Commission on Volcanogenic Sediments (CVS) Newsletter #20 (April 2001)

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Welcome to the 20th and first e-newsletter of the Commission on Volcanogenic Sediments. It has been a year since the last one, due mostly to Ian relocating to the US. We will aim to get a second newsletter out in December this year. If you haven't got an email or we haven't got your email address, then you'll continue to receive the paper copy. If you'd like to get the e-version, then please send Ian your email address. Advantages of the e-version include that we can afford to include colour images and make it more substantial, but we promise to keep it no longer than this one!

In this issue, Wulf Mueller discusses processes, products and terminology associated with subaqueous eruption-fed density currents from small volume mafic eruptions, there are reports on two meetings from last Summer and accounts of several forthcoming meetings and publications of interest to CVS members. We have also added a new section on recent publications relating to any aspect of volcanogenic sediments. If you know of any publications that you feel should be on this list, please let us know. We will compile all the publications together, and hope to have a searchable database on the CVS web page soon.

If you have any information on meetings, or recent and forthcoming publications, please contact Ian at the address below. Please also contact either of us with any suggestions for short research articles that might be suitable for the newsletter. Any images of VS-related features are also very welcome.

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Research article

Subaqueous eruption-fed density currents from small volume mafic eruptions: the crossover from volcanology to sedimentology

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The identification of subaqueous pyroclastic deposits that result directly from explosive subaerial or subaqueous eruptions is a contentious issue. Unless a combination of heat retention structures, including columnar jointing, eutaxitic texture (welding), rootless segregation pipes and fiamme are observed, or unless thermoremanent magnetization studies indicating emplacement temperatures of ≥500°C can be obtained, subaqueous pyroclastic deposits are generally conceived to be reworked and redistributed via mass flows or wave action. I would like to emphasize that a *combination* of heat retention structures is required. For example, fiamme may be preserved in remobilized mass flows or they may be incorrectly identified, and rootless segregation pipes may be difficult to distinguish from water-escape structures. The emplacement of hot, gas-driven pyroclastic flows in subaqueous settings has been contested, but recent well-documented examples show their existence in shallow to moderate water depths (Schnieder et al., 1992; White and McPhie, 1997). In contrast, recognizing primary, non-welded pyroclastic deposits in submarine environments has remained problematic because of the lack of unequivocal criteria permitting distinction between cold, reworked, volcanogenic mass flow deposits and water-laden pyroclastic debris resulting directly from volcanic explosions. It is especially difficult in altered, metamorphosed and/or deformed ancient sequences. Notwithstanding, a recent study by White (1996) on a Quaternary lacustrine cinder cone at Pahvant Butte (Utah, USA), demonstrated that detailed volcanological facies analyses combined with a process-oriented approach led to identification of non-welded subaqueous tephra deposited via cold mass flows. Similarly, Skilling (1994) and Smellie and Hole (1997) recognized eruption-fed density currents derived from subglacial eruptions. Additionally, inferred subaqueous density current deposits fed directly from an eruption were recognized in the shallow-water Paleoproterozoic Kangerluluk sequence, southeast Greenland (Mueller et al., 2000). These studies demonstrate that sound field mapping, careful observations and detailed volcano-sedimentary analyses (coupled with sufficient outcrop exposure) can lead to novel concepts and new criteria (e.g. sedimentary structures) for recognition of subaqueous pyroclastic deposits.

There is still hope for ‘field dinosaurs’ working on ancient rocks. Before we break out in euphoria, caution should be given because, as pointed out by Fritz and Howells (1991), detailed studies of bounding facies must be conducted in ancient sequences to support interpretations of subaqueous pyroclastic deposits. Fritz and Howells (1991) used a sedimentary facies analysis concept to demonstrate that the controversial Ordovician Garth Tuff, a welded tuff, was emplaced in a subaqueous setting. This study was important because it supported the idea that pyroclastic debris could be emplaced under hot conditions in a subaqueous setting. The next logical step was to document the presence of non-welded subaqueous pyroclastic deposits (e.g. White, 1996, 2000; Mueller et al., 2000). Recognition of these types of deposits was of significance because our knowledge of the processes and mechanisms affecting subaerial pyroclastic flows, falls and surges is well advanced, whereas understanding pyroclastic eruption mechanisms and related transport processes in the subaqueous realm is limited. Proving that a water-laden pyroclastic deposit originates from paroxysmal subaqueous explosions may not be possible in many cases, but the fact that they can be documented attests to their existence.

Sedimentary Processes and Terminology

Cold density currents originating from explosive eruptions are probably far more prominent than hitherto perceived. To properly assess volcaniclastic deposits associated with subaqueous eruption-fed density currents, a brief sedimentological overview is required. Furthermore, as with many volcanological papers, terminology is a crucial factor and a short philosophical review is provided to clarify certain aspects.

Sedimentology and subaqueous processes:

Density currents are generally considered to be mass or gravity flows that occur in a subaqueous environment. Mass flow transport systems, referred to as sediment gravity flows, are divided into turbidity, debris, grain, and fluidized flows (± liquefaction and liquefied flows) based on the prevalent support mechanism during transport (Middleton and Hampton, 1976; Lowe, 1982; Stow et al., 1996). Turbidity and debris flows hold sedimentary and volcanic particles in suspension via fluid turbulence or internal (yield) strength of the transporting medium (referred to as the "matrix") under turbulent or laminar flow conditions, respectively. Both flow types represent the two prominent transport mechanisms in a subaqueous setting. Grain and fluidized flows are considered subordinate, but commonly occur in association with turbidity currents and debris flows. Both subordinate processes indicate rapidly changing rheological behavior and buoyancy conditions during transport. Grain flow processes may be the prominent clast-support process in coarse clastic and breccia-size pyroclastic debris. Sedimentary structures, such as inverse grading or dish structures, characteristic of grain and fluidized flows, are important indicators that develop either locally during transport or after deposition. Changing transport conditions from turbulent to laminar or vice-versa during a subaqueous flow, which Fisher (1983) described as flow transformations, have a direct influence on the type of sedimentary structure formed and are relevant to our understanding subaqueous gravity flows. Physical characteristics indicating the principal or subordinate transport processes in turbidity and debris flows include normal or inverse grading (or both), sharp, non-erosive to scoured bases, clast- and matrix-support, massive (structureless) to stratified features, and cross- or wavy-bedding, all of which occur over a complete range of grain sizes from mudstone to boulder-size conglomerate. Bedforms can be produced by volcanic action or sedimentary processes. The key is to determine what mechanism initiated the transport process and to know that a deposit is the combined result of the transporting as well as the ambient medium. No problem, right?

Terminology:

Terminology is a major issue when classifying a volcanic rock. This has become a frustrating exercise in volcanology because pyroclastic rocks, as well as fragmented volcanic rocks, originating from flows or dome collapse can be referred to in several ways. More often than not, the non-specialist reader gets confused. The terms "tuff" and "sandstone" represent grain size denominations in volcanology and sedimentology, respectively, but they also have important connotations concerning origin and transport process. Now the fun begins in giving a fragmented rock and/or an unconsolidated deposit a name. To make life easy, a philosophical approach is taken by dividing the two principal rock-naming groups into "*purists*" and "*realists*". The attributed name for the rock depends on what criterion is considered to be relevant. The eruption mechanism, transport process, depositional setting, transport medium, type of components and abundance, grain size, and combinations thereof, are all qualifiers that influence rock classification. Purists favour a nomenclature based on the eruption or fragmentation mechanism as well as the transporting medium, which is either steam, gas or water. Realists support the usage of grain size with principal components having a volcanic or pyroclastic origin, irrespective of the transport process. In general, the purist group maintains that volcanic terms, such as ash (tuff), lapilli, and bombs (breccia) should be restricted to rocks emanating directly from an explosive eruption, while clastic sedimentary terms are favoured for slumped, reworked and remobilized pyroclastic debris (e.g. Cas and Wright, 1987; McPhie et al., 1993) In striking contrast, the realists adhere to the volcanic grain size classification of Fisher and Schmincke (1984) with components being of volcanic or pyroclastic origin. Fisher and Smith (1991) suggested that remobilization by wind and water cannot change the origin of the deposit, so that the original volcanic grain size scheme tuff, lapilli, etc. is applicable if delicate volcanic and pyroclastic particles and textures can be identified.

Now everything is solved! Well, not quite. Complications arise in the subaqueous realm, where distinct recognition criteria have been especially problematic. If heat retention structures are observed, then both schools agree on a volcanic grain size scheme, but non-welded pyroclastic deposits or hyaloclastites produced by quenching represent the volcanological-sedimentological grey zone. *Que faire? Quo vadis?* Should one emphasize the composition, grain size, and sedimentary structures, or eruption mechanism and transport medium? As a mapping geologist focusing principally on Archean supracrustal sequences, the realist approach suites my needs. Therefore, eruption-fed density current deposits, and hyaloclastites and their reworked counterparts would be described as tuffs, lapilli tuffs or lapilli-tuff breccias with an attribute for descriptive purposes (e.g. turbiditic tuff, stratified lapilli tuff or massive lapilli tuff breccia). On the other hand, if it is possible to discern between primary and reworked pyroclastic debris in the field, then the purist scheme seems more applicable. Whatever scheme is employed, please explain the preferences to the reader. There is a system to madness!

Subaqueous eruption-fed density currents

Subaqueous eruptions and their associated products have been divided into three distinct categories based on the fragmentation mode, transport medium, and prevalent transport process (White, 2000). Group 1 deposits are considered pyroclastic deposits *sensu stricto,* because heat retention structures are indicative of gas (driven) - support during transport. Group II volcaniclastic rocks, referred to as eruption-fed aqueous deposits, are transported in a submarine subaqueous milieu via high- to low-concentration turbidity currents, grain flows and debris flows that originated directly from an eruption, but are cold water-laden processes. Group III products are deposited from lava flow-fed density currents, generally derived from dynamo-thermal quenching and spalling of flows. The focus of this report is on mafic, non-welded, water-laden, pyroclastic deposits produced by shallow-water, Surtseyan-type eruptions, and these represent a subset of Group II rocks.

Emergent Surtsey:

On the 14th of November, 1963 with the emergence of Surtsey, an island off the south coast of Iceland along the Mid-Atlantic Ridge, a new awareness developed concerning shallow-water eruptions of mafic composition (Einarsson, 1966; Thorarinsson, 1967). Surtseyan eruptions, representing a type of phreatomagmatic or hydroclastic eruption process, are violent magma - water interactions from which magma or tephra jets emanate. Multiple tephra jets form a structure referred to as a spiky cock’s tail or cypressoid plume (Kokelaar, 1983). This eruption style is characteristic of emergent Surtseyan eruptions, and reflects intermittent supply of magma rather than a continual uprush (Kokelaar, 1983; Moore, 1985). Individual tephra jets represent small magma-water explosions with the head of the jet composed of large or numerous pyroclasts followed by a trailing stream of vapour, water, gas (air), and volcanic fragments. The deposits resulting from such small-scale, subaerial, paroxysmal eruptions are poorly sorted tuffs and lapilli tuffs disrupted by bombs (breccia-size pyroclasts), from the head of the jet. In addition to inverse and normal graded airfall and bomb sag structures, cold and wet base surges constitute an integral component of Surtseyan eruptions. Base surges are high velocity, low-density, turbulent gas-steam-particulate flows or pyroclastic gravity currents originating directly from an eruption (Fisher, 1979; Orten, 1996). These high energy deposits, displaying planar- and dune-shaped beds with abundant scouring, demonstrate bedform and grain size changes down-slope AND along strike of the volcanic edifice (Sohn and Chough, 1989, 1992). The geometry of small emerging island volcanoes is commonly that of an asymmetric tuff cone in which water has direct access to the vent.

***Surtsey and submarine equivalents*:**

Before the eruptions occurring around Iceland in the North Atlantic, subaqueous explosive processes were of a conjectural nature. Because of the new observations from Surtsey and the resultant excellent descriptions by Icelandic geologists (and studies by Moore, Kokelaar and Durant) many features that had been difficult to reconcile with a subaqueous setting, could now be explained. The subaqueous evolution of Surtsey is poorly known, but eyewitness reports from satellite vents Syrtlingur, Jolnir, and Surtla helped unravel the problem. The former two breached the water surface temporarily between 1965-1966, whereas Surtla, developed to within 5 m of the water surface, exhibited only minor ejecta up to 50 m above sea level (Kokelaar and Durant, 1983). Along with water turbulence and steam rising from the sea, Thorarinsson (1967) reported fire flashes under the sea at Surtla. White (1996) interpreted these incandescent flashes as explosive hydrovolcanic processes and suggested they could be subaqueous counterparts of tephra jets. The observation of fire flashes signified momentary creation of air pockets which were extinguished by seawater. It seems probable that the hydrostatic pressure column forced the collapse of the subaqueous jets?? Tephra at Surtsey is composed of abundant scoria deposits, some with chilled margins, agglutinated fragments, spatter-like forms and bread-crust surfaces collectively indicating a volatile-rich magma interacting with water. These textures and components are also suggestive of subaerial conditions in a subaqueous milieu (Kokelaar and Durant, 1983; Kokelaar, 1986). One of the major conclusions of Kokelaar (1986) at Surtla, based on careful observations and keen reasoning, was that steam-gas envelopes can be created at shallow water depths. Although the formation of a steam cupola could be invoked based on petrographic evidence and theoretical modeling, the nature of the subaqueous transport process and deposit remained elusive. Bombs could be explained by submarine magma spattering under a steam cupola, but the associated graded and stratified tuff, and lapilli tuff beds required rethinking, because they were governed by water-laden transport processes. Similar deposits from exposed ancient volcanic edifices has helped explain this discrepancy. As documented by White (1996) at Pahvant Butte and Mueller et al. (2000) at Kangerluluk, bomb sag structures represent ballistic transport and require a steam-gas-rich cupola, whereas the interstratified water-laden tuffs and lapilli tuffs at Kangerluluk or ash and lapilli beds at Pahvant Butte were water-laden pyroclastic deposits. The subaqueous tephra at both localities was interpreted as high- and low-concentration particulate gravity flows. The 5-100 cm-thick, laterally discontinuous beds forming distinct volcaniclastic sequences between 50-85 m-thick, suggest numerous single eruptive units derived from small volume eruptions. The abundance of scoria, lithic fragments, glass shards and broken and euhedral feldspar or pyroxene crystals in these beds support the contention of a pyroclastic origin. The coexistence of bomb sag structures with pyroclastic debris emplaced by turbidity currents is explained by the collapse of the subaqueous gas-driven tephra jets through water ingestion (Fig. 1).

NOW terminology becomes a problem! When the steam bubble collapsed and the transporting medium changed from steam gas to water, but the subaqueous tephra jets are still propagating, and are still pyroclastic in origin. Is it a tuff or a sandstone? Are you a purist? or Are you a realist?

Sedimentary structures in individual beds transported under turbulent conditions display normal grading, local inverse grading and crossbedding or are massive (structureless). Beds are planar on small outcrop scale (< 3m), but discontinuous and wedge out after several metres or tens of metres, generally being truncated by a subsequent flow. The turbidity flow deposits are locally erosive, forming flat channel scours filled with crossbeds. Shallow scours and subtle low-angle erosion surfaces are ubiquitous. The beds are internally laminated to stratified, and locally display grading within layers as well as on the bed-scale. Layers or laminae within beds may wedge out. Internal structures are accentuated by crystal- or scoria-rich layers. Locally, there is a lateral change over 0.5-2 m from planar stratified or laminated beds grading into low-angle crossbeds, which in turn grade back into planar beds. Individual laminae or layers thicken and thin in the channel-shaped part of the beds. The sedimentary structures display a remarkable resemblance to subaerial base surges

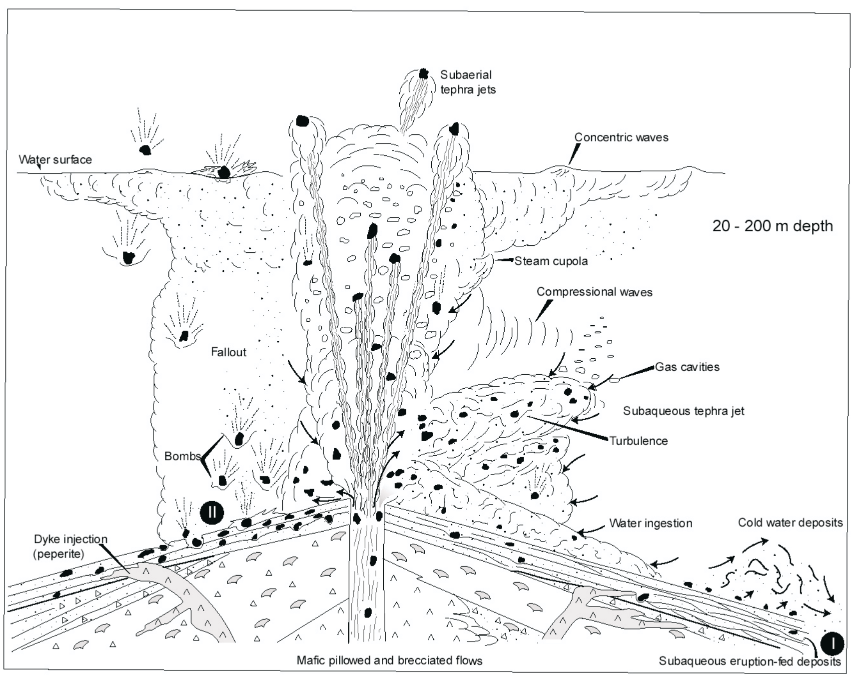

Fig. 1 Subaqueous portion of a Surtseyan eruption. (I) indicates subaqueous eruption-fed density currents. A steam cupola can account for the formation of the bomb sag structures (II). Water ingestion changes the gas-driven tephra jets into water-laden density currents (after Mueller et al., 2000)

(Fisher and Schmincke, 1984; Chough and Sohn, 1990). Massive to graded portions of the tuffs or lapilli tuffs are suggestive of rapid suspension fallout from high particle concentration flows (T_a or S_3-bed of Lowe, 1982), whereas the laminated upper portions of the beds are best explained by reduced suspended fallout rates and decreasing velocity (Bouma T_b; Lowe, 1988). Local inverse graded beds (S_2 bed of Lowe, 1982, 1988) are considered bedload traction carpets resulting from incipient collapse of particle-congested, suspended pyroclastic clouds, in which grain collisions rather than fluid turbulence are prominent. High internal shearing at the base of the flow can generate the dispersive pressure required to develop inverse grading. Well- to poorly developed stratification and lamination in planar beds probably results from unsteady high- to low-concentration turbulent flows, respectively (S_1-bed of Lowe, 1982; see Chough and Sohn, 1990; White, 1996). The cross-bedded tuff and lapilli tuff (ash beds or ash and lapilli beds if unconsolidated) are indicative of density currents dominated by traction processes (Chough and Sohn, 1990; White, 1996). The bases of crossbeds and planar beds with abundant broad, low-angle scours argues for unconfined, high-concentration flows with erosive capacity, supporting a traction-dominated process. In addition, some of the high-concentration density currents had enough strength to transport out-sized pyroclasts, possibly indicating an over-congestion of the flows.

In summary, high velocity tephra jets are low concentration turbulent gas-vapour flows with local scouring power, that due to water ingestion and high-velocity shearing within the medium, develop planar stratified and laminated beds as well as low-angle crossbeds. As the flow decelerates, additional water is ingested and turbulence is increased, creating an abundance of low to high-angle crossbeds. The only problem remains giving the child a name! Is it tuff or sandstone?

Conclusion and significance

Documenting pyroclastic deposits is problematic, but if outcrop density is sufficient and detailed facies analyses can be conducted, it is surprising what the outcome may be. Eruption-fed density currents formed by shallow-water eruptions can produce a number of sedimentary structures that can be confused with subaqueous reworking or slumping of volcaniclastic deposits when in fact they are primary pyroclastic deposits. Interpretation of the turbiditic tuffs and lapilli tuffs as primary subaqueous pyroclastic density current deposits is facilitated by the presence of bomb sags (especially in ancient rocks). Otherwise, the interpretation may be ambiguous. The observed combination of subaqueous density currents and bombs in the same deposit has caused heated discussion, but recent work demonstrates that these two features can be reconciled with formation of a subaqueous small volume eruption that produced a steam-gas cupola. Studies on mafic subaqueous volcanism in ancient sequence can elucidate the dynamics of the active submarine Surtseyan eruptions. Furthermore, although mafic magmas with an intermittent magma supply favour Surtseyan-type eruptions, this does not preclude a felsic counterpart! Small felsic eruptions of the fountaining style should produce similar deposits in a subaqueous setting. Now there's a problem and fruit for thought!

The change from a mechanism to a process is shown by the transition from a volcanic eruption to transport of volcanic debris. The explosive mechanism causes fragmentation and transport produces specific sedimentary bedforms and internal structures. Both represent ongoing events and the result is transport of volcanic debris is transported from point A to B. The change in transporting medium from gas-steam to water should not change the type of deposit. The "deposit" is a stage of a transport process frozen in time and space. Bedforms indicate the sedimentology, whereas the eruption is a volcanological mechanism; the two are intimately linked and defining where volcanology stops and sedimentology is very difficult. We should not use rock names to differentiate between origin and deposits if this is one and the same event. Eruption-fed density currents are an integral part of subaqueous eruptions.

Pyroclastic flows and surges are density currents in a subaerial setting. The problem in distinguishing between primary non-welded and remobilized pyroclastic debris is subtle, but now at least we know that primary non-welded pyroclastic deposits exist.

I remember a saying: "If you are not part of the solution, you are part of the problem". In research, if you have problem, find a solution. Subaqueous eruption-fed density currents are part of the solution, but I am sure other problems will arise from it! What say ye purists and realists?

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Meeting reports

Volcano-Ice Interaction Meeting (August 13-15, Reykjavik, Iceland)

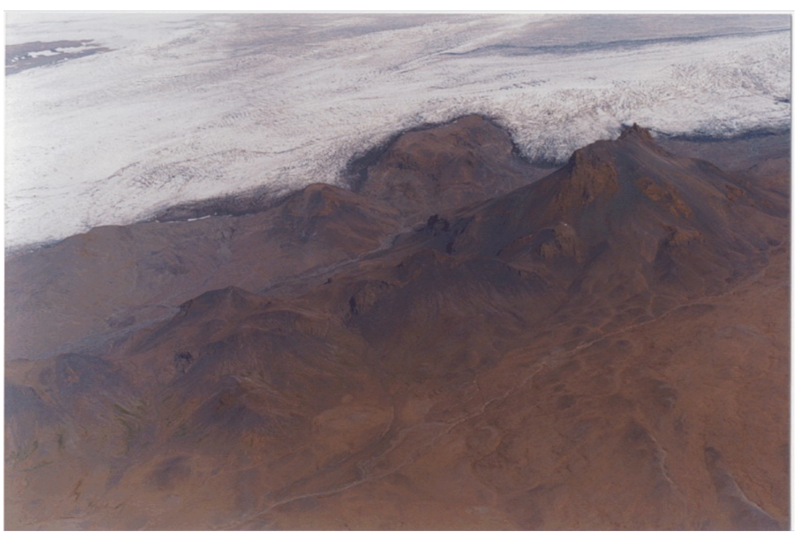

Fig. 2 A basaltic ridge erupted sub/englacially, Jarlhrettur, Iceland (photo by Ian Skilling)

Volcano-Ice interaction on Earth and Mars was explored in the first international conference, which was held at the University of Iceland in Reykjavik. Significant advances in both terrestrial and extraterrestrial study of this phenomena have been made in recent years. Subglacial eruptions in Iceland in 1996 and 1998, and the possibility that similar sub ice eruptions may have occurred on Mars, ensured that the meeting was particularly topical. The conference brought together 76 scientists, including geologists, geophysicists and glaciologists from 10 countries. There was much to interest volcanologists and volcanogenic sedimentologists, including detailed accounts of the lithofacies of basaltic, trachytic and rhyolitic subglacial volcanoes, and studies of associated catastrophic flood deposits (jökulhlaup deposits). Basaltic subglacial volcanism generates a wide variety of landforms, comprising pillow lavas, hydrovolcanic tephra, subaerial lavas and their resedimented equivalents. Such landforms include ridge-like edifices constructed from fissure-fed eruptions (Fig. 2) and flat-topped mountains known as tuyas, which are capped by subaerial lavas. Such features are widely exposed in Iceland, Antarctica and British Columbia. A fabulous 3-day field trip followed the meeting, and concentrated on hydrovolcanic and jökulhlaup deposits. Fabulous weather also allowed superb views of the same areas during a 2 hour overflight. Look out in EOS for a detailed report of this meeting, and for a Geological Society of London Special Publication of papers presented at the meeting, which is to be edited by John Smellie. Details of the meeting are also still available on the web at:

http://wwwflag.wr.usgs.gov/USGSFlag/Land/IcelandMeeting/icelandmeeting.html

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International Maar Conference (Daun, Germany, August 20-23, 2000)

The second-most common subaerial volcanic landform on Earth, maar volcanoes were first recognized in the Eifel region of Germany, just west of the Rhine River, in the early 1800s. The first *International Maar Conference* was organized this year to take place in Daun, Germany in the middle of the Eifel volcanic region. The purpose of the conference was to bring together international experts associated with research on maar volcanoes, their architecture, formation, sediments, paleontology, and hydrogeology.

The conference included 80 presentations that spanned a wide range of earth-science disciplines; the sessions were divided mainly into issues of the architecture of maar volcanoes, eruption phenomena, and sedimentological records in maar craters. Those of us in volcanology are familiar with most of the literature on maar formation, architecture and deposits and the hydrothermal systems that are commonly associated with hydrovolcanic activity. What was fairly new to us was the value of maars for studying climatological and ecological change; sediments in maar lakes are deposited within relatively closed systems. Another application is the use of maars and the fractured country rock surrounding them as isolated aquifers; maar volcanoes are important sources of potable water within the Eifel region.

An important part of the conference were the four field trips that were led before and after the symposia. Maar volcanoes were first described in the Eifel region in 1816; they are still a remarkable collection of volcanoes and must be seen in the field.

Residents of villages in the Eifel region are very much aware of their volcanic heritage. We visited volcano museums in Daun (Vulkanmuseum Daun), Manderscheid (Maarmuseum Manderscheid), Gerolstein (Naturkundmuseum), and Strohn (a small museum is being constructed). This awareness of volcanism plus remarkable hospitality in all of these villages made the educational and social aspects of the conference one of the highlights.

If you are interested in maars and hydrovolcanism, it is imperative that you purchase the 549 page proceedings and the field trip guidebook (cited below). There is a lot of new material in these volumes, along with a number of review papers.

Superb organization, an enthusiastic group of attendees, and great geology-what a way to spend a few weeks in Germany!

Conference Publications:

Jacoby, W., Lorenz V., Negendank, J., Neuffer, F.-O., and Büchel, G. (eds), 2000. *International Maar Conference*, Terra Nostra 2000/6, 549 pp. (In German and English). (Publisher: Alfred-Wegener-Stiftung, Arno-Holz-Straße 14, D-12165 Berlin, Germany; Tel: 49-30-790-1374-0; e-mail: info@aw-stiftung.de)

Neuffer, F.-O. and Lutz, H. (eds), 2000. Field Trip Guidebook (Exkursionsführer), International Maar Conference (Internationale Maar-Tagung). Mainzer Naturwissenschaftliches Archiv, Beiheft 24, 160 pp. (In German and English). (Publisher: Naturhistorisches Museum Mainz, Reichklarastr. 10, D-55116 Mainz, Germany; Ph: 49-6131 122646; e-mail: lsnhmmz@mail.uni-mainz.de)

Grant Heiken and Kenneth Wohletz
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Forthcoming Meetings

International Tsunami Symposium (August 7th-10th 2001, Seattle, USA)

Contact: EN Bernard, NOAA/Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115-6349, USA (tel: +1 206-526-6800, fax: +1 206-526-4576; email: bernard@pmel.noaa.gov, web: http://www.pmel.noaa.gov/its2001

7th International Conference on Fluvial Sedimentology (August 6th-10th, 2001, University of Nebraska, USA)

Contact: Mike Blum (email: mblum1@unl.edu, web: http://www.unl.edu/geology/ICFS.html)

21st IAS Meeting (September 3rd-5th 2001, Davos, Switzerland)

Contact: IAS-2001 Secretariat, Geological Institute ETH-Zentrum, 8092 Zurich, Switzerland (email: info@ias-2001.ethz.ch, web: www.ias-2001.ethz.ch)

AGU CHAPMAN CONFERENCE

"EXPLOSIVE SUBAQUEOUS VOLCANISM"

January 2002, Dunedin, New Zealand

Program Committee

Conveners

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Committee (with conference focus)

K.V. Cashman *(University of Oregon)*
Models of submarine magmatic eruptions

K. Wohletz *(Los Alamos Nat'l Lab)*
Models of submarine phreatomagmatism

I. Skilling *(Univ. Southern Mississippi)*
Subglacial eruptions and deposits

D. Clague *(Monterey Bay Aquarium)*
Modern seafloor hyaloclastite deposits

K. Kano *(Geological Survey of Japan)*
Young submarine pyroclastic deposits

R. Cas *(Monash Univ., Australia)*
Ancient submarine pyroclastic deposits

W Mueller (U. Quebec - Chicoutimi)
Archean submarine pyroclastic deposits

General Description and Objectives

The purpose of this Chapman Conference is to bring together volcanologists, geophysicists and marine geoscientists with interests in the formation of clastic volcanogenic successions on the modern seafloor and in ancient successions, and in the processes and significance of explosive subaqueous eruptions in seafloor settings. Formation of subaqueous pyroclastic deposits is an important topic that has received little mainstream volcanological attention. It is scarcely addressed in volcanological texts yet, because of the preservation bias in favor of sub-wavebase marine deposits in the geological record, it is likely that deposits of subaqueous explosive eruptions exceed in volume and economic significance those of subaerial ones. The aim of the conference is to foster better communication among these groups of scientists, and to provide an opportunity for recent research results to be presented in a forum in which there is scope to develop new perspectives and directions for future collaborative research by interested scientists from a range of backgrounds. The role of explosivity in subaqueous eruptions, particularly in the sea and at large scales, is a topic of both high interest and acknowledged disagreement. A better understanding of the abundance, size and style of subaqueous, particularly submarine, eruptions has practical implications, both for minerals exploration and for our understanding of hazardous natural processes.

Keynote Address

Dr. Richard S. Fiske will give the conference Keynote Address. The goal of his keynote address will be to outline the body of evidence for the nature of large magnitude subaqueous explosive eruptions, to highlight important open questions, and to provide an update of his most recent work on the submarine caldera of Miyoke-jima.

Outline of Format and Schedule

The Conference will include four and a half days of presentations and discussions with a mid-meeting field trip devoted to examining seacliff exposures of early Cenozoic subaqueous Surtseyan deposits. The first day will focus on discussions of physical controls of subaqueous explosivity, and on lessons learned from studies of observed shoaling eruptions. The second day will examine evidence from marine studies of the deposits of subaqueous eruptions, and from studies of recently uplifted onland equivalents. The third day will open with short formal introductions to posters by poster authors, then continue with a fieldtrip. Day four of the conference will address ancient deposits and mineralization. The last day will focus on integration and synthesis by considering both the consistencies and incongruities among information from modern, ancient, analytical and experimental studies.

Posters will be installed the first day and remain available for viewing in an area adjoining the meeting area throughout the conference. All poster authors will have the opportunity to give a 2-3 minute presentation (a single overhead) on their poster to the entire group on the third morning of the conference.

Site, Dates and Duration

Meeting in Dunedin, New Zealand. Five (5) days total in January 2002 (dates not yet fixed), including mid-meeting field trip

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Western Pacific Geophysics Meeting (July 9th-12th 2002, Wellington, New Zealand)

Contact: AGU Meetings Department, 2000 Florida Avenue NW, Washington DC 20009, USA (email: meetinginfo@agu.org, web: www.agu.org/meetings)

Recent publications (February 2000-March 2001)

This is a new section listing all recent publications that we feel will be of interest to CVS members. We hope it will be useful. Eventually we would like to add all of these to the CVS web page as a searchable database. We have surely missed some recent papers, so please let us know!

Bull, SR and Cas, RAF (2001) Distinguishing base-surge deposits and volcaniclastic fluviatile sediments: an ancient example from the Lower Devonian Snowy River volcanics, SE Australia. Sedimentology, 47, 87-98.

Carey, S, Maria, A and Sigurdsson, H (2000) Use of fractal analysis for discrimination of particles from primary and reworked jökulhlaup deposits in SE Iceland. J. Volcanol. Geotherm. Res., 104, 65-80.

Carey, S, Morelli, D, Sigurdsson, H and Bronto, S (2001) Tsunami deposits from major explosive eruptions: an example from the 1883 eruption of Krakatau. Geology, 29, 347-350.

Castañares, LM, Robles, S, Gimeno, D and Bravo, JCV (2001) The submarine volcanic system of the Errigoiti Formation (Albian-Santonian of the Basque-Cantabrian Basin, northern Spain): stratigraphic framework, facies and sequences, J. Sed. Res., 71, 318-333.

Doyle, MG (2000) Clast shape and textural associations in peperite as a guide to hydromagmatic interactions: Upper Permian basaltic and basaltic andesite examples from Kiama, Australia. Aus. J. of Earth Sci. 47, 167-177.

Fretzdorff, S, Paterne, M, Stoffers, P and Ivanova, E (2000) Explosive activity of the Reunion Island volcanoes through the past 260000 yrs as recorded in deep sea sediments. Bull. Volc., 62, 266-277.

Hathway, B and Kelley, SP (2001) Sedimentary record of explosive silicic volcanism in a Cretaceous deep-marine conglomerate succession, northern Antarctic Peninsula. Sedimentology, 47, 451-470.

Iverson, RM and Vallance, JM (2001) New views of granular mass flows. Geology, 29, 115-118.

Kerle, N and van Wyk de Vries, B (2001) The 1998 debris avalanche at Casita volcano, Nicaragua: investigation of structural deformation as the cause of slope instability, using remote sensing. J. Volcanol. Geotherm. Res., 105, 49-64,

Kokelaar, BP and Köninger (2000) Marine emplacement of welded ignimbrite: the Ordovician Pitts Head Tuff, North Wales. J. Geol. Soc. London, 157, 517-536.
Leyrit, H and Montenat, C (2000) (eds) Volcanclastic Rocks, from Magma to Sediments. Gordon and Breach Science Publishers.
Lirer, L, Vinci, A, Alberico, T, Gifuni, F, Belucci, P, Petrosino, P and Tinterri, R (2001) Occurrence of inter-eruption debris flow and hyperconcentrated fllod-flow deposits on Vesuvio volcano, Italy. Sed. Geol., 139, 151-168.
Major, JJ, Pierson, TC, Dinehart, RL and Costa, JE (2000) Sediment yield following severe volcanic disturbance: a two decade perspective from Mount St Helens. Geology, 28, 819-822.
Manville, V, Hodgson, KA, Houghton, BF, Keys, JR and White, JDL (2000) Tephra, snow and water: complex sedimentary responses at an active snow-capped stratovolcano, Ruapehu, New Zealand. Bull. Volc., 62, 278-293.
Mueller, WU, Chown, EH and Thurston, P (eds.) (2000) Physical Volcanology and Volcaniclastic Deposits, Modern and Ancient. Precambrian Research Special Issue.
Mulder, T and Alexander, J (2001) The physical character of subaqueous density currents and their deposits. Sedimentology, 48, (March issue)
Pareschi, MT, Favelli, M, Giannini, F, Sculpizio, R, Zanchetta, G and Santacroce, R (2000) May 5, 1998, debris flows in circum-Vesuvian areas (southern Italy): insight for hazard assessment. Geology, 28, 639-642.
Scasso, RA (2001) High-frequency explosive volcanic eruptions in a late Jurassic volcanic arc: the Ameghino Formation, Antarctic Peninsula. J. Sed. Res., 71, 101-106.
Walder, JS (2000) Pyroclast/snow interactions and thermally driven slurry formation. Part 1: Theory of monodisperse grain beds. Bull. Volc., 62, 105-118.
Walder, JS (2000) Pyroclast/snow interactions and thermally driven slurry formation. Part 2: Experiments and theoretical extension to polydisperse tephra. Bull. Volc., 62, 119-130.
Ward, WT and Little, IP (2000) Sea-rafted pumice on the Australian east coast: numerical classification and stratigraphy. Aus. J. Earth Sci., 47, 95-110.
Waythomas, CF, Miller, TP and Begét, JE (2000) Record of late Holocene debris avalanches and lahars at Iliamna volcano, Alaska. J. Volcano. Geotherm. Res. 104, 97-130.
White, JDL, McPhie, J and Skilling, IP (2000) Peperite: a useful genetic term. Bull. Volc., 62, 65-66
Wright, IC (2001) In situ modification of modern submarine hyaloclastic/pyroclastic deposits by oceanic currents: an example from the Southern Kermadec arc (SW Pacific). Mar. Geol., 172, 287-308.

Forthcoming publications

Volcaniclastic Sedimentation in Lacustrine Settings

Riggs, N and White, JDL (eds)
IAS Special Publication
(due April 2001)

This volume presents a unique compendium of papers assessing the effects of volcanism on lakes, as recorded by the volcaniclastic sediments deposited within them. The unifying theme is that the effects of volcanism on lacustrine sedimentation are diverse and distinctive, and that volcaniclastic lacustrine sediments hold the key to understanding a range of processes and events that cannot be readily addressed by the study of any non-volcanic lakes. Twelve papers, with authors from nine countries, examine both modern and ancient eruption-affected lacustrine deposits. Volcanic eruptions affect lakes and their deposits in many ways, and these papers evaluate processes and products of volcanic eruptions within lakes, of tectonically impounded lakes strongly influenced by volcanism, of eruption-impounded lakes, and of general factors controlling sedimentation of vitric ash and pumice. Tephrastratigraphic studies also take advantage of the exceptional preservation of thin laminae in quiet lakes to precisely date episodes in the evolution of long-lived lakes and their catchment areas, and to understand how volcanism affects normal lacustrine processes. The volume as a whole is an unparalleled source of information on all aspects of the physical sedimentary results of volcanism in lacustrine settings, and serves as a complement to other studies concerned primarily with thermal and geochemical characteristics of lakes within volcanic craters.

The list of papers:

White, J.D.L. and Riggs, N.R., Introduction: styles and significance of lacustrine volcaniclastic sedimentation

Belousov, A. and Belousova, M., Eruptive process, effects and deposits of the 1996 and ancient basaltic phreatomagmatic eruptions in Karymskoye lake, Kamchatka, Russia

Caballero, M., Macias, J.L., Lozano-Garcia, S., Urrutia-Fucugauchi, J., and Casteñeda-Bernal, R., Late Pleistocene-Holocene volcanic stratigraphy and paleoenvironments of the Upper Lerma Basin, Mexico

Cas, R.A.F., Edgar, C., Allen, R.L., Bull, S., Clifford, A., Giordano, G., and Wright, J.V., Influence of magmatism and tectonics on sedimentation in an extensional lake basin: the Upper Devonian Bunga Beds, Boyd Volcanic Complex, southeastern Australia

Gaylord, D.R., Price, S.M., and Suydam, J.D., Volcanic and hydrothermal influences on middle Eocene lacustrine sedimentary deposits, Republic Basin, Northern Washington, USA

Hardardóttir, J., Geirsdóttir, Á., and Thórdarson, T., Tephra layers in a sediment core from Lake Hestvatn, southern Iceland: Implications for evaluating sedimentation processes and environmental impacts on a lacustrine system caused by tephra fall deposits in the surrounding watershed

Königer, S. and Stollhofen, H, Environmental and tectonic controls on preservation of potential of distal fallout ashes in fluvio-lacustrine settings: the Carboniferous-Permian Saar-Nahe Basin, SW Germany

Manville, V., Sedimentology and history of Lake Reporoa: an ephemeral supra-ignimbrite lake, Taupo Volcanic Zone, New Zealand

Palmer, B.A. and Shawkey, E.P. Lacustrine -fluvial transitions in a small intermontane valley, Eocene Challis volcanic field, Idaho

Riedel, J.L., Pringle, P.T., and Schuster, R.L., Deposition of Mount Mazama tephra in a landslide-dammed lake on the upper Skagit River, Washington, U.S.A.

Riggs, N.R., Ort, M.H., White, J.D.L., Wilson, C.J.N., Houghton, B.F., and Clarkson, R., Post-1.8-ka marginal sedimentation in Lake Taupo, New Zealand: effects of wave energy and sediment supply in a rapidly rising lake

Smellie, J.L., Lithofacies architecture and construction of volcanoes erupted in englacial lakes: Icefall Nunakak, Mount Murphy, eastern Marie Byrd Land, Antarctica

White, J.D.L., Eruption and reshaping of Pahvant Butte volcano in Pleistocene Lake Bonneville

White, J.D.L., Manville, V., Wilson, C.J.N., Houghton, B.F., Riggs, N.R., and Ort, M., Settling and deposition of AD 181 Taupo pumice in lacustrine and associated environments

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Look out for:

Peperite: processes and products of magma-sediment mingling

Skilling, IP, White, JDL and McPhie, J (eds)
(publication probably later this year)

Special Issue of Journal of Volcanology and Geothermal Research

List of papers:

Skilling, IP, White, JDL and McPhie, J. Peperite: a review of magma-sediment mingling
Wohletz, K.H. Water/magma interaction: some theory and experiments on peperite formation.
Zimanowski, B. and Büttner, R. Dynamic mingling of magma and liquefied sediments.
Squire, R.J. and McPhie, J. Origin and characteristics of peperite involving coarse-grained host sediment.
Dadd, K.A and Van Wagoner, N.A. Magma composition and viscosity as controls on peperite texture: an example from the Passamaquoddy Bay, southeastern Canada.
Kano, K. Middle Miocene volcaniclastic dikes at Kukedo, Shimane Peninsula, SW Japan: fluidization of volcaniclastic beds by emplacement of synvolcanic andesitic dikes

Hooten, J.A. and Ort, M.H. Peperite as a record of early stage phreatomagmatic fragmentation processes: an example from the Hopi Buttes volcanic field, Navajo Nation, Arizona, USA.

Lorenz, V. and Büttner, R. On the formation of deep-seated subterranean peperites.

Donaire, T, Sáez, R and Pascual, E. Globular peperites originated by upward vesicle migration and buoyant rising from a rhyolitic sill (Iberian Pyrite Belt, Spain)

Martin, U and White, J.D.L Melting and mingling of phonolitic pumice deposits with intruding dykes: an example from the Otago Peninsula, New Zealand

Lavine, A and Aalto, K.R. Morphology of a crater-filling lava lake margin, The Peninsula Tuff Cone, Tulelake National Wildlife Refuge, California: implications for variations in peperite textures.

Coira, B. and Pérez, B. Peperitic textures of Ordovician dacitic synsedimentary intrusions in Argentina's Puna Highland: clues to emplacement conditions.

Gifkins, C.C., McPhie, J. and Allen, R.L. Pumiceous peperite in ancient submarine volcanic successions.

Marriner, G.F., Millward, D., Gill, R.C.O. and Muir, R. Lamproitic peperites and megapillows from the Neogene Vera Basin, south-eastern Spain

McClintock, M.K. and White, J.D.L. Coal peperite: magma interaction with a brittle and thermally unstable host

Corsaro, R.A. and Mazzoleni, P. Textural evidence of peperites inside pillow lavas at Acicastello Castle Rock (Mt. Etna, Sicily)

Jerram, D and Stollhoffen, H. Sediment/lava interaction in desert settings: are all Peperite-like textures the result of magma-water interaction?