colored gas from both the fumarole on the crater's edge and from the pit-crater in the crater's interior. Later in April the SEC's N flank vent continued to emit lava variably, but generally weakly, and beginning 26 April, the flow became visible principally from the volcano's NE quadrant. During 26-28 April degassing increased at SEC, yielding abundant clouds of white steam that diminished on 29 April.

Observations on 27 April revealed two hornitos (at 3,085 m, ~3 m high, and aligned N-S). They produced steady emissions, sounds of pressurized gas, and discontinuous expulsion of vitreous and blistering lava fragments which fell within a few meters of the vents. The more northerly hornito produced a lava flow within a confined channel. At about 3,000 m elevation, this lava river divided into two branches before rejoining just above 2,900 m. In late April, the flow rate was estimated at 2-3 m³/s.

A party viewing the base of BN's crater saw two prominent, steep-sided fissures that were ~100 m in length and at least 30-50 m deep. At a shelf inside the N fissure a small pyroclastic cone gave off dense brown and reddish clouds visible from the slopes of the volcano. The fissure in the SW quadrant also degassed intensely, and both fissures

gave off almost continuous noise associated with magma inferred to reside at depth. A field of semi-circular fissures was observed nearby running S and W from this depression. Observers also noted fumaroles emitting bluish gas. Until at least early May, Voragine and Northeast craters continued weak degassing.

When seen on 3 May SEC's N hornitos had grown by almost 1.5 m compared with the preceding week. The lava canal had also widened to about 2 m, corresponding to a significantly increased flow rate, 5-10 m³/s. Two small lava flows developed on the E and W sides of the hornitos.

Strombolian eruptions starting on 7 May. Strombolian activity began again at the SEC late on the morning of 7 May. When seen on 9 May these eruptions were almost continuous, as frequent as about 45-50 explosions per minute, including some strong ones that sent lava fragments 20-30 m above the crater. Lava fragments as big as a meter in diameter were thrown up to 50 m above the crater rim.

Beginning at 1400, along with a new increase in tremor, the Strombolian activity evolved into a more violent phase at 1520-1540. Ballistics landed at elevations as low as ~3,000 m, reaching the spatter rampart at the S base of the cone. At about 1630 modest lava fountaining was observed from the fracture on the N flank of the SEC. Jets of magma reached ~100 m high. The fragments emitted from the lava fountain fell mostly in the SW sector of the volcano.

At the same time, the Montagnola camera began to register frequent ash emissions from the cone's summit; Strombolian activity and ash emissions continued until midnight in a discontinuous manner and with variable intensity. Observations on 10 May showed a substantial decrease in the activity at the SEC summit. Weak explosive activity was observed from the N fracture.

The lava emission from the fracture cutting the N flank of SEC continued with more or less intense phases. On 9 May, the cessation of lava fountaining was followed by a repeat of effusive activity, still within the same area of emission, which gave rise to finger-like flows ~1.5-2 km long. On 10 and 13 May, short lengths of the active branches of the flows were observed. The outburst led to a considerable plume that impacted local air traffic.

Bocca Nuova continued to issue brown-reddish ash emissions, presumably ongoing ash-bearing eruptions from one of the fissures described above. On 9 May a new fumarolic field was seen in the S part of the Bocca Nuova, extending from the rim to half way down the cone.

Information Contacts: Sistema Poseidon, a cooperative project supported by both the Italian and the Sicilian regional governments, and operated by several scientific institutions (URL: <http://www.poseidon.nti.it/>).

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A series of amendments to the bylaws were passed at the annual meeting this spring. These were, by nature, housekeeping measures to get the Division in line with actual practices. The amendments require approval by ten percent of the membership (around 14). To date four (4) public spirited division members have voted, we need more votes or we have to repeat the process, so I am appealing directly to the executive, present and past and any other member who has the misfortune to have his/her name in my address book to vote now.

Just click on Reply to sender, scroll down to the ballot and make your choice, click on send. Its easy! Its FUN! It may even be considered public spirited.

EHC Returning Officer (Retiring conscience of the Division)

Changes to the By-Laws of the Volcanological and Igneous Petrology Division

The following changes to the By-Laws of the Division were passed at the annual meeting. This requires confirmation by the members -at-large.

Certain required changes in nomenclature, Chairman, Vice Chairman and Past Chairman to be replaced by Chair, Vice-Chair and Past Chair; Volcanology Division to become Volcanology and Igneous Petrology Division throughout the document. In addition the objectives under Article I be changed from "To advance the study of the processes and products of volcanism" be changed to "To advance the study of the processes and products of magmatism".

FOR

AGAINST

Article II Under eligibility to vote "only members and associate members in good standing who have paid annual Division dues are eligible to vote on Division business" be changed to "Members in good standing are eligible to vote on Division business".

FOR

AGAINST

Article IV “and one Councillor representing student members, the oceanic regions and/or geophysical disciplines” be changed to “and one Student Councillor to represent student members”.

FOR

AGAINST